



2020 - 2021  
Game Manual

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# Section 1

## Introduction

### Overview

This section provides an introduction to the VEX Robotics Competition and VRC Change Up.

### The VEX Robotics Competition

Our world faces a serious problem. It's a problem that, without explicit and intentional action, will eventually stagnate global progress and lead to a workforce that is unmotivated and ill-equipped to solve its future problems. As the world grows more technologically complex, the challenges we face every day will continue to escalate along with it. A cell phone has more failure modes than a landline. The internals of an electric car are more difficult to comprehend than a V8 combustion engine. Unmanned drone legislation is more nuanced than defining a maximum speed limit.

Dubbed "the STEM problem", the situation is equally simple to understand, yet difficult to solve. In many cases, the traditional methods of teaching science, technology, engineering, and math (STEM) will not be enough to adequately prepare students for this complex world. This is often coupled with the unfortunate reality that by the time they reach an age capable of grasping these critical topics, students may have already determined that they are "not cool" or "boring". Without the skills or passion necessary to approach these problems in an educated manner, you cannot possibly expect to be productive in making forward progress or even sustaining the status quo.

The VEX Robotics Competition exists to solve this problem. Through its uniquely engaging combination of teamwork, problem solving, and scientific discovery, the study of competitive robotics encompasses aspects of STEM. You're not building VEX V5 robots because your future job will involve tightening shaft collars on a metal bar – you're executing an engineering design and problem-solving process that resembles the

same mindset used by rocket scientists, brain surgeons, and inventors around the world. VEX Robotics Competition Change Up is not just a game that we invented because it is fun to play – it is a vehicle for teaching (and testing) teamwork, perseverance in the face of hardship, and provides a methodology to approach and solve new challenges with confidence.

Contained in this manual are the rules that shape VRC Change Up. These rules are designed to simulate the constraints that will outline any real-world project. They are intended to promote creativity without punishing innovation. They are balanced to promote fair play while encouraging competition.

We encourage you to keep in mind that a VEX Robotics Competition game is more than just a set of game objects worth varying amounts of points. It is an opportunity to hone the life-long skills that will characterize the problem-solving leaders of tomorrow.

Good luck, and we'll see you on the playing field!

Sincerely,

The VEX Robotics Game Design Committee, comprised of members from the Robotics Education & Competition Foundation, DWAB Technology, and VEX Robotics.

## VEX Robotics Competition Change Up: A Primer

VEX Robotics Competition Change Up is played on a 12'x12' square field configured as seen below. Two (2) *Alliances* - one (1) "red" and one (1) "blue" - composed of two (2) *Teams* each, compete in *Matches* consisting of a fifteen second (0:15) *Autonomous Period*, followed by a one minute and forty-five second (1:45) *Driver Controlled Period*.

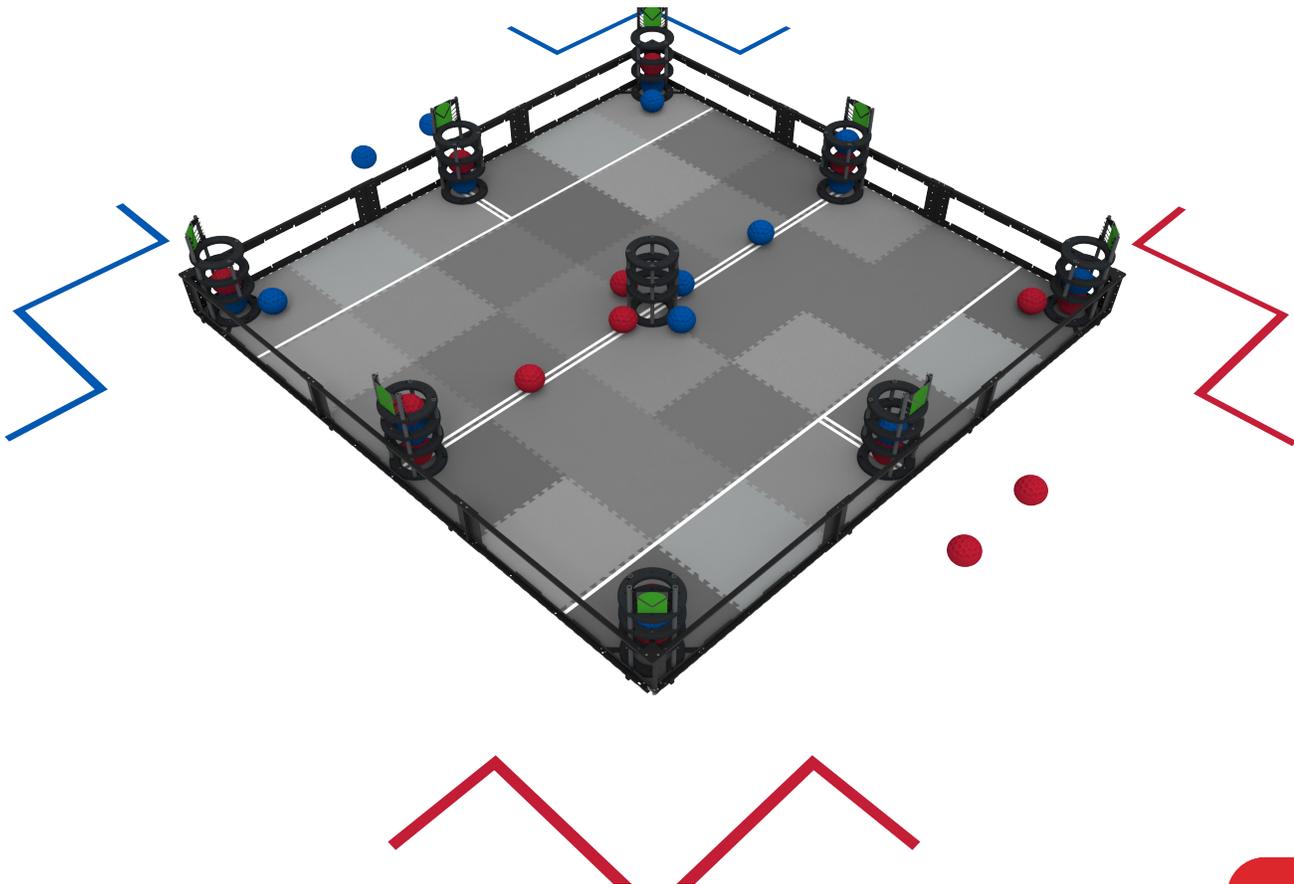
The object of the game is to attain a higher score than the opposing *Alliance* by Scoring *Balls* and *Connecting Rows*.

For more details and specific game-play rules, see "Section 2" – The Game.

For more information about VEX, visit [www.vexrobotics.com](http://www.vexrobotics.com). Follow us on Instagram, Twitter or Snapchat @VEXRobotics. Like us on Facebook at [www.facebook.com/vexrobotics](http://www.facebook.com/vexrobotics).

For more information about the Robotics Education & Competition Foundation, visit [www.roboticse-ducation.org](http://www.roboticse-ducation.org). Follow us on Twitter @REC\_Foundation. Like us on Facebook at [www.facebook.com/RECFoundation](http://www.facebook.com/RECFoundation).

Visit [www.RobotEvents.com](http://www.RobotEvents.com) for more information about the VEX Robotics Competition, including team registration, event listings, and results.



# Section 2

## The Game

### Overview

This section describes the 2020-2021 VEX Robotics Competition game entitled VEX Robotics Competition Change Up. It also lists the game definitions and game rules.

### Game Description

*Matches* are played on a field set up as illustrated in the figures throughout. Two *Alliances* – one “red” and one “blue” – composed of two *Teams* each, compete in each *Match*. The object of the game is to attain a higher score than the opposing *Alliance* by *Scoring Balls* and *Connecting Rows*.

An *Autonomous Win Point* is awarded to any *Alliance* that completes a *Connected Row* using their *Alliance Home Row* at the end of the *Autonomous Period*.

A point bonus is awarded to the *Alliance* that has the most points at the end of the *Autonomous Period*.

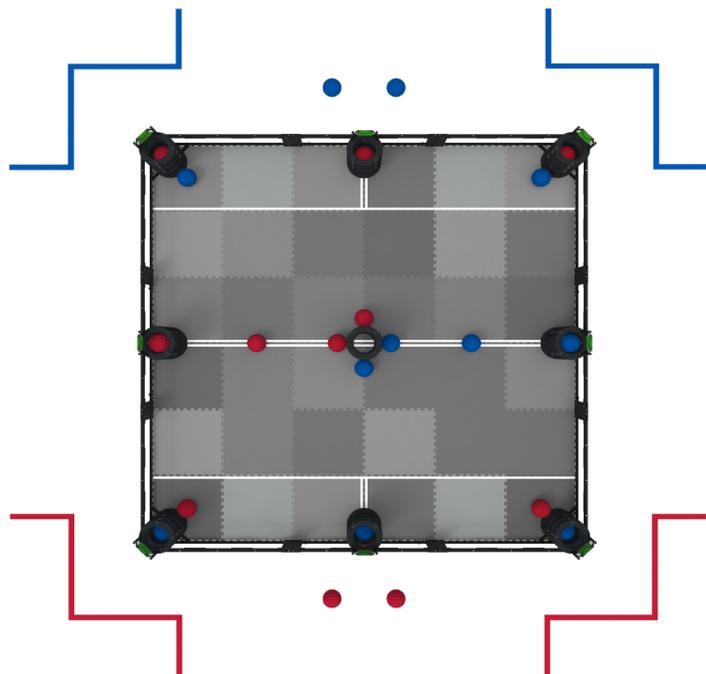


Figure 1: Top view of the field in its initial setup configuration.

*Note: The illustrations in this section of the manual are intended to provide a general visual understanding of the game. Teams should refer to official field specifications, found in Appendix A, for exact field dimensions, a full field bill of materials, and exact details of field construction.*

The VEX Robotics Competition Change Up field consists of the following:

- Thirty-two (32) *Balls*
  - Sixteen (16) red *Balls*, including two (2) used as *Preloads* by the red *Alliance*
  - Sixteen (16) blue *Balls*, including two (2) used as *Preloads* by the blue *Alliance*
- Nine (9) *Goals*, used for Scoring *Balls*

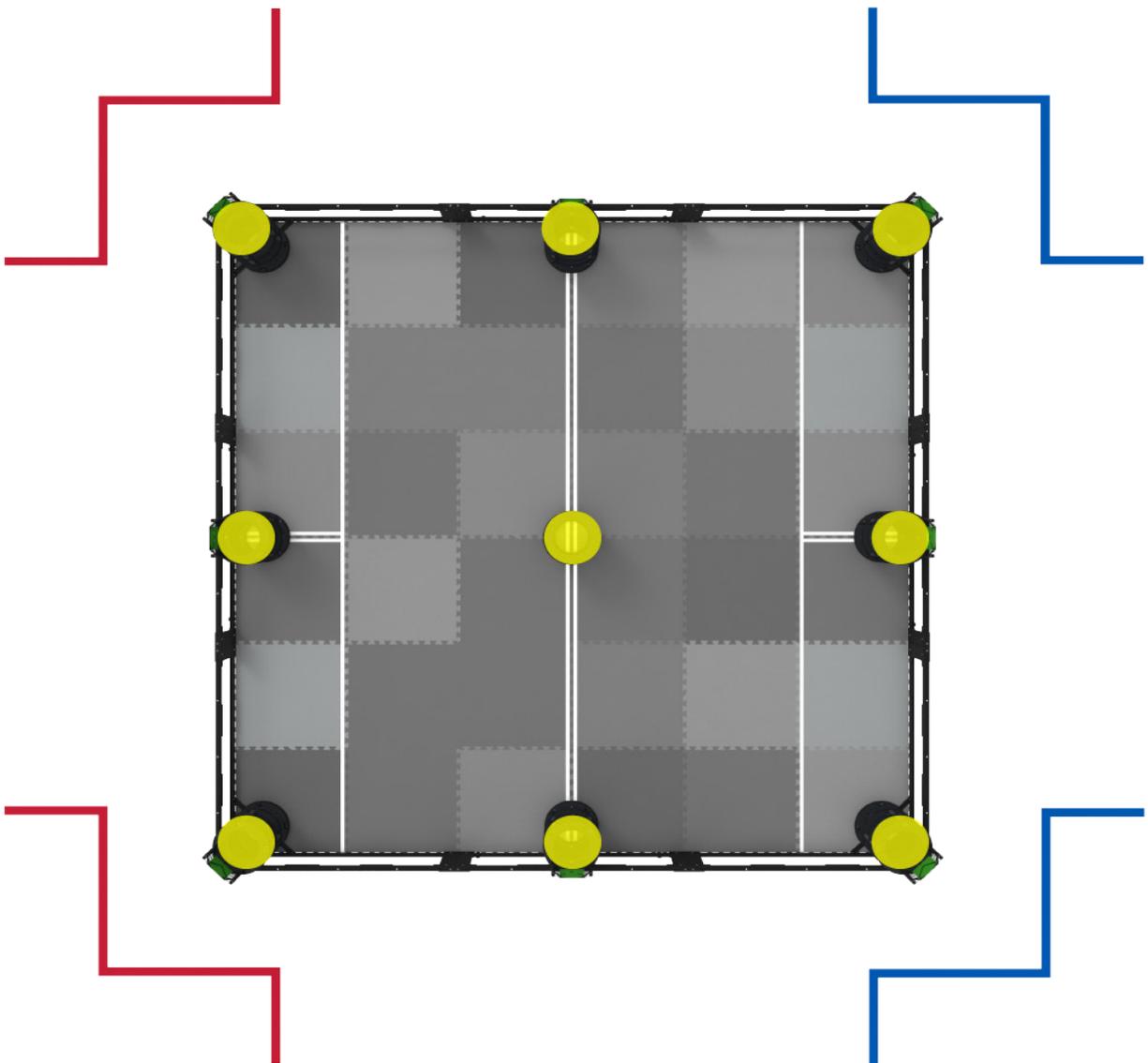


Figure 2: Top view of the field with Goals highlighted.

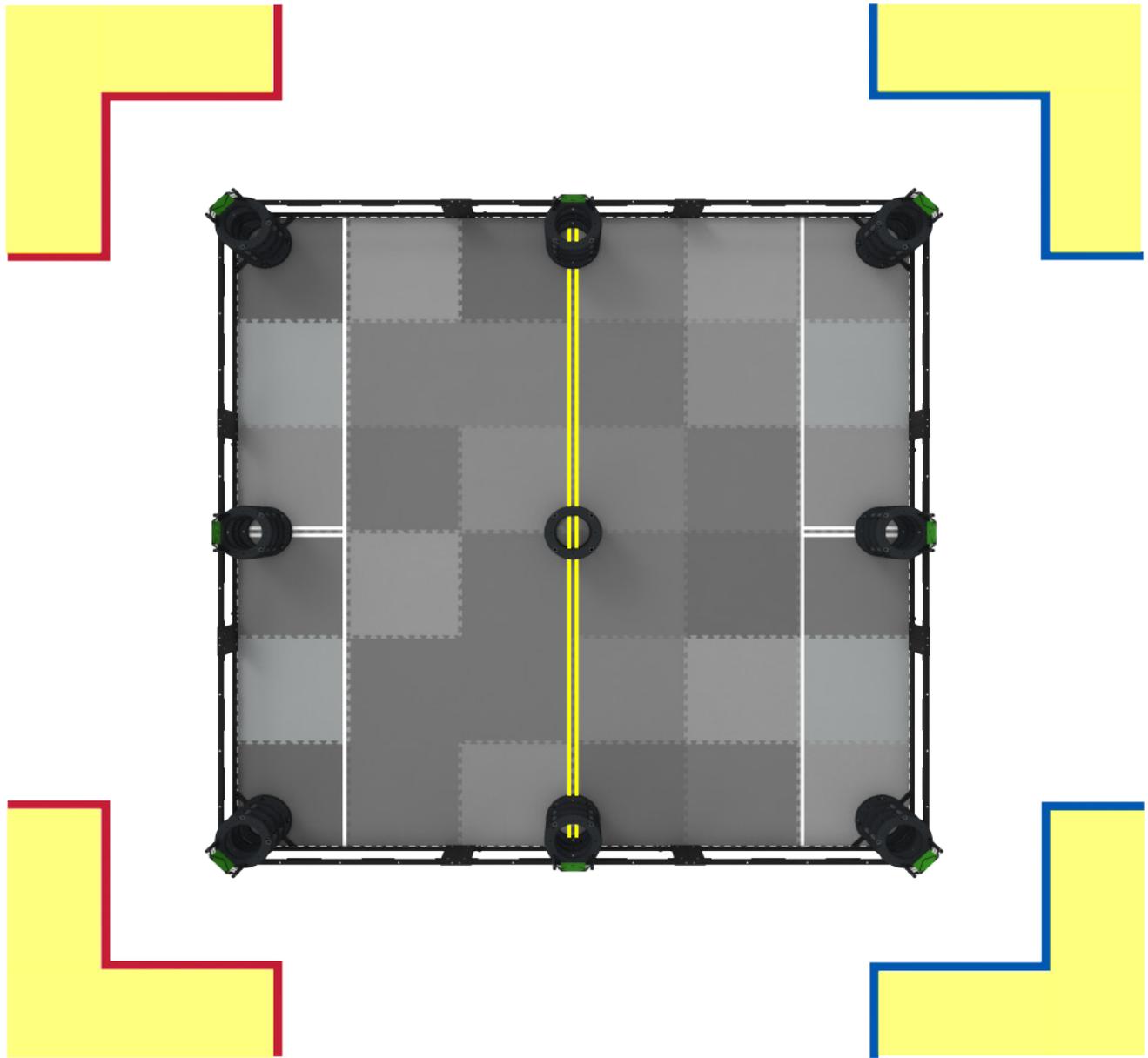


Figure 3: Top view of the field with Alliance Stations and Autonomous Line highlighted.

# Game Definitions

**Adult** – Anyone who is not a *Student*.

**Alliance** – A pre-assigned grouping of two (2) *Teams* that are paired together during a given *Match*.

**Alliance Home Row** – The three (3) *Goals* in each *Alliance's Home Zone*.

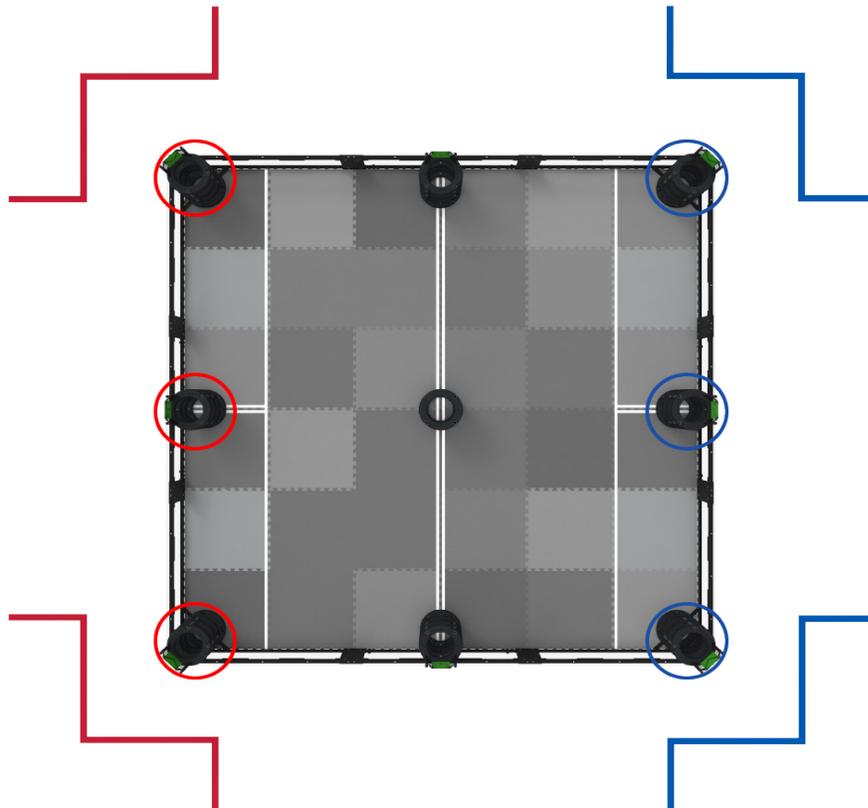


Figure 4: Top view of the field with Home Row Goals highlighted.

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

**Autonomous Bonus** - A point bonus of six (6) points awarded to the *Alliance* that has earned the most points at the end of the *Autonomous Period*.

**Note:** If the *Autonomous Period* ends in a tie, including a zero-to-zero tie, each *Alliance* will receive an *Autonomous Bonus* of three (3) points.

**Autonomous Line** – The pair of white tape lines that run across the center of the field. Per <SG2>, *Robots* may not contact the foam field tiles on the opposite *Alliance's* side of the *Autonomous Line* during the *Autonomous Period*.

**Ball** – A hollow plastic spherical-shaped, dimpled object, with a diameter of 6.3" (160mm), that can be Scored in Goals.



Figure 5: A Ball

**Builder** – The Student(s) on the Team who assemble(s) the Robot. An Adult cannot be the Builder on a Team. Adults are permitted to teach the Builder associated concepts, but may never be working on the Robot without the Builder present and actively participating.

**Connected Row** – A Row where all three (3) Goals in the Row are Owned by the same Alliance.

**Designer** – The Student(s) on the Team who design(s) the Robot to be built for competition. An Adult cannot be the Designer on a Team. Adults are permitted to teach the Designer associated concepts, but may never be working on the design of the Robot without the Designer present and actively participating.

**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 Members 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 is Disqualified in a Qualification Match receives zero (0) Win Points, Autonomous Win Point, 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 Disqualifications for a single Team may lead to its Disqualification for the entire tournament. (see <T11>)

**Drive Team Member(s)** – A Student who stands in the Alliance Station during a Match for each Team per <G7> . Only Drive Team Members are permitted to stand in the Alliance Station and allowed to touch the controls during the Match or interact with the Robot as per <G9>. Adults are not allowed to be Drive Team Members.

**Entanglement** – A Robot status. A Robot is Entangled if it has grabbed, hooked, or attached to an opposing Robot or a Field Element.

**Field Element**– The foam field tiles, field perimeter, white tape, Goal, and all supporting structures or accessories (such as driver station posts, field monitors, etc).

**Goal** - One of nine (9) cylinders in which *Robots* can Score and remove *Scored Balls*. The *Goals* are all 18.41" (467.6mm) tall and have an inside diameter of 7.02" (178.3mm). The *Goal* consists of four (4) retaining rings and four (4) PVC pipes. The outer edge of the ring is considered to be the outer edge of the *Goal*. The upper edge of the top ring is considered to be the upper edge of the *Goal*.



Figure 6: Close-up of a *Goal*, depicting the outer and upper edges of the *Goal*.

**Home Zone** – One of two (2) areas, one (1) for each *Alliance*, where *Robots* start the match and defines the location of the *Alliance Home Row*. The *Home Zones* are defined by the inner edges of the field perimeter and the outer edge of the tape line that runs across the field adjacent to the *Alliance Stations*, i.e. the tape line is part of the *Home Zone*. The *Alliance Home Zone* is closest to their *Alliance Stations*. The *Home Zone* refers to the foam field tiles; it is not a 3-dimensional volume.

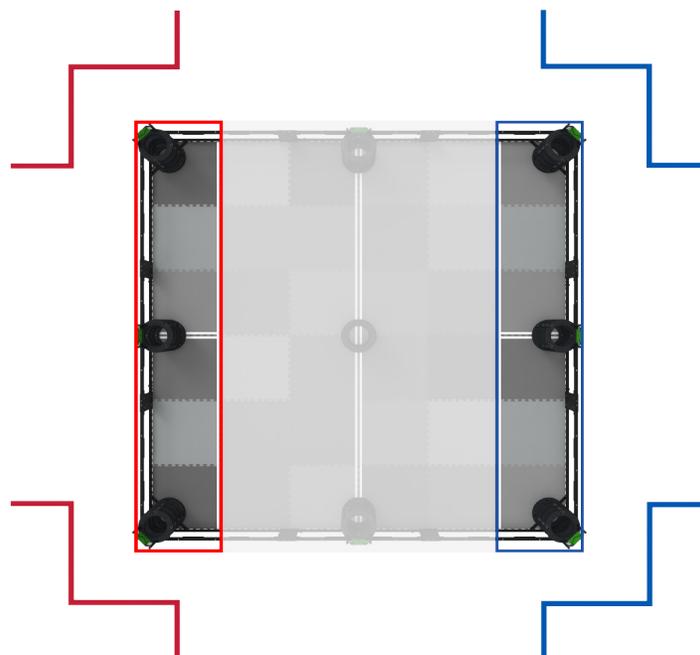


Figure 7: Top view of the field, with the *Home Zone* highlighted.

**Match** – A *Match* consists of an *Autonomous Period* followed by a *Driver Controlled Period* for a total time of two minutes (2:00).

- **Autonomous Period** – A fifteen second (0:15) time period during which *Robots* operate and react only to sensor inputs and to commands pre-programmed by the *Students* into the *Robot* control system.
- **Driver Controlled Period** – The one minute and forty-five second (1:45) time period during which *Drive Team Members* operate their *Robots*.

**Match Affecting** – A rule violation status determined by the head referee. A rule violation is *Match Affecting* if it changes the winning and losing *Alliances* in the *Match*. Multiple rule violations within a *Match* can cumulatively become *Match Affecting*.

**Owned** - A *Goal* status. A *Goal* is considered *Owned* by an *Alliance* if its colored *Ball* is the vertically highest *Scored Ball* in that *Goal*.



Figure 8: This *Goal* is *Owned* by the blue *Alliance*, as the top-most *Ball* is completely within the upper edge of the *Goal*.



Figure 9: This *Goal* is *Owned* by the Red *Alliance*, as the top-most *Ball* is not completely within the upper edge of the *Goal*. The top red *Ball* is *Scored* because it is below the upper edge of the *Goal*.



Figure 10: This *Goal* is *Owned* by the Blue *Alliance*, as the top-most *Ball* is not completely within the upper edge of the *Goal*. The two bottom-most *Balls* would both be considered *Scored*, as they are partially within the outer edge of the *Goal*.

**Possession** – A *Robot* is considered to be *Possessing* a *Ball* if a *Ball* is in an unscored position and any one of the following criteria are met:

- The *Robot* is carrying, holding or controlling the movement of a *Ball* such that if the *Robot* changes direction, the *Ball* will move with the *Robot*. Pushing/plowing *Balls* is not considered *Possession*, however using concave portions of your *Robot* to control the movement of *Balls* is considered *Possession*.
- The *Robot* is blocking opposing *Robots'* access to *Balls*, such as by expanding horizontally and restricting access to a portion of the field (e.g. a "wallbot").
- *Robots* on the same *Alliance* working in tandem to block access to *Balls* would share the *Possession* of the *Balls*.

See <SG8> for more details regarding Possession limits.

**Note:** *Balls* that are *Scored* in *Goals* cannot be considered *Possessed* until the *Robot* removes the *Ball* from that *Scored* position and is carrying, holding, controlling or blocking opposing *Robots'* access to that *Ball*.

**Preload**– The *Ball*, one (1) per *Robot*, that must be placed on the field such that it satisfies the conditions in <SG1> prior to the start of the *Match*.

**Note:** The red *Alliance* always uses red *Balls* as their *Preloads*. The blue *Alliance* always uses blue *Balls* as their *Preloads*.

**Programmer** – The *Student(s)* on the *Team* who write(s) the computer code that is downloaded onto the *Robot*. An *Adult* cannot be the *Programmer* on a *Team*. *Adults* are permitted to teach the *Programmer* associated concepts, but may never be working on the code that goes on the *Robot* without the *Programmer* present and actively participating.

**Robot** – A machine that has passed inspection, designed to execute one or more tasks autonomously and/or by remote control from a human operator.

**Row** - Three (3) *Goals* that make up a straight line. There are a total of eight (8) *Rows* including two (2) *Alliance Home Rows*.

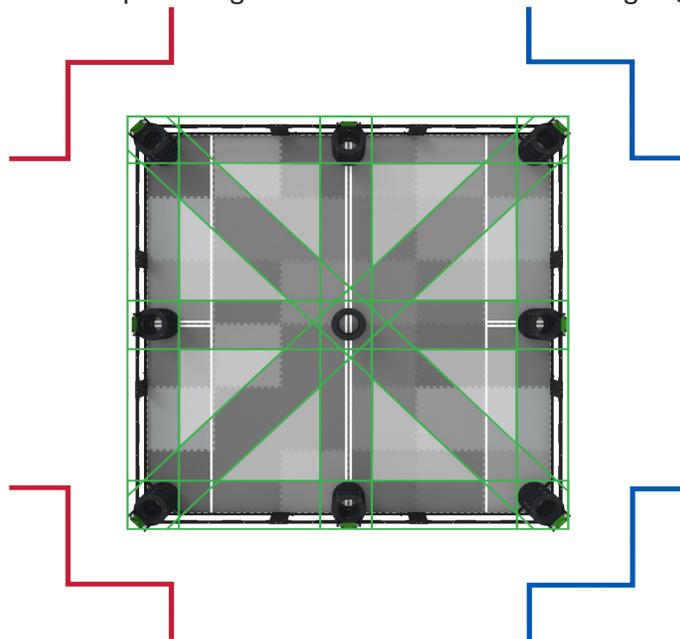


Figure 11: Top view of the field, with the 8 possible Connected Row options highlighted

**Scored** - A *Ball* status. A *Ball* is considered *Scored* in a *Goal* if it is not touching a *Robot* of the same color as the *Ball* and meets all of the following criteria.

- The *Ball* is fully or partially within the outer edge of the *Goal*.
- The *Ball* is fully below the upper edge of the *Goal*.
- The *Ball* is not contacting the foam tiles outside of the *Goal*.

**Note:** In the act of removing a *Ball* from the bottom of a *Goal* with three *Scored Balls* inside, it is possible for the top *Ball* to momentarily break criteria 2 above. If this occurs at the end of the *Match*, this *Ball* should still be considered *Scored*. The intent of this note is to avoid unintended de-scoring via the top of the *Goal*. The intent is not to encourage *Teams* to seek unique scenarios that would not typically be considered *Scored*. This would be considered a violation of rule <SG5>.



Figure 12: Close-up of a Goal, depicting the volume in which a Ball would be considered Scored.

**Student** - A person is considered a *Student* if he or she meets both of the following criteria:

1. Anyone who is earning or has earned credit toward a high school diploma/certificate or its equivalent during the six (6) months preceding the VEX Robotics World Championship. Courses earning credits leading up to high school would satisfy this requirement.
2. Anyone born after May 1, 2001 (i.e. who will be 19 or younger at VEX Worlds 2021). Eligibility may also be granted based on a disability that has delayed education by at least one year.

- **Middle School Student** - A *Student* born after May 1, 2005 (i.e. who will be 15 or younger at VEX Worlds 2021). *Middle School Students* may "play up" and compete as a *High School Student*.

- **High School Student** - Any eligible *Student* that is not a *Middle School Student*.

**Team** - One or more *Students* make up a *Team*. A *Team* is classified as a *Middle School Team* if all members are *Middle School Students*. A *Team* is classified as a *High School Team* if any of its members are *High School Students*, or made up of *Middle School Students* who declare themselves "playing up" as *High School Students* by registering their *Team* as a *High School Team*.

Once declared and playing as a *High School Team*, that *Team* may not change back to a *Middle School Team* for the remainder of the season. *Teams* may be associated with schools, community/youth organizations, or a group of neighborhood *Students*.

**Trapping** – A *Robot* status. A *Robot* is *Trapping* if it has restricted an opposing *Robot* into a small, confined area of the field, approximately the size of one foam field tile or less, and has not provided an avenue for escape. *Trapping* can be direct (e.g. pinning an opponent to a field perimeter wall) or indirect (e.g. preventing a *Robot* from escaping from a corner of the field).

**Note:** If a *Robot* is not attempting to escape, that *Robot* has not been Trapped.

# Scoring

- A *Ball Scored* in a *Goal* is worth one (1) point for the *Alliance* of the color of the *Ball*.
- A *Connected Row* is worth six (6) points for that *Alliance*.
- The winner of the Autonomous Bonus receives a six (6) point bonus. In the case of a tie, both *Alliances* receive a three (3) point bonus.

# Safety Rules

**<S1> Be safe out there.** If at any time the *Robot* operation or *Team* actions are deemed unsafe or have damaged any *Field Elements* or *Game Objects*, the offending *Teams* may be Disabled and/or Disqualified at the discretion of the *Head Referee*. The *Robot* will require re-inspection before it may take the field again.

**<S2> Stay inside the field.** If a *Robot* is completely out-of-bounds (outside the playing field), it will be Disabled for the remainder of the *Match*.

**Note:** The intent is NOT to penalize *Robots* for having mechanisms that inadvertently cross the field perimeter during normal game play.

**<S3> Wear safety glasses.** All *Drive Team Members* must wear safety glasses or glasses with side shields while in the *Alliance Stations* during *Matches*. While in the pit area, it is highly recommended that all *Team* members wear safety glasses.

# General Game Rules

**<G1> Treat everyone with respect.** All *Teams* are expected to conduct themselves in a respectful and professional manner while competing in VEX 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 be Disqualified 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.

Robotics competitions often induce intense, high stress situations. These are good opportunities to model and/or gain experience in handling these situations in a positive and productive manner. It is important that we all exhibit maturity and class when dealing with any difficult situations that may present themselves in both the VEX Robotics Competition and our lives in general.

This rule exists alongside the REC Foundation Code of Conduct. Violation of the Code of Conduct can be considered a 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 at <https://www.roboticseducation.org/competition-teams/vex-robotics-competition>

For the 2020-2021 season, some events may establish additional Health & Safety guidelines beyond the scope of this Game Manual. These guidelines will be communicated to all *Teams* in advance via Health & Safety notes associated with the event registration in RobotEvents. All *Teams* (including *Students* or any *Adults* associated with the *Team*) must abide by these guidelines as written. Violation of an event-specific Health & Safety rule may be considered a violation of <G1> and/or the REC Foundation Code of Conduct.

**<G2>VRC is a student-centered program.** *Adults* may assist *Students* in urgent situations, but *Adults* may never work on or program a *Robot* without *Students* on that *Team* being present and actively participating. *Students* must be prepared to demonstrate an active understanding of their *Robot's* construction and programming to judges or event staff.

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 tasks for an *Adult* to solve without *Students* present and actively participating.

When a mechanism falls off, it is...

- ...okay for an *Adult* to help a *Student* investigate why it failed, so it can be improved.
- ...not okay for an *Adult* to put 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 pre-made 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 on the REC Foundation website for *Teams* to reference throughout the season:

<https://www.roboticseducation.org/documents/2019/08/student-centered-policy-rec-foundation.pdf/>

Violation of this rule could be considered a violation of <G1> and/or the REC Foundation Code of Conduct.

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

**<G4> Robots begin the Match in the starting volume.** At the beginning of a *Match*, each *Robot* must be smaller than a volume of 18" (457.2 mm) long by 18" (457.2 mm) wide by 18" (457.2 mm) tall. Using *Field Elements*, such as the field perimeter wall, to maintain starting size is only acceptable if the *Robot* would still satisfy the constraints of <R5> and pass inspection without the *Field Element*. *Robots* in violation of this limit will be removed from the field prior to the start of the *Match*, at the *Head Referee's* discretion.

**<G5> Keep your Robots together.** *Robots* may not intentionally detach parts during the *Match* or leave mechanisms on the field.

Minor violations of this rule that do not affect the *Match* will result in a warning. *Match Affecting* offenses will result in a *Disqualification*. *Teams* that receive multiple warnings may also receive a *Disqualification* at the *Head Referee's* discretion. Multiple intentional infractions may result in *Disqualification* for the entire competition.

**<G6> The Robot must represent the skill level of the Team.** Each *Team* must include Drivers, *Programmer(s)*, *Designer(s)*, and *Builder(s)*. No *Student* may fulfill any of these roles for more than one VEX Robotics Competition *Team* in a given competition season. *Students* may have more than one role on the *Team*, e.g. the *Designer* can also be the *Builder*, the *Programmer* and a *Driver*.

- a. *Team* members may move from one *Team* to another for non-strategic reasons outside of the *Team's* control.
  - i. Examples of permissible moves may include, but are not limited to, illness, changing schools, conflicts within a *Team*, or combining / splitting *Teams*.
  - ii. Examples of strategic moves in violation of this rule may include, but are not limited to, one *Programmer* "switching" *Teams* in order to write the same program for multiple *Robots*, or one *Student* writing the Engineering Notebook for multiple *Teams*.
  - iii. If a *Student* leaves a *Team* to join another *Team*, <G6> still applies to the *Students* remaining on the previous *Team*. For example, if a *Programmer* leaves a *Team*, then that *Team's Robot* must still represent the skill level of the *Team* without that *Student*. One way to accomplish this would be to ensure that the *Programmer* teaches or trains a "replacement" *Programmer* in their absence.
- b. When a *Team* qualifies for a Championship event (e.g., States, Nationals, Worlds, etc) the *Students* on the team attending the Championship event are expected to be the same *Students* on the *Team* that was awarded the spot. *Students* can be added as support to the *Team*, but may not be added as Drivers or *Programmers* for the team.
  - i. An exception is allowed if one (1) Driver and/or one (1) *Programmer* on the *Team* cannot attend the event. The *Team* can make a single substitution of a Driver or *Programmer* for the Championship event with another *Student*, even if that *Student* has competed on a different *Team*. This *Student* will now be on this new *Team* and may not substitute back to the original *Team*.

Violations of this rule will be evaluated on a case-by-case basis, in tandem with the REC Foundation Student Centered Policy as noted in <G2>, and the REC Foundation Code of Conduct as noted in <G1>.

*Event Partners* should bear in mind <G3>, and use common sense when enforcing this rule. It is not the intent to punish a *Team* who may change *Team* members over the course of a season due to illness, changing schools, conflicts within a *Team*, etc. *Event Partners* and referees are not expected to keep a roster of any *Students* who has ever driven for a day. This rule is intended to block any instance of loaning or sharing *Team* members for the sole purpose of gaining a competitive advantage.

**<G7> Only Drivers, and only in the Alliance Station.** During a *Match*, each *Team* 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 not allowed to use any sort of communication devices while in the *Alliance Station*. Devices with communication features turned off (e.g. a phone in airplane mode) are allowed.

**Note 1:** *Drive Team Members* are the only *Team* members that are allowed to be in the *Alliance Station* during a *Match*.

**Note 2:** 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 <R28> and <G8>. Violations or refusal to comply with this rule could be considered a violation of <G1> and is up to the discretion of the *Head Referee*.

**<G8> Controllers must stay connected to the field towers.** Prior to the beginning of each *Match*, *Drive Team Members* must plug their VEXnet Joystick or V5 Controller into the VEXnet Field Controller's Cat-5 cable via their controller's competition port. 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*.

Minor violations of these rules that do not affect the *Match* will result in a warning. *Match Affecting* offenses will result in a *Disqualification*. *Teams* that receive multiple warnings may also receive a *Disqualification* at the *Head Referee's* discretion.

**Note:** 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.

**<G9> Hands out of the field.** *Drive Team Members* may only touch the *Team's* controls and *Robot* at specified times during a *Match* as per <G9a>. *Drive Team Members* are prohibited from making intentional contact with any Game Object, *Field Element*, or *Robot* during a *Match*, apart from the contact specified in <G9a>.

- 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 and/or power expander.
  - iii. Plugging in a VEXnet Key or V5 Robot Radio.
  - iv. Touching the V5 Robot Brain screen, such as to start a program.
- 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 in <G9a>.
- c. Transitive contact, such as contact with the field perimeter that causes the field perimeter to contact *Balls* inside of the field, would be considered a violation of this rule.

Minor violations of these rules that do not affect the *Match* will result in a warning. *Match Affecting* offenses will result in a *Disqualification*. *Teams* that receive multiple warnings may also receive a *Disqualification* at the *Head Referee's* discretion.

**Note:** Any concerns regarding the *Ball(s)* starting positions should be raised with the *Head Referee* prior to the *Match*; *Team* members may never adjust the *Balls* or *Field Elements* themselves.

**<G10> 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 VEXnet Joysticks or V5 Controllers.
- Unplugging or otherwise manually interfering with the field connection in any way.
- Triggering sensors (including the Vision Sensor) in any way, even without touching them.

Minor violations of this rule will result in a Warning. Violations of this rule that affect the outcome of the Autonomous winner or disrupt the autonomous routine of their opponent will result in the *Autonomous Bonus* being awarded to the opposing *Alliance*. *Teams* that receive multiple warnings may also receive a *Disqualification* at the *Head Referee's* discretion.

**<G11> All rules still apply in the Autonomous Period.** Any infractions committed during the *Autonomous Period* that are not *Match Affecting*, but do affect the outcome of the *Autonomous Bonus*, will result in the *Autonomous Bonus* being automatically awarded to the opposing *Alliance*.

- Teams* are responsible for the actions of their *Robots* at all times, including during the *Autonomous Period*. Any infractions committed during the *Autonomous Period* that are *Match Affecting* can result in a *Disqualification*, if warranted by the rule.
- If both *Alliances* cause infractions during the *Autonomous Period* that would have affected the outcome of the *Autonomous Bonus*, then no *Autonomous Bonus* will be awarded.

**<G12> Don't destroy other Robots.** But, be prepared to encounter defense. Strategies aimed solely at the destruction, damage, tipping over, or Entanglement of opposing *Robots* are not part of the ethos of the VEX Robotics Competition and are not allowed. If the tipping, Entanglement, or damage is ruled to be intentional or egregious, the offending *Team* may be *Disqualified* from that *Match*. Repeated offenses could result in *Disqualification* from the entirety of the competition.

- VEX Robotics Competition Change Up is intended to be an offensive game. *Teams* that partake in solely defensive or destructive strategies will not have the protections implied by <G12> (see <G13>). However, defensive play which does not involve destructive or illegal strategies is still within the spirit of this rule.
- VEX Robotics Competition Change Up is an interactive game. Some incidental tipping, *Entanglement*, and damage may occur as a part of normal gameplay without violation. It will be up to the *Head Referee's* discretion whether the interaction was incidental or intentional.
- A *Team* is responsible for the actions of its *Robot* at all times, including the *Autonomous Period*. This applies both to *Teams* that are driving recklessly or potentially causing damage, and to *Teams* that drive around with a small wheel base. A *Team* should design its *Robot* such that it is not easily tipped over or damaged by minor contact.

**Note:** A *Robot* which has expanded horizontally in an effort to obstruct the field, or is legally covering the top of a *Goal* in a solely defensive manner, should expect vigorous interactions from opponent *Robots*. Damage that is caused by opponent *Robots* pushing, tipping, or Entangling with them would not be considered a violation of <G12>. Gratuitous damage or dangerous mechanisms may still be considered a violation of <R4>, <S1>, or <G1> at the *Head Referee's* discretion.

Put simply: "wall-bots" and "cap-bots" are legal, but they are to be attempted at your own risk.

**<G13> Offensive Robots get the “benefit of the doubt”.** In the case where referees are forced to make a judgment call regarding a destructive interaction between a defensive and offensive *Robot*, or an interaction which results in a questionable rules violation, the referees will err on the side of the offensive *Robot*.

**<G14> You can't force an opponent into a penalty.** Intentional strategies that cause an opponent to violate a rule are not permitted, and will not result in an infraction on the opposing *Alliance*. Minor violations of this rule that do not affect the *Match* will result in a warning. *Match Affecting* offenses will result in a *Disqualification*. *Teams* that receive multiple warnings may also receive a *Disqualification* at the *Head Referee's* discretion.

<G3> should be used when enforcing this rule. In most cases, if a *Robot* causes their opponent to break a rule, the referee will simply not enforce the penalty on that opponent. Only in extreme cases, where the act of forcing the opponent into breaking a rule changes the outcome of the match for the benefit of the *Robot*, should that *Robot* who caused the opponent to break a rule receive a *Disqualification*.

**<G15>No Trapping for more than five seconds (0:05).** A *Robot* may not Trap an opposing *Robot* for more than five seconds (0:05) during the *Driver Controlled Period*. A Trap is officially over once the *Trapping Robot* has moved away and the *Robots* are separated by at least two (2) feet (approximately one [1] foam tile). After ending a Trap, a *Robot* may not Trap the same *Robot* again for a duration of five seconds (0:05). If a *Team* does Trap the same *Robot* again, the count will resume from where it left off when the *Trapping Robot* initially backed off.

Minor violations of this rule that do not affect the *Match* will result in a warning. *Match Affecting* offenses will result in a *Disqualification*. *Teams* that receive multiple warnings may also receive a *Disqualification* at the *Head Referee's* discretion.

**<G16> Don't clamp your Robot to the field.** *Robots* may not intentionally grasp, grapple or attach to 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 both unintentionally damaging the field and/or from anchoring themselves to the field.

Minor violations of this rule that do not affect the *Match* will result in a warning. *Match Affecting* offenses will result in a *Disqualification*. *Teams* that receive multiple warnings may also receive a *Disqualification* at the *Head Referee's* discretion.

**<G17> Let go of Game Objects after the Match.** *Robots* must be designed to permit easy removal of *Balls* from any mechanism without requiring the *Robot* to have power after a *Match*.

**<G18> It's not over until it's over.** Scores will be calculated for all *Matches* immediately after the *Match* ends, once all *Balls*, *Field Elements*, and *Robots* on the field come to rest.

- a. The determination of the *Autonomous Bonus* will occur for all *Matches* immediately after the *Autonomous Period* ends, after all *Balls*, *Field Elements*, and *Robots* come to rest.
- b. The determination of any *Autonomous Win Point(s)* will occur for all *Matches* immediately after the *Autonomous Period* ends, after all *Balls*, *Field Elements*, and *Robots* come to rest.

**<G19> Be prepared for minor field variance.** *Field Element* tolerances may vary from nominal by  $\pm 1.0''$ , unless otherwise specified. *Ball* tolerances and weights may vary from nominal to  $\pm 0.10''$  and 10 grams respectively. *Ball* placement at the beginning of *Matches* may vary from nominal to  $\pm 1.5''$ . The bottom opening of *Goals* between the lowest two rings has a dimensional tolerance of  $-0.0 / +0.5''$ . *Teams* are encouraged to design their *Robots* accordingly. Please make sure to check Appendix A for more specific nominal dimensions and tolerances.

**Note:** The field perimeter must always be resting upon the Field Perimeter Rubber Feet, regardless of whether or not the tabs have been cut from the foam field tiles.

As per the May 25th Game Manual Update, Option A: (1x) 4" Standoff (276-1021) or Option B: (2x) 11" Zipties (275-0125) are added to the four corner *Goals* to aid in proper function of the *Goal*. One of these options will be required for official match play, with option A being preferred.

**<G20> Match Replays are allowed, but rare.** Match Replays, i.e. playing a match over again from its start, are at the discretion of the *Event Partner* and *Head Referee*, and will only be issued in the most extreme circumstances listed but not limited to the following:

- a. Field Fault issues that have directly affected *Match* play.
  - i. Game Elements not in the correct positions
  - ii. Tape lines lifting
  - iii. *Field Elements* detaching or moving beyond normal tolerances that is not a result of team play violations.
  - iv. *Autonomous Period* or *Driver Controlled Period* ending early
  - v. Field Control disconnecting and disabling *Robots*. Not to be confused with a *Robot* that trips its own PTC and has to reboot to reconnect the robot to controller, or teams with controllers that have bent pins that affect only their alliance Field Control tower.
- b. Game Rule issues that affect the outcome of a match.
  - i. Referee disables a robot for a misinterpretation of a rule violation.
  - ii. Referee starts the *Driver Controlled Period* without determining the outcome of the *Autonomous* winner.
  - iii. The field is reset before a score is determined.

**<G21> This manual will have four scheduled updates.** All rules in this manual are subject to change on the following dates: May 25, 2020, August 17, 2020, December 1, 2020, and March 26, 2021. Each version is official and must be used in official VRC events until the release of the newest version making the previous version void. Areas of focus for each update are as follows:

- a. The May update will include rule changes from input from the community that post questions and responses on the official Q&A.
  - i. A portion of this update, regarding Robot Skills and Appendix B, will be released separately on June 15, 2020
- b. The August update will include rule changes to improve game play from early season events along with input from the community that post questions and responses on the official Q&A.
- c. The December update will include clarifications that were posted on the official Q&A.
- d. The March update will be specific to the VEX World Championship.

**<G22> The Q&A system is an extension of this Game Manual.** All *Teams* must adhere to all VEX Robotics Competition rules as written in this Game Manual, and must abide by any stated intent of these rules. Officially registered *Teams* have the opportunity to ask for official rule interpretations in the VEX Robotics Competition Question & Answer system. All responses in this system must be treated as official rulings from the VEX Robotics Competition Game Design Committee (GDC), and they represent the correct and official interpretation of the VEX Robotics Competition Rules.

Previous Definitions, Rules and Rulings found in documents and Q&A's from previous seasons do not apply to the current game. If clarification is needed, the question should be asked on the current Q&A.

The 2020 - 2021 Q&A is the ONLY official source for rulings besides the Game Manual. If there are any conflicts between the Game Manual and other supplemental materials (e.g. Referee Training videos, VRC Hub app, etc), the most current version of the Game Manual takes precedent.

The VRC Q&A system can be found at <https://www.robotevents.com/VRC/2020-2021/QA>

# Specific Game Rules

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

- a. Contacting its *Home Zone*.
- b. Not contacting the gray foam field tiles outside of the *Alliance's Home Zone*.
- c. Not contacting any *Balls* other than the *Preload*.
- d. Not contacting another *Robot*.
- e. Contacting exactly one (1) *Preload*.
  - i. The *Preload* must be contacting exactly one (1) *Robot*.
  - ii. The *Preload* must be fully within the field perimeter.
  - iii. The *Preload* must not be breaking the vertical projection of the *Goal*, i.e. the *Preload* must not be inside or above the *Goal*.

**Note:** If a *Robot* is not present for their *Match*, then their *Preload* will instead be placed in the center of the gray foam tile that is closest to the double tape line that bisects the *Home Zone* and is opposite the half of the *Home Zone* from the placed *Robot* as shown below.

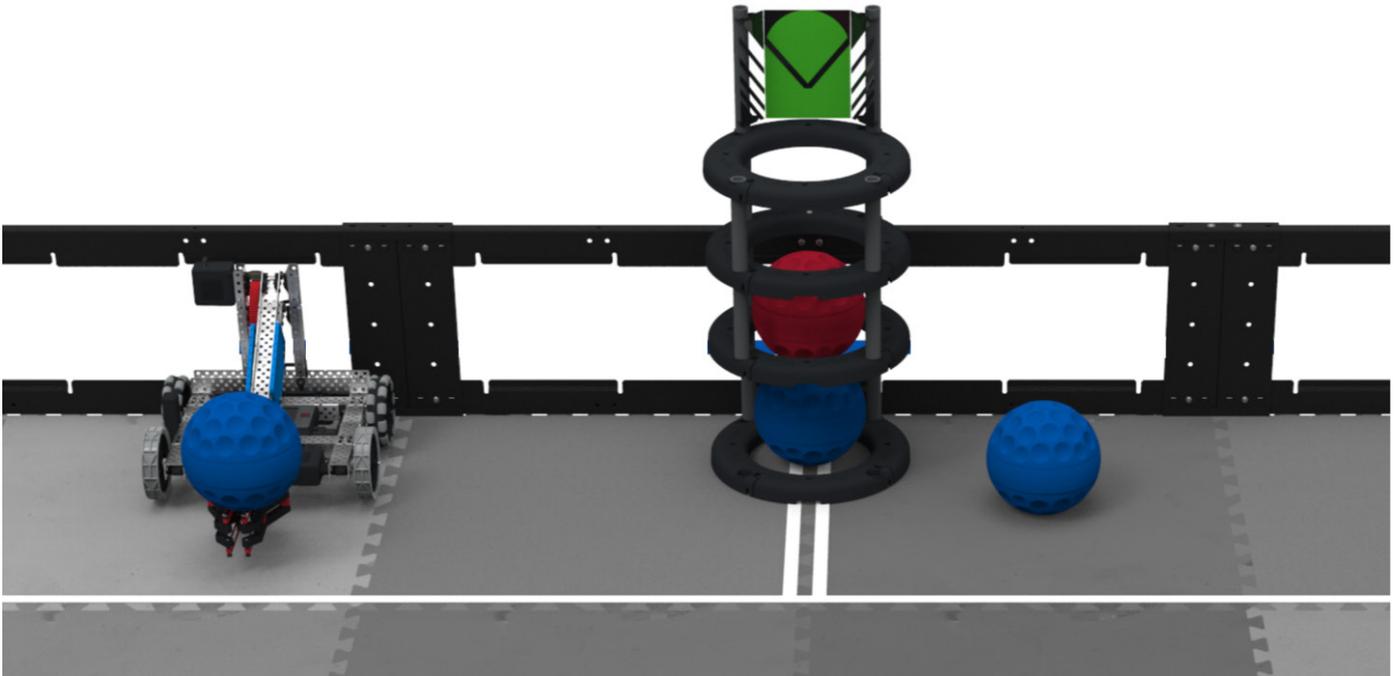


Figure 13: Example of a placed *Robot* with *Preload*, and one *Preload* correctly placed for a non-present *Robot*.

**<SG2> Stay on your side in Autonomous.** During the *Autonomous Period*, Robots may not contact the foam tiles or *Balls* which are on the opposing *Alliance's* side of the *Autonomous Line*. Robots may not contact the *Goals* that are in the opposing *Alliance's Home Zone*.

Violations of this rule will result in the *Autonomous Bonus* being awarded to the opposing *Alliance*. Intentional, strategic, or egregious violations, such as intentional contact with an opposing *Robot* while completely across the *Autonomous Line*, will result in a *Disqualification*.

**Note:** The three (3) *Goals* contacting the *Autonomous Line* are not considered to be on either side, and may be utilized by either *Alliance* during the *Autonomous Period*. If attempting to utilize these *Goals*, *Teams* should be cognizant of the possibility that opponent *Robots* may attempt to do the same. <SG7>, <G10>, <G11>, and <G12> will be taken into account when these types of *Robot* interactions occur.

**<SG3> Keep Balls on your side in Autonomous.** *Balls* that start fully on one side of the *Autonomous Line* may not contact the foam tiles on the opposite side of the *Autonomous Line* during the *Autonomous Period*.

Incidental violations of this rule and have no impact on the opposing *Alliance* will result in a *Warning*. Violations of this rule that affect the opposing *Alliance's* autonomous routine will result in the *Autonomous Bonus* being awarded to the opposing *Alliance*. Examples of affecting the opposing *Alliance* could include, but are not limited to, a *Ball* moving another *Ball* or getting in the path of a *Robot*.

**Note:** *Balls* that start on the *Autonomous Line* are not included in this rule.

**<SG4> Keep Game Objects to yourself.** *Robots* may not intentionally drop or place *Game Objects* on an opponent *Robot*.

Minor violations of this rule that do not affect the *Match* will result in a warning. *Match Affecting* offenses will result in a *Disqualification*. *Teams* that receive multiple warnings may also receive a *Disqualification* at the *Head Referee's* discretion.

**<SG5> Balls may not be de-scored from the top of Goals.** *Balls* that are *Scored* may not be lifted by any means such that the *Ball* goes above the top edge of the *Goal*.

It is expected that while removing *Balls* from the bottom of the *Goal*, this may cause the top *Ball* to momentarily go above the top edge of the *Goal*. This would not be a violation of this rule and is considered to be normal game play.

If the *Match* ends while a *Robot* is removing a *Ball* from the bottom of the *Goal* that contains three (3) *Balls* and the top *Ball* remains partially above the top edge of the *Goal*, that *Ball* will be considered *Scored* and no penalty to the *Team* will be assessed.

Minor violations of this rule that do not affect the *Match* will result in a warning. *Match Affecting* offenses will result in a *Disqualification*. *Teams* that receive multiple warnings may also receive a *Disqualification* at the *Head Referee's* discretion.

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Figure 14: If this situation occurs at the end of a Match, this Goal would still be Owned by the Blue Alliance, and the top-most Ball would be Scored, even though it is not completely within the upper edge of the Goal. No penalty is assessed to the Red Alliance.

**<SG6> Keep Balls in the field.** Teams may not intentionally remove *Balls* from the field. While *Balls* may accidentally leave the field when attempting to Score, doing so intentionally or repeatedly would be a violation of this rule. *Balls* that leave the field during *Match* play, intentionally or unintentionally, will be returned to the field at the location nearest the point at which they exited. Referees will return the *Balls* to the field when it is deemed safe to do so, at the leisure of the referee.

Minor violations of this rule that do not affect the *Match* will result in a warning. *Match Affecting* offenses will result in a *Disqualification*. Teams that receive multiple warnings may also receive a *Disqualification* at the Head Referee's discretion.

**<SG7> Use Balls to play the game.** *Balls* may not be used to accomplish actions that would be otherwise illegal if they were attempted by *Robot* mechanisms (e.g., Interfering with an opponent's *Autonomous Period* per <SG2>.)

The intent of this rule is to prohibit teams from using game objects 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 a *Ball* and a *Robot* needs to be scrutinized with the same intensity as if it were a *Robot*.

**<SG8> Possession is limited.** *Robots* may not have greater-than-momentary *Possession* of more than three (3) *Balls* of its opposing *Alliance's* color at once. When two *Robots* from the same *Alliance* are working in tandem and blocking *Balls*, those *Robots* may not possess a total of more than six (6) *Balls* of its opposing *Alliance's* color at once.

*Robots* that violate this rule must stop all *Robot* actions except for those actions that are attempting to remove the excess *Ball*.

Minor violations of this rule that are not *Match Affecting* will receive a warning. *Match Affecting* offenses will result in a *Disqualification*. Teams that receive multiple warnings may also receive a *Disqualification* at the Head Referee's discretion.

The overarching intent of this rule is to prohibit each *Robot* from keeping more than 3 of the opposing *Balls* from being used by the opposing *Alliance*.

One definition of *Possession* is "blocking opposing *Robots'* access to *Balls*, such as by expanding horizontally and restricting access to a portion of the field (e.g. a "wallbot")." Put simply - as far as *Possession* is concerned, a defensive "wallbot" does not violate <SG8>, as long as 3 or more of the offensive *Alliance's* *Balls* are not being blocked.

Similarly, if two *Robots* work in tandem to prevent access to an opposing *Alliance's* *Balls*, they are not in violation of <SG8> as long as they are not blocking access to more than 6 of the opposing *Alliance's* *Balls* in total, and each *Robot* is not carrying or controlling more than 3 *Balls* each.

# Section 3

## The Robot

### Overview

This section provides rules and requirements for the design and construction of your *Robot*. A VEX Robotics Competition *Robot* is a remotely operated and/or autonomous vehicle designed and built by a registered VEX Robotics Competition *Student Team* to perform specific tasks when competing in VEX Robotics Competition Change Up. Prior to competing at each event, all *Robots* will have to pass an inspection.

There are specific rules and limitations that apply to the design and construction of your *Robot*. Please ensure that you are familiar with these *Robot* rules before proceeding with *Robot* design.

### Inspection Rules

**<R1> One Robot per Team.** Only one (1) *Robot* will be allowed to compete per *Team* in the VEX 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*. As such, a VEX *Robot*, for the purposes of the VEX 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: Additional mechanisms (and associated motors) that allow manipulation of game objects or navigation of field obstacles.

Given the above definitions, a minimum *Robot* for use in any VEX Robotics Competition event (including Skills Challenges) must consist of 1 and 2 above. Thus, if you are swapping out an entire subsystem of either item 1 or 2, you have now created a second *Robot* and are no longer legal.

- a. *Teams* may not compete with one *Robot* while a second is being modified or assembled.
- b. *Teams* may not have an assembled second *Robot* to be used to repair or swap parts to the first *Robot*.
- c. *Teams* may not switch back and forth between multiple *Robots* during a competition. This includes using different *Robots* for Skills Challenge, Qualification 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 *Teams* may compete with it for the duration of the competition season.

The intent of <R1a>, <R1b>, and <R1c> are 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 have 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 be a representation of the skill level of the team.** The *Robot* must be designed, built and programmed by members of the *Team*. *Adults* are permitted to mentor and teach design, building and programming skills to the *Students* on the *Team*, but may not design, build or program that team's *Robot*.

In VRC, we expect *Adults* to teach different linkages, drive-trains, and manipulator applications to the *Students*, then allow the *Students* to determine which designs to implement and build on their *Robot*. *Adults* are encouraged to teach the *Students* how to code various functions involving applicable sensors, 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.

- 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.
- c. *Teams* may be requested to submit to random spot-inspections by event personnel. Refusal to submit will result in *Disqualification*.
- d. *Robots* which have not passed inspection (i.e. who are in violation of one or more *Robot* rules) will not be permitted to play in any *Matches* until they have done so. <T3> will apply to any *Matches* that occur until the *Robot* has passed inspection.
- e. If a *Robot* has passed inspection, but is later found to be in violation of a *Robot* rule during a *Match*, then they will be *Disqualified* from that *Match* and <R2d> will apply until the violation is remedied and the *Team* is re-inspected.

The intent of this rule is to ensure that teams play *Matches* with legal *Robots*. If a *Robot* is determined to not be legal before the *Match* starts, the *Robot* will be removed from the field and a Drive Team member must remain so that the *Team* does not get assessed a "no-show". If the *Match* is played with an illegal *Robot* on the Field, that *Team* will receive a *Disqualification* for the *Match* (see <T11>).

**<R4> Robots must be safe.** The following types of mechanisms and components are NOT allowed:

- a. Those that could potentially damage *Field Elements* or *Balls*.
- b. Those that could potentially damage other competing *Robots*.
- c. Those that pose an unnecessary risk of Entanglement.

**<R5> Robots must fit in a sizing box.** At the beginning of any *Match*, *Robots* must be smaller than 18" (457.2 mm) long by 18" (457.2 mm) wide by 18" (457.2 mm) tall.

- a. *Robots* may expand beyond their starting size constraints after the start of a *Match*.
- b. 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*.

*Robots* may be measured by either being placed in a "sizing box" with interior dimensions matching the above size constraints or by using the VEX Robotics Competition Robot Sizing Tool while the *Robot* is placed on a flat surface. A *Robot* may not touch the box walls or ceiling or the Robot Sizing Tool sides when being measured.

There are two VEX Robotics Competition Robot Sizing Tools that may be used:

<https://www.vexrobotics.com/276-2086.html> and <https://www.vexrobotics.com/276-5942.html>

**<R6> Robots are built from the VEX V5 or Cortex system.** *Robots* may be built ONLY using official VEX V5 and Cortex components, unless otherwise specifically noted within these rules. *Teams* are responsible for providing documentation proving a part's legality in the event of a question. Examples of documentation include receipts, part numbers, official VEX websites, or other printed documentation.

- a. Products from the VEXpro, VEX IQ, or VEX Robotics by HEXBUG product line cannot be used for *Robot* construction, unless specifically allowed by a clause of <R7> or cross-listed as part of the VEX V5 or Cortex Product lines. For example, the Rubber Shaft Collar (228-3510) is a VEX IQ component that can be found on the VEX "Shafts & Hardware" page, and is thus legal: <https://www.vexrobotics.com/shafts-and-hardware.html>
- b. VEX IQ pins used solely for the purpose of attaching VEX Team Identification Number Plates are permitted.
- c. Official VEX V5 and Cortex components which have been discontinued are still legal for competition use. *Teams* must be cognizant of <R6> if attempting to use a discontinued part.
- d. Any parts which are identical to legal VEX parts are permitted. For the purposes of this rule, products which are identical in all ways except for color are permissible. It is up to inspectors to determine whether a component is "identical" to an official VEX component.

- e. Components obtained from the V5 beta program, including V5 beta firmware, are not legal for competition use.
  - 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.

Using VEX apparel, competition support materials, packaging, or other non-robot products on a VEX Robotics Competition Robot goes against the spirit of this rule and is not permitted.

**<R7> VEX products come from VEX Robotics or VEX Robotics Resellers.** Official VEX products are ONLY available from VEX Robotics & official VEX Resellers. To determine whether a product is "official" or not, consult [www.vexrobotics.com](http://www.vexrobotics.com). A complete list of authorized VEX Resellers can be found at <https://www.vexrobotics.com/how-to-order>.

**<R8> 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 VEX Light 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 surface, *Balls*, or other *Robots*.
- c. Anti-static compound, when used in extreme moderation (i.e. such that it does not leave residue on playing field walls, the foam field surface, *Balls*, or other *Robots*).
- d. Hot glue when used to secure cable connections.
- e. An unlimited amount of 1/8" (or local metric equivalent), braided, nylon rope.
- f. Commercially available items used solely for bundling or wrapping of 2-wire, 3-wire, 4-wire, or V5 Smart Cables, and pneumatic tubing are allowed. These items must solely be used for the purposes of cable 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.

Non-functional 3D printed license plates, per <R13> and <R27>, are permitted.

**<R9> Give the radio some space.** The V5 Radio or VEXnet Key 2.0 must be mounted such that no metal surrounds the radio symbol on the V5 Radio or touches the VEXnet logo on the VEXnet Key 2.0.

Teams may use a USB extension cable for the sole purpose of remote mounting of a VEXnet Key 2.0 to a VEX ARM® Cortex®-based Microcontroller.



Figure 15: A V5 Radio



Figure 16: A VEXnet Key 2.0

It is fine to loosely encapsulate the V5 Radio or VEXnet Key 2.0 in *Robot* structure. The intent of this rule is to minimize radio connection issues by minimizing obstructions between VEXnet devices. If a radio is buried in a *Robot*, VEXnet is not able to connect as well and may result in *Robot* communication issues.

**<R10> A limited amount of custom plastic is allowed.** *Robots* may use non-shattering plastic from the following list; polycarbonate (Lexan), acetal monopolymer (Delrin), acetal copolymer (Acetron GP), POM (acetal), ABS, PEEK, PET, HDPE, LDPE, Nylon (all grades), Polypropylene, FEP; as cut from a single 12" x 24" sheet up to 0.070" thick.

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

**<R11> A limited amount of tape is allowed.** *Robots* may use a small amount of tape when used for the following purposes:

- a. For the sole purpose of securing any connection between the ends of two (2) VEX cables.
- b. For labeling wires and motors.
- c. For covering the back of License Plates (i.e. the "wrong color").
- d. For the purposes of preventing leaks on the threaded portions of pneumatic fittings. This is the only acceptable use of Teflon tape.
- e. For securing and retaining a VEXnet Key 2.0 to the VEX ARM® Cortex®-based Microcontroller. Using tape in this manner is highly recommended to ensure a robust connection.
- f. In any other application that would be considered a "non-functional decoration" per <R13>.

**<R12> Certain non-VEX screws, nuts, and washers are allowed.** *Robots* may use any commercially available #4, #6, #8, M3, M3.5, or M4 screw up to 2" (50.8mm) long (nominal), and any commercially available nut, washer, and/or spacer (up to 2" / 50.8mm long) to fit these screws.

The intent of the rule is to allow teams to purchase their own commodity hardware without introducing additional functionality not found in standard VEX equipment. It is up to inspectors to determine whether the non-VEX hardware has introduced additional functionality or not.

**<R13> 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 will have final say in what is considered "non-functional". Unless otherwise specified below, non-functional decorations are governed by all standard *Robot* rules.

In order to be "non-functional," any guards, decals, or other decorations must be backed by legal materials that provide the same functionality. For example, if your *Robot* has a giant decal that prevents *Balls* from falling out of the *Robot*, the decal must be backed by VEX material that would also prevent the *Balls* from falling out.

- a. Anodizing and painting of parts is considered a legal nonfunctional decoration.
- b. If using the VEX speaker (276-1504), the chosen audio must not be distracting and must be in good taste. The Head Inspector and *Head Referee* will make the final decision on the appropriateness of the audio.
- c. 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.
- d. VEX electronics may not be used as non-functional decorations.
- e. Decorations that visually mimic field elements or could otherwise interfere with an opponent's Vision Sensor are considered functional and are not permitted. This includes lights, such as the VEX Flashlight. The Head Inspector and *Head Referee* will make the final decision on whether a given decoration or mechanism violates this rule.
- f. 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 (e.g. does not directly or indirectly influence any functional portions of the *Robot*).
- g. Decorations which provide feedback to the *Robot* (e.g. by influencing legal sensors) or to *Drive Team Members* (e.g. status indicators) would be considered "functional" and are not permitted.

**<R14> No Wi-Fi.** The Vision Sensor must have its wireless transmitting functionality disabled.

**<R15> New VEX parts are legal.** Additional VEX components released during the competition season on [www.vexrobotics.com](http://www.vexrobotics.com) are considered legal for use.

Some "new" components may have certain restrictions placed on them upon their release. These restrictions will be documented in the official Q&A forums, in a Game Manual Update, or on their respective product web pages.

**<R16> Robots have one microcontroller.** Robots must ONLY use one (1) VEX V5 Robot Brain (276-4810), or one (1) VEX ARM® Cortex®-based Microcontroller (276-2194).

- a. 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 VEXpro, 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.

**<R17> Robots use VEXnet.** Robots must ONLY utilize the VEXnet system for all *Robot* communication.

- a. VEX 75Mhz Crystal Radios are prohibited. (Some events may allow the use of 75Mhz Crystal Radios, please see the Special Event Rule Modifications later in this section.)
- b. Electronics from the VEXpro, VEX RCR, VEXplorer, VEX IQ, VEX GO, or VEX Robotics by HEXBUG product line are prohibited.
- c. Mixing and matching of VEXnet transmitters and receivers is prohibited. The VEXnet Joystick may only be used in conjunction with a VEX ARM® Cortex®-based Microcontroller. A VEXnet upgraded 75MHz Transmitter may only be used in conjunction with a PIC Microcontroller. A V5 Controller may only be used in conjunction with a V5 Robot Brain.

Teams are permitted to use the Bluetooth® capabilities of the V5 Robot Brain and/or V5 Controller in team pits or outside of Matches. However, VEXnet must be used for wireless communication during *Matches*.

**<R18> Robots use one control system.** Robots may use exactly one (1) of the following four (4) options:

- Option 1: A VEX ARM® Cortex®-based Microcontroller, up to ten (10) 2-Wire Motors or VEX Servos (in any combination up to ten) and a legal VRC pneumatic system.
- Option 2: A VEX ARM® Cortex®-based Microcontroller, up to twelve (12) 2-Wire Motors or VEX Servos (in any combination up to twelve) and no pneumatic components, excluding pneumatic tubing.
- Option 3: A V5 Robot Brain, up to six (6) V5 Smart Motors, and a legal VRC pneumatic system.
- Option 4: A V5 Robot Brain, up to eight (8) V5 Smart Motors, and no pneumatic components, excluding pneumatic tubing.

- a. 2-Wire Motors must be controlled by a 2-Wire Motor Port, either directly on a VEX microcontroller, or on a VEX Motor Controller 29 module (276-2193).
- b. *Teams* may NOT use multiple 2-wire Motor Ports, 3-wire PWM Motor Ports, or Motor Controller 29 modules on a single motor.

V5 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.

Option	Control System	Pneumatics	2-Wire Motors or Servos	V5 Smart Motors
1	Cortex	Y	10	0
2	Cortex	N	12	0
3	V5	Y	0	6
4	V5	N	0	8

Table 1: The four combinations of control system, motors and pneumatics that are legal

**<R19> One motor or Y cable per motor port.** If using a VEX ARM® Cortex®-based Microcontroller, a maximum of one (1) VEX Y-cable can be used per Motor Port of the Microcontroller or Power Expander, i.e. you cannot “Y off a Y” to have more than two (2) motors controlled by the same Motor Port.

- a. *Teams* using the VEX ARM® Cortex®-based Microcontroller may only power one (1) 2-wire Motor per each of the two 2-wire motor ports on the Microcontroller. It is illegal to “Y” off a 2-wire Motor Port.
- b. *Teams* may not “Y” off of a Motor Controller 29 (276-2193).

**<R20> Electrical power comes from VEX batteries only.** The only allowable source(s) of electrical power are as follows:

- a. If using a VEX ARM® Cortex®-based Microcontroller, robots may use (1) VEX 7.2V Robot Battery Pack of any type.
  - i. *Robots* utilizing the VEX Power Expander may use a second VEX 7.2V Robot Battery of any type. *Robots* are permitted to use a maximum of one (1) VEX Power Expander.
  - ii. The only legal means for charging a VEX 7.2V Battery Pack is via one of the following VEX Battery Chargers: Smart Charger (276-1445); Smart Charger v2 (276-2519); 276-2221 (discontinued), 276-2235 (discontinued). All other chargers are strictly prohibited.
  - iii. *Teams* must connect a charged 9V backup battery to their VEXnet system using the VEXnet Backup Battery Holder (276-2243).
  - iv. VEXnet Joysticks must only be powered by AAA batteries.
  - v. Some events may provide field power for VEXnet Joysticks. If this is provided for all *Teams* at the event, this is a legal source of power for VEXnet Joysticks.

- b. If using a V5 Robot Brain, robots may use (1) V5 Robot Battery (276-4811).
  - i. There are no legal power expanders for the V5 Robot Battery.
  - ii. V5 Robot Batteries may only be charged by the V5 Robot Battery Charger (276-4812) or (276-4841).
  - iii. V5 Wireless Controllers may only be powered by their internal rechargeable battery.
- c. *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 <R8> or <R22>.

VEX ARM® Cortex®-based Microcontroller				V5 Robot Brain		
Component	Legal Parts	Legal Chargers	Maximum Quantity	Legal Parts	Legal Chargers	Maximum Quantity
Robot Battery	276-1456 276-1491	276-1445 276-2519 276-2221 276-2235	1 (2 with Power Expander)	276-4811	276-4812 276-4841	1
Power Expander	276-2271	N/A	1	None	None	0
Transmitter Battery	AAA Battery	Any safe AAA charger	6 (per transmitter)	276-4820 (internal)	Any safe Micro-USB cable	1 (per transmitter)
Transmitter Field Power	276-1701	N/A	1	None	None	0
Backup Battery	9V battery	N/A	1	None	None	0

Table 2: The legal sources of electrical power for Robots

<R21> **One or two controllers per Robot.** No more than two (2) VEX wireless remotes may control a single *Robot* during the tournament.

- a. No modification of these transmitters is allowed of ANY kind.
- 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 acceptable.
- c. Teams may not “mix-and-match” wireless remote types, such as using a VEXnet Joystick and V5 Controller at the same time.

**Note:** This rule does not prohibit objects attached to the controller that assist the Driver in holding the controller or manipulating buttons/joysticks on the controller.

**<R22> No modifications to electronic components are allowed.** Motors (including the internal PTC or Smart Motor firmware), microcontrollers (including V5 Robot Brain firmware), extension cords, sensors, controllers, battery packs, reservoirs, solenoids, pneumatic cylinders, and any other electrical component or pneumatics component of the VEX platform may NOT be altered from their original state in ANY way.

- a. External wires on VEX electrical components may be repaired by soldering, using twist/crimp connectors, electrical tape or shrink tubing such that the original functionality / length is not modified in any way. Wire used in repairs must be identical to VEX wire. *Teams* may make these repairs at their own risk; incorrect wiring may have undesired results.
- b. *Teams* must use the latest official VEXos firmware updates, found at [www.vexrobotics.com](http://www.vexrobotics.com). Custom firmware modifications are not permitted.
- c. *Teams* may change or replace the gears in the "2-Wire 393" or "2-Wire 269" motors with the corresponding official VEX Replacement Gears.
- d. *Teams* may change or replace the gear cartridge in the V5 Smart Motor with other official replacement gear cartridges.

**<R23> Most modifications and repairs to non-electrical components are allowed.** Physical modifications such as bending or cutting are permitted and may be done to legal VEX Robotics Competition metal structure or plastic components.

- a. Physical modifications to electrical components such as a legal microcontroller or radio is prohibited unless otherwise explicitly permitted, per <G21>.
- b. Internal or external mechanical repairs of VEX Limit and Bumper switches are permitted. Modifying the metal arm on the Limit Switch is permitted. Using components from these devices in other applications is prohibited.
- c. Metallurgical modifications that change fundamental material properties, such as heat treating, are not permitted.
- d. *Teams* may cut pneumatic tubing to a desired length.
- e. *Teams* are permitted to fuse/melt the end of the 1/8" nylon rope to prevent fraying.
- f. Welding, soldering, brazing, gluing, or attaching in any way that is not provided within the VEX platform is NOT permitted.

**<R24> Custom V5 Smart Cables are allowed.** *Teams* must use official V5 Smart Cable Stock but may use commodity 4P4C connectors and 4P4C crimping tools. *Teams* who create custom cables acknowledge that incorrect wiring may have undesired results.

**<R25> Keep the power switch accessible.** The *Robot* on/off switch or button must be accessible without moving or lifting the *Robot*. All microcontroller lights and/or screens must also be easily visible by competition personnel to assist in diagnosing *Robot* problems.

**<R26> Pneumatics are limited.** Pneumatic devices may only be charged to a maximum of 100 psi. *Teams* may only use a maximum of two (2) legal VEX pneumatic air reservoirs on a *Robot*.

The intent of this rule is to limit *Robots* to the air pressure stored in two reservoir tanks, as well as the normal working air pressure contained in their pneumatic cylinders and tubing on the *Robot*. *Teams* may not use other elements (e.g. surgical tubing) for the purposes of storing or generating air pressure. *Teams* who use cylinders and additional pneumatic tubing for no purpose other than additional storage are in violation of the spirit of this rule and will fail inspection.

**<R27> Only registered Teams may compete in the VEX Robotics Competition.** To participate in an official VEX Robotics Competition (VRC) event, a *Team* must first register on [robotevents.com](http://robotevents.com). Upon registering they will receive their VRC Team Number and four (4) VRC License Plates. *Teams* may choose to use the VRC License Plate Kit that comes in the VRC Team Welcome Kit, or may create their own, including one made from 3D printed parts. Plates must follow the following requirements.

- a. *Robots* must use the colored plates that match their *Alliance* color for each *Match* (i.e. red *Alliance Robots* must have their red plates on for the *Match*). It must be abundantly clear which color *Alliance* the *Robot* belongs to.

**Note:** If the plates are attached to opposite-color plates, then the incorrect color must be covered, taped over, or otherwise obscured to ensure that the correct *Alliance* color is abundantly clear to Head Referees during a *Match*. Since License Plates are considered non-functional decorations, this is a legal non-functional use of tape.

- b. License Plates must fulfill all *Robot* rules (i.e. they must fit within the 18" cube per <R4>, they cannot cause entanglement, not functionally change the stability of rigidity of the *Robot*, etc.)
- c. Plates must be at least 2.48 inches (63.2mm) tall and 4.48 inches (114mm) wide, i.e. at least the size of the plates in the VRC License Plate Kit ignoring thickness.

The intent of this rule is to make it very easy for *Head Referees* to know which *Alliance* and which *Team* each *Robot* belongs to. Being able to "see through" a *Robot* arm to the wrong color License Plate on the opposite side of the *Robot* would be considered a violation of <R27a>.

It will be at the full discretion of the *Head Referee* and inspector at a given event to determine whether a given custom license plate satisfies the criteria listed in <R27>. *Teams* wishing to utilize custom plates should be prepared for the possibility of this judgment, and ensure that they are prepared to replace any custom parts with official VEX License Plates if requested. Not bringing official replacement plates to an event will not be an acceptable reason for overlooking a violation of one or more points in <R27>.

**<R28> Use the "Competition Template" for programming.** The *Robots* must be programmed to follow control directions provided by the VEXnet Field Controllers.

During the *Autonomous Period*, *Drive Team Members* will not be allowed to use their hand-held controllers. As such, *Teams* are responsible for programming their *Robot* with custom software if they want to perform in the *Autonomous Period*. *Robots* must be programmed to follow control directions provided by the VEXnet Field Controllers (i.e. ignore wireless input during the *Autonomous Period*, disable at the end of the *Driver Controlled Period*, etc).

*Teams* must use a provided "competition template", or functional equivalent, to accomplish this. All *Robots* will be required to pass a functional enable/disable test as part of inspection. For more information on this, *Teams* should consult the help guides produced by the developers of their chosen programming software.

**<R29> There is a difference between accidentally and willfully violating a Robot rule.** Any violation of *Robot* rules will result in a *Team* being unable to play until they pass inspection (per <R3d>). In addition, *Teams* who intentionally 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 may be considered a violation of <G1> and/or the REC Foundation Code of Conduct.

**<R30> Special event modifications.** Some events may choose to make the following rule exceptions to fit their unique circumstances:

- a. Utilize the VEX 75 MHz Crystal Radio Transmitter & Receiver instead of or in conjunction with the VEXnet Wireless link.
- b. Allow AA batteries to power the robot instead of a VEX 7.2V Battery Pack.

**Note:** If an event makes these changes, they must inform all attending *Teams*. It is especially important that any 75 MHz events make sure their *Teams* are using the correct communication type.

# Section 4

## The Tournament

### Overview

The main challenge of the VEX Robotics Competition will be played in a tournament format. Each tournament consists of *Qualification Matches* and *Elimination Matches* and may include *Practice Matches*. After the *Qualification Matches*, *Teams* are ranked based on their *Win Points*, *Autonomous Points*, and *Strength of Schedule Points*. The top ranked *Teams* will then participate in *Elimination Matches* to determine the tournament champions.

### Tournament Definitions

**Alliance Captain** - The *Team Representative* of the highest ranked *Team* in an *Alliance* during *Elimination Matches*. The *Alliance Captain* invites available *Teams* to join his or her *Alliance* until the *Alliance* is formed.

**Alliance Selection** - The process of choosing the permanent *Alliances* for the *Elimination Matches*. *Alliance Selection* proceeds as follows:

1. The highest ranked *Team* at the end of *Qualification Matches* becomes the first *Alliance Captain*.
2. The *Alliance Captain* invites another *Team* to join their *Alliance*.
3. The invited *Team Representative* either accepts or declines as outlined in <T13>.
4. The next highest ranked *Team* at the end of *Qualification Matches* becomes the next *Alliance Captain*.

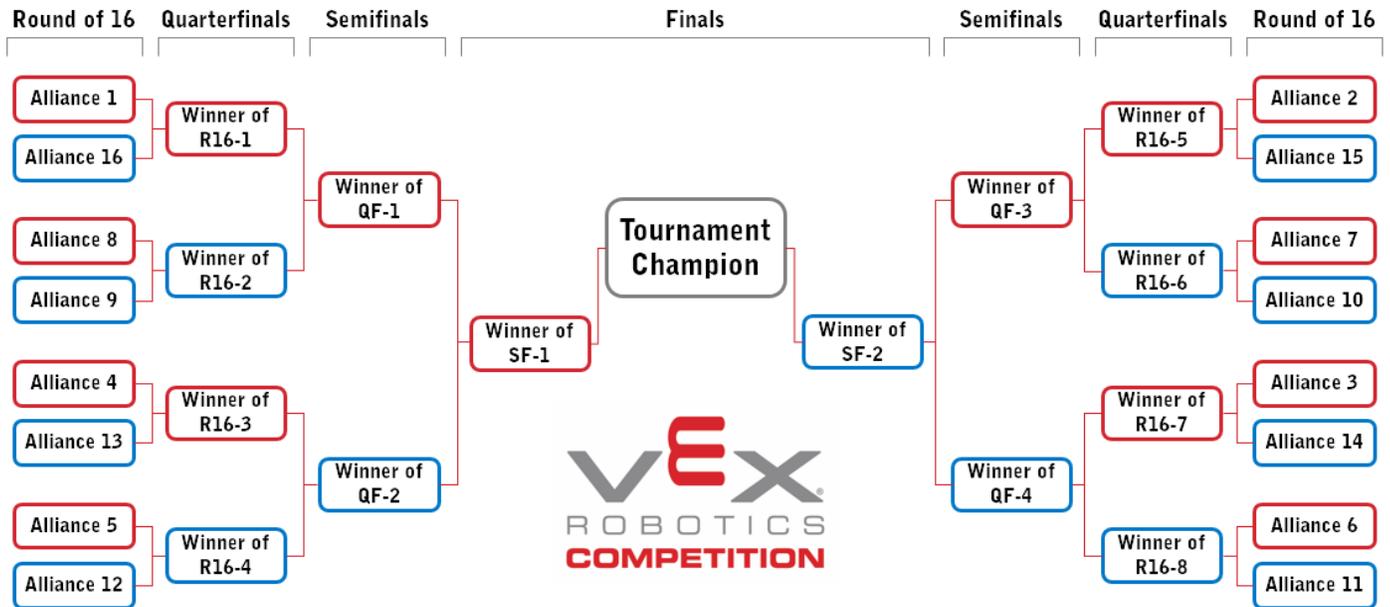
*Alliance Captains* continue to select their *Alliances* in this order until all *Alliances* are formed for the *Elimination Matches*

**Autonomous Points (AP)** - The second basis of ranking *Teams*. An *Alliance* who wins the *Autonomous Bonus* during a *Qualification Match* earns six (6) *Autonomous Points*. In the event of a tie at the end of the *Autonomous Period*, both *Alliances* will receive three (3) *Autonomous Points*.

**Autonomous Win Point** - One (1) *Win Point (WP)* given to an *Alliance* that has completed their *Alliance Home Row* at the end of the *Autonomous Period*. Both *Alliances* can earn this *WP* if both *Alliances* complete their *Alliance Home Row*.

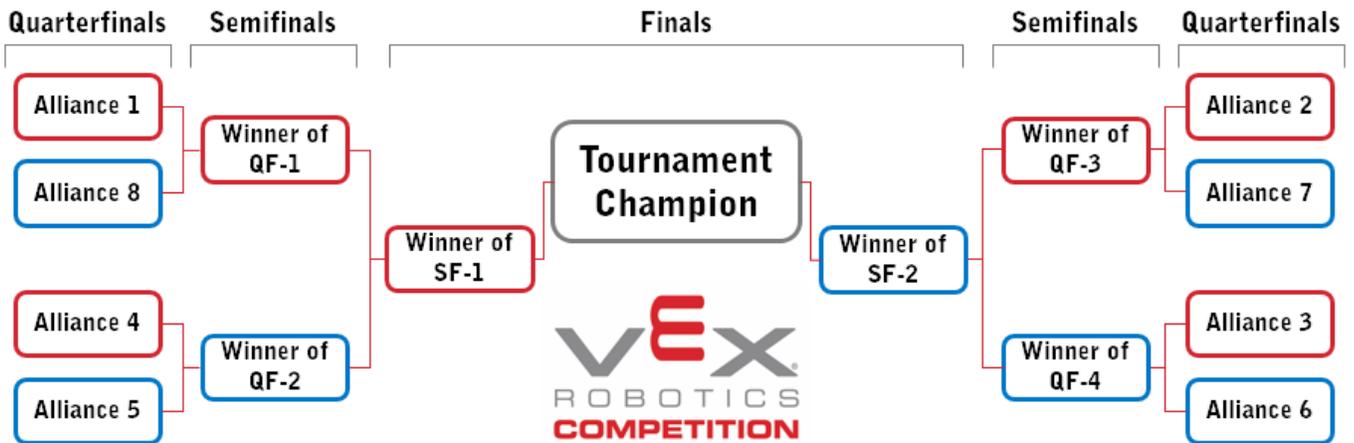
**Elimination Bracket** - A schedule of *Elimination Matches*. Between eight (8) and sixteen (16) *Alliances* are used to fill the *Elimination Bracket*. The exact quantity of *Alliances* in an *Elimination Bracket* is determined by the *Event Partner* per <T16>.

A sixteen (16) *Alliance* bracket would play as follows:



If an event is run with fewer than sixteen (16) *Alliances*, then they will use the bracket shown above, with byes awarded when there is no applicable *Alliance*. For example, in a tournament with fourteen (14) *Alliances*, *Alliances* 1 and 2 would automatically advance.

Thus, an eight (8) *Alliance* bracket would run as follows:



**Elimination Match** - A *Match* used in the process of determining the champion *Alliance*. *Alliances* of two (2) *Teams* face off according to the *Elimination Bracket*; the winning *Alliance* moves on to the next round.

**Event Partner** - The VEX Robotics Competition tournament coordinator who serves as an overall manager for the volunteers, venue, event materials, and all other event considerations. *Event Partners* serve as the official liaison between the REC Foundation, the event volunteers, and event attendees.

**Head Referee** - An impartial volunteer responsible for enforcing the rules in this manual as written. *Head Referees* are the only people who may discuss ruling interpretations or scoring questions with *Teams* at an event.

**Practice Match** - A *Match* used to provide time for *Teams* and volunteers to get acquainted with the official playing field. *Practice Matches* earn *Teams* zero (0) WP, AP, and SP.

**Qualification Match** - A *Match* used to determine the rankings for the *Alliance Selection*. *Alliances* compete to earn *Win Points*, *Autonomous Points*, and *Strength of Schedule Points*.

**Strength of Schedule Points (SP)** - The third basis of ranking *Teams*. *Strength of Schedule Points* are equivalent to the score of the losing *Alliance* in a *Qualification Match*. In the event of a tie, both *Alliances* receive SP equal to the tie score. If both *Teams* on an *Alliance* are Disqualified, the *Teams* on the losing (not Disqualified) *Alliance* will receive their own score as SP for that *Match*.

**Time Out** - A break period no greater than three minutes (3:00) allotted for each *Alliance* during *Elimination Matches*.

**Team Representative** - A *Student* chosen to represent his or her *Team* during *Alliance Selection* for *Elimination Matches*.

**Win Points (WP)** - The first basis of ranking *Teams*. *Teams* will receive zero (0), one (1), two (2) or three (3) *Win Points* for each *Qualification Match*.

- One (1) WP is awarded at the end of the *Autonomous Period* for any *Team* in an *Alliance* earning the *Autonomous Win Point*.
- Two (2) WP are awarded for winning a *Qualification Match*.
- One (1) WP is awarded for tying a *Qualification Match*.
- Zero (0) WP are awarded for losing a *Qualification Match*.

# Tournament Rules

**<T1> The Head Referee has ultimate authority on ruling decisions during the competition.**

- a. *Head Referees* must have the following qualifications.
  - i. Be at least 20 years of age
  - ii. Be approved by the *Event Partner*
  - iii. Contain the following attributes:
    1. Thorough knowledge of the current game and rules of play
    2. Effective decision making
    3. Attention to detail
    4. Ability to work effectively as a member of a team
    5. Ability to be confident and assertive when necessary
    6. Strong communication and diplomacy skills
  - iv. The *Head Referee* must be an REC Foundation Certified VRC Head Referee for the current season.
- b. *Head Referees* may not review any photo or video *Match* recordings to determine a score or ruling.
- c. *Head Referees* are the only people permitted to explain a rule, *Disqualification* or warning to the *Teams*.
- d. The *Head Referee* must give the rule number of the rule violated when issuing a *Disqualification* or warning to a *Team*.

Violations of the REC Foundation Code of Conduct may involve additional escalation beyond the *Head Referee's* initial ruling, including (but not limited to) investigation by an REC Foundation representative. Rules <S1>, <G1>, and <G2> are the only rules for which this escalation may be required.

**Note:** Scorekeeper Referees score the *Match*, serve as observers for the *Head Referees* and advise the *Head Referee*, but may not communicate any rules or infractions directly to the *Teams*. Scorekeeper Referees must be at least 15 years of age.

**<T2>The Drive Team is permitted to immediately appeal the Head Referee's ruling.** If the Drivers wish to dispute a score or ruling, those Drivers must stay in the *Alliance Station* until the *Head Referee* talks with them. The *Head Referee* may choose to meet with the Drivers 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 his or her decision has been made final, the issue is over and no more appeals may be made. The *Event Partner* may not overrule the *Head Referee's* decision.

Violations of this rule may result in the *Team* being disqualified from the *Match* in question and/or the event and is up to the discretion of the *Head Referee*.

Communication and conflict resolution skills are an important life skill for *Students* to practice and learn. In VEX Robotics Competitions, we expect *Students* to practice proper conflict resolution using the proper chain of command. See <G1>.

**<T3> The Team's Robot or a Drive Team Member should attend every Match.** A *Robot* or a *Student* member of the *Team* must report to the field for the *Team's* assigned *Match*. If no *Student* Team members report to the field, the *Team* will be considered a "no-show" and receive zero (0) *Win Points*, *Autonomous Points*, and *Strength of Schedule Points*.

**<T4> Robots at the field must be ready to play.** *Teams* must bring their *Robots* to the field prepared to play. *Teams* who use VEX pneumatics must have their systems charged before they place the *Robot* on the field.

- a. *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 the *Event Partner*, who will consider event schedule, previous warnings or delays, etc.

**<T5> Practice Matches may be run at some events.** If *Practice Matches* are run, they will be conducted on a first-come, first-served basis with every effort made to equalize practice match time for all *Teams*.

**<T6> The red alliance, or the highest seed, places last.** In *Qualification Matches*, the red *Alliance* has the right to place its *Robots* on the field last. In *Elimination Matches*, the higher (better) seeded *Alliance* has the right to place its *Robots* on the field last. Once a *Team* has placed its *Robot* on the field, its position cannot be readjusted prior to the *Match*. If a *Team* violates this rule, the opposing *Alliance* will be given the opportunity to reposition their *Robots* promptly.

**<T7> Qualification Matches follow the Qualification Match schedule.** A *Qualification Match* schedule will be available on the day of competition. The *Qualification Match* schedule will indicate *Alliance* partners, *Match* pairings, and *Alliance* color. For tournaments with multiple fields, the schedule will indicate which field the *Match* will take place on.

- a. *Alliances* are randomly assigned during *Qualification Matches*.

**Note:** The official *Match* schedule is subject to changes at the *Event Partner's* discretion.

**<T8> Each Team will be scheduled Qualification Matches as follows.**

- a. When in a tournament, the tournament must have a minimum of four (4) *Qualification Matches* per *Team*. The suggested amount of *Qualification Matches* per *Team* for a standard tournament is six (6) and up to ten (10) for a championship event.
- b. When in a league, there must be at least three (3) league ranking sessions and each session must have a minimum of two (2) *Qualification Matches* per *Team*. The suggested amount of *Qualification Matches* per *Team* for a standard league ranking session is four (4). Leagues will have a league finals session where elimination rounds will be played. *Event Partners* may choose to have *Qualification Matches* as part of their league finals session.

**<T9> Team rankings are determined during Qualification Matches as outlined below.**

- a. When in a tournament, every *Team* will be ranked based on the same number of *Qualification Matches*.

- b. When in a league, every *Team* will be ranked based on the number of *Matches* played. Teams that participate at least 60% of the total *Matches* available will be ranked above *Teams* that participate in less than 60% of the total *Matches* available, e.g. if the league offers 3 ranking sessions with 4 *Qualification Matches* per *Team*, teams that participate in 8 or more *Matches* will be ranked higher than *Teams* who participate in 7 or fewer *Matches*. Being a no-show to a match that a *Team* is scheduled in still constitutes participation for these calculations.
- c. In some cases, a *Team* will be asked to play an additional *Qualification Match*. The extra *Match* will be identified on the *Match Schedule* with an asterisk and will not impact the *Team's* ranking, *Win Points*, *Autonomous Points* or *Strength of Schedule Points* for that *Qualification Match* (and will not affect participation percentage for leagues). *Teams* are reminded that <G1> is always in effect and *Teams* are expected to behave as if the additional *Qualification Match* counted.

**<T10> Qualification Match tiebreakers.** *Team* rankings are determined throughout *Qualification Matches* as follows:

1. Average *Win Points* (*Win Points* / Number of *Matches* played)
2. Average *Autonomous Points* (*Autonomous Points* / Number of *Matches* played)
3. Average *Strength of Schedule Points* (*Strength of Schedule Points* / Number of *Matches* played)
4. Highest *Match* score
5. Second highest *Match* score
6. Random electronic draw

**<T11> Disqualifications.**

- a. When a *Team* is Disqualified in a *Qualification Match*, they receive zero (0) *Win Points*, *Autonomous Win Point*, *Autonomous Points*, and *Strength of Schedule Points*.
  - i. 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*.
  - ii. If the *Match* was a tie, then each *Team* on the opposing *Alliance* (the *Alliance* that did not receive the *Disqualification*) will receive the win for the *Match* and two (2) *Win Points*.
  - iii. If both *Alliances* have a *Team* receiving a *Disqualification*, then all non-Disqualified *Teams* will receive a tie for the *Match* and one (1) *WP*.

**Note:** *Autonomous Win Points* are not given to teams that are Disqualified, and are not automatically awarded to the opposing *Alliance*.

When a *Team* is Disqualified in an *Elimination Match*, the entire *Alliance* is Disqualified and they receive a loss for the *Match* and the opposing *Alliance* is awarded the win. If both *Alliances* receive a *Disqualification* in an *Elimination Match*, both *Alliances* receive a loss and will play another *Elimination Match* to determine a winner.

**<T12> Send a Team Representative to Alliance Selection.** Each *Team* must send one (1) *Team Representative* to the playing field for *Alliance Selection*. If the *Team Representative* fails to report to the playing field for *Alliance Selection*, their *Team* will be ineligible for participation in the *Alliance Selection* process.

**<T13> Each Team may only be invited once to join an Alliance.** If a *Team Representative* declines an *Alliance Captain's* invitation during *Alliance Selection*, that *Team* is no longer eligible to be selected by another *Alliance Captain*. However, they are still eligible to play *Elimination Matches* as an *Alliance Captain*.

For example:

- *Alliance Captain* 1 invites Team ABC to join their *Alliance*.
- Team ABC declines the invitation.
- No other *Alliance Captains* may invite Team ABC to join their *Alliance*.
- However, Team ABC may still form their own *Alliance*, if Team ABC ranked high enough after *Qualification Matches* to become an *Alliance Captain*.

**<T14> Each Alliance gets one Timeout.** Each *Alliance* may request one (1) *Time Out* during the elimination Bracket between *Elimination Matches*, as permitted by the *Head Referee* and *Event Partner*. *Alliances* may not use their *Time Outs* during a *Match*.

**<T15> Elimination Matches are a blend of "Best of 1" and "Best of 3".**

- a. In Tournaments that do not directly qualify teams to VEX Worlds,
  - i. In Tournaments that only have one division - The first *Alliance* to win a *Match* advances to the next round of the *Elimination Bracket*. Any ties will result in additional *Matches* until one *Alliance* wins and advances or wins and receives the title of "Tournament Champion." i.e. *Elimination Matches* are all Best of 1
  - ii. In Tournaments that have multiple divisions -
    1. In the Division *Elimination Matches* - *Elimination Matches* are all Best of 1 and the *Alliance* that wins the Division Finals will be declared the "Division Champion."
    2. When the Division Champions play each other – If there are more than two divisions and thus will have Quarterfinals and/or Semifinals, these *Matches* will be played as "Best of 1". The Finals *Matches* for any size multi-division event are played as a "Best of 3" where an *Alliance* needs two wins to receive the title of "Tournament Champion."
- b. In Tournaments that directly qualify teams to VEX Worlds,
  - i. In Tournaments that only have one division - *Elimination Matches* are "Best of 1" from Round-of-16 up through the Semi-Finals *Matches*. The Finals *Matches* are played as a "Best of 3" where an *Alliance* needs two wins to receive the title of "Tournament Champion."
  - ii. In Tournaments that have multiple divisions -
    1. In the Division *Elimination Matches* - *Elimination Matches* are "Best of 1" from Round-of-16 up through the Semi-Finals *Matches*. The Division Finals *Matches* are played as a "Best of 3" where an *Alliance* needs two wins to receive the title of "Division Champion."

- When the Division Champions play each other – If there are more than two divisions and thus will have Quarterfinals and/or Semifinals, these *Matches* will be played as “Best of 1”. The Finals *Matches* for any size multi-division event are played as a “Best of 3” where an *Alliance* needs two wins to receive the title of “Tournament Champion.”

**<T16> Small tournaments may have fewer Alliances.** Events with 32 or more teams must use 16-team alliances when starting *Elimination Matches*. Events with fewer than 32 Teams (i.e. the requisite amount for sixteen full *Alliances*) must limit the number of *Alliances* by dividing the number of *Teams* by two, less any remainder.

**<T17> Fields may be raised or on the floor.** Some tournaments may choose to place the playing field on the floor, or elevated off the floor (common heights are 12” to 24” [30.5cm to 61cm]). No *Drive Team Members* may stand on any sort of object during a *Match*, regardless of whether the field is on the floor or elevated.

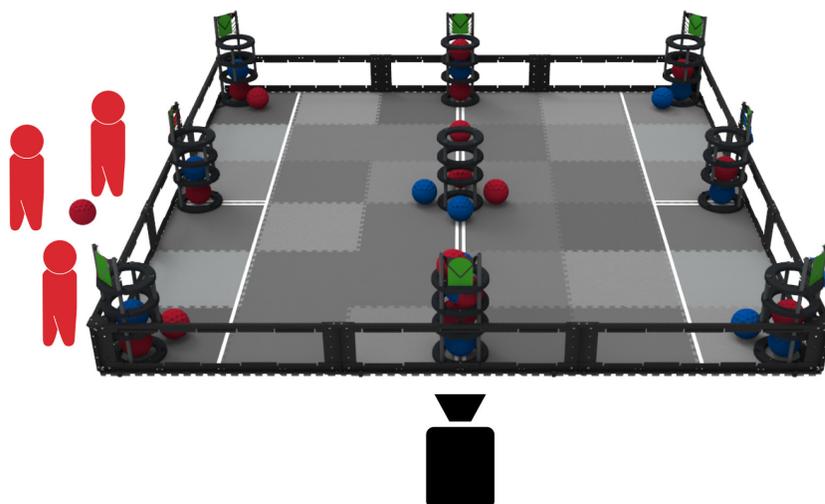
The 2021 VEX Robotics World Championship field will be elevated 24” (61cm) from the floor.

**<T18> Students must be accompanied by an Adult.** - No *Student* may attend a VRC 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 at the event in the case of an emergency.

## Live Remote Tournament Rules

### Live Remote Tournaments

Traditional VEX Robotics Competition events are held “in-person” in a classroom, school gymnasium, or community center. In the 2020-2021 season, *Event Partners* can also choose to hold an event entirely remotely, utilizing the RobotEvents.com Remote Tournament interface. More information about this interface can be found here: <https://www.roboticseducation.org/covid-19-updates/>



In a Live Remote tournament, VRC Change Up is played by two *Alliances* – one “red” and one “blue” – composed of two *Teams* each. Each *Team* competes on a separate field (i.e. there are four *Robots*, four *Teams*, and four fields in each *Match*).

An *Alliance’s* score at the end of a *Match* is calculated by combining the two fields of each *Alliance* (i.e. the two red *Team* fields, and the two blue *Team* fields). The object of the game is to attain a higher score than the opposing *Alliance* by Scoring *Balls* and Connecting *Rows*. To achieve a *Connected Row*, an *Alliance* must have Ownership of all three *Goals* in that *Row*.

An *Autonomous Win Point* is awarded to any *Alliance* that completes a *Connected Row* using their *Alliance Home Row* at the end of the *Autonomous Period*. A point bonus is awarded to the *Alliance* that has the most points at the end of the *Autonomous Period*.

Unless otherwise noted below, all rules and field layouts in the standard Game Manual apply to Live Remote Matches.

## Live Remote Tournaments Definitions

**Alliance Goal Score** - The sum total of *Ball* points in a given *Goal* on both of an *Alliance’s* fields at the end of the *Match*.

- For example, if red *Team 1* has one (1) point in *Goal A*, and red *Team 2* has four (4) points in *Goal A*, then the red *Alliance Goal Score* for *Goal A* would be five (5) points.

**Doubled** - A *Goal* status. A *Goal* is considered Doubled if it is being contacted by a *Robot* at the end of a *Match*. See rule <LRT6> for more details.

**Goal Label** - To aid in remote communication and scoring, each *Goal* has a Goal Label, as shown in Figure 17. These Goal Labels are laid out relative to the *Alliance Stations* and audience view, and should be consistent between all four *Team* fields. For example, if a *Head Referee* were to ask *Team* members to “point at Goal A”, all *Team* members should point to the *Goal* in the top-left corner of the remote webcam feed.

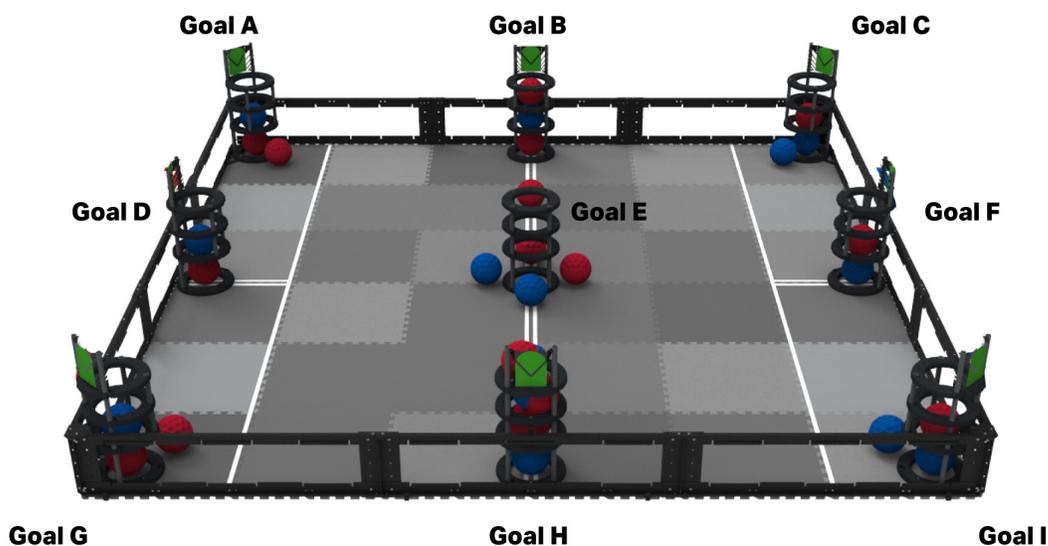


Figure 17: Goal Labels (from the Audience perspective)

**Owned** - A Goal status. A Goal is considered Owned by an Alliance if their Alliance Goal Score for a given Goal is greater than the Alliance Goal Score of the opposing Alliance's Goal with the same Goal Label.

**Quadrupled** - A Goal status. A Goal is considered Quadrupled if it is Doubled by both Robots on an Alliance at the end of a Match (i.e. a Goal with the same Goal Label is being contacted by both Robots, on their respective fields, at the end of a Match). See rule <LRT6> for more details.

## Live Remote Tournament Scoring

Live Remote Matches are scored as follows:

- A Ball of the same color as a Team's Alliance that is Scored in a Goal is worth two (2) points.
- A Ball of the opposite color as a Team's Alliance that is Scored in a Goal is worth one (1) point.
- A Connected Row is worth thirteen (13) points for that Alliance.
- The winner of the Autonomous Bonus receives a six (6) point bonus. In the case of a tie, both Alliances receive a three (3) point bonus.

Red A	Red B	Blue A	Blue B
Red Ball +2	Empty	Blue Ball +2	Empty
Blue Ball +1	Empty	Blue Ball +2	Blue Ball +2
Red Ball +2	Red Ball +2	Blue Ball +2	Blue Ball +2
<b>Total: 5</b>	<b>Total: 2</b>	<b>Total: 6</b>	<b>Total: 4</b>
<b>Red Alliance Total: 7</b>		<b>Blue Alliance Total: 10</b>	
<b>Blue Alliance Owns This Goal</b>			

Red A (Doubled)	Red B	Blue A	Blue B
Red Ball +4	Empty	Blue Ball +2	Empty
Blue Ball +2	Empty	Blue Ball +2	Blue Ball +2
Red Ball +4	Red Ball +4	Blue Ball +2	Blue Ball +2
<b>Total: 10</b>	<b>Total: 4</b>	<b>Total: 6</b>	<b>Total: 4</b>
<b>Red Alliance Total: 14</b>		<b>Blue Alliance Total: 10</b>	
<b>Red Alliance Owns This Goal</b>			

Red A (Doubled)	Red B (Doubled)	Blue A	Blue B
Red Ball +8	Empty	Blue Ball +2	Empty
Blue Ball +4	Empty	Blue Ball +2	Blue Ball +2
Red Ball +8	Red Ball +8	Blue Ball +2	Blue Ball +2
<b>Total: 20</b>	<b>Total: 8</b>	<b>Total: 6</b>	<b>Total: 4</b>
<b>Red Alliance Total: 28</b>		<b>Blue Alliance Total: 10</b>	
<b>Red Alliance Owns This Goal</b>			

## Live Remote Tournament Game Rules

**<LRT1>** The following rules from the Robot Skills Challenge Appendix, pertaining to a Remote Skills-Only event, also apply to Live Remote Tournaments events:

- **<RSE5>** - An *Adult Team* contact must be present in all *Matches*.
- **<RSE6>** - *Teams* will complete a full *Robot* inspection in accordance with **<R3>**.
- **<RSE7>** - All *Team* camera footage must be streamed live, from one camera feed, with no "cuts".
  - A *Team's* camera must be placed on the "audience side" of the field, i.e. the Red *Alliance Station* on the left side of the screen.
- **<RSE8>** - *Matches* must include some live interaction between the *Team* and the *Head Referee*.
- **<RSE9>** - *Match* replays are at the discretion of the *Head Referee*.

**<LRT2>** This rule is an extension of rule **<G7>**. During a Live Remote Tournament *Match*, *Drive Team Members* must still stand in the *Alliance Station* associated with their *Alliance* color.

- a. During a *Match*, the three (3) *Drive Team Members* in the *Alliance Station* are the only *Team* members permitted to influence the operation of their *Robot*, either directly or indirectly. The intent of this rule is to prohibit "sideline coaching" from *Adults* or other *Students* who are in close proximity to the *Drive Team Members*.
- b. *Drive Team Members* are permitted to utilize devices with communication features enabled while in the *Alliance Station*. The intent of this rule is to allow *Drive Team Members* to monitor the Live Remote video feeds of their partners and opponents. Using a device with communication features enabled to receive "sideline coaching" would still be a violation of this rule.
- c. Communication with an *Alliance* partner's *Drive Team Members* is not considered a violation of this rule.

If *Drive Team Members* are unable to stand in the *Alliance Station* due to external circumstances in their remote environment, such as a wall, then they should inform the *Head Referee* of this constraint prior to the *Match*. Exceptions to that portion of this rule may be granted at the *Head Referee's* discretion. *Head Referees* are advised to give *Teams* the "benefit of the doubt" in this situation.

**<LRT3>** This rule is a modification of rule **<G8>**. During a Live Remote Tournament *Match*, a *Drive Team Member's* V5 Controller must be plugged into the computer being used for the remote competition interface via a USB cable for the duration of the *Match*.

**<LRT4>** This rule is a modification of rule **<SG6>**. *Balls* that leave the field during *Match* play, intentionally or unintentionally, will not be returned to the field. Intentionally, strategically, or repeatedly removing *Balls* from the field may still be considered a violation of **<SG6>** at the *Head Referee's* discretion.

**<LRT5>** Rule **<SG8>** does not apply to Live Remote Tournament *Matches*. There is no limit to the number of *Balls*, of either color, that a *Team* may Possess at any given time.

**<LRT6>** If a *Goal* is being contacted by a *Robot* at the end of a *Match*, then it is considered *Doubled*.

- a. When a *Goal* is *Doubled* by a *Team*, then the *Goal* of the same *Goal Label* on their *Alliance* partner's field is also considered *Doubled*.
- b. Only one *Goal* can be *Doubled* per *Team*. If a given *Team* is contacting multiple *Goals* at the end of a *Match*, then no *Goals* are considered *Doubled* by that *Team*.

- i. Any *Goals* that are considered *Doubled* by their *Alliance* partner still apply, per point a.
- c. *Doubled* point values apply both to an *Alliance*'s overall score, and to the determination of a *Goal*'s Ownership.
- d. The decision whether a given *Goal* is *Doubled* is a *Head Referee* judgment call. *Head Referees* are advised to err on the side of the *Team*; if a given *Goal* is "too close to call", then the *Goal* should be considered *Doubled*.
  - i. To aid in this judgment call, *Teams* are advised to make it abundantly clear that they are contacting the *Goal* in question, such as by approaching it a few seconds prior to the end of the *Match*.
  - ii. The *Head Referee*'s decision regarding a *Doubled Goal* is final. Once the *Teams* are no longer in the remote environment to be scored, *Alliances* may not appeal or request a review of a *Doubled Goal* (including photo / video review).
- e. It is possible for the same *Goal* to be *Doubled* by each *Team* on an *Alliance*. If both *Teams* Double the same *Goal*, then that *Goal* is considered *Quadrupled*.

A *Goal* has a Red *Alliance Goal Score* of six (6) and a Blue *Alliance Goal Score* of eight (8). If a *Robot* from the Red *Alliance* is touching this *Goal* at the end of the *Match* then it would have a Red *Alliance Goal Score* of twelve (12) and a Blue *Alliance Goal Score* of eight (8). If two (2) *Robots* from the Red *Alliance* are touching this *Goal* at the end of the *Match*, then it would have a Red *Alliance Goal Score* of twenty-four (24) and a Blue *Alliance Goal Score* of eight (8).

**<LRT7>** In a Live Remote Tournament *Match*, *Teams* must set up their own field in accordance with the layouts, tolerances, and specifications found in the Game Manual and Appendix A.

- a. Prior to a *Match*, a *Head Referee* will verify each *Team*'s field layout and request any adjustments as needed. A *Team* will not be permitted to play in a *Match* until the *Head Referee* has approved their field layout; refusal to comply with any requested adjustments may be considered a violation of <G1> at the *Head Referee*'s discretion.
- b. *Teams* are permitted to construct their own field perimeters, in accordance with the Non-Standard Field Perimeter Guidelines found in Appendix A.
  - i. If using an unofficial field perimeter, *Teams* may be asked to verify their compliance with these guidelines as a part of the inspection process.
  - ii. Official VRC foam tiles (VEX Robotics SKU 278-1502 or 276-7175) must be used.
  - iii. The official VRC Change Up Full Field & Game Elements Kit (VEX Robotics SKU 276-6501) must be used.
- c. *Teams* must still utilize their one (1) *Preload Ball* as specified in rule <SG1>. The three (3) *Balls* that would be used as *Preloads* by the other *Teams* in the *Match* are not placed on the field.

**<LRT8>** In a VEX U Live Remote *Match*, each *Team* plays with two *Robots* per <VUG1> and <VUR1>. The two *Robots* play on one field at the same time. Each *Alliance* is still made up of two *Teams*. Therefore, there are eight *Robots*, four *Teams*, and four fields in each *Match*.

- a. For a *Goal* to be considered *Doubled*, both *Robots* from a given *Team* must be contacting the same *Goal*. All other aspects of <LRT6> still apply.
- b. Both *Robots* from a given *Team*, playing on the same field, must both be connected to the same remote interface computer via separate USB cables for the duration of the *Match*.
  - i. Connection via a multi-port USB hub is permissible, provided that it does not interfere with the remote interface.