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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. Follow us on Instagram, Twitter or Snapchat @VEXRobotics. Like us on Facebook at www.facebook.com/vexrobotics.

For more information about the Robotics Education & Competition Foundation, visit www.robotics-education.org. Follow us on Twitter @REC_Foundation. Like us on Facebook at www.facebook.com/RECFoundation.

Visit 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 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.](image)

**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](image)

**Builder** – The Student(s) on the Team who assemble(s) the Robot. An Adult cannot be the Builder on a Team. Adult 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*.

**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.

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

*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.

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](image)

**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>. 
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:


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.

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.

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.

a. 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.

b. 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.

a. 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.

b. 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.

c. 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.
Be prepared for minor field variance. Field Element tolerances may vary from nominal by ±1.0”, unless otherwise specified. Ball tolerances and weights may vary from nominal to ±0.10” and 10 grams respectively. Ball placement at the beginning of Matches may vary from nominal to ±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.

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.

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.roboevents.com/VRC/2020-2021/QA](https://www.roboevents.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.
**<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.
Components obtained from the V5 beta program, including V5 beta firmware, are not legal for competition use.

- 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](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.**
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.

A limited amount of custom plastic is allowed. Robots may use non-shattering plastic from the following list; polycarbonate (Lexan), acetal monomer (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.

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

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

- For the sole purpose of securing any connection between the ends of two (2) VEX cables.
- For labeling wires and motors.
- For covering the back of License Plates (i.e. the “wrong color”).
- For the purposes of preventing leaks on the threaded portions of pneumatic fittings. This is the only acceptable use of Teflon tape.
- 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.
- In any other application that would be considered a “non-functional decoration” per <R13>.

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.
<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.
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.

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.

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.

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.

<table>
<thead>
<tr>
<th>Option</th>
<th>Control System</th>
<th>Pneumatics</th>
<th>2-Wire Motors or Servos</th>
<th>V5 Smart Motors</th>
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<td>1</td>
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<td>8</td>
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</tbody>
</table>

*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 <G8> or <R22>.

### Table 2: The legal sources of electrical power for Robots

<table>
<thead>
<tr>
<th>Component</th>
<th>VEX ARM® Cortex®-based Microcontroller</th>
<th>V5 Robot Brain</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Legal Parts</td>
<td>Legal Chargers</td>
</tr>
<tr>
<td>Robot Battery</td>
<td>276-1456</td>
<td>276-1445 276-2519 276-2221 276-2235</td>
</tr>
<tr>
<td>Power Expander</td>
<td>276-2271</td>
<td>N/A</td>
</tr>
<tr>
<td>Transmitter Battery</td>
<td>AAA Battery</td>
<td>Any safe AAA charger</td>
</tr>
<tr>
<td>Transmitter Field Power</td>
<td>276-1701</td>
<td>N/A</td>
</tr>
<tr>
<td>Backup Battery</td>
<td>9V battery</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**<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 make the following modifications to the V5 Smart Motor. No other modifications are permitted.
   i. Changing or replacing the gear cartridge with other official replacement cartridges.
   ii. Replacing the V5 Smart Motor Cap (276-6780).
   iii. Replacing the threaded mounting inserts (276-6781).

**<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.
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.

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.

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. 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.

- 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.

- 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 or rigidity of the Robot, etc.)

- 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>.
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.

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.

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.
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:

<table>
<thead>
<tr>
<th>Round of 16</th>
<th>Quarterfinals</th>
<th>Semifinals</th>
<th>Finals</th>
<th>Semifinals</th>
<th>Quarterfinals</th>
<th>Round of 16</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alliance 1</td>
<td>Winner of R16-1</td>
<td>Winner of QF-1</td>
<td>Winner of SF-1</td>
<td>Winner of QF-3</td>
<td>Winner of R16-5</td>
<td>Alliance 2</td>
</tr>
<tr>
<td>Alliance 16</td>
<td>Winner of R16-2</td>
<td>Winner of QF-2</td>
<td>Winner of SF-2</td>
<td>Winner of QF-4</td>
<td>Winner of R16-6</td>
<td>Alliance 15</td>
</tr>
<tr>
<td>Alliance 8</td>
<td>Winner of R16-3</td>
<td>Winner of QF-1</td>
<td>Winner of SF-1</td>
<td>Winner of QF-3</td>
<td>Winner of R16-7</td>
<td>Alliance 14</td>
</tr>
<tr>
<td>Alliance 9</td>
<td>Winner of R16-4</td>
<td>Winner of QF-2</td>
<td>Winner of SF-2</td>
<td>Winner of QF-4</td>
<td>Winner of R16-8</td>
<td>Alliance 13</td>
</tr>
<tr>
<td>Alliance 4</td>
<td>Winner of R16-3</td>
<td>Winner of QF-1</td>
<td>Winner of SF-1</td>
<td>Winner of QF-3</td>
<td>Winner of R16-7</td>
<td>Alliance 14</td>
</tr>
<tr>
<td>Alliance 13</td>
<td>Winner of R16-4</td>
<td>Winner of QF-2</td>
<td>Winner of SF-2</td>
<td>Winner of QF-4</td>
<td>Winner of R16-8</td>
<td>Alliance 13</td>
</tr>
<tr>
<td>Alliance 5</td>
<td>Winner of R16-3</td>
<td>Winner of QF-1</td>
<td>Winner of SF-1</td>
<td>Winner of QF-3</td>
<td>Winner of R16-7</td>
<td>Alliance 14</td>
</tr>
<tr>
<td>Alliance 12</td>
<td>Winner of R16-4</td>
<td>Winner of QF-2</td>
<td>Winner of SF-2</td>
<td>Winner of QF-4</td>
<td>Winner of R16-8</td>
<td>Alliance 13</td>
</tr>
</tbody>
</table>

**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

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.

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

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.”
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.”

< 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.

<table>
<thead>
<tr>
<th>Red A</th>
<th>Red B</th>
<th>Blue A</th>
<th>Blue B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Ball +2</td>
<td>Empty</td>
<td>Blue Ball +2</td>
<td>Empty</td>
</tr>
<tr>
<td>Blue Ball +1</td>
<td>Empty</td>
<td>Blue Ball +2</td>
<td>Blue Ball +2</td>
</tr>
<tr>
<td>Red Ball +2</td>
<td>Red Ball +2</td>
<td>Blue Ball +2</td>
<td>Blue Ball +2</td>
</tr>
<tr>
<td>Total: 5</td>
<td>Total: 2</td>
<td>Total: 6</td>
<td>Total: 4</td>
</tr>
<tr>
<td><strong>Red Alliance Total: 7</strong></td>
<td><strong>Blue Alliance Total: 10</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Red Alliance Owns This Goal

<table>
<thead>
<tr>
<th>Red A (Doubled)</th>
<th>Red B</th>
<th>Blue A</th>
<th>Blue B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Ball +4</td>
<td>Empty</td>
<td>Blue Ball +2</td>
<td>Empty</td>
</tr>
<tr>
<td>Blue Ball +2</td>
<td>Empty</td>
<td>Blue Ball +2</td>
<td>Blue Ball +2</td>
</tr>
<tr>
<td>Red Ball +4</td>
<td>Red Ball +4</td>
<td>Blue Ball +2</td>
<td>Blue Ball +2</td>
</tr>
<tr>
<td>Total: 10</td>
<td>Total: 4</td>
<td>Total: 6</td>
<td>Total: 4</td>
</tr>
<tr>
<td><strong>Red Alliance Total: 14</strong></td>
<td><strong>Blue Alliance Total: 10</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Red Alliance Owns This Goal

<table>
<thead>
<tr>
<th>Red A (Doubled)</th>
<th>Red B (Doubled)</th>
<th>Blue A</th>
<th>Blue B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Ball +8</td>
<td>Empty</td>
<td>Blue Ball +2</td>
<td>Empty</td>
</tr>
<tr>
<td>Blue Ball +4</td>
<td>Empty</td>
<td>Blue Ball +2</td>
<td>Blue Ball +2</td>
</tr>
<tr>
<td>Red Ball +8</td>
<td>Red Ball +8</td>
<td>Blue Ball +2</td>
<td>Blue Ball +2</td>
</tr>
<tr>
<td>Total: 20</td>
<td>Total: 8</td>
<td>Total: 6</td>
<td>Total: 4</td>
</tr>
<tr>
<td><strong>Red Alliance Total: 28</strong></td>
<td><strong>Blue Alliance Total: 10</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Red Alliance Owns This Goal
Live Remote Tournament Game Rules

**<LRT1>** The following rules from the Robot Skills Challenge Appendix, pertaining to a Remote Skills-On-ly 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>**, as well as a possible field inspection at the Event Partner’s discretion.
- **<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.

b. 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).

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.

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.
Note: For Elimination Matches, VEX U Live Remote tournaments will utilize the standard Alliance Selection process as described in <T12> and <T13>.

<LRT9> This rule is a modification of the definition of Scored. In a Live Remote Tournament, a Ball may be considered Scored in a Goal if it is still touching a Robot of either Alliance color.

Note: The intent of this rule is for Head Referees to give Teams the “benefit of the doubt” if they inadvertently contact a Ball when attempting to Double / Quadruple a Goal.