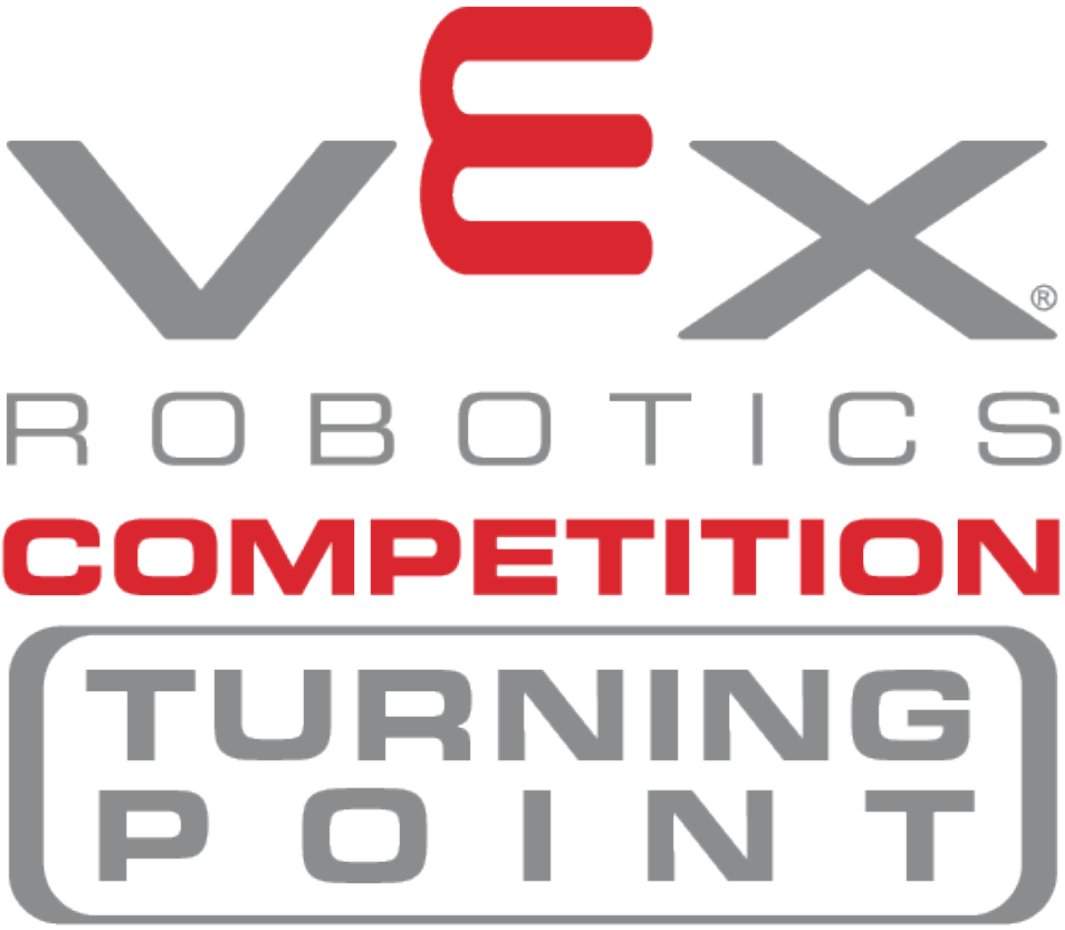


vexrobotics.com

2018-08-17

Table of Contents

The *VEX Robotics Competition Turning Point* Game Manual also includes a series of Appendices. These can be found on www.vexrobotics.com or www.roboticseducation.org, or directly by clicking the links below.

Appendices

Appendix A – Field Specifications (ZIP)	**https://link.vex.com/docs/vrc-turning-point/AppendixA**
Appendix B – Robot Skills Challenge (PDF)	**https://link.vex.com/docs/vrc-turning-point/AppendixB**
Appendix C – VRC Awards (PDF)	**http://link.roboticseducation.org/vrc_turningpoint_awardsappendix**
Appendix D – VEX U Awards (PDF)	**http://link.roboticseducation.org/vexu_turningpoint_awardsappendixd**
Appendix E – VEX U (PDF)	**https://link.vex.com/docs/vrc-turning-point/AppendixE**

Section 1 – Introduction

Overview

This section provides an introduction to the VEX Robotics Competition and VRC Turning Point.

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 EDR 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 Turning Point 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 Turning Point. 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, Robomatter, DWAB Technology, and VEX Robotics.

VEX Robotics Competition Turning Point: A Primer

VEX Robotics Competition Turning Point is played on a 12 ft x 12 ft foam-mat, surrounded by a sheet-metal and polycarbonate perimeter. There are eight *Caps* that can be *Low Scored* on the playing field tiles or *High Scored* on six *Posts* around the field. There are also nine *Flags*, including three *Low Flags* which can be *Toggled* by *Robots*, and six *High Flags*, which can only be *Toggled* by being hit with *Balls*. Teams also score points for *Alliance Parking* at the end of the *Match* on their own *Alliance Platform*, or by *Center Parking* on the *Center Platform*, which can be used by either *Alliance*.

For more details and specific game-play rules, please 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.roboticseducation.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 2018-2019 VEX Robotics Competition game entitled *VEX Robotics Competition Turning Point*. 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 Caps, Scoring Flags*, and by *Alliance Parking* or *Center Parking Robots* on the *Platforms*.

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

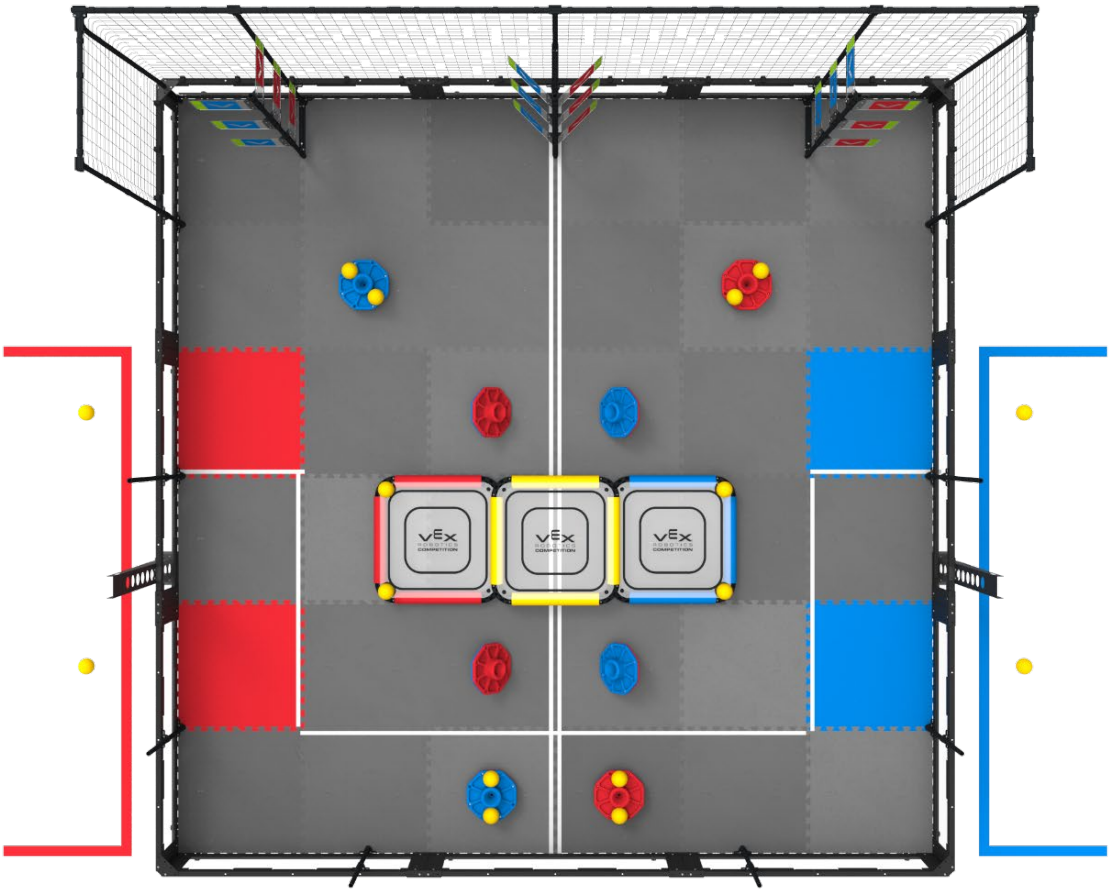


Figure 1: *Top view of the field in its initial setup configuration.*

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.*

Each VEX Robotics Competition Turning Point *Match* includes the following:

- Eight (8) *Caps*
  - Two (2) that start in a blue *Low Scored* position
  - Two (2) that start in a red *Low Scored* position
  - Four (4) that start on *Balls* in a non-*Scored* position
- Nine (9) *Flags*
  - Three (3) that start in a blue *Toggled* position
  - Three (3) that start in a red *Toggled* position
  - Three (3) that start in a non-*Toggled* position
- Twenty (20) *Balls*
  - Four (4) that start on the *Platforms*
  - Eight (8) that start on *Caps*
  - Four (4) that start underneath *Caps*
  - Four (4) as *Preloads*, two (2) per *Alliance*
- Six (6) *Posts*, used for *High Scoring Caps*
- Three (3) *Platforms*, used for *Alliance Parking* and *Center Parking Robots*
  - Two (2) *Alliance Platforms,* one red and one blue
  - One (1) *Center Platform*

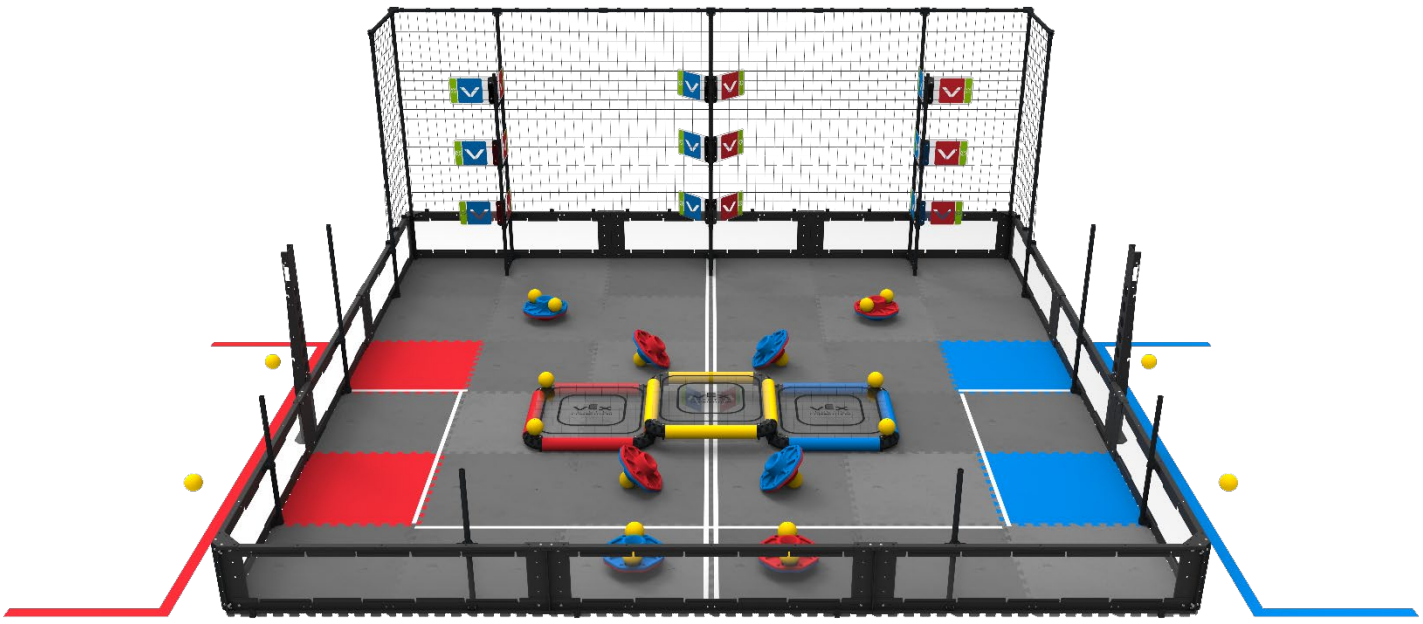
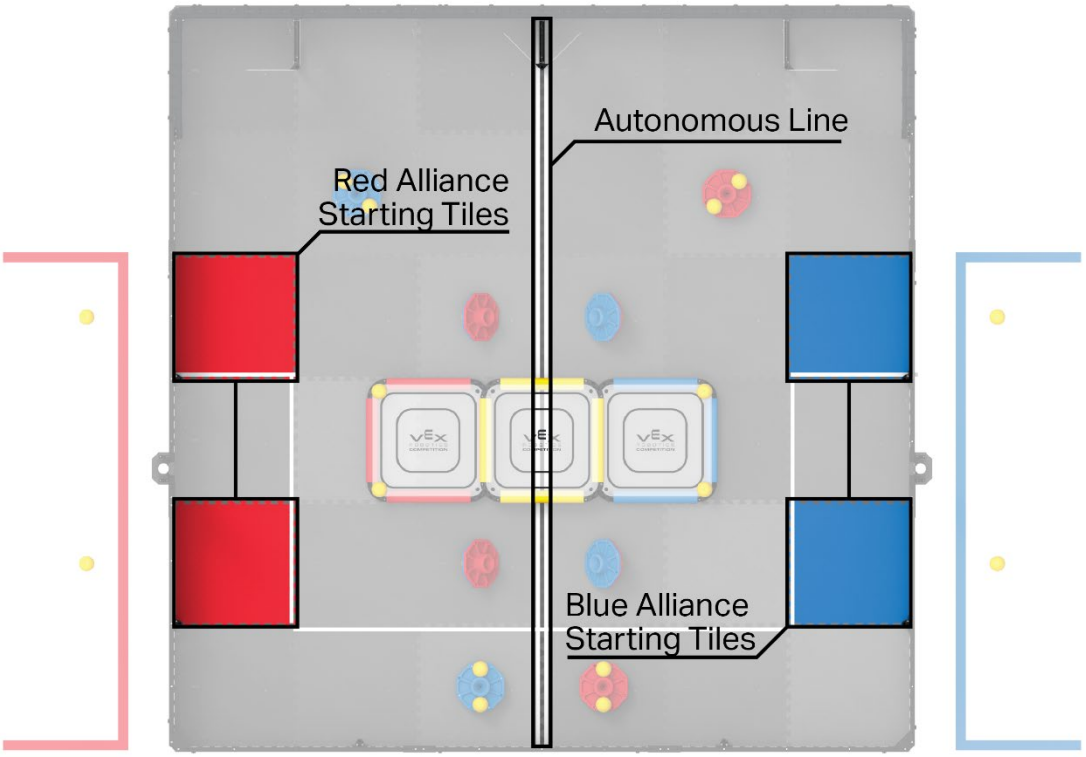
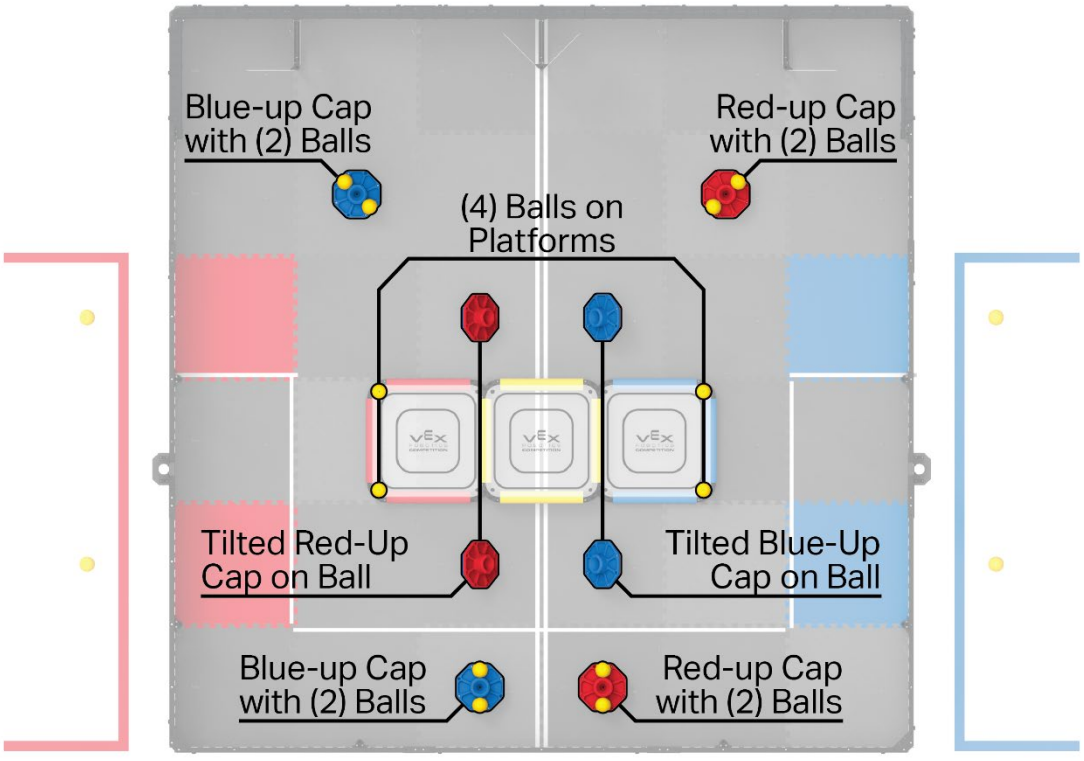
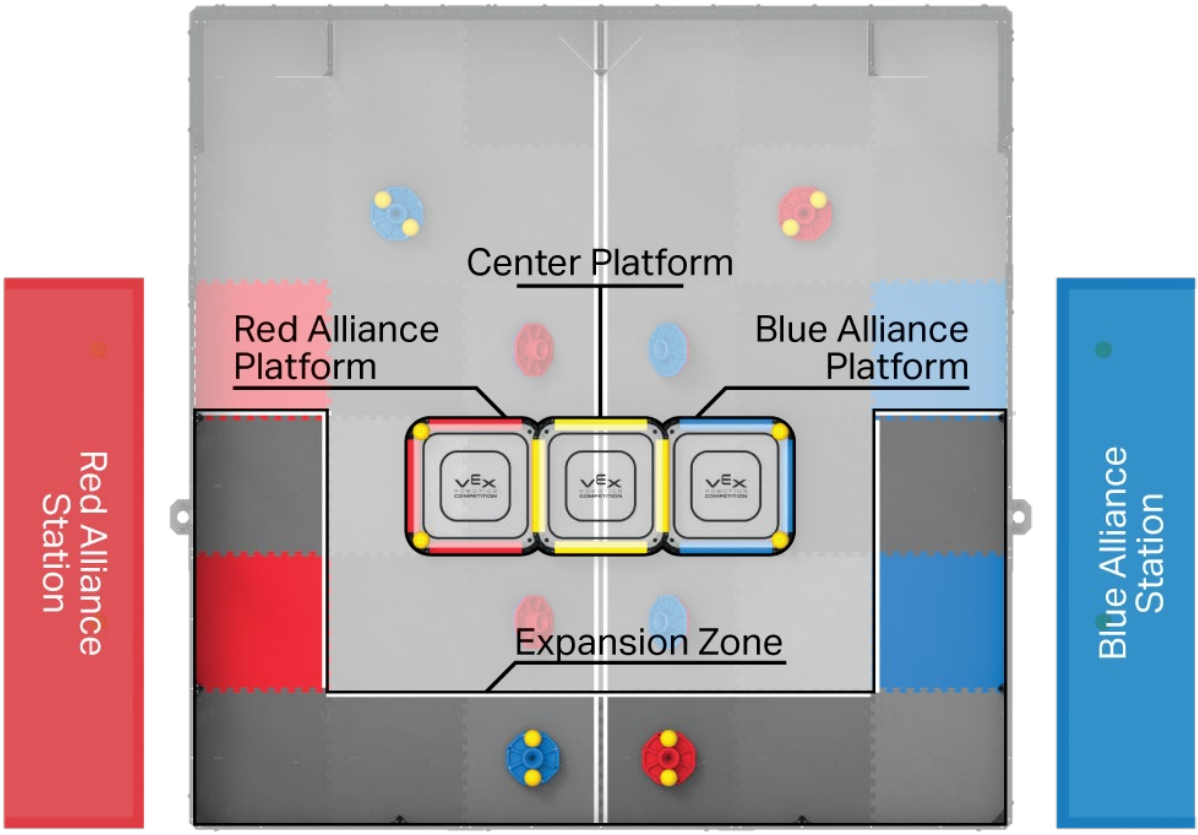


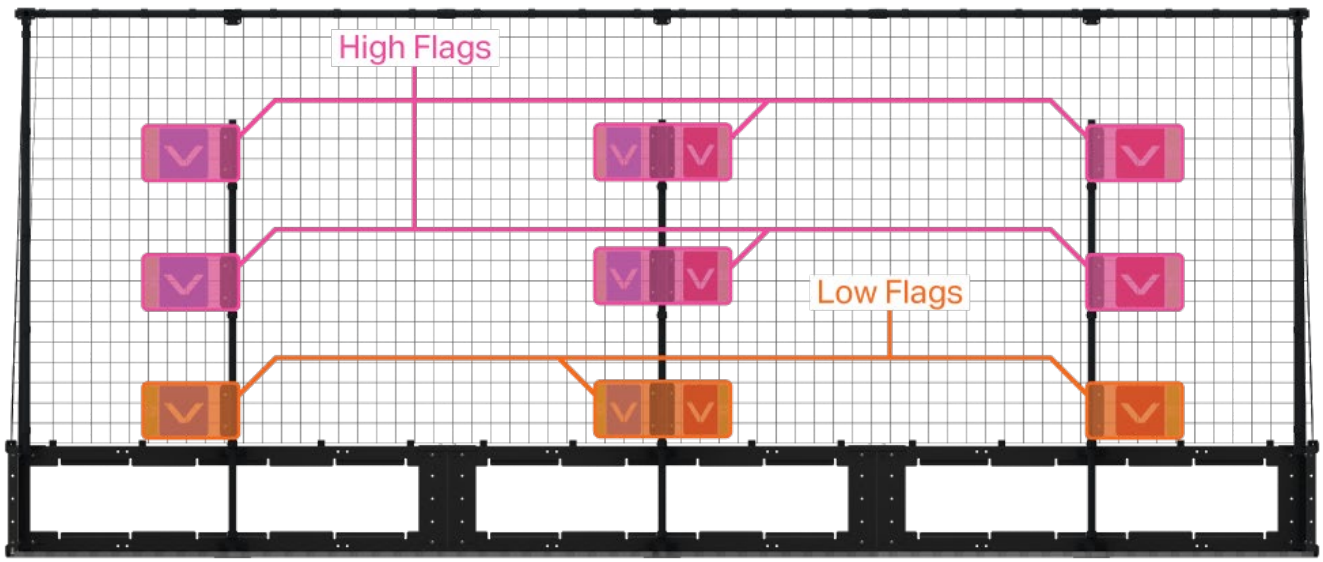
Figure 2: *Front view of the field.*





Figures 3 & 4: *Annotated views of the field*





Figures 5 & 6: *Annotated views of the field*

Game Definitions

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

Alliance Starting Tile – A colored field tile, red or blue, that designates where *Robots* must start the *Match*.

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

Autonomous Bonus - A point bonus awarded to the *Alliance* that has earned the most *Cap, Flag,* and *Alliance Parking* points at the end of the *Autonomous Period*.

Autonomous Line – The pair of white tape lines that run across the center of the field, underneath the *Platforms*. Per <SG3>, *Robots* may not contact the foam field tiles on the opposite *Alliance's* side of the *Autonomous Line* during the *Autonomous Period*.

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.

Ball – A yellow plastic spherical object with a diameter of 3.0" (76mm) and a mass of 0.12lb (55g). *Balls* can be used to *Score Flags*.

Cap – An 8-sided, disc-shaped plastic element with a "flat-to-flat" diameter of roughly 9.25" (234.95mm), an "edge-to-edge" diameter of roughly 9.70" (246.38mm), an overall height of roughly 4.6" (116.8mm), and a mass of roughly 335g (0.74 lb). *Caps* have one blue side and one red side, and a *Core* in the center.

Core – The cylindrical protrusion on either side of a *Cap* with a diameter of roughly 3.8" (96.5mm) and a height of roughly 1.8" (44.5mm) from the wide portion of the *Cap*. The *Core* has a red half and a blue half which are used when *Low Scoring* or *High Scoring*.

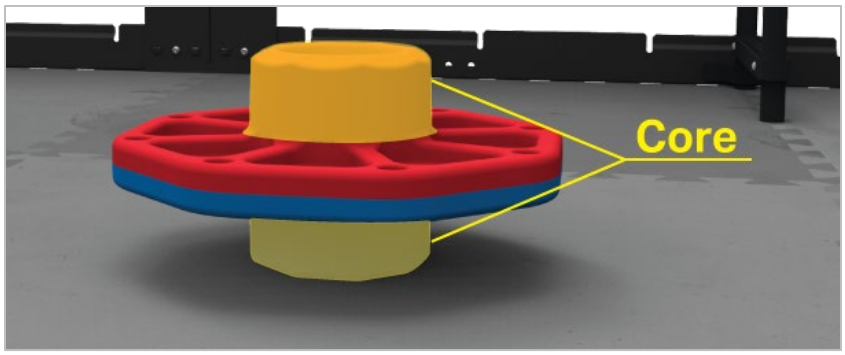


Figure 7: *Close-up of Cap, with the Core highlighted.*

Detent – The protruding feature upon which the *Flag* pivots that is used in conjunction with the *Flag's* pointer to determine if a *Flag* is *Toggled*.

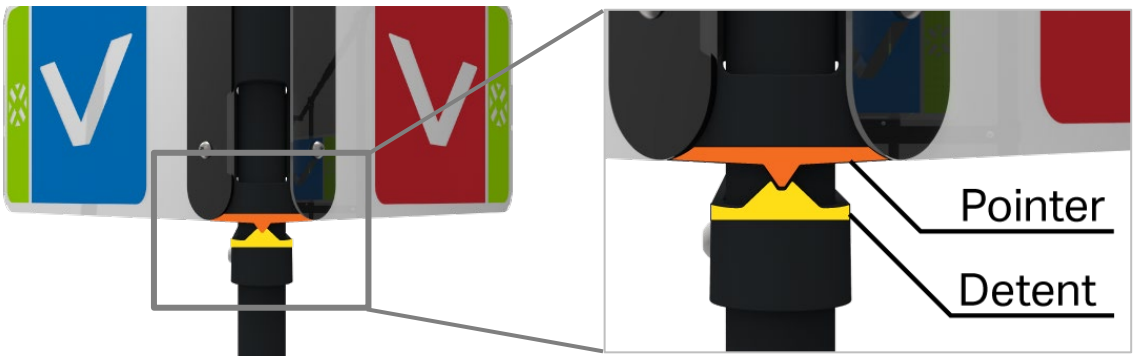


Figure 8: *Close-up of Flag, highlighting the Detent and Flag pointer.*

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* after a *Match* for a rule violation. A *Team* that is *Disqualified* in a *Qualifying Match* receives zero (0) *Win Points, Autonomous Points,* and *Strength of Schedule Points*. When a *Team* is *Disqualified* in an *Elimination Match,* the entire *Alliance* is *Disqualified* and receives 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.

Drive Team Member – Any of the three (3) *Students* allowed in the *Alliance Station* during a *Match* for each *Team*. Only *Drive Team Members* are allowed to touch the controls at any time during the *Match* or interact with the *Robot* as per <G5>. Adults are not allowed to be *Drive Team Members*.

Driver Controlled Period – The one minute and forty-five second (1:45) time period during which *Drive Team Members* operate their *Robots*.

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

Expansion Zone – The area of the foam tile playing surface bounded by the outer edges of the white tape lines and the inner edges of the field perimeter walls. Robots may expand vertically while contacting the foam field tiles or white tape lines within this zone. See rule <SG2> for more details on robot expansion.

Field Element – The foam field tiles, field perimeter, white tape, *Net, Platforms, Posts, Flags,* and all supporting structures.

Flag - A pivoting plastic element consisting of a red target, a blue target, and a hinge. Each target has rectangular dimensions of 9.9" (251.5mm) wide and 6.00" (152.4mm) tall. *Flags* are elevated above the field. The hinge on each *Flag* also features a pointer that is used in conjunction with the *Detent* to determine if the *Flag* is *Toggled*.

- *Low Flags* are roughly 18.3" (464.8mm) from the field tiles to their top edge. Note: the top of the *Low Flags* can be used as a rough visual indicator to see if *Robots* are below 18".
- *High Flags* are made up of two rows: one that is roughly 32.4" (822.9mm) from the field tiles to their top edge, and one that is roughly 46.3" (1176.0mm) from the field tiles to their top edge.

Game Object – A *Cap* or *Ball*.

Hoarding – A *Robot* status. A *Robot* is *Hoarding* if it is actively blocking opposing *Robot* access to more than two (2) *Balls,* or more than one (1) *Cap,* in any of the four (4) corners of the field (i.e. positioned in the corner roughly the size of one foam field tile). See <SG5>.

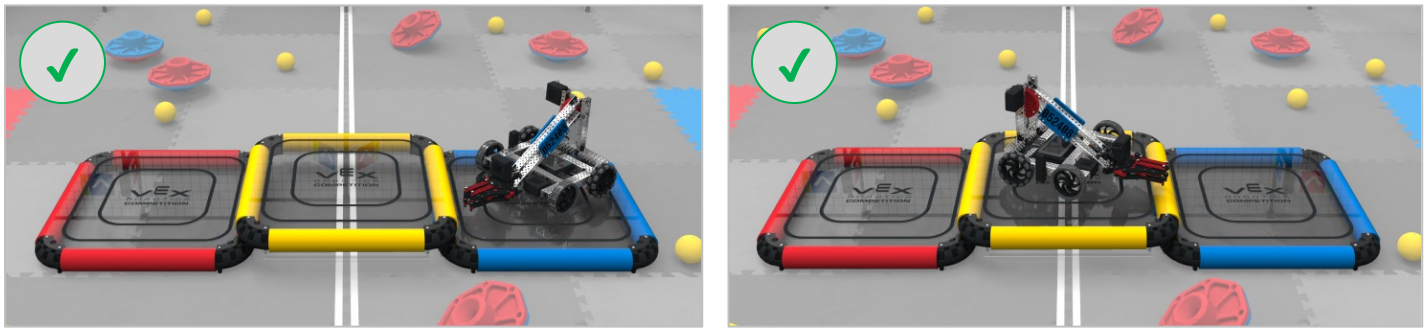
Match – A *Match* consists of an *Autonomous Period* followed by a *Driver Controlled Period* for a total time of two minutes (2:00).

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*.

Net – The roughly 59" (1.5m) tall woven nylon net structure that spans the entire side of the field perimeter where the *Flags* are located, with a mesh width of roughly 2.0" (50.8mm) and an overall height of roughly 58.6" (1488.4mm).

Parked – One of two *Robot* statuses.

- ***Alliance Parked*** – A *Robot* status. A *Robot* is *Alliance Parked* when it is:
  - Contacting its *Alliance Platform*.
  - Not contacting the foam field tiles or white tape.
- ***Center Parked*** – A *Robot* status. A *Robot* is *Center Parked* when it is:
  - Contacting the *Center Platform*.
  - Not contacting any *Alliance Platform*.
  - Not contacting the foam field tiles or white tape.



Figures 9 & 10: *A Robot which is Alliance Parked (left) and Center Parked (right).*

Platform – One of three (3) raised surfaces made of PVC and polycarbonate, roughly 23.875" (606.4mm) by 21.70" (551.2mm), that can be used for *Parking Robots.* See Figures 5, 9, and 10.

- ***Alliance Platforms*** are denoted by their red or blue structural PVC pieces, and can only be used for *Parking* by *Robots* of the same color *Alliance* as the *Platform*.
- The ***Center Platform*** is denoted by its yellow structural PVC pieces, and can be used for *Parking* by *Robots* of either *Alliance*.

Note: The structures on the sides of the *Center Platform* are not considered part of the *Platform*, and cannot be used for *Center Parking*. See Figure 11 and <SG9>.

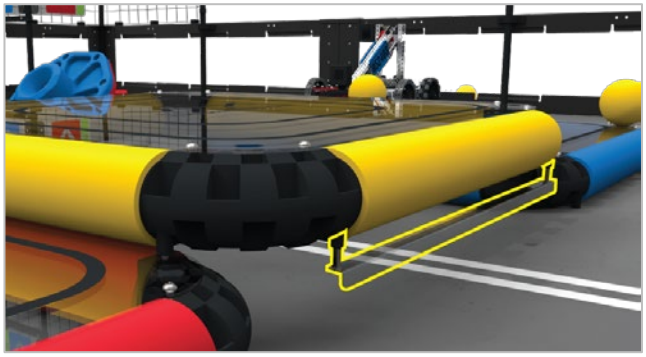


Figure 11: *A close-up view of the Center Platform, with the polycarbonate structure underneath highlighted. This structure's intent is to keep Balls out from underneath the Center Platform per <SG9>; it cannot be used for Parking.*

Possession – A *Game Object* status. A *Robot* has *Possession* of a *Game Object* if it is carrying, holding, or encompassing it. See rule <SG4> for details on *Possession* limits.

Post – One of six (6) vertical PVC pipes attached to the field perimeter with a diameter of approximately 0.84" (~21.5mm) where *Caps* can be *Scored*.

- Four (4) *Posts* (furthest from the *Flags*) are roughly 23" (584.2mm) tall.
- Two (2) *Posts* (closest to the *Flags*) are roughly 34" (863.6mm) tall.

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

- The *Preload* is touching one *Robot*.
- The *Preload* is fully within the field perimeter.

Figure 12: *A legal Preload.*

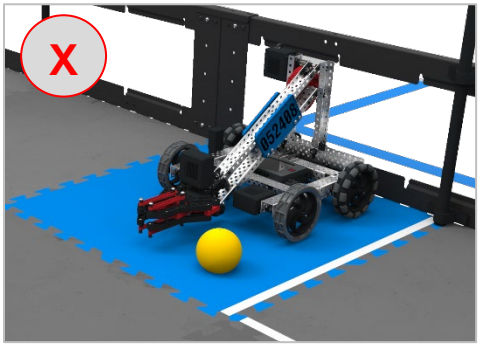
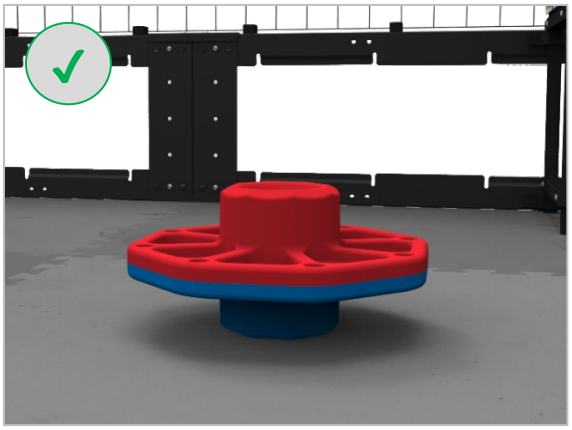


Figure 13: *An illegal Preload.*

Robot – Anything that has passed inspection that a *Team* places on the field prior to the start of a *Match*.

Scored – One of two *Cap* statuses.

> ***Low Scored*** – A *Cap* status. A *Cap* is *Low Scored* when a *Cap's Core* is touching the foam field tiles, white tape lines, or *Platforms*, without touching a *Robot* of the color *Alliance* for which the *Cap* would award points. Points for a *Low Scored Cap* are awarded to the *Alliance* color that is facing "up" when the *Core* half on its opposite side is touching the foam field tiles, white tape lines, or *Platform*.
>
> Note: If a *Core* is touching both the foam field tiles and the *Center Platform*, it should be scored as if it was only touching the foam field tiles.



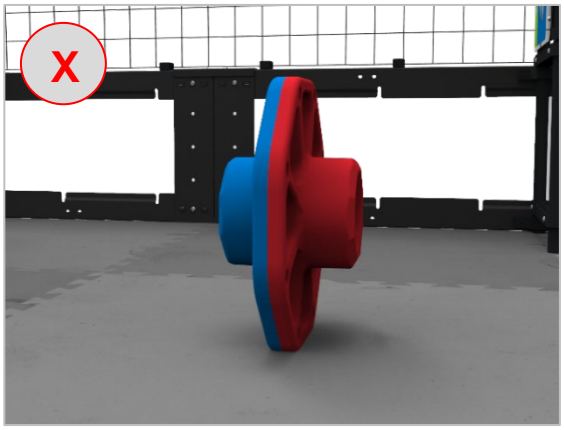


Figure 14 (left): *A Cap which is Low Scored for the Red Alliance, because the opposite Core is contacting the field tiles.*
Figure 15 (right): *A Cap which is not Scored at all, because the Core is not contacting any field tiles, white tape lines, or Platforms.*

High Scored – A *Cap* status. A *Cap* is *High Scored* when its *Core* is touching a *Post*, the *Cap* is not touching any other *Field Elements*, and the *Cap* is not touching a *Robot* of the color *Alliance* for which the *Cap* would award points. Points for a *High Scored Cap* are awarded to the *Alliance* color that is facing "up" when the *Core* half on its opposite side is touching the *Post*.

Figure 16 (left): *A Cap which is High Scored for the Red Alliance, because the opposite Core is contacting the Post.*
Figure 17 (right): *A Cap which is not Scored, because it is being contacted by a Robot of the same color as it would have been awarded points.*

Student – Anyone enrolled in a pre-college school or who is home-schooled as part of a pre-college educational curriculum and is born after April 27th, 2000. Eligibility may also be granted based on a disability that has delayed education by at least one year.

- *Middle School Student* – A *Student* enrolled in grade 8 or lower or enrolled in grade 9 in a school, which includes grade 8 but not grade 10.
- *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*. *Teams* may be associated with schools, community/youth organizations, or a group of neighborhood *Students*.

Toggled – A *Flag* status. A *Flag* is Toggled when the *Flag's* pointer is not nested in the *Detent* and the *Flag* is not touching a robot of the color *Alliance* for which the *Flag* would award points. When *Toggled*, points are awarded to the red *Alliance* if the pointer is to the left of the *Detent*, and awarded to the blue *Alliance* if the pointer is to the right of the *Detent*. In the case that the *Flag* pivots beyond the containing PVC structure, the *Flag* is no longer *Toggled*. See Figures 18-20 on the following page.

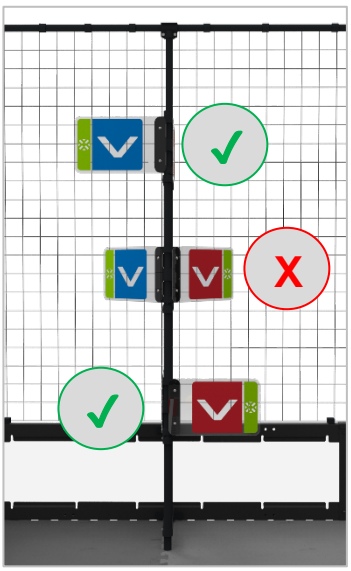


Figure 18 (left): *A Flag tower depicting three Flag states. The top Flag is Toggled, and points would be awarded to the blue Alliance. The middle Flag is not Toggled. The bottom Flag is Toggled, and points would be awarded to the red Alliance.*
Figure 19 (right): *Close-up of a Toggled flag, with the Detent and Flag pointer highlighted. This Flag is Toggled in favor of the red Alliance.*

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).

Game Rules

Scoring

Autonomous Period Scoring:

- A *Toggled High Flag* is worth two (2) points.
- A *Toggled Low Flag* is worth one (1) point.
- A *High Scored Cap* is worth two (2) points.
- A *Low Scored Cap* is worth one (1) point.
- A *Robot* which is *Alliance Parked* earns three (3) points.
- An *Alliance* that wins the *Autonomous Bonus* earns four (4) points.

Driver Controlled Period Scoring:

- A *Toggled High Flag* is worth two (2) points.
- A *Toggled Low Flag* is worth one (1) point.
- A *High Scored Cap* is worth two (2) points.
- A *Low Scored Cap* is worth one (1) point.
- A *Robot* which is *Alliance Parked* earns three (3) points.
- A *Robot* which is *Center Parked* earns six (6) points.

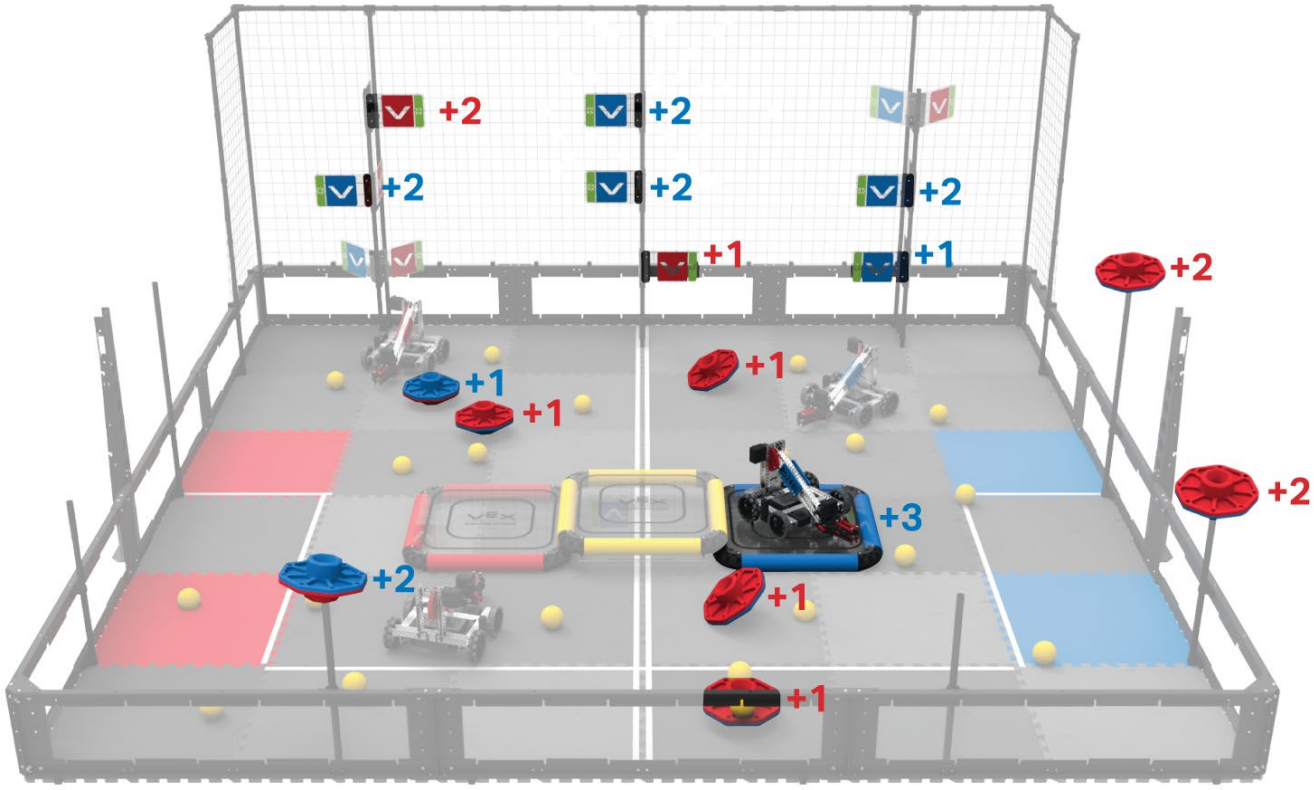


Figure 20: *Example VRC Turning Point match, depicting various point values.*

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 *Team* may be *Disabled* and/or *Disqualified* at the discretion of the Head Referee. The *Robot* will require re-inspection before it may again take the field.

a. Teams should be extra cautious when interacting with the *Net*, per <SG5>.

<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.

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/ .

<G2> 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.

<G3> Robots begin the Match in the starting cube. 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 <R4> 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.

<G4> 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.

<G5> 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.

a. *Robots* must be placed on the field promptly. Repeated failure to do so could result in a violation of <G1>.

> The exact definition of the term "promptly" is at the discretion of the Head Referee and the Event Partner, who will consider event schedule, previous warnings or delays, etc.

<G6> Drive your own Robot. Each *Team* shall include up to three *Drive Team Members*. No *Drive Team Member* may fulfill this role for more than one *Team* in a given competition season.

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

Note: Per <T02>, *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 <R11> and <G9>.

Violations or refusal to comply with this rule could be considered a violation of <G1>.

<G8> 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 <G8a>. *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 <G8a>.

- **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 for only the following reasons:
  1. Turning the *Robot* on or off.
  2. Plugging in a battery and/or power expander.
  3. Plugging in a VEXnet Key or V5 Robot Radio.
  4. 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 <G5a>.

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.

<G9> Autonomous means "no humans". During the *Autonomous Period*, *Drive Team Members* are not permitted to interact with the *Robot* 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 disconnecting from the field in any way.
- Triggering sensors (including the Vision Sensor) in any way, even without touching them.

Violations of this rule would be considered a violation of <G10> and could 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.

<G10> 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.

<G11> **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.

<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 *Turning Point* 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 *Turning Point* 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 1: *Alliances* who attempt to utilize the *Center Platform* should expect vigorous interactions from opponent *Robots*. When a *Robot* is contacting or engaging with the *Center Platform*, incidental damage that is caused by opponent *Robots* pushing, tipping, or *Entangling* with them would not be considered a violation of <G12>. Intentional damage or dangerous mechanisms may still be considered a violation of <R3>, <S1>, or <G1> at the Head Referee's discretion.

Note 2: Damage caused by indirect contact with the *Center Platform* is included in Note 1. In Figure 21, if "BLUE1" pushes "RED1" off the *Center Platform* and this interaction causes damage to "RED2", then "BLUE1" would not be penalized. This was a legal interaction between "BLUE1" and "RED1", which resulted in indirect damage to "RED2".

Figure 21: *Three Robots interacting on the Platforms. Incidental damage caused to these Robots due to interactions on the Center Platform would likely not result in a violation of <G12>.*

Note 3: The *Alliance Platform* by itself is not included in Note 1. *Robots* which are *Alliance Parked* and not contacting or interacting with the *Center Platform* are treated the same as *Robots* on the floor or otherwise playing the game. So, in Figure 22, if "BLUE1" were to tip over or cause damage to "RED2", they would be considered in violation of <G12>.

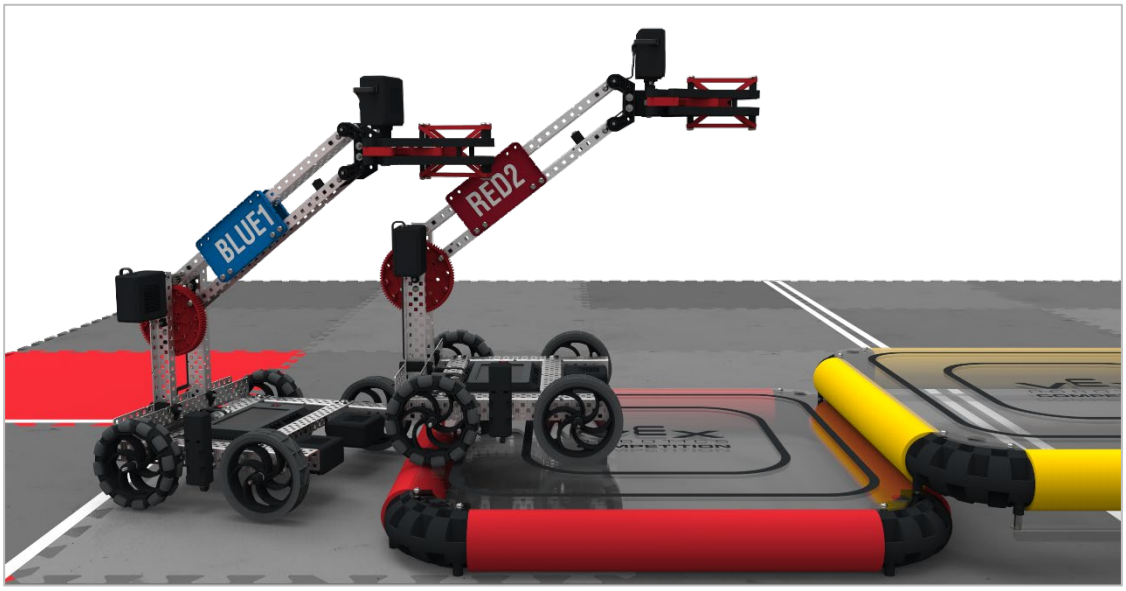


Figure 22: *Two Robots interacting on the Red Alliance Platform. Tipping or damage to "RED2" would likely result in a <G12> violation against "BLUE1".*

<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> **No Trapping for more than 5 seconds.** A *Robot* may not *Trap* an opposing *Robot* for more than five (5) seconds 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 (5) seconds; 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.

<G15> **Let go of Game Objects after the Match.** *Robots* must be designed to permit easy removal of *Game Objects* from any mechanism without requiring the *Robot* to have power after a *Match*.

<G16> **It's not over until it's over.** Scores will be calculated for all *Matches* immediately after the *Match,* once all *Game Objects*, *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,* after all *Game Objects*, *Field Elements*, and *Robots* come to rest.

<G17> **Be prepared for minor field variance.** *Field Element* tolerances may vary from nominal by ±1.0". *Game Object* tolerances and weights may vary from nominal by ±0.25" and 10 grams respectively. *Game Object* placement at the beginning of *Matches* may vary from nominal by ±1.5". *Teams* are encouraged to design their *Robots* accordingly. Please make sure to check Appendix A for more specific nominal dimension and tolerances.

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

Note 2: There is no specification for "tautness" or "looseness" of the *Net*.

Note 3: Minor *Net* repairs that do not impact gameplay are permitted. These could include (but are not limited to) using tape to patch together a torn section, or replacing the stock pipe clips with standard PVC connectors.

<G18> **Replays are allowed, but rare.** Replays are at the discretion of the Event Partner and Head Referee, and will only be issued in the most extreme circumstances.

<G19> **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 intents 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 should 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. The Q&A is the ONLY official source for rulings besides the Game Manual.

The VRC Q&A system can be found at https://www.robotevents.com/VRC/2018-2019/QA

<G20> **This manual will have three scheduled updates.** All rules in this manual are subject to changes, and not considered official until August 17th, 2018. We do not expect any major changes to take place, however we do reserve the right to make game changes until August 17th, 2018. There will also be scheduled manual updates on June 15th, 2018 and April 5th, 2019.

a. The GDC reserves the right to make changes to this manual in the April 5th, 2019 release specifically for the VEX Robotics World Championship. Specific changes to be considered will be the point values of the *Autonomous Bonus*, *Alliance Parking,* and *Center Parking*.

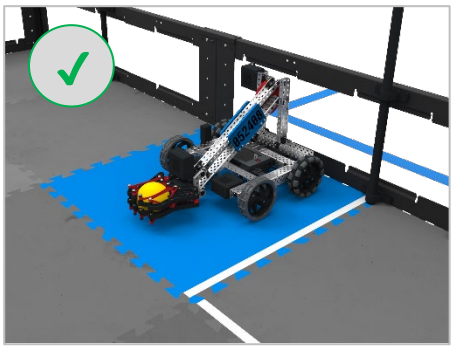
VRC Turning Point Specific Game Rules

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

1. Touching one of its colored *Alliance Starting Tiles.*
2. Not touching any other foam field tiles or *Game Objects* that are not *Preloads*.
3. *Preloaded* with one (1) *Ball.*

Note 1: No more than one (1) *Robot* may start the *Match* on any one (1) *Alliance Starting Tile*.

Note 2: If a *Robot* is not present for their *Match*, their one (1) *Preload Ball* will instead be placed randomly by a referee such that it is touching the unoccupied *Alliance Starting Tile*.



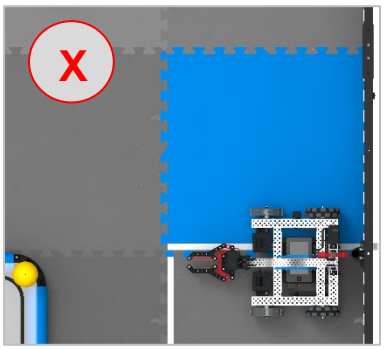


Figure 23 (left): *A legal starting position and Preload.*
Figure 24 (right): *An illegal starting position, because the Robot is contacting another field tile, and has no Preload.*

<SG2> **Robot expansion is limited once the Match begins.** As per <G3>, 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.

- **a.** Once the *Match* begins, a *Robot* which is contacting the *Expansion Zone* may expand vertically with no height limit. However, once fully outside of the *Expansion Zone* (i.e. no longer contacting it), *the Robot* must return to a height limit of 18" (457.2 mm) tall.
- **b.** Once the *Match* begins, *Robots* may expand, but no horizontal dimension can exceed 36" (914.4 mm) at any point during the *Match*.
- **c.** As a result of this rule, *Robots* may not contact *High Flags*.

Note: A *Robot* which interferes with gameplay as a result of violating this rule, such as *Toggling* a *High Flag* or blocking a launched *Ball* while outside of the *Expansion Zone,* will result in a *Disqualification*, whether the interference is *Match Affecting* or not.

Minor violations of this rule that do not affect or interfere with 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.

> Robots which choose to expand vertically in the Expansion Zone should be very cognizant of <SG2a> and the Note. It is expected that brief or minor violations, such as a mechanism that is in the process of retracting while the Robot leaves the Expansion Zone, may occur. These will likely only result in a warning if there is no gameplay interference.
>
> However, Teams should be aware of the risk associated with "cutting it close" like this. If a tall (i.e. vertically expanded) Robot blocks a launched Ball while not in contact with the Expansion Zone, the Note will come into effect whether the action was intentional or accidental. To avoid any confusion or potential violations, Teams are advised to drive and design their Robots such that it is abundantly clear to the Head Referee that they have retracted back to a height of 18" before leaving the Expansion Zone.

> The 18" height limit specified by <SG2c> refers to the Robot height when it is placed on a flat plane, such as a field tile or an inspection table. An 18" tall robot which tips slightly while climbing a Platform would still be legal.

<SG3> **Stay on your side in Autonomous.** During the *Autonomous Period*, *Robots* may not do any of the following:

1. Contact the foam tiles on the opposing *Alliance's* side of the *Autonomous Line.*
2. Contact the opposing *Alliance Platform.*
3. Become *Center Parked*.

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.*

<SG4> Watch your Possession limit. *Robots* may *Possess* a maximum of one (1) *Cap* and two (2) *Balls* at a time.

Note: *Robots* that interact with *High Scored Caps* while already *Possessing* a *Cap* will undergo additional scrutiny regarding this rule.

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.

The intent of the Note is to point out that there are both legal and illegal ways to interact with a High Scored Cap while already Possessing a Cap. Teams should be cognizant of <SG8> and the definition of Possession if attempting any maneuvers around High Scored Caps.

<SG5> Hoarding is prohibited. *Robots* may not *Hoard* more than one (1) *Cap*, or more than two (2) *Balls*, at any point during the *Match.*

a. *High Scored Caps* do not count towards the *Hoarding* limit.
b. *Possessed Game Objects* do not count towards the *Hoarding* limit.

The key phrase in the definition of Hoarding is "actively blocking opposing *Robot* access". This means strategically positioning a Robot such that it is "defending" these Game Objects, and actively preventing an opponent from accessing them.

Hoarding is a very intentional and strategic maneuver. Most scenarios where a Robot interacts with multiple Game Objects in the corner of the field would not be considered Hoarding. However, Teams should exercise caution in these situations, and referees are encouraged to provide verbal warnings if a Robot is in danger of a violation.

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 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.

<SG7> Use Game Objects for gameplay. *Game Objects* cannot be used to accomplish actions that would be otherwise illegal if they were attempted by *Robot* mechanisms.

a. *High Flags* may only be contacted by *Balls* that are not being contacted by a *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.

<SG8> Keep Game Objects in the field. Though it is expected that some *Game Objects* may unintentionally leave the field during *Match* play, *Teams* may not intentionally or strategically remove *Game Objects* from the field.

a. *Balls* that leave the field during regular *Match* play, accidentally or intentionally, will not be returned to the field.

b. *Caps* that leave the field during regular *Match* play will be returned to the nearest foam tile, *Low Scored* for the opposite *Alliance* color of the last *Robot* to contact it. If a referee cannot determine which *Robot* was the last to contact the *Cap,* then the *Cap* will not be returned to the field.

An intent of this rule is to prevent *Robots* from "knocking" *Caps* out of the field to remove them from *Posts*. Any strategic, intentional, or repeated removal of *Game Objects* from the field would be considered a violation of this rule.

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.

<SG9> Don't put Game Objects underneath the Center Platform. *Teams* may not intentionally or strategically place *Game Objects* past the polycarbonate structures on either side of the *Center Platform* (see Figure 11) such that they are kept from opposing *Robots*.

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.

<SG10> **Don't clamp your Robot to the field.** *Robots* may not intentionally grasp, grapple or attach to any *Field Elements*, including the *Platforms*. 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.

Note: Contact with the *Net* of any kind is strictly prohibited, per <SG11>.

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.

<SG11> **Stay away from the Net.** Becoming *Entangled* with the *Net* is considered a violation of <S1> and will result in a *Disablement.* Causing an opponent to become *Entangled* with the *Net* is considered a violation of <G11> and will result in a *Disablement* for both *Teams*.

Momentary or incidental contact, such as while *Toggling Low Flags,* is expected and is not considered a violation. Intentional, strategic, or repeated violations will result in a *Disqualification* at the Head Referee's discretion.

> This rule is a specific exception to <G11>. Normally, under <G11>, a Robot which is forced into breaking a rule (such as being pushed into the Net) is not penalized. However, because Entanglement with the Net is a safety concern, a Robot which becomes Entangled must be Disabled, regardless if it whose fault it was. Of course, strategic or intentional violations could be considered a violation of <G1> and result in a Disqualification.

<SG12> **The field should be laid out according to the Manual.** At the start of the *Match*, all *Game Objects* on the field will be placed in their designated locations with their designated colors facing upward or outward as applicable. The rotation of *Caps* is determined by the *Balls* that rest on top or underneath them, as applicable. See Figures 2-6 and the Field Appendix A for details. Any concerns regarding *Game Object* starting position should be raised with the Head Referee prior to the *Match; Team* members should never adjust *Game Objects* or *Field Elements* themselves.

Section 3 – The Tournament

Overview

The main challenge of the VEX Robotics Competition will be played in a tournament format. Each tournament will include *Practice, Qualifying, and Elimination Matches*. After the *Qualifying Matches*, *Teams* will be ranked based on their performance. The top *Teams* will then participate in the *Elimination Matches* to determine the tournament champions.

Tournament Definitions

Alliance Captain – The *Team Representative* of the highest ranked *Team* that is asked to invite an available *Team* to join his or her *Alliance*.

Alliance Selection – The process of choosing the permanent *Alliances* for the *Elimination Matches*.

Autonomous Points (AP) – The second basis of ranking *Teams*. *Autonomous Points* are awarded in the amount of *Autonomous Bonus* points earned by an *Alliance* in a *Qualifying Match*.

Disqualification – A penalty applied to a *Team* for a rules violation. When a *Team* is *Disqualified* in a *Qualifying Match*, they receive zero (0) WP, AP, and SP, and the opposing *Alliance* receives two (2) WPs. When a *Team* is *Disqualified* in an *Elimination Match,* the entire *Alliance* is *Disqualified* and they receive a loss for the *Match*.

Elimination Match – A *Match* used in the process of determining the champion alliance. *Alliances* of two (2) *Teams* face off in a "ladder" format; the winning *Alliance* moves on to the next round.

Practice Match – An un-scored *Match* used to provide time for *Teams* to get acquainted with the official playing field.

Qualifying 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 *Qualifying Match*.

Team Representative – A *Student* chosen to represent their *Team* during *Alliance Selection* for the final *Elimination Matches*.

Win Points (WP) – The first basis of ranking *Teams*. *Win Points* are awarded for winning (two points) and tying (one point) a *Qualifying Match*.

Practice Matches

At the event, *Practice Matches* may be played in the morning during the team registration time until the driver's meeting begins. Every effort will be made to equalize practice time for all *Teams*, but they may be conducted on a first-come, first-served basis. *Practice Matches* are not scored, and will not affect *Team* ranking.

Qualifying Matches

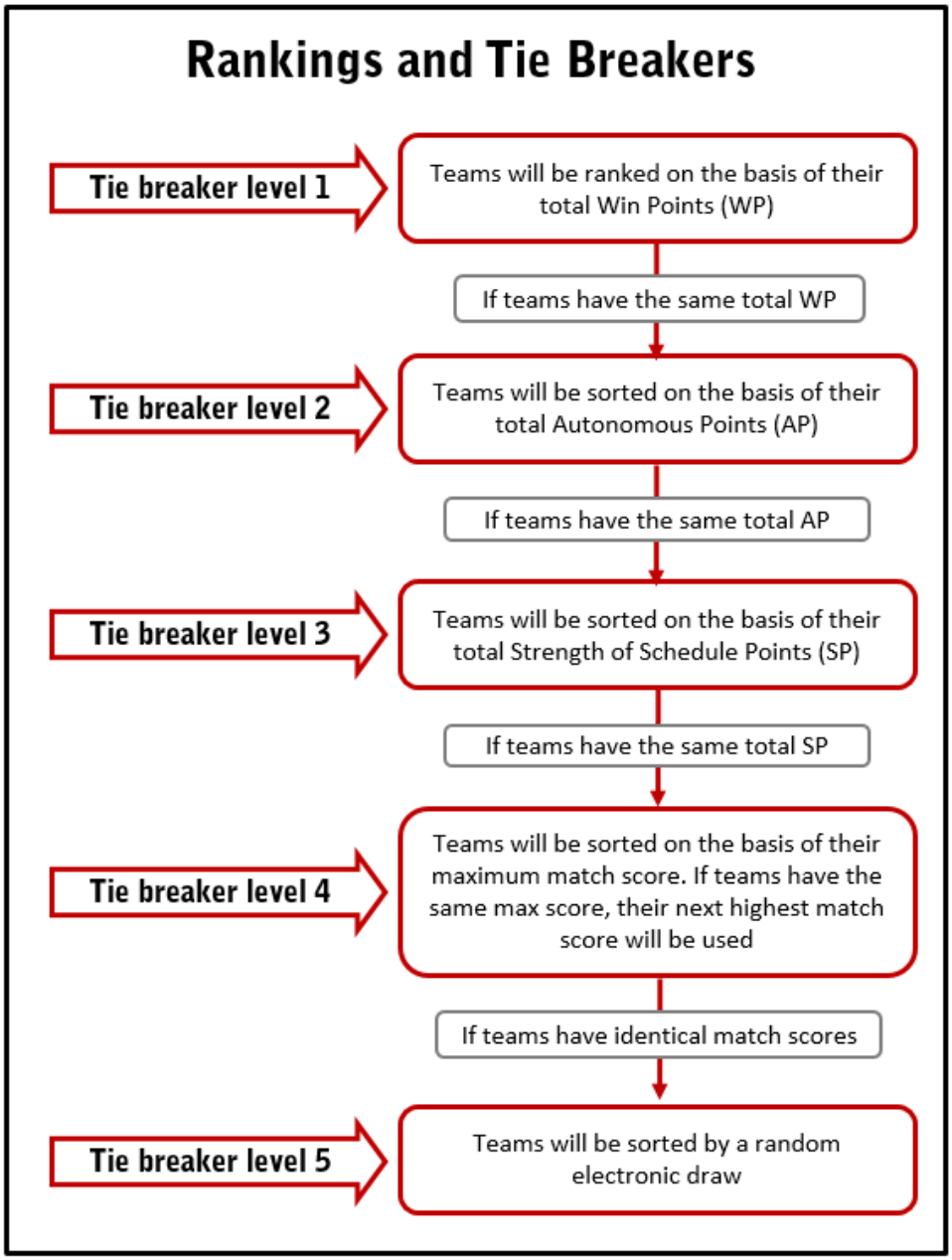
Schedule

- The *Qualifying Match* schedule will be available prior to opening ceremonies on the day of competition. This schedule will indicate *Alliance* partners and *Match* pairings. It will also indicate the *Alliance's* color – red or blue. For tournaments with multiple fields, the schedule will also indicate which field the *Match* will take place on.
- The *Qualifying Matches* will start immediately after opening ceremonies in accordance with the *Qualifying Match* schedule.
- *Teams* will be randomly assigned an *Alliance* partner to compete against two randomly assigned opponents in each *Qualifying Match.*
- All *Teams* will be scored on the same number of *Qualifying Matches*.
    - In some cases, a *Team* will be asked to play in an additional *Qualifying Match*, but will not receive credit for playing this extra *Match*.

Rankings

- At the conclusion of each match, *Win Points (WP)* will be issued:
    - Winning *Teams* in a *Qualifying Match* receive two (2) *WP.*
    - Losing *Teams* in a *Qualifying Match* receive zero (0) *WP.*
    - If a *Qualifying Match* ends in a tie, all four *Teams* receive one (1) *WP.*
    - If a team is *Disqualified,* they receive zero (0) *WP.*
        - If the *Team* receiving the *Disqualification* is on the winning *Alliance*, then *Teams* on the opposing *Alliance* who are not also *Disqualified* will receive two (2) *WP.*
- All teams in each *Qualifying Match* will also receive *Autonomous Points (AP)*.
    - Teams who earn the *Autonomous Bonus* in a *Qualifying Match* receive four (4) AP.
    - Teams who do not earn the *Autonomous Bonus* in a *Qualifying Match* receive zero (0) AP.
    - If a team is *Disqualified,* they receive zero (0) *AP.*
- All teams in each *Qualifying Match* will also receive *Strength of Schedule Points (SP).*
    - The number of *SP* assigned for each match, is that of the losing *Alliance*'s score.
    - In the event of a tie, both *Alliances* will receive the same *SP* (equal to the tie score).
    - If a team is *Disqualified,* they receive zero (0) *SP.*
    - If both teams on an alliance are *Disqualified*, the teams on the winning *Alliance* will be awarded their own score as their *SP* for that *Match*.

- For a *Qualifying Match*, if **no** member of a *Team* is present in the *Driver Station* at the start of a *Match*, that *Team* is declared a "no show" and will receive zero (0) *WP,* zero (0) *AP*, and zero (0) *SP*.



Elimination Matches

- The *Alliance Selection* process will consist of one round of selection, such that eight (8) to sixteen (16) *Alliance Captains* will form elimination *Alliances* consisting of two (2) *Teams*.
- These *Alliances* will participate in a tournament to determine the event champions.
- If a team is *Disqualified* during an *Elimination Match*, then their entire *Alliance* is *Disqualified*, and the *Match* will be recorded as a loss.

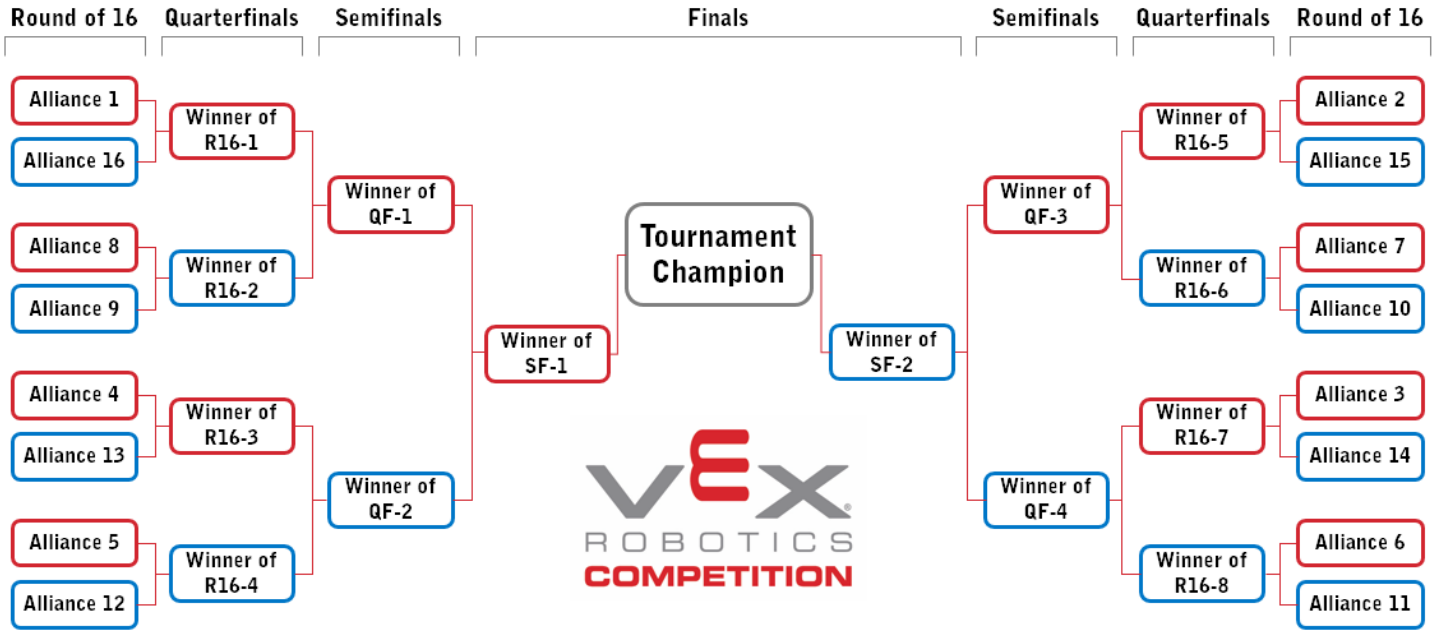
Alliance Selection Process

- Every *Team* will choose one (1) *Student* to act as a *Team Representative*.
    - These representatives will proceed to the playing field at the designated time to represent their *Teams* in the *Alliance Selection*.
- There will be eight (8) to sixteen (16) *Alliances* formed in the *Alliance Selection*, depending on the size of the event.
- In order of tournament ranking, the *Team Representative* of the highest ranked *Team* not already in an *Alliance* will be asked to step forward as an *Alliance Captain* to invite another available *Team* to join their *Alliance*.
- A *Team* is available if they are not already part of an *Alliance*, or have not already declined an *Alliance* invitation.
    - If the *Team* accepts, it is moved into that *Alliance*.
    - If a *Team* declines an invitation, they CANNOT be invited into another *Alliance*, but are still available to select their own *Alliance* if the opportunity arises.
    - If a *Team* declines, the *Alliance Captain* from the inviting *Team* must then extend another invitation.
- This process will continue until all *Alliance Captains* have been designated and chosen one *Alliance* partner.
- Any *Teams* remaining after the final *Alliance's* choice will not compete in the *Elimination Matches*.

Match Ladder

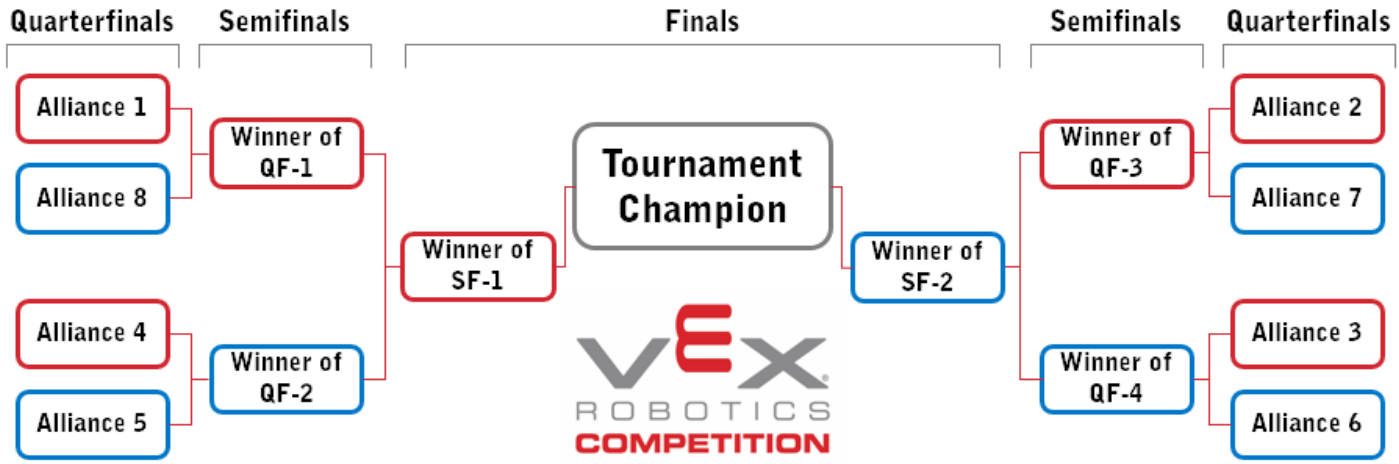
Event Partners may choose to run *Elimination Matches* with eight (8) to sixteen (16) *Alliances*, depending on their event schedule and the number of *Teams* in attendance.

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



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

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



Elimination Scoring

In the elimination rounds, teams do not get *Win Points*; they get a win, loss or tie. Within each bracket of the *Elimination Match* Ladder, *Matches* will be played to determine which *Alliance* advances, as follows:

- The first *Alliance* to win a *Match* advances.
- Any ties will result in additional *Matches* until one *Alliance* has a win, and advances.

Tournament Rules

<T01> Referees have ultimate authority during the competition. **Their rulings are final.**

a. The referees will not review any photo or video *Match* recordings.
b. Any questions for the referees must be brought forward by a *Student Drive Team Member* (not an adult) from the affected *Team* within a time period of two (2) *Qualifying Matches,* or immediately after the score is announced of an *Elimination Match*.
c. Any concerns regarding the *Match* score must be raised by a *Student Drive Team Member* (not an adult) before the playing field has been reset for the next *Match.* Once the field has been cleared, scores may no longer be disputed.

<T02> The only people from a *Team* permitted by the playing field are the three *Drive Team Members* who are identified by their drive team badges. These badges are interchangeable, but not during a *Match*.

<T03> There are no time outs in *Qualifying Matches*; in the elimination rounds, each *Alliance* will be allotted ONE time out of no more than three (3) minutes, as permitted by the head referee. The *Matches* must progress according to schedule.

a. If a *Robot* cannot report for a *Match*, at least one *Student* member of the *Team* should report to the field for the *Match*. If no *Student Team* members report to the field, the *Team* will be considered a "no-show" and receive zero (0) *WP, AP,* and *SP*.

<T04> 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.

Event Modification

Small Tournaments: In the case that an event has fewer than 16 *Teams* (the requisite amount to have eight full *Alliances*), tournaments may be played as follows:

- The number of *Alliances* will be equal to the amount of *Teams* divided by two, less any remainder. (e.g. If there are 13 teams, 13/2 = 6.5 → 6 picking teams)
- The *Elimination Match* ladder follows the same format as a standard tournament, with byes being awarded when there is no applicable *Alliance*. (e.g. If there are seven *Alliances*, there would be no 8th *Alliance*, thereby awarding a bye to the 1st *Alliance* in the quarter-finals.)

Field Height: At many tournaments, the playing field will be placed on the floor. Some tournament organizers may choose to elevate the playing fields by 24" to 36". At the 2019 VEX Robotics World Championship, the platforms will be 24" high. For safety reasons, no *Drive Team Members* will be allowed to stand on any sort of object during a *Match*, despite the presence of raised fields.

Section 4 – 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 Turning Point*. Prior to competing at each event, all robots will have to pass an inspection.

Robot Rules

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.

<R1> 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 switch back and forth between multiple robots during a competition. This includes using different robots for Skills Challenge and Qualification / Elimination Matches.
c. 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 <G2>. 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> 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.** If significant changes are made to a robot, such as a partial or full swap of Subsystem 3, it must be re-inspected before it will be allowed to compete.
- **b.** If a robot has multiple functional configurations, all possible 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.** Referees or inspectors may decide that a robot is in violation of the rules. In this event, the team in violation will be disqualified and the robot will be barred from the playing field until it passes re-inspection.

<R3> The following types of mechanisms and components are NOT allowed:

- **a.** Those that could potentially damage playing field components.
- **b.** Those that could potentially damage other competing robots.
- **c.** Those that pose an unnecessary risk of entanglement.

<R4> At the beginning of any match, robots must be smaller than 18" (457.2 mm) long by 18" (457.2 mm) wide by 18" (45.72 mm) tall.

- **a.** During inspections, robots will be measured in one of two ways:

i. Robots will be placed into a "sizing box" which has interior dimensions matching the above size constraints. To pass inspection, a robot must fit within the box without touching the box walls or ceiling.
ii. Robots will be sized using the VEX Robotics Competition Robot Sizing Tool. Robots will be placed on a flat surface and must not touch the measurement slide as it is passed over the surface. There are two types of sizing tools that may be used:
    1. https://www.vexrobotics.com/276-2086.html
    2. https://www.vexrobotics.com/276-5942.html

b. Robots may expand beyond their starting size constraints after the start of a match in accordance with <SG2>.

c. Any restraints used to maintain starting size (i.e. zip ties, rubber bands, etc.) MUST remain attached to the robot for the duration of the match.

<R5> Robots may be built ONLY using official VEX EDR components, unless otherwise specifically noted within these rules.

a. If there is a question during inspection about whether something is an official VEX component, a team will be required to provide documentation to an inspector which proves the component's source. Such types of documentation include receipts, part numbers, official VEX websites, or other printed documentation.

b. Only VEX EDR components specifically designed to be used for Robot construction are allowed. Using additional components outside of their typical purpose is against the intent of this rule (i.e. please don't try using VEX apparel, competition support materials, packaging or other non-robot products on a VEX Robotics Competition robot).

c. 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>.
i. Products from the VEXpro, VEX IQ, or VEX Robotics by HEXBUG product line which are also cross-listed as part of the VEX product line are legal. A cross-listed product is one which can be found in a VEX EDR section of the VEX Robotics website. For example, the Rubber Shaft Collar (228-3510) is a VEX IQ component that can be found on the VEX EDR "Shafts & Hardware" page: https://www.vexrobotics.com/vexedr/products/accessories/motion/shafts-and-hardware.html

d. Official VEX EDR components which have been discontinued are still legal for competition use. However, teams must be cognizant of <R5a> if attempting to use a discontinued part.

e. 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.

<R6> 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. A complete list of authorized VEX Resellers can be found at www.vexrobotics.com/find-a-reseller.

<R7> 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 parts which are identical to legal VEX parts. 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.
- **c.** Any commercially available #4, #6, #8, M2, M2.5, M3 or M4 screw up to 2" long (nominal), and any commercially available nut and/or washer 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.
- **d.** 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, game objects, or other robots.
- **e.** Non-shattering plastic from the following list; polycarbonate (Lexan), acetel monopolymer (Delrin), acetal copolymer (Acetron GP), POM (acetal), ABS, PEEK, PET, HDPE, LDPE, Nylon (all grades), Polypropylene, FEP; as cut from a single 12" x 24" sheet up to 0.070" thick.
  - **i.** Shattering plastic, such as acrylic, is prohibited.
  - **ii.** 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.
- **f.** A small amount of tape may be used for the following purposes:
  - **i.** For the sole purpose of securing any connection between the ends of two (2) VEX cables.
  - **ii.** For labeling wires and motors.
  - **iii.** For the purposes of preventing leaks on the threaded portions of pneumatic fittings. This is the only acceptable use of Teflon tape.
  - **iv.** 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.
  - **v.** All other functional uses of tape, such as grip tape or duct tape, are prohibited.
- **g.** Hot glue for securing cable connections.
- **h.** A USB extension cable may be used for the sole purpose of remote mounting of a VEXnet Key 2.0 to a VEX ARM® Cortex®-based Microcontroller.
  - **i.** If using a USB extension cable, the VEXnet Key must be mounted such that no metal is touching the key above the VEXnet logo.
  - **ii.** We highly recommend that no metal may be within 2" of the top of the VEXnet Key.

i. An unlimited amount of 1/8" (or local metric equivalent), braided, nylon rope
j. 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.
k. VEX IQ pins used solely for the purpose of attaching VEX Team Identification Number Plates.

<R8> Teams may add non-functional decorations, provided that they do not affect the 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".

a. Anodizing and painting of parts is considered a legal nonfunctional decoration.
b. 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 scoring objects from falling out of the robot, the decal must be backed by VEX material that also prevents the Scoring Objects from falling out.
c. 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.
d. 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.
    i. The Vision Sensor may be used as a functional component, provided that its wireless transmitting functionality is disabled.
e. "Non-VEX" microcontrollers or computing devices are not allowed as non-functional decorations, per <R10>.
f. VEX motors, or components of VEX motors, may not be used as nonfunctional decorations.
g. 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.

<R9> Additional VEX EDR components released during the competition season on 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 webpages.

<R10> Robots must use ONLY one (1) VEX EDR Microcontroller.

- **a.** Examples of VEX EDR Microcontrollers are the VEX ARM® Cortex®-based Microcontroller (276-2194) and the V5 Robot Brain (276-4810).
- **b.** 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, or VEX Robotics by HEXBUG; it also includes devices that are unrelated to VEX, such as Raspberry Pi or Arduino devices.

<R11> 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, 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.
- **d.** 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.

<R12> Robots may use either:

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 per <R19>.

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 per <R19>.

Option 4: A V5 Robot Brain, up to eight (8) V5 Smart Motors, and no pneumatic components, excluding pneumatic tubing.

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

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

- **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.
- **c.** 2-Wire Motors or VEX Servos cannot be used with a V5 Robot Brain. V5 Smart Motors cannot be used with any VEX microcontroller other than a V5 Robot Brain.

<R13> A maximum of one (1) VEX Y-cable can be used per Motor Port of the Microcontroller or Power Expander. (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.

<R14> 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, and one (1) 9V backup battery.
  - **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.** To ensure reliable wireless communication, it is required that all teams connect a charged 9V backup battery to their VEXnet system using the VEXnet Backup Battery Holder (276-2243).
  - **iii.** 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.
  - **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).
  iii. V5 Wireless Controllers may only be powered by their internal rechargeable battery.

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

Table 2: *The batteries, battery chargers, and accessories that are legal, depending on which control system is used.*

<R15> No more than two VEX hand-held transmitters may control a single robot during the tournament. No modification of these transmitters is allowed of ANY kind.

a. No other methods of controlling the robot (light, sound, etc) are permissible. However, using sensor feedback to augment driver control (such as motor encoders or the Vision Sensor) is acceptable.
b. Teams may not "mix-and-match" transmitter types, such as using a VEXnet Joystick and V5 Wireless Controller at the same time.

<R16> Some part modifications are permitted, with the following restrictions and clarifications:

a. 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 EDR platform may NOT be altered from their original state in ANY way.
  i. Official VEXos firmware updates, found at www.vexedr.com, are permitted and highly recommended. Custom firmware modifications are not permitted.

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. 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.

  i. Using the V5 Smart Cable Crimp Tool, V5 Smart Cable Stock, and V5 Smart Cable Connectors to create custom-length Smart Cables is permissible. Teams who create custom cables (using these tools) acknowledge that incorrect wiring may have undesired results. Teams MUST use official V5 Smart Cable Stock if creating custom-length cables.

d. Teams may change or replace the gears in the "2-Wire 393" or "2-Wire 269" motors with the corresponding official VEX Replacement Gears. Teams may also change or replace the gear cartridge in the V5 Smart Motor with other official replacement gear cartridges.

e. Teams may cut pneumatic tubing to a desired length.

f. Welding, soldering, brazing, gluing, or attaching in any way that is not provided within the VEX EDR platform will NOT be allowed.

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

h. Teams are permitted to fuse/melt the end of the 1/8" nylon rope to prevent fraying.

i. The gluing permitted by <R7g> is an exception to this rule.

j. Physical modifications to metal structural components, such as bending or cutting, are permitted. Metallurgical modifications that change fundamental material properties, such as heat treating, are not permitted.

<R17> The Robot on/off switch must be accessible without moving or lifting the robot. The microcontroller lights and/or screen should also be visible by competition personnel to assist in diagnosing robot problems.

<R18> 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.

<R19> 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 teams 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.

<R20> To participate in an official VEX Robotics Competition Tournament, a team must first register on www.robotevents.com. Teams that are not registered will not be eligible to compete.

- **a.** Upon registering, they will choose or receive their VEX Team Identification Number (VEX Team ID#) and a Welcome Kit containing a VRC License Plate Kit. Every robot should have their VEX Team ID# and License Plates displayed on a minimum of two opposing sides.
- **b.** The VRC License Plates are considered a non-functional decoration, and cannot be used as a functional part of the robot.
- **c.** License Plates must fulfill all robot rules (i.e. they must fit within the 18" cube per <R4>, they cannot cause entanglement, etc.)
- **d.** License Plates must be clearly visible and legible at all times. For example, they must not be in a position that would be easily obstructed by a robot mechanism during standard match play.
- **e.** 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.
- **f.** License Plates must be placed on the robots built, programmed, and driven by students associated with the stated plate number (see <R1>).

Figure 24: *Example of a legal VRC License Plate placement.*

<R21> During the Autonomous Period, human operators 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 Autonomous mode. 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 Control Period, etc).

Teams should 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.

<R22> Any violation of robot rules will result in a team being unable to play until they pass inspection (per <R2d>). In addition, teams who intentionally circumvent or violate rules to gain an advantage over their fellow competitors are in violation of the spirit and ethos of the competition. As such, anyone caught violating a rule in this manner may be disqualified from upcoming matches, the event, or even future events at the discretion of the REC Foundation and/or the VEX Robotics Competition Game Design Committee.

Special Event Rule Modifications

The rules listed in this section represent the way the game will be played at ALL VEX Robotics Competition "Championship" Events. We know that some events will choose to modify the rules slightly to suit unique circumstances. We expect some events will make the following rule exceptions:

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

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.