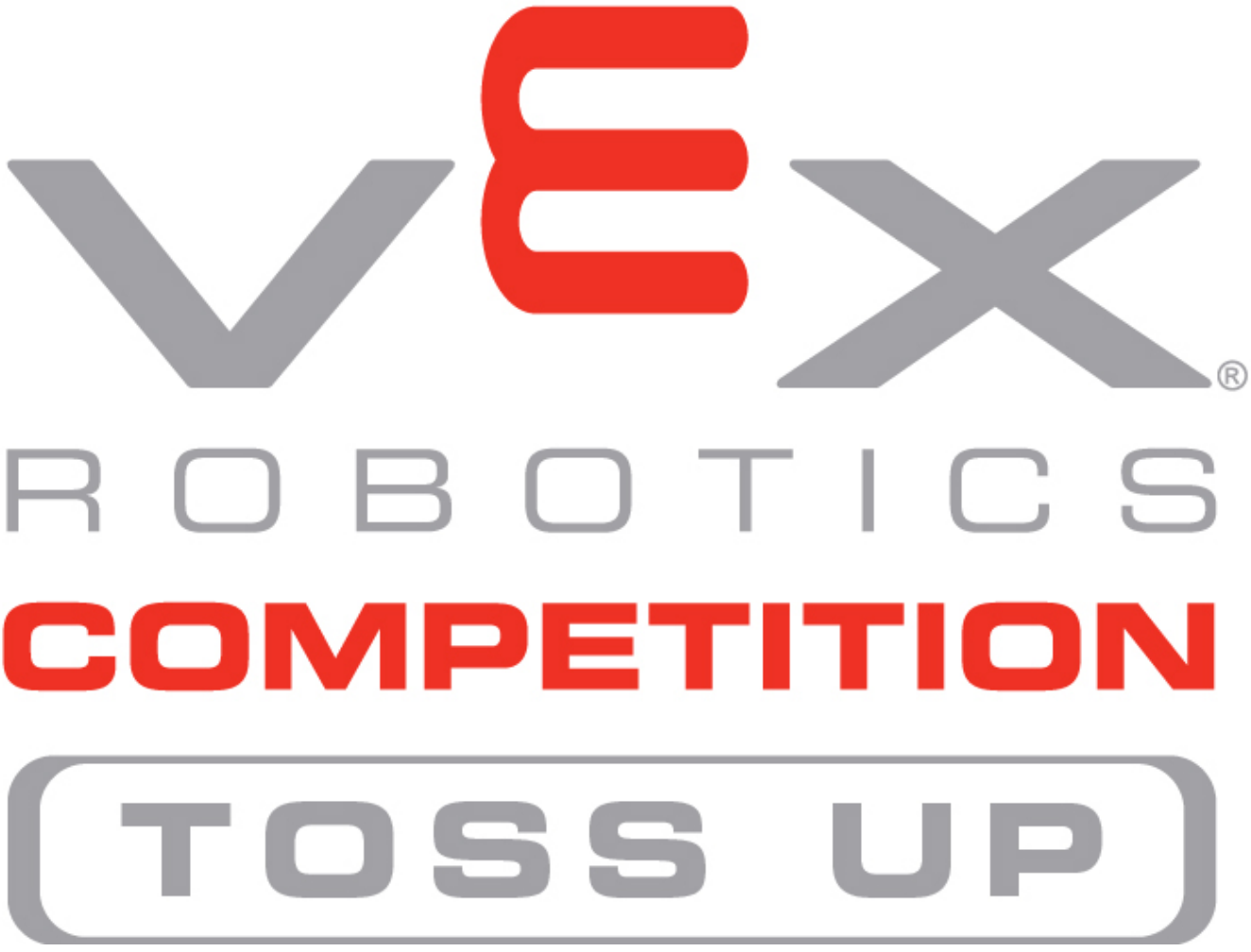

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SECTION 1

Introduction

Overview

This section provides an introduction to *VEX Toss Up* and the VEX Robotics Competition.

The VEX Robotics Competition

The world needs the students of today to become the scientists, engineers, and problem solving leaders of tomorrow. The constant breakthroughs in chemistry, medicine, materials and physics reveal a new set of challenges and create an even greater opportunity for problem solving through technology. These problems are not academic; the solutions could help save the world and those technology problem solvers will be the ones to make it possible.

This underscores the dramatic challenge we face: there are not enough high school graduates choosing technology related disciplines in college. This does not reflect a lack of capacity for new students on the part of technical schools and universities, but a lack of interested and qualified applicants. In short, we will not have the people we require in the next generation to solve the problems of tomorrow unless the shortage is directly addressed today. Who will solve the world's next great crisis?

Recognizing this dilemma, scores of organizations are creating programs designed to attract and engage young students in the study of science and technology. Many have found that robotics is a very powerful platform to attract and hold the attention of today's multi-tasking, connected youths. Robotics has strong appeal to this intensely competitive generation and represents the perfect storm of applied physics, mathematics, computer programming, digital prototyping and design, integrated problem solving, teamwork and thought leadership. Students with a previously undiscovered aptitude for STEM (Science, Technology, Engineering, and Math) curriculum are flourishing in growing numbers due to the efforts of schools, volunteer organizations, corporations, and governments internationally.

The VEX Robotics Competition, operated by the Robotics Education and Competition Foundation, is a program that inspires thousands of students worldwide to pursue STEM-related education and career paths. While there are many quality robotics competitions worldwide, the VEX Robotics user community has overwhelmingly demanded *new* challenges that are easy and economical to host and implement.

The VEX Robotics Design System helps takes the inspiration from the competition to the next level. The system is used as a classroom robotics platform designed to nurture creative advancement in robotics and knowledge of STEM education. VEX provides teachers and students with an affordable, robust, and state-of-the-art robotics system suitable for classroom use and the playing field. VEX's innovative use of pre-manufactured and easily formed structural metal, intuitive mechanical parts combined with a powerful range of user-programmable microprocessors for control, leads to infinite design possibilities.

For more information visit www.vexrobotics.com. Follow us on Twitter @VEXRobotics. Like Us on facebook at www.facebook.com/vexrobotics

Visit RobotEvents.com for more information on the VEX Robotics Competition, including team registration, event listings and results and more.

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VEX Toss Up – A Primer

VEX Toss Up is played on a 12 ft x 12 ft foam-mat, surrounded by a sheet-metal and lexan perimeter. There are two zones and two goals, which teams can score balls into, along with two hanging bars for robots to hang off of. The field is divided by a bump and a trough, with various openings to allow for robot passage.

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

While participating in the VRC *Toss Up* season, teams will develop many new skills in response to the challenges and obstacles that stand before them. Some problems will be solved by individuals, while others will be handled through interaction with their student teammates and adult mentors. Teams will work together to build a VEX robot to compete in one of many tournaments, where they celebrate their accomplishments with other teams, family and friends. After the season, students come away not only with the accomplishment of building their own competition robot, but with an appreciation of science and technology and how they might use it to positively impact the world around them. In addition, they cultivate life skills such as planning, brainstorming, collaboration, teamwork, and leadership as well as research and technical skills.

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SECTION 2

The Game

Overview

This section describes the VEX Robotics Competition game, called *VEX Toss 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 below. 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* your colored *BuckyBalls* and *Large Balls* into the *Middle Zone* and *Goal Zone*, by *Stashing* your colored *BuckyBalls* and *Large Balls* into the *Goals*, and by *Hanging* or *Hanging With A Ball,* at various heights, off your colored *Bar* at the end of the match.

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

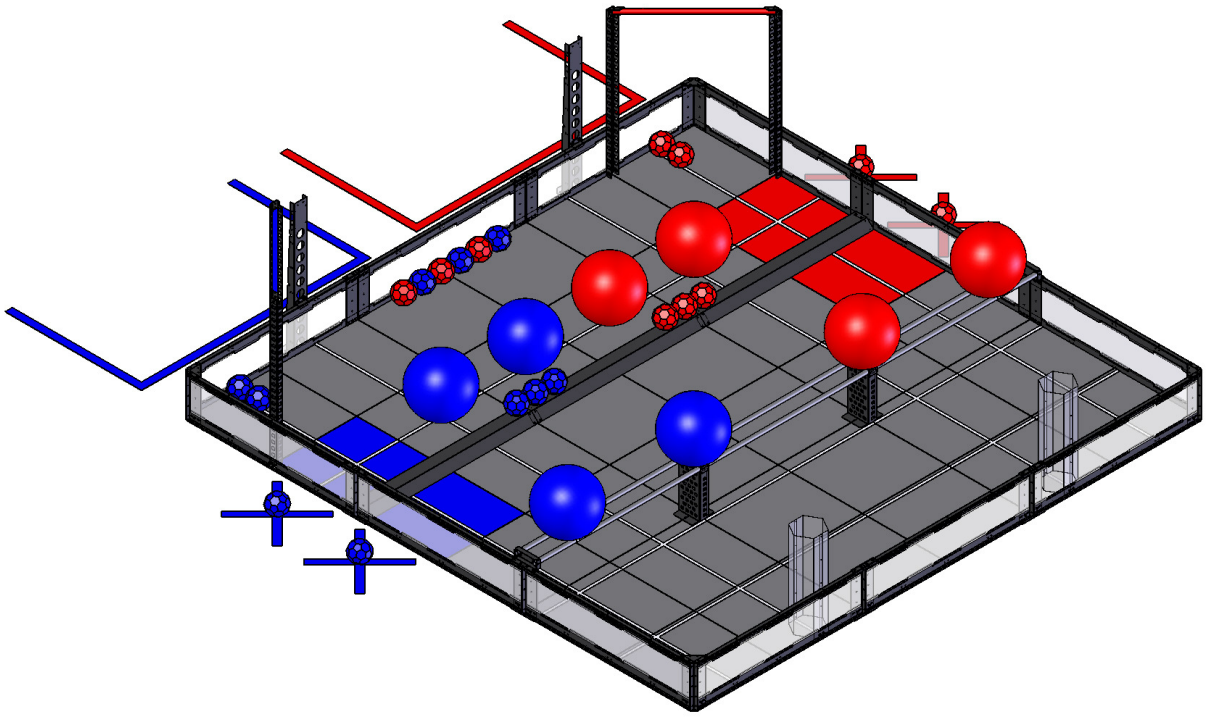

Figure 1: *Isometric view of the field*
Note: *The illustrations in this section of the manual are only provided to give a general visual understanding of the game. Teams should refer to the official field specs available in Appendix A for exact field dimensions, a full field BOM, exact details of field construction, and lower cost field options.*

There are a total of twenty (20) *BuckyBalls,* ten (10) red and ten (10) blue, eight (8) *Large Balls*, four (4) red and four (4) blue available as *Scoring Objects* in the game. Each *Robot* will have one (1) *BuckyBall* available as a *Preload.* Sixteen (16) *BuckyBalls* and all eight (8) *Large Balls* will start at designated locations on the field.

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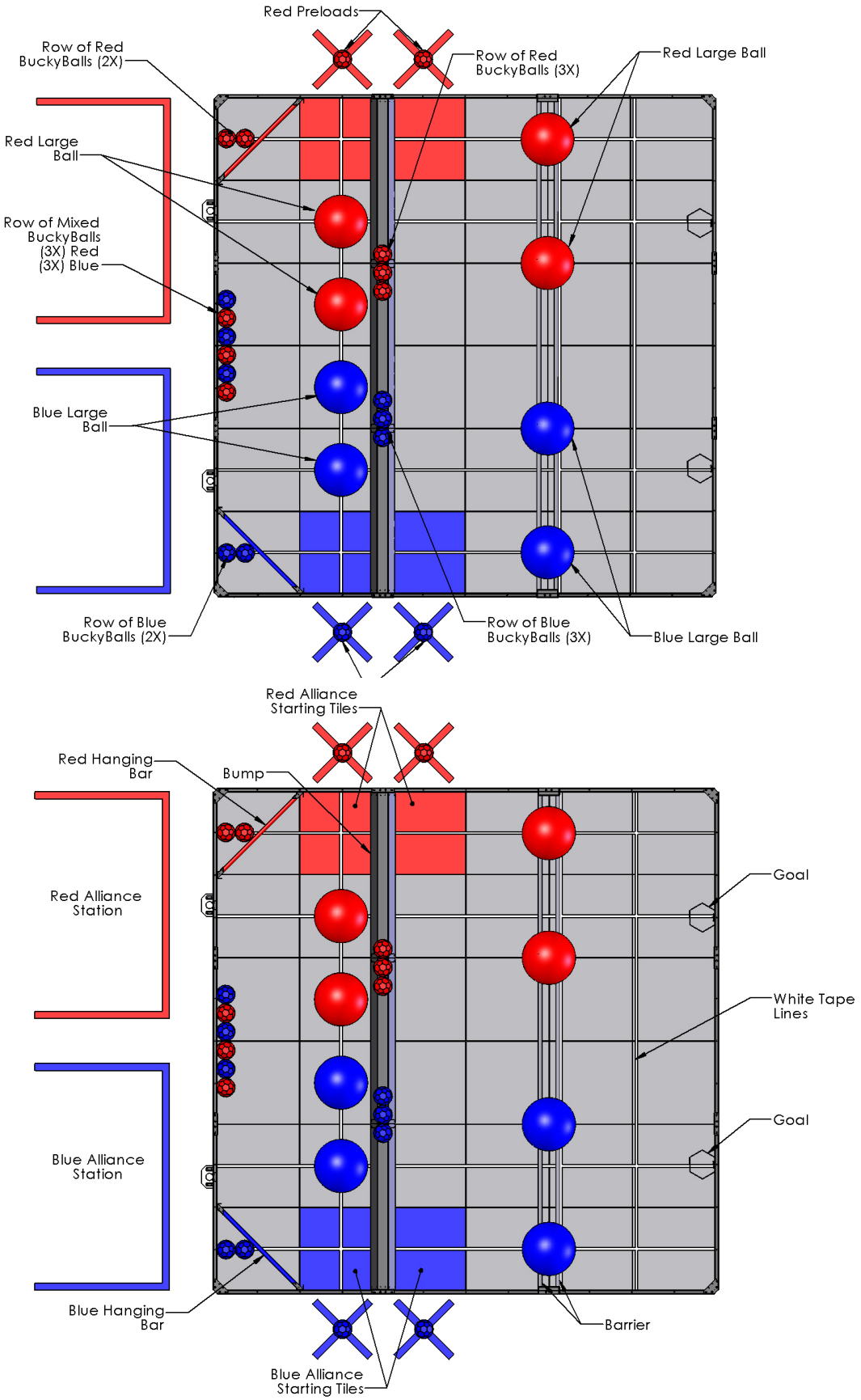

Figures 2 & 3: *Overhead views of the field*

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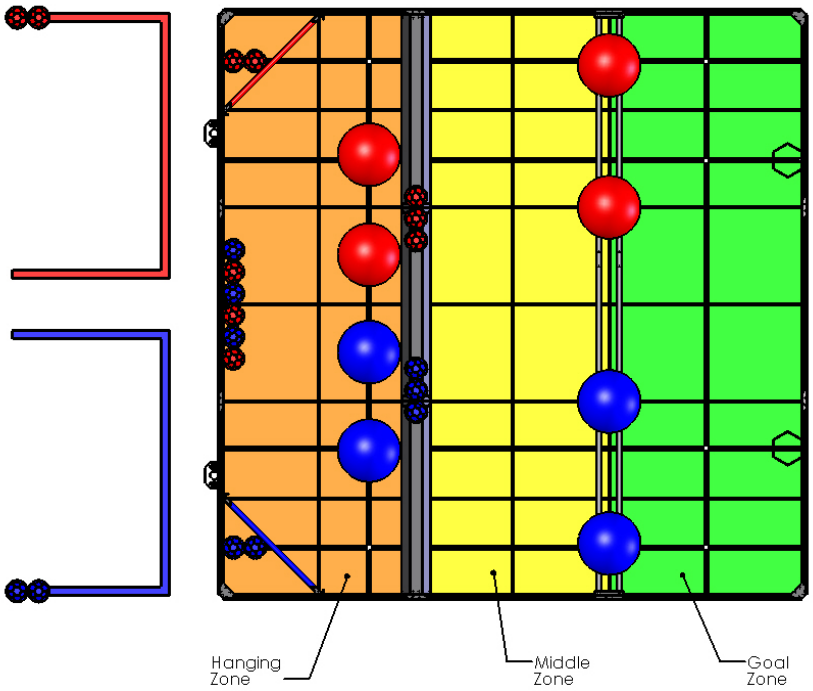
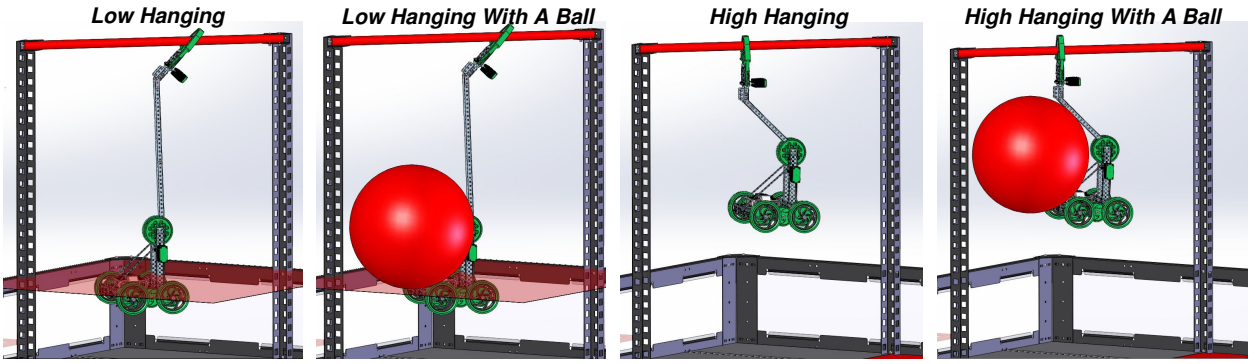


Zone	Scoring Object	Points Earned
Hanging Zone	BuckyBall	0
Hanging Zone	Large Ball	0
Middle Zone	BuckyBall	1
Middle Zone	Large Ball	1
Goal Zone	BuckyBall	2
Goal Zone	Large Ball	5
Stashed	BuckyBall	5
Stashed	Large Ball	10

Figure 4: *Overhead views of the field, highlighting the Zones*
Table 1: *Scoring Zone chart*



Figures 5-8: *Examples of Low Hanging, Low Hanging With A Ball, High Hanging, and High Hanging With A Ball*

Type of Hang	Figure Number	Points Earned
Low Hanging	4	5
Low Hanging With A Ball	5	15
High Hanging	6	10
High Hanging With A Ball	7	20

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Game Definitions

Adult – Anyone not meeting the definition of *Student*.

Alliance – A pre-assigned grouping of two teams that work together for a given *Match*.

Alliance Robot Interaction Spots – The colored (red or blue) X's from which a *Driver* or *Coach* may interact with the *Robot*.

Alliance Starting Tile – A colored tile (red or blue), which designates the location where *Robots* must start the match.

Alliance Station – The designated region where the *Drivers* and *Coaches* must remain during their *Match*.

Autonomous Period – A 15-second (0:15) time period in which the *Robots* operate and react only to sensor inputs and to commands pre-programmed by the team into the onboard *Robot* control system. Human interaction with the robot is allowed during this period as specified in the game rules.

Barrier – The 12" high sheet metal and pipe structure that separates the *Middle Zone* and the *Goal Zone*

BuckyBall – A red or blue truncated icosahedron shaped hard plastic *Scoring Object* with an overall diameter of 5". Each *BuckyBall* weighs approximately 0.25 lbs.

Bump – The 2" high structure that represents the boundary between the *Hanging Zone* and *Middle Zone*

Coach – A student or adult mentor designated as the team advisor during the match. Only one (1) of these is allowed per team at the field at any given time.

Disablement – A penalty applied to a team for a rules violation. A team who is *Disabled* in a *Match*, is no longer allowed to operate their robot, and will be asked to place their controller on the ground.

Disqualification – A penalty applied to a team for a rules violation. A team who is *Disqualified* in a *Qualifying Match* receives zero (0) *WP* and *SP*. 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. Please see Section 3 – The Tournament for further details and associated definitions.

Driver – A *Student* team member responsible for operating and controlling the *Robot*. Only two (2) *Drivers* per team are allowed in the Alliance Station on the field at any given time.

Driver Controlled Period – The 1:45 (one minute and forty-five second) time period in which the *Drivers* operate the *Robots*.

Entanglement – A robot is considered to have *Entangled* an opposing robot if it has grabbed or hooked the opponent robot.

Field Element – The foam field tiles, field perimeter, *Bars, Bump*, *Barrier, Goals* and all supporting structures.

Goal – One of the two (2) 8" diameter, hexagonal, *24"* tall field structures, where teams can *Stash BuckyBalls* or *Large Balls*

Goal Zone – The foam tiles located between the *Barrier* and the field wall that the *Goals* are attached to. The boundary between the *Goal Zone* and *Middle Zone* will be marked by a tape line running along the edge of the tiles that is closest to the *Goals*.

Hanging – A *Robot* is considered to be *Hanging* if it is *Low Hanging* or *High Hanging*

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Hanging Bar – The red or blue 40" high, horizontal PVC pipe, supported by the *Hanging Structure*

Hanging Structure – The steel structure located in two corners of the field that supports the *Hanging Bar*

Hanging With A Ball – A *Robot* is considered to be *Hanging With A Ball* if it is *Hanging* and touching a *Large Ball* of your *Alliance's Color* that is not touching a foam field tile and is not touching another non *Hanging Robot* of your own *Alliance*.
Note: A *Robot* will never be considered *Hanging With A Ball* with more than one *Large Ball*. A *Large Ball* can only be counted towards a single robot *Hanging With A Ball*.

Hanging Zone – The foam tiles located between the field wall adjacent to the Alliance Stations and the Bump.

High Hanging – A *Robot* is considered to be *High Hanging* if it is touching the *Hanging Bar* of its own color and completely above the plane parallel to the foam field tiles, formed by the top of the field perimeter. Note: A *High Hanging Robot* does not also count as a *Low Hanging Robot*.

Large Balls -- A red or blue, approximately spherical, inflatable, soft plastic *Scoring Object* with an overall diameter of 15.5-17.5". Each *Large Ball* weighs approximately 0.9 lbs. Note: Teams should be prepared to handle large balls of any size within the stated range.

Low Hanging -- A *Robot* is considered to be *Low Hanging* if it is touching the *Hanging Bar* of its own color and not touching any foam field tile.

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

Middle Zone – The foam tiles located in between the *Bump* and the *Barrier.* The boundary between the *Goal Zone* and *Middle Zone* will be marked by a tape line running along the edge of the tiles that is closest to the *Goals*.

Pinning – A *Robot* is considered to be *Pinning* an opposing *Robot* if it is inhibiting the movement of an opponent *Robot* while the opposing *Robot* is in contact with the foam playing surface and another *Field Element*.

Possessing – A *Robot* is considered to be *Possessing* a *BuckyBall* if it actively controlling the *BuckyBall*. Examples of *Possessing* include:

- Carrying or holding *BuckyBall(s)* in the *Robot*
- Herding *BuckyBalls*, i.e. intentionally pushing or impelling *BuckyBall(s)* to a desired location or path
    - Accidentally Herding *BuckyBall(s)* (i.e. driving through *BuckyBall(s)* in the path of the *Robot*) is not considered herding, and thus not considered *Possessing*
- Trapping *BuckyBall(s)*, i.e. intentionally pressing *BuckyBall(s)* up against a field object

Preload – The one (1) *BuckyBall* each team must place on the field such that it is touching their *Robot* and/or their *Alliance Starting Tile* prior to each *Match*.

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

Scored – A *Scoring Object* is *Scored* in a *Zone* if it meets the following criteria.

1. A *Scoring Object* is touching a *Zone*
    a. A *BuckyBall Scored* in two *Zones* will only count for the *Goal Zone*
    b. A *Large Ball Scored* in two *Zones* will count for the *Zone* that the majority of the *Large Ball* is in
2. The *Scoring Object* is not *Stashed*

Scoring Object – A *BuckyBall* or a *Large Ball*

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Stashed – A *Scoring Object* is *Stashed* in a *Goal* if some part of the *Scoring Object* is within the two-dimensional space defined by the outer edges of the *Goal*, and not being touched or *Supported* by a *Robot* of the same color as the *Scoring Object*. Note: A goal extends infinitely perpendicular to the playing field surface within the goal boundaries.

Student – Anyone enrolled in a pre-college school or home-schooled as part of a pre-college educational curriculum.

Supported – A *Scoring Object* is considered to be *Supported* by a *Robot* if the *Scoring Object* moves along with the *Robot*. i.e. If a referee were to remove a *Robot* from the field and a *Scoring Object* came with it, this *Scoring Object* would be considered to be *Supported*

Trapping – A *Robot* is considered to be trapped if an opposing *Robot* has restricted it 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.

Zone – The *Hanging Zone, Middle Zone* or the *Goal Zone*

Game Rules

Scoring

- A *BuckyBall Scored* in the *Middle Zone* is worth one (1) point for the *Alliance* of the color of the *BuckyBall*
- A *Large Ball Scored* in the *Middle Zone* is worth one (1) point for the *Alliance* of the color of the *Large Ball*
- A *BuckyBall Scored* in the *Goal Zone* is worth two (2) points for the *Alliance* of the color of the *BuckyBall*
- A *Large Ball Scored* in the *Goal Zone* is worth five (5) points for the *Alliance* of the color of the *Large Ball*
- A *BuckyBall Stashed* in a *Goal* is worth five (5) points for the *Alliance* of the color of the *BuckyBall*
- A *Large Ball Stashed* in a *Goal* is worth ten (10) points for the *Alliance* of the color of the *Large Ball*
- A *Robot* that is *Low Hanging* is worth five (5) points for their *Alliance*
- A *Robot* that is *High Hanging* is worth ten (10) points for their *Alliance*
- A *Robot* that is *Hanging With A Ball* is worth ten (10) additional points for their *Alliance*, on top of the points earned for *Hanging*
- At the end of the *Autonomous Period* the *Alliance* with the most points receives a ten (10) point bonus.

Safety Rules

<S1> If at any time the *Robot* operation or team actions are deemed unsafe or have damaged the *Field Elements* or *Scoring Objects*, by the determination of the referees, the offending team may be *Disqualified*. The *Robot* will require re-inspection before it may again take the field.

<S2> If a *Robot* goes 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 border during normal game play.

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General Game Rules

<G1> When reading and applying the various rules in this document, please remember that common sense always applies in the VEX Robotics Competition.

<G2> At the beginning of a *Match*, each *Robot* must be smaller than a volume of 18 inches wide by 18 inches long by 18 inches tall. An offending *Robot* will be removed from the match at the Head Referee's discretion.

<G3> Each team shall include up to two *Drivers* and one *Coach*. No *Driver* may fulfill this role for more than one team at any given event.

<G4> During a *Match*, the *Drivers* and *Coach* must remain in their *Alliance Station*. *Drivers* and *Coaches* may move to their *Alliance Robot Interaction Spots* when interacting with their *Robot* and following rules <SG4> and <SG5>

<G5> During the qualification rounds, the red *Alliance* has the right to place their *Robots* on the field last. During the elimination rounds, the higher seeded *Alliance* has the right to place their *Robots* on the field last. Once a team has placed their *Robot* on the field, its position cannot be readjusted prior to the match. *Robots* must be placed on the field promptly. Teams who violate this rule will have their robots randomly repositioned by the referees.

<G6> *Drivers* and *Coaches* are prohibited from making intentional contact with any *Scoring Object*, *Field Element* or *Robots* during a *Match,* with the exception of the contact specified in <SG4> and <SG5>. Any intentional contact will result in a *Disqualification*. Accidental contact will not be penalized, unless the contact directly impacts the final outcome of the match. This type of accidental contact will result in a *Disqualification*.

<G7> During a *Match*, *Robots* may be operated only by the *Drivers* and/or by software running in the on-board control system. A *Coach* may not touch his/her team's controls anytime during a *Match*. Violations of this rule will result in a warning for minor offenses which do not affect the match. Egregious (match affecting) offenses will result in a *Disqualification*. Teams who receive multiple warnings may also receive a *Disqualification* at the head referee's discretion.

<G8> *Scoring Objects* that leave the playing field will be promptly returned to the playing field in the same *Zone* as the *Robot* that ejected the *Scoring Object*. Teams may not intentionally remove *Scoring Objects* from the scoring field, while not in the process of *Stashing* or removing *Stashed Scoring Objects*. Violations of this rule will result in a warning for minor offenses which do not affect the match. Egregious (match affecting) offenses will result in a *Disqualification*. Teams who receive multiple warnings may also receive a *Disqualification* at the head referee's discretion. Note: *Scoring Objects* will never be returned to the playing field in a *Stashed* position

<G9> Scores will be calculated for all *Matches* immediately after the *Match* once all objects on the field come to rest.

<G10> *Robots* may not intentionally detach parts during any *Match*, or leave mechanisms on the field. If an intentionally detached component or mechanism affects game play the team shall be *Disqualified* at the referee's discretion. Multiple intentional infractions may result in *Disqualification* for the entire competition.

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<G11> Strategies aimed solely at the destruction, damage, tipping over, or *Entanglement* of *Robots* are not part of the ethos of the VEX Robotics Competition and are not allowed. However, *VEX Toss Up* is an interactive game. Some incidental tipping, *Entanglement*, and damage may occur as a part of normal game play. 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 a team being *Disqualified* from the remainder of the competition.

VEX Toss Up is intended to be an offensive game. Teams that partake in solely defensive strategies will undergo extra scrutiny in regards to <G11>. In the case where referees are forced to make a judgment call on interaction between a defensive and offensive *Robot*, the referees will err on the side of the offensive *Robot*.

a. Robots which have expanded horizontally in an effort to obstruct the field will undergo even more scrutiny under <G11>, and will not be protected under <G11>. e.g. If you choose to undertake this type of strategy, your robot should be built to withstand vigorous interaction.
    i. Furthermore, teams that undertake this type of obstructive strategy would not be protected by <SG3>. e.g. There is no penalty for pinning a "wall-bot".

All teams are responsible for the actions of their *Robots*. This goes for teams who are driving recklessly and potentially causing damage, but also goes for teams who drive around with a small wheel base and arm extended. Teams should design their *Robots* such that they are not easily tipped over or damaged by minor contact.

<G12> *Robots* must be designed to permit easy removal of *Scoring Objects* from any grasping mechanism without requiring that the *Robot* have power after the *Match*.

<G13> Field tolerances may vary by as much as ±1", except where otherwise noted, so teams must design their *Robots* accordingly.

<G14> Replays are at the discretion of the event partner and head referee, and will only be issued in the most extreme circumstances.

<G15> All teams must adhere to all VEX Robotics Competition Rules as they are written, and must abide by the listed intent of the rules. Every team has the opportunity to ask for official rules interpretations in the VEX Robotics Competition Question & Answer Forum. Any responses in this Q&A forum should be treated as official rulings from the VEX Robotics Competition Game Design Committee, and represent the correct and official interpretation of the VEX Robotics Competition Rules.

There may also be periodic "Team Updates" posted on the *VEX Toss Up* webpage in the competition section of www.vexrobotics.com. These updates are also "official" parts of the *VEX Toss Up* rules.

The VEX Robotics Competition Question & Answer Forum can be found at www.vexforum.com, or directly at http://www.vexrobotics.com/Toss_Up.

<G16> All teams are expected to conduct themselves in a respectful and professional manner while competing in VEX Robotics Competition events. If team members are disrespectful or uncivil to event staff, volunteers or fellow competitors, they may be *Disqualified* from their current or upcoming *Match*. It is important to remember that we are all judged based on how we deal with adversity. 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 life in general.

<G17> All rules in this manual are subject to changes, and not considered official until June 1st. 2013. We do not expect any major changes to take place, however we do reserve the right to make changes until June 1st, 2013.

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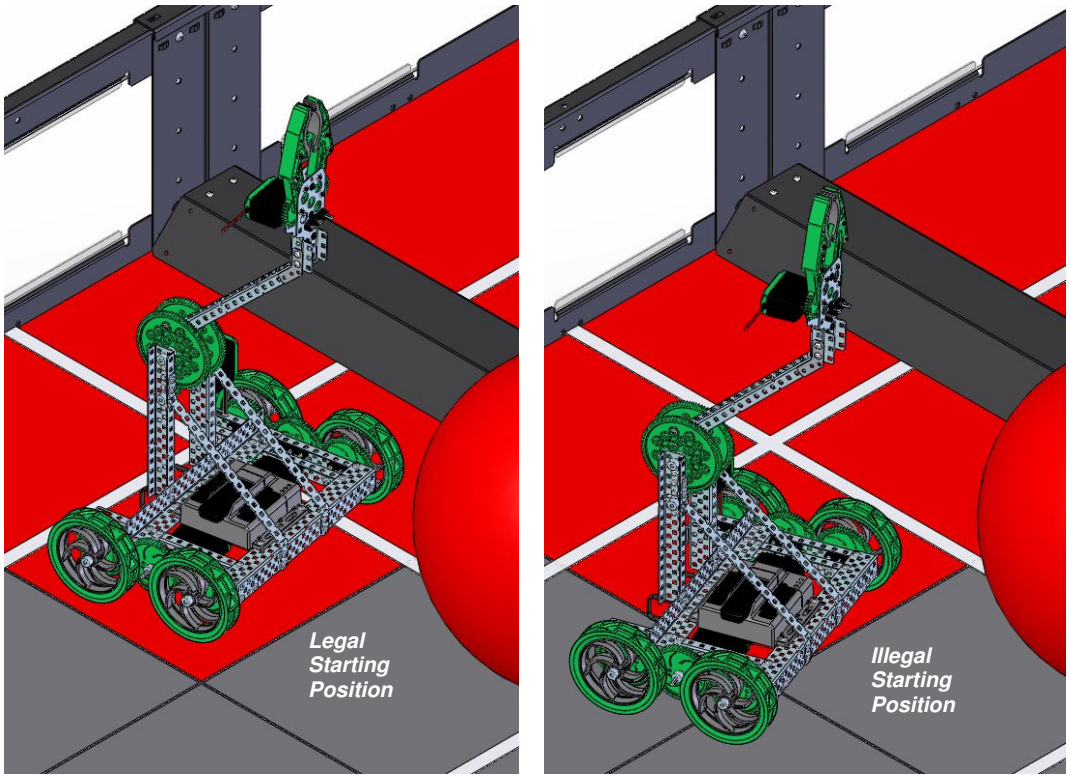
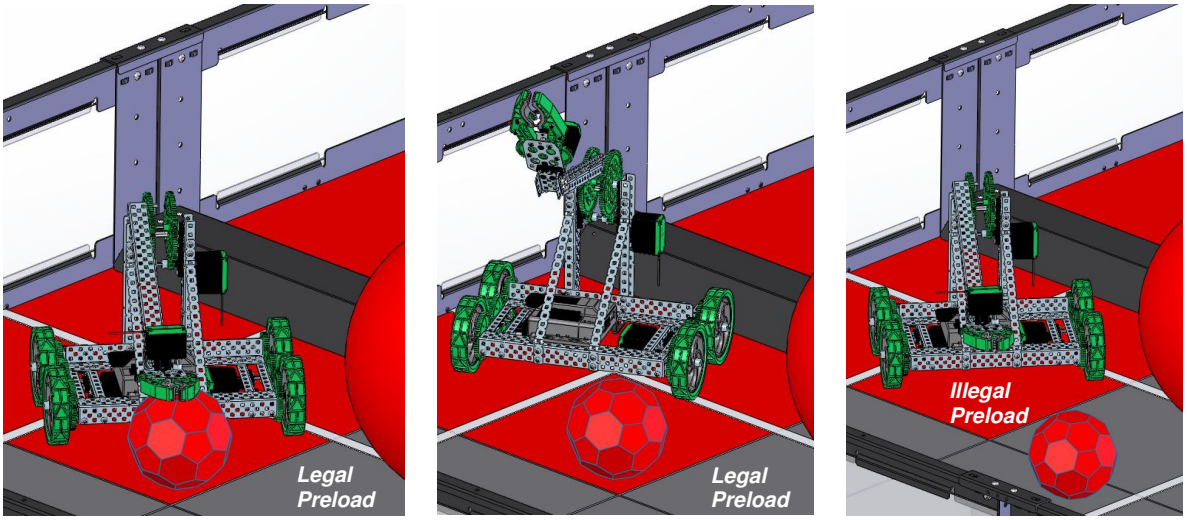
VEX Toss Up Specific Game Rules

<SG1> At the beginning of each *Match*, each *Robot* must be placed such that it is touching one of their colored *Alliance Starting Tiles*, not touching any *Scoring Object* other than those permitted by <SG2> and not touching any other foam field tiles or the *Bump*. No more than one *Robot* may start the match on any one *Alliance Starting Tile*. (See figures 8 & 9)



Figures 9 & 10: *A legal, and illegal starting position*

<SG2> Prior to the start of each *Match*, each *Robot* will have one (1) *BuckyBall* available as a *Preload*. A *BuckyBall* is considered to be legally preloaded if it is touching the *Robot* or the *Alliance Starting Tile* and not touching any other foam tiles or the *Bump*. (See figures 10 & 11)



Figures 11 - 13: *From left to right, legal Preload, legal Preload, illegal Preload*

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<SG3> A *Robot* cannot *Pin* or *Trap* an opposing *Robot* for more than five seconds during the *Driver Controlled Period*. A *Pin* or *Trap* is officially over once the *Pinning* team has moved away from the teams are separated by at least 2 feet (approximately one (1) foam tile). After ending a *Pin* or *Trap*, a team may not *Pin* or *Trap* the same *Robot* again for a duration of 5 seconds. If a referee determines this rule to be violated, the offending *Robot* will be *Disqualified* for the match. There is no penalty for *Pinning* during the *Autonomous Period*.

<SG4> During the *Autonomous Period*, *Drivers* and *Coaches* may handle their own *Robot* while the *Robot* is in contact with their own *Alliance Starting Tile* (i.e. the tile the *Robot* started the match on), and not touching the *Bump*, within the following restrictions.

- **i.** *Drivers* and *Coaches* may only interact with a *Robot* if it is touching their own *Alliance Starting Tile* and no part of the *Robot* is touching a gray foam tile, except the interaction allowed in <SG4ii>
- **ii.** If any part of a *Robot* is touching a grey foam tile, the only interaction that will be allowed is to bring the *Robot* fully into the legal *Alliance Starting Tile*, into a legal position as per <SG4i>
- **iii.** After any legal interaction with the robot by *Drivers* and *Coaches,* and prior to the robot attempting to score or interact with Game Objects, the robot must be in a position such that it is touching the legal *Alliance Starting Tile* and no part of the *Robot* is touching a gray foam tile; a legal position as per <SG4i>. i.e. Before the *Robot* leaves the *Alliance Starting Tile*, *Drivers* and *Coaches* may not be touching the robot. If *Drivers* and *Coaches* touch the *Robot* again, it must be touching a legal *Alliance Starting Tile* and it must immediately be brought fully back onto the tile.
  Note: *Robots* that hang over the edge of the *Alliance Starting Tile*, but do not touch any gray foam tiles, are considered to be in legal positions for interaction as per <SG4>
- **iv.** Drivers and Coaches may only interact with a *Robot* if they are on or in the general vicinity of the *Alliance Robot Interaction Spot* that corresponds to the *Alliance Starting Tile* the *Robot* is on.

During contact with the *Robot*, the *Drivers* or *Coaches* may not intentionally manipulate or modify the position of any *Scoring Objects* relative to the *Robot's* overall system, either by direct hand contact or indirect contact via the *Robot*. (i.e. it is acceptable to change the orientation of a *Robot* that includes *Scoring Objects* in it as long as the position of the elements relative to the *Robot* is not changed).

Drivers or *Coaches* also may not change the configuration of the *Robot* in any way other than in the act of fixing the *Robot* (i.e. it is okay to reposition the robot relative to the field, but it is not okay to manually lift up the *Robot's* arm, unless you are in the act of a repair). Any changes to the *Robot's* configuration performed during the act of repair must be reversed before the *Robot* can leave the *Alliance Starting Tile*.

The intent of this rule is to allow teams to fix *Robots* that are unable to move, to reposition and/or reorient *Robots*, and to activate additional autonomous modes by interacting with the *Robot* via sensors or buttons.

The intent of this rule is not to allow teams to manipulate their *Robot* in such a way that they are controlling the Robot via human contact or creating motions that lead to scoring.

Violations of this rule will result in a warning for minor offenses which do not affect the match. Egregious (match affecting) offenses will result in a *Disqualification*. Teams who receive multiple warnings may also receive a *Disqualification* at the head referee's discretion.

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<SG5> During the *Driver Controlled Period*, *Drivers* and *Coaches* may handle their own *Robot* as long as the robot has **never** left the *Alliance Starting Tile*. The intent of this rule is to allow teams to fix *Robots* which were unable to move at the start of the *Match*.

Violations of this rule will result in a warning for minor offenses which do not affect the match. Egregious (match affecting) offenses will result in a *Disqualification*. Teams who receive multiple warnings may also receive a *Disqualification* at the head referee's discretion.

Note: During the handling specified in <SG4> And <SG5> robots may be repositioned, but must be returned to a valid starting position as per <SG1>.

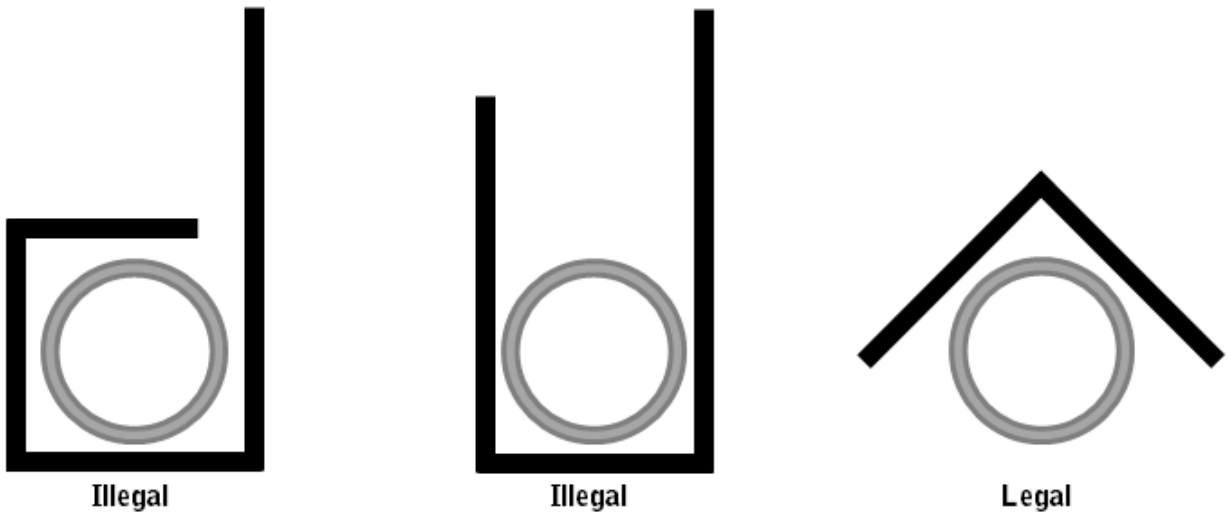
Note: Drivers and Coaches may only interact with a *Robot* if they are on or in the general vicinity of the *Alliance Robot Interaction Spot* that corresponds to the *Alliance Starting Tile* the *Robot* is on.

<SG6> *Robots* are not permitted to break the plane of their opponents *Alliance Starting Tile* during the *Autonomous Period*. Violations of this rule will result in the offending *Alliance* automatically losing the *Autonomous Bonus* and the offending *Robot* being disabled.

<SG7> Once there is less than thirty (0:30) seconds remaining in the match, *Robots* may not touch an opposing *Robot* that is touching their own *Hanging Bar* or *Hanging Structure.* Additionally, *Robots* may not touch the opposing *Alliance's Hanging Bar* or *Hanging Structure* during this time period. Violations of this rule will result in a warning for minor offenses which do not affect the match. Egregious (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> *Robots* may not *Possess* more than three (3) *BuckyBalls* at once. Violations of this rule will result in a warning for minor offenses which do not affect the match. Egregious (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> Robots may not intentionally grasp, grapple or attach to any *Field Elements* with the exception of the *Bar*. Strategies with mechanisms that react against multiple sides of a field element in an effort to latch onto said field element are prohibited. (See figures 8-10) The intent of this rule is to prevent teams from both unintentionally damaging the field, and from anchoring themselves to the field. Special attention will be paid to any teams interacting with the *Hanging Structure*. Violations of this rule will result in a Disqualification.



Figures 14-16: *From left to right, overhead views of illegal, illegal and legal interactions with field elements as per <SG9>. Black lines represent robot parts; the grey circles represent field elements.*

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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 – A student chosen to represent their team during *Alliance Selection* for the final *Elimination Matches*.

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

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* and *SP*. 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 to determine the championship alliance. Alliances of three face off in a best two of three series, with two teams playing in each match. The first alliance to win two matches will proceed to the next round.

Practice Match – An un-scored match used to provide time for teams to get acquainted to the official playing field.

Qualifying Match – A match used to determine the rankings for the *Alliance Selection*. Alliances compete to earn *Win Points* and *Strength of Schedule Points*.

Strength of Schedule Points (SP) – The second basis of ranking teams. *Strength of Schedule Points* are awarded in the amount of the score of the losing alliance in a *Qualifying Match.*

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 drivers 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. These 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*.

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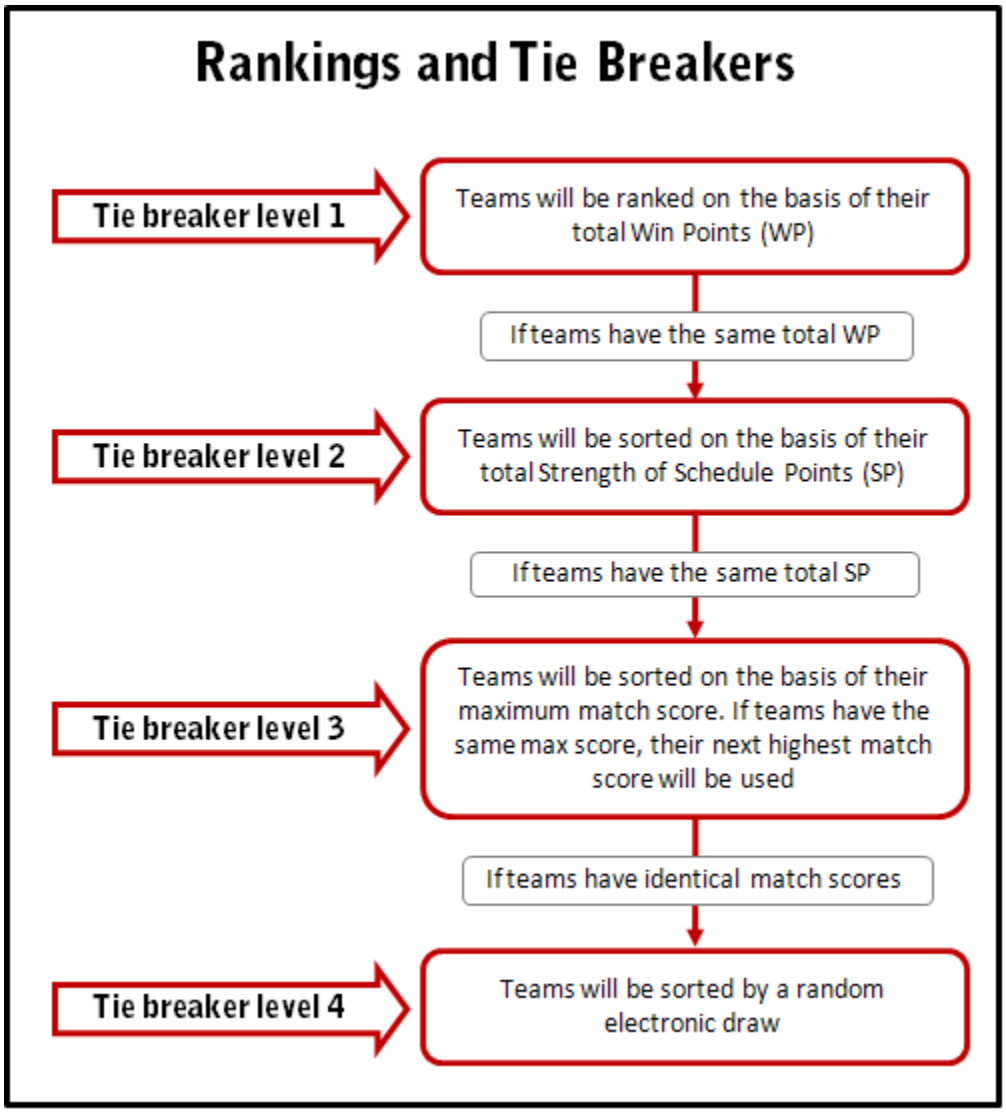
- All teams will be scored on the same number of *Qualifying Matches*.
- In some cases, a team will be asked to play in an additional *Qualifying Match*, but will not receive credit for playing this extra match.

Rankings

- At the conclusion of each match, *Win Points (WP)* will be issued:
  - Winning teams of a *Qualifying Match* receive two (2) *WP*
  - Losing teams of 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*
- 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* and zero (0) *SP*. A "no show" is treated exactly the same as a *Disqualification*.



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Elimination Matches

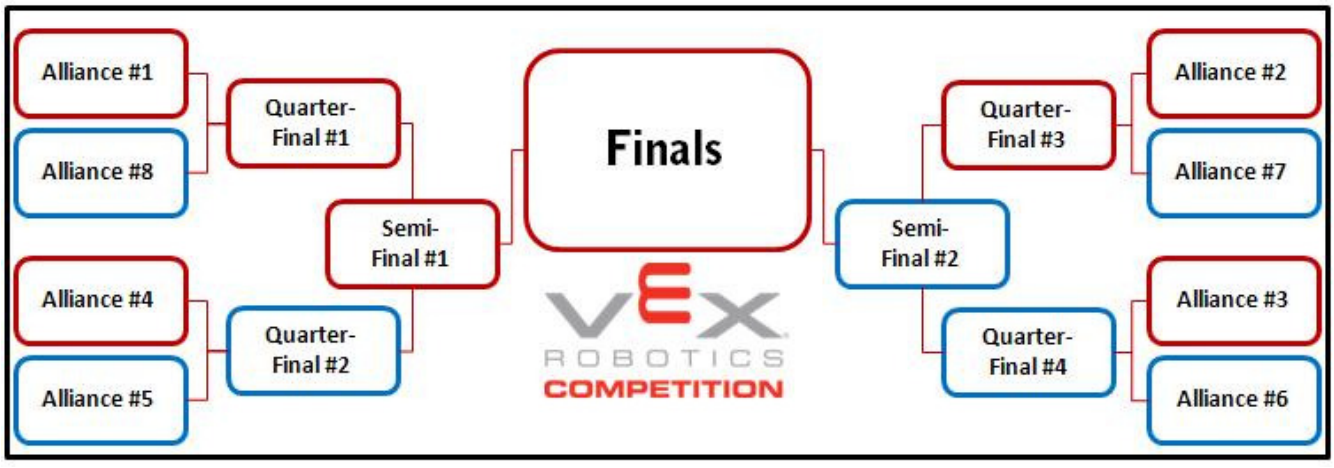
- The *Alliance Selection* process will consist of two rounds of selection, such that eight alliance captains will form elimination alliances consisting of three teams.
- These eight alliances will participate in a tournament to determine the event champions.
- If a team is *Disqualified* during an *Elimination Match*, then their entire alliance is *Disqualified*, and the match will be recorded as a loss.

Alliance Selection Process

- Every team will choose a student to act as a team representative.
  - These student representatives will proceed to the playing field at the designated time to represent their teams in the *Alliance Selection*.
- There will be eight alliances formed in the *Alliance Selection*.
- In order of tournament ranking, the student 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 eight *Alliance Captains* have been designated and chosen one alliance partner.
- **The same method is used for each *Alliance Captain*'s second choice. Teams will select in the same order they did in the first round.** Any teams remaining after alliance eight makes their second choice will not compete in the *Elimination Matches*.
- Some smaller events may choose to use a different alliance format to better suit the number of teams, please see the event modification section of this document for more details.

Match Ladder

The *Elimination Matches* will play in a ladder format as shown below.



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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 two matches advances.
- Any tied matches will be replayed until one alliance has two wins, and advances.

Tournament Rules

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

a. The referees will not review any recorded replays.
b. Any questions for the referees must be brought forward by a student drive team member within the time period of two (2) qualifying matches or immediately after the score is announced of an elimination match.

<T02> The only people from a team permitted by the playing field are the three drive team members who are identified by the drive team badges. These badges are interchangeable but not during a match.

<T03> During matches, two teams from an alliance will play on the field. **Any team which sits out the first match in an elimination series, must play in the second match, with no exceptions.** In the third and any subsequent matches, any two of the three teams may play. Prior to each *Elimination Match*, the *Alliance Captain* must let the referee know which two teams will be playing in the upcoming match.

<T04> There are no time outs in the qualifying rounds; in the elimination rounds, each alliance will be allotted ONE time out of no more than three 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 member of the team should report to the field for the match.

<T05> All team members, including coaches, **must** wear safety glasses or glasses with side shields while in the pit or alliance stations during matches. While in the pit area it is highly recommended that all team members wear safety glasses.

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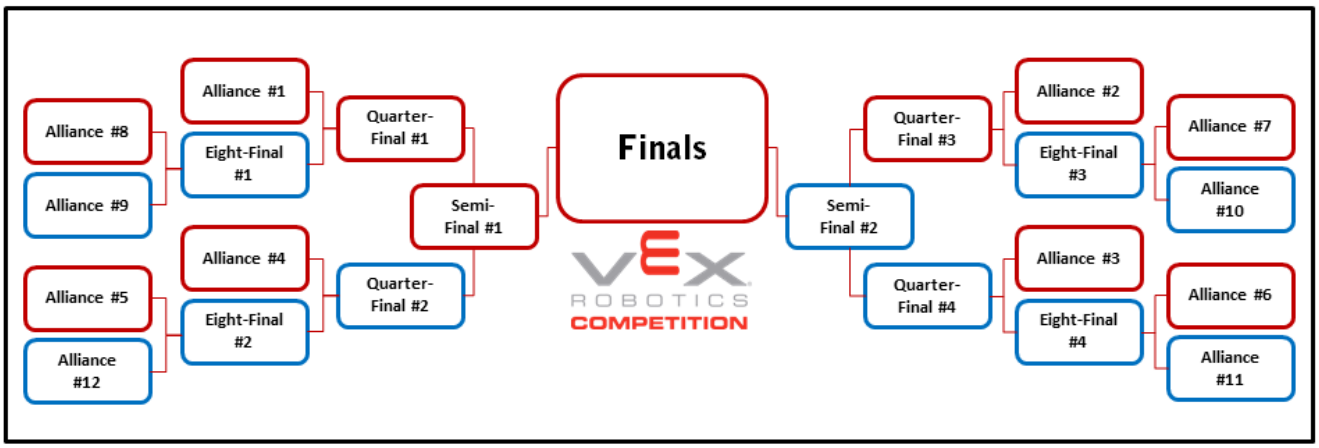
Event Modifications

Small Tournaments (Level 1 Tournaments): In the case that an event has fewer than 24 teams (the requisite amount to have eight full alliances), tournaments may be played as follows:

- If there are between 18 and 23 teams at a tournament
  - Alliances will still consist of three teams
  - The number of alliances will be equal to the amount of teams divided by three, less any remainder. (e.g. If there are 19 teams, 19/3 = 6.33 → 6 picking teams)
- If there are 17 or fewer teams
  - Alliances will consist of two teams
  - 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)
  - Some tournaments of this size may choose to use unbalanced alliances; having one alliance of 3 teams to allow all teams to participate in the elimination rounds. (e.g. If there are 17 teams, 7 alliances of 2 and 1 alliance of 3). Three team alliances must still adhere to <T03> despite competing against other 2 team alliances.
    - If a tournament is using this format, alliances should be selected as per usual until each alliance has two teams. The remaining team would then be added to the lowest ranked alliance. (e.g. 7th is lower ranked than 6th)
- The match ladder follows the same format as a full 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.)

Medium Tournaments (Level 2 Tournaments and above): For all tournaments with at least 24 teams, tournaments may be played as follows:

- The standard format of 8 Alliances of 3 teams
- 12 Alliances of 2 teams
  - This setup is recommended for tournaments that do not have enough qualifying spots to qualify an entire three team alliance for the World Championship
  - The elimination bracket for a 12 alliance tournament would play out as follows:



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 2014 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.

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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 Toss Up*. Prior to competing at each event, all robots will have to pass an inspection. Refer to Appendix D for the Robot Inspection Guidelines and the Inspection Checklist.

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 each of 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. The VEX Robotics Design System is intended to be a mobile robotics design platform. As such, a VEX robot, for the purposes of the VRC, 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.
Subsystem 2: Power and control system that includes a VEX legal battery, a 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 VRC 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.

<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, it must be re-inspected before it will be allowed to compete.
b. All 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. 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.

For further information on the inspection process please refer to Appendix D, Robot Inspection Guidelines

<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.

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<R4> At the beginning of any match, robots must be smaller than 18" x 18" x 18".

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 a VRC Robot Sizing Tool. Robots will be placed on the base plate and must not touch the measurement slide as it is passed over the base plate. Please see http://www.vexrobotics.com/276-2086.html for a visual reference
b. Robots may expand beyond their starting size constraints after the start of a match.
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 from Official **Robot** Components from the VEX Robotics Design System unless otherwise specifically noted within these rules.

a. During inspections if there is a question 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, or other printed documentation.
b. Only the VEX Robotics Design System Components specifically designed to be used for Robot construction are allowed. Using additional components outside their typical purpose is against the intent of the 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 product line cannot be used for robot construction. Products from the VEXpro line which are also cross listed as part of the VEX EDR product are legal.
d. Official Robotics Components from the VEX Robotics Design System which have been discontinued are still legal for competition use. However teams must be cognizant of <R5a>

<R6> Official VEX products are ONLY available from VEX & Official VEX Resellers. To determine whether a product is "official" or not, consult www.VEXrobotics.com.

<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. Note: 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, and any commercially available nut to fit these screws.
d. Teams may add non-functional decorations provided that these 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 "nonfunctional".
   i. Anodizing and painting of parts would be considered a legal nonfunctional decoration
   ii. Any guards or decals must be backed by legal materials that provide the same functionality. i.e. 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.
   iii. If using the VEX speaker (Part #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
e. Any non-aerosol based grease or lubricating compound, when used in **extreme** moderation on surfaces and locations that do NOT come into contact with the playing field walls, foam field surface, game objects, or other robots.
f. Non shattering plastic from the following list; polycarbonate, 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. Plastic can be mechanically altered by cutting, drilling or bending etc., but **it cannot be chemically treated, melted or cast.** Teams may heat the polycarbonate to aid in bending.

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g. 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. Teflon tape solely for the purposes of preventing leaks may be used on the threaded portions of pneumatic fittings.
   iv. For securing and retaining a VEXnet key to the Cortex Microcontroller. Using tape in this manner is highly recommended to ensure a robust connection.
h. Hot glue for securing cable connections
j. A USB extension cable may be used for the sole purpose of remote mounting of a VEXnet key. The key must be mounted in the following manner. (See the below image for reference)
   i. 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.
k. An unlimited amount of 1/8", braided, nylon rope

<R8> Additional VEX Robotics Design System Components that are released during the competition season are considered legal for use.
a. Some "new" components may have certain restrictions placed on them upon their release. These restrictions will be documented in a Team Update. Team Updates will be posted to the "VEX Toss Up" home page in the Competition section of www.VEXrobotics.com

<R9> Robots must use ONLY one (1) VEX EDR Microcontroller.
a. Examples of VEX EDR Microcontrollers are the VEX v.5 PIC Microcontroller and the VEX Cortex Microcontroller.
b. Microcontrollers that are part of other VEX product lines such as VEXpro or VEX RCR are not allowed.

<R10> 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 VEX-RCR product line are prohibited including all VEXplorer electronics.
c. A VEXnet Joystick may only be used in conjunction with a Cortex Microcontroller. A VEXnet upgraded 75MHz Transmitter may only be used in conjunction with a PIC Microcontroller. Mixing and matching VEXnet transmitters and receivers is prohibited.

<R11> Robots may use up to ten (10) VEX EDR motors or VEX Servos (Any combination, up to ten)
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.
b. Teams may NOT use multiple 2-wire Motor Ports, 3-wire PWM Motor Ports, or Motor Controller 29 modules on a single motor.

<R12> 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 Cortex Microcontroller can 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 a Motor Controller 29

<R13> The only allowable sources of electrical power for a VEX Robotics Competition Robot is any single (1) VEX 7.2V Robot Battery Pack of any type, unless the robot is utilizing the VEX Power Expander, and a single (1) 9V backup battery. Robots utilizing the VEX Power Expander can use a second (2) VEX 7.2V Robot Battery of any type.
a. Additional batteries cannot be used on the robot (even ones that aren't connected).
b. Robots are permitted to use a maximum of one (1) VEX Power Expander
c. 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).
d. Any VEX 7.2V Battery Pack is legal, in the quantities described above.

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<R14> 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.

<R15> Parts may NOT be modified as follows:

a. Motors, extension cords, sensors, controllers, battery packs, and any other electrical component of the VEX Robotics Design System may NOT be altered from their original state in ANY way.
   - Internal or external mechanical repairs of VEX Limit and Bumper switches are permitted
     - Using components from these devices in other applications is prohibited
   - 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.**
   - Teams may change or replace the gears in the "2-Wire 393" or "2-Wire 269" motors, with the corresponding official VEX Replacement Gears

b. Welding, soldering, brazing, gluing, or attaching in any way that is not provided within the VEX Robotics Design System will NOT be allowed.
   - Mechanical fasteners may be secured using Loctite or a similar thread-locking product.
     - This may be used for securing hardware ONLY.
   - Teams are permitted to fuse/melt the end of the 1/8" nylon rope to prevent fraying
   - The gluing permitted by <R7h> is an exception to this rule.

<R16> The Robot on/off switch must be accessible without moving or lifting the robot. The Robot Microcontroller lights should also be visible by competition personnel to assist in diagnosing robot problems.

<R17> 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.

<R18> Pneumatic devices may only be charged to a maximum of 100 psi.

<R19> To participate in an official VEX Robotics Competition Tournament a team must first register on robotevents.com. Upon registering they will receive their VEX Team Identification Number (VEX Team ID#) and a welcome kit containing VEX Team Identification Number Plates. Every robot should have their VEX Team ID# Plates displayed on a minimum of 2-opposing sides.

a. The VEX Team Identification Number Plates are considered a non-functional decoration, and cannot be used as a functional part of the robot.
b. These number plates must fulfill all robot rules (i.e. they must fit within the 18" cube per <R4>, they cannot cause entanglement, etc.)

<R20> Robots must include a mounting device to securely hold one VEX Robot Identification Flag throughout an entire match.

a. The VEX Robot Identification Flags are considered a non-functional decoration, and cannot be used as a functional part of the robot.
b. These flags must fulfill all robot rules (i.e. they must fit within the 18" cube per <R4>, they cannot cause entanglement, etc.)

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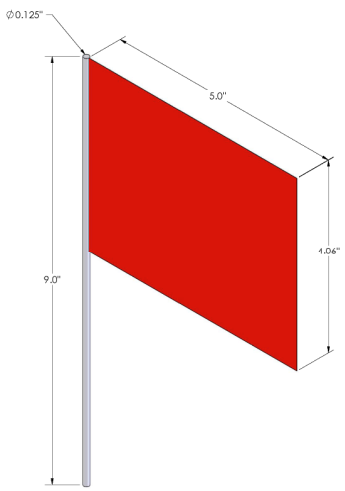
Notes on VEX Robot Identification Flags:

- The flags will be issued to teams in their VEX Robotics Competition registration materials.
- These flags may also be available at some events
- Replacement and extra flags are available for purchase at www.vexrobotics.com
- For flag details please refer to the following diagram.
- VEX Threaded Standoffs work as simple flag holders, as shown below.



<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.

For more information on this, teams should consult the help guides produced by the developers of their chosen programming software.

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. In particular, 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 802.11g Wireless link.
b. Allow AA batteries to power the robot instead of a VEX 7.2V Battery Pack

If an event makes the changes they need to inform all attending teams. It is especially important that any 75 Mhz events make sure their teams are using the correct communication type.

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