



vex[®]

ROBOTICS

COMPETITION

GATEWAY





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SECTION

Introduction

Overview

This section provides an introduction to *VEX Gateway* 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.

VEX Gateway – A Primer



VEX Gateway is played on a 12 ft x 12 ft foam-mat, surrounded by a sheet-metal and lexan perimeter. There are thirteen goals of varying height, which teams can score balls and barrels into. The field is divided by two large gates which teams may lift at their discretion to allow passage.

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

While participating in the VRC *Gateway* season, teams will develop many new skills in response to the challenges and obstacles which 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

The Game

Overview

This section describes the VEX Robotics Competition game, called *VEX Gateway*. It also lists the game definitions and game rules.

Game Description

Matches are played on a field initially 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 your opponent *Alliance* by *Scoring Balls and Barrels in Goals*, *Scoring Bonus Points* and by *Scoring Doubler Barrels or Negation Barrels in Circular Goals*.

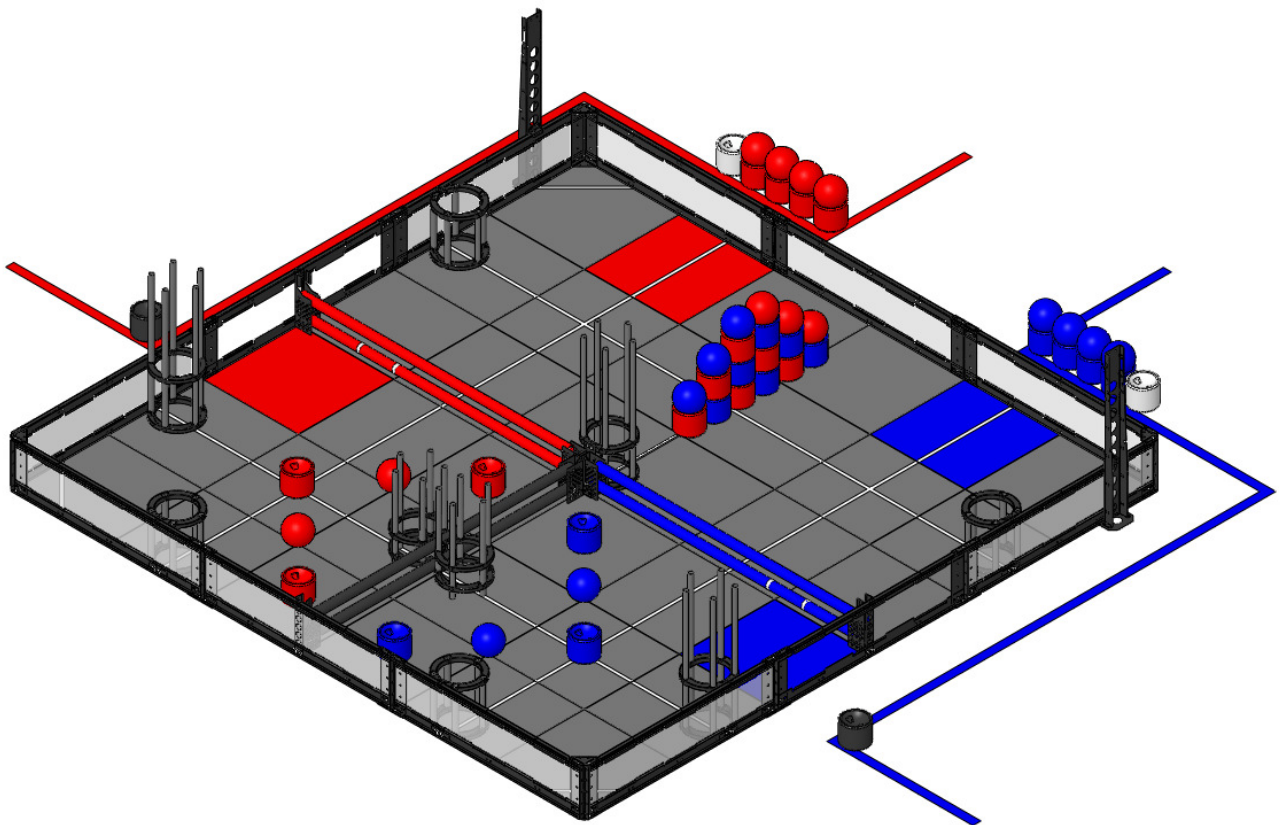
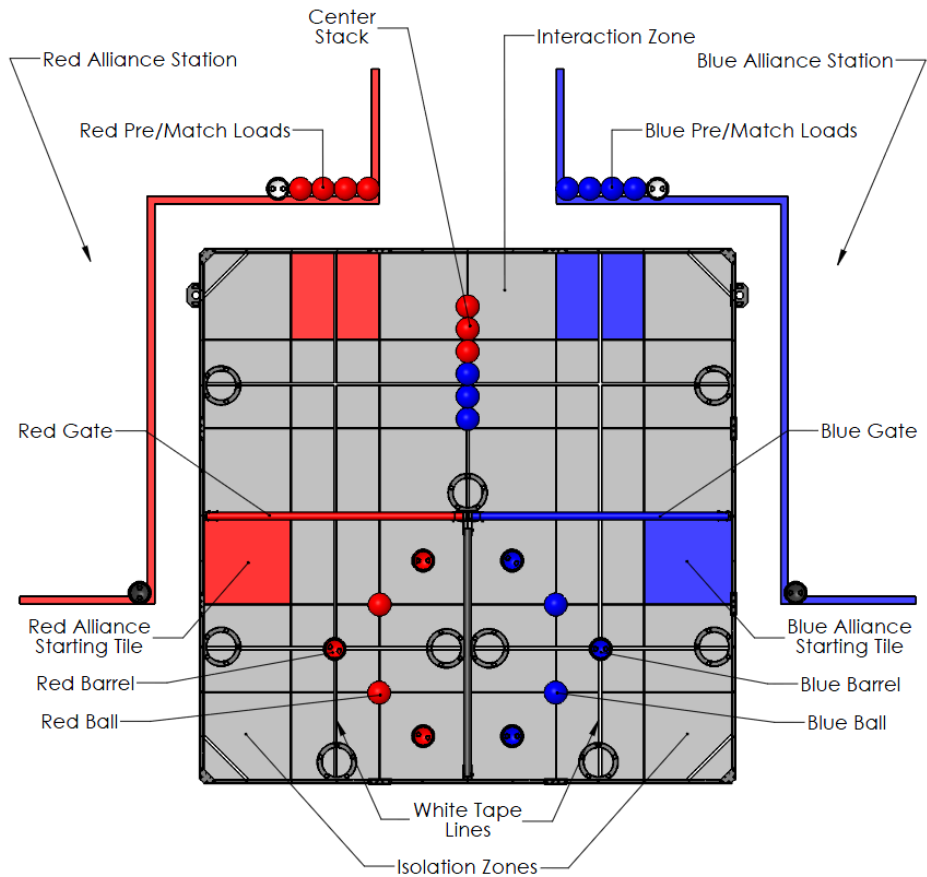
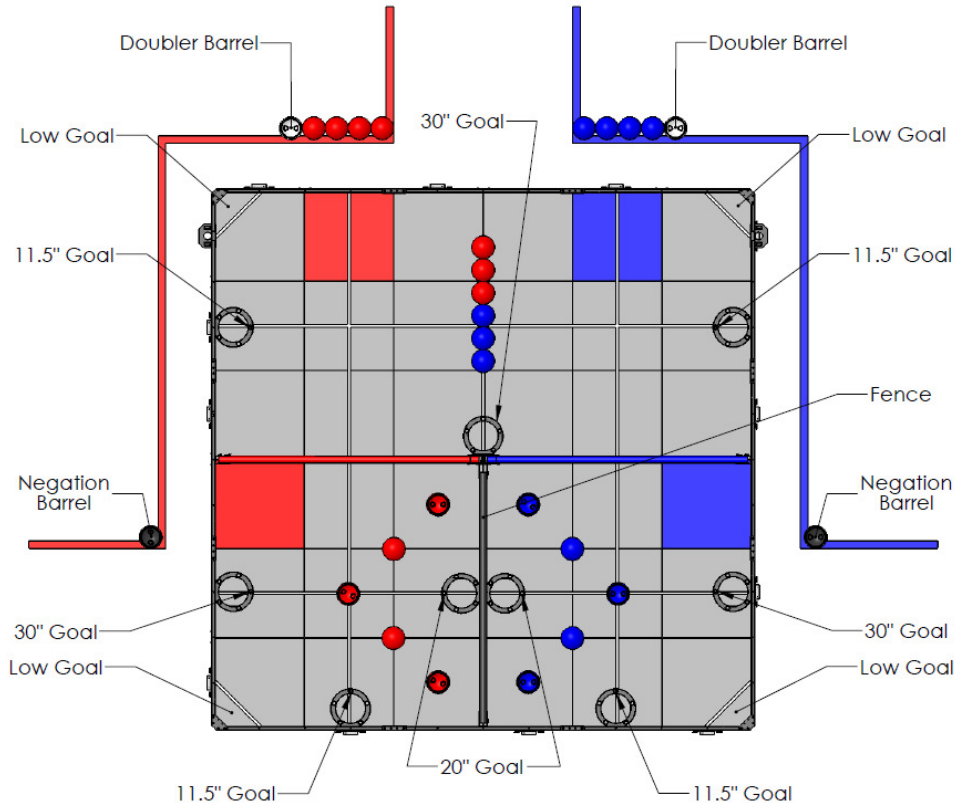


Figure 1: Isometric view of the field

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-six (26) *Barrels*, eighteen (18) *Balls*, two (2) *Doubler Barrels* and two (2) *Negation Barrels* available as *Scoring Objects* in the game. Each *Alliance* will have four (4) *Barrels* and four (4) *Balls* available to them to load during each *Match*. From these *Scoring Objects*, each *Alliance* has the option to *Preload* two (2) *Barrels* and two (2) *Balls*. *Scoring Objects* not *Preloaded* will be available to the *Alliance* as *Match Loads*. Eighteen (18) of the *Barrels* and Ten (10) of the *Balls* will start at designated locations on the field. Each *Alliance* will have one (1) *Doubler Barrel* and one (1) *Negation Barrel* that may be introduced into the field of play sometime in the last thirty seconds (0:30) of the match. The field is divided into *Interaction* and *Isolation Zones* by two large PVC *Gates* which can be lifted by teams during the *Match*.

VEX Robotics Competition - Gateway



Figures 2 & 3: Overhead views of the field

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

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

Autonomous Period – A 20-second 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.

Ball – A red or blue spherical shaped plastic scoring object with a diameter of 6". Each *Ball* weighs approximately 0.24 lbs.

Barrel – A red or blue cylindrical shaped plastic scoring object with a diameter of 6" and a height of 5". Each *Barrel* weighs approximately 0.53 lbs.

Bonus Point – A *Bonus Point* is earned for the lowest *Ball* or *Barrel* (closest to the foam field tile) within a *Circular Goal*.

Circular Goal – One of the nine (9) *Circular* shaped field structures, into which teams place *Scoring Objects*. The goals are 11.5", 20" and 30" high. The *Circular Goal* consists of two retaining rings and five (5) PVC pipes. The outer edge of the ring is considered to be the outer edge of the *Circular Goal*.

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

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.

Doubler Barrel – A white *Barrel* which doubles the value of all points (including the *Bonus Point*) in a *Circular Goal*

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

Driver Controlled Period – The 2:00 (two minute) time period in which the *Robots* are operated by the *Drivers*.

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, *Fence*, *Gates*, and *Circular Goals*.

Fence – The black PVC *Field Element* which separates the red and blue *Isolation Zones*. The *Fence* is 7.5" high.

Floor Goal – One of the four (4) areas of the field marked off by white tape into into which teams *Score Barrels* and *Balls*. The outer edges of the *Floor Goals* are defined by the inner edge of the field perimeter and the outer edge of the white tape line.

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Gate – The red or blue PVC *Field Element* that separates the *Interaction Zone* from the *Isolation Zones*. The *Gate* is hinged and can be lifted. The *Gate* is 7.5" high.

Goal – Either a *Floor Goal* or a *Circular Goal*

Interaction Zone – The 6'x12' area of the field defined by the field perimeter and the *Gates*.

Isolation Zone – The two (2) 6'x6' *Areas* of the field defined by either the red or blue *Gate* along with the *Fence* and field perimeter. *Robots* may not enter or exit an *Isolation Zone* while the *Gate* for that zone is down.

Match – A *Match* consists of an *Autonomous Period* followed by a *Driver Controlled Period* for a total time of 2:20 (two minutes, twenty seconds).

Match Loads – The four (4) *Barrels* and four (4) *Balls* available in each *Alliance Station* to be loaded at any time during the *Match*. Of these *Match Loads*, only two (2) *Barrels* and two (2) *Balls* may be used as *Preloads*.

Negation Barrel – A black *Barrel* which cancels the value of all points (including the *Bonus Point*) with a *Circular Goal*.

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*.

- Please note: The definition of *Pinning* does not require contact between the *Pinning* and pinned *Robot*. Trapping a *Robot* in a corner of the field is considered *Pinning*.

Preloads – The two (2) *Barrels* and two (2) *Balls* each alliance may load into their *Robots* prior to each *Match*. Unused *Preloads* become *Match Loads*.

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

Scored – A *Scoring Object* is *Scored* in a *Goal* if it is not touching a *Robot* of the same color of the *Scoring Object* and it meets one of the following criteria.

1. A *Scoring Object* is fully below the top of the PVC pipes of a *Circular Goal* and fully within the outer ring of the *Circular Goal*. (See figures 4 & 5)
2. A *Scoring Object* is not fully below the top of the PVC pipes of a *Circular Goal* and partially within the outer ring of the *Circular Goal* and is not within the outer ring of any other *Circular Goal*. (See figure 5)
3. A *Ball* or *Barrel* is partially inside the outer edge of a *Floor Goal* and touching a foam field tile. (See figures 6 & 7)

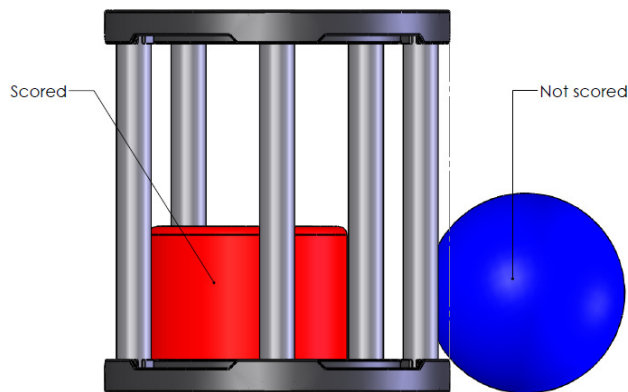
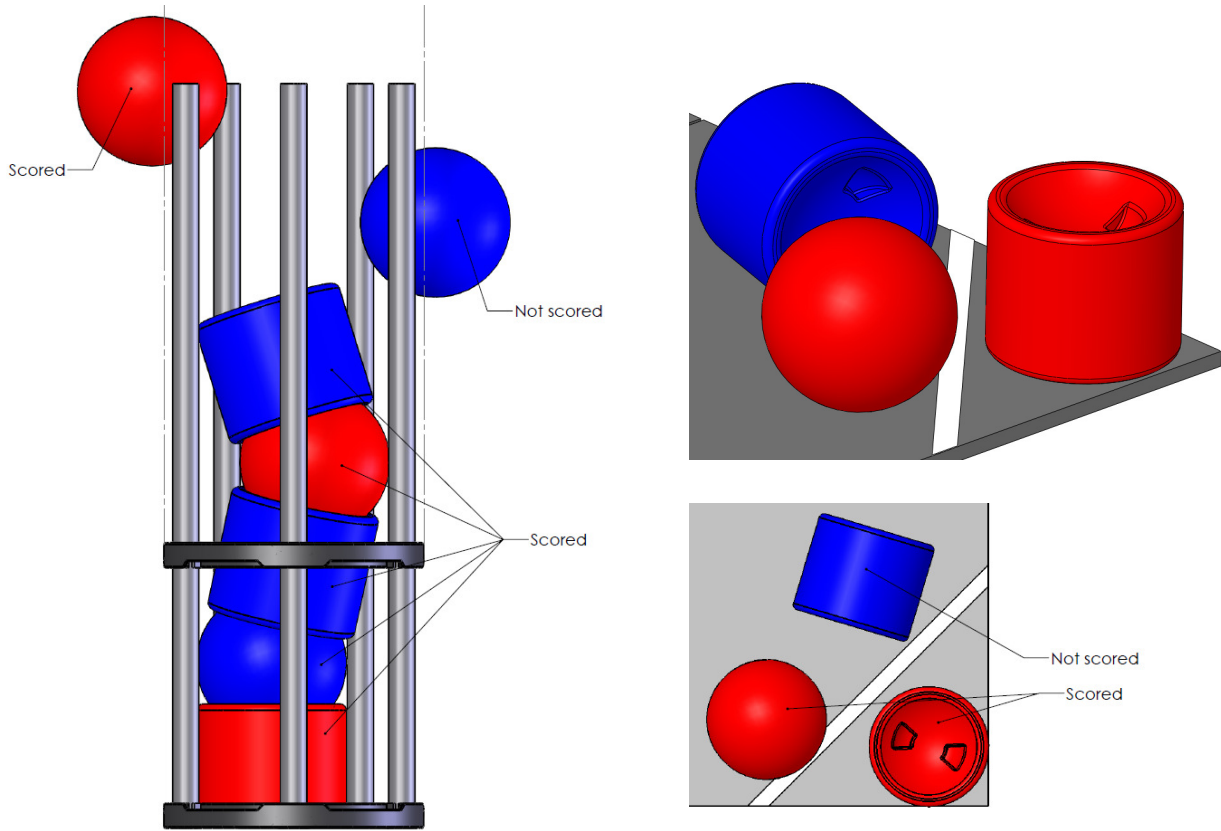


Figure 4: Examples of clause 1 of the definition of *Scored*



Figures 5: Examples of clauses 1 & 2 of the definition of Scored
Figures 6 & 7: Two views of examples of clause 3 of the definition of Scored

Scoring Object – A Barrel, Ball, Doubler Barrel or Negation Barrel

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

Game Rules

Scoring

- A Barrel that is Scored in a Goal is worth one (1) point for the Alliance of the color of the Barrel.
- A Ball that is Scored in a Goal is worth one (1) point for the Alliance of the color of the Ball.
- A Bonus Point earned is worth one (1) point for the Alliance of the color of the Scoring Object.
- A Doubler Barrel that is Scored in a Circular Goal doubles the value of all points in the Goal including the Bonus Point.
- A Negation Barrel that is Scored in a Circular Goal cancels the value of all points in the Goal including the Bonus Point.

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.

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

<S3> At no time during competition, practice or setup should anyone be on a field while a Gate is in the up position. Furthermore, at all times when a Gate is in the up position it must be latched using the provided velcro strap. Please see Appendix A for full instructions on how to use the strap.

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*.

<G4> During a *Match*, the *Drivers* and *Coach* must remain in their *Alliance Station*.

<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. *Robots* must be placed on the field promptly.

<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 <SG5>, <SG6> and <SG7>. Any intentional contact will result in a *Disqualification*. Accidental contact will not be penalized, unless the contact directly impacts the final score of the match. This type of accidental contact will result in a *Disqualification*.

<G7> During a *Match*, *Robots* may be remotely operated only by the *Drivers* and/or by software running in the on-board control system. If a *Coach* touches his/her team's controls anytime during a *Match*, the *Robot* will be disabled and the team *Disqualified*.

<G8> *Scoring Objects* that leave the playing field will be promptly returned to the playing field at the location nearest the point at which they exited. Teams who intentionally remove *Scoring Objects* from the scoring field, while not in the process of scoring or descoring, will be *Disqualified*.

<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.

<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 Gateway* 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 Gateway is intended to be an offensive game. Teams who 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*.

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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 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 " , so teams must design their *robots* accordingly.

<G14> *Scoring object* tolerances may vary by as much as $\pm 1/4$ "

<G15> Replays are at the discretion of the event organizer and head referee, and will only be issued in the most extreme circumstances.

<G16> 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.

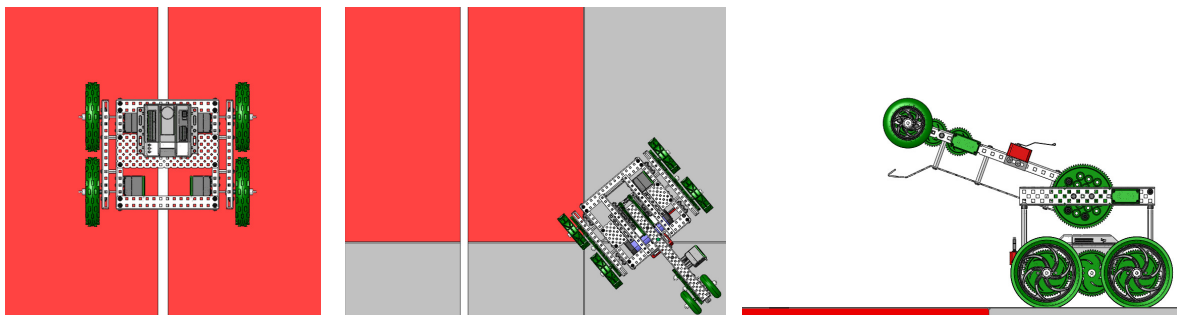
There may also be periodic "Team Updates" posted on the *VEX Gateway* webpage in the competition section of www.vexrobotics.com. These updates are also "official" parts of the *VEX Gateway* rules.

The VEX Robotics Competition Question & Answer Forum can be found at robotevents.com and www.vexforum.com, or directly at <http://www.vexrobotics.com/gateway-qa>.

<G17> 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.

VEX Gateway 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* and not touching any *Scoring Object* or *Goal* other than those permitted by <SG2>. No more than one *Robot* may start the match on any one *Alliance Starting Tile*. (See figures 8-10)



Figures 8-10: From left to right, legal starting position, legal starting position, illegal starting position

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<SG2> Prior to the start of each Match, each Alliance will have two (2) Barrels and two (2) Balls available as Preloads, one (1) of each per Robot. A Scoring Object is considered to be legally preloaded if it is touching the Robot or a legal Preload, and would not be considered Scored if there was no contact with a Robot. Preloads may also not be touching any Goal. (See figure 11)

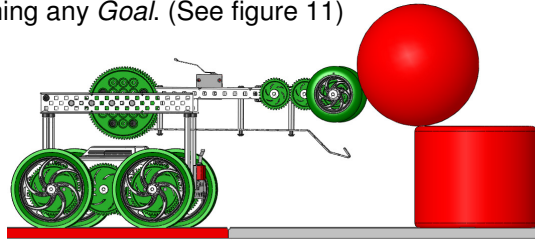
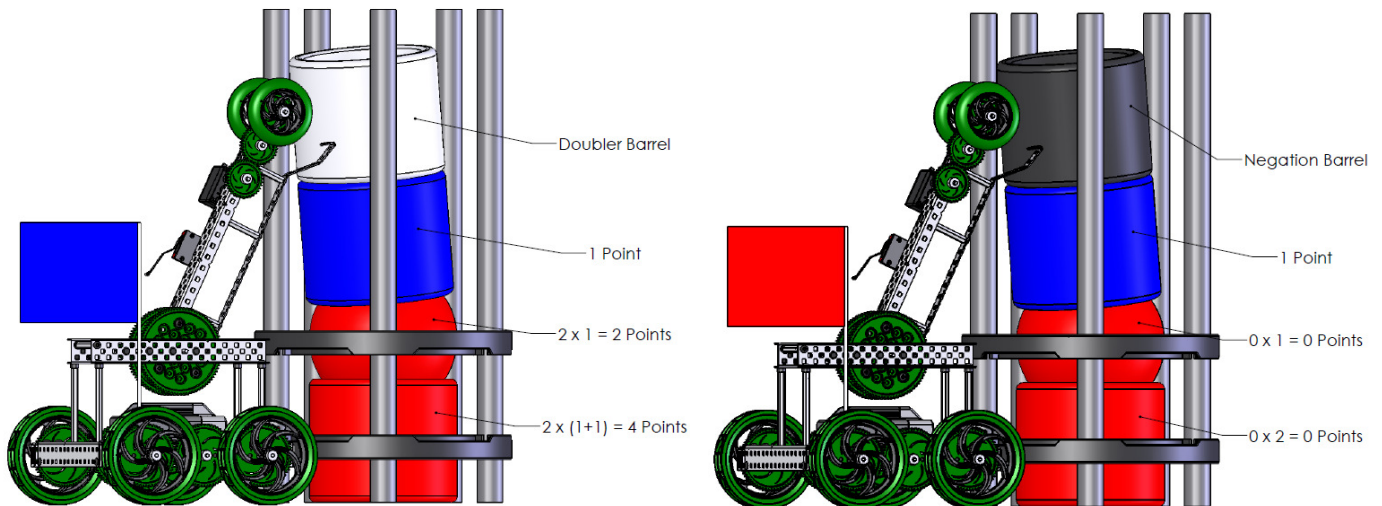


Figure 11:
Examples of legally preloaded Scoring Objects

<SG3> A Barrel or Ball is not considered scored if it is being touched by a robot on an alliance of the same color at the end of the Match.

- If a Robot is touching a Doubler Barrel at the end of the Match, the Doubler Barrel will only double the value of all points for the opposing Alliance in the Circular Goal. (See figure 12)
- If a Robot is touching a Negation Barrel at the end of the Match, the Negation Barrel will only cancel the value of all points for its own Alliance in the Circular Goal. (See figure 13)



Figures 12 & 13: Effects on Scoring of touching a Doubler or Negation Barrel

<SG4> A Robot cannot Pin an opposing Robot for more than five seconds during the Driver Controlled Period while on the foam playing surface. A Pin is officially over once the Pinning team has moved away from the pinned Robot by 2 feet (approximately one (1) foam tile). After ending a Pin, a team may not Pin 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.

<SG5> During the Autonomous Period, Drivers and Coaches may handle their own Robot while the Robot is in contact with their own Alliance Starting Tile. During contact with the Robot, the Drivers or Coaches may not intentionally manipulate or modify the position of any Scoring Objects (aside from any which are being loaded into the Robot), either by direct hand contact or indirect contact via the Robot. Drivers or Coaches also may not change the configuration of the Robot 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).

The intent of this rule is to allow teams to fix Robots that are unable to move, to load Match Loads into the Robot, 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.

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<SG6> 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*.

Note: During the handling specified in <SG5> And <SG6> robots may be repositioned, but must be returned to a valid starting position as per <SG1> within the same zone.

<SG7> Any *Scoring Objects* introduced during the *Match* must be either gently placed on a *Robot* of your own color touching an *Alliance Starting Tile* or gently placed on an *Alliance Starting Tile* of your own color. The intent of this rule is to allow teams to introduce objects into play, but not to impart energy on the *scoring object* which will cause it to end up in a *scored* position. Violations of this rule will result in warning for the first offense. Subsequent offenses or an egregious first offense will result in a *Disqualification*.

- *Match Loads* may be introduced by a *Driver* or *Coach* at any point during the *Match*. *Match Loads* may only be introduced in the *Interaction Zone*. Violations will result in a *Disqualification*.
- *Doubler Barrels* and *Negation Barrels* may only be introduced by a *Driver* or *Coach* during the last 30 seconds of the *Match*. *Doubler Barrels* may only be introduced in the *Interaction Zone*. *Negation Barrels* may only be introduced in the *Isolation zone*. Violations will result in a *Disqualification*.

<SG8> If a *Doubler Barrel* and a *Negation Barrel* are scored in the same *Circular Goal*, they each have no effect on the score. If more than one *Doubler Barrel* or *Negation Barrel* are scored in the same *Circular Goal* only the one closest to the foam field tiles will count.

<SG9> Robots are not permitted to alter the score of any *Scoring Object* that is *Scored* by clause 1 of the definition of *Scored*. Once an object is successfully scored under clause 1, a *Scoring Object's* value cannot be altered (i.e. the object cannot be descored, and moving this object cannot affect which alliance receives a bonus point) even if it no longer meets the clause 1 requirements. Violations of this rule will result in a *Disqualification*. (Note: Altering a *Scoring Object's* value does not include the use of a *Doubler* or *Negation Barrel*). (See figure 14)

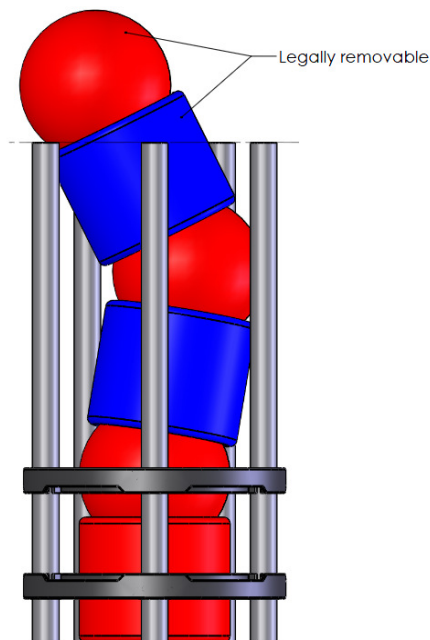


Figure 14: Examples of *Scoring Objects* which can and cannot be legally removed from a goal

<SG10> *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* losing their *Doubler Barrel* and *Negation Barrel*.

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<SG11> *Drivers or Coaches* may lift their own *Gate* at any time during the *Match*. Once lifting of the *Gate* had begun it must be finished promptly and the *Gate* cannot be dropped. Both *Gates* must be lifted and latched before thirty (30) seconds are remaining in the *Match*. Violations of this rule will result in a *Disqualification* of both teams on the offending *Alliance*.

<SG12> *Robots* may not interact with the *Gate* for more than five (5) seconds or after there are thirty-five (35) seconds remaining in the *Match*. *Robots* may not interfere with the raising of the *Gate*, nor may they lift the *Gate*. Violations of this rule will result in a *Disqualification*.

<SG13> Teams are not permitted to lift their *Gate* when an opposing *Robot* is legally interacting with their *Gate*. Violations of this rule will result in a *Disqualification* of both teams on the offending *Alliance*.

<SG14> *Robots* may not enter or exit an *Isolation Zone* (i.e. intentionally touching the foam field tiles in the new zone) while the *Gate* associated with that *Isolation Zone* is down. Simply breaking the plane of the new zone is legal. Violations of this rule will result in a *Disqualification*.

<SG15> Team members may not enter the playing field until the head referee has given the "all clear" signal and both *Gates* are down. Violations of this rule will result in a *Disqualification*.



3

SECTION

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

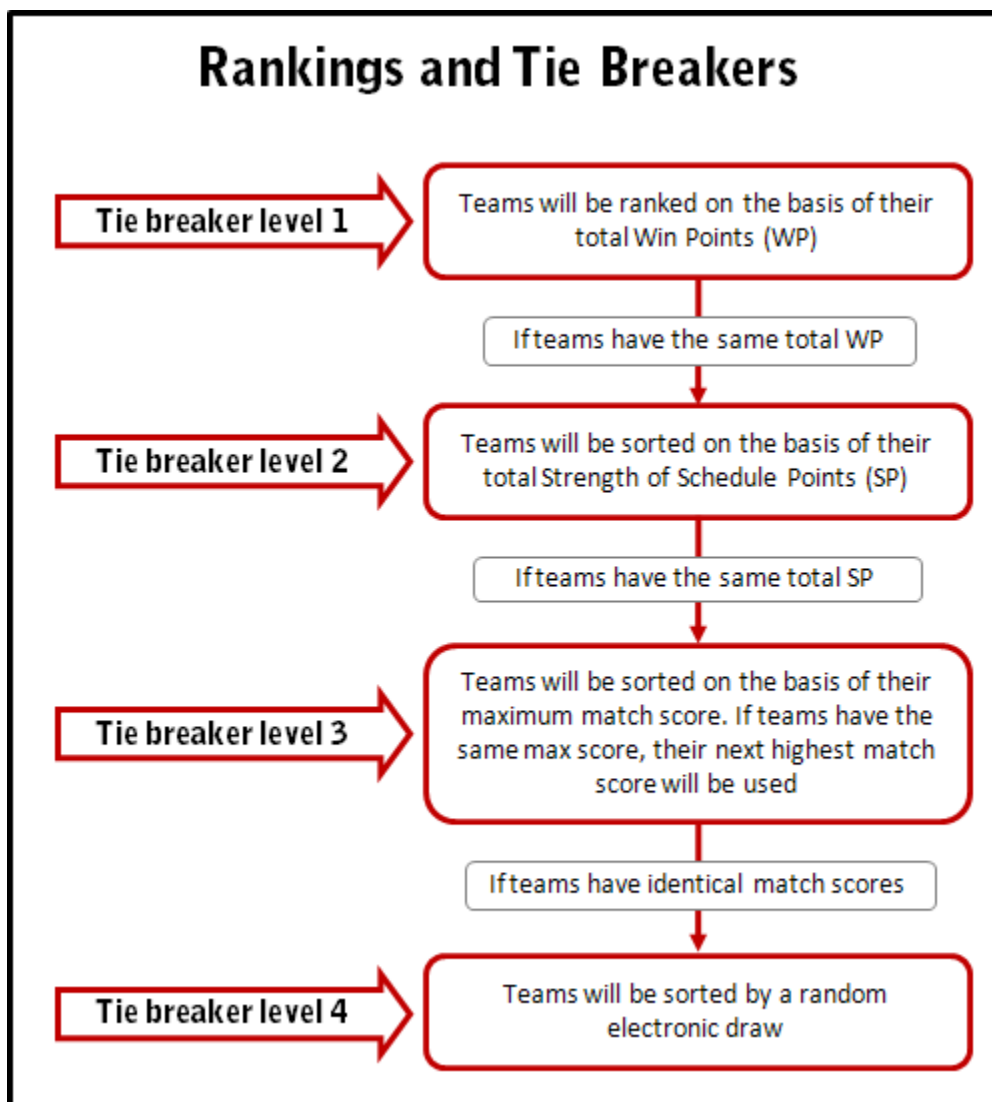
- The *Qualifying Match* schedule will be available prior to opening ceremonies on the day of competition. This schedule will indicate alliance partners and match pairings. It will also indicate the alliance's color – red or blue. For tournaments with multiple fields, the schedule will also indicate 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*.



Elimination Matches

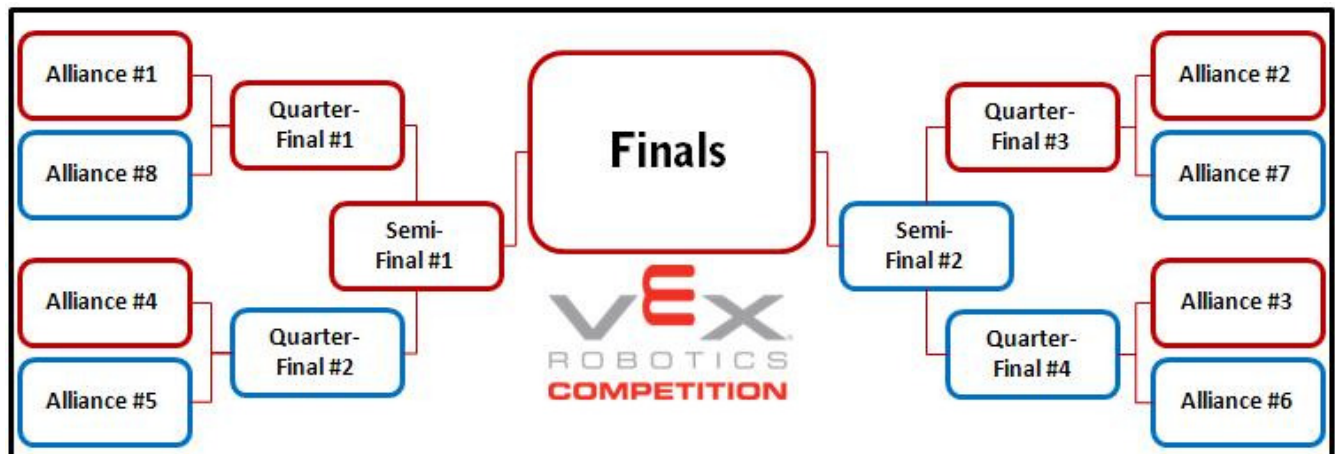
- The *Alliance Selection* process will consist of two rounds of selection, such that eight alliance captains will form elimination alliances consisting of three teams.
- These eight alliances will participate in a tournament to determine the event champions.
- If a team is *Disqualified* during an *Elimination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



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.

Event Modifications

Small 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, $19/3 = 6.33 \rightarrow 6$ 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, $13/2 = 6.5 \rightarrow 6$ 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.)

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 up to 36". 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.

4

SECTION

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 Gateway*. 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/275-1455.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, 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>

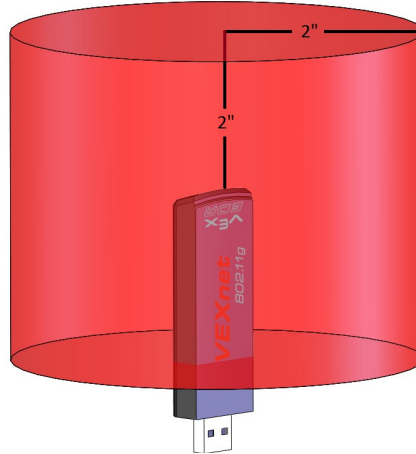
<R6> Official VEX products are ONLY available from VEX & Official VEX Resellers. To determine whether a product is "official" or not, consult www.VEXrobotics.com.

<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 6-32, 8-32, 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 "non-functional".
 - i. Any decoration which interacts with a game piece (even a painted surface) would be considered functional, hence illegal
- e. Any non-aerosol based grease, 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. Polycarbonate as cut from a single 12" x 24" sheet up to 0.0625" thick. (Please note that polycarbonate is different from acrylic sheet, which is not legal. Polycarbonate is sold under trade names such as Lexan® and Makrolon®.)
 - i. Polycarbonate can be mechanically altered by cutting, drilling or bending etc., but **it cannot be chemically treated, melted or molded**. Teams may heat the polycarbonate to aid in bending.
- 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) PWM 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.

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- h. 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. No metal may be within 2" of the top of the VEXnet key.



Space restrictions on the remote mounting of VEXnet keys.

<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 Gateway" 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. Of these ten (10) allowed motors, teams may use a maximum of four (4) "2-Wire Motor 393" modules.
- b. 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.
- c. 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.

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<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.

<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 electrical or mechanical modifications of VEX Limit and Bumper switches are permitted
- 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
- c. External wires on VEX electrical components may become damaged during use. These wires may be repaired using soldering or twist/crimp connectors such that the original functionality / length is not modified or enhanced in any way. These repairs may be covered by up to 1" of insulating tape, or heat shrink tubing as long as this covering is not used for other functional gain. 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.**

<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> 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.)

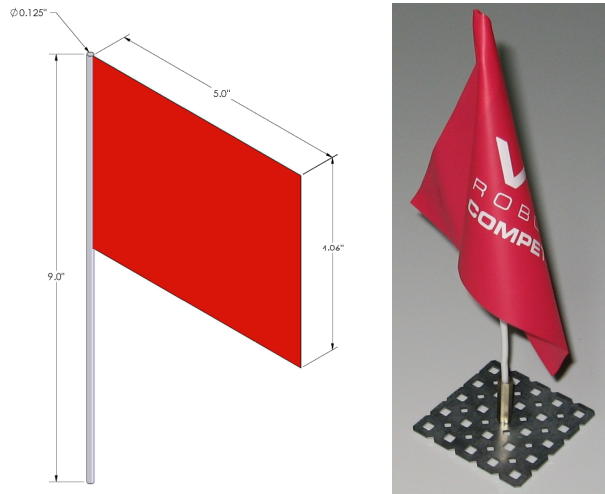
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<R19> Robots must include a mounting device to securely hold one VEX Robot Identification Flag throughout an entire match.

- 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.)

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.



<R20> 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.