VHSRobotics.org

Copyright 2017, 5509A-VHS Crusaders
2017/01/11

Table of Contents

Section 1 – Introduction.....1
Section 2 –The Game.....3
Section 3 – The Tournament.....11
Section 4 – The Robot.....18

Copyright 2017, 5509A-VHS Crusaders
2017/01/11

Section 1 – Introduction

Overview

This section provides an introduction to the VEX Robotics Competion and *VEX Robotics Competition Game Animation Challenge SPIKED*.

The VEX Robotics Competition

Engineering has the highest median earnings, yet less than 20% of high school graduates choose a STEM path. *SPIKED* is a *VEX Robotics Competition* in need of students to create, build, and be unique. People that can achieve these qualities are very important to the system. This community is known for bringing people together quite frequently in order for them to problem solve in a fun and mature fashion.

We believe this is the absolute perfect way for people to get more involved in engineering. This generation is in desperate need of creativity and we think children are more than capable of that. The problem is expressing engineering to them in an appealing way. So how do we make it sound more appealing? Easy! Build a robot and participate in competitions to achieve a fun, common goal! When children of all ages hear this and decide to try something like this out they don't even realize what they're learning. This competition covers various subjects such as Technology, Engineering, Science and Math. Due to these countless possibilities available to people like ourselves, we need to find a way to get it out there.

Robotics includes physics, mathematics, computer programming, digital prototyping and design, integrated problem solving, and teamwork and leadership all in one competition and with one goal. The number of students associated with the STEM (Science, Technology, Engineering, and Math) curriculum are growing and these future scientists and engineers are thriving and giving us hope for the next generation. VEX Robotics inspires thousands every year, and keeps them motivated to keep learning and keep pushing our world towards success.

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

For more information on the Robotics Education and Competition Foundation visit www.roboticseducation.org. Follow us on Twitter @REC_Foundation. Like us on Facebook at www.facebook.com/RECFoundation

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

Copyright 2017, 5509A-VHS Crusaders

VEX Robotics Competition SPIKED: A Primer

VEX Robotics Competition SPIKED is played on a 12 ft x 12 ft foam-mat, surrounded by a sheetmetal and lexan perimeter. In total, 20 foam *Sea Urchins* are scattered across the field, 8 regular positive scoring, 8 regular negative scoring, 2 x2 points positive scoring, and 2 -x2 points negative scoring. Six Towers are set up on the field, three spread in the middle of the blue alliance field, and three spread in the middle of the red alliance field. There are three openings on each face of each tower, the top scoring 3 points for a regular Sea Urchin, the middle scoring 2 points for a regular Sea Urchin, the bottom scoring 1 point for a regular Sea Urchin. There are two Platforms, one on each alliance's side of the field. They are on the Hanging Poles, but they are outside and level with the Field Perimeter. Teams also score points by hanging at various heights on the Hanging Poles.

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

Not only will these competitors enjoy the competition aspect, but they'll also grow an appreciation for science, technology, engineering, and math and aspire to use those skills to better the world. Throughout this robotics challenge, students will learn the aspects of STEM throughout independent work and work as a team. In addition, they cultivate life skills such as planning, brainstorming, collaboration, teamwork, and leadership as well as research and technical skills.

Copyright 2017, 5509A-VHS Crusaders

Section 2 –The Game

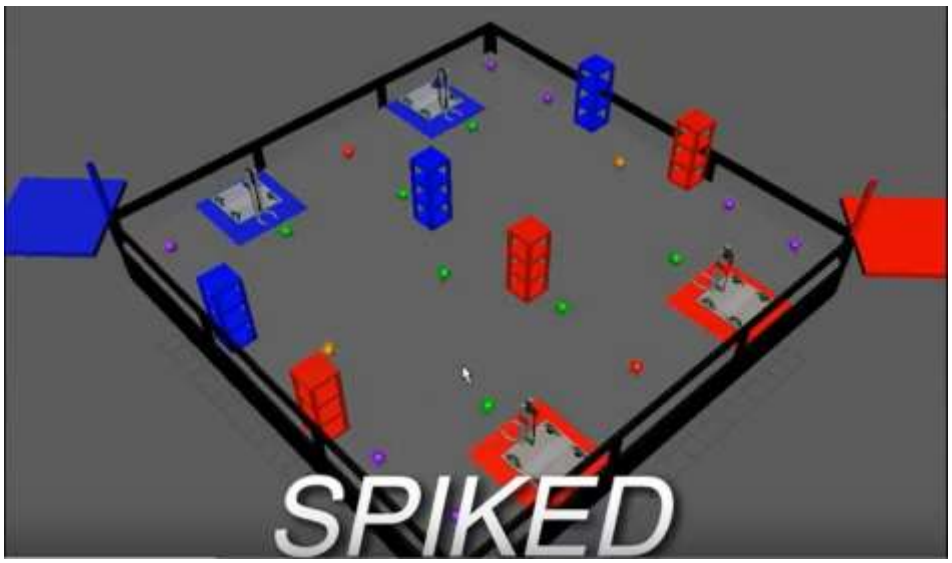
Overview

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

Game Description

Matches are played on a field set up as illustrated in the figure 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 positive *Sea Urchins* into your *Towers*, scoring negative *Sea Urchins* into the opposing *Alliance*'s *Towers*, or removing positive scoring *Sea Urchins* from the opposing *Alliance*'s *Towers* and negative *Sea Urchins* from your *Alliance Towers*. Also you can earn points by *Hanging Robots* on your *Hanging Bar*.

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



There are a total of twenty (20) *Sea Urchins*, eight (8) regular positive scoring *Sea Urchins*, eight (8) regular negative scoring *Sea Urchins*, two (2) x2 positive scoring *Sea Urchins*, two (2) -x2 negative scoring *Sea Urchins*, in a *VEX Robotics Competition SPIKED Match*. Each *Alliance* has one (1) *Hanging Pole* from which one (1) *Robot* can *Hang*.

Copyright 2017, 5509A-VHS Crusaders

Game Definitions

Adult - Anyone above the age of 18 that is 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 tile is the 2′ color-coded square that the robots start on. The starting tiles are color coded for each alliance.

Alliance Station - The designated region where the *Drive Team Members* must remain during their Match.

Autonomous Bonus - Points awarded to the alliance that *Scores* the most points during the *Autonomous Period*.

Autonomous Period - A 15-second (0:15) time period at the start of the match when the *Robots* operate and react only to sensor inputs and to commands pre-programmed by the team into the onboard *Robot* control system.

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

Disqualification - A penalty applied to a team for a rules violation. A team that 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.

Drive Team Member - Any of the three (3) *Students* allowed in the *Alliance Station* during a *Match* for each team. Only *Student Drive Team Member*s are allowed to touch the controls at any time during the *Match*, interact with the *Robot* as per <SG2>, and interact with *Scoring Objects* as per <SG3>. *Adults* are not allowed to be *Drive Team Members*.

Driver Controlled Period - The one minute and forty-five second (1:45) time period when the *Student Drive Team Members* operate the *Robots*.

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

Field Perimeter - the field perimeter is a 12″ high fence surrounding the outside of the field.

Hanging Pole - The Red and Blue 30″ high, vertical PVC pipe, located in the corner of the playing field.

High lift - A *Robot* is considered to be high hanging is it has completed a medium lift and then swings around and lands on the platform (Only one *Alliance Robot* can earn points for Hanging during a match)

Copyright 2017, 5509A-VHS Crusaders

Low Lift - A *Robot* is considered to be low hanging if it is touching the *Hanging Pole* of its own color and not touching any of the foam tiles, but is below the field perimeter. (Only one *Alliance Robot* can earn points for *Hanging* during a match)

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

Medium lift - A *Robot* is considered to be medium hanging if it is touching the *Hanging Pole* of its color and completely above the infinite plane parallel to the foam tiles, formed by the top of the field perimeter. A *Robot* that is touching the field perimeter is not considered to be medium hanging. (A medium hanging robot does not also count as a low hanging robot. Only one *Alliance Robot* can earn points for *Hanging* during a match)

Platform - The platform that is level with the playing field, but is out of the field perimeter.

Preload – The four (4) Green *Sea Urchins*, one (1) for each team, that must be placed on the field such they are touching its *Robot*, not touching any grey foam tiles, and fully within the field perimeter prior to each *Match*.

Robot - Anything that has passed inspection that a team place on the field prior to the start of a *Match*.

Sea Urchins - A sea urchin is a foam spiked ball used to score or subtract points from either team. They are color-coded green, purple, orange, and red.

Student - Anyone enrolled in a pre-college school or home-schooled as part of a pre-college educational curriculum and is born after April 22nd, 1999. Eligibility may also be granted based on a disability that has delayed education by at least one year.

Tower - A tower is a 22″ tall 8″ by 8″ square tower with 6″ openings with 2″ borders that *Sea Urchins* can be scored into. These towers are color coded for each alliance.

Copyright 2017, 5509A-VHS Crusaders

Game Rules

Scoring

- A Green *Sea Urchin* scored into the bottom opening of a *Tower* is worth 1 point.
- A Green *Sea Urchin* scored into the middle opening of a *Tower* is worth 2 points.
- A Green *Sea Urchin* scored into the top opening of a *Tower* is worth 3 points.
- A Orange *Sea Urchin* scored into the bottom opening of a *Tower* is worth 2 points
- A Orange *Sea Urchin* scored into the middle opening of a *Tower* is worth 4 points
- A Orange *Sea Urchin* scored into the top opening of a *Tower* is worth 6 points
- A Purple *Sea Urchin* scored into the bottom opening of a *Tower* is worth -1 points.
- A Purple *Sea Urchin* scored into the middle opening of a *Tower* is worth -2 points.
- A Purple *Sea Urchin* scored into the top opening of a *Tower* is worth -3 points.
- A Red *Sea Urchin* scored into the bottom opening of a *Tower* is worth -2 points
- A Red *Sea Urchin* scored into the middle opening of a *Tower* is worth -4 points
- A Red *Sea Urchin* scored into the top opening of a *Tower* is worth -6 points
- A *Low Lift* is worth 4 points
- A *Medium Lift* is worth 8 points
- A *High Lift* is worth 12 points
- Winning the *Autonomous Period* scores your team 5 points to be calculated in with your final score at the end of the *Match*.

Safety rules

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

a. Teams should be extra cautious when interacting with *Sea Urchins*. Damage such as large scuffs and/or punctures can be ruled as a violation of <S1>.

Copyright 2017, 5509A-VHS Crusaders

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> A team shall include up to three *Drive Team Members*. No *Drive Team Member* may fulfill this role for more than one team at any given event

<G4> Only *Student Drive Team Members* may touch the team's controls and *Robot* at any time during a *Match*, and are the only *Drive Team Members* allowed to interact with the *Robot* as per <SG2>. *Adult Drive Team Members* are not permitted to touch the controls or interact with the *Robot*. Minor violations of this rule that do not affect the match will result in a warning. 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.

<G5> During a *Match*, the *Drive Team Members* must remain in their *Alliance Station*.

<G6> During the qualification rounds, the red *Alliance* has the right to place its *Robots* on the field last. During the elimination rounds, the higher seeded *Alliance* has the right to place its *Robots* on the field last. Once a team has placed its *Robot* on the field, its position cannot be readjusted prior to the match. *Robots* must be placed on the field promptly. A Team that violates this rule will have its robots randomly repositioned by the referees.

<G7> *Drive Team Members* are prohibited from making intentional contact with any *Scoring Object*, *Field Element* or *Robot* during a *Match*, with the exception of the contact specified in <SG2>. Minor violations of this rule that do not affect the *Match* will result in a warning. 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.

a. *Drive Team Members* are not permitted to break the plane of field perimeter at any time during the match, with the exception of the actions described in <SG2>.

<G8> During a *Match*, *Robots* may be operated only by the *Student Drive Team Members* and/or by software running in the on-board control system. During the *Autonomous Period* *Drive Team Members* are not permitted to interact with the *Robot*, the controls on their VEXnet Joysticks, or to unplug from the field, in any way, directly, or indirectly. (e.g. Triggering sensors without touching the *Robot* is still illegal) Minor violations of this rule that do not affect the match will result in a warning. 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.

<G9> It is expected that *Sea Urchins* may unintentionally leave the field during match play. *Sea Urchins* that leave the playing field will be returned to Zone from which they exited from (e.g. The Zone where the *Robot* was that launched it or last contacted it on its way out of the

Copyright 2017, 5509A-VHS Crusaders

field). Teams may not intentionally remove *Sea Urchins* from the field. We do expect *Sea Urchins* to leave the field accidently during *Scoring*, however doing so intentionally or repeatedly would be a violation of this rule. Minor violations of this rule that do not affect the *Match* will result in a warning. 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.

<G10> Scores will be calculated for all *Matches* immediately after the *Match* after all objects and *Robots* on the field come to rest.

<G11> *Robots* may not intentionally detach parts during any *Match*, or leave mechanisms on the field. Minor violations of this rule that do not affect the *Match* will result in a warning. 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. Multiple intentional infractions may result in *Disqualification* for the entire competition.

<G12> Strategies aimed solely at the destruction, damage, tipping over, disruption of *Hanging*, or *Entanglement* of *Robots* are not part of the ethos of the *VEX Robotics Competition* and are not allowed. However, *VEX Robotics Competition SPIKED* 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.

A team is responsible for the actions of its *Robot* at all times, including the *Autonomous Period*. This goes for teams that are driving recklessly and potentially causing damage, but also goes for teams that drive around with a small wheel base. A team should design its *Robot* such that it is not easily tipped over or damaged by minor contact.

<G13> *Robots* must be designed to permit easy removal of *Sea Urchins* from any mechanism without requiring the *Robot* to have power after a *Match*.

<G14> Field tolerances may vary by as much as ±1″, except where otherwise noted, so teams must design *Robots* accordingly. Please make sure to check Appendix A for more specific tolerances. Note: The Field perimeter should always be resting upon the Field Perimeter rubber feet, regardless of whether or not the tabs have been cut off the foam field tiles.

Copyright 2017, 5509A-VHS Crusaders

<G15> Replays are at the discretion of the event partner 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 stated intent of the rules.

<G17> All teams are expected to conduct themselves in a respectful and professional manner while competing in *VEX Robotics Competition* events. If a team or any of its members (students or any adults associated with the team) are disrespectful or uncivil to event staff, volunteers or fellow competitors, they may be *Disqualified* from a current or upcoming *Match*. 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 our lives in general.

VEX SPIKED Specific Game Rules

<SG1> At the beginning of each *Match*, each *Robot* must be placed such that it is touching one of its colored *Alliance Starting Tiles*, not touching any *Scoring Object* and not touching any other foam field tiles, or another *Robot*. No more than one (1) *Robot* may start the *Match* on any one (1) *Alliance Starting Tile*.

<SG2> During the *Driver Controlled Period*, *Student Drive Team Members* may handle their own *Robot* if no part of the robot has moved at all during the *Match*. The type of fixes that are allowed are limited to the following:

a. Turning the Robot on or off
b. Plugging in a battery and/or power expander
c. Plugging in a VEXnet Key
d. Turning the power expander on or off

Minor violations of this rule that do not affect the *Match* will result in a warning. 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.

<SG3> Intentional strategies causing an opponent to violate a rule are not permitted, and will not result in a foul on the opposing *Alliance*. Minor violations of this rule that do not affect the *Match* will result in a warning. 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.

Copyright 2017, 5509A-VHS Crusaders

<SG4> *Robots* may not intentionally grasp, grapple or attach to any *Field Elements* or the opposing *Hanging Bar*. Strategies with mechanisms that react against multiple sides of a field element in an effort to latch onto said *Field Element* are prohibited. The intent of this rule is to prevent teams from both unintentionally damaging the field, and from anchoring themselves to the field. Minor violations of this rule that do not affect the match will result in a warning. 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.

<SG5> Any fouls committed during the *Autonomous Period* that do not affect the final outcome of the *Match*, but do affect the outcome of the *Autonomous Bonus*, will result in the *Autonomous Bonus* being automatically awarded to the opposing *Alliance*.

<SG6> *Scoring Objects* that become split into multiple pieces can no longer be scored.

Copyright 2017, 5509A-VHS Crusaders

Section 3 – The Tournament

Overview

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

Tournament Definitions

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

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

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

Disqualification – A penalty applied to a team for a rules violation. When a team is disqualified in a *Qualifying Match* they receive zero (0) WP, AP, and SP. 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 (3) face off in a best two (2) of three (3) series, with two teams playing in each match. The first alliance to win two (2) 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*, *Autonomous Points*, and *Strength of Schedule Points*.

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

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

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

Copyright 2017, 5509A-VHS Crusaders

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

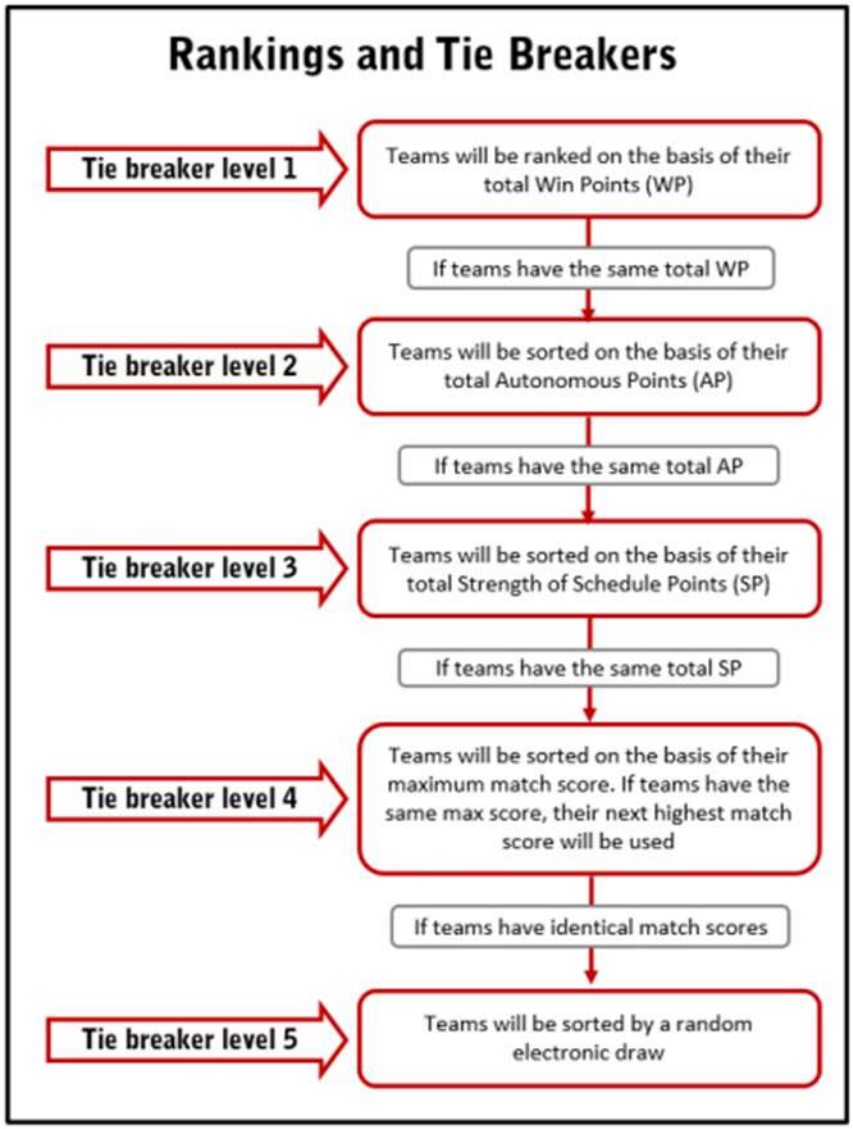
Schedule

- 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*.
- 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 *Autonomous Points (AP)*.
  - Teams who earn the *Autonomous Bonus* in a *Qualifying Match* receive four (4) *AP*
  - Teams who do not earn the *Autonomous Bonus* in a *Qualifying Match* receive zero (0) *AP*
  - If a team is *Disqualified* they receive zero (0) *AP*
- All teams in each *Qualifying Match* will also receive *Strength of Schedule Points (SP)*.
  - The number of *SP* assigned for each *Match,* is that of the losing alliance's score.
  - In the event of a tie, both alliances will receive the same *SP* (equal to the tie score).
  - If a team is *Disqualified* they receive zero (0) *SP*
  - If both teams on an alliance are *Disqualified*, the teams on the winning Alliance will be awarded their own score as their *SP* for that match.
- For a *Qualifying Match*, if no member of a team is present in the driver station at the start of a match, that team is declared a "no show" and will receive zero (0) *WP*, zero (0) *AP*, and zero (0) *SP*. A "no show" is treated exactly the same as a *Disqualification*.

Copyright 2017, 5509A-VHS Crusaders



Copyright 2017, 5509A-VHS Crusaders

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.

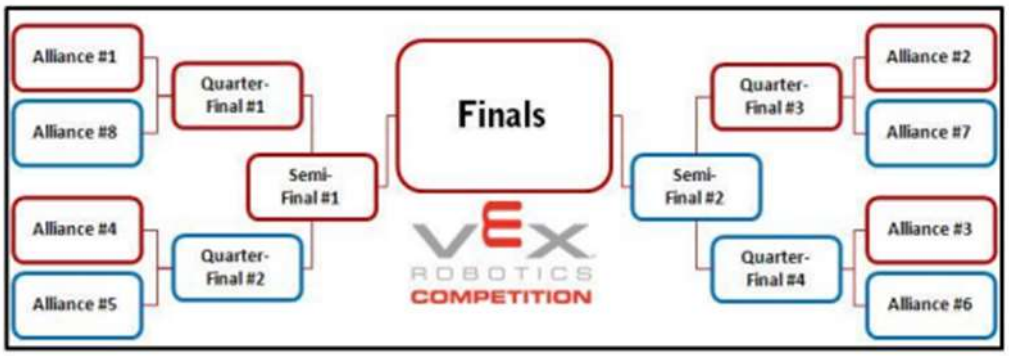
Alliance Selection Process

- Every team will choose a student to act as a *Team Representative*.
    - These Student Representative 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 *Team Representative* of the highest ranked team not already in an alliance will be asked to step forward as an *Alliance Captain* to invite another available team to join their alliance.
- A team is available if they are not already part of an alliance, or have not already declined an alliance invitation.
    - If the team accepts, it is moved into that alliance.
    - If a team declines an invitation, they CANNOT be invited into another alliance, but are still available to select their own alliance if the opportunity arises.
    - If a team declines, the *Alliance Captain* from the inviting team must then extend another invitation.
- This process will continue until all 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.

Copyright 2017, 5509A-VHS Crusaders

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.

Copyright 2017, 5509A-VHS Crusaders

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 *Drive Team Members* must wear safety glasses or glasses with side shields while in the *Alliance Stations* during matches. While in the pit area it is highly recommended that all team members wear safety glasses.

Event Modification

Small Tournaments (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:

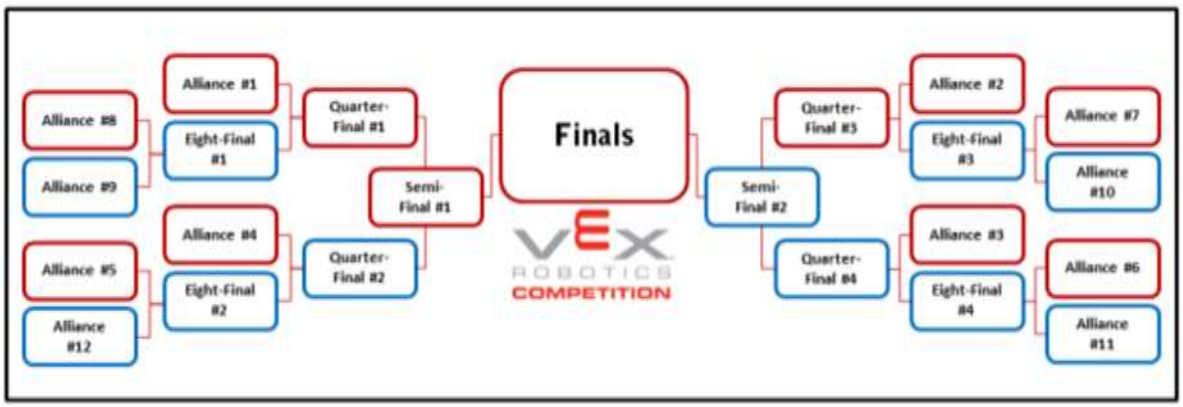
- If there are between 18 and 23 teams at a tournament
  - Alliances will still consist of three teams
  - The number of alliances will be equal to the amount of teams divided by three, less any remainder. [e.g. If there are 19 teams, 19/3 = 6.33 (6 picking teams)]
- If there are 17 or fewer teams
  - 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 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 8th ranked alliance. (i.e. Seeds 1-7 have 2 teams, while Seed 8 gets 3 teams)
- 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.)

Copyright 2017, 5509A-VHS Crusaders

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 2017 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.



Copyright 2017, 5509A-VHS Crusaders

Section 4 – The Robot

Overview

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

Robot Rules

There are specific rules and limitations that apply to the design and construction of your Robot. Please ensure that you are familiar with 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. As such, a VEX Robot, for the purposes of the *VEX Robotics Competition*, has the following subsystems:

Subsystem 1: Mobile robotic base including wheels, tracks, legs, or any other mechanism that allows the Robot to navigate the majority of the flat playing field surface. For a stationary Robot, the robotic base without wheels would be considered Subsystem 1.

Subsystem 2: Power and control system that includes a 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 *VEX Robotics Competition* event (including skills challenges) must consist of 1 and 2 above. Thus if you are swapping out an entire subsystem of either item 1 or 2, you have now created a second Robot and are no longer legal.

a. Teams may not compete with one robot, while a second is being modified or assembled.
b. Teams may not switch back and forth between multiple robots during a competition.

Copyright 2017, 5509A-VHS Crusaders

<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.

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

a. Those that could potentially damage playing field components.
b. Those that could potentially damage other competing Robots.
c. Those that pose an unnecessary risk of Entanglement.

<R4> At the beginning of any Match, Robots must be smaller than 18" 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 *VEX Robotics Competition* Robot Sizing Tool. Robots will be placed on a flat surface and must not touch the measurement slide as it is passed over the surface.
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.

Copyright 2017, 5509A-VHS Crusaders

<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, VEX IQ, or VEX Robotics by Hexbug product line cannot be used for Robot construction, unless specifically allowed by a clause of <R7>. Products from the VEXpro or VEX IQ, or VEX Robotics by Hexbug product line which are also cross listed as part of the VEX product line 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 and/or washer 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 *Sea Urchin* from falling out of the robot, the decal must be backed by VEX material that also prevents the *Sea Urchins* from falling out.

Copyright 2017, 5509A-VHS Crusaders

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.

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 VEX ARM® Cortex®-based Microcontroller. Using tape in this manner is highly recommended to ensure a robust connection.

h. Hot glue for securing cable connections

i. 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.
   i. 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.

j. An unlimited amount of 1/8″, braided, nylon rope

k. Commercially available items used solely for the purpose of bundling or wrapping of 2-wire, 3- wire, 4-wire cables, and pneumatic tubing, for the purposes of protection, organization, or management are allowed. This includes but is not limited to electrical tape, cable carrier, cable track, etc. Note: it is up to inspectors to determine whether a component is serving a function beyond protecting and managing cables.

l. VEX IQ pins used solely for the purpose of attaching VEX Team Identification Number Plates.

Copyright 2017, 5509A-VHS Crusaders

<R8> Additional VEX Robotics Design System Components that are released during the competition season are considered legal for use.

<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 ARM® Cortex®-based Microcontroller.
b. Microcontrollers that are part of other VEX product lines such as VEXpro, VEX RCR, VEX IQ, or VEX Robotics by Hexbug 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 VEXpro, VEX-RCR, VEX IQ, or VEX Robotics by Hexbug product line are prohibited including all VEXplorer electronics.
c. A VEXnet Joystick may only be used in conjunction with a VEX ARM® Cortex®-based Microcontroller. A VEXnet upgraded 75MHz Transmitter may only be used in conjunction with a PIC Microcontroller. Mixing and matching VEXnet transmitters and receivers is prohibited.

<R11> Robots may use either:

Option 1: Up to ten (10) VEX EDR motors or VEX Servos (Any combination, up to ten) and a legal VRC pneumatic system. (See <R18>)

Option 2: Up to twelve (12) VEX EDR motors or VEX Servos (Any combination, up to twelve) and no pneumatic components, excluding pneumatic tubing.

a. 2-Wire Motors must be controlled by a 2-Wire Motor Port, either directly on a VEX Microcontroller (P/N 276-2194), 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.

Copyright 2017, 5509A-VHS Crusaders

<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 VEX ARM® Cortex®-based 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.
e. The only legal means for charging a VEX 7.2V Battery Pack is via one of the following VEX Battery Chargers: Smart Charger, 276-1445; Smart Charger v2, 276-2519; 276-2221 (discontinued), 276-2235 (discontinued). All other chargers are strictly prohibited.
f. VEXnet Joysticks must only be powered by AAA batteries
    i. Some events may provide field power for VEXnet Joysticks. If this is provided for all teams at the event, this is a legal source of power for VEXnet Joysticks.

<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.

Copyright 2017, 5509A-VHS Crusaders

<R15> Parts may NOT be modified as follows:

a. Motors (including the internal PTC), extension cords, sensors, controllers, battery packs, reservoirs, solenoids, pistons and any other electrical component or pneumatics component of the VEX Robotics Design System may NOT be altered from their original state in ANY way.
    i. Internal or external mechanical repairs of VEX Limit and Bumper switches are permitted; using components from these devices in other applications is prohibited
    ii. 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.
    iii. Teams may change or replace the gears in the "2-Wire 393" or "2-Wire 269" motors, with the corresponding official VEX Replacement Gears
    iv. Teams may cut pneumatic tubing to a desired length
b. Welding, soldering, brazing, gluing, or attaching in any way that is not provided within the VEX Robotics Design System will NOT be allowed.
    i. Mechanical fasteners may be secured using Loctite or a similar thread-locking product; this may be used for securing hardware ONLY.
    ii. Teams are permitted to fuse/melt the end of the 1/8" nylon rope to prevent fraying
    iii. The gluing permitted <R7h> by 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.

Copyright 2017, 5509A-VHS Crusaders

<R18> Pneumatic devices may only be charged to a maximum of 100 psi. Teams may only use a maximum of two (2) legal VEX pneumatic air reservoirs on a Robot.

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

<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 , they cannot cause entanglement, etc.)
c. Robots must use the colored plates that match their alliance color for each match. (i.e. Robots on the red alliance must have their red plates on for the match) It must be abundantly clear which color alliance the Robot belongs to.

<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.

<R21> Any violation of robot rules will result in a team being unable to play until they pass inspection (per <R2d>). In addition, teams who intentionally circumvent or violate rules to gain an advantage over their fellow competitors are in violation of the spirit and ethos of the competition. As such, anyone caught violating a rule in this manner may be Disqualified from upcoming Matches, the event, or even future events at the discretion of the *VEX Robotics Competition* Game Design Committee.

Copyright 2017, 5509A-VHS Crusaders

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 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.

Copyright 2017, 5509A-VHS Crusaders