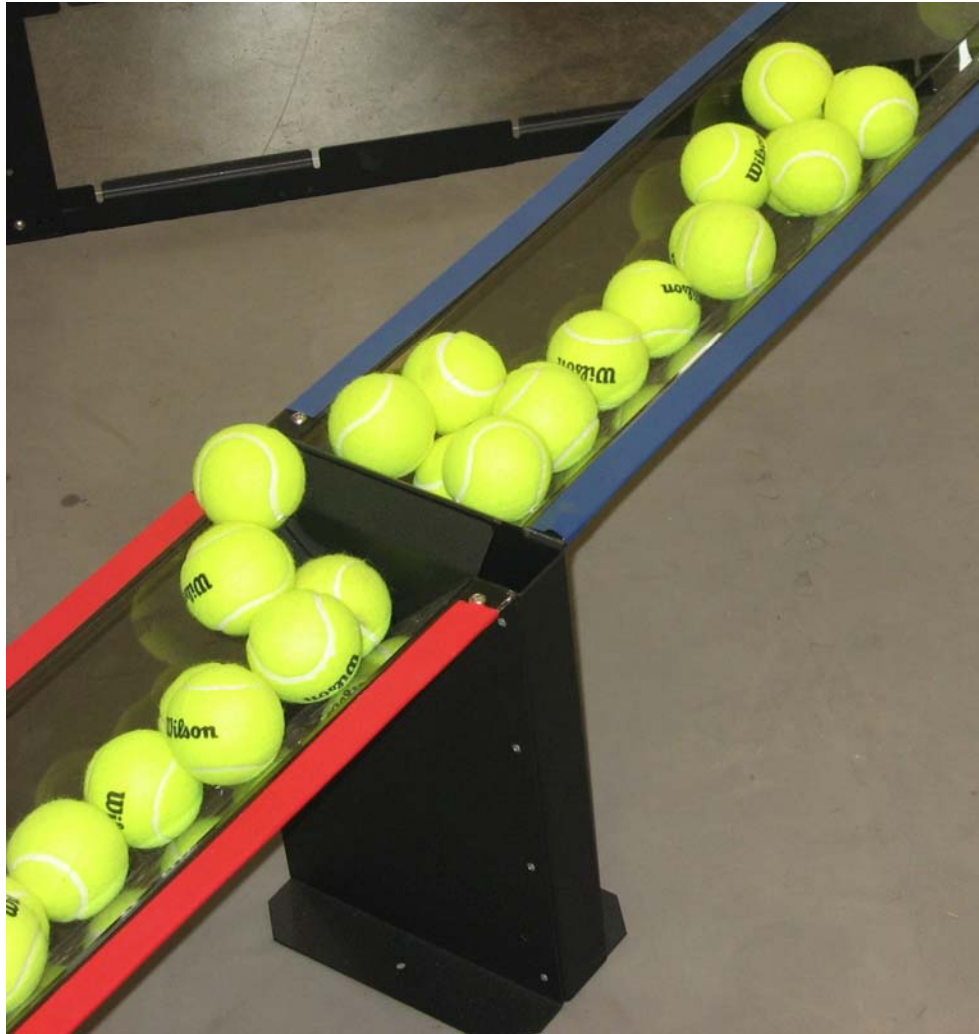


Bridge Battle



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Section
1



Introduction

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Section 1 – Introduction

1.1 – Overview

This section provides an introduction to Vex, and the origins of the Bridge Battle Challenge.

1.2 – Moving Forward

In the history of the world, there has never been an age with a greater need for new scientists and engineers. Recent breakthroughs in chemistry, medicine, materials and physics have revealed a new set of challenges and created even greater opportunity for problem solving through technology. This underscores a dramatic challenge: there are not enough high school graduates choosing engineering majors 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.

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, design, integrated problem solving, teamwork and thought leadership. Students with a previously undiscovered aptitude for STEM (Science, Technology, Engineering, and Math) curriculum are finding themselves in greater numbers due to the efforts of schools, volunteer organizations, corporations, and governments internationally.

The *Bridge Battle* robotics challenge was developed at the request of the organizers of the upstart Asian Robotics League consisting of teams from China, Hong Kong, Singapore, Taiwan, Japan and Korea. The challenge will debut at their inaugural event to be held in Seoul, Korea in October 2007 and centers around robots built with the popular Vex Robotics Design System.

Designed by Innovation First, Inc., a leader in educational and competitive robotics products, *Bridge Battle* is available for free use by any organization with the time, energy and resources to organize a robotics event of any scale. While there are many existing quality robotics competitions worldwide, the Vex Robotics user community has overwhelmingly demanded new challenges that are easy and economical to host and implement. It is IFI's strong desire to serve the needs of all Vex Robotics users in order to attract, nurture and grow new engineering candidates worldwide.

1.3 – Bridge Battle – A Primer

Bridge Battle is an exciting and dynamic challenge which will provide teams with a high paced challenge for the duration of each two minute and twenty second match. Each game match consists of two distinct types of play – operator-controlled and autonomous. Each tournament features alliances of two teams playing from opposite sides of the playing field. Teams will compete to score the most points by completing various tasks including, lifting tennis balls and placing them in troughs and navigating themselves onto one of the scoring platforms.

While participating in the *Bridge Battle* 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, leadership as well as research and technical skills.

Section 2



The Game

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Section 2 – The Game

2.1 – Overview

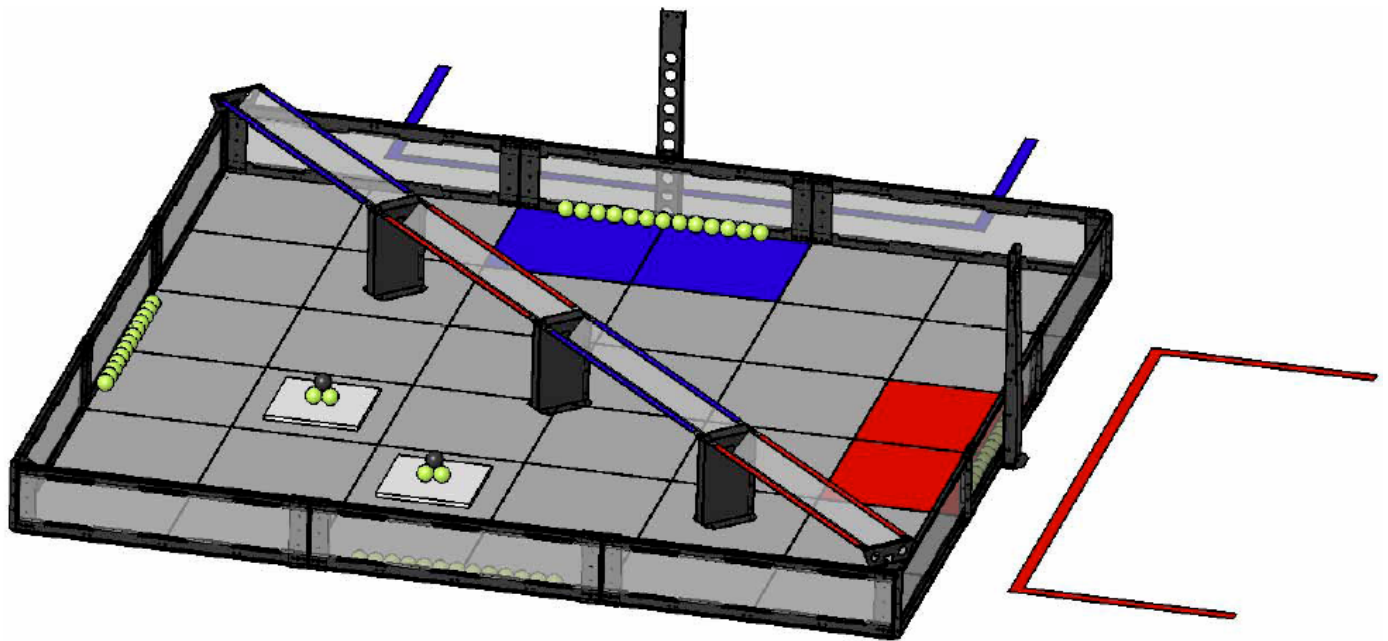
This section describes the Vex Robotics Competition game, called *Bridge Battle*. It also lists the game definitions and game rules.

2.2 – 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 placing *tennis balls* into your colored *goals* and by being *parked* on a *platform*.

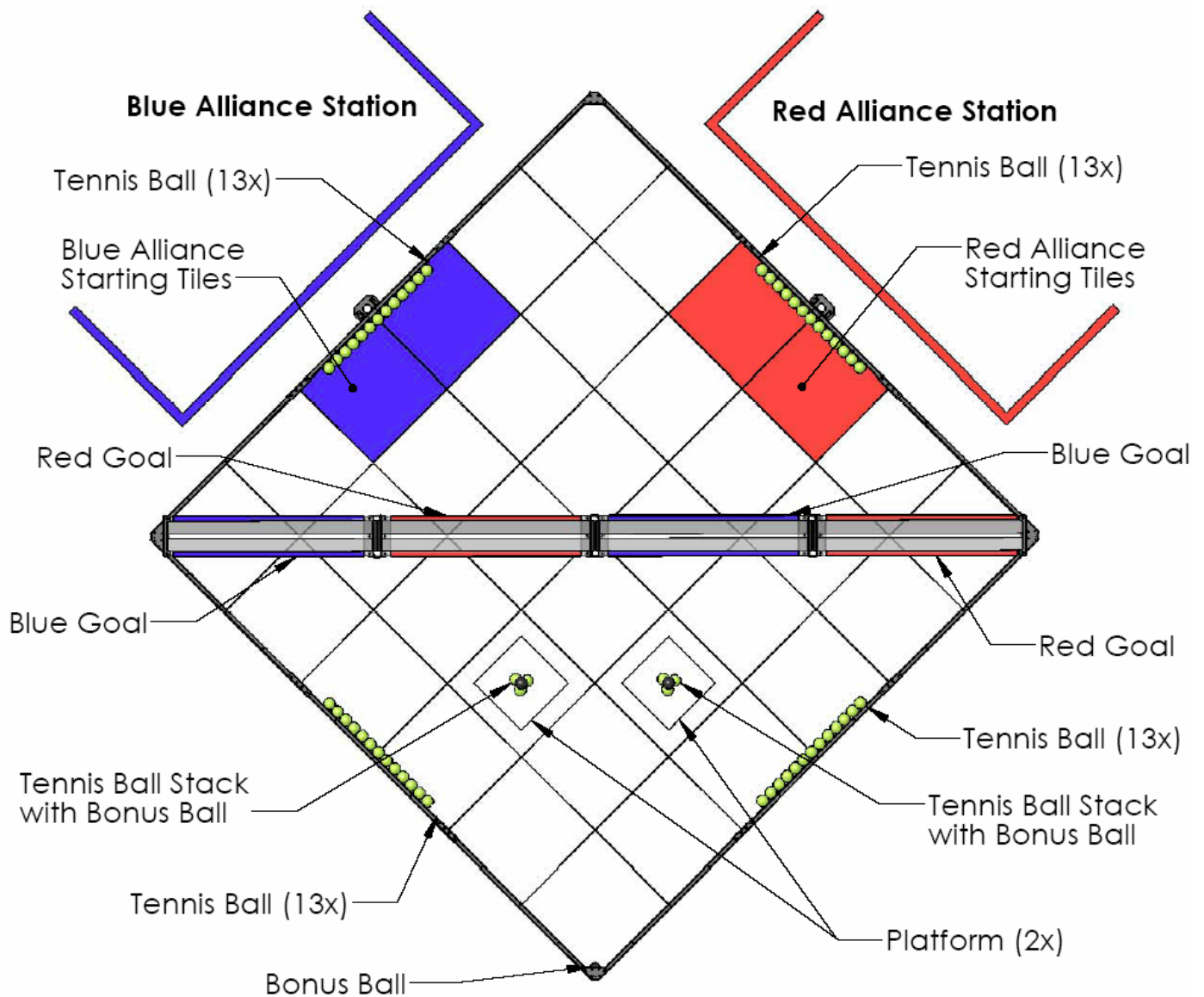
A bonus is awarded to the *alliance* that has the most total points at the end of the *Autonomous Period*.

There are a total of seventy-seven (77) *tennis balls* available as scoring objects in the game. Sixty-one (61) of these *tennis balls* will be found on the field, while eight (8) will be available to each *alliance* prior to the *match*. Three (3) of the sixty-one *tennis balls* on the field are *bonus balls*.



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 drawings available in appendix 3 & appendix 4 for exact field dimensions, a full field BOM and exact details of field construction.





2.3 – Game Definitions

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

Alliance Station – The designated region where the *drivers* and *coach* stand during any *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 control of the *robot* is not permitted during this time.

Bonus Ball – A black tennis ball.

Coach - A student or adult mentor designated as the team advisor during the match and identified as the person wearing a “*coach*” badge.

Driver - A student team member responsible for operating and controlling the *Robot* and wearing a “*Driver*” badge.

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

Goal – One of the four 14.5” tall, rectangular bin shaped field structures (two designated red, two designated blue) into which teams can score *tennis balls*.

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).

Parked – A robot is considered to be *parked* when it is in contact with the platform, and no part of the *robot* is in contact with the foam playing surface.

Platform – One of the two 15” squares located on the audience side of the playing field.

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

Scored – A *tennis ball* is *scored* in a *goal* if some part of the *ball* is within the two-dimensional space defined by the edges of the *goal*, and not touching a *robot* of the same *alliance*.

Note: A *goal* extends infinitely perpendicular to the playing field surface within the *goal* boundaries.

Tennis Ball – A standard regulation tennis ball that is located in rows around the perimeter of the playing field, and in stacks on the *platforms*.

2.4 – Game Rules

2.4.1 – Scoring

- A *tennis ball* that is *scored* in a *goal* is worth one (1) point for the *alliance* that the *goal* is designated for.
- A *bonus ball* that is *scored* in a *goal* is worth five (5) points for the *alliance* that the *high goal* is designated for.
- A *robot* that is *parked* at the end of the *match* is worth five (5) points for the corresponding *alliance*.

2.4.2 – Scoring in Autonomous Mode

- At the end of the *autonomous period*, the *alliance* that has more total points receives a five (5) point bonus.

2.4.3 – Safety Rules

<S1> If at any time the *robot* operation is deemed unsafe or has damaged the playing field, surface, or barriers, by the determination of the referees, the offending team may be disqualified. The *robot* will require re-inspection before it may again take the field.

<S2> If a *robot* goes completely out-of-bounds (outside the playing field), it will be disabled for the remainder of the match.

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

2.4.4 – General Game Rules

<G1> At the beginning of a *match*, each *robot* must not exceed 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.

- a. Alignment devices (templates, tape measures, lasers, etc.) that are not part of the *robot* may NOT be used to assist with the positioning of the *robot*.
- <G2> Each team shall include up to two *drivers* and one *coach*.
- <G3> During a *match*, the *drivers* and *coach* must remain in their *alliance station*.
- <G4> *Balls* that leave the playing field are considered out of play. These *balls* will not be returned to the field.
- <G5> *Drivers* and *coaches* are prohibited from making intentional contact with any game or field object. The first instance of intentional contact will result in a warning, with any following instances resulting in a disqualification.
- <G6> 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.
- <G7> Scores will be calculated for all *matches* either immediately after the *match* or when all objects on the field come to rest.
- <G8> *Robots* may not intentionally detach parts during any *match*, or leave mechanisms on the field. If a detached component or mechanism prevents scoring, the team will be disqualified. Multiple infractions may result in disqualification for the entire competition.
- <G9> Strategies aimed solely at the destruction, damage, tipping over, or entanglement of *robots* are not in the spirit of the Vex Robotics Competition and are not allowed. However, *Bridge Battle* is a highly interactive contact game. Some tipping, entanglement, and damage may occur as a part of normal game play. If the tipping, entanglement, or damage is ruled to be intentional, the offending team may be disqualified from that *match*. Repeated offenses could result in a team being disqualified from the remainder of the competition.
- <G10> *Robots* must be designed to permit easy removal of *balls* from any grasping mechanism without requiring that the *robot* have power after the *match*.
- <G11> Field tolerances may vary by as much as +/-1", so teams must design their *robots* accordingly.
- <G12> A *robot* cannot pin (inhibit the movement of an opposing *robot* while in contact with one or more field elements) an opposing *robot* for more than five seconds. If a referee determines this rule to be violated, the offending *robot* will be disabled for the match.

2.4.5 – Bridge Battle Specific Game Rules

- <SG1> At the beginning of each *match*, the two *alliance robots* must be placed such that they are touching one of the colored alliance station tiles for their alliance.
- <SG2> Prior to the start of each *match*, each team will have four (4) *tennis balls* available to preload into their robot.
- a. A *tennis ball* is considered to be legally preloaded if it is touching the *robot* and not touching any part of the playing field or game objects.
 - b. Any *tennis balls* a team chooses not to preload are removed from play and not available during the match.
- <SG3> A *tennis ball* is not considered *scored* if it is being touched by a *robot* on an *alliance* of the same color at the conclusion of either period.

Section 3



The Tournament

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Section 3 – The Tournament

3.1 – Overview

The Vex Challenge 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 event champions.

3.2 – 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*.

Crystal Assignment – The designated radio frequency crystal that a team will use for a given match. These crystals will be provided to teams before each 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 *Qualifying Points* and *Ranking Points*.

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

Ranking Points (RPs) – The second basis of ranking teams. *Ranking points* are awarded in the amount of the score of the losing alliance in a *Qualifying Match*.

3.3 – Practice Matches

At the event *Practice matches* will 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 will be conducted on a first-come, first-served basis. These matches are not scored, and will not affect team ranking.

3.4 – Qualifying Matches

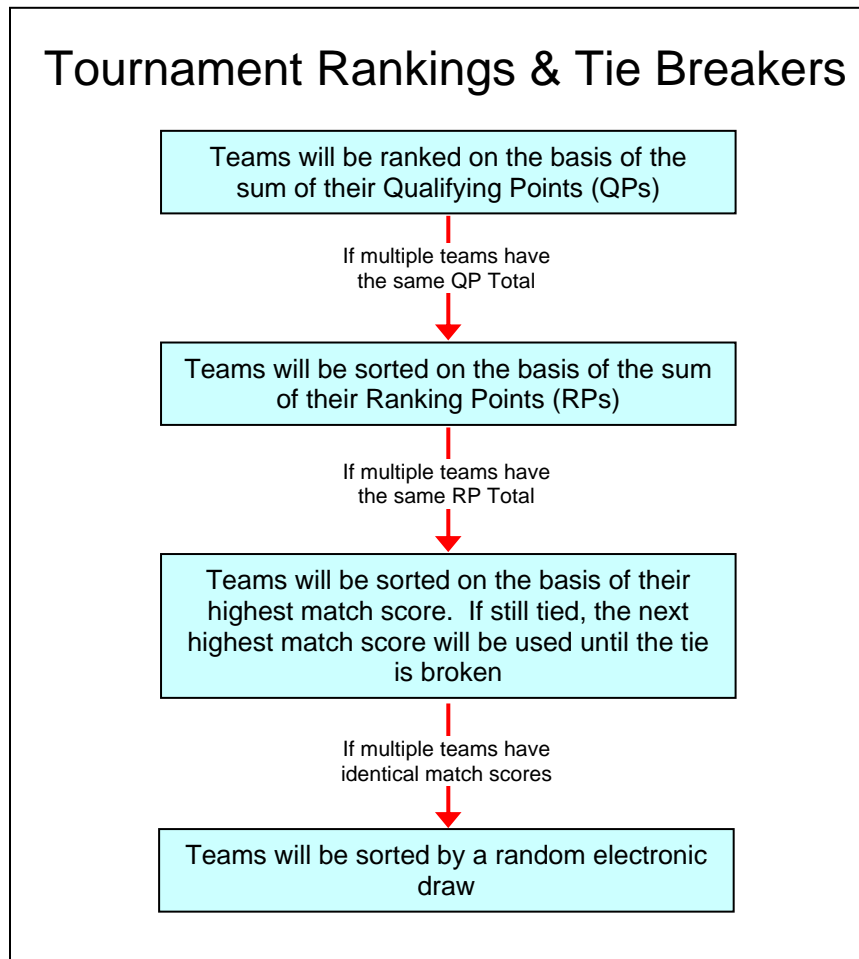
3.4.1 – Schedule

- 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 – and your team's starting position for each match. This starting position is used to determine the placement of each team within the alliance station, as well as your *crystal assignment*.
- 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.

3.4.2 – Rankings

- At the conclusion of each match, *Qualifying Points (QP)* will be issued:
 - Winning teams of a *qualifying match* receive two (2) *QP*
 - Losing teams of a *qualifying match* receive zero (0) *QP*
 - If a *qualifying match* ends in a tie, all four teams receive one (1) *QP*
 - If a team is disqualified they receive zero (0) *QP*
- All teams in each *Qualifying Match* will also receive *Ranking Points (RP)*.
 - The number of ranking points assigned for each match, is that of the losing alliance's score.
 - In the event of a tie, both alliances will receive the same *RP* (equal to the tie score).
 - If a team is disqualified they receive zero (0) *RP*
 - If both teams on an alliance are disqualified, the teams on the winning Alliance will be awarded their own score as their *RP* 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) *QP* and zero (0) *RP*.



3.5 – 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.

3.5.1 – 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. Any teams remaining after alliance eight makes their second choice will not compete in the *Elimination Matches*.
- 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.** Teams should consider the robustness of the robots when picking alliance partners.
- Prior to each *elimination match*, the *alliance captain* must let the referee know which two teams will playing in the upcoming match

3.5.2 – Match Ladder

The *elimination matches* will play in a ladder format as shown on the right.

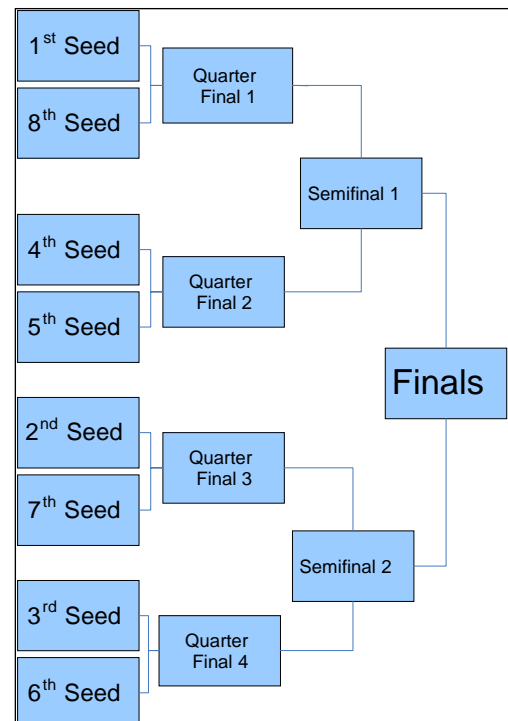
3.5.3 – Elimination Scoring

In the elimination rounds, teams do not get *qualifying 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.

3.6 – 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) matches.

<T02> The only people permitted by the playing field are the three drive team members who are identified by the drive team badges. These badges are interchangeable.

<T03> 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. 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.

<T04> All team members, including coaches, must wear safety glasses or glasses with side shields while in the pit or alliance stations during matches.

3.7 – Small Tournament Structure

In the case that a tournament has less than 24 teams (the requisite amount to have eight full alliances), the tournaments will be played with one of the following structures.

- If there are less than 24 teams, but more than 16 teams
 - Alliances will still consist of three teams
 - The number of picking teams in the alliance selection 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)
 - 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.)
- If there are less than 17 teams
 - Alliances will consist of two teams
 - The number of picking teams in the alliance selection 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)
 - 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.)

Section
4



The Robot

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Section 4 – The Robot

4.1 – Overview

This chapter provides rules and requirements for the design and construction of your robot. A Vex Challenge robot is a remotely operated vehicle designed and built by a registered Vex Challenge student team to perform specific tasks when competing in *Bridge Battle*. Prior to competing at each event, all robots will have to pass an inspection. Refer to Appendix 1 for the Robot Inspection Guidelines and the Inspection Checklist.

4.2 – 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 robot will be allowed to compete per team in the Vex Challenge. Though it is expected that teams will make changes to their *robot* at the competition, a team is limited to only ONE robot.
- It is against the intent of this rule to compete with one robot, while a second is being modified or assembled.
 - It is against the intent of this rule to 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.
- If significant changes are made to a robot, it must be re-inspected before it will be allowed to compete.
 - All robot configurations must be inspected before being used in competition.
 - Teams may be requested to submit to random spot-inspections by event personnel. Refusal to submit will result in disqualification.
 - 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 1, Robot Inspection Guidelines

- <R3>** The following types of mechanisms and components are NOT allowed:
- Those that could potentially damage playing field components.
 - Those that could potentially damage other competing robots.
 - Those that pose an unnecessary risk of entanglement.
- <R4>** At the beginning of any match, the maximum allowed size of a robot is 18" x 18" x 18".
- During inspections, 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 exerting ANY force on the box walls or ceiling (i.e., if the robot cannot be held inside the constraints by the box itself).
 - Robots may expand beyond their starting size constraints after the start of a match.
 - Any restraints used to maintain starting size (i.e. zip ties, rubber bands, string, etc.) MUST remain attached to the robot for the duration of the match.

- <R5>** Robot construction is constrained to the following:
- Any Official Vex Component may be used (except as limited below).
 - Only one (1) Vex Microcontroller
 - Up to two (2) Vex Y-Cables

- Up to ten (10) Motors or Servos (Any combination, up to ten)
- Only one (1) Battery Pack from the Vex Power Pack (Vex P/N: 230-0036)
- Up to two (2) RF receivers
- Electrical components found in the Vex-RC “Blue” product line are prohibited
- The packaging, manual binders, Styrofoam, cardboard, plastic bags, etc. from the Vex kits are NOT included and CANNOT be used for robot construction. Only the Vex parts themselves are allowed.

Note: Official Vex products are ONLY available from Vex & Official Vex Resellers. Products on the VexLABS.com web site will denote what is available for use in this competition, not all products may apply. Products identical to those listed as competition legal on the www.vexrobotics.com site are also considered “official Vex products”.

- b. The following additional components may also be used:
 - Ten (10) elastic bands, #32 size only
 - 40” of 1/8” Nylon Rope
 - 6” of 3/4” Wide Velcro
 - 12” x 15” of Non-Slip Pad
 - Any material strictly used as a color filter for a Vex Light Sensor
- c. Any parts which are identical to legal Vex parts may be used.
- d. Teams may add non-functional decorations from parts not on the above list, provided that these parts do not affect the outcome of the match, and must be in the spirit of the competition.
- e. No additional components may be used.

<R6> All parts that are used must be tracked through a Bill of Materials (BOM).

<R7> 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.

<R8> No more than two transmitters may control a single robot during the tournament. No modification of the Vex transmitter is allowed of ANY kind.

<R9> 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.
- b. Welding, soldering, brazing, gluing, or attaching in any way that is not provided within the Vex System will NOT be allowed.
 - i. Mechanical fasteners may be secured using Loctite or a similar thread-locking product.
 - 1. This may be used for securing hardware ONLY.

<R10> Robots must display their team number (numerals only, i.e. “148”).

- a. The judges, referees, and announcers must be able to easily identify robots by team number.
- b. Team number must be visible from two sides of the robot (180 degrees apart).
- c. The numerals must each be at least three inches high, at least in 3/4-inch stroke width and in a contrasting color from their background.

<R11> Robot receiver must be accessible by competition personnel.

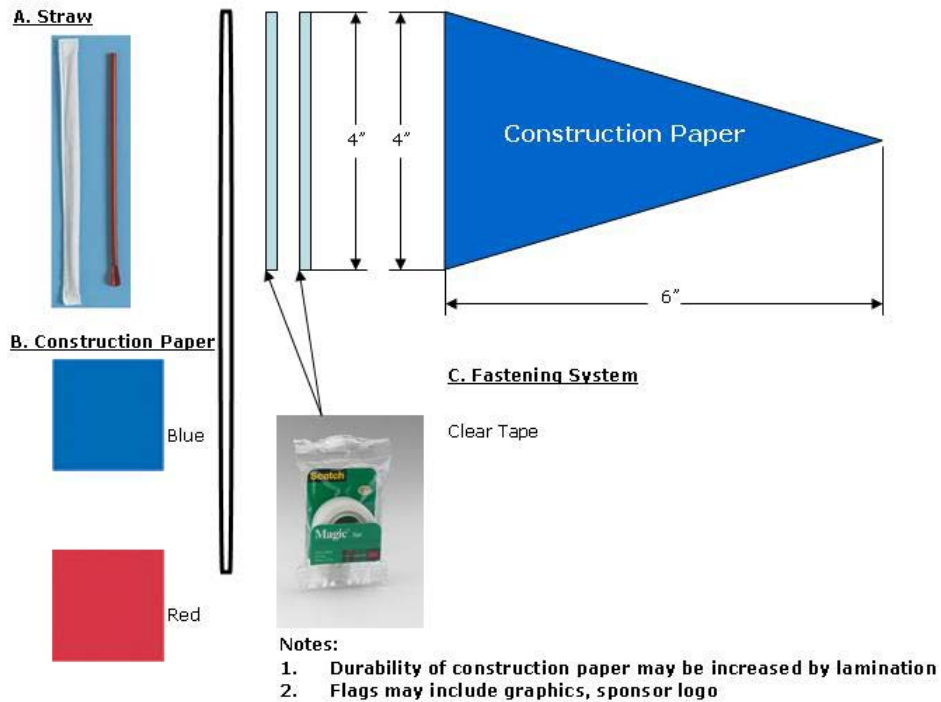
- a. The radio crystal must be easily removed from the robot without any robot disassembly.
- b. The radio crystals will be provided to each team for each match.

<R12> Robots must include a mounting device to securely hold one Robot Identification Flag throughout an entire match.

- The flags will be provided at the event
- The flag tube dimensions are .250" OD x .200" ID x 8.250" length with a triangular flag 4.000" high x 6.000" wide.
- For full details please refer to the following diagram

Robot Identification Flag

Quantity required per Vex Robot: 2 each (1 red flag, 1 blue flag)



4.3 – Autonomous Programming Guidelines

Please refer to the Programming Guide in Appendix 2 for requirements concerning programming a competition robot.