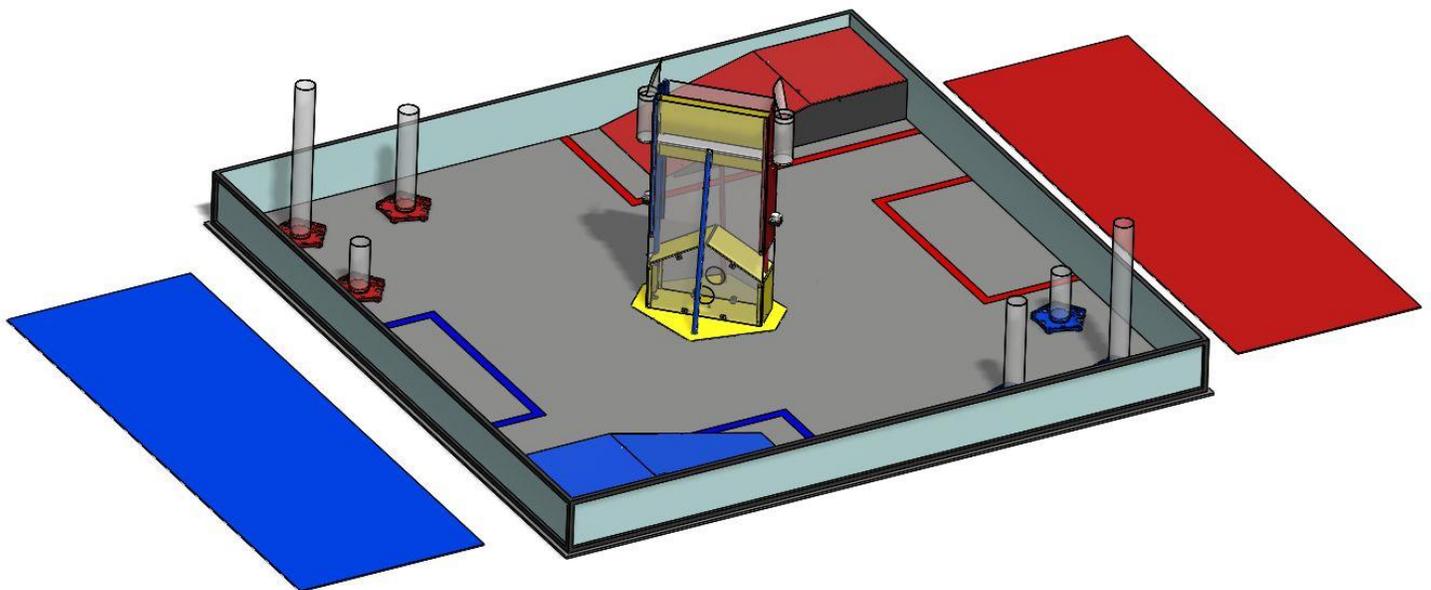




FIRST TECH CHALLENGE®

2014 – 2015 GAME MANUAL PART 1

TOURNAMENT INFORMATION, AWARDS AND ROBOT RULES



Volunteer Thank You

Thank you for taking the time to volunteer for a *FIRST* Tech Challenge Event. *FIRST* and FTC rely heavily on Volunteers to ensure Events run smoothly and are a fun experience for Teams and their families, which could not happen without people like you. With over 3,500 Teams competing annually, your dedication and commitment are paramount to the success of each Event and the FTC program. Thank you for your time and effort in supporting the mission of *FIRST*!



Sponsor Thank You

Thank you to our generous sponsors for your continued support of the *FIRST* Tech Challenge!

***Rockwell
Collins***

Official Program Sponsor

PTC®

CAD and Collaboration Sponsor

IMPORTANT NOTICE:

THE GAME MANUAL PART 2 INCLUDES A DESCRIPTION OF THE GAME AND GAME RULES. THE GAME MANUAL PART 2 WILL BE RELEASED ON SEPTEMBER 6, 2014.

TEAMS MUST COMPLY WITH ALL RULES AND REQUIREMENTS STATED IN THIS DOCUMENT AND IN PART 2 OF THE GAME MANUAL. ANY UPDATES TO THE GAME RULES ARE ISSUED ON THE Q&A SECTION OF THE GAME FORUM AT FTCFORUM.USFIRST.ORG. FORUM RULINGS TAKE PRECEDENCE OVER INFORMATION IN THE MANUALS FOR THIS SEASON.

Revision History		
Rev	Date	Description
1	July 14, 2014	Initial Release
1.1	September 6, 2014	<ul style="list-style-type: none">• Thank you page for Volunteers and Sponsors added.• Section 3 – Update to YPP page• Section 4.9 – added rule <T3>, shifted previous rules down.• Section 5.3 – corrected size allowance of engineering notebook<ul style="list-style-type: none">○ Changed “Kit of Parts” to “Registration and Welcome Kit”• Section 6.2.2 – Added new rule – <R08>c USB Surge protector allowed, shifted rules down.• Section 6.2.2 – Added Clarification to rule <R11>d• Section 8.3 – added taglines for Think Award, Rockwell Collins Innovate Award, PTC Design Award, Control Award, Promote Award, and Compass Award.• Section 8.5 – changed section 3.8 in paragraph to 4.8 to reference correct section.• Section 9.3 and 9.4 – Clarified rules participation and process to register for the FTC Q&A Game forum.• Added Appendix 3 – Control Award Instructions and Content Sheet

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1.0 Introduction

About *FIRST*®

“...to create a world where science and technology are celebrated... where young people dream of becoming science and technology heroes.”

Dean Kamen, Founder, *FIRST*

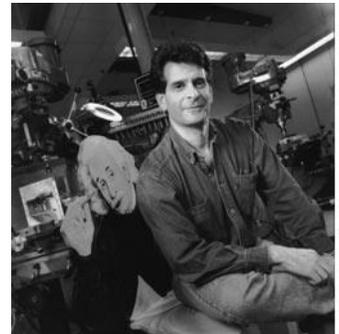
FIRST® (For Inspiration and Recognition of Science and Technology) was founded by inventor Dean Kamen to inspire young people’s interest and participation in science and technology. Based in Manchester, New Hampshire, *FIRST* is a 501(c)(3) not-for-profit public charity.

As a volunteer-driven organization, *FIRST* is built on partnerships with individuals as well as businesses, educational institutions, and government. Some of the world’s most respected companies provide funding, mentorship time and talent, and equipment to make *FIRST*’s mission a reality. As a team coach, you join over 120,000 committed and effective volunteers who are key to introducing over 300,000 young people to the joy of problem solving through engineering.

FIRST provides four programs: the *FIRST* Robotics Competition (FRC®) for grades 9-12, the *FIRST* Tech Challenge (FTC®) for grades 7-12; *FIRST* LEGO® League (FLL®) for 9 to 14 year-olds, and Junior *FIRST* LEGO League (Jr.FLL®) for 6 to 9 year-olds. Also located at *FIRST* headquarters is the research and development facility called *FIRST* Place™. *FIRST* Place is integral to game design, new program development, evaluation, and professional development of *FIRST* mentors.

“We want to change the culture by celebrating the mind. We need to show kids that it’s more fun to design and create a video game than it is to play one.”

Dean Kamen,
Founder, *FIRST*



Dean Kamen is President of DEKA Research & Development Corporation; a dynamic company focused on the development of revolutionary new technologies that span a diverse set of applications. As an inventor, physicist, and entrepreneur, Dean has dedicated his life to developing technologies that help people lead better lives. Dean’s proudest accomplishment is founding *FIRST*.

2.0 What is FIRST Tech Challenge?

FIRST Tech Challenge (FTC) had its beginnings in 2005 and grew out of a need for a mid-level robotics program to transition teams from *FIRST*® LEGO® League to the *FIRST*® Robotics Competition. Piloted for two years as the *FIRST* Vex Challenge, FTC became an official *FIRST* program and was renamed *FIRST* Tech Challenge in 2007.

FIRST Tech Challenge is a student-centered activity that is mentor supported and is about giving students a unique and stimulating experience. We want students to learn the value of teamwork and to respect everyone's ideas and contributions to the team. *FIRST* Tech Challenge allows high school students to work hand-in-hand with technical professionals to develop a solution to the annual challenge. The students do a majority of the work, but the mentor is there to offer guidance, suggestions, and coaching to keep the students on task and successful. *FIRST* values are about appreciating our differences and learning what those differences add to our lives. *FIRST* programs succeed most fully when team members bring the *FIRST* values they learn back to their communities.

The FTC Competition Kit challenges students' creative problem-solving skills by enabling them to build robots that do amazing things. When you bring dedicated, enthusiastic students and a mentor together, the results can be phenomenal! Students design and construct robotic devices which can be autonomously programmed or operator-controlled to perform various tasks.

FIRST Tech Challenge teams receive each year's game during a September Kickoff. The game's rules and regulations are provided on the www.usfirst.org website.

2.1 Gracious Professionalism™ – A FIRST Credo

Dr. Woodie Flowers, National Advisor for *FIRST*, speaks about Gracious Professionalism™ in this way: "The *FIRST* spirit encourages doing high-quality, well informed work in a manner that leaves everyone feeling valued. Gracious Professionalism seems to be a good descriptor for part of the ethos of *FIRST*. It is part of what makes *FIRST* different and wonderful."

Gracious Professionalism can and should mean different things to each of us. It is possible however, to outline some of its meanings:

- ❖ Gracious attitudes and behaviors are 'win-win.'
- ❖ Gracious folks respect others and let that respect show in their actions.
- ❖ Gracious professionals make a valued contribution in a manner pleasing to others and to themselves as they possess special knowledge and are trusted by society to use that knowledge responsibly.

As Woodie says, "In the long run, Gracious Professionalism is part of pursuing a meaningful life. One can add to society and enjoy the satisfaction of knowing that you have acted with integrity and sensitivity. That's good stuff!"

"In *FIRST*, Gracious Professionalism means that we learn and compete like crazy, but treat one another with respect and kindness in the process. We try to avoid leaving anyone feeling like they have lost. No chest-thumping barbarian tough talk, but no sticky sweet platitudes either. Knowledge, pride and empathy comfortably blended."

3.0 Youth Protection Program

The purpose of the *FIRST* Youth Protection Program (*FIRST* YPP) is to provide coaches, mentors, volunteers, employees, others working in *FIRST* programs, team members, parents, and guardians of team members with information, guidelines, and procedures to create safe environments for everyone participating in *FIRST* programs.

The *FIRST* YPP sets minimum standards recommended for all *FIRST* activities. Adults working in *FIRST* programs must be knowledgeable of the standards set by the *FIRST* YPP, as well as those set by the school or organization hosting their team.

Youth Protection Expectations and Guidelines

Coaches and Mentors are expected to read and follow elements in the [FIRST Youth Protection Program guide](#) that are labeled as required are mandatory in the United States and Canada, and may not be waived without the approval of the *FIRST* Youth Protection Department.

FIRST recommends that the standards set forth in the [FIRST Youth Protection Program guide](#) be applied outside of the United States and Canada to the extent possible. At a minimum, local regulations regarding youth protection must be complied with.

Everyone working with FIRST Teams should be familiar with the *FIRST* YPP policies.

Forms are available here: <http://www.usfirst.org/aboutus/youth-protection-program>

Information on the US Screening process is available here: http://www.usfirst.org/sites/default/files/uploadedFiles/About_Us/US-Youth-Protection-Clearance-Process.pdf

Information on the Canadian Screening process is available here: http://www.usfirst.org/sites/default/files/uploadedFiles/About_Us/Canadian-Youth-Protection-Clearance.pdf

You can find FAQ and additional information about the *FIRST* Youth Protection Program on the *FIRST* website at: <http://www.usfirst.org/aboutus/youth-protection-program>



4.0 The Tournament

4.1 Overview

The *FIRST* Tech Challenge is played in a tournament format. Each tournament includes qualifying and elimination matches. After the qualifying matches, teams are ranked based on their match performance. The top-ranked teams select alliance partners and participate in the elimination matches to determine the event champions.

This section provides a general summary regarding a *FIRST* credo, mascots, uniforms, recommended items and equipment for teams to bring, pit rules, event schedules, registration, practice rules and time slots, and robot inspections. Please read the following to get a feel for competition schedules, registration procedures, practice times, and matches.

4.2 Tournament Definitions

Alliance – Each FTC match is comprised of two, two-team Alliances. At events with more than 20 teams, the semi-final and final round Alliances are made up of three teams each. However, only two of those teams compete during any one match.

Alliance Captain – The student representative from an Alliance’s highest ranked team chosen to represent an Alliance during Alliance Selection and for the final Elimination Matches. The entire team may also be referred to as the Alliance Captain.

Alliance Selection – The process by which top-ranked teams choose Alliance Partners for the Elimination Matches.

Alliance Station – The designated region where the *Drivers* and *Coach* stand or move within during *Matches*.

Competition Area – The *Area* where all the *Playing Fields*, *Alliance Stations*, *Scoring tables*, and other Event officials and tables are located.

Elimination Match – A match used to determine the Winning Alliance. Alliances of two or three teams face off in a series of matches, with two teams per alliance playing in each match. The first alliance to win two matches proceeds to the next round.

Playing Field – The part of the *Competition Area* that includes the 12’ x 12’ (3.66m x 3.66m) Field and all of the Elements described in the official Field drawings.

Practice Match – A match used to provide time for teams to get acquainted with the official playing field.

Qualifying Match – A match used to determine the teams that qualify for the Alliance Selection and move on to the Elimination Matches. Alliances compete to earn Qualifying Points and Ranking Points.

Qualifying Points (QPs) – The first basis for 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 used as the tiebreakers when teams have equal Qualifying Points. Ranking Points are awarded in the amount of the final score of the losing Alliance in a Qualifying Match. Both Alliances receive the pre-penalized score of the losing Alliance as their RP.

Surrogate Match – An additional Qualifying Match for some teams depending on the number of teams in the tournament. A Surrogate Match will not count in the standings for Qualifying Points or Ranking Points to the teams that

are marked as playing as surrogates. However, these matches are very important in the entire standings and should be played by all as if they were regular Qualification Matches. Surrogate Matches will be marked as such on the official Qualifying Match schedule.

4.3 Tournament Event Schedule

Event schedules will be available through your Tournament Host prior to or at your tournament. Qualification Match schedules are created on tournament day by the scoring system after all teams have checked-in and have completed the inspection process.

4.4 Courtesy and Rules

You will hear the expression Gracious Professionalism (GP) often throughout your involvement in FTC. One of FTC's main goals is to encourage all team members to conduct themselves with kindness, consideration, and sharing. We hear heartwarming stories of teams sharing parts, helping to build or repair competing robots, and helping rookie teams avoid preventable pitfalls. These examples of GP are some of the benefits of being involved with this organization. Please display GP throughout the event.

The pit is where the behind-the-scenes action takes place. The *FIRST* staff and volunteers want you to enjoy the competition. Follow the rules below while in the pit as well as in the audience so everyone can work and compete in a safe, sportsmanlike, friendly, and orderly manner.

Bands: No live bands are allowed in the audience or pit.

Battery Safety: Charge your batteries in an open, well-ventilated area.

Fire Extinguishers: These are usually located at the pit administration station and in the competition area.

Food: Check with the Tournament Director before bringing food to an event, as some venues will not allow outside food on-site due to contracts and agreements.

Internet/Wireless Network Access: Teams may not setup a wireless computer network for any purpose (i.e. Internet access, team communication, team computer to robot, etc.). Teams are required to use the wireless computer network provided by the Tournament Director or venue for all robot communication. Internet access for the teams will be at the discretion of the Tournament Director.

Music/Noise: No loud music, audio systems, whistles, banging sticks, blow horns, etc. allowed. They prevent teams from hearing important announcements. Power may be shut off and/or noisemakers confiscated.

Painting: There is no painting in the pit.

Pit Displays: Pit display structures may not exceed ten (10) feet in height.

Radios/Walkie-Talkies: Teams are not allowed to use radios and walkie-talkies anywhere in the tournament facility.

Running: There is no running in the pit.

Sales: Because of site regulations/contracts, *FIRST* cannot allow teams or individuals to sell items, such as T-shirts, pins, etc., at any events. Fundraising for a cause is permitted; fundraising for a team is not permitted.

Seat Saving: Sitting together in a group during competition matches makes the game more exciting and fun. It allows you to show support for your team. Teams are not allowed to save seating space as there is often not enough seating to

accommodate everyone.

Team Safety Captain: Each team appoints a safety captain who will help maintain safety at events, especially in the pit. He or she will remind attendees about the safety rules listed here.

Soldering, Gluing, Brazing, or other Large Power Tools: These activities and tools are not allowed in the pit areas or at the competitions unless the Tournament Director specifically allows them.

4.5 Eye Protection and Safety

FIRST requires all teams to bring and supply ANSI Z87.1 certified safety glasses for their members and guests for each competition. Regular glasses and sunglasses do not qualify as safety glasses. If you wear prescription glasses, you must wear safety goggles over them or attach safety side shields. For our purposes, amber lenses that allow for enhanced vision are considered tinted, not shaded, and their use is allowed at *FIRST* events. Sunglasses or deeply shaded safety glasses used in our indoor event environment are not acceptable.

Students, adult team members, and guests must wear eye protection while working on the robot, when observing robot building/repair work, while in the pit area, and in the competition area. Teams without eye protection are not allowed in the competition area.

Open-toed or open-backed shoes are not permitted in the pit area or in the competition area.

4.6 Tournament Day Overview

FTC events pack a lot of activities into one day. The main events for a typical tournament are:

1. Team Check-in
2. Robot Hardware and Software Inspection
3. Judges' Interviews
4. Drivers' Meeting
5. Practice Matches
6. Opening Ceremony
7. Qualification Matches
8. Alliance Selection
9. Elimination Matches
10. Awards and Closing Ceremony

4.6.1 Team Check-In

As a team arrives at the venue, the Coach or other adult mentor should register the team with the tournament officials. During check-in, the Coach will receive a packet of information for the team that may include drive team badges, a judging schedule, a map of the facilities and pits, and other information that is very important to the teams. At this time, the team should set up their Pit area and get familiar with the venue, including where the practice and playing fields are and where judging takes place, and review the schedule of events for the day.

4.6.2 Robot Hardware and Software Inspection

FTC robots are required to pass hardware and software inspections before being cleared to compete. These inspections ensure that all FTC robot rules and regulations are met. A copy of the official FTC "Robot Inspection Sheet" is located in Appendices 1 and 2. The "Robot Inspection Sheet" must be used by teams as a guide to pre-inspect their robot. A Bill of Materials (BOM) of non-TETRIX, non-MATRIX, or non-LEGO parts must be presented at Hardware Inspection.

4.6.3 Judges' Interviews

At *FIRST* Tech Challenge events, there are generally three parts to the judging process: 1) interview with judges; 2) evaluation of performance during the tournament; and 3) evaluation of the Engineering Notebook. Each team will have a ten to fifteen minute "fact finding" interview with a panel of two or three judges.

The Judges' Interviews generally take place before any qualification matches so that the entire team may be interviewed. When teams arrive at the event, the interview schedule should be included in the registration materials. Make sure you know when your team will be interviewed and arrive to the interview room early. Please have at least two student team representatives and the robot available; the entire team is encouraged to participate. Mentors (no more than two) are welcome to observe the Judges' Interview at most events, but should not participate (see Section 7.4 for more details).

4.6.4 Drivers' Meeting

The Drivers' Meeting takes place prior to the start of qualification rounds and is a time when the drive team meets with the referees. During this time, the head referee gives a brief overview of what is expected of teams and any venue specific information, such as queuing paths, and explains any signals and commands referees will give during matches.

4.6.5 Practice Time

At the event, practice field time is offered in the morning until the drivers' meeting begins. Every effort will be made to equalize practice time for all teams, but it may also be conducted on a first-come, first-served basis. If practice matches are run, these matches may be scored, but the scores do not affect team ranking.

4.6.6 Opening Ceremony

The Opening Ceremony is the official kickoff of the event's activities for the teams, the fans, and the public. During the Opening Ceremony, a tournament official or the emcee will welcome the teams and the public, introduce dignitaries and other special guests, and introduce the judges and the referees. Then the game will be described (usually with a video) and the national anthems of all the teams' countries will be played. Immediately after, the Qualification Matches take place.

If your team is in any of the first four matches on the day of your event, volunteers will ask you to line up before the opening ceremonies. Please, make sure your team is on time in case you have an early match.

4.6.7 Qualification Matches

Teams are randomly assigned to qualifying matches and alliances. The qualifying match schedule is available prior to opening ceremonies on the day of the event. This schedule indicates alliance partners and match pairings. It also indicates the alliance's color (red or blue) and the position in the alliance station (1 or 2) for the drive team. These matches start immediately after the Opening Ceremonies in accordance with the qualification match schedule. The queue volunteer crew works together throughout the day to line up teams for the matches and maintain the schedule. It is very important to pay attention to the match schedule and listen for announcements throughout the day. You need to know when you will compete, find out the number of the ending match before lunch, and find out which match is the last match of the tournament day.

All teams are ranked based on the same number of qualifying matches. In some cases, a team is asked to play a surrogate match which does not count towards their standings during the event. This additional match is denoted on the match schedule or announced to the teams prior to the start of the qualifying matches.

At the conclusion of each match, Qualifying Points (QP) and Ranking Points (RP) are awarded:

- ❖ Teams receive Qualifying Points based on the following:
 - Winning teams of a qualifying match each 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.
- ❖ Ranking Points (RP) are awarded based on the following:
 - The number of ranking points assigned for each match is that of the losing alliance's score. Both Alliances receive the pre-penalized score of the losing alliance as their RP.
 - In the event of a tie, both alliances receive the same number of ranking points, equal to the lowest pre-penalized 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 are awarded their own score as their RP for that match.

Teams with non-functioning robots may receive credit for a qualifying match if their robot has passed inspection and at least one member of the drive team is present in the alliance station for the scheduled 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 receives zero (0) QP and zero (0) RP.

At the conclusion of all Qualification Matches, the teams are ranked from first through last on the basis of their total Qualifying Points (QPs). If multiple teams have the same QP total, then teams are ranked on the basis of their total Ranking Points (RPs). If multiple teams have the same RP total as well, then teams are ranked on the basis of their highest match score. If still tied, the next highest match score is used until the tie is broken. In the unlikely event that there is still a tie based on identical match scores, then the teams are ranked by a random electronic draw.

4.6.8 Alliance Selection

The number of teams in the Elimination Matches is based on the number of teams in the tournament. If there are 21 or more teams in the tournament, the Elimination Matches consist of alliances of 3 teams each. If there are 20 teams or less, then the alliances consist of 2 teams each. There are a total of four (4) alliances that will compete in the Elimination Bracket.

The alliance selection process consists of a number of rounds of selections, such that all alliance captains form elimination match alliances consisting of the requisite number of teams. These alliances participate in a ladder-type tournament to determine the event's Winning Alliance. The alliance selection process is as follows:

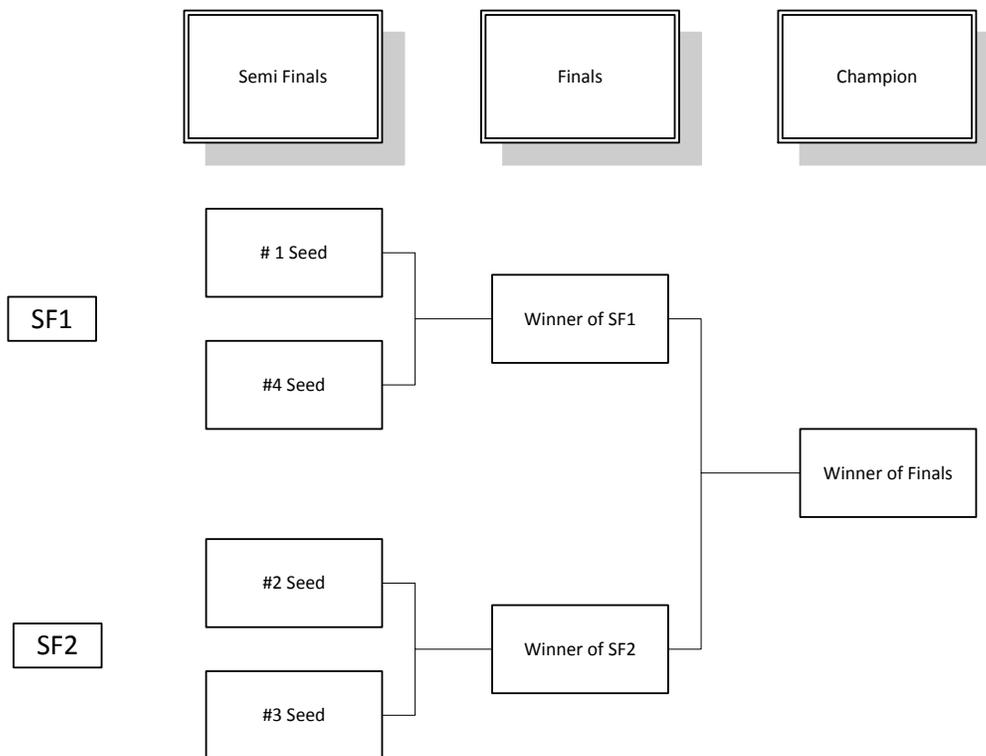
- ❖ Each team chooses one student to act as the team's representative. These representatives will proceed to the competition area at the designated time to represent their teams in the alliance selection. It is recommended that the representative also bring their robot to the competition area as teams making selections may not know team names or numbers, but do know what the robots look like.
- ❖ In order of tournament ranking, the student representative of the highest ranked team not already in an alliance is asked to step forward as the Alliance Captain to invite another available team to join their alliance.
- ❖ A team is available if it is not already part of an alliance, or has not already declined an alliance invitation. If the team accepts, it is moved into that alliance. If a team declines, it CANNOT be invited into another alliance, but it is 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 an invitation to another team.

- ❖ The process continues until all alliance captains have been designated and chosen one alliance partner.
- ❖ If there are more than 20 teams, the same method is used for each alliance captain's second choice (the third member of the alliance) from highest seed to lowest seed (i.e. 1 -> 2 -> 3 -> 4). Any teams remaining after the lowest seeded captain makes their choice do not compete in the Elimination Matches.

4.6.9 Elimination Matches

The Elimination Matches are very exciting. This is when the alliances determine who the Champion of the event is. The matches are played in a seeded format where the top seed goes up against the 4th seed, and the number 2 seed goes up against the 3rd seed.

In the elimination matches, teams do not get qualifying points; they get a win, loss or tie. Within each bracket of the elimination, matches are played to determine which alliance advances. The advancing alliance is the first one to win two matches. Any tied matches are replayed until one alliance has two wins and advances. An example tournament bracket appears here:



During the elimination matches, two teams from an alliance compete on the playing field. If the alliance has three teams, the team that sits out the first match in an elimination series must play in the second match, with no exceptions. If the alliances play more than two matches in any round, any combination of two alliance robots may be used. The Captain of the Alliance is not required to participate in every match. No special accommodations are made for robots that fail during the Semi Final and Final Rounds. Teams should consider the robustness of the robots when picking alliance partners.

If a team is disqualified during an elimination match, then their entire alliance is disqualified and the match is recorded as a loss. Prior to each elimination match, the alliance captain must let the referee know which two teams are playing in the upcoming match.

4.6.10 Awards and Closing Ceremony

The Awards and Closing Ceremony celebrates the accomplishments of the teams during the season and how they all performed during the event. The ceremony begins as soon as the last match is played, however some awards may be given out earlier in the event day. During the ceremony, teams are recognized for their accomplishments as the awards are handed out. The Winning Alliance teams and the Finalist Alliance teams are also recognized. Finally, the Inspire Award winner is announced.

4.7 Tournament Types

There are several types of events and tournaments that teams and other organizers hold throughout the FTC season and off-season. These are categorized in the following sections.

4.7.1 Local Events

Anyone can host a local event, also known as a scrimmage, to prepare for a Championship or Qualifier, or as an alternative to attending other events. If you choose to create and host a local event, you are responsible for finding a location, organizing the format for the day, and inviting other teams to participate. You may also have to secure the field elements, computers, and other items depending on how you would like the local event to look and feel.

4.7.2 Meets and League Play

If your region has chosen to participate in the League format, some of the standard Tournament and Championship guidelines may be modified. For information about the scheduling, structure, advancement and processes that are unique to a pilot event in your region, please contact your local Affiliate Partner.

4.7.3 Qualifying Tournaments and League Championship

Hosted and managed by FTC Affiliate Partners or Partner-appointed hosts. Qualifying Tournaments follow the same judging and game guidelines and format of Championship Tournaments. Qualifying Tournaments are usually held prior to Championship Tournaments in regions where there are many FTC teams. The number of teams advancing to the state Championship Tournament depends on the capacity of the state Championship Tournament, the number of Qualifying Tournaments, and the number of teams attending the Qualifying Tournament. The Advancement Criteria for moving up to the next level of tournament is detailed in Section 4.8 below.

4.7.4 Championship Tournaments

Hosted and managed by an FTC Affiliate Partner, Championship tournaments abide by certain standards in format, judging, awards, and overall quality. Some Championship tournaments require that teams win at a qualifying tournament or advance through a League in order to advance to the Championship. Championships may include teams from a geographic region, province, state, country, or several countries. Advancement eligibility for the Super-Regional Championship Tournament is the same as moving on from Qualifying Tournaments to the local Championship Tournament and is detailed in Section 4.8 below.

4.7.5 Super-Regional Championship Tournaments

US Teams have the opportunity to compete in an additional level of Championship Play. Four Super-Regional Championship Events will be held, and hosted by an FTC Affiliate Partner. Super-Regional Championship tournaments abide by certain standards in format, judging, awards, and overall quality. Teams advance from their State or Regional Championship to the Super-Regional Championship using the same advancement criteria described in section 4.8 below. Teams advance from the Super-Regional Championships to the FTC World Championship.

4.8 Advancement Criteria

Teams advance to the next level of competition in the order indicated below according to the number of spots available. The advancement criteria will be applied to teams in North America as follows:

1. Teams advance from a Qualifying Tournament or a League Championship to a Championship Tournament
2. Teams advance from a Championship Tournament to one Super-Regional Championship Tournament. Once a team has qualified for an invitation to a Super-Regional Championship, that team is no longer eligible to be invited to a second Super-Regional Championship.
3. Teams advance from a Super Regional Championship Tournament to the FTC World Championship

In the event that the team listed has already advanced or there is no team fitting that description (as in 2nd team selected at smaller events), the advancement will continue in order.

1. Optional
Qualifier Host Team (*NOTE: Each region's Affiliate Partner decides if this advancement opportunity will be offered, and if so, when the host team must be identified. Team should compete at one other tournament within the region and must meet the criteria set forth by the Affiliate Partner in the agreement. This advancement applies to Qualifying Tournament hosts only, and does NOT apply to host teams of meets, League Championships or Championship Tournaments*).
2. [Inspire Award Winner](#)
3. [Winning Alliance Captain](#)
4. Inspire Award 2nd place
5. Winning Alliance, 1st team selected
6. Inspire Award 3rd place
7. Winning Alliance, 2nd team selected
8. [Think Award Winner](#)
9. [Finalist Alliance Captain](#)
10. [Connect Award Winner](#)
11. Finalist Alliance, 1st team selected
12. [Rockwell Collins Innovate Award Winner](#)
13. Finalist Alliance, 2nd team selected
14. [PTC Design Award Winner](#)
15. [Motivate Award Winner](#)
16. [Control Award Winner](#)
17. Highest Ranked Team* not previously advanced until all spaces are filled, beginning with the Winning Division and alternating to the Finalist Division team of equal rank.
18. Think Award 2nd Place
19. Highest Ranked Team not previously advanced until all spaces are filled, beginning with the Winning Division and alternating to the Finalist Division team of equal rank.
20. Connect Award 2nd Place
21. Highest Ranked Team not previously advanced until all spaces are filled, beginning with the Winning Division and alternating to the Finalist Division team of equal rank.
22. Rockwell Collins Innovate Award 2nd Place
23. Highest Ranked Team not previously advanced until all spaces are filled, beginning with the Winning Division and alternating to the Finalist Division team of equal rank.

24. PTC Design Award 2nd Place
 25. Highest Ranked Team not previously advanced until all spaces are filled, beginning with the Winning Division and alternating to the Finalist Division team of equal rank.
 26. Motivate Award Winner 2nd Place
 27. Highest Ranked Team not previously advanced until all spaces are filled, beginning with the Winning Division and alternating to the Finalist Division team of equal rank.
 28. Control Award Winner 2nd Place
 29. Highest Ranked Team not previously advanced until all spaces are filled, beginning with the Winning Division and alternating to the Finalist Division team of equal rank.
 30. Think Award 3rd Place
 31. Highest Ranked Team not previously advanced until all spaces are filled, beginning with the Winning Division and alternating to the Finalist Division team of equal rank.
 32. Connect Award 3rd Place
 33. Highest Ranked Team not previously advanced until all spaces are filled, beginning with the Winning Division and alternating to the Finalist Division team of equal rank.
 34. Rockwell Collins Innovate Award 3rd Place
 35. Highest Ranked Team not previously advanced until all spaces are filled, beginning with the Winning Division and alternating to the Finalist Division team of equal rank.
 36. PTC Design Award 3rd Place
 37. Highest Ranked Team not previously advanced until all spaces are filled, beginning with the Winning Division and alternating to the Finalist Division team of equal rank.
 38. Motivate Award 3rd Place
 39. Highest Ranked Team not previously advanced until all spaces are filled, beginning with the Winning Division and alternating to the Finalist Division team of equal rank.
 40. Control Award 3rd Place
 41. Highest Ranked Team not previously advanced until all spaces are filled, beginning with the Winning Division and alternating to the Finalist Division team of equal rank until all spots are filled.
- *Refers to qualifying ranking

4.9 Tournament Rules

<T1> Referees have ultimate game play and scoring authority during the competition. Their rulings are final.

- a. The referees may not review any recorded match replays or pictures.
- b. Any questions for the referees must be brought forward by one student drive team member per team within the time period of two (2) matches following the disputed match. Students are required to support their questions by referencing specific rules or posts to the Q&A section of the official FTC Forum. Team members are required to ask their questions in a gracious and respectful manner.
- c. Team members are not allowed onto the playing field for any reason other than to place or retrieve their robots. Inspection of the playing field elements by team members for the express purpose of determining scoring is prohibited. Individuals and teams that violate this rule will be subject to possible team penalties that could include match disqualifications or even removal from the tournament.

<T2> Only three team representatives are permitted in the competition area; two (2) student drivers, and one (1) coach who are identified by badges designating 'driver' or 'coach.' These badges are interchangeable within a team in between matches. Only student team members wearing a badge designated as 'driver' may drive the robot during the match.

<T3> Scores will be recorded at the end of the *Autonomous Period* and *Driver-Controlled Period* when all objects on the *Playing Field* have come to rest. Scores may or may not be announced to the teams until some amount of time after the *Match* has completed.

<T4> There are no time outs during the qualifying rounds. The matches must progress according to schedule. If a robot cannot report for a match, at least one member of the team should report to the playing field for the match.

<T5> Teams are guaranteed a minimum of five minutes (5:00) between participating in consecutive matches.

<T6> During the elimination rounds, each alliance will be allotted ONE time out of no more than three minutes (3:00). Time outs must be called at least two minutes (2:00) prior to their next match's starting time. The time out begins at the time their match was going to start.

<T7> All team members and their guests, including coaches, must wear ANSI 87.1 certified safety glasses or prescription glasses with side shields while in the pits or alliance stations during matches.

NOTE: *FIRST* requires all teams to bring and supply, for each competition, ANSI-approved non-shaded safety glasses for its team members, mentors, and guests. For our purposes, amber lenses that allow for enhanced vision are considered tinted, not shaded, and their use is allowed at *FIRST* events. Sunglasses or deeply shaded safety glasses used in our indoor event environment are not acceptable.

<T8> No Team, Team Member, or event attendee is allowed to set up their own Wi-Fi 802.11a/b/g/n/ac (2.4GHz or 5GHz) wireless communication in the venue. Non-allowed wireless communications include, but are not limited to:

- ❖ Cellular Hotspots (e.g. cell phones, tablets, MiFi).
- ❖ Ad-hoc networks.
- ❖ Nintendo DS peer-to-peer.
- ❖ Bluetooth communication with Robots in the Competition area.

No Team, Team Member, or event attendee shall interfere with a Team's wireless communication with their own Robot. This includes illegal interference with the Wi-Fi system for the Competition Fields, Practice Fields, and the Scoring System.

The Penalty for violating rule <T8> is disqualification of the entire Team from the Event and their removal from the venue property. Teams may not appeal the penalty and no refunds will be given for registration fees, pre-paid meals, etc. *FIRST* may conduct a post-Event review and determine if any additional penalties are to be imposed upon the offending Team.

Teams are encouraged to report wireless security vulnerabilities to the Field Tech Advisor at an Event. Teams should always keep in mind *Gracious Professionalism™*, and therefore only report valid and verifiable violations of this rule. After the FTA is alerted of a potential rule violation, he/she will confer with the Head Referee. The FTA and Head Referee will further investigate the potential violation of this rule. The final decision will be made by the Head Referee if rule <T8> has been violated, and to disqualify the offending Team.

4.10 Team Spirit

Competing as a team is fun as well as rewarding. Part of the pleasure and reward of being a team member is the way the team styles itself with team T-shirts, trading buttons, hats, cheers, cheerleaders, and costumes.

4.11 Team Styling

When deciding on a team name or acronym, consider how you can work a theme around it to make your team more fun and recognizable. Refer to Section 8.6 for information about *FIRST* and FTC logo use requirements.

4.12 Banners and Flags

Sponsors provide *FIRST* with banners so we can display them in specified areas as a way of thanking them for their generosity. We encourage teams to bring team flags or sponsor banners, but we ask that you adhere to the following:

- ❖ Do not use banners or flags to section off seating. Saving group seats is not permitted.
- ❖ Hang banners in your pit station only, not on the pit walls.
- ❖ Teams may bring banners to the competition area but please do not hang them there. This area is designated for official *FIRST* sponsors' banners.

4.13 Spectators and Etiquette

Teams are permitted to have 2 student drivers and 1 coach (the Drive Team) at the playing field during their scheduled matches. Spectators are not allowed in the competition area at any time and must remain outside of the designated competition area. Some events may provide media passes for one additional team member to gain access to a designated "media area." Access to this area is only permitted with a media pass and only while the media representative's team is on the playing field. Spectators blocking the sidelines or accessing the media area without a pass will be asked to move. Repeated violations of this rule may cause the associated team to be disqualified.

4.14 Scouting

In the qualifying rounds, the scoring system selects your ally and opponent teams for each match. In elimination rounds, top ranking teams are able to choose their own alliance partners. It is important to select an alliance partner with abilities that complement those of your team. Scouting during the qualifying rounds is a good way to learn the capabilities and limitations of the teams and robots around you.

This information has been provided by the 2007 FRC Chairman's Award winners, FRC Team #365, the Miracle Workerz:

Teams use different methods to record information about other teams – paper, computer, tablets, etc. Use whatever method is most comfortable for your team. Scouting is important to determine how you complement other teams in your alliance and how you match up against your opponents. No matter how you record it, focus on information which will be useful to your team when you meet your alliance partners to discuss strategy.

Some possible areas to gather information include:

- ❖ CAPABILITIES – what can the robot/team do and what does it not do?
- ❖ STRATEGIES – what does the robot / team do during the match? How does the team play the game?
- ❖ PERFORMANCE – how well does the robot / team do what it attempts? What are the robot's strengths and weaknesses?
- ❖ AUTONOMOUS – what does the robot do in autonomous mode? Does the team have multiple program options?

The more data points you can collect on strategies and performance, the better understanding you will have of a given team. Information on a team's capabilities can be obtained by visiting the team in the pit area or watching match play.

5.0 Engineering Notebooks

5.1 Overview

This section describes the requirements for creating the Engineering Notebook, including formatting guidelines, Judges' tips, and the use of various forms of engineering support. It also provides links for sample pages from an award winning FTC Engineering Notebook.

5.2 What is an Engineering Notebook?

One of the goals of *FIRST* and FTC is to recognize the engineering design process and “the journey” that a team makes during the phases of the problem definition, concept design, system-level design, detailed design, test and verification, and production.

Throughout the building of your robot you will come across obstacles, lessons learned, and the need to draw things out on paper. This is where you and your team will use an engineering notebook. These notebooks follow your team from kickoff throughout the competitions. Judges review your engineering notebook to better understand your journey, design, and team.

Note: Refer to the judging criteria in the Awards & Judging Criteria section for more details on how your Engineering Notebook will be judged.

5.3 The Notebook

Teams may choose to record their season with either handwritten, electronic, or online documents. No distinction is made between handwritten and electronic Engineering Notebooks during judging.

Electronic/Online: Teams may choose to use electronic or online programs to create their Engineering Notebook. For the purposes of judging, teams must print out their Engineering Notebooks and place them in a binder, no larger than 3” All pages must be numbered and in order. Only one copy is required per team.

Handwritten: Spiral-bound, laboratory, or documentation notebooks are available through your school or local stationary supply store, or you may use the binder supplied by Rockwell Collins delivered to you in your Registration and Welcome Kit. Use the following criteria:

1. Your Team Number and Team Name must be clearly printed on the cover of your Engineering Notebook.
2. Numbered pages are required so that pages cannot be substituted or deleted.
3. Only one Engineering Notebook is required per team.
4. Multiple teams may not share an Engineering Notebook.

5.4 Guidelines/Format

The FTC engineering notebook is a complete documentation of your team’s robot design. This documentation should include sketches, discussions and team meetings, design evolution, processes, obstacles, and each team member’s thoughts throughout the journey for the entire season. A new notebook should be created for each new season.

5.4.1 Guidelines

1. Document EVERYTHING!!
2. Your Team Number and Team Name must appear on the outside of the Engineering Notebook. Engineering Notebooks will not be considered without this information.

3. Attach a “summary page” to the front cover of your Engineering notebook. Your summary should be a brief, one page narrative about your team, your school or organization, and an overview of the highlights of your season. Your summary page should also include your team number and point the Judges to the pages in your Engineering Notebook that you would most like the Judges to consider.
4. The Engineering Notebook must be divided into multiple sections, including:
 - a. An Engineering Section that includes your robot design processes (required)
 - b. A Team Section that includes information about your team, your outreach activities (required)
 - c. Your business plan, strategic plan or sustainability plan (not required)
5. Engineering Notebooks should be organized enough that an outsider (e.g. a potential sponsor) can understand your team and your journey.
6. Start the Team Section of your notebook by introducing each team member and mentor with a brief biography of their name, age (or school year), interests, and reasons for joining your FTC team.
 - a. The Team Section of the Engineering Notebook is also a good place to discuss and show team activities that are done throughout the team’s season.
7. Start a fresh page in the Engineering Section at every meeting. The date, and start/stop times should be recorded when starting a new page. Each day should start with two columns:
 - a. Task Column – What is your team doing and discovering?
 - b. Reflections Column – Where your team records thoughts on what is happening and any questions that need to be answered
8. All designs and changes to your robot should be recorded directly into the Engineering Section of your notebook. The inclusion of all details and sketches are preferable. Notes and calculations should be done in your notebook, NOT on loose paper
9. Insert a copy of your robot’s Bill of Materials (BOM) as part of your Engineering Notebook as required by rules in the annual Game Manual.

5.4.2 Format

1. Written entries should be in permanent ink – not pencil.
2. Entries should be made by every team member, initialed and dated.
3. Use both sides of a page. Never leave any white space: “X” out or crosshatch all unused space, and initial and date.
4. To insert pictures or outside information into your notebook, tape the picture into your notebook and outline with permanent ink, to note that it was there in case it falls out. Put the corresponding page number on that inserted page
5. In the case of an error, draw a single line through the incorrect data. Do NOT erase or use correction fluid. All corrections should be initialed and dated.

5.5 Judges’ Tips

- ❖ Every notebook is a work in progress, forever changing and developing. Judges do not want to see a “final” copy notebook if yours is handwritten; they want the real thing complete with misspellings, stains, worn edges and

wrinkled pages. Just remember to keep it real!

- ❖ Pictures along with the bios would serve as a great visual for the judges to get to know each member of your team.
- ❖ A judging panel is always interested to see a unique design or playing strategy. On the other hand, a design without the substance to support its reasoning is not viewed as highly.
- ❖ Pictures or sketches of your robot designs are recommended as part of a thorough documentation.
- ❖ Bring a second copy of the BOM for robot hardware inspection.

5.6 Notebook Examples

A scanned copy of an award-winning Engineering Notebook example is posted on the FTC [website](#). It is strongly encouraged for teams to look over this as a great example of what the judges will be looking for when reading through your Engineering Notebooks.

6.0 The Robot

6.1 Overview

A *FIRST* Tech Challenge Robot is a remotely operated vehicle designed and built by a registered *FIRST* Tech Challenge team to perform specific tasks when competing in the annual game challenge. This section provides rules and requirements for the design and construction of your Robot. Please ensure that you are familiar with the Robot and game rules before beginning Robot design.

6.2 Robot Rules

The intent of the FTC Game Design Committee (GDC) is to create games that can be played with Robots constructed with the TETRIX®, MATRIX®, and/or LEGO® robotics system kits using basic tools and equipment. Anyone that has attended a tournament knows that FTC teams think outside the kit-of-parts to create unique and creative robots. For the 2014-2015 season the GDC has upped the creative potential for Robot design by removing many of the legacy restrictions for mechanical/structural items. The GDC hopes that veteran FTC students will enjoy the increased freedom of choice and the resulting simplification of hardware inspection.

6.2.1 General Robot Rules

<RG01> Only ONE Robot will be allowed to compete per registered *FIRST* Tech Challenge team. It is expected that teams will make changes to their Robot throughout the season and at competitions.

- a. It is against the intent of this rule to compete with one Robot while a second is being modified or assembled at a tournament.
- b. It is against the intent of this rule to switch back and forth between multiple Robots at a tournament.

<RG02> Every Robot will be required to pass a full inspection before being cleared to compete. This inspection ensures that all FTC Robot rules and regulations are met. Teams are required to conduct a self-inspection of their Robot and submit the completed hardware and software inspection forms at tournament check-in or at another designated place.

All Robot configurations must be inspected before being used in competition.

- a. If significant changes are made to a Robot after it has passed the initial inspection, it must be re-inspected before it will be allowed to compete.

- b. Referees or inspectors may request the re-inspection of a Robot. The Robot is not allowed to participate in a match until it passes re-inspection. Refusal to submit to re-inspection will result in disqualification of the team.
- c. Appendices 1 and 2 of this manual contain copies of the Robot inspection forms and provide additional information about the inspection process.

<RG03> 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 or flip other competing Robots.
- c. Those that contain hazardous materials (e.g. mercury switches, lead, or lead containing compounds).
- d. Those that pose an unnecessary risk of entanglement.
- e. Those that contain sharp edges or corners.
- f. Those that contain animal-based materials (due to health and safety concerns).
- g. Those that contain liquid or gel materials.
- h. Those that contain materials that would cause a delay of game if released (e.g. ball bearings, coffee beans, etc.).
- i. Those that are designed to electrically ground the Robot frame to the floor.

<RG04> The maximum size of the Robot for starting a Qualifying or Elimination Match is 45.72cm (18 inches) wide by 45.72cm (18 inches) long by 45.72cm (18 inches) high. The Robot Sizing Box will be used as the official gauge in determining conformance to this rule. To pass inspection a Robot must fit within the box without exerting force on the sides or top of the box. Robots may expand beyond the starting size constraint after the start of the match. The alliance flag and pre-loaded game elements may extend outside the starting volume constraint.

The Robot must be self-supporting while in the Robot Sizing Box by either:

- a. A mechanical means with the Robot in a power-OFF condition. 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.
- b. A Robot Initialization Routine in the Autonomous mode program that may pre-position the servo motors, with the Robot in a power-ON condition, to the desired position by means of a single instruction to the Servo controller for each servo motor effected. If the Robot Initialization Routine does move the servos when a program is executed, there must be an indicator on the Robot of this fact. A warning label placed near the Robot's main power switch is required. Affix the image below to your Robot if servos are commanded to move during the initialization routine:



<RG05> The Robot main power switch(es) MUST be mounted/positioned to be readily accessible and visible to competition personnel. A Main Robot Power label must be placed near the main power switch(es) of the Robot. Please print this page and affix the image (below) to your Robot.



**MAIN ROBOT
POWER**

<RG06> Batteries MUST be securely attached to the Robot.

<RG07> The NXT controller and Samantha Wi-Fi Communication Module MUST be accessible and visible by competition personnel.

- a. The NXT battery MUST be easily removable with minimal disassembly of the Robot.
- b. The USB ports and buttons on the NXT and Samantha Wi-Fi Communication Module MUST be easily accessible.
- c. The NXT Controller liquid crystal display and Samantha Wi-Fi Communication Module LEDs MUST be readily visible.
- d. The NXT Controller and Samantha Wi-Fi Communication Module shall be mounted such that they are protected from contact with the Playing Field elements or other Robots. These and other electrical components (batteries, motor and servo controllers, switches, etc.) make poor bumpers and are unlikely to survive the rigors of game play when attached in a Robot-to-Robot contact area.

<RG08> Robots MUST include a mounting device to securely hold one tournament supplied FTC Robot Alliance Identification Flag throughout an entire match. Because of the need to clearly identify a Robot's Alliance, the flag MUST be mounted at the TOP of the Robot and be clearly visible throughout the match. Flag posts are typically a soda straw with dimensions that are close to 0.635cm (0.25") OD x 0.5cm (0.20") ID x 21 cm (8.25") length with a triangular flag 10.16cm (4.0") high x 15.24cm (6.0") wide. These may vary from event to event. Mounting devices that damage the flag post are not acceptable.

<RG09> Robots MUST prominently display their team number (numerals only, e.g. "1234").

- a. The judges, referees, and announcers must be able to easily identify Robots by team number.
- b. Team number must be visible from at least two sides of the Robot (180 degrees apart).
- c. The numerals must each be at least three inches high, at least in 1.27cm (0.5") stroke width, and in a contrasting color from their background.
- d. Team numbers must be robust enough to withstand the rigors of match play.

<RG10> Energy used by *FIRST* Tech Challenge Robots, (i.e., stored at the start of a MATCH), shall come only from the following sources:

- a. Electrical energy derived from the onboard TETRIX or MATRIX battery pack, HiTechnic 9-volt Battery Box for the sensor multiplexer, MATRIX Battery Box for powering the Samantha unit (MATRIX Robots only), the battery for the visible LEDs, a 9-volt battery connected to an approved prototype board, and the NXT battery.
- b. A change in the position of the Robot center of gravity.
- c. Storage achieved by deformation of Robot parts. Teams must be very careful when incorporating spring-like

mechanisms or other items to store energy on their Robot by means of part or material deformation. A Robot may be rejected at inspection if, in the judgment of the inspector, such items are unsafe.

- d. Compressed air and pneumatic devices are not allowed.

<RG11> Game elements launched by Robots should not have a velocity greater than that required to reach a maximum of five (5) feet (1.5 meters) above the playing field surface, nor travel a horizontal distance greater than ten (10) feet (3 meters) from the point that the game element ends contact with the Robot. Parts of the Robot itself may not be launched.

6.2.2 Robot Parts and Materials Rules

<R01> All LEGO parts are allowed except for the following:

- a. Any DUPLO parts
- b. LEGO MINDSTORMS EV3
- c. LEGO pneumatics

<R02> All TETRIX parts are allowed except for the following:

- a. R/C Controller (Product Id W34243 or W36117)
- b. R/C Receiver (Product Id W35496)
- c. Infrared Electronic Ball (Product Id W991458)
- d. DC Motor Speed Controller (Product Id W34244)
- e. Wireless Camera Kit (Product Id W39683)
- f. Autonomous Mounting Deck (W37799)
- g. R/C Mounting Deck (W37663)
- h. Battery Holder (W39136).
- i. 2.4 GHZ 4 Channel Wireless Joystick Receiver (Product Id 40377)
- j. 2.4 GHZ 4 Channel Wireless Joystick Gamepad (Product Id 40377)
- k. 3.6 to 7.2 Volt NIMH Charger (Product Id 40378)
- l. TXP Prime Gripper Kit (Product Id 40234)
- m. TXP Battery pack 5AA cell 1500mAh 6 Volt NIMH (Product Id 40235)

<R03> All MATRIX parts are allowed.

<R04> In addition to the TETRIX, LEGO, and/or MATRIX components, teams may use additional materials and COTS (Commercial Off The Shelf) components to construct their Robots subject to the following restrictions:

- a. All raw materials are allowed provided they are readily available to the majority of teams from standard distributors (e.g. McMaster-Carr, Home Depot, Grainger, AndyMark, etc.).

Examples of allowable raw materials are:

- sheet goods
- Extruded shapes
- Metals, plastics, wood, rubber, etc.

- b. All post-processed materials are allowed provided they are readily available to the majority of teams from standard distributors (e.g. McMaster-Carr, Home Depot, AndyMark, etc.).

Examples of allowable post processed materials are:

- perforated sheet and diamond plate
- Injection molded parts
- 3D printed parts

- c. COTS parts and assemblies may only have a maximum of a single degree of freedom. It is the intent of *FIRST* that teams design and build their devices to achieve the game challenge. Assemblies of COTS components, such as linear slides, and gearboxes are allowed while a pre-fabricated gripper assembly designed to grab the game elements is not. Holonomic wheels (omni or mecanum) are exempt from the one degree of freedom limitation.

Examples of single degree of freedom COTS components are:

- Hinges
- Sprockets
- Gears of any type, including Rack and Pinion gears
- Simple and compound gear trains
- Planetary gear trains
- Lazy Susan

- d. High traction wheels, eg. AM- 2256, that may damage the playing field are not allowed.
- e. All TETRIS, MATRIX, raw materials, and COTS may be modified (e.g. drilled, cut, painted, etc.) provided no other rules are violated.

<R05> Welding, brazing, soldering and fasteners of any type are legal methods for assembling a Robot.

<R06> Any type of COTS lubricant is allowed, provided that it doesn't contaminate the playing field, game elements, other Robots, etc.

<R07> Team designed 3D printed parts are allowed.

<R08> Robot electronics are constrained to the following:

- Exactly one (1) LEGO MINDSTORMS NXT Controller MUST be used in FTC competitions. No other Robot controllers, including the EV3 controller, may be used in FTC competitions.
- Exactly one (1) Samantha Wi-Fi Communication Module with USB A-B cable (and optional pigtail) to go from the Samantha module to the NXT (24"/60.96 cm or shorter is recommended) must be used. USB cables with integral ferrite chokes (e.g. Tripp Lite U023-003) are allowed. Separate ferrite choke cores that snap onto cables (e.g. RadioShack # 273-105) are also allowed. No other wireless communication is permitted during match play.
- Use of USB Surge Protectors connected to USB cables are allowed.
- Additional electronics are allowed provided they are an integral part of an allowed part, or attached to the

HiTechnic SuperPro Prototype or the NXT Prototype Boards, or are purely decorative in function. Approved prototype boards may optionally include a 9-volt battery per <R11>d.i.

- e. The NXT controller must be powered either by the NXT rechargeable AC battery (W979798), NXT DC Battery (W979639), or six (6) AA batteries.
- f. Battery Packs
 - i. Exactly one (1) TETRIX rechargeable battery pack used to power HiTechnic DC Motor Controllers, HiTechnic Servo Controllers, the Samantha Wi-Fi module, and visible light LEDs.
 - Or
 - ii. Not more than two (2) MATRIX battery packs used to power MATRIX Motor and Servo Controllers. One battery pack is to be used per Motor and Servo Controller. Battery Packs must power independent electrical circuits; multiple battery packs may not be connected together in parallel or serial.
- g. Exactly one (1) MATRIX Battery Box to power the Samantha Wi-Fi module for Robots using the MATRIX electronics.
- h. Exactly one (1) power switch that turns the Robot on or off per Battery Pack. The power switch MUST be installed between the battery and all electronics that it powers. MATRIX Battery Pack Power Switches must be placed side by side on the Robot.

<R09> Robot motors and servos are constrained to the following:

- a. A Robot is constructed with either TETRIX or MATRIX motor and servo controllers, not both. Any quantity of TETRIX (HiTechnic) or MATRIX Motor and Servo Controllers are permitted provided that the quantity doesn't exceed the technical specifications for these devices, the NXT, and the software. Motor controller outputs may only be used to directly control DC motors. Servo controller outputs may only be used to directly control servos.
- b. A maximum total of eight (8) TETRIX /AM-2964 motors (in any combination) or eight (8) MATRIX DC motors are allowed and must be controlled by a compatible TETRIX or MATRIX controller. A Robot is constructed with either TETRIX /AndyMark or MATRIX DC motors, not both.
- c. A maximum of twelve (12) servos are allowed, provided that they are compatible with and controlled by TETRIX (HiTechnic) or MATRIX controllers. For TETRIX (HiTechnic) Servo Controllers:
 - i. Any unmodified quarter-scale or smaller servo is allowed.
 - ii. The sum of the rated stall current for all servos connected to a single Servo Controller must be no greater than 5 Amps per controller.
- d. LEGO approved/certified motors may be used with the following constraints (per NXT motor port):
 - i. One (1) NXT Interactive Servo Motor (LEGO Part # W979842)
 - ii. One (1) XL Power Function Motor (LEGO Part # W778882)
 - iii. Two (2) E Power Function Motors (LEGO Part # W979670)
 - iv. Two (2) M Power Function Motors (LEGO Part # W978883)
 - v. One (1) E Motor and one (1) M Motor
- e. Any number of NXT conversion cables to connect the Power Function Motors with the NXT (LEGO Part #s W770323, W778886, or W778871) are allowed.

- f. Power Function Battery Packs (LEGO Part #s W778881 or W778878) are NOT allowed.
- g. Motors, sensors, controllers, and any other electrical components may not be altered from their original state in ANY way unless specifically allowed by the Robot rules. The following motor modifications are allowed:
 - i. Teams may solder wires to the motor leads
 - ii. Motor shafts may be modified (i.e. cut short, drilled thru, etc.)

Gearboxes may be replaced and repaired with replacement parts that are equivalent (identical in performance) to the original.

<R10> Robot wiring is constrained as follows:

- a. LEGO-Approved NXT Mindstorm cables are allowed. Approved cables are currently only available from LEGO and HiTechnic. NXT implementation limits cable lengths to 0.9 meter maximum length. NXT Mindstorm cables cannot be modified in any way.
- b. LEGO-Approved NXT Conversion Cables to connect RCX sensors or Power Function Motors to the NXT (LEGO Part #s W770323, W778886, or W778871) are allowed.
- c. Anderson PowerPole, and similar crimp or quick connect style connectors for joining electrical wires are allowed. Power distribution splitters may also be used (and are strongly recommended) to make wiring easier. All connectors/distribution splitters should be appropriately insulated.
- d. Non-NXT power, motor control, servo, and encoder wires and their connectors may be extended, custom made, or COTS subject to the following constraints:
 - i. Battery wires are 16 AWG or larger
 - ii. Samantha power wires are 18 AWG or larger
 - iii. Motor control wires are 22 AWG or larger
 - iv. PWM wires are 20 AWG or 22 AWG
- e. Power and motor control wires are strongly recommended to use consistent color coding with different colors used for the Positive (red, white, brown, or black with a stripe are recommended) and Negative/Common (black or blue are recommended) wires. Wire and cable management products of any type are permitted (e.g. cable ties, cord clips, sleeving, etc.).
- f. Wire insulation materials of any type are permitted when used to insulate electrical wires or secure motor control wires to motors (e.g. electrical tape, heat shrink, etc.).
- g. The connectors on the TETRIX and MATRIX battery packs may be replaced or augmented with any compatible connector described in <R10.c> above.

<R11> Additional Robot electronics are constrained as follows:

- a. Only LEGO Approved NXT and RCX sensors (as indicated by the LEGO certified hardware label), and HiTechnic NXT compatible sensors are allowed to be directly connected to the NXT, the HiTechnic Sensor Multiplexer, and the HiTechnic Touch Sensor Multiplexer.
- b. The HiTechnic NXT Touch Sensor Multiplexer (MUX) and NXT Sensor Multiplexer (MUX) are allowed.
- c. The HiTechnic 9-volt Battery Box that is sold as part of the NXT Sensor Multiplexer set may be used in conjunction with each NXT Multiplexer (i.e. one Battery Box per Sensor Multiplexer). It may be used only in conjunction with the NXT Sensor Multiplexer(s) to provide power for the MUX.

- d. Prototype Boards are allowed but are limited to the HiTechnic SuperPro Prototype Boards and NXT Prototype Boards. Any number of Prototype Boards are allowed, providing no other rules are violated, with the following constraints:
- i. All power used in the circuits connected to the Prototype Board must be derived from the power connections provided within the board including the board's optional additional 9V battery, if one is supported by the Prototype Board. Note that at most one additional 9V battery is allowed per Prototype Board.

Circuits may connect only to the designated connections provided by the NXT Prototype Board. (i.e. A4-A0, B5-B0, 3V, 4V, 9V, 5V, GND) or HiTechnic SuperPro Prototype Board (i.e., A3-A0, B7-B0, S3-S0, O1-O0, WR, RD, 3V, 9V, 5V, GND). No changes to this interface are allowed. No direct connections to batteries or power sources is allowed.
 - ii. Circuitry that is connected to the Prototype Board may communicate with the NXT Controller only through the provided NXT interface on the Prototype Board. No changes to this interface, either hardware or software, are allowed. Any compatible electronics may be connected to and controlled by the Prototype Board, provided that no other rules or constraints are violated.

Compatible electronics include both simple circuit elements (such as resistors and capacitors) as well as more advanced elements (such as microcontrollers). Circuitry may not increase the electrical power (either voltage or current) provided by the Prototype Board.
 - iii. Circuitry that is connected to the Prototype Board may be distributed throughout the Robot.
 - iv. Circuits included as part of the Prototype Board may not cause interference with any Robot on the playing field, any part of the field management system or any game element.
 - v. Circuits implemented on or connected to a Prototype Board may not communicate in any way with other Robots on the playing field, any part of the field management system, or any other external device
- e. Visible light LEDs with their connected electronic circuits are allowed; infrared (IR) LED's are NOT allowed.
- i. Power for the LEDs may be provided by the main Robot battery pack (TETRIX or MATRIX) or by no more than one (1) battery of any type not to exceed 9 volts. LEDs controlled by the Robot must be controlled and powered only by connections to a HiTechnic SuperPro Prototype Board or the NXT Prototype Board.
 - ii. LEDs may not cause interference with any Robot Driver, field personnel, any Robot on the playing field, any part of the field management system or any game element.
 - iii. LEDs may not communicate in any way with other Robots on the playing field, any part of the field management system, or any game element.
- f. Video recording devices (GoPro or similar) are allowed providing they are used only for non-functional post match entertainment and the wireless capability is turned off.

<R12> Robots may contain decorations provided that that they are non-functional; do not affect how the Robot interacts with the playing field, field elements, or other Robots; do not require external power except as specified in rule <R11.e> do not affect the outcome of the match; are not hazardous to themselves or other teams; and are in the spirit of Gracious Professionalism. A simple test of decorative vs. functional; if the items in question were turned off and/or removed from the Robot, there would be no change in the capabilities of the Robot, the team, or the alliance, nor any change in the outcome of the match.

6.2.3 Robot Software Rules

<RS01> The Robot must be designed to be controlled by no more than two (2) Logitech Gamepads. Official FTC tournaments will provide either the Logitech DualAction or Logitech F310 gamepads in any combination for the competition playing fields.

<RS02> Each team MUST “name” their NXT with their official FTC Team number (e.g. “1234”). Spare NXTs should be named with the team number followed by a hyphen then a letter designation beginning with “B” (e.g. “1234-B”, “1234-C”). Should a spare NXT be “loaned” to another team, the receiving team should rename the NXT with their corresponding team number along with the hyphenated letter designation showing the Field Control System that it is a spare.

<RS03> Programming for the *FIRST* Tech Challenge must be done with an approved programming language, using MANDATORY FTC Competition Templates, and corresponding firmware. Approved programming languages are:

- a. ROBOTC version 3.0 or later (firmware version 9.0 or later)
- b. LabVIEW for LEGO MINDSTORMS 2012 (LVLM 2012) (NXT Firmware version 1.31 or later)

Templates for all programming choices are available through the links located at <http://www.usfirst.org/roboticsprograms/ftc/team-resources>.

If updates are announced later in the season, teams must update to the latest version prior to time of competition.

<RS04> The “Samostat” program MUST be installed on the NXT. Once installed, the team does not have to install Samostat again unless a new version of the Samostat code is released, the programming environment is updated, or firmware is re-installed on the NXT.

<RS05> The “Program Chooser” program MUST be installed on the NXT. The Program Chooser enables teams to select the program started by the FCS for the Driver-Controlled portion of the match without having to connect the NXT to a computer. Once installed, the team does not have to install it again unless firmware is re-installed on the NXT, a new version of the Program Chooser code is released, or the programming environment is updated.

<RS06> The NXT MINDSTORMS Controller Sleep Timer must be set to NEVER.

<RS07> Robots will connect to the tournament supplied Field Control System (FCS) located at each field.

Teams must demonstrate that their Robot switches between Autonomous mode and Driver-Controlled mode correctly using the latest version of the FCS. This is done during Software Inspection.

<RS08> Immediately prior to the start of the Autonomous Period and during the pause between the end of the Autonomous and the start of the Driver Controlled periods, Robots shall be motionless, with the exception of initialization of positioning for servos. Violations subject the Robot to random repositioning by the head referee. Repeated violations may lead to disqualification of the Robot.

7.0 Robot Inspection

7.1 Overview

This section describes *Robot* Inspection for the *FIRST* Tech Challenge competition. It also lists the inspection definitions and inspection rules.

7.2 Description

The FTC *Robot* will be required to pass hardware and software inspections before being cleared to compete. These inspections will ensure that all FTC *Robot* rules and regulations are met. Initial inspections will take place during team check-in/practice time. The official FTC “Robot Inspection Checklists” are located in the appendix. **Teams are required to conduct a self-inspection of their *Robot* and submit the completed hardware and software inspection forms at tournament check-in.**

7.3 Definitions

Robot - An operator controlled and/or autonomous programmed vehicle designed and built by a *FIRST* Tech Challenge team to perform specific tasks while competing in the annual game challenge. The *Robot* may only be constructed from materials and components outlined in Section 6.

Robot Initialization Routine – A set of programming instructions inserted immediately prior to the match control loop of the Autonomous or Driver-Controlled programs that serves to ready the *Robot* for a match.

Robot Sizing Box – A sturdily constructed cube with the interior dimensions; 45.72cm (18 inches) wide by 45.72cm (18 inches) long by 45.72cm (18 inches) high that has one open side with an interior opening size of 45.72cm (18 inches) wide by 45.72cm (18 inches) long. The Sizing Box is used for *Robot* Inspection as outlined in Section 7.4.

7.4 Inspection Rules

<I1> FTC teams must submit their *Robot* for inspection prior to participating in practice rounds. At the discretion of the FTC Lead Inspector, the *Robot* may be allowed to participate in practice rounds before passing inspection.

<I2> The team’s *Robot* must pass all inspections before participating in Qualification Rounds. Noncompliance with any *Robot* design, construction rule, or programming requirements may result in disqualification of the *Robot* at an FTC event.

<I3> The maximum size of the *Robot* for starting a Qualifying or Elimination Match is 45.72cm (18 inches) wide by 45.72cm (18 inches) long by 45.72cm (18 inches) high. The *Robot Sizing Box* will be used as the official gauge in determining conformance to this rule. To pass inspection a *Robot* must fit within the box without exerting force on the sides or top of the box. The *Robot* must be self-supporting while in the *Robot Sizing Box* either:

- a. by mechanical means with the *Robot* in a power-OFF condition, or
- b. by a *Robot Initialization Routine* in the Autonomous mode program that may pre-position the servo motors, with the *Robot* in a power-ON condition, to the desired position by means of a single instruction to the servo controller for each servo motor effected. The label shown in rule <RG04> must be affixed to the *Robot* if servos move during the *Robot* Initialization Routine.

<I4> The team is required to request a re-inspection of their *Robot* by an Inspector when a modification to improve performance or reliability of their *Robot* has been made.

<I5> It is the FTC Inspector’s responsibility to evaluate *Robots* to insure each *Robot* has been designed to operate and function safely. Section 5 and Game Manual Part 2, Section 1.5.1 specify the safety rules and limitations that apply to the design and construction of all *Robots*.

<16> *Robot* inspection is a Pass / Fail process. A *Robot* has passed inspection when ALL requirements listed on the official FTC “hardware and software *Robot* Inspection Sheets” have been successfully met and recorded as passed by an FTC Inspector

8.0 Judging & Award Criteria

8.1 Overview

This chapter provides a complete description of all of the FTC Awards; the judging process, criteria and philosophy that teams need to be aware of in preparation for participating at FTC Tournaments.

Teams have spent a significant amount of time designing, building, programming their robot, and learning what it takes to be a part of a team. For many FTC teams, the event is the reward for all their hard work throughout the season. While there are several types of events, they all offer a fun and exciting way for teams to demonstrate the result of their efforts.

The judged awards represent another positive way we recognize teams who embody important values like teamwork, creativity, innovation, and the value of the engineering design process. These judging guidelines are a part of the road map to success.

Teams that are transitioning to *FIRST* Tech Challenge (FTC) from *FIRST* Lego League (FLL) must review FTC specific guidelines for judging. Unlike *FIRST* Lego League (FLL), FTC judging sessions do not include written or verbal feedback for students. FTC judging is a subjective process; and helps students prepare for professional interviews while developing other real world life skills.

8.2 FTC Award Eligibility

To ensure fairness to all teams and to provide equal opportunity for all teams to win an award at an FTC Championship tournament, teams are only eligible to win an award at the first three Championship tournaments that they attend. Those teams who compete in more than three Qualifying Tournament, League Championships, and Championship tournaments do so for the purpose of being involved in the fun and excitement of the tournament and not with the intention of winning awards or advancing to the next tournament level.

Teams are allowed to win the Inspire Award only once during each tournament level (Qualifying Tournament/League Championship, Championship) within a state or region. Once a team wins the Inspire Award at a Qualifying tournament, they are not eligible for consideration for the Inspire Award and are only eligible to win the other judged or alliance awards at subsequent Qualifying tournaments. The same restriction applies to teams attending multiple League Championship tournaments and Championship tournaments. Each team is responsible for informing tournament organizers and judges if they are ineligible for awards or advancement based on these policies. It is the Teams responsibility to let the Tournament Director know if they have already won the Inspire Award at the same level competition within a region.

8.3 FTC Award Categories

8.3.1 FTC Inspire Award

This formally judged award is given to the team that truly embodied the ‘challenge’ of the FTC program. The team that receives this award is chosen by the judges as having best represented a ‘role-model’ FTC Team. This team is a top contender for all other judging categories and is a strong competitor on the field. The Inspire Award Winner is an inspiration to other teams, acting with Gracious Professionalism™ both on and off the playing field. This team is able to

communicate their experiences, enthusiasm and knowledge to other teams, sponsors, and the Judges. Working as a unit, this team will have demonstrated success in accomplishing the task of creating a working and competitive robot.

In past seasons, the winner of the Inspire Award at each tournament level has received an automatic invitation to the next tournament level. Once a team has won an Inspire Award at a Championship, they are no longer eligible to win the Inspire Award at additional championship tournaments they may attend. Similarly, once a team wins an Inspire Award at a Qualifying tournament, they are no longer eligible to win the Inspire Award at subsequent Qualification tournaments within the same region.

Guidelines for the Inspire Award:

- ❖ Team must demonstrate respect and Gracious Professionalism towards everyone they encounter at an FTC event.
- ❖ Team is a strong contender for all Judged awards. The Inspire Award is based on the guidelines for all of the Judged Awards
- ❖ Engineering Notebook must be submitted, and must include an Engineering Section, a Team Section and a Business or Strategic Plan. The entire Engineering Notebook must impress the judges
- ❖ Team demonstrates and documents their work in their community spreading awareness of the team, *FIRST*, and FTC within the community
- ❖ Team displays good communication and teamwork skills within the team as well as with their alliance partners
- ❖ Team communicates clearly about their robot design and strategy to the judges
- ❖ Team presents themselves well in the judges' interview
- ❖ Robot and team effectively competes in the game challenge and impresses the judges
- ❖ Team and robot consistently perform well during matches

8.3.2 Think Award

Removing engineering obstacles through creative thinking.

This judged award is given to the team that best reflects the “journey” the team took as they experienced the engineering design process during the build season. The engineering section of the notebook is the key reference for judges to help identify the most deserving team. The team’s engineering notebook should focus on the design and build stage of the team’s robot. Journal entries of interest to judges for this award will include those describing the underlying science and mathematics of the robot design and game strategies, the designs, re-designs, successes, and those ‘interesting moments’ when things weren’t going as planned. A team is not a candidate for this award if they have not completed the Engineering Section of the Engineering Notebook.

Guidelines for the Think Award:

- ❖ Team demonstrates respect and Gracious Professionalism towards everyone they encounter at an FTC event.
- ❖ Team must submit an engineering notebook with an Engineering Section Team notebook must be clearly identified with the Team # and Team Name
- ❖ Engineering notebook must demonstrate that the team has a clear understanding of the engineering design process, with pictures or drawings and details documenting all stages of robot design
- ❖ Engineering notebook must be organized and follow the formatting guidelines provided by *FIRST* and include a Summary Page
- ❖ Teams must tab/flag 6 to 8 pages of the Engineering Section to support entries on the summary page.
- ❖ It is acceptable to include designs/ideas that are adapted from an outside source, providing that this is noted

and credit is cited to the original source

- ❖ Supporting drawings and diagrams must be included in the correct chronological order, not in a separate section.

Note: Teams should review the engineering notebook section of this manual for a complete description and format specifications.

8.3.3 Connect Award

Connecting the dots between community, *FIRST*[®], and the business world.

This judged award is given to the team that most connects with their local and engineering community. A true *FIRST* team is more than a sum of its parts, and recognizes that its schools and communities play an essential part in their success. The recipient of this award is recognized for helping the community understand *FIRST*, the *FIRST* Tech Challenge, and the team itself. The team that wins the Connect Award aggressively seeks engineers and explores the opportunities available in the world of engineering, science and technology. In addition, this team has a clear Business or Strategic Plan and has identified steps to achieve their goals.

Guidelines for the Connect Award:

- ❖ Team demonstrates respect and Gracious Professionalism towards everyone they encounter at an FTC event.
- ❖ An Engineering Notebook must be submitted and must include a Business or Strategic plan that identifies their future goals and the steps they will take to reach those. The plan could include fundraising goals, sustainability goals, timelines, outreach, and community service goals.
- ❖ Team provides clear examples of outreach to the community and has developed an in person or a virtual connection with the engineering, science, or technology community.

8.3.4 Rockwell Collins Innovate Award

Bringing great ideas from concept to reality.

The Rockwell Collins Innovate Award celebrates a team that not only thinks outside the box, but also has the ingenuity and inventiveness to make their designs come to life. This judged award is given to the team that has the most innovative and creative robot design solution to any or all specific field elements or components in the FTC game. Elements of this award include elegant design, robustness, and 'out of the box' thinking related to design. This award may address the design of the whole robot, or of a sub-assembly attached to the robot. The creative component must work consistently, but a robot does not have to work all the time during matches to be considered for this award. The team's Engineering Notebook should be marked with journal entries to show the design of the component(s) and the team's robot in order to be eligible for this award, and entries should describe succinctly how the team arrived at that solution.

Guidelines for the Rockwell Collins Innovate Award:

- ❖ Team demonstrates respect and Gracious Professionalism towards everyone they encounter at an FTC event.
- ❖ Robot or robot sub-assembly must be elegant and unique in its design
- ❖ Creative component must work reliably
- ❖ Team must submit an Engineering Notebook with an Engineering Section
- ❖ Robot is stable, robust and controllable
- ❖ Robot design is efficient and consistent with team plan and strategy

8.3.5 PTC Design Award

Industrial design at its best.

This judged award recognizes design elements of the robot that are both functional and aesthetic. All successful robots have innovative design aspects; however, the PTC Design Award is presented to teams that incorporate industrial design elements into their solution. These design elements could simplify the robot's appearance by giving it a clean look, be decorative in nature, or otherwise express the creativity of the team. The winning design should not compromise the practical operation of the robots but complement its purpose. This award is sponsored by Parametric Technology Corporation (PTC), developers of the CAD tools, Creo and Mathcad. PTC gives licenses to the FTC student teams for these software products to help them with their designs. Use of these tools is not required to be eligible, however, teams that use them in their design are given extra consideration for this award.

Guidelines for the PTC Design Award:

- ❖ Team demonstrates respect and Gracious Professionalism towards everyone they encounter at an FTC event.
- ❖ Team must submit an Engineering Notebook with an Engineering Section that includes detailed robot design drawings
- ❖ Robot differentiates itself from others
- ❖ Design is both aesthetic and functional
- ❖ Basis for the design is well considered (i.e. inspiration, function, etc.)

8.3.6 Motivate Award

Showing the community what it means to be a team.

This judged award celebrates the team that exemplifies the essence of the *FIRST* Tech Challenge competition through team building, team spirit and exhibited enthusiasm. This team celebrates their team, their individuality and their spirit through team attire, a team cheer and exhibiting their outstanding team spirit. This teams enthusiasm and spirit motivates others to embrace the culture of the competition and *FIRST*. The team has also made a collective effort to make *FIRST* known throughout their school and community.

Guidelines for the Motivate Award:

- ❖ Team demonstrates respect and Gracious Professionalism to all and functions as a cohesive unit to discover and accomplish the goals of the *FIRST* program.
- ❖ Team can articulate the journey of becoming a team of individuals with different roles and can articulate internal processes to assign and communicate between team members.
- ❖ Team has formed and can articulate internal processes to assign roles and communicate between team members
- ❖ Team attitude of celebration and spirit is consistent throughout the team and the competition
- ❖ Team is enthusiastic and displays this enthusiasm in their community outreach.
- ❖ Team functions well as a unit

8.3.7 Control Award

Mastering robot intelligence.

The Control Award celebrates a team that uses sensors and software to enhance the robot's functionality on the field.

This award is given to the team that demonstrates innovative thinking in the control system to solve game challenges such as autonomous operation, enhancing mechanical systems with intelligent control, or using sensors to achieve better results on the field. The control component should work consistently on the field. The team's Engineering Notebook should contain details about the implementation of the software, sensors, and mechanical control.

Guidelines for the Control Award:

- ❖ Team demonstrates respect and Gracious Professionalism towards everyone they encounter at an FTC event.
- ❖ Team must apply for the Control Award by filling out the Control Award Content Sheet, located in [Appendix 3](#).
- ❖ Team must submit an Engineering Notebook with an Engineering Section
- ❖ Control Components must be documented in the Engineering Notebook
- ❖ Control Components must enhance the functionality of the robot on the field
- ❖ Control Components should work reliably
- ❖ Teams are encouraged to demonstrate control components to the Judges
- ❖ Advanced software techniques and algorithms are encouraged
- ❖ Prototyped sensors and custom hardware are encouraged

8.3.8 Promote Award (Optional)

Many decisions, but choosing *FIRST* was easy!

This judged award is optional and may not be given at all tournaments. Please contact your tournament organizer to determine if it will be given at an event you attend.

The Promote Award is given to the team that is most successful in creating a compelling video message for the public designed to change our culture and celebrate science, technology, engineering and math.

Guidelines for the Promote Award:

- ❖ Team must present a thoughtful and high-quality video which appeals to the general public.
- ❖ Strong production value is important, but the message and impact of the video are of greater weight for the judges.
- ❖ Creativity in interpreting the annually assigned theme is desired.
- ❖ Submissions for this award will be considered for the Inspire Award but are not required.
- ❖ Team must have rights to any music used in the video.

Winning videos will be submitted to *FIRST* and used to promote the higher values of FTC. Teams may win the Promote Award only once at a Championship level event and only once at a qualifying level event.

Team must submit a one-minute long public service announcement (PSA) video one full week prior to the event to be eligible for this award. Additional submissions are welcome but will not be eligible for awards. The submission process for this award may vary by tournament. Please check with your Tournament Director for details.

PSA Subject for 2014 – 2015 Season

- ❖ Create a one minute PSA video that demonstrates the following sentence: "Why I choose FIRST"

8.3.9 Compass Award (Optional)

A beacon and leader in the journey of FTC®

An FTC team is about more than building robots, and competing at tournaments, it is a journey to a destination through trial and error, success and failure, with challenging new technology and obstacles to navigate where no road maps are provided. How does a team find their way?

The Compass Award recognizes an adult Coach or Mentor who has provided outstanding guidance and support for a team throughout the year. The winner of the Compass Award will be determined from candidates nominated by FTC team members, via a 40-60 second video submission, highlighting how their Mentor has helped them become a champion team. We want to hear what sets the Mentor apart.

Guidelines for the Compass Award:

- ❖ Only one video submission per team will be considered. Teams may submit new or updated videos at each tournament.
- ❖ The video must be submitted at least one week prior to tournament day. Instructions for submitting videos may vary from tournament to tournament. Please check with your tournament's organizer for details.
- ❖ Videos must not be longer than 60 seconds (including introduction and credits if you choose to use them).
- ❖ Videos must be submitted in AVI, WMV or MOV format. Remember that the winning video may be shown on a large screen during the awards ceremony. Use the best resolution you have available for your final version.
- ❖ Team must have rights to any music used on the video.
- ❖ Team must submit an Engineering Notebook.

8.3.10 Judges' Award

During the course of the competition, the judging panel may encounter a team whose unique efforts, performance or dynamics merit recognition, yet doesn't fit into any of the existing award categories. To recognize these unique teams, *FIRST* offers a customizable judges award. The judging panel may select a team to be honored, as well as the name of the judges' award.

8.3.11 Winning Alliance Award

This award will be given to the winning alliance represented in the final match.

8.3.12 Finalist Alliance Award

This award will be given to the finalist alliance represented in the final match.

8.4 Judging Process, Schedule, and Team Preparation

The schedules at the FTC tournaments may vary from site to site. Exact times for both the matches and meeting with judges cannot be given within this manual. All teams receive this schedule prior to or during check-in at the competition.

8.4.1 Judging Process

At FTC Championship Tournaments, there will be three parts to the judging process:

1. Interview with judges
2. Evaluation of performance
3. Evaluation of the Engineering Notebook.

Each team will have an interview with a panel of two or three judges. No awards will be determined on the basis of this interview alone. Judges use the guidelines provided in this chapter to assess each team.

Teams should present their engineering notebooks at the Pit Administration Table during check-in unless otherwise directed by the tournament officials. The engineering notebooks are generally provided to the judges prior to the team interviews.

After the judges review the submitted Engineering Notebooks, complete the initial team interviews and evaluate the team and robot performance during matches, they convene to review their assessments and create a list of top candidates for the various judged awards. Judges may require additional impromptu discussions with teams if necessary. Deliberations are usually completed during the elimination matches. When the judges have finished their deliberations, the engineering notebooks are returned to teams.

Teams are asked to bring their robot to the judge interview. This is the best chance for teams to explain and demonstrate their robot design to the judges in a quiet and relaxed environment.

8.4.2 Judging Schedule

The judging generally takes place in a separate area away from the noise of the competition and pit. Teams follow the schedule that outlines team interview times and locations. In some cases, teams may receive this information in advance, but more often, teams will receive this information when they check-in on the morning of the event.

Upon arrival, please familiarize yourself with where the judging will occur and allow enough time to get there. To keep this process on time throughout the event, we require that all teams arrive at the judge queuing area five minutes before their scheduled judging interview.

8.4.3 Team Preparation

Teams are encouraged to use the award guidelines to assess where they are within an award category and help them establish higher goals. These guidelines are the same ones used by the judges during each FTC tournament, Super-Regional Championship, and at the FTC World Championship.

The judges want to know highlights about the team; its history and make up; what the team achieved during the competition season; and the experiences that were gained. Team representatives' abilities to answer the questions or elaborate on robot design functions or attributes are evaluated during the team interview. Check with the event organizer to see if Mentors and Coaches are allowed to observe the team interview. Mentors may not contribute to the judging process. Mentors should always keep in mind that FTC is a student-centered activity and it is about giving the students a unique and stimulating experience in all aspects of the program.

8.5 FTC World Championship Event Eligibility

The culmination of the *FIRST* event season is the *FIRST* Championship Event held in St. Louis, MO. This event represents the conclusion of the season for Jr. *FIRST* LEGO League (Jr. FLL), *FIRST* LEGO League (FLL), the *FIRST* Tech Challenge (FTC), and the *FIRST* Robotics Competition (FRC). This is a fun and exciting experience for teams in all programs to participate.

FIRST Tech Challenge teams earn their way to the FTC World Championship with their performance on and off the field. Advancement Criteria for the FTC World Championship is outlined in Section 4.8 and is similar to advancing from local Qualifiers to local Championship tournaments and to Super Regional Championships. Teams are responsible for their own entry fees, lodging, and travel costs to all *FIRST* events.

9.0 Team Resources

9.1 Overview

This chapter provides teams with necessary information for contacting FTC staff, accessing technical support, using the FTC Q&A system, and using the *FIRST* and FTC logos.

9.2 *FIRST* Contact Information

Teams can reach the FTC staff by e-mail at FTCteams@usfirst.org. The office is open Monday through Friday from 9:00 a.m. to 5:00 p.m., EST. Be sure to provide your team number and contact information.

9.3 Getting Answers to your Questions

For general information and questions regarding FTC, please send an e-mail request to: FTCteams@usfirst.org.

For specific information and questions regarding the FTC program in your area, please contact your region's Affiliate Partner. Search for your area's Affiliate Partner on the FTC web site: www.usfirst.org/regional-contacts.

For questions regarding the annual FTC game (released in September), Teams can access the official FTC Game Q&A forum. The FTC Game Q&A is accessed directly at ftcforum.usfirst.org or by browsing to forums.usfirst.org and following the "*FIRST* Tech Challenge" link found under the "*FIRST* Programs" heading.

Note: Accounts are updated weekly by the *FIRST* IT Department. If you have trouble accessing the forums, please feel free to contact *FIRST* at FTCteams@usfirst.org.

9.4 Rules for Forum Participation

In order to ask official game questions in the FTC Forum, please have your team leader log into the *FIRST* TIMS (Team Information Management System) to see your FTC team forum login under the 'What's New' information once your team has registered and paid. The FTC Forum opens in September.

Anyone can read this moderated forum. Only a single team leader is allowed to ask questions on the forum. Before posting a question, please make sure it has not already been answered. Game questions are not answered after 11:59 AM EST on Thursday during the competition season. Questions asked after this time are answered after the events have concluded for that weekend. As the forum is moderated, questions and answers will be visible only after they have been reviewed and answered.

For detailed information on the FTC program, robot kit and accessories, playing field, etc., visit the following web pages:

FTC information, game information, FAQs, and team resources: www.usfirst.org/roboticsprograms/ftc/

FTC Game Q&A: ftcforum.usfirst.org

9.5 Team Development Support

In addition to the staff at *FIRST* Headquarters, an additional regional level of support is available through the *FIRST* Tech Challenge Affiliate Partners, *FIRST* Regional Directors, *FIRST* Senior Mentors, and VISTA Volunteers. The FTC Affiliate Partners coordinate all FTC activities within a state, province, or region, and should be your foremost resource for help with the program. To find an Affiliate Partner, Regional Director, Senior Mentor, or VISTA volunteer available in your area, please contact *FIRST* at FTCteams@usfirst.org.

9.6 Using the *FIRST* and FTC Logos

We encourage teams to develop and promote team identity. It is a great way to help *FIRST* judges, announcers, and audiences recognize your team at the competition, and it is also a way to help teams create excitement in their communities.

Teams have incredibly creative opportunities in terms of designing your own identity. There are many examples of how teams brand their efforts with websites, team logos on robots, T-shirts, hats, banners, fliers, and giveaways.

You can download the *FIRST* and FTC logos and Logo Standards information from the FTC web site at: www.usfirst.org/roboticsprograms/resourcecenter.aspx?id=17122. Keep in mind the following when working with the *FIRST* and FTC logos:

Positive Promotion: Use the *FIRST* and FTC logos in a manner that is positive and promotes *FIRST*.

Unmodified: Use the *FIRST* and FTC logos without modification. This means that you will use our name and the triangle, circle, square as you see it on our website or letterhead. You can use it in red, blue, and white, or in black and white.

Modification Permission: If you have an interest in modifying the *FIRST* and FTC logos, you must first contact *FIRST*. Please submit a written request letting us know why you want to modify the logo, how you plan to do it, and where you plan to apply it. Send an e-mail request to the *FIRST* Marketing Department, marketing@usfirst.org.

Advertising Use Approval: All teams and sponsors must obtain approval from *FIRST* prior to incorporating our logo in any advertising. Send an e-mail request for advertising approval to: marketing@usfirst.org.

Appendix 1 – Hardware Inspection Checklist

Team Number: _____ Overall Software Inspection Status (circle): **PASS / FAIL**

Team	Inspector	General Robot Rules	Rule#
		Robot fits within the Sizing Box without exerting force on box sides or top	RG04
		Robot does NOT contain any components that could damage the playing field or other robots	RG03 a&b
		Robot does NOT contain hazardous, liquids, or materials that could delay the game	RG03 c, g,h
		Robot poses NO obvious unnecessary risk of entanglement	RG03d
		Robot does NOT contain any sharp edges or corners	RG03e
		Robot Motion Warning Label is attached if servo motors move during the robot initialization routine	RG04b
		Main Power Switch(es) are installed properly, labeled, and readily accessible and visible to competition	RG05 R08g
		All batteries are securely attached to the robot	RG06
		NXT Battery can be easily removed with minimal disassembly of the robot	RG07a
		NXT Controller and Samantha Module buttons and USB ports are readily accessible	RG07b
		NXT Controller liquid crystal display and Samantha LED's are readily visible	RG07c
		Electrical components are mounted such that they are protected from Robot-to Robot contact	RG07d
		Robot Flag Holder is present and adequately holds the flag during normal robot operation	RG08
		Team number is visible from at least 2 sides (180 deg. Apart)	RG09
		Energy used by the <i>Robot</i> , (i.e., stored at the start of a MATCH), shall come only from approved sources	RG10
		Game Elements launched by the robot do not exceed height and range constraints	RG11
		Robot Parts and Materials Rules	
		All components on the Robot are from the TETRIX, LEGO, and MATRIX robotic systems and allowable Raw Materials and COTS	R01, R02, R03, R04
		Robot has exactly one (1) NXT controller and one (1) official NXT rechargeable battery pack (AC or DC) or six (6) AA batteries (not both)	R08a,d
		Robot has exactly one (1) Samantha module and one (1) USB cable (and optional pigtail)	R08b
		Robot has exactly one (1) official TETRIX or no more than two (2) MATRIX main battery packs	R08e
		Exactly one (1) MATRIX Battery Box to power the Samantha Module (Only for MATRIX Robots)	R08f
		Only HiTechnic or MATRIX (not both) motor and servo controllers are used (any quantity is permitted)	R09a
		Maximum of eight (8) TETRIX/AM-2964 motors (in any combination) or MATRIX motors and twelve (12) servos, all controlled by HiTechnic or MATRIX controllers	R09b,c
		Each NXT motor port (A, B or C) controls no more than the allowed motors	R09d
		Any additional electronics comply with the rules	R11
		All electronics attached directly to the NXT, HiTechnic Sensor Multiplexor, or HiTechnic Touch Sensor Multiplexor are LEGO or HiTechnic products	R11a
		HiTechnic 9-volt Battery Box (if used) is only used as part of the NXT Sensor Multiplexor	R11c
		HiTechnic SuperPro Prototype Board and NXT Prototype Board comply with the specified constraints	R11d
		Only LEGO approved NXT Mindstorm extension and conversion cables are used	R10a
		Power, motor control, servo and encoder wires are the correct size	R10d
		Only visible light LEDs are used and powered by either the main battery or no more than one battery of any type not to exceed 9 volt	R11e
		Robot contains only specifically allowed electrical components and the electrical components have NOT been modified from their original state except as permitted by the rules	R09g
		Video recording devices, if used, do not have the wireless communication capability turned on	R11f
		Decorative components used on the robot are constructed with allowed parts or they are non-functional. Decorations are in the spirit of Gracious Professionalism	R12

General Comments or Reason(s) for Failure (if any):

I hereby state that all of the above is true, and to the best of my knowledge all rules and regulations of the *FIRST* Tech Challenge have been abided by.

Hardware Inspector

Team Student Representative

Appendix 2 - Software Inspection Checklists

Team Number: _____

Overall Software Inspection Status (circle): **PASS / FAIL**

Queuing Area Checklist:

Team	Inspector	Drive Team Members Present	Rule #
NA		Coach	
NA		Driver1	
NA		Driver 2 (optional)	
		NXT Configuration	
NA		Samantha unit has the latest firmware and competition connection settings flashed to it (See Instructions Below)	
		NXT named with team number (optional hyphenated letter appended)	RS02
		NXT Firmware Version (circle one)	RS03
		LabVIEW - 1.31 or newer ROBOTC - 9.0 or newer	
		Samostat program is loaded on the NXT	RS04
		Program Chooser program is loaded on the NXT	RS05
		NXT Sleep Timer set to NEVER	RS06
		Queuing Process	
		Team understands that no software changes are allowed in Queue Area.	
		Team understands that the match schedule is only an estimate. Matches may start prior to or after the scheduled time and it is the teams' responsibility to monitor schedule changes and show up when required.	
NA		Team knows where to receive alliance flags and where to return them after the match.	

I certify that the robot is in the proper software configuration.

Queuing Area Inspection Completed by: _____

How to Flash Samantha For Competition at Software Inspection:

1. Obtain the flash drive created by the FTA/FCS Operator with the Samantha.hex file and network key folders loaded.
2. Turn off the power to the Samantha Module.
 - a. TETRIX – Turn off the main robot power switch
 - b. MATRIX – Turn off/disconnect the MATRIX Battery Box
3. Remove the NXT USB cable from Samantha and insert the flash drive into the USB port on the Samantha.
4. Hold down the red button on the Samantha, then power on the Samantha Module. Release the red button when the LEDs on the Samantha light up.
5. The Samantha LEDs will complete TWO cycles of: Red-White-Blue-White-Red.
6. After two full light cycles are complete (approximately 40-seconds), remove the flash drive from the Samantha and reconnect the NXT USB cable.

Important: ENSURE two full LED light cycles complete before removing the flash drive from the module. Repeat the steps if two full LED light cycles are not observed.

Field Inspection Checklist:

Team	Inspector	Field Setup	Rule #
NA		Connection with tournament-supplied FCS is successful	RS07
		Robot Setup procedure on the field is understood by the team and is successful	
		Robot Functionality	
		(Optional) Robot successfully ran an Autonomous program	
		Robot did not move prior to the start of the Autonomous period except for servo initialization	RS08
		Robot did not move between the Autonomous and Driver-Controlled periods	RS08
		Robot's Driver-Controlled mode started when commanded to do so by the FCS	
		Robot stopped at the end of the Driver-Controlled period	
		Match Process	
NA		Team understands how to call for FTA assistance during a match	
		Team understands they cannot touch any robot or field element after the match ends until instructed to do so by the referees	
		Teams understand they are to clear the alliance station as soon as the match ends with one team member remaining behind to collect the robot	

I hereby certify that this team has demonstrated their understanding of the match process, their ability to properly control their robot, and that their robot operates as required during a match.

General Comments or Reason(s) for Failure (if any):

I hereby state that all of the above is true, and to the best of my knowledge all rules and regulations of the *FIRST* Tech Challenge have been abided by.

Software Field Inspector

Team Student Representative

Appendix 3 – Control Award Content Sheet & Instructions

To be considered for the Control Award, teams must submit a Content Sheet describing the observable actions of the control software. Judges will use this sheet when evaluating control designs and when observing robots on the competition field to see how well they perform.

For autonomous operations, teams should draw and label a typical path the robot will take. The labeled points identify key observable actions the robot makes. For each labeled point, a brief description of what to observe should be noted (see example below). Especially describe those key operations where adjustments are made to ensure accurate and repeatable performance.

For teams with multiple autonomous programs, document the most commonly used program and note the basic differences between them, e.g. program for blue alliance is a mirror of the red alliance.

If advanced control elements are being used during the driver controlled period, then a brief description of what to observe should be included at the end of the Content Sheet.

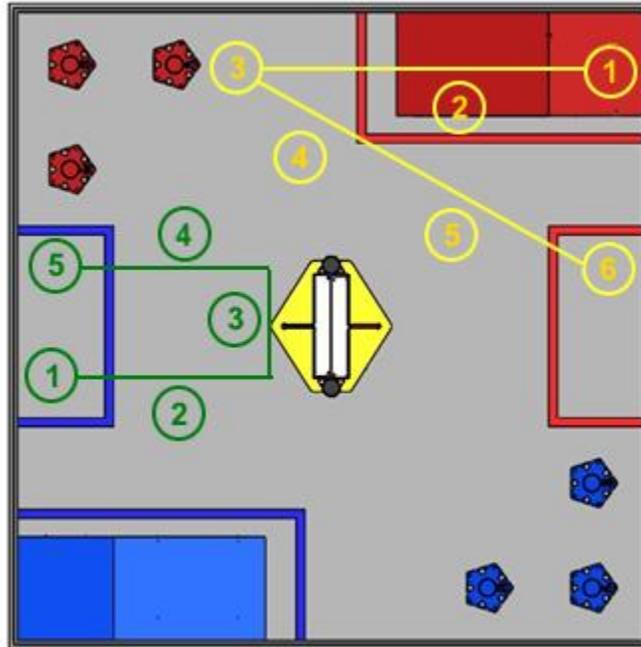
In addition to observing robots on the field, judges will use the teams Engineering Notebook to evaluate details of the Control elements. To facilitate this task, teams should provide information as to where in the Engineering Notebook this information is located. This can be done through adding a section in the Summary Sheet (described in section [5.4](#) in this manual) or through a well identified page in the Engineering Notebook (see example below).

Sample Engineering Notebook Roadmap

The design of several key control algorithms that produce a very repeatable set of autonomous programs can be found throughout the Engineering Notebook. In addition, some control mechanisms were developed to enhance the driver controlled period.

Feature	Notebook Page
Autonomous Goals and Strategies	10, 22, 35
Basic goal Alignment Algorithm	45, 52
Sensor design and placement	72, 74
Alignment performance tests	45, 64
Motor stall detection algorithm	87

Example Content Sheet



Autonomous:

Ramp Start (Yellow)

1. Align robot with moveable goal directly in front.
2. Use odometry to drive down ramp. With side US Sensor, follow wall at distance of 12" until front US Sensor reads 6" from goal.
3. Sweep front US Sensor to find middle of goal, adjust position, drop ball in tube and grab goal.
4. Use gyro to set heading to parking zone, use odometry to drive past ramp to parking zone.
5. Use US Sensor to adjust driving distance from ramp to park at right edge of parking zone.
6. Stop when touch sensor detects contact with wall.

Parking Zone Start (green)

1. Identify beacon location to set path to do drive-by to knock down kickstand.
2. Using gyro and odometry, get into position to drive by kickstand.
3. Using odometry drive by and knock down kickstand.
4. Use gyro to set course back to parking zone.
5. Stop when touch sensor detects contact with wall.

If at any time the motors stall due to unexpected contact, shut down to avoid motor burnout.

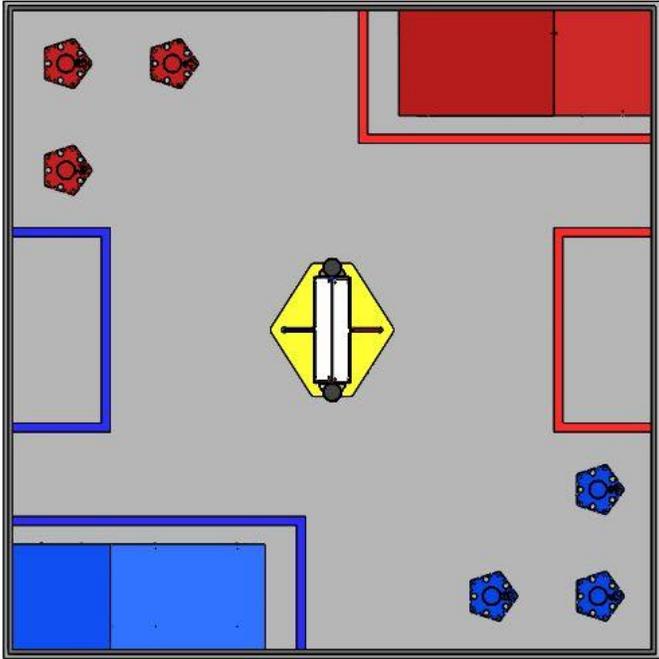
Teleop:

- Use limit switches to quickly lower and raise arm to specified locations.
- Use light sensor to count balls as they are collected. When maximum is reached, light LED so operator knows fully loaded.
- Map joystick controls to each operator's preference.

Use virtual gearing to adjust speed to achieve fine positioning when needed.

Control Award Content Sheet

Team #	Team Name:
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Autonomous:

Driver Controlled: