2015-2016 *FIRST*® Tech Challenge
Game Manual Part I

Volunteer Thank You

Thank you for taking the time to volunteer for a *FIRST* Tech Challenge Event. *FIRST* and FTC rely heavily on Event Volunteers, Coaches, and Mentors alike to ensure Events run smoothly and to support students through their FTC journey. The experience these students receive in the FTC program will surely shape their lives in many positive ways, which could not happen without people like you. With over 4,500 Teams competing annually, your dedication and commitment are paramount to the success to 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!

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Revision History		
Revision	**Date**	**Description**
1	7/8/2015	Initial Release

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1.0 Introduction

1.1 What is the FIRST Tech Challenge?

FIRST Tech Challenge is a student-centered activity that focuses on giving students a unique and stimulating experience. Each year, Teams participate in a new Game that requires them to design, build, test, and program autonomous and driver-operated Robots that must perform a series of tasks.

The *Playing Field* for the Game consists of the *FIRST* Tech Challenge Game Pieces set up on a foam-mat surface, surrounded by a metal and Lexan Field frame. Each Tournament features Alliances, which are comprised of two Teams, competing against one another on the *Playing Field*. Teams work to overcome obstacles and meet challenges, while learning from and interacting with their peers and adult Mentors. Students develop a greater appreciation of science and technology and how they might use that knowledge to impact the world around them in a positive manner. They also cultivate life skills such as:

FTC is More Than Robots! **While competing, students develop personal and professional skills they will be able to rely on throughout their life.**

- Planning, brainstorming, and creative problem-solving.
- Research and technical skills.
- Collaboration and Teamwork.
- Appreciation of differences and respect for the ideas and contributions of others.

To learn more about FTC and other *FIRST* Robotics Competitions, visit www.usfirst.org.

1.2 FIRST Tech Challenge (FTC) Core Values

Volunteers are integral to the *FIRST* community. The *FIRST* Tech Challenge relies on Volunteers to run the program at many levels, from managing a region to Mentoring an individual Team. FTC Affiliate Partners coordinate the program in each region or state. These FTC Partners fundraise, run Tournaments, hold workshops and demonstrations, market FTC locally, handle public relations, and recruit Volunteers and Teams. They are a tremendous resource for Mentors and FTC would not exist without them.

FIRST asks everyone who participates in FTC to uphold and promote the following values:

- We act in a Gracious and Professional manner with everyone we engage with and in everything we do.
- We act with integrity.
- We have fun.
- We are a welcoming community of students, mentors, and volunteers.
- What we learn is more important than what we win.
- We respect each other and celebrate our diversity.
- Students and adults work together to find solutions to challenges.
- We honor the spirit of friendly competition.
- We behave with courtesy and compassion for others at all times.
- We act as ambassadors for *FIRST* and the *FIRST* Tech Challenge.
- We inspire others to adopt these values.

2.0 Gracious Professionalism^{TM}

FIRST uses this term to describe the program's intent. This is one of the most important concepts that can be taught to a young person who is learning to get along in the work world. At *FIRST*, Team members help other Team members, but they also help other Teams.

Gracious Professionalism is not clearly defined for a reason. It can and should mean different things to everyone.

Some possible meanings of Gracious Professionalism include:

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

An example of Gracious Professionalism is offering assistance to another Team with passing Robot Inspection on Event day.

In the context of *FIRST*, this means that all Teams and participants should:

- Learn to be strong competitors, but also treat one another with respect and kindness in the process.
- Avoid leaving anyone feeling as if they are excluded or unappreciated.
- Knowledge, pride and empathy should be comfortably and genuinely blended.

In the end, Gracious Professionalism is part of pursuing a meaningful life. When professionals use knowledge in a gracious manner and individuals act with integrity and sensitivity, everyone wins, and society benefits.

Watch Dr. Woodie Flowers explain Gracious Professionalism in this [short video](#).

 "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."

- Dr. Woodie Flowers, National Advisor for *FIRST*

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.

3.1 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. These 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

3.2 NOTICE OF NON-DISCRIMINATION

United States Foundation for Inspiration and Recognition of Science and Technology (*FIRST*®) does not discriminate on the basis of race, color, national origin, sex, disability, or age in its programs and activities. The following person has been designated to handle inquiries regarding the non-discrimination policies: Lee Doucette, Youth Protection Program Manager, 200 Bedford Street, Manchester, NH 03101, 603-666-3906, Ext. 250.

4.0 The Tournament

4.1 Overview

The *FIRST* Tech Challenge program celebrates the accomplishments of Teams on Tournament day. Tournaments are exciting sporting events with head-to-head competition between Team built Robots, Team and Robot performance awards, fast paced Robot maintenance/repair in the Pit between Matches, cross-Team strategy sessions, mascots, Team cheers, and stupendous acts of Gracious Professionalism. This section provides critical information that will help Teams have a fun and successful tournament day.

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.

Sports Start – A model of Competition where Teams start and stop their Robot after the 3-2-1 countdown. Teams will also

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 the Event Director prior to or at the 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
Teams will hear the expression Gracious Professionalism (GP) often throughout their involvement in FTC. One of FTC's main goals is to encourage all Team members and Volunteers 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 all Teams 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 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 Event 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.).

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 or a limit specified by the venue, whichever is shorter.

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 Team members to show support for their 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. Team members or spectators that wear prescription glasses must wear safety goggles over them or attach safety side shields. Tinted lenses are allowed as long as Event personnel can see the Volunteers, spectators, or Team member's eyes through the safety glasses. 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*.

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 and Field Inspection
3. Judges' Interviews
4. Drivers' Meeting
5. Opening Ceremony
6. Qualification Matches
7. Alliance Selection
8. *Elimination Matches*
9. 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. The Coach or mentor should be sure to bring a roster of students which can either be printed from the Team Information Management System (TIMS) or filled out 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 review the schedule of events for the day, 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 and Field Inspection

FTC Robots are required to pass Robot and Field 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" and "Field Inspection Sheet" is located in Appendices A and B. The "Robot Inspection Sheet" must be used by Teams as a guide to pre-inspect their Robot.

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. Teams must know when they will be interviewed and arrive to the interview room early. Each Team

should 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 some Events, practice fields are set up so that Teams can practice throughout the Event. 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.

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 immediately after, the Qualification Matches take place.

Teams that are scheduled in the first four Qualification Matches will be asked by Volunteers to line up before the opening ceremonies. The Qualification Match schedule will be available prior to the start of Opening Ceremonies. It is the Team's responsibility to check the schedule and make sure they are on time for their Matches.

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. Teams need to know when they 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.
   o   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*.

- 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 Captain* 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:
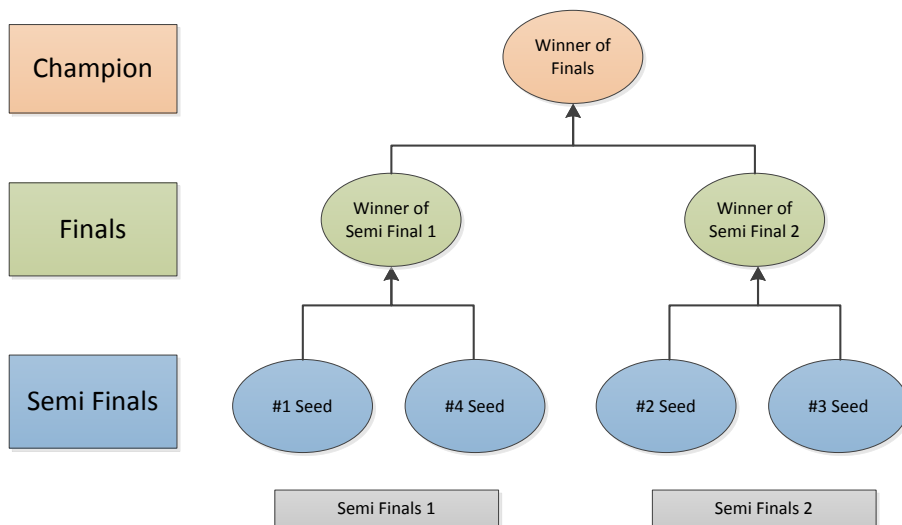
During the *Elimination Matches*, two Teams from an *Alliance* compete on the *Playing Field*. If the *Alliance* has three Teams, the Team that sits out the first Match in an elimination series must play in the second Match, with no exceptions. If the *Alliances* play more than two Matches in any round, <u>any combination of two *Alliance* Robots may be used.</u> 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.

All questions about a Match or scores must be must be brought forward to the Referees by using the Referee Question Box located in the *Competition Area*. Only one **student** from an Alliance is permitted to enter the question box, and must do so within the time period of three (3) Matches following the disputed 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 Scrimmage
Anyone can host a scrimmage to prepare for a Championship or Qualifier. Teams that choose to create and host a local event are responsible for finding a location, organizing the format for the day, and inviting other Teams to participate. Teams may also have to secure the field elements, computers, and other items.

4.7.2 Meets and League Play
A League Meet is a one-Field Competition with modified Judging that uses the same Field and Game as other Events. Teams may participate in as few or as many League Meets as they choose, but participating in more improves their League Ranking. Some of the standard Tournament and Championship guidelines may be modified for those regions that have chosen to participate in the League format. Teams should contact their Affiliate Partner for more information about the scheduling, structure, advancement and processes that are unique to the League/Meet in their region.

4.7.3 Qualifying Tournaments and League Championship
Hosted and managed by FTC Affiliate Partners or Partner-appointed hosts. Qualifying Tournaments follow the judging, game guidelines, and format out lined in sections 4.6 and 7.0 of the Game Manual Part 1. 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.

4.7.4 Super Qualifiers
These events are held in regions with a large number of teams and/or Leagues. In these regions, teams advance from either a League Championship or Qualifying Tournament to a Super-Qualifying Tournament, and then to the regional or state Championship. Super-Qualifying Tournaments adhere to *FIRST* standards in format, judging, and awards.

4.7.5 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 advance from a Qualifying Tournament or League Championship in order to advance to the State/Regional Championship. Championships may include Teams from a geographic region, province, state, country, or several countries.

4.7.6 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. 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. Teams outside North America should contact their FTC partner for information about advancement criteria. The advancement criteria will be applied to Teams in North America as follows:

1. Teams advance from a Qualifying Tournament, League Championship, or Super Qualifier to a State or

Regional 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. The 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> Egregious behavior by any Team, Team member, or other representative of the Team during the Tournament, as determined by the Event staff, will result in a warning by the Event Director. Subsequent violations will result in *Team Disqualification* from the tournament. Egregious behavior includes, but is not limited to, repeated and/or flagrant violation of game rules, unsafe behavior or actions, uncivil behavior towards Volunteers, Competition personnel, or event attendees.

<T2> Referees have ultimate game play and scoring authority during the Competition. Their rulings are final.

a. The referees will not review any recorded Match replays or pictures.

b. All questions about a Match or scores must be must be brought forward to the Referees by using the Referee Question Box located in the *Competition Area*. Only one **student** from an Alliance is permitted to enter the question box, and must do so within the time period of three (3) Matches following the disputed Match.

    i. 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.

<T3> 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:

a. Cellular Hotspots (e.g. cell phones, tablets, MiFi).

b. Ad-hoc networks.

c. Nintendo DS peer-to-peer.

d. Bluetooth communication with Robots in the *Competition Area*.

No Team, Team Member, or event attendee shall interfere with a Team's Wi-Fi Direct® communication with their own Robot.

The Penalty for violating rule <T3> 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 <T3> has been violated, and to disqualify the offending Team.

<T4> Wi-Fi Direct® connectivity between the Android devices used as the *Robot Controller* and the *Drivers Station* is allowed. No other wireless communication is allowed.

The Penalty for violating rule <T4> 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.

<T5> Team members may be asked by the Event Director to use a specific Wi-Fi channel on the Event day. It is the intent of this rule that Teams must comply with the request of the Event Director if asked to use a specific Wi-Fi Channel.

<T6> Only one (1) 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.

c. It is against the intent of this rule to register and attend concurrent events with a second Robot.

<T7> 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.

<T8> *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.

<T9> 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.

<T10> Teams are guaranteed a minimum of five minutes (5:00) between participating in consecutive Matches.

<T11> 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.

<T12> 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 safety glasses for its Team members, mentors, and guests. Tinted lenses are allowed as long as Event personnel can see the Volunteers, spectators, or Team member's eyes through the safety glasses. Sunglasses or deeply shaded safety glasses used in our indoor event environment are not acceptable.

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 to work a theme around it to make the Team more fun and recognizable. Refer to the Marketing and Outreach section of the website for information about *FIRST* and FTC logo use requirements: http://www.usfirst.org/Roboticsprograms/ftc/Team-resources.

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 pit stations 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 each Team's ally and opponent for each Match. In elimination rounds, top ranking Teams are able to choose their own *Alliance* partners. Teams should select *Alliance* Partners with abilities that complement their own strengths. Scouting during the qualifying rounds is a good way to learn the capabilities and limitations of the Teams and Robots competing at the Event.

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 The Robot

5.1 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 a Robot. Teams should be familiar with the Robot and game rules before beginning Robot design.

5.2 Robot Control System – New for the 2015-2016 Season
A *FIRST* Tech Challenge Robot is controlled by a new, Android based platform powered by Snapdragon processors. Teams will use two (2) Android devices to control their Robot and compete in a "*Sports Start*" model of competition. The Android based platform replaces the LEGO NXT, Samantha unit, and the Field Control System that were used in previous seasons. Instead, one Android device will be mounted directly onto the Robot and act as a *Robot Controller*. The other Android device will be connected to a pair of gamepads and will act as the *Driver Station*.

There are two (2) allowed Android devices that Teams will use to control their Robot:

- ZTE Speed.
- Motorola Moto G (2nd Generation).

No other Android devices are allowed.

For more information, tutorials, and to access our Android Technology forum, please visit:

http://www.usfirst.org/Roboticsprograms/ftc/technology

5.2.1 Android Technology Definitions
Core Device Interface Module – A USB-enabled device that can be used to provide input/output ports for the *Robot Controller*. The *Core Device Interface Module* has 8 digital I/O ports, 8 analog input ports, 2 analog output ports, 2 PWM output ports and 6 high speed (100kHz) I^2C ports.

Core Legacy Module – The device that acts as a bridge between the Android *Robot Controller* and LEGO NXT compatible devices (motor controllers, servo controllers and sensors).

Core Motor Controller – A USB-enabled DC motor controller with two (2) motor control channels.

Core Power Distribution Module – The electronic device that connects the *Robot Controller* Android device to one or more USB-enabled modules such as the *Core Legacy Module, Core Motor Controller*, *Core Servo Controller*, and the *Core Device Interface Module*. The *Core Power Distribution Module* draws power from the 12V TETRIX battery, the 12V MATRIX battery, or the 9.6V MATRIX battery to power an internal USB Hub, DC motor controllers and servo controllers, and certain specified electronics.

Core Servo Controller – A USB-enabled servo controller with six (6) servo control channels.

Driver Station – The component Teams use to provide human input to the *Robot Controller*. This is accomplished through hardware consisting of an Android device, an adapter cable, an unpowered USB hub and up to two Logitech F310 Gamepads.

Java – The approved programming language for the *Robot Controller*.

Gracious Professionalism - *"Doing your best work while treating others with respect and kindness - It's what makes FIRST, first."*

Legacy TETRIX DC Motor Controller - TETRIX DC Motor Controller used with the past season NXT/Samantha control system. This controller can be used in conjunction with the *Core Legacy Module* for the new control system.

Legacy TETRIX Servo Controller - TETRIX Servo Controller used with the past season NXT/Samantha control system. This controller can be used in conjunction with the *Core Legacy Module* for the new control system.

Legacy MATRIX DC Motor/Servo Controller – MATRIX DC Motor/Servo Controller used with the past season NXT/Samantha control system. This controller can be used in conjunction with the *Core Legacy Module* for the new control system.

Legacy Sensors – *Legacy Sensors* are any LEGO approved NXT-compatible sensor including sensors from LEGO and HiTechnic.

Mini USB to OTG (On-The-Go) Micro Cable – The connection between the *Robot Controller* and the *Core Power Distribution Module*.

Modern Robotics Sensors – Sensors designed by Modern Robotics that connect to the *Core Device Interface Module*.

OTG Adapter – Connects a non-powered USB hub to Micro USB On the Go (OTG) port on the *Driver Station* Android device.

Robot Controller – An Android device located on the Robot that processes Team written software, reads on board sensors, and receives commands from the Drive Team by way of the *Driver Station*. The *Robot Controller* sends instructions to the motor and servo controllers to make the Robot move.

USB Mini Type B Cable – These cables are used to connect the USB-enabled modules (*Core Legacy, Core DC Motor Controller, Core Servo Controller* and *Core Device Interface*) to the *Core Power Distribution Module*. The cables provide 5V DC power to the modules and send information to/from the modules.

5.3 Robot Rules
Anyone that has attended an FTC tournament knows that Teams think outside the kit-of-parts to create unique and creative Robots. The intent of the Robot construction rules is to create a level *Playing Field* and a framework for Teams to build Robots that safely play the annual game challenge.

5.3.1 General Robot Rules
It is the intent of *FIRST* to encourage creativity in design to the extent that it does not present a safety hazard or unfairly affect the opportunities of the opposing-alliance Teams to compete. Although there is significant creative freedom allowed in the Robot design rules, Teams should consider the adverse effects of any design decisions that they make. One example of a guiding principle is that if a Team would not want an opponent to use a particular design feature against them, it is likely that it will not be allowed in competition.

<RG01> 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 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 from the tournament.

c. Appendices A and B (will be released 9/12/2015) of this manual contain copies of the Robot and Field Inspection forms and provide additional information about the inspection process.

d. A Robot may be rejected at inspection if, in the judgment of the Lead Inspector, it is unsafe.

<RG02> 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 such as mercury switches, lead, or lead containing compounds, or lithium polymer batteries (except for the Android devices internal battery).

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 *Playing Field*.

<RG03> The maximum size of the Robot for starting a 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 operation mode (op mode) program that may pre-position the servo motors, with the Robot in a power-ON condition, to the desired stationary position. 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 ("WARNING! - Robot moves during Initialization Routine") to your Robot near the Robot main power switch if servos are commanded to move during the initialization routine:

<RG04> The Robot main power switch 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 of the Robot. Affix the image ("MAIN ROBOT POWER") to your Robot near the main power switch.

<RG05> Batteries MUST be securely attached to the Robot in a location where the battery will not make direct contact with other Robots or the *Playing Field*.

<RG06> The *Robot Controller* MUST be accessible and visible by competition personnel.

a. The *Robot Controller* shall be mounted such that the display screen is protected from contact with the *Playing Field* elements or other Robots. This 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.

Important Note: The *Robot Controller* contains a built-in wireless radio that communicates with the Android device in the *Driver Station*. In addition to protecting the device from impact, the *Robot Controller* should not be obscured by metal or other material that could block or absorb the radio signals from the *Robot Controller*.

<RG07> The *Driver's Station* must comply with the following constraints:

a. The *Driver's Station* must consist only of:

    i. One (1) Android device

    ii. One (1) OTG Cable

    iii. No more than one (1) non-powered USB hub

    iv. No more than two (2) gamepads

b. The touch display screen of the *Driver Station* must be accessible and visible by competition personnel.

c. Teams are responsible for providing their own gamepads and non-powered USB hub as part of their *Driver Station* at a Match.

d. The *Driver's Station* must be set to airplane mode, and Bluetooth must be turned off.

Important Note: The *Driver Station* is a wireless device with a built-in wireless radio. During a match, the *Driver Station* should not be obscured by metal or other material that could block or absorb the radio signals from the *Driver Station*.

<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 or wooden dowel with dimensions that are close to 0.635cm (0.25 inches) outer diameter x 0.5cm (0.20 inches) inner diameter x 21 cm (8.25 inches) length with a triangular flag 10.16cm (4.0 inches) high x 15.24cm (6.0 inches) 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 7.62cm high (3.0 inches), at least in 1.27cm (0.5 inches) 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 approved batteries.

   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.

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

5.3.2 Robot Mechanical Parts and Materials Rules
<RM01> Teams may use materials and COTS (Commercial Off The Shelf) components to construct their Robots subject to the following constraints:

   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.
> - Magnets

b. All post-processed materials are allowed provided they are readily available to the majority of Teams from standard distributers (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
> - Cable, string, rope, filament, etc.
> - Springs of all types including compression, extension, torsion, surgical tubing, etc.

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 mechanum) are exempt from the one degree of freedom limitation.

> Examples of single degree of freedom COTS components are:
> - Hinges (including spring loaded)
> - Sprockets and roller chain
> - Gears of any type, including Rack and Pinion gears
> - Simple and compound gear trains
> - Planetary gear trains
> - Lazy Susan

Note that while some supplier's websites may claim that a part is FTC approved, the only official reference for the legality of parts and materials are the Game Manual Part 1 and the Official FTC Q&A Forum.

d. High traction wheels (e.g. AM- 2256), and high grip tread (e.g. Rough top), that may damage the *Playing Field* are not allowed.

e. Raw materials and legal COTS may be modified (i.e. drilled, cut, painted, etc.) provided no other rules are violated.

<RM02> Welding, brazing, soldering and fasteners of any type are legal methods for assembling a Robot.

<RM03> Any type of COTS lubricant is allowed, provided that it doesn't contaminate the *Playing Field*, game elements, other Robots, etc.

<RM04> 3D printed parts are allowed.

5.3.3 Robot Electrical Parts and Materials Rules

There are many possible ways to build and wire a Robot. These rules provide specific requirements on what is allowed and what is not allowed. Teams must ensure that electrical and electronic devices are used consistent with manufacturer's requirements and specifications. Teams are encouraged to review the FTC Robot Electrical Wiring Guide for suggestions on how to build a Robot with safe and reliable wiring.

<RE01> Robot control modules are constrained as follows:

a. Exactly two (2) Android devices MUST be used in FTC competitions:

    i. Exactly one (1) Android device must be used as the Robot Controller.

    ii. Exactly one (1) Android device must be used as a component of the Driver Station.

    iii. The only allowed Android devices are the ZTE Speed and the Motorola Moto G 2nd Generation phone. No other devices may be used as Robot Controllers or in Driver Stations in FTC competitions.

b. The *Robot Controller* Android device USB interface may only connect to the *Core Power Distribution Module.*

c. The *Driver Station* Android device USB interface may only connect using a *Mini USB to OTG (On-The-Go) Cable* to an unpowered USB Hub and to one (1) or two (2) Logitech F310 gamepads (part number 940-000110). The USB hub is optional if only one (1) gamepad is used.

d. No more than one (1) *Core Power Distribution Modules* is allowed.

e. No more than two (2) *Device Interface Modules* are allowed.

f. No more than two (2) *Core Legacy Modules* are allowed.

g. Motor and Servo Controllers are allowed in one of the following two configurations:

> **Either:**
>
> - Modern Robotics and Legacy HiTechnic motor and servo controllers
>   - Any number of motor and servo controllers may be used
>
> **Or**
>
> - Legacy MATRIX motor and servo controllers (unified module)
>   - No more than (2) motor and servo controllers (unified module) may be used

<RE02> Approved electrical and electronic devices may be modified to make them more usable; they may not be modified internally or in any way that affects their safety.

Examples of modifications that are allowed:
- Shortening or extending wires
- Replacing or adding connectors on wires
- Shortening motor shafts
- Replacing gearboxes

Examples of modifications that are **not** allowed:
- Replacing an H-Bridge in a motor controller
- Rewinding a motor
- Replacing a fuse with a higher value than specified by the manufacturer
- Shorting out a fuse

<RE03> Robot power is constrained as follows:

a. Both the *Driver Station* and *Robot Controller* Android devices must be powered by their own internal batteries; external power is not allowed.

b. Robot Power is provided by a single (1) approved battery pack.

    i. Battery packs are constrained as follows:

Modern Robotics and Legacy HiTechnic motor and servo controllers
- Battery packs are TETRIX (W39057) or MATRIX (14-0014) 12 VDC
- Robots may use one (1) battery pack at a time
- The battery pack must only power a single *Core Power Distribution Module*

Legacy MATRIX Motor and Servo controllers (unified module)
- Battery pack is Legacy MATRIX (14-0004) 9.6 VDC
- Robots may use one (1) battery pack
- The battery pack must only power a single *Core Power Distribution Module*
- Up to two (2) Matrix Motor and Servo Controllers may be powered from a *Core Power Distribution Module*

c. The battery pack must connect first to a single power switch before connecting to any powered modules on the Robot. See the FTC Robot Wiring Guide (coming soon!) for sample Robot-power wiring

diagrams.

d. All other powered modules must connect to a power output port of a *Core Power Distribution Module.*

e. Where present, fuses must not be replaced with fuses of higher rating than originally installed or according to manufacturer's specifications; fuses may not be shorted out. Fuses must not exceed the rating of those closer to the battery; if necessary, a fuse must be replaced with a smaller rating.

f. Approved video cameras must be powered by an internal (as supplied by the manufacturer) battery.

g. Approved light sources may include an internal (as supplied by the manufacturer) battery. Additional approved power sources are the use of a power port on the *Core Power Distribution Module*, a motor-control port on the *Core Motor Controller Module,* or a motor controller port on the *Legacy HiTechnic Motor Controller*.

h. External power adapters or voltage converters are not allowed.

<RE04> Robot motors and servos are constrained as follows:

A Robot is constructed with a maximum of eight (8) motors and twelve (12) servos. Any compatible servo may be used; motors are constrained as follows:

> **Modern Robotics and Legacy HiTechnic motor and servo controllers**
> *   Allowed motors are TETRIX/AndyMark/MATRIX 12 VDC
>   *   TETRIX W39530
>   *   AM-2964, AM-3102, AM-3103, AM-3104
>   *   MATRIX 14-0014
>
> **Legacy MATRIX Motor and Servo controllers (unified module)**
> *   With a 12 VDC MATRIX Battery Pack, allowed motors are MATRIX 12 VDC
>   *   MATRIX 14-0014
> *   With a 9.6 VDC MATRIX Battery Pack, allowed motors are Legacy MATRIX 9.7 VDC motors
>   *   MATRIX 50-0001, 50-0012
>
> **Modern Robotics and Legacy HiTechnic and servo controllers**
> *   Allowed motors are VEX motors
>   *   VEX EDR 393

<RE05> Robot wiring is constrained as follows:

a. USB Surge Protectors connected to USB cables are allowed.

b. Ferrite chokes (beads) on wires and cables are allowed.

c. Either A *Mini USB to OTG (On-The-Go) Micro Cable* or a *Mini USB adapter* and *OTG (On-The-Go) Micro Cable* is used to connect the *Robot Controller* Android device to the built-in USB input port of the *Core Power Distribution Module.*

d. Stand-alone USB hubs are allowed.

e. Allowed electronic devices may only be powered by power ports on the *Core Power Distribution Module* except as follows:

    i. Light sources per <RE03>g.

    ii. Allowed sensors connected to the Core Device Interface Module and the Core Legacy Module.

f. Anderson PowerPole, and similar crimp or quick connect style connectors are required to connect downstream electronics with the *Core Power Distribution Module* and are recommended for joining electrical wires throughout the Robot. Power distribution splitters are recommended where appropriate to reduce wiring congestion. All connectors and distribution splitters should be appropriately insulated.

g. Motor control, servo, and encoder, and sensor wires and their connectors may be extended, modified, custom made, or COTS subject to the following constraints:

    i. Battery wires are 16 AWG or larger

    ii. Motor control wires are 22 AWG or larger

    iii. PWM (servo) wires are 20 AWG or 22 AWG

    iv. Sensor wires should be the same size or larger than the original wiring

h. Power and motor control wires must use consistent color coding with different colors used for the Positive (red, white, brown, or black with a stripe) and Negative/Common (black or blue) wires.

i. Wire and cable management products of any type are permitted (e.g. cable ties, cord clips, sleeving, etc.).

j. 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.).

k. Installed connectors (such as battery-pack connectors, battery charger connectors, and *Core Power Distribution Module* power input connectors) may be replaced with Anderson PowerPoles or any compatible connector.

<RE06> Additional Robot electronics are subject to the following constraints:

a. Light sources (including LEDs) are allowed; these may not be focused or directed in any way (for example: lasers and mirrors are not allowed).

b. Sensors

    i. Sensors from any manufacturer may be connected to the Core Device Interface Module.

    ii. Legacy Sensors are allowed and must be directly connected to the Core Legacy Module.

    iii. The HiTechnic Touch Sensor Multiplexor (NTX1060) is allowed.

    iv. The HiTechnic Sensor Multiplexor (NSX2020) is not allowed.

c. 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.

    d. Other electronics are **not** allowed.

5.3.4 Robot Software Rules
<RS01> The Robot must be designed to be controlled by no more than two (2) Logitech F310 Gamepads. Teams are responsible for bringing their own F310 Gamepads with them to every event they attend, as these will not be provided by the Event Host.

<RS02> Each Team MUST "name" their *Robot Controller* with their official FTC Team number and –RC (e.g. "1234-RC"). Each Team MUST "name" their Driver Station with their official FTC Team number and –DS (e.g. 1234-DS). Spare Android devices should be named with the Team number followed by a hyphen then a letter designation beginning with "B" (e.g. "1234-B-RC", "1234-C-RC").

<RS03> *Java* is the only approved programming language for the *FIRST* Tech Challenge. Programming must be done using one of the following applications:

    a. Android Studio – a text-based integrated development environment.

    b. App Inventor – a visual blocks-based programming tool.

If updates are announced by FIRST later in the season, teams must install them prior to the time of competition.

Templates for all programming choices are available through the links located at http://www.usfirst.org/Roboticsprograms/ftc/Team-resources.

<RS04> The *Robot Controller* Android operating system must have version 4.2 (JellyBean) or 4.4 (Kit Kat) installed.

<RS05> 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 Team.

<RS06> Teams must demonstrate that their Robot switches between Autonomous mode and Driver-Controlled mode correctly. This is done during Field Inspection.

<RS07> The *Robot Controller* must have a designated *Robot Controller* app that is the default application for the Core Robot modules (Legacy, Servo, Motor, and Device Interface).

<RS08> The *Robot Controller* must be set to airplane mode, and Bluetooth must be turned off.

6.0 Robot Inspection

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

6.2 Description
The FTC *Robot* will be required to pass Robot and Field 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 Appendices A

and B (will be released 9/12/2015). **Teams are required to conduct a self-inspection of their *Robot* and submit the completed Robot Inspection forms to the Robot Inspectors.**

6.3 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 5.

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 6.4.

6.4 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 Matches*. Noncompliance with any *Robot* design, construction rule, or programming requirements may result in disqualification of the Team 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 operation mode (op mode) program that may pre-position the servo motors, with the Robot in a power-ON condition, to the desired stationary position. 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. The label in rule <RG03> b must be affixed to the *Robot* if servos move during *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*.

<I6> *Robot* inspection is a Pass / Fail process. A *Robot* has passed inspection when ALL requirements listed on the official FTC "*Robot* and *Field* Inspection Sheets" have been successfully met and recorded as passed by an FTC Inspector.

7.0 Judging & Award Criteria

7.1 Overview
This section provides a complete description of all of the FTC Awards; the judging process, award criteria, Engineering Notebook guidelines, 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 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 a positive way we recognize Teams who embody important values like Gracious Professionalism™, Teamwork, creativity, innovation, and the value of the engineering design process. These judging guidelines are a part of the road map to success.

FTC judging sessions do not include written or verbal feedback for students. FTC judging is a subjective process; and students are encouraged to learn the important life skill of self-evaluation. This helps students prepare for professional interviews while developing other real world life skills. For a copy of the FTC Team Judging Session Self-Reflection Sheet please visit the website:
http://www.usfirst.org/Roboticsprograms/ftc/Team-resources

7.2 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 in a season. 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.

Each season, 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 Team's responsibility to let the Tournament Director know if they have already won the Inspire Award at the same level Competition within a region.

7.3 Engineering Notebook

7.3.1 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.

7.3.2 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 process of building and designing a Robot, Teams will come across obstacles, lessons learned, and the need to draw things out on paper. This is where Teams will use an Engineering Notebook.

These notebooks follow the Team from kickoff throughout the Competitions. Judges review a Teams Engineering Notebook to better understand the journey, design, and Team as a whole.

The FTC Engineering Notebook is a complete documentation of the 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.

7.3.3 Engineering Notebook Formats
Teams may choose to record their season with either handwritten or electronic documents. There is no distinction made between handwritten and electronic Engineering Notebooks during judging; each format is equally acceptable.

Electronic: Teams may choose to use electronic 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 should be numbered and in order. Only one copy is required per Team.

Handwritten: Teams can choose from spiral-bound, laboratory, or documentation notebooks available through their school or local office supply store. Teams can also use loose leaf paper and place them in the binder supplied by Rockwell Collins delivered in the Registration and Welcome Kit.

7.3.4 Engineering Notebook Requirements
1. The Team Number and Team Name must appear on the outside of the Engineering Notebook. Engineering Notebooks will not be considered without this information.

2. Attach a summary page to the front cover of the Engineering Notebook. The summary should be a brief, one page narrative about the Team, the school or organization, and an overview of the highlights of the Team's season. The Team summary page should also include the Team number and point the Judges to pages in the Engineering Notebook that the Team would most like the Judges to consider.

3. The Engineering Notebook must be divided into multiple sections, including:

    a. An Engineering Section that includes the Robot design processes.

    b. A Team Section that includes information about the Team and outreach activities.

    c. A business plan, strategic plan or sustainability plan.

7.3.5 Engineering Notebook Requirements by Award
The chart below provides a quick overview of the Engineering Notebook requirements by Award:

Engineering Notebook Requirements by Award	
Inspire Award	• 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 be high quality, thoughtful, thorough, detailed and well organized.
Think Award	• 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. • Notebook must recount the Team's journey, experience and lessons

	learned throughout the season.
	• Engineering Notebook must include entries describing underlying science, mathematics, and game strategies.
Connect Award	• 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 goals. The plan could include fundraising goals, sustainability goals, timelines, outreach, and community service goals.
Rockwell Collins Innovate Award	• Team must submit an Engineering Notebook with an Engineering Section that documents the design process and how the Team arrived at their design solution.
PTC Design Award	• Team must submit an Engineering Notebook with an Engineering Section that includes detailed Robot design drawings.
Control Award	• The Engineering Notebook must include an Engineering Section that documents the control components.

7.3.6 Judges' Tips
- Every notebook is a work in progress, forever changing and developing. Judges do not want to see a "final" copy notebook; 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 the 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 the Robot designs are recommended as part of a thorough documentation.

7.3.7 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 the Engineering Notebooks.

7.4 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 the schedule prior to or during check-in at the Competition.

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

1. Interview with the 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 section 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.

7.4.2 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, Teams should familiarize themselves 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.

7.4.3 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.

7.4.4 Video Award Submission Guidelines
The submission process for this award may vary by tournament. Please check with the Event Director for details. 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. Teams can also send their Promote videos directly to *FIRST*; however these submissions will not be formally judged.

- 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 the Event Director for details.
- 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. Teams should use the best resolution available for the final version.
- Only one video submission per Team will be considered. Teams may submit new or updated videos at each tournament.

7.5 Award Categories

7.5.1 Inspire Award

This judged award is given to the Team that truly embodied the 'challenge' of the FTC program. The Team that receives this award is a strong ambassador for *FIRST* programs and a role model FTC Team. This Team is a top contender for many other judged awards and is a gracious competitor. 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, their community, and the Judges. Working as a unit, this Team will have demonstrated success in accomplishing the task of designing and building a Robot.

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 or League Championship, they are no longer eligible to win the Inspire Award at subsequent Qualification tournaments or League Championships within the same region.

Required criteria for the Inspire Award:

- **Team must demonstrate respect and Gracious Professionalism toward everyone they encounter at an FTC event.**
- **Team is a strong contender for several other Judged awards. The Inspire Award celebrates the strongest qualities of all the Judged Awards.**
- **The Team is an ambassador for *FIRST* programs and demonstrates and documents their work in their community.**
- **Team dynamic is positive and inclusive, and each Team member contributes to the success of the Team.**
- **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 be high quality, thoughtful, thorough, detailed and well organized.**
- **Robot design is creative and innovative, and the Robot performs reliably on the field. Team communicates clearly about their Robot design and strategy to the judges.**
- **Team presentation is professional and engaging.**

7.5.2 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 Section should focus on the design and build stage of the Team's Robot. Journal entries should 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.

Required criteria for the Think Award:

- **Team must demonstrate respect and Gracious Professionalism toward everyone they encounter at an FTC event.**
- **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.

- **Notebook must recount the Team's journey, experience and lessons learned throughout the season.**
- **Engineering Notebook must include entries describing underlying science, mathematics, and game strategies.**

Strongly suggested criteria for the Think Award:

- Teams should tab/flag 6 to 8 pages of the Engineering Section to support entries on the summary page.
- Engineering Notebook should be organized and follow the formatting guidelines provided by *FIRST* and include a Summary Page. Note: Teams should review the Engineering Notebook section of this manual for a complete description and format specifications.

7.5.3 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 science, technology, engineering and math (STEM) community. A true *FIRST* Team is more than a sum of its parts, and recognizes that engaging their local STEM community plays 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. This Team has a clear Business or Strategic Plan and has identified steps to achieve their goals.

Required criteria for the Connect Award:

- **Team must demonstrate respect and Gracious Professionalism toward 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 goals. The plan could include fundraising goals, sustainability goals, timelines, outreach, and community service goals.**
- **Team provides clear examples of developing in person or virtual connections with the engineering, science, or technology community.**
- **Team actively engages with the engineering community to help them understand *FIRST*, the *FIRST* Tech Challenge, and the Team itself.**

7.5.4 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.

Required criteria for the Rockwell Collins Innovate Award:

- **Team must demonstrate respect and Gracious Professionalism towards everyone they encounter at an FTC event.**
- **Team must submit an Engineering Notebook with an Engineering Section that documents the design process and how the Team arrived at their design solution.**
- **Robot or Robot sub-assembly must be elegant and unique in its design.**
- **Creative component must be stable, robust, and work reliably.**
- **Robot design is efficient and consistent with Team plan and strategy.**

7.5.5 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 Robot 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.

Required criteria for the PTC Design Award:

- **Team must demonstrate respect and Gracious Professionalism toward everyone they encounter at an FTC event.**
- **Team must submit an Engineering Notebook with an Engineering Section that includes detailed Robot design drawings.**
- **Team demonstrates industrial design principles, striking a balance between form, function, and aesthetics.**
- **Robot differentiates itself from others by its aesthetic and functional design.**
- **Basis for the design is well considered (i.e. inspiration, function, etc.).**
- **Use of PTC's Creo is not required to be eligible; however Teams that use them in their design are given extra consideration for this award.**

7.5.6 Motivate Award
More than Robots!

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 embraces the culture of *FIRST* and clearly demonstrates what it means to be a Team. This is a Team who makes a collective effort to make *FIRST* known throughout their school and community, and sparks others to embrace the culture of *FIRST*.

Required criteria for the Motivate Award:

- **Team must demonstrate respect and Gracious Professionalism toward everyone they encounter at an FTC event.**
- **The Team is an ambassador for *FIRST* programs.**
- **Team can clearly demonstrate the successful recruitment of new Teams, mentors, coaches and volunteers who are not otherwise active within the STEM community.**
- **Team can articulate the individual contributions of each Team member, and how these attribute to the overall success of the Team.**

Strongly suggested criteria for the Motivate Award:

- All Team members participate in their presentation, and actively engage with the judges.
- Team can show a creative approach to materials that market the Team and *FIRST*.

7.5.7 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 must contain details about the implementation of the software, sensors, and mechanical control.

Required criteria for the Control Award:

- **Team must demonstrate respect and Gracious Professionalism toward 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 C (will be released 9/12/2015).**
- **The Engineering Notebook must include an Engineering Section that documents the control components.**
- **Control Components must enhance the functionality of the Robot on the field.**

Strongly suggested criteria for the Control Award:

- Advanced software techniques and algorithms are encouraged.
- Control Components should work reliably.

7.5.8 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 director 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. Teams

must submit a one-minute long public service announcement (PSA) video based on the PSA subject for the season.

PSA Subject for 2015 – 2016 Season:

"Now that I've succeeded in FIRST…."

Required criteria for the Promote Award:

- **Video must meet the following criteria:**
    - o **Video cannot be longer than 60 seconds.**
    - o **Video must be of a high quality, as submissions may be used at a later time to promote *FIRST*.**
    - o **Team must have rights to music used in the video.**
    - o **Video must have strong production value.**
    - o **Video must be submitted by the designated deadline.**
- **Team must present a thoughtful and impactful video which appeals to the general public.**
- **Creativity in interpreting the annually assigned theme is required.**
- **Follow video award submission guidelines.**

7.5.9 Compass Award (Optional)
A beacon and leader in the journey of FTC.

An FTC Team is about more than building Robots and competing in 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, and demonstrates to the Team what it means to be a Gracious Professional. 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 an inspirational Team. We want to hear what sets the Mentor apart.

Required criteria for the Compass Award:

- **Video must meet the following criteria:**
    - o **Video cannot be longer than 60 seconds.**
    - o **Video must be of a high quality, as submissions may be used at a later time to promote *FIRST*.**
    - o **Team must have rights to music used in the video.**
    - o **Video must be submitted by the designated deadline.**
- **Video highlights the mentor's contribution to the Team and demonstrates what sets the mentor apart.**
- **Follow video award submission guidelines.**

7.5.10 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. The Judges Award recognizes a Team for their outstanding efforts, but does not factor into the Advancement Criteria.

7.5.11 Winning Alliance Award
This award will be given to the winning alliance represented in the final match.

7.5.12 Finalist Alliance Award
This award will be given to the finalist alliance represented in the final match.