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Volunteer Thank You

Thank you for taking the time to volunteer for a FIRST® Tech Challenge event. FIRST® and FIRST® Tech Challenge rely heavily on volunteers to ensure events run smoothly and are a fun experience for teams and their families, which could not happen without people like you. With over 5,500 teams competing yearly, your dedication and commitment are essential to the success of each event and the FIRST Tech Challenge program. Thank you for your time and effort in supporting the mission of FIRST®!

Revision History

<table>
<thead>
<tr>
<th>Revision</th>
<th>Date</th>
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| 1.1      | 9/8/2018   | • Updated table of contents   
• Section 4.3, Rule <T5> - Changed the wording “Wi-Fi Direct” to “Wi-Fi”.   
• Section 8.2.1 – Removed reference to Core Legacy Module in the definition of the Core Power Distribution Module and the USB Mini Type B Cable.   
• Section 8.3.1. Rule <RG04> - Added kilogram equivalent to maximum robot weight.   
• Section 8.3.3. Rule <RE14>l – Electrically grounding the Robot electronics to the frame of the Robot is allowed with REV resistor cable.   
• Section 9.4, Rule <I1> - Changed “required” to “highly recommended” for Team self-inspections.   
• Section 10 – Added Judging and Award Criteria Section.   
• Appendix B – Robot Inspection Checklist, updated rule <RE14>l.   
• Appendix E – Added Control Award Submission Form. |
| 1.2      | 9/13/2018  | • Section 10.4.8 – Updated Promote Award PSA for the 2018-2019 season.       |
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  o Edited Driver Station definition.   
  o Edited UVC Camera definition.   
• Section 8.3.3   
  o <RE06>b. – Removed “non-powered” reference for USB hub.   
  o <RE13> - Cameras should be connected via powered USB hub.   
  o <RE14>c(iii) – Covers use of where powered hub draws energy.   
  o <RE16>b(i) – Removed ”non-powered” from definition.   
• Section 8.3.4, Rule <RS9>, changed to <RS09>, edited rule.   
• Appendix C – Removed reference to “non-powered” USB hub from checklist rules <RE06> & <RE16>a&b. |

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1.0 Introduction

1.1 What is FIRST® Tech Challenge?
FIRST® Tech Challenge is a student-centered program that focuses on giving students a unique and stimulating experience. Each year, teams engage in a new game where they design, build, test, and program autonomous and driver operated robots that must perform a series of tasks. To learn more about FIRST® Tech Challenge and other FIRST® Programs, visit www.firstinspires.org.

1.2 FIRST Core Values
We express the FIRST® philosophies of Gracious Professionalism® and Coopertition® through our Core Values:

- **Discovery**: We explore new skills and ideas.
- **Innovation**: We use creativity and persistence to solve problems.
- **Impact**: We apply what we learn to improve our world.
- **Inclusion**: We respect each other and embrace our differences.
- **Teamwork**: We are stronger when we work together.
- **Fun**: We enjoy and celebrate what we do!

2.0 Gracious Professionalism®

FIRST® uses this term to describe our programs’ intent and Gracious Professionalism® is not clearly defined for a reason. It has different meanings 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.
- Gracious Professionals make valued contributions in a way that is pleasing to others and to themselves.

In the end, Gracious Professionalism® is part of everyday life. When professionals use their knowledge graciously and individuals act with integrity and sensitivity, everyone wins, and society benefits.

Watch Dr. Woodie Flowers explain Gracious Professionalism in this short video.

2.1 Gracious Professionalism for Volunteers
It is a good idea to spend time going over this concept with volunteers. Provide volunteers with real-life examples of Gracious Professionalism in practice before, during, and after the event and recognize great Gracious Professionalism when you see it in action!

3.0 Youth Protection Program

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 should read and follow the FIRST Youth Protection Program guide. Anything labeled as required is mandatory in the United States and Canada, and cannot be waived without approval from 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.

Most up to date forms are available here: [http://firstinspires.org/resource-library/youth-protection-policy](http://firstinspires.org/resource-library/youth-protection-policy)

The US Screening process, the Canadian Screen process, Frequently Asked Questions (FAQ), and additional information are on the FIRST Youth Protection Program Website: [http://firstinspires.org/resource-library/youth-protection-policy](http://firstinspires.org/resource-library/youth-protection-policy)

### 3.2 NOTICE OF NON-DISCRIMINATION

For Inspiration and Recognition of Science and Technology (FIRST®) does not discriminate based on race, color, national origin, sex, disability, age, status as a veteran who served in the military, religion, gender, gender identity, or gender expression in its programs and activities.

Keep updated at: [http://www.firstinspires.org/about/legal-notices](http://www.firstinspires.org/about/legal-notices)

### 4.0 The Tournament – Definitions and Rules

#### 4.1 Overview

Students that engage in the FIRST Tech Challenge program develop STEM skills and practice engineering principles (like keeping an engineering notebook), while realizing the value of hard work, innovation, and sharing ideas. Tournaments are exciting sporting events with head-to-head competition, judging interviews, and Teams and Robot performance awards. This section provides critical information that will help Teams have a fun and successful tournament day.

#### 4.2 Tournament Definitions

**Alliance** – Each FIRST Tech Challenge match consists of two, two-Team Alliances. These two Teams compete against an opposing Alliance (also made up of two Teams) to complete the game challenge and to earn the highest score. At tournaments with more than 20 Teams, the semi-final and final round Alliances consists 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 is called the Alliance Captain.

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

**Alliance Station** – The designated “Red” or “Blue” Alliance area next to the Playing Field where the Drivers and Coach stand or move within during a match. Station One is the Alliance Station closest to the audience.

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

**Drive Team** - Up to three representatives (two Drivers and one Coach) from the same Team. The Drivers are two student Team members. The Coach of the Drive Team can be a student Team member, or the adult coach of the Team.
Elimination Matches – A match used to decide 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 continues to the next round.

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

Pit Area – The Pit Area is a separate space from the Competition Area where Teams can work on their Robot between matches. The Team is provided a pit space which includes a table, a power source, and is 10 ft. (3.05 m) x. 10 ft. (3.05 m). Some pit spaces may vary based on tournament venue size limits. Check with your Tournament Director for official pit space sizes.

Practice Match – A match used to provide time for Teams to get familiar with the official Playing Field.

Qualification Match – A match used to decide the Teams that qualify for the Alliance Selection and move on to the Elimination Matches. Alliances compete to earn Ranking Points and TieBreaker Points.

Ranking Points – The first basis for ranking Teams. Teams earn Ranking Points for winning (two points), tying (one point), and losing (zero points) in a Qualification Match.

Robot - Any mechanism that has passed inspection and a Team places on the Playing Field before the start of a Match. To be legal, Robots must comply with the Robot Build rules in Section 8 of this manual.

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

Surrogate Match – Surrogate Matches are scheduled into the Qualification rounds of a tournament if the number of Teams at the tournament is not evenly divisible by four. The Surrogate Match is a way to ensure all Teams compete in a minimum of five matches. This is an extra Qualification Match for those Teams scheduled in a Surrogate Match and does not count in the standings for Ranking Points or TieBreaker Points. These matches are important in the entire standings of the tournament. These matches should be played as if they were regular Qualification Matches. Surrogate Matches will be marked on the official Qualification Match schedule.

Team – An official FIRST Tech Challenge Team consists of no more than 15 student Team members. All Teams in North America are required to register through the Team Registration System. Teams must have a minimum of TWO Lead Coaches or Mentors that have registered through the Team Registration System and have passed the Youth Protection Program screening. The Team must be in good standing through the registration system to compete in FIRST Tech Challenge official tournaments.

TieBreaker Points – The second basis of ranking Teams. TieBreaker Points are used as the tiebreakers when Teams have equal Ranking Points. TieBreaker Points are awarded in the amount of the final score of the losing Alliance in a Qualification Match. Both Alliances receive the pre-penalized score of the losing Alliance as their TieBreaker Points.

4.3 Tournament Rules
<T1> Egregious behavior by any Team, Team member, or other representative of the Team is not tolerated at a FIRST Tech Challenge tournament. Violations of this rule result in penalties to the Team, and/or the issuance of a Yellow or Red Card. 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 tournament attendees.

<T2> Yellow cards and red cards are used in the FIRST Tech Challenge to manage Team and Robot behavior that does not align with the mission of FIRST. Yellow and red cards are not limited to just the
Competition Area. Teams that display egregious behavior in the Pit Area, judging rooms, stands, or any other location of the tournament can be issued a yellow or red card for egregious behavior.

Egregious or repeated (3 or more) Robot or Team member behavior at the tournament can result in a yellow and/or Red card. Yellow cards are additive, meaning that a second yellow card is automatically converted to a red card. A Team is issued a red card for any subsequent incident in which they receive an additional yellow card, for example, earning a second yellow card during a single match.

Yellow and Red Cards at the Competition Field

The Head Referee may assign a yellow card as a warning, or a red card for Disqualification in a match. A yellow card or red card is signaled by the Head Referee standing in front of the Team’s Alliance Station and holding a yellow card and/or red card in the air.

To issue the second yellow card, the Head Referee will stand in front of the Team’s Alliance Station and hold a yellow card and red card. The Head Referee will signal the second yellow card after the match has ended.

A Team that has received either a yellow card or a red card carries a yellow card into following matches, except as noted below. A red card results in match Disqualification. Multiple red cards may lead to tournament disqualification. Once a Team receives a yellow card or red card, the Team number is presented with a yellow background on the audience screen at the beginning of all following matches. This is a reminder to the Team, referees, and audience the Team carries a yellow card.

Yellow cards do not carry over from the Qualification Matches to the Elimination Matches. During the Elimination Matches, yellow and red cards count against the entire Alliance, not to a specific Team. If a Team receives a yellow card or red card, it results in the entire Alliance receiving the yellow card or red card for that match. If two different Teams on the same Alliance are issued yellow cards, the entire Alliance is issued a red card. A red card results in zero (0) points for that match, and the Alliance loses the match. If both Alliances receive red cards, the Alliance which committed the action earning the red card first chronologically loses the match.

Yellow and Red Cards off the Competition Field

Teams can incur yellow and red cards for their actions off the competition field. Egregious behavior off the competition field should be reported to the Tournament Director. The Tournament Director will first consult with the coach of the Team about the behavior of the team or its members, explain the ways in which the behavior is considered egregious, and give a warning to discontinue this behavior. If the behavior persists, the Tournament Director will work with FIRST Headquarters to assess whether or not the behavior exhibited by the team is considered egregious and if a yellow and/or red card should be issued. If it is determined that the Team should receive a yellow and/or red card, the Tournament Director will report to the Head Referee. The yellow and/or red card will be recorded into the scoring software based on the next match played by the team during Qualification Matches. If a Team is competing in Elimination Matches receives a yellow or red card between the Qualification Matches and Elimination Matches, the card will be applied to the first Elimination Match. If a Team receives a yellow or red card during the Elimination Matches for off field behavior, the yellow or red card applies to the current or just completed Elimination Match.

<T3> Referees have final game play and scoring authority during the competition. Their rulings are final.

a. The referees will not review any recorded match replays or photographs.

b. All questions about a match or scores must be brought forward to the Referees by using the Referee
question box located in the Competition Area. Only one student from an Alliance can enter the question box. All questions must be brought forward within the outlined time:

i. Qualification Matches: A Team must enter the question box to dispute a Match within a period of three (3) matches following the disputed Match. Teams participating in the final two Qualification Matches must report to the question box within 5 minutes after scores after the announcement of the match score.

ii. Elimination Matches and Final Matches: A Team must enter the Referee Question Box to dispute a match before the start of the next match played by the Alliance, regardless if the Team is playing in the next match. The next match played could involve different Alliances. Questions about the last match of the Finals must be brought to the question box no later than 5 minutes after the announcement of the match score.

Students must support their questions by referencing specific rules or posts to the Q&A section of the official FIRST Tech Challenge Forum. Team members must ask their questions in a gracious and respectful manner.

c. Team members cannot enter the Playing Field for any reason other than to place or retrieve their Robots. Inspection of the Playing Field elements by Team members to determine scoring is not allowed. 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.

<T4> No Team, Team Member, or tournament attendee is allowed to set up their own Wi-Fi 802.11 (2.4GHz or 5GHz) wireless communication in the venue. Non-allowed wireless communications include, but are not limited to:

- a. Cellular hot spots (for example, cell phones, tablets, MiFi).
- c. Nintendo DS peer-to-peer.
- d. Bluetooth communication with Robots in the Competition Area.

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

The Penalty for violating rule <T4> is disqualification of the entire Team from the tournament and their removal from the venue property. Teams may not appeal the penalty and no refunds will be given for registration fees, prepaid meals, etc. FIRST may conduct a post-tournament review and decide if any added penalties will be imposed on the offending Team.

Teams are encouraged to report wireless security vulnerabilities to the Field Technical Advisor (FTA) at a tournament. Teams should always keep in mind Gracious Professionalism®, and therefore only report valid and verifiable violations of this rule. After the Field Technical Advisor is alerted of a potential rule violation, he or she will confer with the Head Referee. The Field Technical Advisor and Head Referee will further explore the potential violation of this rule. The Head Referee will work with FIRST Headquarters staff to determine if rule <T4> has been violated, and to disqualify the offending Team.

<T5> Wi-Fi connectivity between the Android devices used as the Robot Controller and the Drivers Station is allowed. Additionally, in the Pits only, Wi-Fi connectivity between the same Android devices and a computing device (phone, tablet or computer) is allowed for Robot programming purposes only. No other wireless communication is allowed.
The penalty for violating rule <T5> is disqualification of the entire Team from the tournament and their removal from the venue property. The Head Referee will work with FIRST Headquarters staff to determine if rule <T5> has been violated, and to disqualify the offending Team. Teams may not appeal the penalty and no refunds will be given for registration fees, prepaid meals, etc. FIRST may conduct a post- tournament review and determine if any additional penalties are to be imposed on the offending Team.

<T6> Team members may be asked by the Tournament Director to use a specific Wi-Fi channel on the tournament day. Teams must comply with the request of the Tournament Director if asked to use a specific Wi-Fi Channel when supported by an approved Android Device. Teams that have Android Devices that support channel changing must comply with the request of the Tournament Director to switch their channel before playing in the next match.

<T7> Each registered Team may enter only one Robot (a Robot built to play the current season’s game challenge) into the FIRST Tech Challenge competition. It is expected that Teams will make changes to their Robot throughout the season and at competitions.

a. It is against this rule to compete with one Robot while a second is being adjusted or assembled at a tournament.

b. It is against this rule to switch back and forth between multiple Robots at a tournament.

c. It is against this rule to register and attend concurrent tournaments with a second Robot.

d. It is against this rule to use a Robot built by another Team at a tournament.

Violations of this rule will immediately be considered egregious and a deliberate violation of the rule.

<T8> Only three Team representatives are allowed in the Competition Area; two (2) student drivers, and one (1) coach who are identified by badges labeled ‘driver’ or ‘coach.’ These badges are interchangeable within a Team between matches. Only student Team members wearing a badge labeled as ‘driver’ may drive the Robot during the match. Team representatives beyond the two student drivers and one coach will be asked to leave the Competition Area immediately.

<T9> Pre-Match Robot Setup - Team members cannot enter the Playing Field for any reason other than to place/retrieve their Robots. Teams may not measure, test, or adjust field or game elements prior to the start of a match. Inspection of the Playing Field elements by Team members to determine scoring is not allowed. Individuals and Teams that violate this rule will be subject to possible penalties that could include match disqualifications or even removal from the tournament.

<T10> Pre-Match Robot Placement – At the beginning of a match, each Alliance Robot must be set up on the Playing Field according to Section 1.5.1 Pre-Match in the Game Manual Part 2. After Robots are set up on the Playing Field, Drive Teams must stand completely inside the Alliance Station at the location (Station one or Station two) specified by the Qualification Match schedule.

a. During the Qualification Matches, the blue Alliance Robots are set up on the Playing Field first, unless the red Alliance waives their right to set up on the Playing Field second.

b. During the Elimination Matches, the 3rd and 4th seeded Alliance Robots are set up on the Playing Field first, unless the higher seeded Alliance waives their right to set up on the Playing Field second. Alliance color doesn’t change the seeding of a Team during the Elimination Matches. If the 4th seed defeats the 1st seed in the Semi-Finals, they will still have to place their Robot on the field first in the Finals because their seeding will be lower than the 2nd or 3rd seed.
c. During *Elimination Matches*, 3 Team *Alliances* may only place *Robots* that are intended to compete in that match. Once two *Robots* are placed for the two teams competing in a match, the *Alliance* cannot swap in the 3rd *Alliance’s Robot* for a *Robot* already placed.

d. *Teams* may implicitly waive their right to place their *Robots* on the *Playing Field* last by placing their *Robots* on the *Playing Field* before or with the opposing *Alliance*. There is no need to tell the referees; *Teams* waive their right by the act of placing their *Robots* on the *Playing Field*.

e. *Teams* that unnecessarily delay the beginning of a match and/or field reset will incur a Minor Penalty for each offense.

*Drive Teams* are expected to stage their *Robots* for a match, and remove it from the *Playing Field* afterwards, safely and swiftly. *Drive Team* efforts that either intentionally or unintentionally delay the start of a match or the *Field* reset are not allowed. Examples include, but are not limited to:

- Late arrival to the *Playing Field*.
- *Robot* maintenance once on the *Playing Field*.

<T11> The state of the field (game and scoring elements) is recorded as the match is played by the Score Tracker. *Scores* may not be announced to *Teams* until some time after the match is complete. At some tournaments, live scoring software may be used to show the status of the match as it is played, with the final, official score displayed at the end of the match.

<T12> There are no time-outs during the *Qualification Matches*.

<T13> If no member of the *Drive Team* is present in the *Driver Station* at the start of a match, that *Team* is declared a “no show”. If a *Robot* cannot report for a match, at least one member of the *Drive Team* should report to the *Playing Field* for the match.

<T14> *Teams* will receive a minimum of five minutes (5:00) between consecutive matches.

<T15> 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) before their next match’s starting time. The time-out begins at the time their match was going to start.

<T16> All *Team* members, coaches, and their guests must wear ANSI Z87.1 certified safety glasses while in the *Pit* or *Competition Area*. Prescription glasses with ANSI Z87.1 approved commercial off the shelf side shields are also allowed.

**NOTE:** *FIRST* requires all *Teams* to bring and supply ANSI-approved safety glasses for its *Team* members, mentors, and guests for each competition. Tinted lenses are allowed if tournament personnel can see the volunteer’s, spectator’s, or *Team* member’s eyes through the safety glasses. Sunglasses or deeply shaded safety glasses used in our indoor tournament environment are not acceptable.

<T17> Skateboards, roller skates, ‘hover boards’, and drones are not allowed at any tournament. These items can create safety hazards to the *Teams*, spectators, or volunteers attending the tournament.

<T18> No live bands are allowed in the audience or *Pit*. No loud music, audio systems, whistles, banging sticks, blow horns, etc. are allowed. They prevent *Teams* from hearing important announcements. Power may be shut off and/or noisemakers confiscated.

*Gracious Professionalism®* - “Doing your best work while treating others with respect and kindness - It’s what makes *FIRST*, first.”
<T19> Batteries must be charged in an open, well-ventilated area.

<T20> Painting or applying harmful products, sprays, or aerosols are not allowed anywhere in the tournament. This includes the Pit, Competition, and spectator areas.

Note: Teams may apply antistatic spray to their Robot if done outside the venue.

<T21> Pit displays may not exceed 10 ft. (3.05 m) x. 10 ft. (3.05 m) x. 10 ft. (3.05 m) or a limit set by the venue, whichever is less.

<T22> Teams are not allowed to use radios and walkie-talkies anywhere in the venue.

<T23> There is no running anywhere during the tournament. This is a safety hazard.

<T24> Teams are not allowed to save seating space as there is often not enough seating to hold everyone. Repeated offenses could be considered egregious, and Teams could face consequences for violating this rule.

<T25> Soldering, gluing, brazing, or large power tools are not allowed in the Pit or Competitions Areas unless the Tournament Director specifically allows them.

<T26> Because of site rules or contracts, FIRST cannot allow Teams or individuals to sell items, such as T-shirts, pins, etc., at any tournaments. Fundraising for a cause is allowed with consent of the Tournament Director; fundraising for a Team is not allowed.

<T27> Check with the Tournament Director before bringing food to a tournament, as some venues will not allow outside food on-site because of contracts and agreements.

<T28> Open-toed or open-backed shoes are not allowed in the Pit Area or in the Competition Area.

<T29> Once the Autonomous portion of the Match ends, Drive Teams will have 5 seconds to pick up their Driver Station. The scoring system display will provide visual and audio cues for Drive Teams to pick up their Driver Stations. After the 5 seconds, there will be a 3-2-1 countdown and the Driver Controlled period of the Match will begin.

<T30> Teams competing in a Meet, League Tournament, Qualifying Tournament, and Championship Tournament will compete in no fewer than 5 Matches, and no more than 6 Matches.

### 5.0 Tournament Day Outline

FIRST Tech Challenge tournaments pack many activities into one day. The main events for a tournament (Qualifying Tournament, League Tournament, State Championship, World Championship) are as follows:

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
Teams competing in a League and attending Meets will only participate in the following activities during the meet:

1. Team Check-in
2. Robot and Field Inspection
3. Driver’s Meeting
4. Qualification Matches

5.1 Tournament Schedule
Tournament schedules will be available through the Tournament Director before or at the tournament. Qualification Match schedules are created on tournament day after all Teams have checked-in and have passed all Inspections.

5.2 Team Check-In

5.2.1 Consent and Release Forms
Each student competing at a FIRST Tech Challenge tournament must have a signed consent and release form completed by a parent or legal guardian. **Students cannot compete without a signed consent and release form.** These forms can be filled out electronically or by hard copy.

- Electronically – A printed roster showing that each student’s parent or guardian has electronically filled out the consent and release form online. This is shown on the roster with a green checkmark.
- Hard copy – The coach or mentor must bring a signed hard copy of the form signed by the student’s parent or legal guardian.

The roster from the Team Registration System MUST be handed in at event registration, regardless if the coach is handing in hard copies of each consent and release form. If the roster from the Team Registration System is blank, the coach should write in the names of each student competing at the tournament.

5.2.2 Team Check-In Packets
Once checked in, the Coach will receive their Team packet. **Team Packets generally include Drive Team badges, a judging schedule, a map of the venue, and other information that is important to the Teams. The Team should review the schedule of events for the day. Teams should set up their Pit Area and get familiar with the venue, including where the practice and Playing Fields are and where judging takes place.**

5.3 Robot and Field Inspection
**FIRST Tech Challenge Robots** are required to pass Robot and Field inspections before being allowed to compete. These inspections ensure that all Robot rules are met. A copy of the official FIRST Tech Challenge “Robot Inspection Sheet” and “Field Inspection Sheet” are found in Appendices A and B of this manual. The “Robot Inspection Sheet” must be used by Teams as a guide to pre-inspect their Robot.

5.4 Judges’ Interviews
At FIRST Tech Challenge tournaments, there are 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. At the start of the interview, students will get a minimum of 5 minutes to present to the judges. After the Teams five-minute presentation, the Judges will have the opportunity to ask questions about the Team, the Robot, outreach efforts, etc.

The judges’ interviews take place before any Qualification Matches so the entire Team may be interviewed. When Teams arrive at the tournament, 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 join.

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in. Mentors (no more than two) are welcome to watch the Judges’ Interview at most tournaments, but cannot take part in the interview.

**Teams** may **not** opt out of Judges’ Interviews. **Teams** may attend their scheduled Judges’ Interviews if their **Robots** have not passed inspection.

### 5.5 Drivers’ Meeting
The Drivers’ Meeting takes place before the start of **Qualification Matches** and is a time when the **Drive Team** meets with the referees. During this time, the Head Referee gives a brief outline of what is expected of **Teams**. They will provide venue specific information, such as queuing paths, and explains any signals and commands referees will give during matches.

### 5.6 Practice Time
At some tournaments, practice fields are available for **Teams** to practice throughout the tournament. Practice time is offered on a first-come, first-served basis. **Teams** should check with the Tournament Director if practice time will be allowed on tournament day.

### 5.7 Opening Ceremony
The Opening ceremony is the official kickoff of the tournament for the **Teams**, volunteers, and spectators. During the opening ceremony, a tournament official or the Emcee will welcome the **Team**, 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 before the start of opening ceremony. It is the **Team’s** responsibility to check the schedule and make sure they are on time for their matches.

### 5.8 Qualification Matches
**Teams** are randomly assigned to **Qualification Matches** and **Alliances**. The **Qualification Match** schedule is available before opening ceremonies on the day of the tournament. This schedule shows **Alliance** partners and match pairings. It also shows 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 and follow the **Qualification Match** schedule. The queue volunteer crew works together throughout the day to line up **Teams** for the matches and maintain the schedule. **Teams** must 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 last 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 **Qualification Matches**. **Team** may be required to play a **Surrogate Match**, which is an extra **Match** marked by an asterisk on the match schedule. The additional **Surrogate Match** does not count towards their standings during the tournament.

At the conclusion of each match, **Ranking Points** and **TieBreaker Points** are awarded:

- **Teams** receive **Ranking Points** based on the following:
  - Winning **Teams** of a **Qualification Match** each receive two (2) **Ranking Points**.
  - Losing **Teams** of a **Qualification Match** receive zero (0) **Ranking Points**.
  - If a **Qualification Match** ends in a tie, all four **Teams** receive one (1) **Ranking Point**.
  - If a **Team** is disqualified or does not show up for a match, they receive zero (0) **Ranking Points**.
- **TieBreaker Points** are awarded based on the following:
The number of TieBreaker 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 TieBreaker Points.

If a match ends in a tie, both Alliances receive the same number of TieBreaker Points, equal to the lowest pre-penalized score. If a Team is disqualified, they receive zero (0) TieBreaker Points.

If both Teams on an Alliance are disqualified, the Teams on the winning Alliance are awarded their own score as their TieBreaker Points for that match.

Example:

<table>
<thead>
<tr>
<th>Match</th>
<th>Result</th>
<th>Red</th>
<th>Blue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q-1</td>
<td>30-15 R</td>
<td>5555</td>
<td>8888</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4444</td>
<td>6666</td>
</tr>
<tr>
<td>Q-2</td>
<td>15-45 B</td>
<td>1111</td>
<td>7777</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3333</td>
<td>2222</td>
</tr>
<tr>
<td>Q-3</td>
<td>30-30 T</td>
<td>8888</td>
<td>4444</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7777</td>
<td>3333</td>
</tr>
<tr>
<td>Q-4</td>
<td>25-45 B</td>
<td>2222</td>
<td>5555</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6666</td>
<td>1111</td>
</tr>
</tbody>
</table>

- Q-1 – The red Alliance has won the match 30-15. Teams 5555 and 4444 will receive two (2) Ranking points, and Teams 8888 and 6666 receive zero (0) Ranking Points. Teams from both Alliances will receive 15 TieBreaker Points.
- Q-2 – The blue Alliance has won the match 45-15. Teams 7777 and 2222 will receive two (2) Ranking Points, and Teams 1111 and 3333 will receive zero (0) Ranking Points. Teams from both Alliances will receive 15 TieBreaker Points.
- Q-3 – This match ended in a tie, which will result in Teams from both Alliances receiving one (1) Ranking Point and thirty (30) TieBreaker Points.
- Q-4 – The red Alliance originally had a match score of 15 points (not shown in image), the blue Alliance had a match score of 45 points. The blue Alliance then incurred a Minor penalty, which added 10 points to the red Alliances score. The result is the blue Alliance wins, and therefore Teams 5555 and 1111 each receives two (2) Ranking Points. The red Alliance (Teams 2222 and 6666) receives zero (0) Ranking Points. However, the lowest pre-penalized score between the Alliances is still 15, therefore both Alliances will receive 15 TieBreaker Points.

Teams may receive credit for a Qualification Match if their Robot is not functioning. To receive credit for the match, the Robot has passed inspection and at least one member of the Drive Team is present in the Alliance Station for the scheduled match.

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 can enter the question box, and must do so within a period of three (3) matches following the disputed match.

After all Qualification Matches, the Teams are ranked from first through last based on their total Ranking Points. If multiple Teams have the same Ranking Points total, these Teams are ranked based on their total TieBreaker Points. If multiple Teams have the same TieBreaker Points total as well, then these Teams are ranked based on their highest match score. If still tied, the next highest match score is used until the tie is

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broken. In the unlikely event there is still a tie based on identical match scores, then the Teams are ranked by a random electronic draw. These rankings are done automatically through the scoring system software.

5.9 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 four (4) Alliances that will compete in the Elimination Matches.

The Alliance Selection consists of several rounds of selections so all Alliance Captains form Elimination Match Alliances. These Alliances participate in a ladder-type tournament to determine the tournament’s Winning Alliance. The Alliance Selection is as follows:

- Each Team chooses one student to act as the Team’s representative. These representatives will continue to the Competition Area at the appointed time to represent their Teams in the Alliance Selection.
  - Teams can bring their scouting documents or communicate by phone with other teammates in the venue to aid them with their Alliance choices. Teams must remember that if they are communicating with teammates by phone, they must be gracious and considerate and not hold up Alliance Selection.
- The top four ranked teams are called to the floor first. The student representative of the highest ranked Team is asked to step forward as the Alliance Captain to invite another available Team to join their Alliance.
- A Team is available if they are not already part of an Alliance or has not already declined an Alliance invitation. If a Team accepts, they are moved into that Alliance. If a Team declines, they CANNOT be invited to another Alliance, but are still available to select their own Alliance if the opportunity arises. If a Team declines, the Alliance Captain from the inviting Team must extend an invitation to another Team.
- The selection continues until all four Alliance Captains have been appointed 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 each Alliance) from highest seed to lowest seed (that is, 1 → 2 → 3 → 4). Any Teams remaining after the lowest seeded captain makes their choice do not compete in the Elimination Matches.

5.10 Elimination Matches

The Elimination Matches are when the Alliances compete to determine who the winning Alliance 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. Alliance colors are assigned as follows:

- Semi Finals
  - Seed #1 and Seed #4 compete against each other in the Semi Finals 1; Seed #1 is assigned as the red Alliance and Seed #4 is assigned as the blue Alliance.
  - Seed #2 and Seed #3 compete against each other in the Semi Finals 2; Seed #2 is assigned as the red Alliance, and Seed #3 is assigned as the blue Alliance.

- Finals
  - The winner of Semi Finals 1 is assigned as the red Alliance.
  - The winner of Semi Finals 2 is assigned as the blue Alliance.
In the Elimination Matches, Teams do not get Ranking Points; they get a win, loss or tie. Within each bracket (Semi-Finals or Finals) of the elimination, matches are played to determine which Alliance advances. The advancing Alliance is the first Team to win two matches. Any tied matches are replayed until one Alliance has two wins and advances. An example tournament bracket appears here:

![Tournament Bracket Diagram]

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 must play in the second match, with no exceptions. If the Alliances play more than two matches in any bracket, any combination of two Alliance Robots may be used. The Alliance Captain 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, the entire Alliance is disqualified and the match is recorded as a loss. Before each Elimination Match, the Alliance Captain must let the referee know which two Teams are playing in the next match two (2) minutes before the start of the match.

All questions about a match or scores 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 allowed to enter the question box. A Team must enter the referee question box to dispute a match before the start of the next match played by the Alliance, regardless if the Team is participating in the next match. The next match played could involve different Alliances. Questions about the last match of the Finals must be brought to the question box no later than 5 minutes after the announcement of the match score.

### 5.11 Awards and Closing Ceremony

The awards and closing ceremony celebrates the Teams and their accomplishments throughout the tournament, as well as the volunteers who helped make the tournament possible. At the awards and closing ceremony, the finalists and winners of each award are announced. At most tournaments, the judges will line up to high five each Team as they receive an award.

### 5.12 Team Spirit & Styling

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

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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 FIRST Tech Challenge logo use requirements: https://www.firstinspires.org/brand

5.13 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 allowed.
- 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.

5.14 Spectators and Etiquette
Teams are allowed 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 designated Competition Area at any time. Some tournaments may provide media passes for one additional Team member to gain access to a designated “media area”. Access to this area is only allowed 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 are considered egregious behavior.

5.15 Scouting
During the Qualification Matches, the scoring system selects each Team’s ally and opponent for each match. In elimination rounds, top ranking Teams can 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 abilities and limits of the Teams and Robots competing at the tournament.

The following scouting strategy has been provided by the 2007 FIRST® Robotics Competition Chairman’s Award winners, FIRST Robotics Competition 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 find out 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.
6.0 Tournament Types

There are several types of tournaments that Teams and other organizers hold throughout the FIRST Tech Challenge season and off-season. The tournament types are listed in the following section.

6.1 Scrimmage
A scrimmage is an unofficial FIRST Tech Challenge Event where Teams do not advance. Teams compete at a scrimmage solely to prepare for an official tournament. Anyone can host a scrimmage to prepare for an official tournament. Teams hosting a scrimmage are encouraged to notify their local Affiliate Partner that such a tournament is taking place. Teams that choose to create and host a local tournament 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.

6.2 Meets and League Play
A League Meet is a one-field competition that uses the same field and game as other tournaments. Teams may take part in as few or as many League Meets as they choose, but competing in more improves a Teams League ranking. Some of the standard tournament guidelines may be adapted for those regions that 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.

6.3 Qualifying Tournaments and League Tournaments
Hosted and managed by FIRST Tech Challenge Affiliate Partners or Affiliate Partner-appointed hosts. Qualifying tournaments follow the judging, game guidelines, and format outlined in sections 5.4 and 10.0 of the Game Manual Part 1. Qualifying Tournaments are usually held before Championship Tournaments in regions where there are many 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 7.0.

6.4 Super-Qualifying Tournaments
These tournaments 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.

6.5 Championship Tournaments
Hosted and managed by a FIRST Tech Challenge 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 Tournament to advance to the State/Regional Championship. Championship Tournaments may include Teams from a geographic region, province, state, country, or several countries. Teams should expect a higher level of competition, both on the field and in the judging room at Championship Tournaments.

7.0 Eligibility and Advancement Criteria

7.1 Eligibility to Compete in Official FIRST Tech Challenge Tournaments:
To compete in an official FIRST Tech Challenge tournament at any level, a Team must be registered and in good standing with FIRST.

✓ The Team has completed the registration process.
✓ The Team registration fee is paid. *For North America Teams. Teams outside North America should consult the Affiliate Partner for their region.
✓ In North America, two adults must pass the Youth Protection screening process.

7.2 Eligibility for Judged Awards
Teams are eligible to be considered for all Judged Awards (except the Inspire Award, please see Inspire section for details) at any of the first three tournaments they participate in at each of the following levels. Teams may compete at each level in any region that will accept them. Affiliate Partners have the authority to decide if their tournament is open to Teams from other regions, or only for Teams within their region.

- League Tournament
- Qualifying Tournament
- Super Qualifying Tournament
- Championship Tournament

7.2.1 Inspire Award Eligibility
Teams that have won the Inspire Award at another event of the same level, regardless of the region, cannot be considered for the Inspire Award or as an Inspire Award Finalist at additional tournaments at that level.

All Teams are eligible to be considered for all Judged Awards at a World Championship Tournament.

7.3 Eligibility for Advancement
Teams are eligible for advancement at any one of the first three tournaments they participate in at any of the following levels, regardless of the region. This applies to both Teams in North America, and Teams outside of North America:

- League Tournament
- Qualifying Tournament
- Super Qualifying Tournament
- Championship Tournament

A Team can only earn a spot to one World Championship event per season.

<table>
<thead>
<tr>
<th>Tournament Type</th>
<th>Advances To</th>
<th>Special Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qualifying Tournament</td>
<td></td>
<td>A Team is eligible to advance to the next competition tier from one of the first three Qualifying, League, or Super-Qualifying Tournaments they attend.</td>
</tr>
<tr>
<td>League Tournament</td>
<td>State or Regional Championship Tournament</td>
<td>A Team may participate in more than three Tournaments in the same competition tier, but they are not eligible for consideration for advancement or Awards at Tournaments beyond their third.</td>
</tr>
</tbody>
</table>
### 7.4 Order of Advancement

If the *Team* listed has already advanced or there is no *Team* fitting that description (as in 2nd *Team* selected at smaller tournaments), 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* MUST 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. Design Award Winner
15. Motivate Award Winner
16. Control Award Winner
17. Highest Ranked *Team* not previously advanced, from the Winning Division.
18. Think Award 2nd Place
19. Highest Ranked *Team* not previously advanced, from the Finalist Division.
20. Connect Award 2nd Place
21. Highest Ranked *Team* not previously advanced, from the Winning Division.
22. Rockwell Collins Innovate Award 2nd Place
23. Highest Ranked *Team* not previously advanced, from the Finalist Division.
24. Design Award 2nd Place
25. Highest Ranked *Team* not previously advanced, from the Winning Division.
26. Motivate Award Winner 2nd Place
27. Highest Ranked *Team* not previously advanced, from the Finalist Division.
28. Control Award Winner 2nd Place
29. Highest Ranked *Team* not previously advanced, from the Winning Division.
30. Think Award 3rd Place
31. Highest Ranked *Team* not previously advanced, from the Finalist Division.
32. Connect Award 3rd Place
33. Highest Ranked Team* not previously advanced, from the Winning Division.
34. Rockwell Collins Innovate Award 3rd Place
35. Highest Ranked Team* not previously advanced, from the Finalist Division.
36. Design Award 3rd Place
37. Highest Ranked Team* not previously advanced, from the Winning Division.
38. Motivate Award 3rd Place
39. Highest Ranked Team* not previously advanced, from the Finalist Division.
40. Control Award 3rd Place
41. Highest Ranked Team* not previously advanced, from the Winning Division.
42. Highest Ranked Team* not previously advanced, from the Finalist Division.
43. Highest Ranked Team* not previously advanced, from the Winning Division.
44. Highest Ranked Team* not previously advanced, from the Finalist Division.
45. Highest Ranked Team* not previously advanced, from the Winning Division.
46. Highest Ranked Team* not previously advanced, from the Finalist Division.
47. Highest Ranked Team* not previously advanced, from the Winning Division.
48. Highest Ranked Team* not previously advanced, from the Finalist Division.
49. Highest Ranked Team* not previously advanced, from the Winning Division.
50. Highest Ranked Team* not previously advanced, from the Finalist Division.
51. Highest Ranked Team* not previously advanced, from the Winning Division.
52. Highest Ranked Team* not previously advanced, from the Finalist Division.

*Refers to Qualification Match ranking. These advancements are in order. There is no normalizing of rank between divisions.

8.0 The Robot

8.1 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.

8.2 Robot Control System
A FIRST Tech Challenge Robot is controlled by an 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. 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.

For more information, tutorials, and to access our Android Technology forum, please visit: https://www.firstinspires.org/resource-library/ftc/robot-building-resources

8.2.1 Robot 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) I²C ports.
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 Motor Controller, Core Servo Controller, and the Core Device Interface Module. The Core Power Distribution Module draws power from an approved 12V 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 – Hardware and software used by a Drive Team to control their Robot during a match. The Driver Station consists of an Android device, FIRST Tech Challenge supplied Android App, adapter cable(s), optional USB Hub, an optional commercial off the shelf USB external battery connected to the USB Hub to charge the Android device at any time, and up to two controllers to drive the Robot. Teams may use either of the two models of controller device(s) in any combination—either the Logitech F310 Gamepad Controllers or the Xbox 360 Controller for Windows (Part #: 52A-00004). The Driver Station also includes any components used to hold the above listed legal devices.

Java – The recommended programming language for the Robot Controller.

Logic Level Converter – An electronic device that allows an encoder or sensor that operates using 5V logic levels to work with the REV Expansion Hub, which operates using 3.3V logic levels. This device may contain a step-up voltage converter (from 3.3V to 5V) and a dual channel, bidirectional logic level converter. This device may be used directly with a 5V digital sensor, or with an I\textsuperscript{2}C Sensor Adaptor Cable to a 5V I\textsuperscript{2}C sensor.

I\textsuperscript{2}C Sensor Adapter Cable – An adapter to change the pin orientation of the REV Robotics Logic Level Converter to match a Modern Robotics compatible I\textsuperscript{2}C sensor.

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

Modern Robotics Core Control Modules – The Core Motor Controller, the Core Servo Controller, the Core Power Distribution Module, and the Core Device Interface Module are all considered to be Core Control Modules.

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

Op Mode – An Op Mode (short for "operational mode") is software that is used to customize the behavior of a competition Robot. The Robot Controller can execute a selected Op Mode to perform certain tasks during a match.

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

REV Expansion Hub – An integrated electronic device with four (4) DC motor channels, six (6) servo channels, eight (8) digital I/O channels, four (4) analog input channels, and four (4) independent I\textsuperscript{2}C busses. The REV Expansion Hub draws power from an approved 12V battery to power these input/output channels.

REV SPARK Mini Motor Controller - An electronic device that accepts a PWM control signal (from a servo controller) and supplies 12V power to a DC motor.

REV Robotics Sensors – Sensors designed by REV Robotics that connect to the REV Expansion Hub.

REV Servo Power Module – An electronic device that boosts the power supplied to 3-wire servos. A REV Servo Power Module has 6 input servo ports and 6 matching output ports. It draws power from a 12V source.

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and provides 6V power to each output servo port. A *REV Servo Power Module* can provide up to 15A of current across all output servo ports for a total of 90 Watts of power per module.

**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 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.

**UVC Compatible Camera** – A USB Video Class (UVC) Compatible Camera is a digital camera that conforms to the *USB Video Class specification*.

### 8.3 Robot Rules

Anyone that has attended a *FIRST* Tech Challenge 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. *Teams* should read all the *Robot* rules before building. *Teams* can also reference our *Legal and Illegal Parts List* on our website for common legal and illegal *Robot* parts. Some supplier’s websites may claim that a part is *FIRST* Tech Challenge approved. The only official references for the legality of parts and materials are the Game Manual Part 1, the *Legal and Illegal Parts List*, and the *Official Game Q&A Forum*.

#### 8.3.1 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 any 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. When considering your *Robot* design and your game strategy, ask yourself the following questions. If the answer to any of these questions is yes, the design part is not allowed:

- Could it damage or disable another *Robot*?
- Could it damage the *Playing Field*?
- Could it injure a participant or volunteer?
- Is there already a rule that prohibits this?
- If everybody did this, would the game play be impossible?

**<RG01> Illegal Parts** - The following types of mechanisms and parts are not allowed:

a. Those used in a *Robot* drive system that could potentially damage the *Playing Field* and/or Scoring Elements such as high traction wheels (for example, AM- 2256) and high grip tread (for example, Rough top).

> **Black tire marks on an Element is not considered *Playing Field* damage. However, digging a hole into the *Playing Field* tiles can be considered damage.**

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 batteries).
d. Those that pose an unnecessary risk of entanglement.

e. Those that contain sharp edges or corners.

f. Those that contain animal-based materials (because of 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 (for example, loose ball bearings, coffee beans, etc.).

i. Those that are designed to electrically ground the Robot frame to the Playing Field.

j. Closed gas devices (for example, gas storage vessel, gas spring, compressors, etc.).

k. Hydraulic devices.

**<RG02> Maximum Starting Size** - The maximum size of the Robot for starting a match is 18 inches (45.72 cm) wide by 18 inches (45.72 cm) long by 18 inches (45.72 cm) high. A Robot Sizing Tool will be used as the official gauge to make sure Robots comply with this rule. To pass inspection a Robot must fit within the sizing tool while in its match start configuration without exerting force on the sides or top of the sizing tool. 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 tool by either:

a. A mechanical means with the Robot in a power-OFF condition. Any restraints used to maintain starting size (that is, zip ties, rubber bands, string, etc.) MUST remain attached to the Robot for the entire match.

b. A Robot Initialization Routine in the Autonomous Op Mode that may pre-position the servo motors, with the Robot in a power-ON condition, to the desired stationary position.

   i. 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. Attach the image (“WARNING! - Robot moves on Initialization”) to your Robot near the Robot main power switch if servos are commanded to move during the initialization routine. To be easily seen by field personnel the label should be at least 1 in x 2.63 in (2.54 cm x 6.68 cm, Avery Label # 5160) and placed on a flat surface (not wrapped around corners or cylinders): 

![WARNING](image)

**<RG03> Robot Controller Mount** – It is recommended the Robot Controller be accessible and visible by competition personnel. If a Team’s Robot Controller is not accessible and/or visible to competition personnel, the Team may not receive adequate support from the field personnel.

The Robot Controller should be mounted so the display screen is protected from contact with the Playing Field.
elements and other Robots. This and other electrical parts (batteries, motor and servo controllers, switches, sensors, wires, 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.

**<RG04> Maximum Robot Weight** – Robots must not weigh more than 42 pounds (19.05 kg) including battery. To account for variances between scales, there will be a .5 pound (.23kg) overage allowance on top of the 42 pound weight limit. This weight constraint does not include the Alliance Flag or Team Marker. If a Team is using multiple mechanisms that will be swapped out from one match to the next, all components and the robot must be weighed together during weight inspection and must not weigh more than 42 pounds.

**<RG05> Alliance Flag Holder** - Robots MUST include a mounting device to securely hold one tournament supplied FIRST Tech Challenge Robot Alliance Identification Flag throughout an entire match. The flag MUST be mounted at the TOP of the Robot and be clearly visible throughout the match to clearly identify a Robot’s Alliance. Flag posts are typically a soda straw or wooden dowel. Dimensions of each are close to 0.25 inches (0.635 cm) outer diameter x 0.20 inches (0.5 cm) inner diameter x 8.25 inches (21 cm) length with a triangular flag 4.0 inches (10.16 cm) high x 6.0 inches (15.24 cm) wide. These may vary from tournament to tournament; Alliance Flag Holders should be able to securely hold both solid core dowels and open core straws. Mounting devices that damage the flag post are not acceptable.

**<RG06> Team Number Display** - Robots MUST prominently display their Team number (numerals only, for example “12345”) on two separate signs.

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 opposite sides of the Robot (180 degrees apart).

c. The numerals must each be at least 2.5 inches (6.35 cm) high, at least in 0.5 inches (1.27 cm) stroke width, and in a contrasting color from their background. Teams can use Arial Font, Bold, 250 point to meet the minimum size requirements.

d. Team numbers must be robust enough to withstand the rigors of match play. Example robust materials include: 1) self-adhesive numbers (that is, mailbox or vinyl numbers) mounted on polycarbonate sheet, wood panel, metal plate, etc.; 2) Ink jet or laser printed numbers on paper and laminated.

**<RG07> Allowed Energy Sources** - Energy used by FIRST Tech Challenge Robots, (that is, stored at the start of a match), shall come only from the following sources:

a. Electrical energy drawn 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 careful when incorporating spring-like mechanisms or other items to store energy on their Robot by means of part or material deformation.

**<RG08> Launching Robot Parts** - Parts of the Robot itself may not be launched, even if the part launched is still connected to the Robot by a tether (for example, wire, rope, or cable).

**<RG09> Launching Game Scoring Elements** – Robots are allowed to launch Scoring Elements through the
air unless limited by a game specific rule. It is expected that Teams will launch the elements with just enough velocity to score. If the referees feel that a Robot is launching Scoring Elements with excessive velocity that would cause a safety issue if they were to leave the field, the Robot will be required to be inspected. Robots must then demonstrate that a launched Game Element cannot travel in the air more than a distance of 16 ft. (4.88 m) or more than 6 ft. (1.83 m) in elevation.

8.3.2 Robot Mechanical Parts and Materials Rules

<RM01> Allowed Materials - Teams may use raw and post-processed materials to build their Robots, provided they are readily available to the majority of Teams from standard distributors (for example, McMaster-Carr, Home Depot, Grainger, AndyMark, TETRIX/PITSCO, MATRIX/Modern Robotics, REV Robotics, etc.).

Examples of allowed raw materials are:
- Sheet goods
- Extruded shapes
- Metals, plastics, wood, rubber, etc.
- Magnets

Examples of allowed post-processed materials are:
- Perforated sheet and diamond plate
- Injection molded parts
- 3D printed parts
- Cable, string, rope, filament, etc.

Springs of all types: compression, extension, torsion, surgical tubing, etc.

<RM02> Commercial Off The Shelf Parts - Teams may use Commercial Off The Shelf (COTS) mechanical parts that have a single degree of freedom. A single degree of freedom is a system whose motion is defined just by a single independent co-ordinate (or function)\(^1\).

It is the intent of FIRST is to encourage Teams to design their own mechanisms rather than purchasing pre-designed and pre-manufactured solutions to achieve the game challenge. Purchased mechanism kits (for example, grippers) that violate the single degree of freedom rule, either assembled or requiring assembly, are not allowed. COTS drive chassis (for example, AndyMark TileRunner, REV Robotics Build Kit) are allowed provided none of the individual parts violate any other rules.

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Examples of allowed single degree of freedom parts:
- Linear Slide
- Single Sped (non-shifting) gearboxes
- Pulley
- Lazy Susan
- Lead screws

Examples of illegal multiple degrees of freedom parts:
- Gripper assemblies or kits
- Ratcheting wrenches

<RM03> Holonomic Wheels - Holonomic wheels (omni or mechanum) are allowed.

<RM04> Modifying Materials and COTS Parts - Allowed materials and legal COTS parts may be modified (that is, drilled, cut, painted, etc.), as long as no other rules are violated.

<RM05> Allowed Assembly Methods - Welding, brazing, soldering, and fasteners of any type are legal methods for assembling a Robot.

<RM06> Lubricant - Any type of COTS lubricant is allowed, if it doesn’t contaminate the Playing Field, game elements, other Robots, etc.

8.3.3 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 and is not allowed. Teams must ensure that electrical and electronic devices are used consistently with manufacturer’s requirements and specifications. Teams are encouraged to review the FIRST Tech Challenge Robot Wiring Guide for suggestions on how to build a Robot with safe and reliable wiring.

<RE01> Main Power Switch - The Robot Main Power Switch must control all power provided by the Robot main battery pack. FIRST requires Teams to use either the TETRIX (part # W39129), MATRIX (part # 50-0030), or REV (REV-31-1387) power switch. This is the safest method for Teams and field personnel to shut down a Robot.

The Robot main power switch MUST be mounted or 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. Attach the image (“POWER BUTTON”) to your Robot near the Main Power Switch. To be easily seen by field personnel the label should be at least 1 in x 2.63 in (2.54 cm x 6.68 cm, Avery Label # 5160) and placed on a flat surface (not wrapped around corners or cylinders).

The Robot Main Power Switch should be mounted on the Robot so it is protected from Robot-to-Robot contact to avoid inadvertent actuation or damage.
<RE02> **Battery Mount** - Batteries MUST be securely attached (for example, VELCRO, zip tie, rubber band) to the Robot in a location where they will not make direct contact with other Robots or the Playing Field.

<RE03> **Robot Main Battery** – All Robot power is provided by a single 12 V Robot main battery.

The only allowed Robot main power battery packs are:

a. TETRIX (W39057, formally 739023) 12 VDC battery pack
b. Modern Robotics/MATRIX (14-0014) 12 VDC battery pack
c. REV Robotics (REV-31-1302) 12 VDC Slim Battery pack

**Note:** There are similar looking batteries available from multiple sources but the ONLY legal batteries are those listed above.

<RE04> **Fuses** - 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 may be replaced with a smaller rating. Fuses must be single use only, self-resetting fuses (breakers) are not allowed.

<RE05> **Robot Power** - Robot power is constrained by the following:

a. Allowed electronic devices may only be powered by power ports on the Core Power Distribution Module or the REV Expansion Hub except as follows:
   
i. The Core Power Distribution Module or REV Expansion Hub is powered by the Robot main battery.

   ii. REV SPARK Mini Motor Controllers are powered by the Robot main battery.

   iii. Allowed sensors connected to the Core Device Interface Module and/or the REV Expansion Hub.

   iv. Light sources per <RE12>.

   v. Video cameras per <RE13>.

b. The Robot Controller Android device must be powered by its own internal battery or by the built-in charging feature of the REV Expansion Hub; external power is not allowed.

<RE06> **Android Devices** - The following Android devices are allowed:

- ZTE Speed
- Motorola Moto G 2nd Generation
- Motorola Moto G 3rd Generation
- Motorola Moto G4 Play
- Motorola Moto G5
- Motorola Moto E4

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• Google Nexus 5®
• Samsung Galaxy S5®
  a. No other devices may be used as Robot Controllers or in Driver Stations. See Rule <RS03> for the approved list of Android Operating System versions.
  b. Exactly one (1) Android device must be used as the Robot Controller and the USB interface may only connect to the Core Power Distribution Module, a REV Expansion Hub, or a USB hub.
  c. The Robot Controller Android device must be powered by its own internal battery or by the built-in charging feature of the REV Expansion Hub; external power is not allowed.

<RE07> Control Module Quantities - Robot control module quantities are constrained as follows:
  a. Exactly one (1) Core Power Distribution Module is required for Teams using any Modern Robotics Core Control Modules.
  b. No more than two (2) Core Device Interface Modules are allowed.
  c. Any quantity of Core Motor, or Core Servo Controllers are allowed.
  d. Any quantity of REV Servo Power Modules is allowed.
  e. No more than two (2) REV Expansion Hubs are allowed.
  f. Any quantity of REV SPARK Mini Motor Controllers are allowed.
  g. The REV Control Hub is not allowed.
  h. The Core Legacy Module is not allowed.

<RE08> Motor and Servo Controllers - Motor and Servo Controllers are allowed in the following configuration.

<RE09> DC Motors – A maximum of eight (8) DC motors are allowed. The only allowed motors are:
  a. TETRIX 12V DC Motor
  b. AndyMark NeveRest series 12V DC Motors
  c. Modern Robotics/MATRIX 12V DC Motors
  d. REV Robotics HD Hex 12V DC Motor
  e. REV Robotics Core Hex 12V DC Motor

No other DC motors are allowed.

* Does not support Wi-Fi Direct channel changing through the Robot Controller app.
**<RE10> Servos** – A maximum of twelve (12) servos are allowed. Any servo that is compatible with the attached servo controller is allowed. Servos may only be controlled and powered by an allowed Servo Controller, *REV Expansion Hub* or *REV Servo Power Module* (when used with an allowed Servo Controller or *REV Expansion Hub*). Servos may be rotary or linear but are limited to 6V or less and must have the three-wire servo connector.

*Teams should be prepared during Robot inspection to show documentation confirming that the servos individually and together on the same servo controller do not exceed the manufacturer specifications for the controller.*

The VEX EDR 393 motor is considered a servo and it is subject to the overall total maximum of twelve (12) servos. *Core Servo Controllers* may control up to two (2) VEX EDR 393 Motors per module. A VEX Motor Controller 29 must be used between a servo module and each VEX EDR 393 motor. *REV Expansion Hubs* must use a *REV Servo Power Module* between the *REV Expansion Hub* and the VEX Motor Controller 29. A maximum of two (2) VEX EDR 393 Motors may be controlled/powered per *REV Servo Power Module*.

**<RE11> Sensors** - Sensors are subject to the following constraints:

a. Compatible sensors from any manufacturer may be connected to the *Core Device Interface Module* or *REV Expansion Hub*.

b. Compatible sensors from any manufacturer may be connected to the *Logic Level Converter* and/or the *I^2^C Sensor Adapter Cable*. Refer to Rule <RE14.k> for details on the use of *Logic Level Converter* and the *I^2^C Sensor Adapter Cable*.

c. Passive electronics may be used as recommended by sensor manufacturers at the interfaces to the sensors.

d. Voltage sensors are allowed; except on an output port of a motor or servo controller.

e. Current sensors are allowed; except on an output port of a motor or servo controller.

f. Simple I^2^C multiplexers are allowed and they may only be connected to and powered from the I^2^C connections available on the *Core Device Interface Module* or the *REV Expansion Hub*.

g. Voltage and/or current sensors are also allowed to connect between the battery pack and the *REV Expansion Hub* or *Core Power Distribution Module*.

**<RE12> Light Sources** - Functional and/or decorative light sources (including LEDs) are allowed with the following constraints:

a. Focused or directed light sources (for example: lasers and mirrors) are not allowed except for the REV Robotics 2m Distance sensor (REV-31-1505).

b. Light source control by compatible ports on the REV Expansion Hub and Modern Robotics Core Control Modules is allowed.

c. Commercial off the Shelf interface modules (without user programmable microprocessors) are allowed between the light source and the components listed in <RE12>b.

d. The only approved power sources for lights are as follows:

   i. Internal (as supplied by the Commercial off the Shelf manufacturer) battery pack or battery holder.

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ii. Power ports on the Core Power Distribution Module.

iii. Motor-control ports on the Core Motor Controller Module.

iv. REV Expansion Hub Motor-control ports, spare XT30 ports, 5V auxiliary power ports, and I2C sensor ports.

<RE13> Video Cameras

a. Self-contained video recording devices (GoPro or similar) are allowed providing they are used only for non-functional post-match viewing and the wireless capability is turned off. Approved self-contained video cameras must be powered by an internal (as supplied by the manufacturer) battery.

b. UVC Compatible Cameras are allowed for computer vision-related tasks. It is recommended that UVC Compatible Cameras be connected to the Robot Controller through a powered USB hub that is in turn connected to the Robot Controller through an OTG adapter.

<RE14> Robot Wiring - 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. A Mini USB to OTG (On-The-Go) Micro Cable or any combination of a Mini USB cable, a USB hub, and an OTG Micro Adapter may be used to connect the Robot Controller Android device to the Robot electronics. Note that the OTG Micro Adapter may be integrated into the USB hub. These devices may connect to the Robot electronics in the following ways:
   i. Built-in USB input port of the Core Power Distribution Module, or
   ii. Built-in USB input port of the REV Expansion Hub, or
   iii. A USB hub that connects to the built-in USB input port of the REV Expansion Hub. If a powered hub is used, it must draw its energy from either
      i. A commercial USB battery pack, or
      ii. A 5V auxiliary power port on a REV Expansion Hub.

d. Non-powered USB hubs connected to the Core Power Distribution Module are allowed.

e. 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.

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

g. 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.

h. Wire and cable management products of any type are permitted (for example, cable ties, cord clips,
sleeving, etc.).

i. Wire insulation materials of any type are permitted when used to insulate electrical wires or secure motor control wires to motors (for example, electrical tape, heat shrink, etc.).

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

   i. Power wires are 18 AWG or larger.

   ii. Motor control wires as follows:

      ii. 22 AWG or larger for TETRIX Max 12V DC motors and REV Robotics Core Hex (REV-41-1300) 12V DC motors

      ii. 18 AWG or larger for all other 12V DC motors

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

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

k. Logic Level Converters – Logic Level Converters that are used to connect a REV Expansion Hub to a 5V-compatible I²C sensor or a 5V-compatible digital sensor are allowed. Exactly one Logic Level Converter per I²C device and one Logic Level Converter per digital sensor are allowed. A Logic Level Converter should only draw power from the REV Expansion Hub.

l. Electrically grounding the Control System electronics to the frame of the Robot is only permitted using a FIRST-approved, commercially manufactured Resistive Grounding Strap. The only Resistive Grounding Strap approved for use is the REV Robotics Resistive Grounding Strap (REV-31-1269). Teams that have electronics with Powerpole-style connectors may also use the REV Robotics Anderson Powerpole to XT30 Adapter (REV-31-1385) in conjunction with the REV Robotics Resistive Grounding Strap. No other grounding straps or adapters are permitted. For additional details on installation of the grounding strap or adapter, please see the Robot Wiring Guide.

<RE15> Modifying Electronics - 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 gearboxs and/or changing gears

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

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<RE16> **Driver Station Constraints** – Teams provide their own Driver Station and it 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) USB hub
   iv. No more than two (2) gamepads
   v. Any components used to hold the above listed legal devices.

b. The Driver Station Android device USB interface may only connect to either:
   i. A Mini USB to OTG (On-The-Go) cable or combination of cables connected to a USB Hub, or
   ii. One (1) gamepad and an OTG Micro Adapter.

c. One optional COTS USB external battery connected to the USB Hub to charge the Android device is allowed.

d. The only allowed gamepads are listed below. They may be used in any combination.
   i. Logitech F310 gamepad (Part# 940-00010)
   ii. Xbox 360 Controller for Windows (Part# 52A-00004)

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

**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.

<RE17> **Additional Electronics** – Electronic devices that are not specifically addressed in the preceding rules are not allowed. A partial list of electronics that are not allowed includes: Arduino boards, Raspberry Pi, relays, and custom circuits.

**8.3.4 Robot Software Rules**

<RS01> **Android Device Names** - Each Team MUST “name” their Robot Controller with their official FIRST Tech Challenge Team number and –RC (for example, “12345-RC”). Each Team MUST “name” their Driver Station with their official Team number and –DS (for example, 12345-DS). Spare Android devices should be named with the Team number followed by a hyphen then a letter designation beginning with “B” (for example, “12345-B-RC”, “12345-C-RC”).

<RS02> **Recommended Programming Language** - Java and the Blocks Development Tool are the
recommended programming languages for the FIRST Tech Challenge. The minimum allowed app version number is 4.0. Programming must be done using one of the following applications:

a. FTC Blocks Development tool – a visual, blocks-based programming tool hosted by the Robot Controller.

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

c. Java Native Interface (JNI) & Android Native Development Kit (NDK) – Teams can incorporate native code libraries into their apps using the JNI framework and the Android NDK.

d. FTC OnBot Java Programming tool – a text-based integrated development environment hosted by the Robot Controller.

If mandatory updates are announced by FIRST later in the season, Teams must install them before the time of competition. Additionally, beta versions of the software are allowed at official tournaments.

<RS03> **Allowed Android Operating Systems** - The only allowed operating systems for the Robot Controller and Driver Station Android devices are:

a. ZTE Speed: 4.4 or higher (Kit Kat)

b. Motorola Moto E4: 7.1 or higher (Nougat)

c. Motorola Moto G 2\textsuperscript{nd} Generation, Motorola Moto G 3\textsuperscript{rd} Generation, Google Nexus 5, Samsung Galaxy S5: 6.0 or higher (Marshmallow)

d. Motorola Moto G4 Play: 6.0.1 or higher (Marshmallow)

e. Motorola Moto G5: 7.0 or higher (Nougat)

**IMPORTANT**: Rules <RS02> or <RS03> do not require that Teams upgrade to the latest version of the software. A mandatory upgrade would only be required if FIRST determined there was a critical software fix that must be adopted by Teams. Mandatory upgrades will be communicated in the following ways:

- Via **Team Blast** – The mandatory upgrade and version number will be communicated to Teams on the Team Blast, which will also show the date the required upgrade must be made.
- Online – the minimally required software will be listed on our Technology Resources page, with the date Teams are required to make the mandatory software upgrade.
- Forum – The minimally required software will be listed in the Technology Forum page, with the date Teams are required to make the mandatory software upgrade.

Templates for all programming choices are available through the links located at [http://www.firstinspires.org/node/5181](http://www.firstinspires.org/node/5181).

<RS04> **Autonomous to Driver-Controlled Transition** - Teams that expect to operate their Robot during the Autonomous period must demonstrate during Field Inspection the Driver Station switches the Robot Controller between Autonomous mode and Driver-Controlled mode.

<RS05> **Robot Controller App** - The Robot Controller must have a designated “FTC Robot Controller” app that is the default application for the Core Robot modules (Servo, Motor, and Device Interface) or the REV Expansion Hub.
Driver Station App - Teams must install the official “FTC Driver Station” app onto their Driver Station Android Device and use this app to control their Robot during a match. The Driver Station software version number must match the version number of the Robot Controller app.

Android Device Operating System Settings - The Robot Controller and Driver Station must be set to airplane mode, and Bluetooth must be turned off.

Wi-Fi Direct Channel Changing App - The Robot Controller must have the FIRST Tech Challenge “Wi-Fi Direct Channel Changing” App installed (ZTE Speed ONLY).

Software Modification - Teams are not allowed to modify the FIRST Tech Challenge Driver Station in any fashion. When using the Robot Controller SDK, Teams are not allowed to replace or modify the portions of the SDK which are distributed as binary .AAR files.

Driver Station Communication - Communication between the Robot and Driver Station is only allowed via the Robot Controller and Driver Station applications.

Communication between the Robot Controller and the Driver Station is limited to the unmodified mechanisms provided by the official FIRST Tech Challenge (FTC) software, which consists of the official FTC Software Development Kit (SDK), the FTC Robot Controller app, and the FTC Driver Station app. Teams are not allowed to stream audio, video or other data using third party software or modified versions of the FTC software. Teams may only use the unmodified telemetry feature included with the FTC software to transfer additional data between the Robot Controller and the Driver Station. Software that is preinstalled by an approved phone’s manufacturer and cannot be disabled is exempt from this constraint.

During a Match a Team’s Robot Controller and a Team’s Driver Station are not allowed to be connected wirelessly to any other device besides each other.

8.4 Team Marker Rules
The Team Marker is a new, game specific scoring element that will be used in the ROVER RUCKUS™ game. The Team Marker must pass Inspection before it allowed to be used in a Match.

Material Constraints - The Team Marker is subject to the Robot Mechanical Parts and Materials Rules in section 8.3.2.

Size Constraints - The maximum size of the Team Marker is 4 inches (10.16 cm) by 4 inches (10.16 cm) by 8 inches (20.32 cm). The minimum size of the Team Marker is 3 inches (7.62 cm) by 3 inches (7.62 cm) by 4 inches (10.16cm).

Team Number - Team Markers must be labeled with their Team number (numerals only, for example “12345”). The letters must be legible when viewed from a distance of 12 inches away. The Team number needs to appear only once on the Team Marker.

Illegal Parts - The following types of mechanisms and parts are not allowed:

a. Electronics.

b. Any other part or material that violates Robot construction rules outlined in section 8.3.
9.0 Robot Inspection

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

9.2 Description
The FIRST Tech Challenge Robot will be required to pass Robot and Field inspections before being cleared to compete. These inspections will ensure that all Robot rules and regulations are met. Initial inspections will take place during Team check-in/practice time. The official “Robot Inspection Checklists” are located in Appendices B and C.

9.2.1 Team Self-Inspection
Teams are highly recommended to conduct a self-inspection of their Robot and submit the completed Robot Inspection forms to the Robot Inspectors. Teams should go through each checklist at least a week before the competition to make sure their Robot is made up of legal parts. Teams should bring their self-inspection sheets to the competition and hand them in to the Robot and Field Inspectors.

9.3 Definitions
Robot Initialization Routine – A set of programming instructions that runs after Init is pressed on the Driver Station, but before Start for both Driver Controlled and Autonomous periods.”

Robot Sizing Tool – A sturdy constructed device with the interior dimensions: 18 inches (45.72 cm) wide by 18 inches (45.72 cm) long by 18 inches (45.72 cm) high that has one open side with an interior opening size of 18 inches (45.72 cm) wide by 18 inches (45.72 cm) long. The Sizing Tool is used for Robot Inspection as outlined in section 8.3.1.

9.4 Inspection Rules
<1> Inspection - Every Robot will be required to pass a full inspection before being cleared to compete. This inspection ensures that all FIRST Tech Challenge Robot rules and regulations are met. Teams are highly recommended to conduct a self-inspection of their Robot and submit the completed inspection forms at their designated Robot Inspection appointment.

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

a. If significant changes are made to a Robot after passing 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 Team disqualification from the tournament.

c. Appendices B and C 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 the Lead Inspector considers it unsafe.

<2> Practice Matches - FIRST Tech Challenge Teams must submit their Robot for inspection before participating in Practice Matches. At the discretion of the Lead Inspector, the Robot may be allowed to participate in practice rounds before passing inspection.

Gracious Professionalism® - “Doing your best work while treating others with respect and kindness - It’s what makes FIRST, first.”
Qualification Matches - 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 a FIRST Tech Challenge tournament.

Re-Inspection – Teams that modify their Robot to improve performance or reliability are required to request a re-inspection of their Robot by an Inspector.

Safety - It is the Inspector's responsibility to evaluate Robots to insure each Robot has been designed to operate and function safely. Section 8 of this manual, and Game Manual Part 2, section 1.6.1 specify the safety rules and limits that apply to the design and construction of all Robots.

Passing Inspection - Robot inspection is a Pass/Fail process. A Robot has passed inspection when all requirements listed on the official FIRST Tech Challenge "Robot and Field Inspection Sheets" have been successfully met and recorded as passed by an Inspector.

All Mechanisms are Inspected - At the time of Inspection, the Robot must be presented with all mechanisms (including all components of each mechanism), configurations, and decorations that will be used on the Robot during the competition. It is acceptable for a Robot to play matches with a subset of the mechanisms that were present during inspection. Only mechanisms that were present during inspection may be added, removed, or reconfigured between matches. The Robot should be assembled in a typical configuration used for match play when reporting for inspection.

- Robot and all mechanisms must be inspected in every starting configuration.
- If mechanisms are swapped out between matches, the reconfigured Robot must still meet all Robot rules and inspection criteria.
- The sum of all electronics (motors, servos, Core modules, Android devices, etc.) used to construct all mechanisms and base Robot, whether they are used on the Robot at the same time or not, may not exceed the constraints specified in the Robot construction rules.

Wheel/Tread Playing Field Damage Test - Robot Inspectors have the authority to request that a Team test their wheels/treads that they feel might cause damage to the Playing Field. Since not every tread or wheel can be evaluated and posted as a legal or illegal part, the tread test is a quick way to determine if a Team's wheels/treads are competition legal.

The Robot Inspector should place the Robot on top of a field tile and against an immovable surface (wall), and run the wheels at full power for 15 seconds. If there is any physical damage to the floor tile, the wheels will not be allowed. Discoloration or black marks alone are not considered field damage. The test must be made with the Robot at the weight it will be at during the competition since this will affect the degree of damage.

Team Marker Inspection - Team Markers will be inspected prior to the start of the competition, and concurrently with Robot inspection. A Team Marker must be re-inspected if it is modified after initial inspection.

10.0 Judging & Award Criteria

10.1 Overview
This section provides descriptions of all the FIRST Tech Challenge Awards; the judging process, award criteria, Engineering Notebook guidelines, and philosophy that Teams need to be aware of in preparation for participating at FIRST Tech Challenge 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 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 show the results 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.

FIRST Tech Challenge judging sessions do not include written or verbal feedback for students. The 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 FIRST Tech Challenge Team Judging Session Self-Reflection Sheet please visit the website: http://www.firstinspires.org/node/5226

10.2 Engineering Notebook

10.2.1 Overview
This section describes the requirements for creating the Engineering Notebook, including formatting guidelines, and the use of various forms of engineering support. It also provides links for sample pages from award winning Engineering Notebooks.

10.2.2 What is an Engineering Notebook?
One of the goals of FIRST and FIRST Tech Challenge 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 Engineering Notebook is a complete documentation of the Team, outreach and fundraising efforts, business or strategic plans, and the 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.


10.2.3 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 inches (7.62 cm). 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 a three ring binder no larger than 3 inches (7.62 cm).
10.2.4 Engineering Notebook Requirements
Engineering Notebooks will NOT be considered without the following information.

1. Teams may not submit more than two notebooks at a competition.
2. The Team Number must appear on the outside front cover of the Engineering Notebook.
3. Attach a summary page to the front cover of the Engineering Notebook. This should include:
   a. The Team number.
   b. A brief, one-page narrative about the Team, the school or organization, and an overview of the highlights of the Team's season.
   c. The summary page must point the Judges to pages in the Engineering Notebook that the Team would most like the Judges to consider.
4. 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.


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

<table>
<thead>
<tr>
<th>Engineering Notebook Requirements by Award</th>
<th>Inspire Award</th>
<th>Think Award</th>
<th>Connect Award</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Team must submit an Engineering Notebook. The Engineering notebook 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.</td>
<td>• Engineering Notebook must have an Engineering section that includes entries describing underlying science, mathematics, and game strategies. • The Engineering Notebook must show 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 be organized and follow the formatting guidelines provided by FIRST and include a Summary Page. Note: Teams should review the Engineering Notebook resources published in the Team Management section of the FIRST website.</td>
<td>• Team must submit an Engineering Notebook. The Engineering Notebook must include a Business or Strategic plan. The plan could</td>
</tr>
</tbody>
</table>
include the future goals of the team, and the steps they will take to reach those goals. The plan could include fund-raising goals, sustainability goals, timelines, outreach, and community service goals.

**Rockwell Collins Innovate Award**
- Team must submit an Engineering Notebook. The Engineering Notebook must include an Engineering section that documents the design process and how the Team arrived at their design solution.

**Design Award**
- Team must submit an Engineering Notebook with an Engineering section that includes detailed Robot design drawings.

**Motivate Award**
- Team must submit an Engineering Notebook. The Engineering Notebook must include a Business or Strategic plan. The plan could include the future goals of the team, and the steps they will take to reach those goals. The plan could include fund-raising goals, sustainability goals, timelines, outreach, and community service goals.

**Control Award**
- The Team must submit an Engineering Notebook. The Engineering Notebook must include an Engineering section that documents the control components.

### 10.2.6 Notebook Examples
Scanned copies of award-winning Engineering Notebook examples are posted on the FIRST website. It is strongly encouraged for Teams to look over these as great examples of what the judges will be looking for when reading through the Engineering Notebooks.

### 10.3 Judging Process, Schedule, and Team Preparation
The schedules at the FIRST Tech Challenge 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.

#### 10.3.1 Judging Process
At FIRST Tech Challenge Championship Tournaments, there will be three parts to the judging process:

1. Interview with the judges.
2. Evaluation of performance.

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.
10.3.1.1 Feedback to Teams

FIRST Tech Challenge does not permit feedback provided to Teams during or after their Interview has taken place at official Tournaments. FIRST Tech Challenge judging is a subjective process; the goal is to prepare student Team members with real life Interview skills, and to continue to build upon those skills from Event to Event.

FIRST encourages Teams to utilize the Self-Reflection Sheet to evaluate themselves through the Interview, and the Team Engineering Notebook Self-Reflection Sheet to evaluate their Engineering Notebook. These sheets are accessible online. Teams should not ask the Judges for feedback after the interview is complete. An essential aspect of FIRST Tech Challenge Judging is the subjectivity, and that FIRST Tech Challenge encourages students to learn how to self-evaluate. Although it may be that Teams are discouraged by this, learning this process is an invaluable life skill.

10.3.2 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.

10.3.3 Team Preparation

Teams are strongly encouraged to read and understand the award requirements for each award 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 Tournament, and at the FIRST Tech Challenge World Championship Tournaments. Please see the Award Categories section of this manual for award requirements, and also look over the Engineering Notebook Requirements by Award to ensure the Team’s Engineering Notebook meets the required criteria by award.

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 the FIRST Tech Challenge is a student-centered activity and it is about giving the students a unique and stimulating experience in all aspects of the program.

10.3.4 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 FIRST Tech Challenge. 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, MOV or better format. Submission through use of a streaming service such as YouTube is not acceptable. Remember 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.
- Teams must have permission from the copyright owners for music used in the video.

### 10.4 Award Categories

Each Award listed below has a list of non-negotiable requirements. Please note that each award has a set of required criteria. Gracious Professionalism® is listed as the first criteria for every award. This is a mandatory requirement for every FIRST Tech Challenge Award. Teams who behave in an ungracious way are not eligible for consideration for any Award.

#### 10.4.1 Inspire Award

This judged award is given to the Team that embodied the ‘challenge’ of the FIRST Tech Challenge program. The Team that receives this award is a strong ambassador for FIRST programs and a role model FIRST 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 shares their experiences, enthusiasm and knowledge with other Teams, sponsors, their community, and the Judges. Working as a unit, this Team will have showed success in performing the task of designing and building a Robot.

Required criteria for the Inspire Award:

- Team shows respect and Gracious Professionalism® to everyone they meet at a FIRST Tech Challenge 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. They demonstrate and document their work in their community.
- Team is positive and inclusive, and each Team member contributes to the success of the Team.
- Team must submit an Engineering Notebook. The Engineering notebook 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.

#### 10.4.2 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 must focus on the design and build stage of the Team’s Robot. Journal entries must include descriptions of the underlying science and mathematics of the Robot design and game strategies, the designs, redesigns, successes, and opportunities for improvement. A Team is not a candidate for this award if they have not completed the Engineering section of the Engineering Notebook.

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Required criteria for the Think Award:

- Team shows respect and Gracious Professionalism® to everyone they meet at a FIRST Tech Challenge event.
- Team must submit an Engineering Notebook. The Engineering Notebook must have an Engineering section that includes entries describing underlying science, mathematics, and game strategies.
- The Engineering Notebook must show 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 be organized and follow the formatting guidelines provided by FIRST and include a Summary Page. Note: Teams should review the Engineering Notebook resources published in the Team Management section of the FIRST website.

Strongly suggested criteria for the Think Award:

- Teams should tab or flag 6 to 8 pages of the Engineering section to support entries on the summary page.

10.4.3 Connect Award
Connecting the dots between community, FIRST, and the diversity of the engineering 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 and recruits 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 shows respect and Gracious Professionalism® to everyone they meet at a FIRST Tech Challenge event.
- Team must submit an Engineering Notebook. The Engineering Notebook must include a Business or Strategic plan that identifies their future goals and the steps they will take to reach those goals. Examples of what the plan could include are fund-raising goals, sustainability goals, timelines, outreach, and community service goals.
- Team provides clear examples of developing in person or virtual connections with individuals in 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.
10.4.4 Rockwell Collins Innovate Award
Bringing great ideas from concept to reality.

The Rockwell Collins Innovate Award celebrates a Team that thinks outside the box, and 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 specific components in the FIRST Tech Challenge 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 must include journal entries to show the design of the component or components and the Team’s Robot to be eligible for this award. Entries must describe how the Team arrived at their solution.

Required criteria for the Rockwell Collins Innovate Award:

- **Team** shows respect and **Gracious Professionalism®** to everyone they meet at a FIRST Tech Challenge event.
- **Team** must submit an Engineering Notebook. The Engineering Notebook must include 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.

10.4.5 Design Award
Industrial design at its best.

This judged award recognizes design elements of the Robot that are both functional and aesthetic. The 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.

Required criteria for the Design Award:

- **Team** shows respect and **Gracious Professionalism®** to everyone they meet at a FIRST Tech Challenge 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** distinguishes itself from others by its aesthetic and functional design.
- **Basis** for the design is well considered (that is inspiration, function, etc.).

10.4.6 Motivate Award
Sparking others to embrace the culture of FIRST!

This Team embraces the culture of FIRST and clearly shows what it means to be a Team. This judged award celebrates the Team that represents the essence of the FIRST Tech Challenge competition through Team

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**Gracious Professionalism®** - “Doing your best work while treating others with respect and kindness - It’s what makes FIRST, first.”
building, Team spirit and displayed enthusiasm. 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** shows respect and Gracious Professionalism® to everyone they meet at a FIRST Tech Challenge event.
- **Team** must submit an Engineering Notebook. The Engineering Notebook must include a Business or Strategic plan that identifies their future goals and the steps they will take to reach those goals. Examples of what the plan could include are fund-raising goals, sustainability goals, timelines, outreach, and community service goals.
- The Team is an ambassador for FIRST programs.
- **Team** can clearly show the successful recruitment of new Teams, mentors, coaches and volunteers who were not already active within the STEM community.
- **Team** can explain the individual contributions of each Team member, and how these apply to the overall success of the Team.

Strongly suggested criteria for the Motivate Award:

- All Team members take part in their presentation, and actively engage with the judges.
- Team shows a creative approach to materials that market their Team and FIRST.

10.4.7 Control Award

Mastering Robot intelligence.

The Control Award celebrates a Team that uses sensors and software to increase 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, improving 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** shows respect and Gracious Professionalism® to everyone they meet at a FIRST Tech Challenge event.
- **Team** must apply for the Control Award by filling out the Control Award Content Sheet, located in Appendix D.
- The Team must submit an Engineering Notebook. The Engineering Notebook must include an Engineering section that documents the control components.
- Control Components must enhance the functionality of the Robot on the Playing Field.

Strongly suggested criteria for the Control Award:

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

The Control award is different from other Awards because Teams must apply for this Award. A Team applying
for this Award must turn in their Control Award Content Sheet to the Judges at the event. This Award focuses on a Team’s ability to program a Robot that can reliably and efficiently carry out tasks during Match play, in a way that improves their ability to score during a Match. A Team can submit their code for Autonomous operation as well as their code for the Driver Controlled operation, if they choose.

The Judges are responsible for collecting the content sheet at the beginning of the Teams’ Interview. After the Team Interview is complete, the Judges will reference the sections of the Engineering Notebook the Team has pointed out on the Control Award Content Sheet. The Judges should pay attention to look for:

- What sensors and hardware the Team has tried on the Robot; what worked, what didn’t, and why.
- What algorithm or code the Team has programmed their Robot with; what worked, what didn’t, and why.
- The Judges should pay attention to the program and design process. The design process is more critical than the code itself.

Just like having Engineering Notebook reviewers, the Judge Advisor will assign a group of 2-3 Judges to review the Control Award Content Sheets, once Interviews are complete.

### 10.4.8 Promote Award (Optional)
This judged award is optional and may not be given at all Tournaments. Your Judge Advisor will have information about the Judging for this Award.

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.

Teams may win the Promote Award only once at a Championship level event and only once at a qualifying level event.

PSA Subject for 2018-2019 Season:

“If every student participated in FIRST, the world would be…”

Required criteria for the Promote Award:

- **Video must meet the following criteria:**
  - Video Must follow FIRST branding and design standards
  - Video cannot be longer than 60 seconds.
  - Video must be of a high quality, as submissions may be used at a later time to promote FIRST.
  - Team must have rights to music used in the video.
  - Music and permissions must be listed in video credits
  - Video must have strong production value.
  - Video must be submitted by the deadline given by the Event Organizer
- **Team** must present a thoughtful and impactful video which appeals to the public.
- Creativity in interpreting the yearly theme is required.

**Gracious Professionalism®** - “Doing your best work while treating others with respect and kindness - It’s what makes FIRST, first.”
• Follow [video award submission guidelines](#).

### 10.4.9 Compass Award (Optional)

A beacon and leader in the journey of the *FIRST* Tech Challenge.

This judged award is optional and may not be given at all tournaments. Your Judge Advisor will have information about the Judging for this Award.

The Compass Award recognizes an adult Coach or Mentor who has given outstanding guidance and support to 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 *FIRST* Tech Challenge student *Team* members, via a 40-60 second video submission. The video must highlight 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:**
  - Video Must follow *FIRST* branding and design standards
  - Video cannot be longer than 60 seconds.
  - Video must be of a high quality, as submissions may be used at a later time to promote *FIRST*.
  - *Team* must have permission from the copyright owners for music used in the video.
  - Music and permissions must be listed in video credits
  - Video must be submitted by the deadline given by the Event Organizer.
- Video highlights the mentor’s contribution to the *Team* and demonstrates what sets the mentor apart.
- Follow [video award submission guidelines](#).

### 10.4.10 Judges’ Award

This award is optional and may not be given at all tournaments. Your Judge Advisor will have information about the Judging for this Award.

During the competition, the judging panel may meet a *Team* whose unique efforts, performance or dynamics merit recognition, but 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.

### 10.4.11 Winning Alliance Award

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

### 10.4.12 Finalist Alliance Award

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

### 11.0 *FIRST*® Tech Challenge Dean’s List

In an effort to recognize the leadership and dedication of *FIRST’s* most outstanding *FIRST* Tech Challenge students, the Kamen family sponsors an Award for selected top students known as the *FIRST* Dean’s List.
Since its introduction in 2010, the FIRST Dean’s List Award has attracted the attention of prestigious colleges and universities who desire to recruit FIRST Dean’s List students. Similar to the very prestigious National Merit Scholarship Award winners, there are three (3) “categories” of FIRST Dean’s List Award students:

1. **FIRST Dean’s List Semi-Finalists**
   - FIRST Dean’s List Semi-Finalists are the students nominated by each Team to compete for the FIRST Dean’s List Finalist spots.

2. **FIRST Dean’s List Finalists**
   - The students selected to be recognized at each State/Regions Championship that are in the running for the FIRST Dean’s List Winner spots.

3. **FIRST Dean’s List Winners**
   - The group of 10 students who are the final selection for the Dean’s List Award at the FIRST World Championship.

Each FIRST Tech Challenge Team is invited to select up to two (2) students who are in the 10th or 11th grade (sophomores or juniors) as FIRST Dean’s List Semi-Finalists. The students who earn FIRST Dean’s List Award status as a Semi-Finalists, Finalist or Winner, are great examples of student leaders who have led their Teams and communities to increased awareness for FIRST and its mission. These students have also achieved personal technical expertise and accomplishment. It is the intention of FIRST that these individuals will continue, post-award, as great leaders, student alumni, and advocates of FIRST.

Prestigious colleges have expressed great interest in meeting FIRST Dean’s List’s Award winners and FIRST hopes that each Team will take advantage of the opportunity to nominate the most qualified students as FIRST Dean’s List Nominees!

For more information on the Dean’s List Award, and to see past FIRST Tech Challenge winners, please visit our website! [http://www.firstinspires.org/Robotics/ftc/deans-list](http://www.firstinspires.org/Robotics/ftc/deans-list)

**11.1 Eligibility**
Every registered Team in North America can submit up to two (2) students as FIRST Dean’s List Award Semi-Finalists.

- Students must be a sophomore (grade 10) or junior (grade 11) to be eligible for this Award.
- The Coach or Mentor nominating the student(s) must submit an essay explaining why the student should receive this Award. The essay must be 4,000 characters or less.

**11.2 Criteria**
Criteria for selection of the FIRST Dean’s List shall include, but not be limited to a student’s:

- Demonstrated leadership and commitment to the ideals of FIRST;
- Interest in and passion for a long term commitment to FIRST and its ideals;
- Overall individual contribution to their Team;
- Technical expertise and passion;
- Entrepreneurship and creativity;
- Ability to motivate and lead fellow Team members; and
- Ability to effectively increase awareness of FIRST in their school and community.

The Mentor or Coach, who is not related to either of the students chosen as the Team’s Dean’s List Semi-finalists, should gather the required information for the student Team member to interview for the FIRST Gracious Professionalism® - “Doing your best work while treating others with respect and kindness - It’s what makes FIRST, first.”
Dean’s List Semi-Finalist designation at one (1) Qualifying Tournament, League Championship or Interview Only Event. Applications will require:

- Nominee name
- Nominee Grade
- Nominee GPA
- Qualifying Tournament for the Dean’s List Interview to take place
- Nomination essay of no more than 4,000 characters
- Photo of Semi-Finalist (optional)

A photograph of the FIRST Dean’s List Semi-Finalist is encouraged, but optional. Coaches can submit up to three photos of the student, and FIRST encourages at least one of the photos to be a head shot of the student. The essay submission and such photos may be used, in promotion of the recipient and/or the Award, at the discretion of FIRST.

11.3 Dean’s List Nominations

There are specific instructions on how to submit Dean’s List Nominations. The Dean’s List Submission Guide has been created for Coaches and Mentors looking to submit a student for the Dean’s List Award. Please visit our website for a copy of the Guide, which provides in depth information about the Dean’s List, and step by step visual aids to complete the nominations.
Appendix A – Resources

Game Forum Q&A
http://ftcforum.usfirst.org/forum.php
Anyone may view questions and answers within the FIRST® Tech Challenge Game Q&A forum without a password. To submit a new question, you must have a unique Q&A System User Name and Password for your team.

Volunteers that apply for a specific volunteer role will receive an email from FTCTrainingSupport@firstinspires.org with their username and password to the forum. You will receive access to the forum thread specific to your role.

FIRST Tech Challenge Game Manuals

FIRST Headquarters Pre-Event Support
Phone: 603-666-3906
Mon – Fri
8:30am – 5:00pm
Email: Firsttechchallenge@firstinspires.org

FIRST Websites
FIRST homepage – www.firstinspires.org
FIRST Tech Challenge Page – For everything FIRST Tech Challenge.
FIRST Tech Challenge Volunteer Resources – To access public Volunteer Manuals.
FIRST Tech Challenge Event Schedule – Find FIRST Tech Challenge events in your area.

FIRST Tech Challenge Social Media
FIRST Tech Challenge Twitter Feed - If you are on Twitter, follow the FIRST Tech Challenge Twitter feed for news updates.
FIRST Tech Challenge Facebook page - If you are on Facebook, follow the FIRST Tech Challenge page for news updates.
FIRST Tech Challenge YouTube Channel – Contains training videos, Game animations, news clips, and more.
FIRST Tech Challenge Blog – Weekly articles for the FIRST Tech Challenge community, including Outstanding Volunteer Recognition!
FIRST Tech Challenge Team Email Blasts – contain the most recent FIRST Tech Challenge news for Teams.

Feedback
We strive to create support materials that are the best they can be. If you have feedback about this manual, please email firsttechchallenge@firstinspires.org. Thank you!

Gracious Professionalism® - “Doing your best work while treating others with respect and kindness - It’s what makes FIRST, first.”
# Appendix B – Robot Inspection Checklist

## Team Number: ____________

<table>
<thead>
<tr>
<th>Team Insp.</th>
<th>Robot Inspection Status (circle): PASS / FAIL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Robot Size &amp; Weight Inspection</td>
</tr>
<tr>
<td></td>
<td>Robot is presented at inspection with all mechanisms (including all components of each mechanism), configurations, and decorations that will be used on the Robot during the competition.</td>
</tr>
<tr>
<td></td>
<td>Separately test the Robot in all of its unique starting (pre-match setup) configurations. The Robot fits within the Sizing Tool without exerting undue force on the Sizing Tool sides and top.</td>
</tr>
<tr>
<td></td>
<td>Robot Motion Warning Label is attached if servo motors move during the Robot initialization.</td>
</tr>
<tr>
<td></td>
<td>Robot weighs no more than 42 pounds (19.05kg). + .5 pound overage allowance</td>
</tr>
<tr>
<td>✔ ✔</td>
<td>General Robot Rules</td>
</tr>
<tr>
<td></td>
<td>Robot does not contain any components that could damage the Playing Field or other Robots.</td>
</tr>
<tr>
<td></td>
<td>Robot does not contain materials that are hazardous.</td>
</tr>
<tr>
<td></td>
<td>Robot poses no obvious unnecessary risk of entanglement.</td>
</tr>
<tr>
<td></td>
<td>Robot does not contain sharp edges or corners.</td>
</tr>
<tr>
<td></td>
<td>Robot does not contain animal-based, liquid, or gel materials.</td>
</tr>
<tr>
<td></td>
<td>Robot does not contain materials that would cause a delay of game if released.</td>
</tr>
<tr>
<td></td>
<td>Robot does not contain elements that electrically ground the Robot frame to the Playing Field.</td>
</tr>
<tr>
<td></td>
<td>Robot does not contain closed gas devices.</td>
</tr>
<tr>
<td></td>
<td>Robot does not contain hydraulic devices.</td>
</tr>
<tr>
<td></td>
<td>Alliance Flag Holder is present and adequately holds the Flag during normal Robot operation.</td>
</tr>
<tr>
<td></td>
<td>Team number is visible from at least 2 sides (180 deg. apart). Numerals must be at least 2.5 inches (6.35 cm high), at least in 0.5 inches (1.27 cm) stroke width.</td>
</tr>
<tr>
<td></td>
<td>Energy used by the Robot, (i.e., stored at the start of a Match), shall come only from approved sources.</td>
</tr>
<tr>
<td></td>
<td>Robot is not capable of launching its own components.</td>
</tr>
<tr>
<td>✔ ✔</td>
<td>Robot Mechanical Parts and Materials Rules</td>
</tr>
<tr>
<td></td>
<td>All components on the Robot are from allowable raw materials and Commercial Off The Shelf products.</td>
</tr>
<tr>
<td>✔ ✔</td>
<td>Robot Electrical Parts and Materials Rules</td>
</tr>
<tr>
<td></td>
<td>The Main Power Switch is installed properly, labeled, readily accessible, and visible to competition personnel. The TETRIX, REV, and MATRIX switches are the only allowed Main Power Switch.</td>
</tr>
<tr>
<td></td>
<td>All batteries are securely attached to the Robot in a location where they will not make direct contact with other Robots or the Playing Field.</td>
</tr>
<tr>
<td></td>
<td>Exactly one (1) Robot Main Battery Pack of an approved type is on the Robot and it is properly connected to the Main Power Switch and either the Core Power Distribution Module or REV Expansion Hub.</td>
</tr>
<tr>
<td></td>
<td>Where present, fuses must not be replaced with fuses of higher rating than originally installed or according to manufacturer's specifications.</td>
</tr>
<tr>
<td></td>
<td>Allowed electronic devices are powered by power ports on the Core Power Distribution Module or REV Expansion Hub except as noted in &lt;RE05&gt;a&amp;b, &lt;RE12&gt;, and &lt;RE13&gt;.</td>
</tr>
<tr>
<td></td>
<td>The Core Power Distribution Module or REV Expansion Hub is powered by the Robot main battery. If a hybrid of Modern Robotics modules is used with the REV Expansion Hub, the REV Expansion Hub must be powered from a power port on the Core Power Distribution Module.</td>
</tr>
</tbody>
</table>
REV SPARK Mini Motor Controllers are powered by the Robot main battery. <RE05>a(ii)

Allowed sensors may only receive power from the Core Device Interface Module, and/or the REV Expansion Hub. <RE05>a(iii)

Light sources (including LEDs) are not focused or directed in any way, except for the REV Robotics 2m Distance Sensor. Light sources are powered by allowed methods. <RE05>a(iv) <RE12>

Video recording devices, if used, are powered by an internal battery and their wireless communication capability is turned off. <RE05>a(v) <RE13>

The Robot Controller is powered by its internal battery or by the built-in charging feature of the REV Expansion Hub. <RE05>b

Exactly one (1) Core Power Distribution Module is mounted on the Robot if any Modern Robotics Core Control Modules are used. <RE07>a

No more than two (2) REV Expansion Hubs are mounted on the Robot. <RE07>a

No more than two (2) Core Device Interface Modules are mounted on the Robot. <RE07>b

Robot contains no more than eight (8) DC motors of the allowed models. <RE09>

Robot contains no more than twelve (12) servos. They must be compatible with the attached REV Expansion Hub, REV Servo Power Module, or servo controller and not exceed the manufacturer specifications for the controller. <RE10>

Robot contains only allowed sensors and they are connected only to the REV Expansion Hub or the Core Device Interface Module. <RE11>

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. <RE14>h

Power, motor control, servo and encoder wires are the correct size. <RE14>k

If electronics are grounded to the Robot frame, the only approved method is the REV Robotics Resistive Grounding Strap. If needed, the REV Robotics Anderson Powerpole to XT30 adapter may connect to the Resistive Grounding Strap. No other grounding straps or cables are allowed. <RE14>l

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. <RE15>

✔ ✔ Wheel/Tread Playing Field Damage Test - Optional Rule #

Robot did not damage the Playing Field tile. [This is an optional test that is performed only when an Inspector believes that the drivetrain tread may damage a Playing Field tile.] <I8>

✔ ✔ Team Marker Inspection Rule #

The Team Marker is subject to the Robot Mechanical Parts and Materials Rules in section 8.3.2. <TM01>

Maximum size of the Team Marker is 4 inches (10.16cm) by 4 inches (10.16cm) by 8 inches (20.32 cm). Minimum size of the Team Marker is 3 inches (7.62 cm) by 3 inches (7.62 cm) by 4 inches (10.16cm). <TM02>

Team Markers must be labeled with their Team number (numerals only, for example “12345”). <TM03>

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


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

Robot Inspector ___________________________ Team Student Representative ___________________________
## Appendix C – Field Inspection Checklist

**Team Number:** _________  

**Field Inspection Status (circle):**  **PASS** / **FAIL**

<table>
<thead>
<tr>
<th>✓ Drive Team Members Present</th>
<th>Rule #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coach</td>
<td>&lt;T8&gt;</td>
</tr>
<tr>
<td>Driver 1 (required); Driver 2 (optional)</td>
<td>&lt;T8&gt;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>✓ Driver Station and Robot Controller Hardware Rules</th>
<th>Rule #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driver Station consists only of one Android device (Circle): ZTE Speed, Motorola Moto G 2nd Generation, Motorola Moto G 3rd Generation, Motorola Moto G4 Play, Motorola Moto G5, Motorola Moto E4, Google Nexus 5, or Samsung Galaxy S5.</td>
<td>&lt;RE06&gt;</td>
</tr>
<tr>
<td>Robot Controller consists only of one Android device (Circle): ZTE Speed, Motorola Moto G 2nd Generation, Motorola Moto G 3rd Generation, Motorola Moto G4 Play, Motorola Moto G5, Motorola Moto E4, Google Nexus 5, or Samsung Galaxy S5. The Android device’s USB interface only connects to the Core Power Distribution Module, a REV Expansion Hub, or a USB hub.</td>
<td>&lt;RE06&gt;</td>
</tr>
<tr>
<td>Driver Station Android device USB interface is only connected to either a Mini USB to OTG cable or combination of cables connected to one USB Hub, or one gamepad.</td>
<td>&lt;RE16&gt;a &amp; b</td>
</tr>
<tr>
<td>No more than one (1) optional Commercial Off The Shelf USB external battery connected to the USB hub is allowed.</td>
<td>&lt;RE16&gt;c</td>
</tr>
<tr>
<td>The Driver Station consists of no more than two of the allowed gamepads (Logitech F310 or Xbox 360 in any combination).</td>
<td>&lt;RE16&gt;a &amp; d</td>
</tr>
<tr>
<td>The touch display screen of the Driver Station must be accessible and visible to field personnel.</td>
<td>&lt;RE16&gt;e</td>
</tr>
</tbody>
</table>

### Driver Station (DS) and Robot Controller (RC) Software Rules

<table>
<thead>
<tr>
<th>Rule #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Android operating system satisfies the requirements: ZTE Speed – version 4.4 or higher, Motorola Moto G4 Play 6.0.1 or higher, Motorola Moto G5 7.0 or higher, Motorola Moto E4 7.1 or higher, all other allowed Android devices – version 6.0 or higher.</td>
</tr>
<tr>
<td>The Android device is set to airplane mode, and Bluetooth is turned off.</td>
</tr>
<tr>
<td>Robot is not connected to any local networks.</td>
</tr>
<tr>
<td>Android device is named with the official team number followed by –DS or –RC as appropriate.</td>
</tr>
<tr>
<td>All remembered Wi-Fi Direct Groups and Wi-Fi connections have been removed.</td>
</tr>
<tr>
<td>DS and RC apps are version 4.0 or higher and the DS and RC apps have the same version numbers.</td>
</tr>
<tr>
<td>Communication between the Robot and Driver Station is only through the RC and DS applications. Out of band communication is not allowed.</td>
</tr>
<tr>
<td>Driver Station uses the official FTC Driver Station app to control the Robot.</td>
</tr>
<tr>
<td>The FTC controller app is the default application, the application launches, and no other messages pop up.</td>
</tr>
<tr>
<td>The FTC Wi-Fi Direct Channel Changing App is installed on the Robot Controller (for ZTE Speed devices only).</td>
</tr>
<tr>
<td>Robot Controller is set to the correct Wi-Fi Direct channel (ZTE Speed, Motorola Moto G 2nd Generation, Motorola Moto G 3rd Generation, Motorola Moto G5, Motorola Moto G4 Play, and Motorola Moto E4 only).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>✓ Robot Operation Verified at the Playing Field</th>
<th>Rule #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robot Controller connects with the Driver Station.</td>
<td>&lt;RS04&gt;</td>
</tr>
<tr>
<td>Robot switches between autonomous and driver controlled operation correctly.</td>
<td>&lt;RS05&gt;</td>
</tr>
<tr>
<td>Robot starts and stops when commanded by the Driver Station.</td>
<td>&lt;RS06&gt;</td>
</tr>
<tr>
<td>The Stop Button, when pressed on the Driver Station, functions and stops the robot.</td>
<td>&lt;RS07&gt;</td>
</tr>
</tbody>
</table>
The team understands how to disable their Robot, if instructed to do so by a Referee.

<table>
<thead>
<tr>
<th>✓</th>
<th>Queuing Process Information Provided at the Playing Field</th>
<th>Rule #</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Team understands that software changes are not allowed in the Queue Area.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Team understands that the match schedule is only an estimate. Matches may start prior to or after the scheduled time. It is the team’s responsibility to monitor schedule changes and show up when required.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Team knows where to receive alliance flags and where to return them after the match.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The team understands how to disable their Robot, if instructed to do so by a Referee.</td>
<td></td>
</tr>
</tbody>
</table>

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


I hereby state that all the above is true, and to the best of my knowledge all software, Driver Station and Robot Controller rules of the FIRST® Tech Challenge have been abided by.

__________________________________________  ______________________________________
Field Inspector                             Team Student Representative

Gracious Professionalism® - “Doing your best work while treating others with respect and kindness - It’s what makes FIRST, first.”
Appendix D – Control Award Content Sheet & Instructions

To be considered for the Control Award, Teams must submit a Control Award Submission Form. On this form, Teams identify and summarize the key control elements that make their Robot unique. Included is a description of key observable actions for Judges to look for as well as the sensor and algorithm use that make it all possible. Judges will use this form for both evaluating control designs and when observing Robots on the competition field. Information on this form will typically fit on one page, with an additional page for each autonomous mode described. Optionally, additional summary pages may be added at the end to help the judges understand key developmental activity.

**Autonomous Objectives**
List the overall actions that the Robot is capable of completing. These should include scoring actions as well as other positioning and defensive operations. The Robot does not have to do accomplish all these in every program, but should be demonstrable in at least one autonomous program.

**Sensors Used**
List the sensors used to control the Robot and a brief description of how they are used.

**Key Algorithms**
List the key algorithms that make your Robot unique or are vital to its success on the field. Particularly complex or unique algorithms or those that integrate the use of multiple sensors are good candidates to highlight here.

**Driver Controlled Enhancements**
List any advanced control elements that are used during the driver controlled period to enhance performance. These may include signaling operations when a certain condition is detected on the field, auto-complete functions, fail-safe algorithms, or just any enhancements that make the control of the Robot easier or more efficient for the driver.

**Engineering Notebook References**
Judges also use the Teams Engineering Notebook to evaluate details of the Control elements. To help guide this effort, Teams should provide pointers to where in the Engineering Notebook control related information is located.

Some things to consider including as pointers are: Team goals for control activities, strategies for autonomous mode, Robot performance with and without added sensors, requirements for successful autonomous operation, performance improvements using algorithms and sensors, and testing results.

**Autonomous Program Diagrams**
For autonomous operations, Teams should draw and label a typical path the Robot takes. The labeled points identify key observable actions the Robot makes. For each labeled point, a brief description of what is taking place should be noted (see example below). Especially describe those key operations where adjustments are made to ensure accurate and repeatable performance.

For Teams with multiple autonomous programs, it is not necessary to document every program on a separate sheet. It is sufficient document the most commonly used or complex programs and note variances for the rest.

**Additional Summary Information (optional)**
For those Teams that have developed many different control features, they may want to provide additional information to assist the judges in understanding their work. This is a place where Teams can provide more detailed information about their designs. It should be organized such that separate topics are easily identified and can be quickly found.
Appendix E – Control Award Submission Form

**Please turn in this sheet during your Judge Interview along with your Engineering Notebook**

<table>
<thead>
<tr>
<th>Team #</th>
<th>Team Name:</th>
</tr>
</thead>
</table>

Autonomous objectives:

Sensors used:

Key algorithms:

Driver controlled enhancements:

Engineering notebook references:

Autonomous program diagrams:

---

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