2022-2023 FIRST® Tech Challenge

Game Manual Part 1 – Traditional Events
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1.0 Introduction

**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. Participants and alumni of FIRST programs gain access to education and career discovery opportunities, connections to exclusive scholarships and employers, and a place in the FIRST community for life. To learn more about FIRST® Tech Challenge and other FIRST® Programs, visit [www.firstinspires.org](http://www.firstinspires.org).

2.0 Gracious Professionalism®

FIRST® uses this term to describe our programs’ intent.

Gracious Professionalism® is a way of doing things that encourages high-quality work, emphasizes the value of others, and respects individuals and the community.

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

3.0 The Competition – Definitions and Rules

3.1 Overview

Students that engage in the FIRST Tech Challenge program develop Science, Technology, Engineering, and Math (STEM) skills and practice engineering principles while realizing the value of hard work, innovation, and sharing ideas. Competitions are exciting sporting events with Robot Matches, judging interviews, and Teams and Robot performance awards. This section provides critical information that will help Teams have a fun and successful Competition day.

There are three formats of Competition a Team might experience this season; traditional, remote, and hybrid events. This manual describes traditional events; however, some Teams may switch between formats depending on social distancing rules within their state/region. Below are descriptions of these formats.

3.1.1 Traditional Events

A traditional FIRST Tech Challenge event is typically held in a school or college gymnasium, where Teams use Robots to compete in the current season’s game challenge. Teams participating in traditional events compete with Alliance partners in a head-to-head style of competition on the official FIRST Tech Challenge Playing Field. Teams compete in a series of Matches that determine their ranking at a traditional tournament. The size of a traditional event can range anywhere from 8 Teams to over 50 Teams competing in one place. Traditional events are generally scheduled by the local program delivery partner, and are run by many volunteers including referees, judges, scorekeepers, queuers, and other key volunteers. Traditional events consist of Robot inspections, Robot Competitions, judging interviews (for most Competitions), and an overall celebration of Teams and their accomplishments.

3.1.2 Remote Events

Remote events were developed to mimic traditional FIRST Tech Challenge events, while practicing social distancing guidelines. Since Teams may not be able to gather and compete in the traditional head-to-head competition format, the season’s official full Playing Field has been adapted to allow Teams to play as a single Team. Remote Teams may order an official half version of this season’s field, or compete using a modified version of the field, which will be released at kickoff on 9/10/2022. Teams will sign-up for events and will be provided with a time window to submit their own Match scores, which will determine their rankings. Unlike
traditional events, the scoring of the official Matches is done by the Team, rather than an event volunteer. Teams will participate in judging interviews via video conference when judging is part of the event. To learn more about remote events, please read the Game Manual Part 1 – Remote Events manual.

3.1.3 Hybrid Events
A Hybrid event blends traditional in-person match play with judging interviews held via video conference. Teams use Robots to compete in the current season’s game challenge in the traditional style of an in-person event and participate in judging remotely using a video conferencing tool for their initial and follow-up presentations with the judge panel.

3.2 Eligibility to Compete in Official FIRST Tech Challenge Competitions:

3.2.1 North America Team Registration
To compete in an official FIRST Tech Challenge Competition at any level, a Team must be registered and in good standing with FIRST.

1. The Team must complete the registration process through the Team Registration System.
2. The Team registration fee must be paid.
3. Two adults must pass the Youth Protection screening process.

3.2.2 Outside North America Registration
Teams outside of North America are required to register through the Team Registration System. Fees will not be due to FIRST for the registration. Teams outside of North America should consult the program delivery partner in their region for program fees and product purchase.

3.2.3 Youth Team Member Registration
Every youth Team member competing on a FIRST Tech Challenge Team is required to register through the https://www.firstinspires.org dashboard. Every Team member’s parent or legal guardian must then electronically accept the consent and release form. Instructions on how to register youth Team members can be found on our website: https://www.firstinspires.org/resource-library/youth-registration-system

3.3 Competition Types
FIRST Tech Challenge has several types of Competitions categorized as official or unofficial events. These Competitions are created and managed by the regional program delivery partner (PDP) and hosted by a tournament director or local Team throughout the FIRST Tech Challenge season and off season. Information regarding regional events can be found on https://ftc-events.firstinspires.org.

3.3.1 Scrimmage
A scrimmage is an unofficial FIRST Tech Challenge event where Teams help each other improve their Robots, play Robot Matches, attend workshops, and socialize. Anyone can host a scrimmage to prepare for an official Competition. Teams hosting a scrimmage are required to tell their local program delivery partner that such an event is taking place. Teams that choose to create and host a local scrimmage 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.

3.3.2 League Meets
A league meet is an official FIRST Tech Challenge Competition in which a Team’s rankings follow the Team to future meets and the league tournament. League meets include Qualification Matches but no judging sessions, awards, or Elimination Matches. Teams participating in league meets are expected to play in a minimum of ten Qualification Matches spread across several meets prior to the league tournament. Whenever possible, it is highly encouraged that Teams participate in as many meets as they can. Rankings from one meet to the next accumulate as outlined in section 5.3.
3.3.3 Qualifying Tournaments and League Tournaments
League Tournaments and qualifying Tournaments include Qualification Matches, Elimination Matches, judging sessions and awards. Teams may compete in multiple qualifying Tournaments in a season. Teams may only participate in one league for the season, and therefore only one league Tournament each season. Qualifying Tournaments and league Tournaments are held before regional championship Tournaments. The number of Teams advancing to the regional championship Tournament depends on the capacity of the regional championship Tournament, the number of qualifying Tournaments and/or league Tournaments, and the number of Teams attending the Tournaments. The advancement criteria for moving to the next Tournament level is detailed in section 6.0.

3.3.4 Super Qualifying Tournaments
A super qualifying Tournament is an official FIRST Tech Challenge Competition in which Teams participate in qualifying Tournaments and/or a league Tournament to advance to the super qualifying Tournament, then advance to the regional championship Tournament. These Tournaments are held in regions with large numbers of Teams.

3.3.5 Regional Championship Tournaments
Regional championship Tournaments are hosted and managed by a FIRST Tech Challenge program delivery partner. In most regions, Teams are required to advance from a qualifying Tournament or league Tournament to participate, while some regions host a single regional championship Tournament. Regional 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 sessions at regional championship Tournaments.

3.3.6 World Championship
Hosted and managed by FIRST, the World Championship, held in Houston, Texas is the culminating event for all FIRST programs. FIRST Tech Challenge Teams advance to the World Championship through their regional championship Tournament. The World Championship includes Teams from many countries, and Teams should expect a higher level of Competition, both on the field and in the judging sessions.

3.4 Competition Definitions
Alliance – A collaboration of Teams for a Match.

Alliance Captain – The Student representative from an Alliance’s highest ranked Team chosen to represent an Alliance during Alliance Selection and for the semi-final and final Elimination Matches. The entire Team is also 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 Drive Team stands or moves within during a Match. Station One is the position in the Alliance Station that is closest to the audience.

Autonomous Period – A thirty-second (0:30) Match period in which the Robots operate and react only to sensor inputs and to commands pre-programmed by the Team into the onboard Robot control system. Human control of the Robot is not permitted during this period.

Competition – A Competition is an activity a Team attends as part of the FIRST Tech Challenge program that is organized or sanctioned by the local program delivery partner or FIRST Headquarters. Competitions are all levels of FIRST Tech Challenge events that include Robot Matches or judging.

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

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Divisions - Competitions that have 42 or more Teams may have multiple Divisions. Teams at a multi-Division Competition are divided evenly between the Divisions. Each Division plays its own Qualification Matches and Teams are ranked only with the Teams in the same Division. Each Division then has its own Alliance Selection and plays its own Elimination Matches. The winning Alliances from each Division play an inter-Division final series of Elimination Matches to determine the winning and finalist Alliances for the Competition.

Drive Team - Up to four representatives two (2) drivers, one (1) human player, and one (1) coach from the same Team.

Driver-Controlled Period – The two-minute (2:00) Match time period in which the drivers operate the Robot.

Elimination Matches – A Match used to decide the winning Alliance. Alliances of two or three Teams compete 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 series.

End Game – The last thirty seconds of the two-minute (2:00) Driver-Controlled Period.

Match - A head-to-head competition between two Alliances. Matches are made up of several periods totaling two minutes and thirty seconds (2:30). There is a thirty (30) second Autonomous Period, followed by a two (2) minute Driver-Controlled Period. The last thirty (30) seconds of the Driver-Controlled Period is called the End Game. There is an eight-second transition between the Autonomous Period and the Driver-Controlled Period for Teams to pick up the controllers and switch programs.

Penalty - The consequence imposed for a rule or procedure violation that is identified by a referee. Penalties may also include and/or escalate to the issuing of a yellow card or red card as a result of a continued occurrence of a rule violation and upon discretion of the Referee. Please see rule <C03> for yellow and red card definitions.

Traditional Events - An Alliance’s Penalty points are added to the opposing Alliance’s score at the end of the Match.

Remote Events - When a Penalty occurs, points are deducted from the Score of the Team that incurred the Penalty. Penalties are further categorized into Minor Penalties and Major Penalties.

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 a maximum of 10 ft. (3.05 m) x 10 ft. (3.05 m) x 10 ft. (3.05 m). Some pit spaces may vary based on Competition 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 – Points that Teams earn for playing a Match that are subsequently used in the competition ranking calculation (for more information, see Section 5).

Traditional Events – Teams earn Ranking Points for winning (two points), tying (one point), or losing or disqualification/no show (zero points) in a Qualification Match.
Remote Events – For a single Team competing remotely, the Team’s final score (after applying Penalties) for a Match is used as their Ranking Points.

**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 7.0 of this manual.

**Student** - A person who has not completed high-school, secondary school, or the comparable level as of September 1st prior to the season Kickoff.

**Surrogate Match** – Surrogate Matches are scheduled into the Qualification Matches of a Traditional Tournament if the number of Teams at the Tournaments is not evenly divisible by four. The Surrogate Match is a way to ensure all Teams are Ranked using the same number of Matches. This is an extra Qualification Match for those Teams scheduled as a Surrogate and does not contribute towards those Teams Ranking calculations. Surrogate Matches are important to the other Teams; therefore, these Matches should be played as if they were regular Qualification Matches. Surrogate Matches will be identified on the official Qualification Match schedule and will always be a Team’s third Qualification Match.

**Team** – Mentors, supporters, and Students affiliated with an entity registered with FIRST. An official FIRST Tech Challenge Team consists of no more than fifteen (15) Student Team members and is designed for Students in grades 7-12. Students cannot be older than high school-aged if they are participating Team members. All Teams are required to register through the Team Registration System. For eligibility to compete in FIRST Tech Challenge events, please see section 3.2 of this document.

**TieBreaker Points/Total TieBreaker Points** – TieBreaker Points are used as the tiebreakers when Teams have equal average Ranking Points. There are two types of TieBreaker Points, TBP1 and TBP2.

- **TBP1**: Each Team receives their Alliance’s Autonomous Period score for a Qualification Match as TBP1. Average TBP1 is the sum of the TBP1s of all non-Surrogate Qualification Matches divided by the number of Matches that a Team plays in a Competition.

- **TBP2**: Each Team receives their Alliance’s End Game specific task score for a Qualification Match as TBP2. Average TBP2 is the sum of the TBP2s of all non-Surrogate Qualification Matches divided by the number of Matches that a Team plays in a Competition.

Remote Events – For a single Team competing remotely,

- **TBP1**: Each Team receives their Autonomous Period score for a Qualification Match as TBP1.

- **TBP2**: Each Team receives their End Game specific task score for a Qualification Match as TBP2.

Please see section 5.0 for further explanation for how this is used to determine a Team’s ranking.

**Tournament** – A Tournament is an event that advances Teams to the next level of Competition within a state/region, or to the world championship.

### 3.5 Competition Rules

**<C01> Egregious Behavior** - Egregious behavior by any Team, Team member, or other representative of the Team is not tolerated at a FIRST Tech Challenge Competition. 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, or uncivil behavior towards volunteers, Teams, Competition personnel, or Competition attendees.

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**C02** Referee Authority - Referees have final gameplay 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 the announcement of the *Match* score.

ii. **Elimination 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 of 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.

**C03** Yellow and Red Cards - 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*.

Egregious or repeated (3 or more) *Robot* or *Team* member behavior at a *Competition* 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 subsequent *Matches*, except as noted below. A red card results in *Match* disqualification. Multiple red cards may lead to *Competition* disqualification. Once a *Team* receives a yellow card or red card, the *Team* number is presented with a yellow background on the audience screen for 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*. For regions that compete in league meet formats which carry *Qualification Match* scores from meet to meet, yellow and red cards do not carry from one meet to the next meet or to a league *Tournament*. 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 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 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 most recently completed Match. If no Match has been completed, the yellow or red card applies to the next Elimination Match.

**<C04> Ethical Match Play** - A Team may not encourage another Team to purposely lose a Match or to play beneath its ability. Likewise, a Team may not let another Team coerce them into purposely losing a Match or playing beneath their own ability. FIRST considers the action of a Team influencing another Team to purposely lose a Match, to deliberately miss scoring objectives, etc. incompatible with FIRST values and not a strategy any Team should employ. Violations of this rule are likely to escalate rapidly to yellow or red cards and may lead to dismissal from the Competition. The following examples violate rule <C04>.

- **Example 1**: A Match is being played by Alliance partner Teams A and B in which Team B is encouraged by Team C to underperform/not score during a Match. Team C’s motivation for this behavior is to negatively affect Team A’s ranking.

- **Example 2**: A Match is being played by Alliance partner Teams A and B in which Team A is assigned to participate as a Surrogate. Team C encourages Team A not to fully participate in the Match so that Team C gains ranking position over Team B.

- **Example 3**: A Match is being played by Alliance partner Teams A and B in which Team A is assigned to participate as a Surrogate. Team A accepts Team C’s request not to fully participate in the Match so that Team C gains ranking position over Team B.

**NOTE**: This rule is not intended to prevent an Alliance from planning and/or executing its own good faith strategy in a specific Match in which all the Teams are members of the same Alliance.

**<C05> One Robot Per Team** - 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 Competition.

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

- **c.** It is against this rule to use multiple Robots to register and attend concurrent traditional Competitions.
d. It is against this rule to use a Robot built by another Team. Violations of this rule will immediately be considered deliberate and egregious.

<C06> Competition Area Access - Only the Drive Team members with appropriate badges are allowed in the Competition Area. Additional Team members will be asked to leave the Competition Area immediately. Drive Team 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.

Only one human player represents the entire Alliance at the Playing Field. For Qualification Matches, an Alliance must decide which Team will name the human player. If the Alliance cannot decide quickly, the Team listed in the Match list as "Red 1" or "Blue 1" for the Alliance has the responsibility for naming the human player. For Elimination Matches, the Alliance Captain has that responsibility. The human player must be from the Alliance’s Teams.

<C07> Qualification Match Count - Teams competing in a meet, league Tournament, qualifying Tournament, and regional championship Tournament will compete in either five (5) or six (6) Qualification Matches as determined by the tournament director. Teams competing remotely will have a total of six (6) Qualification Matches.

<C08> Consecutive Match Timing – A Team playing in consecutive Matches will receive a minimum of five minutes (5:00) between the time a referee signals the Field to be reset and when the Robot is placed onto the Field for the next Match.

<C09> Live Scoring - The state of the field (game and scoring elements) is recorded by the scoring referees as the Match is played. Scores may not be announced to Teams until sometime after the Match is complete. At some Competitions, live scoring software may be used to show the status of the Match. Scores become official after the referees and scorekeeper have finalized the Match and the official Match Scores have been announced or the "Match Results" screen displayed.

<C11> Team No-Show for a Match - If no member of the Drive Team is present in the Alliance 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 their scheduled Match to receive credit for the Match.

<C12> Wireless Communication - No Team, Team member, or Competition attendee can 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).

b. Ad-hoc networks.

c. Communication between portable Nintendo consoles.

d. Bluetooth communication with Robots in the Competition Area.

No Team, Team member, or Competition attendee shall interfere with a Team’s Wi-Fi communication with their own Robot.

The Penalty for violating rule <C12> is disqualification of the entire Team from the Competition 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-Competition 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 <C12> has been violated, and to disqualify the offending Team.

<C13> Robot Controller and Driver Station Wireless Communication - Wi-Fi connectivity between the Android Devices used as the Robot Controller and the Driver 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 <C13> is disqualification of the entire Team from the Competition and their removal from the venue property. The head referee will work with FIRST Headquarters staff to determine if rule <C13> 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.

<C14> Robot Controller Wi-Fi Channel - Team members may be asked by the Tournament director to use a specific Wi-Fi channel on the Competition day. Teams that refuse to comply with this request will receive a yellow card.

<C15> Safety Glasses - 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 (COTS) 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 Competition personnel can see the volunteer’s, spectators, or Team member’s eyes through the safety glasses. Sunglasses or deeply shaded safety glasses used in an indoor Competition environment are not acceptable.

<C16> Battery Safety - Batteries must be charged in an open, well-ventilated area.

<C17> Footwear Safety - Open-toed or open-backed shoes are not allowed in the Pit Area or in the Competition Area.

<C18> General Safety - Running, skateboarding, roller skating, ‘hover boards’, and/or flying drones are not allowed at any Competition. These can create safety hazards to the Teams, spectators, or volunteers attending the Competition.

<C19> Audio Safety - 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.

<C20> Hazardous Materials - Painting or applying harmful products, sprays, glues, or aerosols are not allowed anywhere at the Competition. This includes the Pit, Competition, and spectator areas.

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

<C21> Team Pit Size - Team Pit size 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 tournament director, whichever is less. Teams may not extend or store material beyond their allocated Team Pit.

<C22> Two-Way Radios - Teams are not allowed to use two-way radios/walkie-talkies anywhere in the venue.
**Spectator Seating** - 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.

**Power Tool Constraints** - Soldering, brazing, or using large power tools is not allowed in the Pit or Competitions Areas unless the tournament director specifically allows it.

**Monetary Transactions** - Teams or individuals may not fundraise, sell items such as T-shirts, pins, etc., at any Competition unless the tournament director specifically allows it.

**Outside Food** – Teams or individuals may not bring food or beverages to a Competition unless the tournament director specifically allows it.

**Attendee Gracious Professionalism** - Individuals (whether associated with a Team or not) that block the playing field sightlines, or access reserved areas without credentials will be asked to move. Repeated violations of this rule are considered egregious behavior. Spectators may be removed from the Competition at the discretion of the tournament director, while Teams may receive a yellow or red card, as well as be subject to Competition removal.

**Government and Venue Requirements** – Teams must comply with government and venue specific requirements (for example, wearing a mask, social distancing, tornado warning procedures, etc.).

**Elimination Matches** - Elimination Matches differ from Qualification Matches in the following ways:

a. **Alliance Size** – The number of Teams on an Alliance is dependent upon the number Teams at the Competition:
   i. 20 or fewer Teams: Two Team Alliances – both Teams play in all Elimination Matches in which the Teams compete.
   ii. 21 or more Teams: Three Team Alliances. Two of the Teams represent their Alliance in each Match as described below.

b. **Three Team Alliances** - For Competitions with three Team Alliances:
   i. All three Teams must play at least once in the first two Matches of a round. The Team that sits out the first Match must play in the second Match, with no exceptions.
   ii. The Alliance Captain must let the referee know which two Teams are playing in each Match. Failure to do this will in a timely manner as described below results in a coin toss to decide which Team will compete in the Match.
      - Match 1: Two minutes prior to the start of the Match.
      - Match 2 and higher: Within two minutes following the display of scores from the Alliance’s previous Match.

c. **Timeouts** – There are no Team requested timeouts during the Qualification Matches. Each Alliance is allowed one 3-minute timeout during the Elimination Matches. The timeout begins at the time their Match was going to start. To call a timeout, the Alliance Captain must notify a referee:
   i. Match 1: Two minutes prior to the start of the Match.
   ii. Match 2 and higher: Within two minutes following the display of scores from the Alliance’s previous Match.

d. **Team Disqualification** - If a Team is disqualified during Elimination Matches, the entire Alliance is disqualified.
4.0 Competition Day Outline

FIRST Tech Challenge Competitions pack many activities into one day. The main activities for Competitions (qualifying Tournament, league Tournament, regional championship Tournament, 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

4.1 Competition Schedule

Competition schedules will be available through the tournament director before or at the Competition. Qualification Match schedules are created on Competition day after all Teams have checked-in and have passed all inspections.

4.2 Team Check-In

4.2.1 Consent and Release Forms

Each Student competing at a FIRST Tech Challenge Competition 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 must be filled out electronically through the FIRST dashboard. A parent or legal guardian of the Student can create a youth Team member registration through the FIRST website and complete the consent and release form online.

4.2.2 Team Roster

The Lead Coach 1 or 2 must bring the Team roster to the event, which shows a list of the Students competing and the status of each Student’s consent and release form. The roster will show that each Student’s parent or guardian has electronically filled out the consent and release form online with a green checkmark. The roster, printed from the Team registration system must be handed in at event registration.

4.2.3 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.

4.3 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. FIRST encourages Teams to use the Robot Inspection Sheet as a guide to pre-inspect their Robot prior to attending a Tournament.

4.4 Judges’ Interviews
At FIRST Tech Challenge Competitions (except for league meets), 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 portfolio. 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, Teams will have a maximum of 5 minutes to present to the judges. After the Team’s 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 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.

Teams that are participating in an event that do not have a Robot are still eligible to receive an interview, and are also eligible for judged awards.

4.5 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.

4.6 Practice Time
At some Competitions, practice fields are available for Teams to practice throughout the Competition. 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 Competition day.

4.7 Opening Ceremony
The opening ceremony is the official kickoff of the Competition for the Teams, volunteers, and spectators. During the opening ceremony, a Competition official or the emcee will welcome the Teams, 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 several 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 the opening ceremony. It is the Team’s responsibility to check the schedule and make sure they are on time for their Matches.

4.8 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 Competition. This schedule shows Alliance partners, Match pairings, and the Alliance’s color (red or blue). These Matches start immediately after the opening
ceremonies and follow the *Qualification Match* schedule. The queue volunteer crew works with *Teams* throughout the day to maintain the *Qualification Match* 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 *Competition* day.

### 4.9 Alliance Selection

The number of *Teams* in the *Elimination Matches* is based on the number of *Teams* in the *Competition*. If there are 21 or more *Teams* in the *Competition*, 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 *Competition* to decide the *Competition*’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 selected one *Alliance* partner.

- If there are 21 or more *Teams*, the same method is used for each *Alliance Captain*’s second choice (also known as 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*.

- Following *Alliance* selection, the head referee will hold an *Alliance Captain*’s meeting to discuss how the *Elimination Matches* will work.

### 4.10 Elimination Matches

The *Elimination Matches* are when the *Alliances* compete to determine the winning *Alliance*. The *Matches* are played in a seeded format where the #1 seed plays against the #4 seed, and the #2 seed plays against the #3 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 decide 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 Competition bracket appears here:

During the Elimination Matches, two Teams from an Alliance compete on the Playing Field. If the Alliance has three Teams, the Team that sits out the first Match must play in the second Match in all rounds (semi-final and final) that the Alliance competes in, 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 compete in every Match. No special accommodation is made for Robots that fail during the semi-final and final Matches. 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. The Match is then 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 can 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 of 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.
4.11 Awards and Closing Ceremony
The awards and closing ceremony celebrate the Teams and their accomplishments throughout the Competition, as well as the volunteers who helped make the Competition possible. At the awards and closing ceremony, the finalists and winners of each award are announced.

4.12 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.

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

4.13 Banners and Flags
Sponsors provide FIRST with banners to display 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.

4.14 Spectators and Etiquette
Spectators are not allowed in the designated Competition Area. Some Competitions 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.

4.15 Scouting
During the Qualification Matches, the scoring system selects each Team’s ally and opponents for each Match. In Elimination Matches, top ranking Teams can choose their own Alliance partners. Teams should select Alliance partners with abilities that complement their own strengths. Scouting during the Qualification Matches is a good way to learn the abilities and limits of the Teams and Robots competing at the Competition.

The following scouting approach has been provided by 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.

5.0 Calculating Scores and Ranking

5.1 Competition Ranking Calculation

Ranking Points and TieBreaker Points are awarded at the end of each Match. Teams that are Surrogates, Disqualified, or do not show up (no show) for a Match receive zero Score, Ranking, and TieBreaker Point contributions towards their Ranking calculation. Please note that Ranking Points differ from traditional to remote events. Please see the definition of Ranking Points and TieBreaker points in section 3.4 of this manual.

5.1.1 Traditional Events –
Each Team at a Competition is ranked according to the following sort order:

1. Averaged Ranking Points; highest to lowest, then
2. Averaged TieBreaker Points (TBP1); highest to lowest, then
3. Averaged TieBreaker Points (TBP2); highest to lowest, then
4. Highest Match Score, then
5. Random Electronic Draw

Averages are based on the number of Matches played during a Competition. Teams may be required to play a Surrogate Match, which is an extra Match marked by an asterisk on a Team’s Match schedule. The added Surrogate Match does not count towards their rankings or averages during the Competition.

5.1.2 Remote Events –
Each Team at a Competition is ranked according to the following sort order:

1. Averaged Ranking Points; highest to lowest, then
2. Averaged TieBreaker Points (TBP1); highest to lowest, then
3. Averaged TieBreaker Points (TBP2); highest to lowest, then
4. Highest Match Score, then
5. Random Electronic Draw

Averages are based on the number of Matches played during a Competition.

5.2 League Meet and Tournament Ranking

League tournament Team rankings are based on the top ten (10) Matches from all previous league meets plus all Matches played at the league tournament. The ten (10) league meet Matches are selected using the sort order from Section 5.1. All Teams at a league tournament are ranked based on the same total number of Matches (either 15 or 16 depending on the number of Qualifying Matches at the league tournament). Teams that played fewer than ten (10) Matches at meets will have Ranking Points and TieBreaker Points that are effectively zero for the missing Matches.
5.2.1 League Meet Ranking
1. Meet Ranking – For meets that track the ranking of Teams attending that meet, rankings are based on matches played at that meet using the sort order described in section 5.1. Averages for ranking are calculated based on ten (10) matches, regardless of the number of matches played by a Team.
2. Cumulative Meet League Ranking – A Team’s league ranking is based on their performance at all of the meets attended. The Team’s cumulative league ranking calculation is based on the average of the best ten (10) league meet Matches selected using the sort order described in Section 5.1. For Teams with fewer than ten (10) played meet Matches the Ranking Points and TieBreaker Points will be effectively zero for the unplayed Matches.

5.2.2 League Tournament Ranking
League tournament rankings are based on the cumulative meet league ranking described in section 5.3.1 plus all of the Matches played at the league tournament. Ranking averages are calculated across all of the cumulative ten (10) league meet Matches described in section 5.3.1 plus all Matches played at the league tournament.

5.3 Penalties

5.3.1 Traditional Events
Penalty points are added to the opposing Alliance’s score at the end of the Match.

5.3.2 Remote Events
Penalty points are subtracted from the Team’s Score. A Team’s intermediate score will go negative if the Penalties incurred are more than the points they have earned in a Match. However, any negative net score will be recorded as zero (0) as the final Match score.
# 6.0 Advancement Criteria

## 6.1 Eligibility for Advancement

*Teams* are eligible to advance from any one of the first three Qualifying *Tournaments* or Regional Championship *Tournaments* they participate in at any of the following levels, *regardless of the region*. *Teams* may only compete in one league and one League *Tournament* per season.

This applies to both *Teams* in North America, and *Teams* outside of North America:

A *Team* can only earn a spot to one championship event each season.

<table>
<thead>
<tr>
<th>Tournament Type</th>
<th>Advances To</th>
<th>Special Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>League <em>Tournament</em></td>
<td>Qualifying <em>Tournament</em></td>
<td>A <em>Team</em> is eligible to advance to the next <em>Competition</em> tier from the League <em>Tournament</em> they attend. <em>Teams</em> can only compete in one league, and therefore only one League <em>Tournament</em>.</td>
</tr>
<tr>
<td></td>
<td>Super Qualifying <em>Tournament</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Regional Championship <em>Tournament</em></td>
<td>A <em>Team</em> is eligible to advance to the next <em>Competition</em> tier from one of the first three qualifying <em>Tournaments</em> they attend.</td>
</tr>
<tr>
<td>Qualifying <em>Tournament</em></td>
<td>Super Qualifying <em>Tournament</em></td>
<td>A <em>Team</em> may participate in more than three <em>Tournaments</em> in the same <em>Competition</em> tier but are not eligible for consideration for advancement or awards at <em>Tournaments</em> beyond their third.</td>
</tr>
<tr>
<td></td>
<td>Regional Championship <em>Tournament</em></td>
<td></td>
</tr>
<tr>
<td>Super Qualifying <em>Tournament</em></td>
<td>Regional Championship <em>Tournament</em></td>
<td>A <em>Team</em> is eligible to advance to the next <em>Competition</em> tier from one of the first three super-qualifying <em>Tournaments</em> they attend.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A <em>Team</em> may participate in more than three <em>Tournaments</em> in the same <em>Competition</em> tier but are not eligible for consideration for advancement or awards at <em>Tournaments</em> beyond their third.</td>
</tr>
<tr>
<td>Regional Championship <em>Tournament</em></td>
<td><em>FIRST</em> Tech Challenge World Championship</td>
<td><em>Teams</em> advance from a regional championship <em>Tournament</em> to one of the <em>FIRST</em> Tech Challenge world championships.</td>
</tr>
</tbody>
</table>
6.1.1 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 subsequent Tournaments at that level. The levels include:

1. Qualifying Tournament/League Tournament
2. Super Qualifying Tournament
3. Regional Championship Tournament.

For example, if a Team has won the Inspire award at a qualifying Tournament in their own region, they cannot win the inspire award at any other qualifying Tournament or league Tournament in any other region.

All Teams are eligible to be considered for all judged awards at a world championship.

6.2 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, or 3rd place award finalists at smaller Tournaments), the advancement will continue in order.

1. Optional – Qualifier host Team (Note: Each region’s program delivery partner decides if this advancement opportunity is offered. The Team MUST compete at one other Tournament within the region and must meet the criteria set forth by the program delivery partner in the agreement. This advancement applies to qualifying Tournament hosts only, and does NOT apply to host Teams of meets, league Tournaments, super qualifying Tournaments, 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. Innovate Award sponsored by Raytheon Technologies Winner
13. Finalist Alliance, 2nd Team selected.
14. Control Award sponsored by Arm Winner
15. Motivate Award Winner
16. Design 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. Innovate Award sponsored by Raytheon Technologies 2nd Place.
23. Highest Ranked Team* not previously advanced, from the Finalist Division.
24. Control Award sponsored by Arm Winner 2nd Place.
25. Highest Ranked Team* not previously advanced, from the Winning Division.

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26. Motivate Award Winner 2nd Place.
27. Highest Ranked Team* not previously advanced, from the Finalist Division.
28. Design Award 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. Innovate Award sponsored by Raytheon Technologies 3rd Place.
35. Highest Ranked Team* not previously advanced, from the Finalist Division.
36. Control Award sponsored by Arm 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. Design 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.

** Events with 20 or less Teams may select an award winner and a single award finalist. Events with 21 or more Teams may select an award winner and a 2nd and 3rd place winner.

7.0 The Robot

7.1 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.

7.2 Robot Control System
A FIRST Tech Challenge Robot is controlled by an Android-based platform. Teams will use two (2) Android Devices to control their Robot. One Android Device is mounted directly onto the Robot and acts as a Robot
Controller. The other Android Device is connected to one or two gamepads to make up the Driver Station.

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

7.2.1 Robot Technology Definitions

**Android Device** – An electronic device running the Android operating system. See rules <RE07> and <RS03> for a list of allowed devices and operating system versions.

**Driver Station** – Hardware and software used by a Drive Team to control their Robot during a Match.

**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 and/or REV Control 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 I2C Sensor Adaptor Cable to a 5V I2C sensor.

**I2C Sensor Adapter Cable** – An adapter to change the pin orientation of the REV Robotics Logic Level Converter to match a Modern Robotics compatible I2C sensor.

**Mini USB to OTG (On-The-Go) Micro Cable** – The connection between the Android Device Robot Controller and the REV Expansion Hub.

**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 executes 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 a smartphone Driver Station Android device.

**REV Control Hub** – An integrated Android 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 I2C buses.

**REV Driver Hub** – A compact mobile Android Device designed specifically for use as part of the Driver Station.

**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 I2C buses.

**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 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 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** – A REV Control Hub or an allowed smartphone Android Device connected to a REV Expansion Hub 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.

**Team Scoring Element** – A Team designed and manufactured part that may be used in the Match. Compliance with construction rules will be verified during Robot Inspection.

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

**VEX Motor Controller 29** - An electronic device that accepts a PWM control signal from a servo controller through a REV Servo Power Module to drive a VEX EDR 393 motor.

### 7.3 Robot Rules

Anyone that has attended a FIRST Tech Challenge Competition 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 their Robot. Teams can also reference our Legal and Illegal Parts List on our website for common legal and illegal Robot parts. Some suppliers’ 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.

#### 7.3.1 General Robot Rules

It is the intent of FIRST to encourage creativity in design as long as it does not present a safety hazard or unfairly affect the opportunities of any 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 restricts this?
- If everybody did this, would the gameplay 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, AndyMark am-2256) and high grip tread (for example, Roughtop, AndyMark am-3309).
- 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, pneumatic tires, etc.).
- k. Hydraulic devices.
- l. Vacuum based mechanisms.
<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. Preloaded game elements may extend outside the starting size constraint. Robots may expand beyond the starting size constraint after the Match starts.

During inspection, 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 satisfy all of the following requirements:

a. Robot is placed on its drivetrain inside the robot size tool.
b. The Robot must maintain the same shape/configuration as it will have at the start of a Match.
c. Fit completely within the robot sizing tool in the same manner that it sits on the Playing Field floor at the start of a Match.
d. Any restraints used to maintain starting size (e.g., zip ties, rubber bands, string, etc.) must remain attached to the Robot for the entire Match.
e. Be fully self-supported (i.e., does not exert force on the sides or top of the sizing tool) by either:
   i. A mechanical means while powered-off.
   ii. Powered-on using mechanical means and/or an Autonomous Op Mode initialization routine that pre-positions servo motors to the desired stationary position.

Note: If the Robot Initialization routine moves the servos when a program is executed, then there must be an indication label on the Robot. 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):

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

The Robot Controller Android Device should be mounted so the display screen (if it is equipped with one) is protected from contact with the Playing Field elements and other Robots. This and other electrical parts (for example, batteries, motor and servo controllers, switches, sensors, wires) make poor bumpers and are unlikely to survive Robot-to-Robot contact during gameplay.

Important Note: The Robot Controller contains a built-in wireless radio that communicates with the Android Device in the Driver Station. 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> 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 from at least 12 feet (3.66 meters) away.

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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 and in a contrasting color from their background.

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

<RG05> Alliance Marker – Robots must include a Team supplied, Alliance specific marker on two opposite sides of the Robot to easily identify which Alliance a Robot is assigned to. The Alliance marker must be displayed on the same side of the Robot as the Team number, within a 3-inch (7.62 cm) distance of the number.

a. The red Alliance marker must be a solid red square, 2.5 inches x 2.5 inches (6.35 cm x 6.35 cm) +/- 0.25 inches (0.64 cm).

b. The blue Alliance marker must be a solid blue circle, 2.5 inches (6.35 cm) +/- 0.25 inches (0.64 cm) in diameter.

c. The Alliance marker must be visible to the referees during a Match and must indicate the Alliance color for the Match.

d. The Alliance marker must be robust enough to withstand the rigors of Match play. Example robust materials include: 1) Alliance marker template printed and laminated; 2) painted or gaff tape covered polycarbonate sheet, wood panel, metal plate, etc.

e. It is highly recommended that the Team add their Team number anywhere to their Alliance marker. This allows field personnel the ability to return Alliance markers that might be left on the Playing Field.

The intent of this rule is to allow easy identification of the Robot and their Alliance to field personnel. A template is located on the FIRST Tech Challenge game and season page https://www.firstinspires.org/resource-library/ftc/game-and-season-info

<RG06> 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.

<RG07> Detached Robot Parts – Robots may not detach parts of the Robot. Tethered elements of the Robot are considered detached if either is able to move independently of the other.

<RG08> Propelling Game Scoring Elements – Robots can propel (i.e., able to move independently of the Robot) scoring elements unless limited by a game specific rule. If allowed, Robots may only propel the elements with enough velocity to score. Propelling elements with excessive velocity could create a safety hazard for other Teams and field personnel. If the referees feel that a Robot is propelling scoring elements with excessive velocity, the Robot must be re-inspected. Robots must then show that a propelled scoring element cannot travel in the air more than a 16 ft. (4.88 m) distance or more than 5 ft. (1.52 m) in elevation.
7.3.2 Robot Mechanical Parts and Materials Rules

<RM01> Allowed Materials - Teams may use raw and post-processed materials to build their Robots, provided these materials are readily available to all Teams (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. For the FIRST Tech Challenge, a single degree of freedom part uses a single input to create a single output. The following are examples of single degree of freedom parts:
- Linear Actuator: a single rotary input results in a single direction linear output
- Pulley: rotates around a single axis
- Single Speed Gearbox: a single rotary input results in a single rotary output

It is the intent of FIRST to encourage Teams to design their own mechanisms rather than buying 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. Holonomic wheels (omni or mechanum) are allowed.

Examples of allowed COTS parts:
- Linear Slide Kit
- Linear Actuator Kit
- Single Speed (non-shifting) Gearboxes
- Pulley
- Turntable
- Lead Screws

Examples of illegal multiple degrees of freedom COTS parts:
- Gripper Assemblies or Kits
- Ratcheting Wrenches

<RM03> Modifying Materials and COTS Parts - Allowed materials and legal COTS parts may be modified (drilled, cut, painted, etc.), as long as no other rules are violated.

<RM04> Allowed Assembly Methods - Welding, brazing, soldering, and fasteners of any type are legal.

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methods for assembling a Robot.

<RM05> Lubricant - Any COTS lubricant is allowed, if it does not contaminate the Playing Field, scoring elements or other Robots.

<RM06> Current Season Game and Scoring Elements - The following season game and scoring elements are not allowed for Robot construction:

a) COTS scoring elements
b) Team manufactured replicas of COTS scoring elements
c) Navigation images

7.3.3 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 - Exactly one 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 field 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).

<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. Batteries should be protected from contact with sharp edges and protrusions (screw heads, screw ends, etc.)

<RE03> Robot Main Battery – All Robot power is provided by exactly one (1) 12V Robot main battery. Only one (1) of the approved battery packs is allowed on the Robot.

The only allowed Robot main power battery packs are:

a. TETRIX (W39057, formally 739023) 12V DC battery pack
b. Modern Robotics/MATRIX (14-0014) 12V DC battery pack

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.
c. REV Robotics (REV-31-1302) 12V DC Slim Battery pack

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

<RE04> Fuses - 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. Replaceable 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 REV Expansion Hub or REV Control Hub except as follows:

i. The REV Control Hub is powered by the Robot main battery.

ii. The REV Expansion Hub, REV Servo Power Module, and REV SPARK Mini Motor Controllers are powered by the Robot main battery or by a REV Control or Expansion Hub XT30 port.

iii. Allowed sensors are powered by the REV Expansion Hub or REV Control Hub: analog, digital, encoder, or I2C ports.

iv. Light sources per <RE13>.

v. Video cameras per <RE14>.

b. The smartphone 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> Robot Controller – Exactly one (1) Robot Controller is required. An optional REV Expansion Hub may also be added.

<RE07> Android Devices - The following Android Devices are allowed:

Smartphones:

a. Motorola Moto G 2nd Generation†

b. Motorola Moto G 3rd Generation†

c. Motorola Moto G4 Play (4th Generation)/Motorola Moto G4 Play‡

d. Motorola Moto G5

e. Motorola Moto G5 Plus

f. Motorola Moto E4 (USA versions only, includes SKUs XT1765, XT1765PP, XT1766, and XT1767)

g. Motorola Moto E5 (XT1920)

h. Motorola Moto E5 Play (XT1921)

Other:

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i. REV Driver Hub**

j. REV Control Hub***

No other Android Devices may be used as Robot Controllers or Driver Stations. See Rule <RS03> for the approved list of Android Operating System versions.

A smartphone Android Device Robot Controller USB interface may only connect to a REV Expansion Hub, or a USB hub.

†The use of smartphones operating on Android version 6 (Marshmallow) are allowed in the 2022-2023 season. However, in the 2023-2024 season the minimum version is Android 7 (Nougat); this will effectively end support for the moto G2, Moto G3, and non-updated Moto G4 smartphones.

*The Motorola Moto G4 Play may be sold as either Motorola Moto G Play (4th gen)*, or “Motorola Moto G4 Play”. Either phone is acceptable however FIRST Tech Challenge highly recommends that Teams purchase either model number XT1607 or XT1609, as these are the US versions and have been tested and are fully compatible with the FIRST Tech Challenge software. Teams that have purchased phones with model numbers XT1601, XT1602, XT1603, or XT1604 may continue to use these phones as legal, however there is a potential for issues with these phones not being fully compatible with the software or the approved gamepads.

**The REV Driver Hub may only be used as part of the Driver Station and not as the Robot Controller.

***The REV Control Hub may only be used as part of the Robot Controller and not as the Driver Station.

<RE08> Control Module Quantities - The control module consists of one of the following:

a. A REV Control Hub; or

b. An allowed smartphone Android Device connected to a REV Expansion Hub

In addition to “a” or “b” above, a Robot may also contain:

c. No more than one additional REV Expansion Hub

d. Any quantity of REV SPARK Mini Motor Controllers

e. Any quantity of REV Servo Power Modules

<RE09> Motor and Servo Controllers – The only allowed motor and servo controllers are: REV Expansion Hub, REV Control Hub, REV Servo Power Module, REV SPARK Mini Motor Controller, and VEX Motor Controller 29.

<RE10> DC Motors – A maximum of eight (8) DC motors are allowed in any combination. 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.

**<RE11> 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 a REV Expansion Hub, REV Control Hub, or REV Servo Power Module. Servos may be rotary or linear but are limited to 6V or less and must have the three-wire servo connector.

The VEX EDR 393 motor is considered a servo. It must be used in conjunction with a VEX Motor Controller 29 and a REV Servo Power Module. A maximum of two (2) VEX EDR 393 Motors per REV Servo Power Module is allowed.

**<RE12> Sensors** - Sensors are subject to the following constraints:

a. Compatible sensors from any manufacturer may only be connected to the I2C, digital I/O, encoder, and analog ports of the REV Expansion Hub or REV Control Hub.

b. Compatible sensors from any manufacturer may be connected to the Logic Level Converter and/or the I2C Sensor Adapter Cable. Refer to Rule <RE15.j> for details on the use of Logic Level Converter and the I2C 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 I2C multiplexers are allowed, and they may only be connected to and powered from the I2C connections available on REV Expansion Hub or REV Control Hub.

g. Voltage and/or current sensors are also allowed to connect between the battery pack and the REV Expansion Hub or REV Control Hub.

**<RE13> 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 or REV Control Hub is allowed.

c. Commercial Off the Shelf (COTS) interface modules (without user programmable microprocessors) are allowed between the light source and the components listed in <RE13>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.
ii. **REV Expansion Hub or REV Control Hub** Motor-control ports, XT30 ports, 5V auxiliary power ports, and I2C sensor ports.

The common rates to trigger seizures is between 3 and 30 hertz (flashes per second) but varies from person to person. While some people are sensitive to frequencies up to 60 hertz, sensitivity under 3 hertz is not common. Please keep in mind that event attendees could have sensitivities to flashing lights. ¹

*Teams* that choose to install flashing lights should ensure the lights can be turned either completely off or on (not flashing). Tournament directors have the discretion of asking *Teams* to turn their lights to either state if an event attendee or participant has a sensitivity to flashing lights.

*Teams* may still use LED lights to signal events provided the flash rate is approximately 1 hertz or less (in other words, cannot change states more frequently than approximately once a second). For example:

- *Teams* may signal via LED light that they have a scoring element ready.

¹ See [https://www.epilepsysociety.org.uk/photosensitive-epilepsy#Xujbwy22PsE](https://www.epilepsysociety.org.uk/photosensitive-epilepsy#Xujbwy22PsE) accessed on 5/04/2022

**<RE14> 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 battery (as supplied by the manufacturer).

b. COTS *UVC Compatible Cameras* are allowed for computer vision-related tasks. *UVC Compatible Cameras* must be connected directly to a *REV Control Hub*, or to the *Robot* control system through a powered USB hub.

**<RE15> 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 smartphone *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 *REV Expansion Hub* or

   ii. 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* or *REV Control Hub*.

d. Anderson Powerpole, XT30, and similar crimp or quick-connect style connectors 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.

e. Installed connectors (such as battery-pack connectors, battery charger connectors) may be replaced with Anderson Powerpole, XT30 or any compatible connector.

f. 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.

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

h. 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.).

i. Manufacturer supplied power, motor, servo, encoder, and sensor lead wires may be extended or modified using custom made or COTS wire extensions subject to the following constraints:

   i. Power wires are 18 AWG or larger diameter (for example, 16 AWG wire has a larger diameter than 18 AWG wire).

   ii. Motor control wires as follows:

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

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

   iii. PWM (servo) wires should be the same size or larger diameter than the original wiring or as specified by the manufacturer. If the original servo wire size is unknown, 22 AWG or larger diameter wire extensions are recommended.

   iv. Sensor wires should be the same size or larger diameter than the original wiring or as specified by the manufacturer.

   j. Logic Level Converters – Logic Level Converters that are used to connect a REV Expansion Hub or REV Control 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 or REV Control Hub.

   k. Electrically grounding the Control System electronics to the frame of the Robot is recommended and 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 must 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.
**<RE16> 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 gearboxes 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

**<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, electromagnets, and custom circuits.

### 7.3.4 Driver Station Rules

**Teams** provide their own **Driver Station**, and it must comply with the following constraints:

**<DS01> Driver Station Controller** – The **Driver Station** must consist of no more than one (1) of the following options:

a. One (1) smartphone **Android Device** listed in rule <RE07>, or

b. One (1) **REV Driver Hub**.

**<DS02> Driver Station Controller Touch Screen** - The touch display screen of the **Driver Station Controller** must be accessible and visible by field personnel.

**<DS03> Gamepad** – The **Driver Station** must contain no more than two (2) of the following gamepads in any combination:

a. Logitech F310 gamepad (Part# 940-00010)

b. Xbox 360 Controller for Windows (Part# 52A-00004)

c. Sony DualShock 4 Wireless Controller for PS4 (ASIN # B01LWVX2RG) operating in wired mode only (i.e., connected through USB 2.0 Type A to Type B Micro cable with Bluetooth turned off)

d. Etpark Wired Controller for PS4 (ASIN # B07NYVK9BT).

e. Quadstick game controller in Xbox 360 Emulation Mode (any model).

**<DS04> USB Hub** – No more than one (1) external battery powered or unpowered USB hub is allowed.

**<DS05> Charging the Driver Station Controller at the Playing Field** – One (1) optional COTS USB external battery is allowed to charge the **Driver Station Controller**. The USB battery connects to the **Driver Station Controller** only by these methods:
a. Through the built-in USB-C port on the REV Driver Hub.

b. Through a USB Hub connected to the smartphone Android Device.

**<DS06> Smartphone Android Device (if used) Additional Constraints –**

a. One (1) OTG Cable is required

b. The Driver Station smartphone 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, USB cable, and an OTG Micro Adapter.

**<DS07> Driver Station Carrier –** A Team is allowed to bring one (1) Driver Station carrier to the Playing Field. The Driver Station carrier’s intended use is for organizing and transporting Driver Station components. Driver Station carrier constraints are as follows:

a. Driver Station carrier may not damage Competition provided equipment, the Playing Field, or the venue floor.

b. Decorative electronics (including LEDs) are allowed, and they must be powered by a 12V or lower COTS DC battery. The smartphone Android Device and REV Driver Hub may not power or control decorative electronics.

c. Non-decorative electronics are not allowed.

d. The Driver Station carrier must not be a distraction to gameplay, field personnel, Teams, or spectators.

The intent of this rule is to allow Teams to use a container to store, organize, and transport the Driver Station components. The Driver Station carrier rule is not intended to allow carriers that function as a Robot cart or replace a Competition provided Driver Station stand, table, etc.

**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.

**<DS08> Driver Station Sounds –** Team initiated sounds via Team code and sounds not generated by the official Driver Station app are not allowed to be played through the Driver Station Android Device at any official Competition.

The intent of this rule is to prevent sounds that may distract gameplay. Android operating system power up sounds are not subject to this rule.

**7.3.5 Robot Software Rules**

For software resources and troubleshooting guides, please visit our website:


**<RS01> Android Device Names -** Each Team MUST “name” their Robot Controller Android device Wi-Fi name with their official FIRST Tech Challenge Team number and –RC (for example, “12345-RC”). Each Team MUST “name” their Driver Station Android device with their official Team number and –DS (for example, 12345-DS). Teams with more than one Driver Station or Robot Controller Android Device must name these devices with the Team number followed by a hyphen then a letter designation beginning with “A” (for example, “12345-A-RC”, “12345-B-RC”).

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<RS02> **Recommended Programming Tools** – Java is the recommended programming language for the *Robot Controller*. The following tools are recommended for use in the *FIRST* Tech Challenge:

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

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

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

d. 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.

<RS03> **Allowed Software System Versions** - The following table lists the *Android Devices*, minimum Android versions, minimum operating system and firmware versions, and minimum FTC software versions allowed per device.

### Android Smartphones

<table>
<thead>
<tr>
<th>Device</th>
<th>Minimum Android Version</th>
<th>Minimum FTC Software Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motorola Moto G 2nd Generation</td>
<td>6.0 (Marshmallow)</td>
<td>8.0</td>
</tr>
<tr>
<td>Motorola Moto G 3rd Generation</td>
<td>6.0 (Marshmallow)</td>
<td></td>
</tr>
<tr>
<td>Motorola Moto G4 Play (4th Generation) / Motorola Moto G4 Play (See &lt;RE06&gt; for details)</td>
<td>6.0 (Marshmallow)</td>
<td>8.0</td>
</tr>
<tr>
<td>Motorola Moto G5</td>
<td>7.0 (Nougat)</td>
<td></td>
</tr>
<tr>
<td>Motorola Moto G5 Plus</td>
<td>7.0 (Nougat)</td>
<td></td>
</tr>
<tr>
<td>Motorola Moto E4 (USA versions only, includes SKUs XT1765, XT1765PP, XT1766, and XT1767)</td>
<td>7.0 (Nougat)</td>
<td></td>
</tr>
<tr>
<td>Motorola Moto E5 (XT1920)</td>
<td>7.0 (Nougat)</td>
<td></td>
</tr>
<tr>
<td>Motorola Moto E5 Play (XT1921)</td>
<td>7.0 (Nougat)</td>
<td></td>
</tr>
</tbody>
</table>

### REV Hubs

<table>
<thead>
<tr>
<th>Device</th>
<th>Minimum Software</th>
<th>Minimum Firmware Version</th>
<th>Minimum FTC Software Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>REV Control Hub</td>
<td>Control Hub OS 1.1.2</td>
<td>Firmware 1.8.2</td>
<td>Robot Controller 8.0</td>
</tr>
<tr>
<td>REV Expansion Hub</td>
<td></td>
<td>Firmware 1.8.2</td>
<td></td>
</tr>
<tr>
<td>REV Driver Hub</td>
<td>Driver Hub OS 1.2.0</td>
<td></td>
<td>Driver Station 8.0</td>
</tr>
</tbody>
</table>

*Note: The REV Hardware Client software can be used to install software onto the REV Hubs.*
**IMPORTANT**: Rules <RS02> or <RS03> do not require that Teams upgrade to the latest version of the software. A mandatory upgrade (announced by FIRST) would only be required if FIRST determined there was a critical software fix that must be adopted by Teams. Teams must install the upgrade before the time of Competition. Additionally, beta versions of the software are allowed at official tournaments. 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 that the Drive Team can use the Driver Station to switch the Robot Controller between Autonomous mode and Driver-Controlled mode.

**<RS05> Robot Controller App** - The Robot Controller smartphone Android Device (if used) must have a designated “FTC Robot Controller” app that is the default application for the REV Expansion Hub. The Robot Controller app must not be installed on the Driver Station Android Device.

**<RS06> Driver Station App** – Teams must install the official “FTC Driver Station” app onto their Driver Station Android Device or REV Driver Hub and use this app to control their Robot during a Match. The Driver Station FTC software version number must match the version number of the Robot Controller app. The Driver Station App must not be installed on the Robot Controller Android Device.

**IMPORTANT**: Rules <RS05> or <RS06> may require initial installation of the software, or updates throughout the season. Teams receiving the Driver Hub or Control Hub for the first time should install the most recent version of the software.

For initial installation or to install the most current version the software, please visit the following link: [https://docs.revrobotics.com/control-hub/managing-the-control-system/rev-hardware-client](https://docs.revrobotics.com/control-hub/managing-the-control-system/rev-hardware-client)

If updates to the SDK software are required, Teams will be notified 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.

**<RS07> Android Device, REV Driver Hub, and REV Control Hub Operating System Settings** - The Robot Controller and Driver Station must be set to:

a. Airplane mode must be turned on (does not apply to the REV Control Hub and REV Driver Hub).


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b. Bluetooth must be turned off.

c. Wi-Fi must be turned on.

d. REV Control Hub password must be different than the factory default value of “password.”

<RS08> Software Modification –

a. Teams are not allowed to modify the FIRST Tech Challenge Driver Station app in any fashion.

b. Teams are required to use the FIRST Robot Controller SDK, and are not allowed to remove, replace, or modify the portions of the SDK which are distributed as binary .AAR files.

The intent of this rule is for Teams to download the official version of the SDK from FIRST and make modifications to add Team created code.

Reengineered, reverse engineered, or modified versions of the official FIRST SDK are not allowed.

<RS09> 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 permitted 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 smartphone’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.

<RS10> Robot Controller Sounds - Team initiated sounds via Team code and sounds not generated by the official Robot Controller app are not allowed to be played through the Robot Controller Android Device at any official Competition.

The intent of this rule is to prevent sounds that may distract gameplay. Android operating system power up sounds are not subject to this rule.

7.4 Team Scoring Element

The Team Scoring Element is an optional Team designed and manufactured scoring element that will be used in the POWERPLAY™ game. The Team Scoring Element must pass inspection before it is allowed to be used in a Match.

<TE01> Color Constraint - The predominant color of a Team Scoring Element must match the Team’s assigned Alliance for the Match (red or blue). The purpose of this rule is to ensure that field personnel, Teams, and the audience can easily associate Team Scoring Elements with their corresponding Alliance. Teams will need two Team Scoring Elements (one red and one blue) to fully play the game.

<TE02> Material Constraints - The Team Scoring Element is subject to the Robot Mechanical Parts and Materials Rules in section 7.3.2.
**<TE03> Size Constraints** - The maximum size of the *Team Scoring Element* is 4 inches (10.16 cm) by 4 inches (10.16 cm) by 4 inches (10.16 cm). The minimum size of the *Team Scoring Element* is 3 inches (7.62 cm) by 3 inches (7.62 cm) by 3 inches (7.62 cm). In other words, a *Team Scoring Element* must be small enough to fit inside a 4 inch x 4 inch x 4 inch cube and large enough to not fit in a 3 inch x 3 inch x 3 inch cube.

**<TE04> Team Number** - *Team Scoring Elements* must be labeled with their *Team* number (numerals only, for example “12345”). The numbers must be legible when viewed from a distance of 12 inches (30.48 cm) away. The *Team* number needs to appear only once on the *Team Scoring Element*. The intent of this rule is to facilitate *Team Scoring Element* ownership identification for non-gameplay reasons.

**<TE05> 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 7.3.
- c. COTS game elements used in the current season’s game.

**<TE06> COTS Scoring Elements** – The *Team Scoring Element* may not resemble any current season’s COTS scoring elements.

### 8.0 Robot Inspection

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

#### 8.2 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 in Appendices B and C.

#### 8.2.1 Team Self-Inspection
*Teams* are highly recommended to conduct a self-inspection of their *Robot*. *Teams* should go through each checklist at least a week before the *Competition* to make sure their *Robot* is made up of legal parts.

#### 8.3 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 sturdily constructed device with interior dimensions: 18 inches (45.72 cm) wide by 18 inches (45.72 cm) long by 18 inches (45.72 cm) high. The *Sizing Tool* is used for *Robot* Inspection as outlined in section 7.3.1.

#### 8.4 Inspection Rules
- **<I01> Inspection** - Every *Robot* and *Team* supplied game element are required to pass a full inspection before being cleared to compete. Failure to follow any *Robot* design, construction rule, or programming rules may result in disqualification of the *Team* from *Match* play at a *Competition*. Inspection ensures that *Teams* comply with *FIRST* Tech Challenge rules.

All *Robot* configurations must be inspected before being used in *Competition*.

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a. If significant changes are made to a Robot after passing initial inspection, it must be re-inspected before it can compete.

b. Referees or inspectors may request the re-inspection of a Robot. The Robot cannot participate in a Match until it passes re-inspection. Refusal to submit to re-inspection will result in Team disqualification from the Competition.

c. A Robot may be rejected at inspection if the lead inspector considers it unsafe.

<i02> Practice Matches - Teams must submit their Robot and Team supplied game element(s) for inspection before participating in Practice Matches. A Team may be allowed to participate in Practice Matches before passing inspection if allowed by the lead robot inspector.

<i03> Re-Inspection – Physical changes to a Robot or Team supplied game element that modify or add capability must pass re-inspection prior to being eligible to play in the next Match.

<i04> Safety - It is the inspector’s responsibility to evaluate Robots to ensure each Robot is designed to operate safely. Section 7 of this manual, and Game Manual Part 2, section 4.5.1 outlines the safety rules and limits that apply to the design and construction of all Robots.

<i05> Passing Inspection - Inspection is a pass or fail process and is determined by successful completion of the inspection checklists in Appendices B and C. Robot and Team supplied game element inspection status are independent.

<i06> All Robot Mechanisms are Inspected - For Inspection, the Robot must be presented with all mechanisms, including all parts of each, configurations, and decorations that will be used on the Robot during the Competition. Robots are allowed 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 Matches play when reporting for inspection.

a. Robot and all mechanisms must be inspected in every starting configuration.

b. If mechanisms are swapped out between Matches, the reconfigured Robot must still meet all Robot and inspection rules.

c. The total of all electronics (motors, servos, Android devices, etc.) used to build 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 rules.

<i07> Wheel or Tread Playing Field Damage Test - Robot inspectors have the authority to ask that a Team test their wheels or treads that they feel might cause damage to the Playing Field. Not every tread or wheel can be evaluated and posted as a legal or illegal part. Therefore, the damage test is a quick way to find out if a Team’s wheels or 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 done with the Robot at the weight it will be at during the Competition since this will affect the degree of damage.

<i08> Software – Driver Station and Robot Controller software must pass field inspection before being used in a Match.
Driver Station – The Driver Station and Driver Station carrier must pass field inspection before being used in a Match.

Team Supplied Elements – Team supplied elements are inspected during Robot inspection. Any functional changes (e.g., Team number, appearance, size) to a Team supplied element after the initial inspection must pass re-inspection prior to being eligible to play in the next Match.

9.0 Judging and Award Criteria

9.1 Overview
This section provides descriptions of:

- Engineering notebook recommendations
- Engineering portfolio requirements and recommendations
- How judging works
- FIRST Tech Challenge award criteria

Teams have spent a significant number of hours 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 give us the opportunity to 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 provides judging feedback for Team who submit a completed judging feedback request form. When receiving feedback, Team should note the judging is a subjective process; and Students are encouraged to learn the important life skill of self-evaluation to help them prepare for their judged interview. 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: https://www.firstinspires.org/node/5226

9.2 Engineering Notebook

9.2.1 Overview
This section describes the engineering notebook.

9.2.2 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 in the phases of creating their Robot, including:

- Problem definition
- Information gathering
- Brainstorming solutions
- Concept design
- System level design
- Testing
- Design improvement
- Production
- Promotion
- Budgeting

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• Planning
• Outreach

Throughout the process of building and designing a Robot, Teams will draw ideas on paper, encounter obstacles, and learn valuable lessons. This is where Teams will use an engineering notebook. These notebooks follow the Team from the end of the prior season throughout the Competitions.

The engineering notebook is an optional item but is a fundamental source of information for the Team to use to be able to create the engineering portfolio.

Judges may ask the Team to provide specific information from their engineering notebook to better understand the journey, design, and Team and to get more details and background than would be in the Team’s engineering portfolio.

The engineering notebook is the documentation repository of the Team, outreach and fund-raising efforts, Team plans, and the Robot design. This documentation can include sketches, discussions and Team meetings, design evolution, processes, obstacles, and each Team member’s thoughts throughout the journey for the entire season.

In the FIRST Tech Challenge, engineering notebooks can include business planning, outreach goals and achievement, and a Team’s insights into what it is to be a FIRST Tech Challenge Team.

Teams should be careful to include only the first name of Team members in their engineering notebook.

Please note: An engineering notebook is not a requirement for any team, or for any award consideration.

A new notebook and portfolio must be created for each new season. Teams may consider their new season as beginning after their final event for the previous season.

9.2.3 Engineering Notebook Formats
Teams may 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.

a) Electronic: Teams may use electronic programs to create their engineering notebook.

b) Handwritten: Teams may add handwritten text, drawings, or cad drawings, but recognize that the Team may need to scan (or take a picture) of each page.

For judging at a remote event, Teams should create an electronic copy of their engineering notebook. During the second interview, Judges may ask the Team to share specific pages from the engineering notebook. Teams will not upload their engineering notebook to the FTC Scoring System.

For judging purposes at a traditional event, Teams could have a physical copy of their engineering notebook available in the Team’s Pit Area for judges to look at as needed. Judges may ask about specific content, which can be conveyed verbally, shown on a laptop, or captured in an engineering notebook. Engineering notebooks will not be collected by the event organizer or the event judges.

9.2.5 Engineering Notebook Recommendations
We strongly recommend that a one-page summary be included in the notebook near the front that connects the information from the engineering portfolio to the relevant section or pages in the engineering notebook. This will help the Team quickly find specific content to share with Judges.
The engineering notebook could include:

- **a.** Engineering content that includes the *Robot* design processes.
- **b.** *Team* information that includes information about the *Team* and outreach activities.
- **c.** A *Team* plan. This could be a business plan, a fund-raising plan, a strategic plan, a sustainability plan, or a skills development plan.

### 9.3 Engineering Portfolio

#### 9.3.1 Overview
This section describes the requirements for creating the engineering portfolio, including formatting guidelines.

#### 9.3.2 What is an Engineering Portfolio?
An engineering portfolio is a short and concise summary of the content collected within the *Team’s* engineering notebook.

The engineering notebook is a complete documentation of the *Team*, outreach and fund-raising efforts, *Team* plans, and the *Robot* design. The engineering portfolio should include sample sketches, discussions and *Team* meetings, design evolution, processes, obstacles, goals and plans to learn new skills, and each *Team* member’s concise thoughts throughout the journey for the season. The engineering portfolio is like the *Team’s* cover letter or resume. *Teams* should be careful to include only the first name of *Team* members in their engineering portfolio.

#### 9.3.3 Engineering Portfolio Formats
*TGrams* may document their summary portfolio with either handwritten or electronic documents. There is no distinction made between handwritten and electronic engineering portfolios during judging; each format is equally acceptable.

- **a.** **Electronic:** *Teams* may use any electronic programs to create their engineering portfolio. For remote event judging, *Teams* must create a single file that is a sharable, online, non-editable version (such as a PDF) of their engineering portfolio. For traditional events, *Teams* must print their engineering portfolio.
- **b.** **Handwritten:** *Teams* may create a handwritten version but for remote judging events, this is discouraged due to difficulties in scanning into a readable, sharable, online version.

#### 9.3.4 Engineering Portfolio Requirements

- **a.** To be considered for judged awards, a *Team must* submit an engineering portfolio.
  - i. Teams who do not submit an engineering portfolio will not be considered for judged awards.
- **b.** The total number of pages for an engineering portfolio must not exceed 15 pages, plus a cover sheet for a total of 16 pages.
  - i. Pages must be the equivalent of standard A sized paper (US 8.5 x 11) or Standard A4 sized paper (EU 210 x 297 mm).
  - ii. Fonts used must be a minimum of 10 points. Please avoid the use of narrow fonts, as they can be difficult for judges to read.

A *Team number on the top of every page makes it easy for judges to know who created the engineering portfolio they are reviewing. The *Team number on the front page is a required component of the engineering portfolio.*

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iii. Judges are instructed to only review the cover sheet and the first 15 pages of content that follow the cover sheet. Information included beyond 15 pages and the cover sheet will not be reviewed or considered.

c) The engineering portfolio must not include links to other documents, videos, or any other additional content.

i. Please note that judges will not review linked content in the engineering portfolio, including websites, or videos.

d) The Control Award Submission Form is not a part of the engineering portfolio and is not included in the total engineering portfolio page count.

9.3.5 Engineering Portfolio Recommendations

a) We strongly recommend the Team number is at the top of each page.

b) The engineering portfolio could include:

i. Summary of the engineering content that includes the Robot design processes.

ii. Summary of the Team information that includes information about the Team and outreach activities.

iii. Summary of the Team plan and information about the Team overall. The Team plan could be a business plan, a fund-raising plan, a strategic plan, a sustainability plan, or a plan for the development of new skills.

Teams can use the Self-Assessment sheet (coming soon!) to be sure their engineering portfolio provides answers for each of the requirements for specific awards.

9.3.6 Engineering Portfolio Requirements by Award

The chart below provides a quick outline of the engineering portfolio requirements by award:

<table>
<thead>
<tr>
<th>Engineering Portfolio Requirements by Award</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requirements are indicated using the word “must,” recommendations are indicated using words like “could” or “should.”</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Inspire Award</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Team <strong>must</strong> submit an engineering portfolio. The engineering portfolio <strong>must</strong> include summary information about the Robot design, information about the Team, and a Team plan. The entire engineering portfolio <strong>must</strong> be high quality, thoughtful, thorough, concise, and well-organized. The engineering portfolio could inspire the judges to ask about specific information.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Think Award</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Engineering portfolio <strong>must</strong> have engineering content. The engineering content <strong>could</strong> include entries describing examples of the underlying science, mathematics, and game strategies in a summary fashion.</td>
</tr>
<tr>
<td>• The engineering portfolio <strong>must</strong> provide examples that show the Team has a clear understanding of the engineering design process including an example of lessons learned.</td>
</tr>
<tr>
<td>• The portfolio <strong>could</strong> inspire the judges to ask about specific, detailed engineering information.</td>
</tr>
<tr>
<td>• Portfolio format is less important but enables the judges to <strong>It is a good idea to connect the award criteria to specific content in your engineering portfolio!</strong></td>
</tr>
</tbody>
</table>

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understand the Team’s design maturity, organizational capabilities, and overall Team structure.
- Portfolio could reference specific experiences and lessons learned but should capture the summary of the status of the Team and their Robot design.
- Portfolio could summarize experiences and lessons learned from outreach with concise tables of outcomes.
- Portfolio could summarize how they acquired new mentors and/or acquired new knowledge and expertise from their mentors.
- Portfolio could contain a summary of overall Team plan.
- Portfolio could contain information about the plans to develop skills for Team members.
- Portfolio could be organized in a logical manner.

<table>
<thead>
<tr>
<th>Connect Award</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Team must submit an engineering portfolio.</td>
</tr>
<tr>
<td>• Portfolio must include a Team plan. The Team plan could the Team’s goals for the development of Team member skills, and the steps the Team has or will take to reach those goals. Other examples of what the plan could include are timelines, outreach to science, engineering, and math communities, and training courses.</td>
</tr>
<tr>
<td>• Portfolio must include a summary of how they acquired new mentors or acquired new knowledge and expertise from their mentors.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Innovate Award sponsored by Raytheon Technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Team must submit an engineering portfolio.</td>
</tr>
<tr>
<td>• The engineering portfolio must include examples of the Team’s engineering content that illustrate how the Team arrived at their design solution.</td>
</tr>
<tr>
<td>• The portfolio could inspire the judges to ask about specific, detailed engineering information.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Control Award sponsored by Arm</th>
</tr>
</thead>
<tbody>
<tr>
<td>• The Team must submit an engineering portfolio. The engineering portfolio must include engineering content that documents the control components.</td>
</tr>
<tr>
<td>• The Team must submit a control award submission form as a separate document. Teams should identify the control aspects of their Robot that they are most proud of.</td>
</tr>
<tr>
<td>• The Control Award submission form must not exceed 2 pages.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Motivate Award</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Team must submit an engineering portfolio.</td>
</tr>
<tr>
<td>• The engineering portfolio must include a Team organization plan, which could describe their future goals and the steps they will take to reach those goals. Other examples of what the plan could include are Team identity, fund-raising goals, sustainability goals, timelines, outreach to non-technical groups, finances, and community service goals.</td>
</tr>
<tr>
<td>• The Team is an ambassador for FIRST programs.</td>
</tr>
<tr>
<td>• Team can explain the individual contributions of each Team member, and how these apply to the overall success of the Team.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Design Award</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Team must submit an engineering portfolio that includes examples of Robot CAD images or detailed Robot design drawings.</td>
</tr>
<tr>
<td>• The portfolio could inspire the judges to ask about specific, detailed design engineering content.</td>
</tr>
</tbody>
</table>
9.4 Judging Process, Schedule, and Team Preparation
The schedules at the FIRST Tech Challenge Competitions may vary from event to event. At traditional events, judging interviews are scheduled for before the start of match play. For remote events, judging will take place during a pre-determined window of time. Exact times for both the matches and meeting with judges cannot be given within this manual. All Teams receive the schedule before or during check-in at the Competition, or in advance of their scheduled remote interview.

9.4.1 How Judging Works
At FIRST Tech Challenge Competitions, there will be four parts to the judging process:

1. Interview with the judges.
   a. Teams take part in scheduled, private interviews with a panel of two or more judges.
   b. Teams are asked to bring their Robot to the judge interview. This is the best chance for Teams to explain and show their Robot design to the judges in a quiet and relaxed environment. For remote events, Teams may show photos of their Robot to the judges as a part of their remote interview.
      i. Teams who have not built a Robot or have a Robot that has not passed Robot inspection are permitted to participate in judging and are eligible for consideration for all awards.
   c. The interview will last at least 10 minutes.
   d. During the first 5 minutes of the interview, Teams can present to the judges, without interruption.
      i. Teams are not required to prepare a presentation and will not be penalized if they do not have a prepared presentation.
      ii. Teams will not receive more than 5 minutes for their uninterrupted presentation.
      iii. Teams may not pre-record their presentation.
   e. At the five-minute mark, the judges will begin to ask questions of the Team.
2. Match observations by judges (traditional events only).
   a. Judges observe the Robot, student interactions, and the Gracious Professionalism® of the entire Team.
3. Judges follow up with additional interviews in the pits during Competition. For remote events, this second interview will be pre-scheduled.
4. Evaluation of the engineering portfolio.
No awards will be decided based on the judges’ interview or engineering portfolio alone. Judges use the guidelines provided in this section to assess each Team.

Teams should present their engineering portfolio, their control award submission form, and their judging feedback request form to the judges at the start of their interview unless otherwise directed by the Competition.
officials. In remote events, the Team coach, as the Team admin, is designated to upload these materials to the FTC Scoring System.

After the judges review the submitted engineering portfolio, complete the scheduled Team interviews, and evaluate the Team and Robot performance on the field, they meet to review their assessments and create a list of top candidates for the various judged awards. Judges may require more discussion with Teams.

9.4.1.1 Feedback to Teams
Teams who wish to receive feedback from judges must submit a completed judging feedback request form.

Judges will conduct the Team interview and review the documentation submitted by the Team. After the event, the lead coach/mentor 1 for the Team will receive access to the judging feedback form which has been completed by the event judges.

The feedback form is completed by the judges immediately following the formal interview.

The feedback form is not used by the judges during their deliberation process.

9.4.1.2 Teams Without a Robot
Teams who have not built a Robot or have a Robot that has not passed Robot inspection are permitted to participate in judging and are eligible for award consideration.

9.4.2 Judging Schedule
The judging interviews take place in a separate area or room away from other Teams as well as the noise of the Competition and pit. Teams follow the schedule that outlines Team interview times and locations. Sometimes, 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. For remote events, Team coaches will receive the Team’s judging schedule in advance of the event.

As much as possible, Teams should familiarize themselves with where and how judging will occur and allow enough time to get there. We expect that all Teams arrive at the judge queuing area five minutes before their scheduled judging interview. This helps us keep the event running on time.

9.4.3 Team Preparation
Teams are 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 Competition, and at the FIRST Tech Challenge world championships. Please see the Award Categories section of this manual for award requirements and look over the Engineering Portfolio Requirements by Award to ensure the Team’s engineering portfolio meets the criteria by award. Teams should attend judging workshops and judging practice days if they are available in their region. Practice makes for a better presentation, and practice in front of others could help a Team identify gaps in their presentation. Judging self-reflection sheets are another tool that Teams can use to prepare for their judging interview.

Teams may also read the Judges Manual to gain more insight into the entire judging process.

During the Team’s interview, the judges want to know highlights about the Team; what the Team learned during the Competition season; and the experiences that were gained. Team representatives’ abilities to answer the questions or elaborate on Robot design functions or qualities are evaluated during the Team interview.

9.4.4 Coaches Involvement in Interviews
Check with the tournament director to see if mentors and coaches can watch the Team interview. Mentors and coaches may not contribute to the judging interviews. Mentors and coaches should always keep in mind that
FIRST Tech Challenge is a student-centered activity. It is about giving the students a unique and stimulating experience in all aspects of the program.

9.4.4.1 Coaches Involvement in Interviews Exceptions
FIRST Tech Challenge will make exceptions for coaches who are needed to translate for students, for coaches of students with different abilities, and other exceptional circumstances. Please let the tournament director know in advance if your Team would like to be considered for an exception.

9.4.5 Video Award Submission Guidelines for Compass and Promote Awards
The submission process for this award may vary by Competition. The compass and promote awards are not offered at all events. Please check with the tournament 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. If you would like to send your promote video to FIRST, please email firsttechchallenge@firstinspires.org with the subject line “Promote Award Video”.

- The video must be submitted at least one week before Competition day. Instructions for submitting videos may vary from Competition to Competition. Please check with the tournament 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 Competition.
- Teams must have permission from the copyright owners for music used in the video and indicate this in their video.

9.5 Award Categories

9.5.1 Inspire Award
This judged award is given to the Team that best embodies 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 shown success in performing the task of designing and building a Robot.

Required Criteria for the Inspire Award:

- Team must show respect and Gracious Professionalism® to everyone they meet at a FIRST TechChallenge event.
- Team must be a strong contender for several other judged awards. The Inspire Award celebrates the strongest qualities of all the judged awards.
- The Team must be an ambassador for FIRST programs. They demonstrate and document their work in their community.
- Team must be positive and inclusive, and each Team member contributes to the success of the Team.
• **Team** must submit an engineering portfolio. The engineering portfolio must include engineering content, **Team** information and a **Team** plan. The entire engineering portfolio must be high quality, thoughtful, thorough, concise, and well-organized.

• **Robot** design must be creative and innovative, and the **Robot** performs reliably on the **Field**. The **Team** communicates clearly about their **Robot** design and strategy to the judges.

• **Team** interview session must be professional and engaging.

**Strongly Suggested Criteria for the Inspire Award:**

• The **Team** should be able to share or provide more detailed information to support the information in the portfolio. This information could be provided in an engineering notebook, as affidavits from other parties, or can be shared verbally.

• The **Team** should refer to the Award Definitions for judging outlined in Appendix F for outreach and be able to provide supporting documentation to the judges, where applicable.

**9.5.2 Think Award**

Removing engineering obstacles through creative thinking.

This judged award is given to the **Team** that best reflects the journey the **Team** took as they experienced the engineering design process during the build season. The engineering content within the portfolio is the key reference for judges to help identify the most deserving **Team**. The **Teams** engineering content must focus on the design and build stage of the **Team’s Robot**.

The **Team** must be able to share or provide additional detailed information that is helpful for the judges. This could 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 their portfolio does not include engineering content.

**Required Criteria for the Think Award:**

• **Team** must show respect and **Gracious Professionalism®** to everyone they meet at a **FIRST Tech Challenge** event.

• **Team** must submit an engineering portfolio.

• Engineering portfolio must have engineering content. The engineering content could include entries describing examples of the underlying science, mathematics, and game strategies in a summary fashion.

• The engineering portfolio must provide examples that show the **Team** has a clear understanding of the engineering design process including examples of lessons learned.

**Strongly Suggested Criteria for the Think Award:**

• **Team** must be able to describe or provide additional information to the judges about their portfolio content.

• Engineering portfolio could summarize how the **Team** acquired new mentors or acquired new knowledge and expertise from their mentors.

• Engineering portfolio could contain a summary of the overall **Team** plan.

• Engineering portfolio could contain information about the plans to develop skills for **Team** members.

• Portfolio format is less important but enables the judges to understand the **Team’s** design maturity, organizational capabilities, and overall **Team** structure.

• Portfolio could reference specific experiences and lessons learned but should capture the summary of the status of the **Team** and their **Robot** design.

• Portfolio could also summarize experiences and lessons learned from outreach with concise tables of outcomes.

• The **Team** should refer to the Award Definitions for judging outlined in Appendix F for outreach and **Gracious Professionalism** - “Doing your best work while treating others with respect and kindness – It’s what makes FIRST, first.”
be able to provide supporting documentation to the judges, where applicable.

9.5.3 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 actively seeks and recruits engineers and explores the opportunities available in the world of engineering, science, and technology. This Team has a clear Team plan and has identified steps to achieve their goals.

Required Criteria for the Connect Award:

- Team must show respect and Gracious Professionalism® to everyone they meet at a FIRST TechChallenge event.
- Team must submit an engineering portfolio.
- Portfolio must include a Team plan that covers the Team’s goals for the development of Team member skills, and the steps the Team has taken or will take to reach those goals. Examples of what the plan could include are timelines, outreach to science, engineering, and math communities, and training courses.
- Portfolio must include a summary of how the Team acquired new mentors or acquired new knowledge and expertise from a mentor. Working with mentors from FIRST’s Mentor Matching site is an acceptable way to learn from mentors.

Strongly Suggested Criteria for the Connect Award:

- 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.
- The Team should refer to the Award Definitions for judging outlined in Appendix F for outreach and be able to provide supporting documentation to the judges, where applicable.

9.5.4 Innovate Award sponsored by Raytheon Technologies
Bringing great ideas from concept to reality.

The Innovate Award celebrates a Team that thinks imaginatively and has the ingenuity, creativity, 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 portfolio must include a summary of 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 Innovate Award sponsored by Raytheon Technologies:

- Team must show respect and Gracious Professionalism® to everyone they meet at a FIRST TechChallenge event.
- Team must submit an engineering portfolio.
• The engineering portfolio must include examples of the Team’s engineering content that illustrate how the Team arrived at their design solution.
• Robot or Robot sub-assembly must be creative, elegant, and unique in its design.
• Creative component must be stable, robust, and work reliably most of the time.

Strongly Suggested Criteria for the Innovate Award sponsored by Raytheon Technologies:

• The portfolio could inspire the judges to ask the Team about the specific detailed engineering information.

9.5.5 Control Award sponsored by Arm:
Mastering Robot intelligence.

The Control Award celebrates a Team that uses sensors and software to increase the Robot’s functionality in the field. This award is given to the Team that demonstrates innovative thinking to solve game challenges such as autonomous operation, improving mechanical systems with intelligent control, or using sensors to achieve better results. The control component should work consistently in the Field. The Team’s engineering portfolio must contain a summary of the software, sensors, and mechanical control, but would not include copies of the code itself.

Required Criteria for the Control Award, sponsored by Arm:

• Team must show respect and Gracious Professionalism® to everyone they meet at a FIRST TechChallenge event.
• Team must apply for the Control Award by filling out the Control Award Submission Form, located in Appendix E. The Control Award Submission Form must not exceed 2 pages.
• The Team must submit an engineering portfolio. The engineering portfolio must include engineering content 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, sponsored by Arm:

• Advanced software techniques and algorithms are encouraged, but not required.
• Control components should work reliably.
• Learnings from the Team about what they tried and what did not work with regards to sensors, hardware, algorithms, and code could be included in the engineering portfolio.

9.5.6 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 Gracious Professionalism and general enthusiasm for the overall philosophy of FIRST and what it means to be a FIRST Tech Challenge Team. This is a Team who makes a collective effort to make FIRST known throughout their school and community, and sparks others to embrace the culture of FIRST.

Required Criteria for the Motivate Award:

• Team must show respect and Gracious Professionalism® to everyone they meet at a FIRST TechChallenge event.
• Team must submit an engineering portfolio. The engineering portfolio must include a Team organization plan, which could describe their future goals and the steps they will take to reach those goals. Examples of what the plan could include are Team identity, fund-raising goals, sustainability goals, timelines, outreach, finances, and community service goals.
• The Team must be an ambassador for FIRST programs.

Gracious Professionalism® - “Doing your best work while treating others with respect and kindness - It’s what makes FIRST, first.”
• Team must be able to 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:

• Team takes part in their presentation, and actively engages with the judges.
• Team shows a creative approach to materials that market their Team and FIRST.
• Team can clearly show the successful recruitment of people who were not already active within the STEM community.
• Team could also summarize experiences and lessons learned from outreach.
• The Team should refer to the Award Definitions for judging outlined in Appendix F for outreach and be able to provide supporting documentation to the judges, where applicable.

9.5.7 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 Robot should be durable, efficiently designed, and effectively address the game challenge.

Required Criteria for the Design Award:

• Team must show respect and Gracious Professionalism® to everyone they meet at a FIRST TechChallenge event.
• Team must submit an engineering portfolio with engineering content. This could be CAD images or Robot drawings of the Team’s overall design and/or components.
• Team must document and implement strong industrial design principles, striking a balance between form, function, and aesthetics.

Strongly Suggested Criteria for the Design Award:

• Distinguishes itself from others by its aesthetic and functional design.
• Basis for the design is well considered (that is inspiration, function, etc.).
• Design is effective and consistent with Team plan and strategy.
• The portfolio could inspire the judges to ask the Team about specific detailed engineering information.

9.5.8 Promote Award (Optional)
This judged award is optional and may not be given at all tournaments.

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.

Team may win the Promote Award only once at a Championship level event and only once at a qualifying tournament or league tournament level event.

PSA Subject for 2022-2023 season:

“How I learned about FIRST”

Required criteria for the Promote Award:
• 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 later to promote FIRST.
• Team must have rights to the 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 tournament director.
• Team must present a thoughtful and impactful video which appeals to the public.
• Creativity in interpreting the yearly theme is required.
• Follow video award submission guidelines.

9.5.9 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.

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 chosen 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 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 later to promote FIRST.
• Team must have permission from the copyright owners for the music used in the video.
• Music and permissions must be listed in video credits.
• Video must be submitted by the deadline given by the tournament director.
• Video highlights the mentor’s contribution to the Team and demonstrates what sets the mentor apart.

9.5.10 Judges’ Choice Award
This award is optional and may not be given at all tournaments.

During the competition, the judging panel may meet a Team whose unique efforts, performance, or dynamics merit recognition, but does not fit into any of the existing award categories. To recognize these unique Team, FIRST offers a customizable Judges Choice Award. The judging panel may select a Team to be honored, as well as the name of the Judges Choice Award. The Judges Choice Award recognizes a Team for their outstanding efforts but does not factor into the advancement criteria.

9.5.11 Winning Alliance Award
This award will be given to the winning Alliance represented in the final Match.

9.5.12 Finalist Alliance Award
This award will be given to the finalist Alliance represented in the final Match.
10.0 Dean’s List Award

In an effort to recognize the leadership and dedication of the most outstanding secondary school Students from FIRST®, the Kamen family sponsors awards for selected 10th or 11th grade* Students known as the FIRST® Robotics Competition and the FIRST® Tech Challenge FIRST Dean’s List Award.

Similar to the very prestigious National Merit Scholarship Award, there are three (3) levels of FIRST Dean’s List Award Students.

1. **FIRST Dean’s List Semi-finalists** – comprised of the two (2) students in their 10th or 11th school year* nominated by each team.

2. **FIRST Dean’s List Finalists** - The students selected for each Regional Championship.

3. **FIRST Dean’s List Winners** - comprised of the ten (10) FIRST Robotics Competition and ten (10) FIRST Tech Challenge Students selected from the applicable FIRST Dean’s List Finalists.

The Students who earn FIRST Dean’s List status as a Semi-finalist, Finalist or Winner, are great examples of current Student leaders who have led their teams and communities to increased awareness for FIRST and its mission while achieving personal technical expertise and accomplishment. It is the goal of FIRST that all Dean’s List Semi-finalists, Finalists and Winners will continue, after high school, to stay engaged with FIRST as alumni.

Since its introduction in 2010, the FIRST Dean’s List Award has attracted the attention of prestigious colleges and universities who desire to have FIRST Dean’s List Students apply for admissions. Additionally, in 2019, the Woodie Flowers Memorial Grant was established for Dean’s List Award Winners pursuing STEAM fields of study. *NOTE:* For regions of the world that do not use grade levels such as this to identify years of schooling: This award is intended for Students who are two (2) to three (3) years away from entering college or university. Students that would be attending college or university in the next academic year are not eligible. Mentors will be asked for the year of graduation during the nomination process.

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)

10.1 Eligibility

Every registered FIRST Tech Challenge Team 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.
  - Note: For regions of the world that do not use grade levels such as this to identify years of schooling: This award is intended for Students who are two (2) to three (3) years away from entering college or university. Students that would be attending college or university in the next academic year are not eligible. Mentors will be asked for the year of graduation during the nomination process.

- 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.

10.2 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 FIRST Core Values
- Effectiveness at increasing awareness of FIRST in their school and community
- Interest in and passion for a long-term commitment to FIRST
- Overall individual contribution to their Team
- Technical expertise and passion
- Entrepreneurship and creativity
- Ability to motivate and lead fellow Team members

10.3 Dean’s List Nominations
There are specific instructions on how to submit Dean’s List Nominations. There are two sets of instructions, The Dean’s List Nomination Guide – US, and the Dean’s List Nomination Guide – International. Please visit our website for a copy of the guides, 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
https://ftc-qa.firstinspires.org/
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.

Volunteer Forum
Volunteers can request access to role specific volunteer forums by emailing FTCTrainingSupport@firstinspires.org. 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!
# Appendix B – Robot Inspection Checklist

**Team Number:** __________  
**Robot Inspection Status (circle):** PASS / FAIL

<table>
<thead>
<tr>
<th>Team</th>
<th>Insp.</th>
<th>Robot Size Inspection</th>
<th>Rule #</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<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>
<td>&lt;I06&gt;</td>
</tr>
<tr>
<td></td>
<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>
<td>&lt;I06&gt;a &lt;RG02&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Robot Motion Warning Label is attached if servo motors move during the Robot initialization.</td>
<td>&lt;RG02&gt;</td>
</tr>
<tr>
<td>✔</td>
<td>✔</td>
<td><strong>General Robot Rules</strong></td>
<td>Rule #</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Robot does not contain any components that could damage the Playing Field or other Robots.</td>
<td>&lt;RG01&gt;a&amp;b</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Robot does not contain materials that are hazardous.</td>
<td>&lt;RG01&gt;c</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Robot poses no obvious unnecessary risk of entanglement.</td>
<td>&lt;RG01&gt;d</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Robot does not contain sharp edges or corners.</td>
<td>&lt;RG01&gt;e</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Robot does not contain animal-based, liquid, or gel materials.</td>
<td>&lt;RG01&gt;f&amp;g</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Robot does not contain materials that would cause a delay of game if released.</td>
<td>&lt;RG01&gt;h</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Robot does not contain elements that electrically ground the Robot frame to the Playing Field.</td>
<td>&lt;RG01&gt;i</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Robot does not contain closed gas, hydraulic, or vacuum based devices.</td>
<td>&lt;RG01&gt;j,k&amp;l</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Team number is visible from at least 2 opposite sides and meets requirements.</td>
<td>&lt;RG04&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Alliance Markers are present and meet requirements.</td>
<td>&lt;RG05&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Energy used by the Robot shall come only from approved sources.</td>
<td>&lt;RG06&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Robot is not capable of detaching its own components.</td>
<td>&lt;RG07&gt;</td>
</tr>
<tr>
<td>✔</td>
<td>✔</td>
<td><strong>Robot Mechanical Parts and Materials Rules</strong></td>
<td>Rule #</td>
</tr>
<tr>
<td></td>
<td></td>
<td>All components on the Robot are from allowable raw materials and Commercial Off The Shelf products.</td>
<td>&lt;RM01&gt; &lt;RM02&gt; &lt;RM06&gt;</td>
</tr>
<tr>
<td>✔</td>
<td>✔</td>
<td><strong>Robot Electrical Parts and Materials Rules</strong></td>
<td>Rule #</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Exactly one Main Power Switch is installed properly, labeled, readily accessible, and visible. The TETRIX, REV, and MATRIX switches are the only allowed Main Power Switch.</td>
<td>&lt;RE01&gt;</td>
</tr>
<tr>
<td></td>
<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>
<td>&lt;RE02&gt;</td>
</tr>
<tr>
<td></td>
<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 REV Expansion Hub or REV Control Hub.</td>
<td>&lt;RE03&gt; &lt;RE05&gt;a(i&amp;ii)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Where present, fuses must not be replaced with fuses of higher rating than originally installed or according to manufacturer’s specifications. Fuses are single use only.</td>
<td>&lt;RE04&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Allowed electronic devices are powered by power ports on the REV Expansion Hub or REV Control Hub except as noted in &lt;RE05&gt;, &lt;RE13&gt;, and &lt;RE14&gt;.</td>
<td>&lt;RE05&gt;a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The REV Expansion Hub and/or REV Control Hub is powered by the Robot main battery.</td>
<td>&lt;RE05&gt;a(i&amp;ii)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>REV SPARK Mini Motor Controllers and REV Servo Power Modules are powered by the Robot main battery or a REV Control or Expansion Hub XT30 port.</td>
<td>&lt;RE05&gt;a(ii)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Allowed sensors only receive power from the REV Expansion Hub or REV Control Hub.</td>
<td>&lt;RE05&gt;a(iii)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>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.</td>
<td>&lt;RE05&gt;a(iv) &lt;RE13&gt;</td>
</tr>
<tr>
<td>Rule</td>
<td>Description</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>&lt;RE05&gt;a(v)</td>
<td>Video recording devices, if used, are powered by an internal battery and their wireless communication capability is turned off.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;RE05&gt;b</td>
<td>The smartphone Robot Controller Android device (if used) is powered by its internal battery or by the built-in charging feature of the REV Expansion Hub.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;RE06&gt;</td>
<td>Exactly one Robot Controller (a) smartphone Android Device + REV Expansion Hub or b) REV Control Hub is required. One additional REV Expansion Hub is allowed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;RE09&gt;</td>
<td>The only allowed Motor and Servo Controllers are: REV Expansion Hub, REV Control Hub, REV Servo Power Module, REV Spark Mini Motor Controller, and VEX Motor Controller 29.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;RE10&gt;</td>
<td>Robot contains no more than eight (8) DC motors of the allowed models.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;RE11&gt;</td>
<td>Robot contains no more than twelve (12) servos. They must be compatible with the attached REV Expansion Hub, REV Control Hub, REV Servo Power Module, or VEX Motor Controller 29 and not exceed the manufacturer specifications for the controller.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;RE12&gt;</td>
<td>Robot contains only allowed sensors and they are connected only to the REV Expansion Hub or the REV Control Hub.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;RE15&gt;f</td>
<td>Power and motor control wires have 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.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;RE15&gt;i</td>
<td>Power, motor control, servo and sensor wires are the correct size.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;RE15&gt;k</td>
<td>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.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;RE16&gt;</td>
<td>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.</td>
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</tr>
</tbody>
</table>

**Wheel/Tread Playing Field Damage Test - Optional**

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.]

**Team Scoring Element (TSE) Inspection**

Teams must present all of their Alliance specific TSEs for inspection. The predominant color of the TSE must match the Team’s assigned Alliance for the Match (red or blue). The TSE satisfies the Robot Mechanical Parts and Materials Rules in section 7.3.2. Maximum size of the TSE is 4 inches (10.16 cm) by 4 inches (10.16 cm) by 4 inches (10.16 cm). The minimum size of the TSE is 3 inches (7.62 cm) by 3 inches (7.62 cm) by 3 inches (7.62 cm). The Team Scoring Element is labeled with their Team number (numerals only). The TSE does not contain electronics, or any other part or material that violates Robot construction rules outlined in section 7.3. The TSE does not use or resemble any current season’s COTS scoring elements.

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

____________________________

Robot Inspector
## Appendix C – Field Inspection Checklist

Team Number: __________

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

<table>
<thead>
<tr>
<th>Check</th>
<th>Description</th>
<th>Rule #</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔</td>
<td><strong>Drive Team Members Present</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Coach (required), Driver 1 (required); Driver 2 (optional)</td>
<td>&lt;C06&gt;</td>
</tr>
<tr>
<td>✔</td>
<td><strong>Driver Station and Robot Controller Hardware Rules</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Driver Station consists of only one Android device (Circle): Motorola Moto G 2(^{nd}) Generation, Motorola Moto G 3(^{rd}) Generation, Motorola Moto G4 Play, Motorola Moto G5, Motorola G5 Plus, Motorola Moto E4, Motorola Moto E5, Motorola Moto E5 Play, or REV Driver Hub.</td>
<td>&lt;RE07&gt;</td>
</tr>
<tr>
<td></td>
<td>&lt;DS01&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Smartphone Robot Controller Android device (if used) is one of the following models (Circle): Motorola Moto G 2(^{nd}) Generation, Motorola Moto G 3(^{rd}) Generation, Motorola Moto G4 Play, Motorola Moto G5, Motorola G5 Plus, Motorola Moto E4, Motorola Moto E5, Motorola Moto E5 Play. The Android device’s USB interface only connects to a REV Expansion Hub or a USB hub.</td>
<td>&lt;RE07&gt;</td>
</tr>
<tr>
<td></td>
<td>&lt;DS01&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The touch display screen of the Driver Station is accessible and visible to field personnel.</td>
<td>&lt;DS02&gt;</td>
</tr>
<tr>
<td></td>
<td>The Driver Station consists of no more than two of the allowed gamepads (Logitech F310, Xbox 360, wired Sony DualShock 4 for PS4, Etpark Wired Controller for PS4), or Quadstick game controller in any combination.</td>
<td>&lt;DS03&gt;</td>
</tr>
<tr>
<td></td>
<td>No more than one (1) optional external battery powered or unpowered USB hub is present.</td>
<td>&lt;DS04&gt;</td>
</tr>
<tr>
<td></td>
<td>No more than one (1) optional COTS USB external battery connected to the REV Driver Hub USB-C port or a USB hub connected to the smartphone Android Device is present.</td>
<td>&lt;DS05&gt;</td>
</tr>
<tr>
<td></td>
<td>Driver Station smartphone Android device (if used) 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 USB cable connected to an OTG Micro Adapter.</td>
<td>&lt;DS06&gt;</td>
</tr>
<tr>
<td></td>
<td>Driver Station Carrier (if present) meets requirements.</td>
<td>&lt;DS07&gt;</td>
</tr>
<tr>
<td></td>
<td>The Driver Station Android Device only plays allowed sounds.</td>
<td>&lt;DS08&gt;</td>
</tr>
<tr>
<td></td>
<td><strong>Driver Station (DS) and Robot Controller (RC) Software Rules</strong></td>
<td></td>
</tr>
<tr>
<td>DS</td>
<td>Android smartphone(s), REV Driver Hub, and REV Control Hub are named with the official team number followed by –DS or –RC as appropriate.</td>
<td>&lt;RS01&gt;</td>
</tr>
<tr>
<td>RC</td>
<td>Android operating system satisfies the requirements: Motorola Moto G 2(^{nd}) Generation, Motorola Moto G 3(^{rd}) Generation, Motorola Moto G4 Play – version 6.0 or higher. All other allowed Android devices – version 7.0 or higher.</td>
<td>&lt;RS03&gt;</td>
</tr>
<tr>
<td></td>
<td>DS and RC apps are version 8.0 or higher and the DS and RC apps have the same version numbers. The RC app is not installed on the DS and the DS app is not installed on the RC.</td>
<td>&lt;RS03&gt;</td>
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<td></td>
<td>&lt;RS05&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&lt;RS06&gt;</td>
<td></td>
</tr>
<tr>
<td>NA</td>
<td>REV Driver Hub (if used) operating system is version 1.2.0 or higher.</td>
<td>&lt;RS03&gt;</td>
</tr>
<tr>
<td>NA</td>
<td>REV Driver Hub (if used) has Bluetooth turned off and Wi-Fi turned on.</td>
<td>&lt;RS07&gt;</td>
</tr>
<tr>
<td>NA</td>
<td>REV Control Hub (if used) operating system is version 1.1.2 or higher and the firmware version is 1.8.2 or higher.</td>
<td>&lt;RS03&gt;</td>
</tr>
<tr>
<td>NA</td>
<td>REV Expansion Hub (if used) firmware version is 1.8.2 or higher.</td>
<td>&lt;RS03&gt;</td>
</tr>
<tr>
<td>NA</td>
<td>REV Control Hub (if used) has Wi-Fi turned on, Bluetooth is turned off, and the password is different than the factory default value of “password”.</td>
<td>&lt;RS07&gt;</td>
</tr>
<tr>
<td>NA</td>
<td>Android smartphones (if used) are set to airplane mode, Wi-Fi is turned on, and Bluetooth is turned off.</td>
<td>&lt;RS07&gt;</td>
</tr>
<tr>
<td>NA</td>
<td>Android devices are not connected to any local networks.</td>
<td>&lt;RS09&gt;</td>
</tr>
<tr>
<td></td>
<td>All remembered Wi-Fi Direct Groups and Wi-Fi connections on Android devices have been removed.</td>
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*Gracious Professionalism®* - “Doing your best work while treating others with respect and kindness - It’s what makes *FIRST*, first.”
| NA | Communication between the Robot and Driver Station is only through the RC and DS applications. Out of band communication is not allowed. <RS09> |
| NA | Driver Station uses the official FTC Driver Station app to control the Robot. <RS06> |
| NA | The FTC Robot Controller app on the smartphone Android Device (if used) is the default application, the application launches, and no other messages pop up. <RS05> |
| NA | Robot Controller is set to the correct Wi-Fi channel (if required by the competition). <C14> |

**Robot Operation Verified at the Playing Field**

| ✔ | Robot Controller connects with the Driver Station. |
| ✔ | Robot switches between autonomous and driver-controlled operation correctly. <RS04> |
| ✔ | Robot starts and stops when commanded by the Driver Station. |
| ✔ | The team understands how to disable their Robot, if instructed to do so by a referee. |

**Queuing Process Information Provided at the Playing Field**

| ✔ | Team understands that software changes are not allowed in the Queue Area. |
| ✔ | 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. |
| ✔ | Team knows that they are responsible for attaching their Team Supplied Alliance Marker on two sides of their Robot before they approach the competition playing field. <RG05> |

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

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____________________________________

Field Inspector
Appendix D – Control Award sponsored by Arm 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. Teams should identify the control aspects of their Robot that they are most proud of. The Control Award Submission form may not exceed 2 pages.

**Autonomous Objectives**
List the overall actions that the Robot can complete. 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 Portfolio References**
Judges also use the Teams engineering portfolio to evaluate details of the control elements. To help guide this effort, Teams should provide pointers to where in the engineering portfolio 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 Sponsored by Arm Submission Form

Will be released on kickoff, 9/10/2022.
Appendix F: Award Definitions

All Teams are required to adhere to the following definitions in their award submissions and in their judge interviews.

**Team Support Definitions**

**Started** (a FIRST LEGO League / FIRST Tech Challenge / FIRST Robotics Competition team) - “A Team has Started a Team if they have met one of the following requirements:

1. Funded or sourced funding (for example, grants or sponsorship) of at least 50% of the Team registration fee.
2. Made the Team aware of FIRST and/or the specific program and helped the Team with the official registration process.

As well as:

1. The Started team agrees that the Starting Team did in fact Start them.
2. The Started team competes in an official FIRST event.

The intent of this definition is to make it clear when a Team is responsible for bringing a new group into a specific FIRST program. Keys here are helping with funding OR introducing the new group to FIRST and helping them get registered as a Team in their specific program.

Cases where one team has Started another Team will be rare. Cases where one Team has Mentored or Assisted a Team through their initial phases are very valuable, however they are distinct from Starting a Team.

Teams are encouraged to provide documentation (for example, a letter from the Team that has been Started) supporting the fact that they did indeed Start each Team referred to in the submission. New Teams can only be Started by two Teams and can only provide two of these letters. All provided documentation may be made available for judges during the second interview as an additional resource item.

**Mentored** (a FIRST LEGO League / FIRST Tech Challenge / FIRST Robotics Competition team) - “A Team has Mentored a Team if they have met all of the following requirements:

1. Providing consistent communication, either in person or via phone/email/video conference, to the Mentored Team helping with technical or non-technical FIRST program specific issues.
2. The Mentored Team agrees that the Mentoring Team did in fact Mentor them.

Mentoring a Team is a consistent and ongoing relationship. To be considered a Mentoring Team, you must be providing regular help to the Mentee Team during the season within their schedule. We understand that all Teams may not meet as regularly as once a week, however this is a general standard. For some Teams communication may be more infrequent and still considered consistent. We encourage Teams to use their best discretion when evaluating these edge cases. Helping Teams on a less consistent basis is still immensely valuable and important, however it would simply be considered Assisting a Team.

Teams are encouraged to provide documentation (for example, a letter from the Team that has been Mentored) supporting the fact that they did indeed Mentor each Team referred to in the submission. All provided documentation may be made available for judges during the second interview as an additional resource item.

Examples (but not limited to) of consistent communication for Mentoring a Team include:

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*Gracious Professionalism*: “Doing your best work while treating others with respect and kindness - It’s what makes FIRST, first.”
● **Team A** regularly sends **Students** to a nearby school to help their **FIRST LEGO League** team(s) with their **Robot** design and project presentations.

● **Team A** sends an email to **Team B** asking for advice on future **Robot** design. The two **Teams** email back and forth over a period of time exchanging questions and answers.

● **Team A** meets **Team B** at a competition. **Team B** expresses concern that their **Team** is struggling to keep the **Team** going and is looking for help. The two **Teams** live far away from each other, but over the next year, they exchange many emails, they video chat a few times during the off-season and even meet in person.

Examples (but not limited to) of Not **Mentoring a Team**:

- Answering a single email question.
- Inviting a **Team** to your shop so they may make parts on your machinery.
- Hosting a **Team** in your build space during inclement weather when they are unable to access their own facilities.
- Giving a **Robot** part to another **Team**.
- Allowing a **Team** to practice at your practice facility.

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**Assisted** (a **FIRST LEGO League** / **FIRST Tech Challenge** / **FIRST Robotics Competition Team**) - “**A Team** has **Assisted** a **Team** if they have met all of the following requirements:

1. Providing communication, either in person or via phone/email/video conference, to the **Assisted Team** helping with technical or non-technical program specific issues. OR Providing funding and/or supplies to the **Assisted Team**.
2. The **Assisted Team** agrees that the **Assisting Team** did in fact **Assist** them.

**Assisting** a **Team** is a form of **Mentorship**, however it does not require the long term or consistent communication that is a defining characteristic of **Mentorship**. It is expected that all **FIRST Tech Challenge Teams** are constantly assisting their fellow **FIRST Teams**, and it is not necessary to try and document or count all the instances of **Assisting** that your **Team** has participated in.

Examples (but not limited to) of **Assisting a Team**:

- Answering a single email question.
- Inviting a **Team** to your shop so they may make parts on your machinery.
- Hosting a **Team** in your build space during inclement weather when they are unable to access their own facilities.
- Giving a **Robot** part to another **Team**.
- Allowing a **Team** to practice at your practice facility

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**Provided Published Resources** to (a **FIRST LEGO League** / **FIRST Tech Challenge** / **FIRST Robotics Competition Team**) – A **Team** has **Provided Published Resources** to a **Team** if they have met all the following requirements:
1. The Team has created resources designed to aid Teams with technical or non-technical FIRST program specific issues.
2. The resources have been published or presented publicly (for example, presented at a conference, published on a Team website, etc.)

Many FIRST Tech Challenge Teams have created a wealth of resources that benefit numerous Teams. This kind of assistance is enormously valuable to our community and is heavily encouraged. However, these acts do not meet the definition of Mentoring since they lack consistent communication involved in mentoring. To recognize and encourage these important efforts, the definition of Provided Published Resources was created.

Teams are encouraged to provide documentation (for example, letters from Teams who have used the resources; screenshots of downloads/engagement/digital impression statistics; attendance numbers) supporting the overall reach of their Published Resources.

If Published online, Teams should provide a link to the resource. Links to team websites, sharing sites (e.g., YouTube), or collaborative sites between FIRST Teams are all appropriate. All provided documentation may be made available for judges during the second interview as an additional resource item.

Examples (but not limited to) of Providing Published Resources

- Team A creates and publishes a scouting database compiling statistical data from competitions, and the database is downloaded and used by other Teams.
- Team A creates and gives a presentation on FIRST fundraising to an audience of 15 local FIRST Tech Challenge and FIRST LEGO League Teams.
- Team A develops and publishes a mobile app that contains FIRST LEGO League tutorials, and the app is downloaded and used by FIRST LEGO League Teams.
- Team A creates and publishes FIRST Tech Challenge drivetrain video tutorials on YouTube, and videos are watched and used by FIRST Tech Challenge Teams.

Event Support Definitions:

Ran (a FIRST LEGO League / FIRST Tech Challenge / FIRST Robotics Competition Team) - A Team has Run an event if they have met all the following requirements:

1. Team members are involved in the majority of the planning of the event.
2. Team members are involved in the majority of the on-site event execution or have arranged for and are supervising the volunteers to handle the majority of the on-site event execution.

Running an event essentially means that this event would not be possible without the efforts and actions of the given Team. The Team in question must be responsible for the majority of the work that goes into the event.

Team are encouraged to provide documentation (for example, a letter from organizing body/program delivery partner that the event was Run for) supporting the fact that they did indeed Run the event. All provided documentation may be made available for judges during the second interview as an additional resource item.

Examples (but not limited to) of Running an event:

- Team A acts as the majority of the planning committee for a FIRST LEGO League event, and Team members recruit and train the event volunteers.
Hosted (a FIRST LEGO League / FIRST Tech Challenge / FIRST Robotics Competition Team) - A Team has Hosted an event if they have met one of the following requirements:

1. The event takes place at a Team facility.
2. The event takes place at a facility arranged for by the Team.

Hosting an event occurs when a Team opens one of their own facilities or arranges for a facility to allow for an event to occur. Often Teams will Run and Host the same event, but these terms do not necessarily have to be linked.

Supported (FIRST LEGO League / FIRST Tech Challenge / FIRST Robotics Competition Team) - A Team has Supported an event if they have met any of the following requirements:

1. Multiple Team members are involved in some part of the planning of the event.
2. Multiple Team members are involved in the on-site or online event execution for the entirety of the event (for example, Team members have volunteered for the entirety event)

Teams Support events by helping with the planning or execution of the event. This is less encompassing than Running an event.

Examples (but not limited to) of Supporting an event:

- Having multiple Team members volunteer at the entirety of an event.
- Having a few mentors serve on a large planning committee for a FIRST Tech Challenge regional event.

Examples (but not limited to) that do not qualify as Supporting an event:

- Having 1 Team member volunteer at an event.
- Helping tear down the field at the end of an event.
- Having 1 mentor serve on a large planning committee for a FIRST Tech Challenge regional event.

Reached - A Team has Reached someone if someone has interacted or observed the team in some capacity whether it be digitally or in person, regarding the Reaching team’s program(s).

Reach is the all-encompassing number of people who became aware of your Team via a stated medium/event. Reach requires tangible interaction or observation of the Team, not merely seeing the team in the background of a show or public exhibit.

Examples (but not limited to) of Reaching:

- 6,000,000 people watch a TV show that features a Team’s Robots. This Team has Reached 6,000,000 people.
- 1,000,000 people attend an event where the Team has an exhibit. However, only 500 of those people see the Team’s actual exhibit. This Team has Reached 500 people.
- 30,000 people attend a football game, where the Team performs with their Robots during the halftime show. This Team has Reached 30,000 people.
- 700 people follow a Team on Instagram. This Team Reached people 700 people.

Examples (but not limited to) of not Reaching:
- 6,000,000 people watch a TV show in which the Team’s Robots are used as background props. Since the Robots nor the Team have been featured, this Team has not Reached the audience.

- 30,000 people attend a football game, where the Team’s name is shown on the big screen at the stadium. This is not a tangible interaction or observation of the Team; thus, this team has not Reached the audience.

The goal with using Reach in submissions is to accurately convey the number of people who have become aware of your Team. However, it is difficult to provide exact numbers when it comes to the numerous public demos Teams participate in every year. It is important that Teams do not embellish or exaggerate these numbers, as doing so would paint a misleading picture of the Team’s accomplishments. When in doubt, Teams should try and estimate on the low end.

Teams are encouraged to provide documentation that shows the basis of their estimates of Reach. (for example, letters from event organizers stating event attendance and specific area attendance). Documented evidence and breakdowns of Reach numbers are far more compelling than simply stating the Team’s estimated Reach. All provided documentation may be made available for judges during the second interview as an additional resource item.

**Advocated** - A Team has engaged in Advocacy if they meet any of the following criteria

1. Met with government officials, community leaders, school administration, or business leaders (or their staff) to discuss and engage with and promote public policy changes towards the promotion of STEM/FIRST.

2. Developed relationships with government officials, community leaders, school administration, or business leaders (or their staff) to promote public policy changes towards the promotion of STEM/FIRST.

3. Served as a resource for government officials, community leaders, school administration, or business leaders (or their staff) as they create public policy changes towards the promotion of STEM/FIRST.

Examples (but not limited to) of engaging in Advocacy are:

- Attending an advocacy day where Teams from the area met with local officials on afterschool STEM engagement programs
- Working with leaders to craft a bill or resolution that was introduced

Examples (but not limited to) of not engaging in Advocacy are:

- Using social media/tweeting to government officials
- Volunteering for a campaign
- Hosting a table/tabling/handing out flyers at parade or event (people must engage not just a passive act)
- Soliciting and recruiting sponsors solely for your Team (for example, fundraising)

Teams are encouraged to be specific about when they started an initiative or participated in one. All provided documentation may be made available for judges during the second interview as an additional resource item.