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2023-2024 FIRST® Tech Challenge

Game Manual Part 2 – Traditional Events

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**Raytheon
Technologies**

Revision History		
Revision	Date	Description
1	8/17/2023	Limited Program Delivery Partner Release
1.1	9/9/2023	<ul style="list-style-type: none"> • Section 4.5.2 – Rule <G16> added Human Player Station to the rule • Section 4.5.3 – Rule <GS01> added new <GS01>f., shifted following rules down • Section 4.6 – Corrected set bonus language in scoring summary
1.2	10/11/2023	<ul style="list-style-type: none"> • Section 4.3 – Corrected referenced images in Mosaic definition • Section 4.4.1 – Pre-Match 3.c) – Clarification that only one Drone may be brought to each match • Section 4.5.3 <ul style="list-style-type: none"> ◦ Added <GS03>c. ◦ <GS04> - Added further clarification and examples to descoring ◦ Added <GS11>h. • Section 4.7 – Added new rules to Rule Summary

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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.

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 How to Use This Document

The Game Manual Part 2 – Traditional Events is a resource for all FIRST® Tech Challenge Teams for information specific to the 2023-2024 season's game.

The intent of this manual is that the text means exactly, and only, what it says. Please avoid interpreting the text based on assumptions about intent, implementation of past rules, or how a situation might be in "real life". There are no hidden requirements or restrictions. If you have read everything, you know everything.

Key words that have a specific meaning within this document are defined in the Game Definitions section and are indicated with the first letter capitalized, and the entire word in *Italics*.

4.0 The Game

4.1 Introduction

This document describes CENTERSTAGESM presented by RTX, the *FIRST*[®] Tech Challenge game for the 2023-2024 season. We recommend viewing the game animation prior to reading this manual to gain a general understanding of the game. The animation is a brief summary of the game; it is not intended to provide the necessary information to fully understand the official game rules. The animation can be accessed on our website under “Videos and Promotional Materials”: <https://www.firstinspires.org/resource-library/ftc/game-and-season-info>.

Teams must comply with all the rules and requirements stated in this document and in the Game Manual Part 1 - Traditional Events. Clarifications to the game rules are issued on the question & answer section of the forum at <https://ftc-qa.firstinspires.org>. Forum rulings take precedence over information in the game manuals.

Teams should refer to the [Game Manual Part 1 – Traditional Events](#) for information about the competition such as how rankings work (Ranking and TieBreaker Points), advancement, judged awards, *Robot* construction rules, and general competition rules.

4.2 Game Description

4.2.1 Field Illustration

The following illustrations identify the *Game Elements* and give a general visual understanding of the game. Teams should refer to andymark.com/FTC for the exact *Game Element* dimensions. The official *Playing Field* documents, including the official Field Setup and Assembly Guide, are available at <https://www.firstinspires.org/resource-library/ftc/game-and-season-info>.

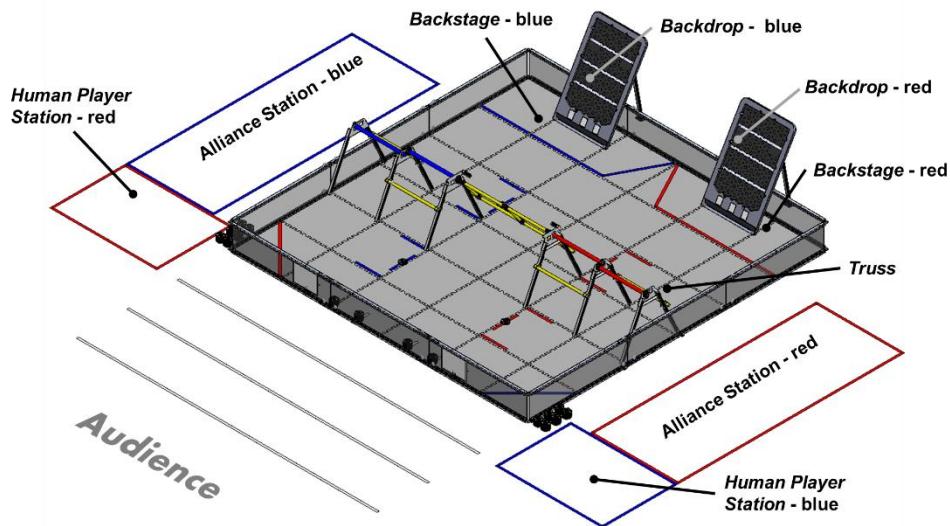


Figure 4.2-1 – Isometric view of the *Playing Field*

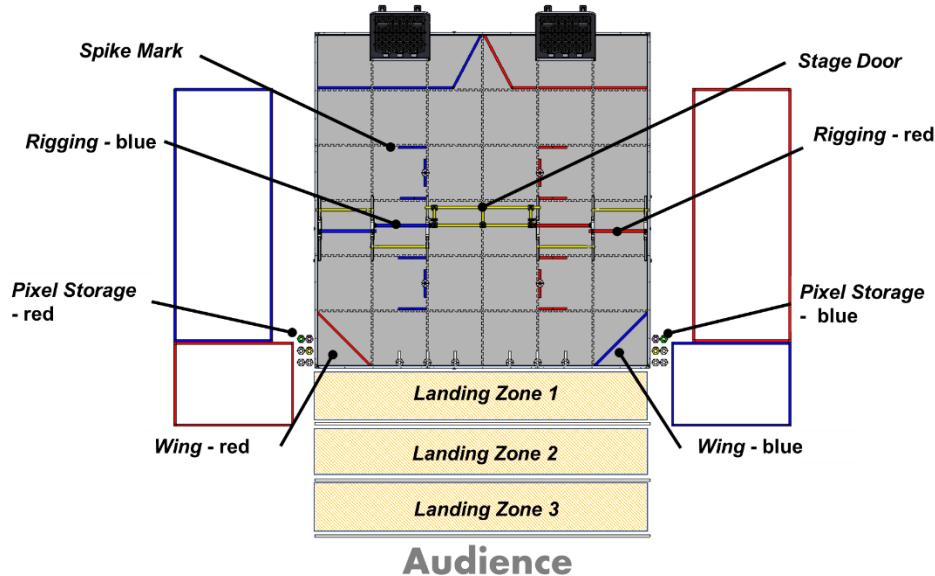


Figure 4.2-2 – Top view of the *Playing Field*

4.2.2 Gameplay Overview

Welcome to CENTERSTAGESM presented by RTX. Matches are played on a *Playing Field* initially set up as illustrated in Figure 4.2 -1. Two *Alliances* – one “red” and one “blue”, made up of two *Teams* each – compete in each *Match*. The object of the game is to earn as many points as possible by performing the achievements outlined below.

The *Match* starts with a 30-second *Autonomous Period* in which *Robots* operate using only pre-programmed instructions and sensor inputs. The following *Robot* actions earn points during the *Autonomous Period*:

1. *Navigating to their Alliance Backstage.*
2. *Placing Pixels On their Alliance Backdrop or In their Alliance Backstage.*
3. Identifying the *Randomization Object* on the randomly selected *Spike Mark*. *Alliances* can earn points by:
 - a. *Placing a purple Pixel On the randomly selected Spike Mark.*
 - b. *Placing a yellow Pixel On their Alliance Backdrop in the location corresponding to the randomly selected Spike Mark.*

Additional points are earned for these tasks when a *Team* uses their *Team Prop* in place of the tournament provided white *Pixel*.

The two-minute *Driver-Controlled Period* follows the *Autonomous Period*. *Robots* earn points by:

1. *Placing Pixels On their Alliance Backdrop or In their Alliance Backstage.*
2. *Creating Mosaics.*
3. *Scoring Pixels that cross the Set Line on their Alliance Backdrop.*

The final 30 seconds of the *Driver-Controlled Period* is called the *End Game*. In addition to the previously listed *Driver-Controlled Period Scoring* activities, *Alliances* earn points by:

1. *Suspending Robots from their Alliance Rigging.*
2. *Parking Robots In their Alliance Backstage.*

3. *Parking their Launched Drones In Landing Zone 1, 2, or 3.*

4.2.3 Gameplay Technology

Each game comes with its own unique set of challenges. In CENTERSTAGESM there are multiple ways *Teams* can utilize technology to assist them in solving these challenges. *Teams* may use the built-in technology, or they can come up with their own solutions to solve the challenges.

This season, the challenges include:

1. Object Identification:
 - a) *Robots* can use their on-board control system and sensors to identify *Game Elements*.
 - b) *Robots* can use the built-in TensorFlow technology to decode the randomized *Autonomous* task.
2. Field Navigation: Built-in *AprilTag* technology helps the *Robot* identify and navigate to important locations on the *Playing Field*.
3. Situational Awareness: Sensors provide situational awareness during the *Autonomous Period*, automate operations, and provide feedback during the *Driver-Controlled Period*. Cameras, IMUs, motor encoders, distance, and color sensors are useful for solving gameplay tasks.

For resources on how to use the available technologies, please visit https://ftc-docs.firstinspires.org/control_hard_compon/rc_components/sensors/sensors.html.

4.3 Game Definitions

The following definitions and terms are used for CENTERSTAGESM. Defined terms begin with a capital letter and are italicized throughout the manual (for example, *Alliance*). Game rules mean exactly and only what it plainly says. If a word isn't given a game definition, then you should use its common conversational meaning.

Alliance – Each *FIRST* Tech Challenge *Match* consists of two, two-*Team Alliances*^[OBJ], designated as red or blue. The two *Teams* in one *Alliance* compete against the two *Teams* in the other *Alliance* to complete the game challenges and to earn the highest *Score*.

Alliance Neutral – Available to a *Robot* from any *Alliance*.

Alliance Specific – Associated with a specific *Alliance* (i.e., red or blue *Alliance*).

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.

AprilTag – A visual fiducial system, useful for a wide variety of tasks including augmented reality, robotics, and camera calibration¹. Three (3) *AprilTags* are affixed to each *Backdrop* to identify target locations for the *Autonomous* randomization task outlined in section 4.4.2. Two additional sets of *AprilTags* are placed at the audience side of the field for assistance with field localization. Information about *AprilTags* may be found here: <https://ftc-docs.firstinspires.org/en/latest/apriltag-intro>.

¹ See <https://april.eecs.umich.edu/software/apriltag> accessed on 5/18/2023.

Area – The space defined by the vertical projection of the outside edge of a region’s boundary (for example, gaffer tape, goal, *Playing Field Wall*). The boundary element (tape, wall, markings, etc.) is part of the *Area* for the purposes of determining *Inside* and *Outside*.

Autonomous Period – The initial thirty-second *Match* period in which the *Robots* operate and react only to sensor inputs and to commands pre-programmed by the *Team* onto the onboard *Robot* control system. Human control of the *Robot* is not permitted during this time.

Backdrop – A structure upon which *Robots* place *Pixels* to score points. There are two (2) *Alliance Specific Backdrops*, one (1) red and one (1) blue. See Appendix C-2 for specifications.

Backstage – The *Alliance Specific Area* beneath a *Backdrop*. The *Backstage* is defined by nominal 1-inch (24 mm) wide tape and is approximately 72-inches (183 cm) long by 23-inches (58.4 cm) deep. There are two (2) *Alliance Specific Backstages*, one (1) red and one (1) blue.

Block / Blocking – Preventing an opposing *Alliance Robot* from accessing an *Area* or *Game Element* for an extended period by obstructing ALL paths of travel to the object or *Area*. Active defense played by a *Robot* shadowing an opposing *Alliance Robot* that eliminates all paths of travel between the opposing *Alliance Robot* and an *Area* or *Alliance Specific Game Element* or all remaining *Alliance Neutral Game Elements* is considered *Blocking*, even though at a given moment there is an open path. See also the definition of *Trap / Trapping*.

Coach – A *Student Team* member or adult mentor designated as the *Drive Team* advisor during the *Match* and identified by wearing a *Coach* badge or identifying marker.

Competition Area – The *Area* where all the *Playing Fields*, scoring areas, *Alliance Stations*, scoring tables, on-deck queuing tables, event officials, and other competition items relating to *Match* play are located. The *Team Pit* area and practice *Playing Fields* are not part of the *Competition Area*.

Control / Controlling – An object is *Controlled* by a *Robot* if the object is following the movement of the *Robot*. Objects that are *Controlled* by a *Robot* are considered to be a part of the *Robot*. See also the definition of *Possess / Possessing*. Examples of interaction with *Game Elements* that are *Controlled* include, but are not limited to:

- a) Carrying one or more *Game Elements*.
- b) *Herding* of *Game Elements*. See also the definition of *Herding* in this section.
- c) *Propelled Game Elements* are considered *Controlled* until they make contact with something other than the *Playing Field Floor* or come to rest. See also the definition of *Propelled* in this section. *Inadvertent* loss of *Control* of a *Scoring Element* is not considered *Propelling*.

Examples of interaction with *Game Elements* that are not *Controlled* include, but are not limited to:

- d) *Plowing* of *Game Elements* is not considered *Control*. See also the definition of *Plowing* in this section.
- e) *Inadvertent* contact with a *Propelled Game Element* as it bounces off the *Playing Field* or a *Robot*. See also the definition of *Inadvertent* in this section.

Disable / Disabled – A *Robot* that is no longer active for the remainder of the *Match* due to a *Robot* failure or by the request of a referee. Only a *Referee* can declare a *Robot Disabled*. If a referee *Disables* a *Robot* during a *Match*, they may ask the *Team* to drive their *Robot* to a neutral position on the *Playing Field*, issue a stop command with the *Driver Station*, and place their *Driver Station* in a hands-off location on a competition provided structure or the *Alliance Station* floor.

Disqualified / Disqualification / Disqualify – A *Team* that is ineligible to compete in a *Match*. A *Team* that is *Disqualified* from a *Match* will not receive credit for the *Match* (that is, no *Score*, no *Ranking* and no *TieBreaker* points).

Drive Team – Up to four (4) representatives; two (2) *Drivers*, one (1) *Human Player* and one (1) *Coach* from the same *Team*. Only one (1) *Human Player* represents an entire *Alliance* in a *Match*.

Driver – A *Student Team* member responsible for operating and controlling the *Robot* and identified by wearing a competition supplied *Driver* badge or identifying marker.

Driver-Controlled Period – The two-minute *Match* time in which the *Drivers* operate the *Robots*.

Driver Station – Hardware and *FIRST* supplied software used by a *Drive Team* to control their *Robot* during a *Match*. A detailed description of the *Driver Station* rules is listed in [Game Manual Part 1 – Traditional Events](#).

Drone – A paper airplane *Scoring Element* built and supplied by a *Team*. The *Drone* must be constructed using materials and methods described in Game Manual Part 1 – Traditional events and have passed inspection.

End Game – The last thirty (30) seconds of the two-minute *Driver-Controlled Period*.

End of the Period/Match – The moment when the *Match* timer reaches 2:00 for the *Autonomous Period* or 0:00 for the *Driver-Control Period* and which coincides with the start of the sound that designates the *End of the Period*.

Game Element – Any item *Robots* interact with to play the game. *Game Elements* for this year's game include *Pixels*, *Backdrops*, *Trusses*, *Stage Door*, *Riggings*, *Team Prop*, and *Drone*.

Grasp – Securely holding an object.

Herding – Pushing or moving one or more *Scoring Elements* to a desired location or direction that gains a strategic advantage beyond moving the *Robot* around the *Playing Field*. See also the related definition of *Plowing* in this section.

Human Player – A *Student Team* member responsible for handling *Scoring Elements* and identified by wearing a competition supplied *Human Player* badge or identifying marker.

Human Player Station – The designated red or blue *Area* adjacent to the *Playing Field* where the *Human Players* are located during a *Match*.

In (Inside) / Completely In (Completely Inside) – An object that has crossed into the upwards vertical extension (i.e., at a right angle to the *Playing Field Floor*) of a defined *Area*'s boundary is *Inside* the *Area*. An object that is entirely within the upwards vertical extension of a defined *Area*'s boundary is *Completely Inside* the *Area*. The boundary element (tape, wall, markings, etc.) is part of the *Area* for the purposes of determining *Inside* and *Outside*, unless otherwise specified.

Inadvertent – An unintended side effect of a *Robot* action. Unforced or unexpected *Robot* actions based on software commands are not considered to be *Inadvertent*.

Inconsequential – An outcome that does not influence *Scoring* or gameplay.

Interference – Interaction between opposing *Alliance Robots* that amplifies the difficulty of a *Scoring* activity. Actions that constitute *Interference* should not be considered illegal except as specified by a game rule.

Landing Zone – *Alliance Neutral Areas* outside the *Playing Field Perimeter* on the audience side of the *Playing Field Wall*. There are three (3) *Landing Zones*:

- a) *Landing Zone 1* – A 144-inch (3.66 m) wide x 24-inch (610 mm) deep *Area* immediately adjacent to the audience side *Playing Field Wall*.
- b) *Landing Zone 2* – A 144-inch (3.66 m) wide x 24-inch (610 mm) deep *Area* immediately adjacent to *Landing Zone 1*.
- c) *Landing Zone 3* – A 144-inch (3.66 m) wide x 24-inch (610 mm) deep *Area* immediately adjacent to *Landing Zone 2*.

The first white tape line from the *Playing Field Wall* is part of *Landing Zone 1*, the second white tape line is part of *Landing Zone 2*, and the third white line is part of *Landing Zone 3*. (see Appendix C-9).

Recognize that *Landing Zone* surfaces and marking materials may vary from event to event. Potential surfaces include hardwood floors, carpeting, gym tarp, cement, tiles, mats, etc. Potential marking materials include tape, paint, etc. *Teams* should plan for these variances when competing at different events.

Launch / Launching – *Propelling Game Elements* through the air or water above the *Playing Field Floor*.

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.

Mosaic – A cluster of three (3) non-white *Pixels Scored On a Backdrop*. See Appendix F, figures F-2 and F-3 for examples.

1. A *Mosaic* consists of three (3) non-white *Pixels*, either all the same color (all green, all purple or all yellow) or each *Pixel* a different color (one (1) green, one (1) purple, and one (1) yellow).
2. A completed *Mosaic* cannot be in contact with another non-white *Pixel*.
3. Each *Pixel* in a *Mosaic* must be in contact with the other two (2) *Pixels* of that *Mosaic*.

Navigating – A *Scoring* task where a *Robot* is *Parked In* or *Completely In* a specified *Area*.

Off / Completely Off – Not physically in contact with or *Supported* by an object, surface, etc. Objects that are *Off* are also considered *Completely Off*.

On / Completely On – An object that is physically in contact with and at least partially *Supported* by an object, surface, etc. is considered *On*. An object that is entirely *Supported* by an object, surface, etc. is *Completely On*.

Out / Outside – An object that does not extend into any part of a defined *Area* is *Outside* the *Area*.

Park / Parked – The condition where a *Robot* or *Drone* is motionless.

Penalty – The consequence imposed for a rule or procedure violation that is identified by a referee. When a *Penalty* occurs, points will be added to the non-offending *Alliance's Score*. *Penalties* are further defined as *Minor Penalties* and *Major Penalties*.

Penalties may also 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.

Yellow Cards and Red Cards – In addition to rule violations explicitly listed in section 4.5, *Yellow Cards* and *Red Cards* are used in the *FIRST* Tech Challenge to manage *Team* and *Robot* behavior that does not align with the mission of *FIRST*. *Yellow* and *Red Cards* are not limited to just the

Competition Area. Teams that display egregious behavior in the pit area, judging rooms, stands, or any other location of the competition can be issued a *Yellow* or *Red Card* for egregious behavior.

Illegal behaviors that are repeated (3 or more times), or egregious behaviors by a *Robot* or *Team* member at the 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* may be issued on or off the competition field. For details, please make sure to read the Competition Rules outlined in section 3.5 of the [Game Manual Part 1 – Traditional Events](#).

Pin / Pinning – Preventing the movement around the *Playing Field* in all directions of an opposing *Alliance* *Robot* while it is in contact with the *Playing Field Wall*, one or more *Game Elements*, or another *Robot*.

Pixel – A hexagonal shaped *Scoring Element*, 3-inches (76.2 mm) across by 0.5-inches (12.7 mm) thick. There are sixty-four (64) white *Pixels*, ten (10) yellow *Pixels*, ten (10) green *Pixels*, and ten (10) purple *Pixels*.

Pixel Storage – The designated *Alliance Specific* area outside of the *Playing Field Wall* directly adjacent to the *Wing* (see Figure 4.2-2) where *Pixels* are stored to be introduced by the *Human Player*. There are two (2) *Alliance Specific Pixel Storage* areas, one (1) red and one (1) blue.

Playing Field – The part of the *Competition Area* that includes the 12 ft. x 12 ft. (3.66 m x 3.66 m) field, the *Landing Zones*, and all the *Game Elements* described in the official field documents. From the audience viewpoint, the *Red Alliance Station* is on the right side of the *Playing Field*.

Playing Field Damage – A physical change to a *Game Element* or *Playing Field* that affects gameplay.

Playing Field Floor – The top surface of the *Tiles* that make up the base of the *Playing Field*.

Playing Field Perimeter – The boundary defined by the outside edge of the extrusion that holds the *Playing Field Wall* panels.

Playing Field Wall – An approximate 12-inches (30.5 cm) tall, 12 ft. (3.66 m) long by 12 ft. (3.66 m) wide wall surrounding the *Playing Field Floor*. The height of the *Playing Field Wall* and inside dimensions will vary depending on which manufacturer's *Playing Field Wall* is being used at the event. *Robots* should be built to interact with all legal *Playing Field Walls*.

Plowing – Inadvertent contact with *Game Elements* while in the path of the *Robot* moving about the *Playing Field* that provides no additional advantages beyond field mobility. See also the definition of *Herd* in this section.

Possess / Possessing – An object is *Possessed* by a *Robot* if, as the *Robot* moves or changes orientation (for example, moves forward, turns, backs up, spins in place), the object remains in approximately the same position relative to the *Robot*. Objects *Possessed* by a *Robot* are considered to be *Controlled*, and they are part of the *Robot*. See also *Control/Controlling*.

Pre-Load – A *Game Element* that a *Drive Team* positions during pre-*Match* setup so that it touches a *Robot* or is *Possessed* by a *Robot* at the start of the *Autonomous Period*.

Propel / Propelling – Giving *Game Elements* enough force such that they move independent of contact with the *Robot* or *Human Player*. Movement solely due to gravity is not *Propelling*. *Launching*, *Rolling*, and *Sliding* are forms of *Propelling*.

Queuing Area – The location in the *Competition Area* where *Drive Teams*, *Robots*, and optional *Robot* transportation carts are staged until directed by competition personnel to set up their *Robots* on a competition *Playing Field*.

Randomization Object – A white *Pixel* or *Team Prop* that is placed in one of three randomly chosen locations. There are four (4) *Randomization Objects*, one (1) placed opposite each *Robot*.

Randomization Task – An *Autonomous Period Scoring* achievement designated by the target *Randomization Object*.

Rigging – Part of the *Truss* from which *Robots Suspend*. There are four (4) *Alliance Specific Riggings*, two (2) red and two (2) blue.

Robot – Any mechanism that has passed *Robot* inspection and a *Drive Team* places on the *Playing Field* prior to the start of a *Match*. A detailed definition of *Robot* is in the *Robot* rules section in the [Game Manual Part 1 – Traditional Events](#).

Rolling – *Propelling Game Elements* along the *Playing Field Floor*.

Score / Scoring – *Robots* earn points for their *Alliance* by interacting with *Scoring Elements* and *Navigating* to specific *Areas* of the *Playing Field*.

The specific method for each *Scoring* achievement is stated in the achievement's description in Section 4.4. Individual *Scoring* achievements are determined by one of three methods:

1. **Scored as Completed**: The achievement is considered Scored the moment it is successfully completed, i.e., all criteria are met.
2. **Scored at End of the Period**: The achievement's *Scoring* status is determined based on the *Robot* or *Scoring Element*'s position at the *End of the Period* (*Autonomous* or *Driver-Controlled*).
3. **Scored at Rest**: The achievement is considered Scored based on the position of the *Robot* or *Scoring Element* when the entire field has come to rest after the *Period* (*Autonomous* or *Driver-Controlled*) ends.

Use of the real-time scoring system display is intended to help the audience and *Teams* keep up with the action on the *Playing Field* and give a general sense of the *Match Score*. Those watching should keep in mind that the *Scoring* for the *Match* is not official until the referees finalize the *Score* after the *End of the Match*.

Scoring Elements – Objects that *Robots* manipulate to earn points for their *Alliance*. The *Scoring Elements* for CENTERSTAGESM are *Pixels* and *Drones*.

Set Bonus – *Scoring* achieved by *Robots* when they place *Pixels* that cross the bottom edge of a *Set Line* on the *Backdrop*.

Set Line – A line on the *Backdrop* that indicates a height achievement. There are three (3) *Set Lines* on each *Backdrop*.

Slide / Sliding – *Propelling Game Elements* along the *Playing Field Floor*.

Spike Mark – A one (1) inch by twelve (12) inch long tape line. There are three (3) *Spike Marks* in each of the *Tiles* B2, B4, E2, and E4. They are positioned on the left, center, and right of the *Tiles* from the corresponding *Alliance Station* perspective. The *Spike Marks* identify locations for the *Autonomous Randomization Task* outlined in section 4.4.2.

Stage Door – A horizontally hinged, height restricting barrier that spans the gap between the *Trusses*. Robots can manipulate to allow their passage from one side of the *Playing Field* to another. The *Stage Door* opens towards the rear of the *Playing Field* (see Appendix C for a drawing of the *Stage Door*'s range of motion).

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

Support / Supported / Completely Supported – An object (i.e., *Robot*, *Scoring Element*, *Game Element*, etc.) is *Supported* by another object if the second object is bearing at least some of the weight of the first object. If the second object is bearing all the weight of the first object, it is *Completely Supported* by the second object.

Suspend / Suspended – A *Robot* is *Suspended* when it is *Completely Supported* by the *Rigging* and is not in contact with any other *Game Element*, *Robot*, or the *Playing Field Floor*. Incidental contact with *Scoring Elements*, the *Truss*, another *Robot* or the *Stage Door* is allowed (for example, *Possession of Scoring Elements* is allowed). *Teams* are encouraged to make these actions obvious and unambiguous.

Team – Mentors, supporters, and *Students* affiliated with an entity registered with *FIRST* and for the competition.

Team Prop – A *Team* designed and supplied *Game Element* used during the *Autonomous Period*. The *Team Prop* must meet the specifications described in Game Manual Part 1 – Traditional Events.

Tile – An approximate 24-inch x 24-inch (610 mm x 610 mm) foam rubber mat. The *Playing Field Floor* has thirty-six (36) *Tiles*. *Tile* size may vary depending on which manufacturer's *Tile* is used at the event. *Robots* should be built to interact with all legal *Tiles*. *Tile* size variation may affect locations of *Game Elements* and gap sizes between the *Tile* and *Playing Field Walls*.

Trap / Trapping – Preventing an opposing *Alliance Robot* from escaping a constrained *Area* of the *Playing Field* for an extended period of time by obstructing all paths of travel from the object or *Area*. See also the definition of *Block / Blocking* in this section.

Truss – A structure that contains two (2) *Alliance-specific Riggings*. There are two (2) *Alliance Specific Trusses* on the *Playing Field*, one (1) red and one (1) blue. The *Stage Door* connects the two *Trusses*.

Warning – An alert given by a referee to an individual or group. *Warnings* are applied to the entire *Team*, and they have no effect on an *Alliance's Score*. *Warnings* are used as a way to point out rule violations while not issuing formal *Penalties*. Repeated *Warnings* throughout a *Competition* may escalate to *Penalties* and/or *Yellow/Red Cards*.

Wing - Taped off locations on the *Playing Field Floor* where a *Human Player* places *Pixels* and *Drones*. There are two (2) *Alliance Specific Wings*, one (1) red and one (1) blue.

4.4 Gameplay

Prior to the start of the *Match*, *Drive Teams* perform some basic *Robot* setup steps that are described in section 4.4.1. *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. When the *Match* is over and referees signal, *Drive Teams* collect their *Robots* and *Team Supplied Game Elements*, return *Possessed* tournament provided *Game Elements* to the *Playing Field*, and exit the *Competition Area*.

4.4.1 Pre-Match

1. Field personnel set up the *Playing Field* as depicted in Figure 4.2-1.
2. *Pixel* placement
 - a) On-Field:
 - i. Six (6) stacks of five (5) white *Pixels*
 - b) *Pixel Storage*: there are two *Pixel Storage* locations, one (1) for the red *Alliance* and one (1) for the blue *Alliance*. Each *Pixel Storage* contains the following:
 - i. Three (3) stacks of five (5) white *Pixels*
 - ii. One (1) stack of five (5) purple *Pixels*
 - iii. One (1) stack of five (5) yellow *Pixels*
 - iv. One (1) stack of five (5) green *Pixels*
 - c) *Randomization Task*
 - i. Four (4) white *Pixels*, one (1) for each set of *Spike Marks*. The *Pixels* will start centered on top of the center *Spike Marks*.
3. *Drive Teams* set up their *Robots* on the *Playing Field* with the following constraints:
 - a) **Starting Location**
 - i. *Drive Teams*, with the agreement of their *Alliance* partners, select their *Robots*' starting locations.
 - ii. Blue *Alliance* *Robots* must start *Completely In Tile A2 or A4*, red *Alliance* *Robots* must start *Completely In Tile F2 or F4*. See Appendix B for Tile nomenclature.
 - iii. *Drive Teams* must place their *Robot*, in any orientation, touching the *Playing Field Wall* adjacent to their *Alliance Station*.
 - b) **Pre-Loaded Pixels** – The *Drive Team* may *Pre-Load* exactly one (1) yellow *Pixel* and/or one (1) purple *Pixel*. If used, *Pre-Loaded Pixels* are taken from *Pixel Storage*. When loaded, the *Pre-Loaded Pixels* must be *Outside* all *Scoring Areas*.
 - c) **Drones** - *Drive Teams* may either *Pre-Load* exactly one (1) *Drone* or place one (1) *Drone* into the *Pixel storage area*.
 - d) **Team Prop** – *Drive Teams* intending to use their *Team Prop* must place it centered on top of the center *Spike Mark* closest to their *Robot*. If a *Team Prop* is used, the white *Pixel* is placed into that *Alliance's Pixel Storage*.

e) **Op Mode –**

i. Drive Teams use their *Driver Station* to select an *Autonomous* op mode. If the Team does not have an *Autonomous* op mode, steps ii and f) below can be skipped.

ii. Press the *Driver Station* “Init” button.

f) **Autonomous Timer** – The thirty-second timer must remain enabled.

g) **Robot Motion** - Robot must be motionless prior to the start of the Match.

h) **Driver Station** - Drive Teams may not touch their *Driver Stations* or controllers until the *Autonomous Period* has ended, except to start their Autonomous program (if applicable) with a single touch to the Driver Station Android device screen.

4. Once the referees signal that set-up is complete:

a) Drive Teams may no longer touch their Robots until the conclusion of the Match.

b) Drive Teams may not touch their *Driver Stations* or controllers until the *Autonomous Period* has ended. Exceptions to this include using the *Driver Station* to start their *Autonomous* program or to *Disable* their *Robot* as instructed by a referee.

c) The Scoring System will choose one of the *Spike Marks* (left, center, right) as the target for the *Randomization Tasks*. Field personnel will move the *Randomization Object* to the chosen *Spike Mark* as specified in Appendix E.

4.4.2 Autonomous Period

The Match starts with a thirty (30) second *Autonomous Period* where *Robots* are operated only via pre-programmed instructions. Teams are not allowed to control *Robot* behavior with the *Driver Station* or any other actions during the *Autonomous Period*. The *Driver Station* is placed in a hands-off location during the *Autonomous Period* so that it is evident that there is no human control of *Robots*. The only exception is to allow Drive Teams to start their *Robot* with the “start” command issued on the *Driver Station* touch screen. Teams must use the built-in thirty-second timer.

Following a countdown by field personnel, the *Autonomous Period* begins. Drive Teams may issue *Robot* start commands with their *Driver Station* Android device to run the *Autonomous Op Mode* that was selected during *Pre-Match* setup. Failure to adhere to this procedure may subject the Team to a *Penalty* as specified in the game rules in section 4.5.2. Drive Teams are not required to start executing an Op Mode during the *Autonomous Period*.

Autonomous points are *Scored at Rest* for the following achievements:

1. **Navigating** – Robots that *Park In the Backstage* for the corresponding *Alliance* earn five (5) points for each *Robot*.

2. **Randomization Tasks** – There are two distinct tasks based on the *Spike Mark* location that was designated during *Randomization*. A *Robot* may only use its own *Pre-Loaded Pixels* to earn *Randomization Task* points.

a) A purple *Pixel* placed *On the Robot’s designated Spike Mark* in the *Tile* immediately adjacent to the starting location, earns points depending on the *Randomization Object* used:

i. Ten (10) points for using the white *Pixel*; or

ii. Twenty (20) points if *Team Prop* is used.

- b) A yellow *Pixel* on the *Backdrop* in the location corresponding to the designated *Spike Mark* earns points depending on the *Randomization Object* used:
 - i. Ten (10) points for using the white *Pixel*; or
 - ii. Twenty (20) points if *Team Prop* is used.
3. ***Pixels*** – Robots placing *Pixels* earn points as follows:
- a) All *Pixels* On the recessed *Scoring* area of their *Alliance Backdrop* earn five (5) points per *Pixel*.
 - b) *Pixels* In their *Alliance Backstage* earn three (3) points per *Pixel*.
- Pixels that are Scored in the *Autonomous Period* will earn additional points at the end of the *Driver-Controlled Period* if they remain in place.

4.4.3 Driver-Controlled Period

Directly following the end of the *Autonomous Period*, *Drive Teams* have five (5) seconds plus a “3-2-1-go” countdown to prepare their *Driver Stations* for the start of the 120 second *Driver-Controlled Period*. On the countdown word “go,” the *Driver-Controlled Period* starts, and *Drive Teams* press their *Driver Station* start button to resume playing the *Match*.

Driver-Controlled tasks are Scored at Rest for the following achievements:

- 1. ***Pixel*** – Robots placing *Pixels* earn points as follows:
 - a) *Pixels* On the recessed *Scoring* area of their *Alliance Backdrop* earn three (3) points per *Pixel*.
 - b) *Pixels* In their *Alliance Backstage* earn one (1) point per *Pixel*.
- 2. ***Artist Bonus*** – *Mosaics* earn ten (10) points per *Mosaic*.
- 3. ***Set Bonus*** – *Alliances* earn ten (10) points when Scored *Pixels* On a *Backdrop* extend In a horizontal *Set Line*. Vertically crossing In each *Set Line* earns one (1) *Set Bonus*, regardless of the number of *Pixels* that cross it. The maximum *Set Bonus* for an *Alliance* is thirty (30) points.

4.4.4 End Game

The last thirty seconds of the *Driver-Controlled Period* is called the *End Game*. *Driver-Controlled Period Scoring* can still take place during the *End Game*. *End Game* achievements, other than *Navigating*, begun before the start of *End Game* are worth zero (0) points.

- 1. ***Robot Location*** – There are two mutually exclusive location-based *Scoring* opportunities. A *Robot* may only earn points for one of these tasks. *Teams* are encouraged to make these actions obvious and unambiguous. *Robot Location* is Scored at End of the Period.
 - a) ***Suspended from the Rigging*** - A *Robot* Suspended by a corresponding *Alliance*'s *Rigging* earns twenty (20) points. Only one (1) *Robot* per *Rigging* counts as Scored.
 - b) ***Parked In the Backstage*** – *Robots* that Park In the *Backstage* for the corresponding *Alliance* earn five (5) points for each *Robot*.
- 2. ***Drone Launching*** – Launched *Drones* that end up Parked In a *Landing Zone* earn points as shown below. Launched *Drones* must pass over the *Truss* and/or *Stage Door* for each scoring attempt to earn points. *Drone Launching* is Scored at Rest.
 - a) *Landing Zone 1* earns thirty (30) points.
 - b) *Landing Zone 2* earns twenty (20) points.
 - c) *Landing Zone 3* earns ten (10) points.

4.4.5 Post Match

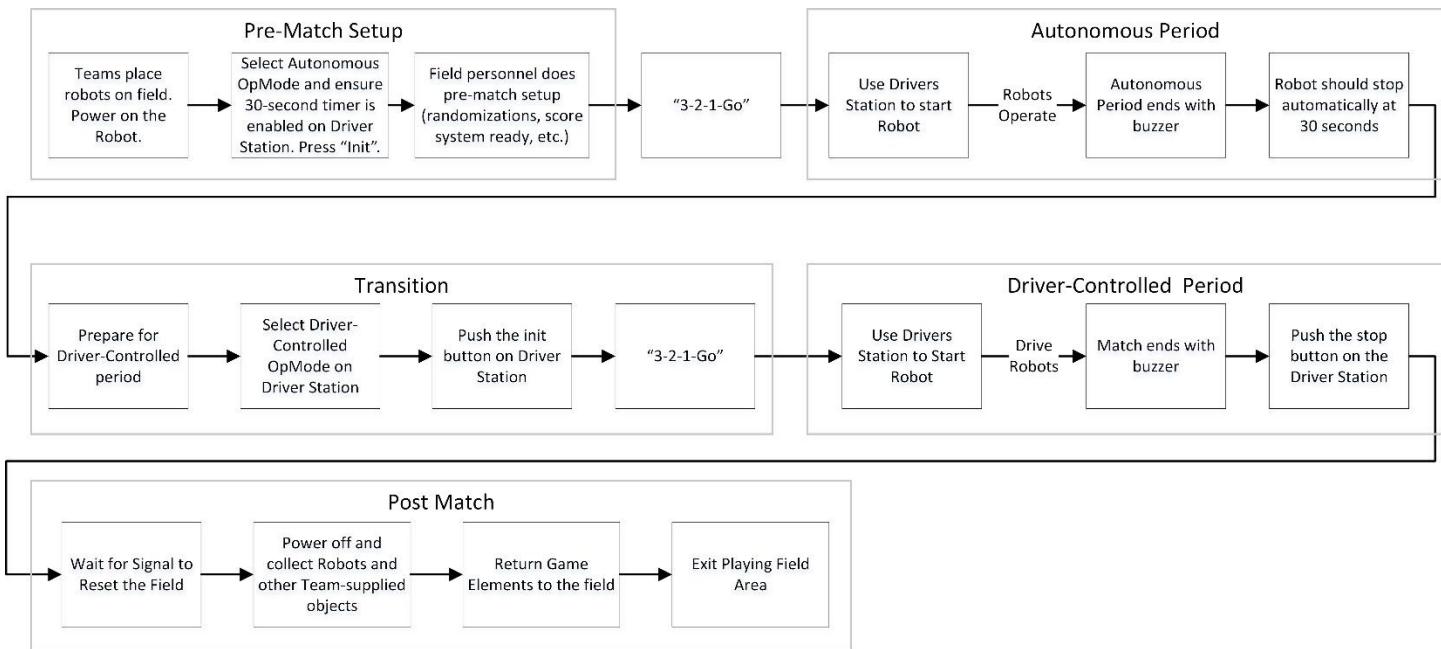
By the conclusion of the stop *Match* sound, *Drive Teams* must press the stop button on their *Driver Stations*. *Field Personnel* will then finalize the *Score*. Referees will signal for the *Drive Teams* to enter the *Playing Field* and retrieve their *Robots* and *Drones*. *Drive Teams* should return any tournament provided *Game Elements* that are *Possessed* by the *Robot* to the *Playing Field*. The *Playing Field* reset crew will set up the *Playing Field* for the next *Match*.

4.4.6 Penalties

Penalty points are added to the non-offending *Alliance*'s *Score* at the *End of the Match*. *Minor Penalties* give the non-offending *Alliance* ten (10) points per occurrence. *Major Penalties* give the non-offending *Alliance* thirty (30) points per occurrence. *Warnings* have no effect on an *Alliance*'s *Score*.

4.4.7 Flowchart of Match Play

The following figure shows the typical flow of the *Match* and the actions taken on the *Driver Station* Android device.



4.5 Rules of Gameplay

Gameplay is restricted by the Safety rules (<S#>), the General rules (<G#>), and the Game-Specific rules (<GS#>). Violation of rules may lead to *Warnings*, *Penalties*, *Yellow Cards*, *Red Cards*, a *Disabled Robot*, or *Disqualification* of the offending *Team* or *Alliance* from either a *Match* or the competition. Rules apply to all periods of play unless otherwise specified. If rules are in conflict, Safety rules take precedence over all rules and Game-Specific rules take precedence over General rules. **The official FIRST Tech Challenge Question & Answer Forum rulings take precedence over all information in the game manuals.**

4.5.1 Safety Rules

<S01> Unsafe Robot or Playing Field Damage – If at any time the *Robot* operation is deemed unsafe or has damaged the *Playing Field* or another *Robot*, by the determination of the referees, the offending *Robot* may be *Disabled*, and the *Team* may be issued a *Yellow Card*. Re-inspection of the *Robot* is required before it may play another *Match*. Damage that requires significant repair and/or delays subsequent *Match* play is likely to escalate to a *Red Card*.

<S02> Robot Extension Outside the Playing Field Perimeter – If any portion of the *Robot* contacts anything *Outside the Playing Field Perimeter*, the *Team* will be issued a *Yellow Card* and the *Robot* may be *Disabled* immediately for the remainder of the *Match*, unless allowed by Game-Specific rule(s) listed in section 4.5.3. See the game definitions in section 4.3 for a complete description of the *Playing Field Perimeter*.

The intent of this rule is not to *Penalize* an *Alliance* for *Inadvertent*, safe *Robot* extension *Outside the Playing Field Perimeter*. Intentional *Robot* extension *Outside the Playing Field* is not permitted.

<S03> Safety Gear – All members of the *Drive Team* are required to wear approved eye protection and shoes with closed toe and a closed back. If any member of the *Drive Team* is not wearing these safety items, the referee will issue a *Warning* to the *Team* member(s) and if the situation is not remedied within thirty (30) seconds, the offending member(s) of the *Drive Team* must leave the *Competition Area* for the remainder of the *Match* and may not be replaced by another *Team* member. Failure to comply with a request to leave the *Competition Area* violates rule <G30>. Repeated *Team* violations during the competition will escalate to an entire *Team Warning*. Following the *Team Warning*, subsequent violations by any member of the *Team* will result in a *Minor Penalty* for the *Alliance*.

<S04> Competition Area Safety – When a competition has venue-specific safety rules for the *Competition Area*, all members of a *Team* are required to abide by those rules. Initial violations will result in a verbal *Warning*. Subsequent violations at a competition will result in a *Yellow Card*.

4.5.2 General Game Rules

<G01> Autonomous to Driver-Controlled Period Transition – At the conclusion of the *Autonomous Period*, *Robots* will remain in a hands-off state. Field personnel will not enter the field and will not touch *Robots* on the field during the *Autonomous* to *Driver-Controlled* transition. The scoring system display will provide visual and audio cues for *Drive Teams* to pick up their *Driver Stations*. *Drive Teams* will have five (5) seconds to pick up and prepare their *Driver Station*. After five (5) seconds, there will be a “3-2-1 go” countdown and the *Driver-Controlled Period* of the *Match* will begin.

<G02> Score Certification at the End of the Match – Scores will be tracked by field personnel throughout the *Autonomous* and *Driver-Controlled* *Periods* of the *Match*. At the *End of the Match*, the final *Score* will be certified as quickly as possible. A change in state of a *Game Element* or *Robot* at the *End of the Match* after its final *Score* is recorded will not change an already-recorded *Score*. *Scoring Elements* will not be recounted after the *End of the Match* unless otherwise specified by a Game-Specific rule.

<G03> Forcing an Opponent to Break a Rule – The actions of an *Alliance* or their *Robots* shall not cause an opposing *Alliance* or *Robot* to break a rule and thus incur *Penalties*. Any forced rule violations committed by the affected *Alliance* shall be excused, and no *Penalties* will be assigned to the affected *Alliance*.

<G04> Robot Manipulation of Scoring Elements – *Scoring Elements* that are *Controlled* or *Possessed* by a *Robot* are part of the *Robot* except when determining the location of the *Robot* or otherwise specified by a Game-Specific rule.

For Example: If a *Robot* Possesses a *Scoring Element*, and only that *Scoring Element* breaks the plane of a *Scoring Area*, the *Robot* does not receive points for being *In* that *Area*.

<G05> Robot or Scoring Elements In Two or More Scoring Areas – Robots or *Scoring Elements* that are eligible for two or more *Scoring* achievements earn points only for the highest value achievement. If the achievement values are equal, only one achievement counts as *Scored*.

<G06> Scoring Elements in Contact with Robots – *Scoring Elements* in a *Scoring Area* that are in contact with or *Controlled* by a *Robot* on the corresponding *Alliance* for the *Scoring Area* have zero *Score* value.

<G07> Disabled Robot Eligibility – If a referee *Disables* a *Robot*, it will not be eligible to *Score* or earn points for the remainder of the *Match*. A *Disabled Robot* (whether referee induced or *Robot* failure) does not earn *Penalties* after being declared *Disabled* unless otherwise specified by a Game-Specific rule.

<G08> Playing Field Tolerances – Competition provided *Playing Field* and *Game Elements* will start each *Match* with tolerances that may vary by +/-1.0 inch (25.4 mm). Teams must design their *Robots* accordingly.

Playing Field and *Game Elements* are expected to be manufactured, assembled, and set up using a high standard for dimensional and location accuracy. The intent of the generous +/- 1.0 inch tolerance is to accommodate unintentional size and location variations that may occur. The tolerance is not an excuse for intentional or imprecise accuracy in construction or setup.

<G09> Match Replay – *Matches* are replayed at the discretion of the head referee only for a failure of a non-*Team* supplied *Game Element* or verified Wi-Fi interference that was likely to have impacted which *Alliance* won the *Match*.

Unexpected *Robot* behavior will not result in a *Match* replay. *Team*-induced failures, such as low battery conditions, processor sleep time-outs, *Robot* mechanical, electrical, software, or communication failures, etc. are NOT valid justifications for a replaying of a *Match*.

<G10> Inadvertent and Inconsequential – *Robot* actions that violate a rule may be ruled at the referee's discretion to be *Inconsequential* and *Inadvertent* and will not be *Penalized*.

<G11> Illegal Match Communication – Electronic communication (cell phone, two-way radio, Wi-Fi, Bluetooth, etc.) by *Drive Team* members after an *Alliance* has been called from the queue to the *Playing Field* for its *Match* is not allowed. The first instance of violating this rule will result in a *Warning*, with any following instances during the competition resulting in a *Minor Penalty*. Items that may be mistaken by a casual observer as being in violation of this rule should not be brought to the *Playing Field*. The *Driver Station* is exempt from this rule but must be used only for operating the *Robot*.

<G12> Playing Field Access – *Team* members must not enter the *Playing Field* for any reason other than to place/retrieve their *Robots*. While placing *Robots*, *Teams* may not measure, test, or adjust *Game Elements* *Inside* or *Outside* of the *Playing Field* unless allowed by Section 4.4.1. When retrieving *Robots*, *Teams* may not verify the *Scoring* of *Game Elements*.

The consequences for violating this rule are:

- a) *Minor Penalty* for violations during *Match* setup or following the *End of the Match*.
- b) *Major Penalty* for violations that delay the start of the *Match*.

- c) Violations of this rule outside of normal *Match* play will result in a *Yellow Card*.

If a *Team* feels the *Playing Field* is not set up correctly, *Teams* should notify a referee or FIRST technical advisor prior to the start of the *Match*.

<G13> Pre-Match Robot Placement – At the beginning of a *Match*, each *Alliance Robot* must be set up on the *Playing Field* according to section 4.4.1 Pre-Match.

- a) During the Qualification *Matches*, the blue *Alliance Robots* are set up on the *Playing Field* first, unless the red *Alliance* waives their right to set up on the *Playing Field* second.
- b) During the Elimination *Matches*, the 3rd and 4th seeded *Alliance Robots* are set up on the *Playing Field* first, unless the higher seeded *Alliance* waives their right to set up on the *Playing Field* second. *Alliance* color doesn't change the seeding of a *Team* during the Elimination *Matches*. If the 4th seed defeats the 1st seed in the Semi-Finals, they will still have to place their *Robot* on the field first in the finals because their seeding will be lower than the 2nd or 3rd seed.
- c) During Elimination *Matches*, three *Team Alliances* may only place two *Robots* that are intended to compete in that *Match*. After the *Robots* are placed, the *Alliance* cannot swap in the 3rd *Alliance's Robot* for a *Robot* already placed.
- d) *Teams* may implicitly waive their right to place their *Robots* on the *Playing Field* last by placing their *Robots* on the *Playing Field* before or with the opposing *Alliance*. There is no need to tell the referees; *Teams* waive their right by the act of placing their *Robots* on the *Playing Field*.
- e) *Teams* that unnecessarily delay the beginning of a *Match* and/or field reset will incur a *Minor Penalty* for each offense. Significant delays may escalate to a *Major Penalty* at the discretion of the head referee.

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

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

If the field is waiting for the *Team*, they would be subject to this *Penalty*.

<G14> Robot Starting Volume – Before the start of a *Match*, each *Robot* in its starting location must not exceed a volume of 18 inches (457.2 mm) by 18 inches (457.2 mm) by 18 inches (457.2 mm). Flexible materials (i.e., zip tie, surgical tube, string, etc.) may extend up to 0.25 inches (0.635 cm) beyond the 18-inch (45.72 cm) size constraint. A *Pre-Loaded Scoring Element* may extend *Outside* the 18-inch (457.2 mm) cube volume constraint. Once a violation has been identified, if the *Team* cannot fix the violation within thirty (30) seconds, the offending *Robot* will be removed from the *Playing Field*. *Robots* removed from the field are not subject to a delay of game (<G13>e) *Penalty*. The *Team* remains eligible to earn Ranking and TieBreaker Points if a member of the *Drive Team* is in their *Alliance Station* during the *Match*.

After the start of a *Match*, the *Robot* may extend in any direction unless otherwise specified by the Game-Specific rules detailed in section 4.5.3.

<G15> Robot Setup Alignment – Teams may align their *Robots* during Pre-Match setup if they do so with legal components that are part of the *Robot* and can be reset to be within the 18-inch (457.2 mm) cube starting volume constraint. *Robot* setup alignment devices that extend outside the 18-inch starting volume constraint cannot be powered. A single member of the *Drive Team* may also align the *Robot* by sight if they are next to the *Robot* and their action does not delay the start of a *Match*. A *Minor Penalty* will be assessed to the *Alliance* for violation of this rule.

<G16> Alliance and Human Player Stations – During a *Match*, the *Drive Team* must remain *In* their *Alliance* or *Human Player Station*.

- a) *Drive Teams* may be anywhere in their respective *Alliance* or *Human Player Station*.
- b) The first instance of leaving the *Alliance* or *Human Player Station* will result in a *Warning*, with any following instances during the *Match* resulting in a *Minor Penalty*. Leaving the *Alliance* or *Human Player Station* for safety reasons will not result in a *Warning* or *Penalty*.
- c) Opposing *Alliance*'s *Drive Team* members cannot distract/interfere with each other or the off-field *Scoring Elements* (if present in the current season's challenge). Violations of this rule will result in an immediate *Major Penalty* and a possible *Yellow Card*.
- d) After *Robots* are set up on the *Playing Field*, and before the *Match* starts, *Drive Teams* must stand *Inside* their respective *Alliance* or *Human Player Station*. Once the *Match* starts, the members of the *Drive Teams* may stand, sit, or kneel for the remainder of the *Match*. Violations of this rule (for example, lying down in the *Alliance Station*) will result in a *Minor Penalty*. Repeated violations of this rule will be handled per rule <G30>.

The intent of this rule is to prevent *Drive Team* members from leaving their assigned *Station* during a *Match* to gain a competitive advantage. For example, moving to another part of the *Field* for better viewing, reaching into the *Field*, etc. Simply breaking the plane of the *Station* during normal *Match* play is not a *Penalty*.

<G17> Post-Match Removal of Robots – *Robots* must be designed to permit easy removal of *Game Elements* from the *Robot* after the *Match*. *Robots* should also be able to be removed from the *Playing Field* without unnecessary delay or damaging the *Playing Field*. A *Minor Penalty* will be assessed for violations of this rule.

The intent of this rule is to have timely removal of *Robots* from the *Playing Field* following a *Match*. *Drive Teams* are expected to stage their *Robots* for a *Match*, and remove them from the *Playing Field* afterwards, safely, and swiftly. *Drive Team* efforts that either intentionally or unintentionally delay the start of a *Match* or the *Playing Field* reset are not allowed. Examples include, but are not limited to:

- a) Failing to exit the *Playing Field* once instructed by a referee.
- b) Failing to remove *Driver Stations* in a timely manner.

<G18> Starting Gameplay Early – *Robots* that start playing the game (*Autonomous* or *Driver-Controlled Period*) prior to the start of a *Match Period* receive a *Minor Penalty*. Referees have the option of issuing a *Major Penalty* in place of the *Minor Penalty* if the early start results in a competitive advantage for the offending *Alliance*.

<G19> Late Start of the Autonomous Period – A Drive Team that starts their Robot’s Autonomous Op Mode late will receive a Minor Penalty. Any delay in Robot movement must be done by its programming. Referees have the option of issuing a Major Penalty in place of the Minor Penalty if the late start results in a competitive advantage for the offending Alliance.

<G20> Robot Actions at End of the Period –

- a) Robots must Park at the end of the Autonomous and Driver-Controlled Periods. Robots that are not Parked at the conclusion of the “game sound” receive a Minor Penalty and the Robot’s following actions do not count towards their Alliance’s Score. Drive Teams should make their best effort to stop gameplay immediately when the End of the Period game sound begins. Referees have the option of issuing a Major Penalty in place of the Minor Penalty if the late stop results in a competitive advantage (other than Scoring) for the offending Alliance.
- b) Scoring achievements that were started (unless disallowed by Game-Specific rules) before the End of the Period are eligible to be counted as Scored.
- c) Robot Scoring achievements that occur after the announced End of the Autonomous Period and before the start of the Driver-Controlled Period do not count towards the Score for the Autonomous or Driver-Controlled Periods.

<G21> Robot Control During Autonomous Period – During the Autonomous Period, Drive Teams may not directly or indirectly control or interact with Robots or Driver Stations. Early stopping of the Robot while running its Autonomous code is not allowed, except in cases of personal or equipment safety, and any achievements earned due to early stoppage will not Score points. A Major Penalty will be assessed for violating this rule. Teams that stop their Robots during the Autonomous Period are allowed to participate in the Driver-Controlled Period provided it can be done safely.

<G22> Drive Team Contact with the Playing Field or Robot – During a Match, the Drive Team is prohibited from making contact with the Playing Field, any Robot, or any Game Element unless allowed by Game-Specific rules. The first instance of contact will result in a Warning, with any following instances during the competition resulting in a Minor Penalty. Contact that affects Scoring and/or gameplay will result in issuance of a Yellow Card at the discretion of the referees. Contact with the Playing Field, a Game Element, or a Robot for safety reasons will not result in a Warning or Penalty.

For example, a Game Element is Launched from a Robot on the Playing Field and it Inadvertently hits a Team member in the Alliance Station and is deflected back onto the field. The Team would not receive a <G22> Penalty because the Team member was protecting themselves (safety). However, if that same Game Element is caught and/or directed to a specific location on the Playing Field, the Team may be issued a <G22> Penalty.

<G23> Drive Team Coach Driver Station Control – During the Driver-Controlled Period, Robots must be remotely operated only by the Drivers using the Gamepads connected to the Team’s Driver Station and/or by software running on the on-board Robot control system. The first instance of the Coach operating a Gamepad will result in a Warning, with any following instances during the competition resulting in a Major Penalty. During the Driver-Controlled Period, Drive Team Coaches and/or Drivers are allowed to hold the Team’s Driver Station Android device and interact with it to select an Op Mode, view information displayed on the screen, and initialize, start, stop, and reset the Robot.

<G24> Robots Deliberately Detaching Parts – Robots may not deliberately detach parts during a Match or leave mechanisms on the *Playing Field* unless permitted by a Game-Specific rule. Possessed or Controlled Scoring Elements are not considered to be a part of the Robot for the purpose of this rule. The consequence of deliberately detaching a part is a *Minor Penalty* if it does not *Block* an opposing Alliance Robot, Alliance Specific Scoring Element or Scoring Area. If a deliberately detached component or mechanism affects gameplay by any Robot, the offending Robot will receive a *Major Penalty* and will be issued a *Yellow Card*. Robot parts that are released but remain connected by a tether are considered detached for the purposes of this rule.

Tethered components that move independently of the main Robot are considered a detached component and are illegal.

<G25> Robots Grasping Game Elements – Robots may not *Grasp* and/or attach to any *Game Element*, *Robot*, or structure other than *Scoring Elements*, unless specifically allowed by Game-Specific rule(s) listed in section 4.5.3. The first instance will result in a *Warning* with any following violations during the competition resulting in a *Major Penalty*.

<G26> Destruction, Damage, Tipping, etc. – Robot actions aimed at the destruction, damage, tipping over, or entanglement of *Robots* or *Game Elements* are not in the spirit of the FIRST Tech Challenge and are not allowed unless permitted by Game-Specific rules. However, FIRST Tech Challenge games are highly interactive. *Robot-to-Robot* contact and defensive gameplay should be expected. Robot interactions that result in tipping, entanglement, or impair the functions of an opposing Alliance's Robot may result in a *Major Penalty* and/or a *Yellow card*.

<G27> Removing Game Elements from the Playing Field – Robots may not deliberately remove *Game Elements* from the *Playing Field* during a Match unless specifically allowed by Game-Specific rule(s) listed in section 4.5.3. *Game Elements* that *Inadvertently* fall *Outside* the *Playing Field* will be returned to the *Playing Field* by field personnel at the earliest safe and convenient opportunity at a non-*Scoring* location approximately where it left the field. *Game Elements* removed from the *Playing Field* in an attempt to *Score* are also not subject to this *Penalty*. Teams deliberately removing *Game Elements* from the *Playing Field* will incur a *Minor Penalty* per *Game Element* removed from the *Playing Field*. Game-Specific rules listed in section 4.5.3 that address the removal of specified *Scoring Elements* from the *Playing Field* take precedence over this general game rule.

<G28> Pinning, Trapping, or Blocking Robots – A Robot may not cause an opposing Alliance Robot to become *Pinned*, *Trapped*, or *Blocked*.

Once a referee determines this rule is being violated, a *Minor Penalty* will be assessed for every 5 seconds the violation continues.

A Robot is in violation until it has moved at least 3 feet (0.9 m), approximately 1.5 *Tiles*, from the *Pinned*, *Trapped*, or *Blocked Robot*.

During the *Autonomous Period*, Robots will not incur this *Penalty* unless it is determined by the referee to be part of a deliberate strategy, which will then be penalized as described above. If the violation happens during the *Autonomous Period*, the first action done by the offending Robot during the *Driver-Controlled Period* must be to move away from the *Pinned*, *Trapped*, or *Blocked Robot* or a *Minor Penalty* will be assessed immediately.

and again for every five-seconds that they are in violation. Game-Specific rule(s) listed in section 4.5.3 that further define *Pinning*, *Trapping*, or *Blocking* take precedence over this general game rule.

The intent of this rule is that *Drive Teams* begin to immediately move their *Robots* away and have a five second grace period to move the required distance. The grace period is not permission to intentionally *Block/Pin/Trap* for up to five seconds.

<G29> Illegal Usage of Game Elements – *Robots* may not deliberately use *Game Elements* to ease or amplify the difficulty of any *Scoring* or game activity. A *Major Penalty* will be assessed for violations of this rule. Continued violations of this rule will quickly escalate to a *Yellow Card* at the discretion of the Head Referee.

<G30> Egregious Behavior – Egregious *Robot* or *Team* member behavior is not in the spirit of Gracious Professionalism and will not be tolerated at a *FIRST* Tech Challenge event. Egregious behavior includes, but is not limited to, repeated and/or flagrant violation of rules, unsafe behavior or actions, or uncivil behavior towards volunteers, *Drive Team*, competition personnel, or event attendees. In most cases, as determined by the referees, the offending team will result in a *Major Penalty* and issuance of a *Yellow Card* and/or *Red Card*. Subsequent violations may result in Team disqualification from the competition.

Continued and repeated violations will be brought to *FIRST* Headquarters' attention. *FIRST* Headquarters will work with event staff to determine if further escalations are necessary, which can include removal from award consideration and removal from the event.

In cases where the egregious behavior is deemed to be unsafe, such as physical contact or threatening behaviors to other event attendees, event staff will work with *FIRST* Headquarters to determine if the behavior warrants immediate removal of the team from the event.

4.5.3 Game-Specific Rules

<GS01> General Rule Exceptions – The following instances of gameplay are Game-specific exceptions to General Game Rules in section 4.5.2:

- a) *Robot* contact with a *Pixel* in a *Backstage* is allowed as an exception to rule <G06> if the *Pixel* is not *Possessed* by the *Robot*.
- b) *Robots* are allowed to *Grasp* the *Rigging* as an exception to rule <G25>.
- c) A *Robot* may *Launch* their *Drone* to the *Outside* of the *Playing Field* as an exception to rule <G27>.
- d) Rule <GS06>.f modifies the application of rule <G28>.
- e) Rule <GS07> constraints are an exception to rule <G07>.
- f) Consequences for violating rule <GS07>.a apply a stricter penalty than outlined in rule <G25>.
- g) Rule <GS08>.c is an exception to rule <G07>.
- h) The rule <GS09> consequence for a *Disabled Robot In a Wing* is an exception to rule <G07>.

<GS02> Drive Teams Touching Robots or Driver Stations after Randomization – *Drive Teams* are not allowed to touch or interact with their *Robots* or *Driver Stations* once field personnel have begun the *Playing Field* randomization process. If this occurs, a *Minor Penalty* will be assessed to the *Alliance*. The offending *Robot* is not eligible to earn points for the *Randomization Tasks* in the *Autonomous Period*. The non-offending *Alliance* partner *Robot* remains eligible for the *Randomization Tasks Scoring* achievement.

<GS03> Autonomous Interference – During the *Autonomous Period* a *Major Penalty* is assessed for the following actions:

- a) *Interfering with an opposing Alliance Robot In the opposing Alliance's half of the Playing Field.* Tiles A, B, C constitute the blue side of the Playing Field, Tiles D, E, F constitute the red side of the Playing Field. The tabs joining Tiles C and D are neutral.
- b) *Interfering with the opposing Alliance's Randomization Task setup or Randomization Task Scoring.*
- c) *Robots moving the pre-placed white Pixel stacks in the opposing Alliance half of the Playing Field that impacts or impedes the opposing Alliance's Autonomous Period Scoring actions.*

The intent of this rule is to protect *Robot* actions performed while *Completely In* their *Alliance's* side of the *Playing Field*. Navigating into the opposing *Alliance's* side of the *Playing Field* is a risky gameplay strategy.

<GS04> Descoring – Robots may not descore *Pixels* or affect scoring achievements from the opposing *Alliance's Backdrop* or *Backstage*.

- a) A *Minor Penalty* will be assessed for each *Pixel* that is descored.
- b) An additional *Minor Penalty* is assessed for each affected completed *Mosaic* and/or *Set Line Bonus* scoring achievement.

Examples:

1. A *Robot* descores a *Pixel* from the opposing *Alliance's Backdrop*. The opposing *Alliance's Mosaic* or *Set Line* points are unaffected. The offending *Robot* that descored the *Pixel* receives one *Minor Penalty*.
2. A *Robot* descores a *Pixel* from the opposing *Alliance's Backdrop*. The opposing *Alliance's Mosaic* score is affected by the descore. The offending *Robot* that descored the *Pixel* receives two *Minor Penalties*.
3. A *Robot* repositions a *Pixel* on the opposing *Alliances Backdrop*. This causes the affected *Alliance* to lose points for an already achieved *Set Line* bonus. The offending *Robot* receives one *Minor Penalty*.

<GS05> Robot Control/Possession Limits for Scoring Elements –

- a) Robots may *Control* or *Possess* a maximum of two (2) *Pixels* and one (1) *Drone* at a time. *Controlling* or *Possessing* more than the allowed quantity of *Scoring Elements* is an immediate *Minor Penalty* for each *Scoring Element* above the limit plus an additional *Minor Penalty* per *Scoring Element* in excess of the limit for each 5-second interval that the situation continues.
- b) *Scoring a Pixel* while in *Control* or *Possession* of more than the allowed quantity of *Scoring Elements* will result in a *Minor Penalty* per *Element Scored*.
- c) *Control/Possession* limit exceptions:
 - i. Knocking over a stack of unscored *Pixels* is allowed.
 - ii. *Inadvertent* and *Inconsequential* movement of a pre-set stack of unscored *Pixels* is allowed. Moving the stack *Completely Off* the tape is considered consequential.
 - iii. *Plowing* through any quantity of *Scoring Elements* is allowed.

- iv. *Pixels In the Backstage* that are directly *Supported* by the *Playing Field Floor* or *Supported* by a *Pixel* that is directly *Supported* by the *Playing Field Floor*, are exempt from the *Control/Possession* limit. The intent of this rule is to prevent penalizing a *Robot* maneuvering *In the Backstage*.
- v. *Pixels On the Backdrop* are exempt from the *Control/Possession* limit.

<GS06> Truss Constraints –

- a) *Robots* may only *Grasp* one of either *Rigging* of their corresponding *Alliance Specific Trusses*. Contact with the other parts of the *Truss* is allowed for stabilization of the *Robot* while *Suspended*. The intent is that the *Rigging* is the primary support for the *Robot*. Violation of this rule results in zero Score value for the *Suspend* task.
- b) *Robots* may not *Grasp* or *Suspend* from any other part of the *Truss* structure. Violation of this rule results in a *Minor Penalty* per occurrence.
- c) There is a limit of one (1) *Supported Robot* per *Rigging*. Additional *Robots Supported* by a *Rigging* or by a *Robot Supported* by that *Rigging* earn a *Major Penalty*.
- d) A *Robot* may not impede or obstruct an opposing *Alliance Robot* from *Suspending* during the *End Game Period*. Each violation of this rule results in an immediate *Major Penalty* and additional *Blocking Penalties* per rule <G28>.
- e) Contact with a *Suspended* opposing *Alliance Robot* will not invalidate the *Suspend*. The action will also result in a *Minor Penalty* per occurrence for contacting the *Suspended Robot*.
- f) During the *End Game*, the height restricted paths leading to the *Rigging* are not an open path of travel when applying rule <G28>.

<GS07> Stage Door Constraints – Stage Door constraints apply to both operational and *Disabled Robots*.

- a) *Robots* may not *Grasp* the *Stage Door*. Violation of this rule results in a *Major Penalty*.
- b) Preventing the *Stage Door* from operating normally while an opposing *Alliance Robot* attempts to travel through the *Stage Door* is not allowed. Violation of this rule results in a *Major Penalty*. For example:
 - i. *Robots* may not limit the upward motion of the *Stage Door*.
- c) Transit constraints: Violations of this rule are addressed per rule <G28>. Repeated violations will quickly escalate to a *Yellow Card* at the discretion of the Head Referee.
 - i. Disrupting the transit of an opposing *Alliance Robot* through the *Stage Door* is not allowed.
 - ii. *Robots* passing through the *Stage Door* from the audience side of the *Playing Field* to the back have transit priority. *Robots* traveling from the back of the *Playing Field* to the audience side of the *Playing Field* must yield a free path of travel.

The *Stage Door* is wide enough for two *Robots* to pass through at the same time without disruptions. *Robots* that allow a free path of travel to faster *Robots* are less likely to incur transit constraint *Penalties*.

<GS08> Backdrop and Backstage Constraints –

- a) A *Robot* may not impede or obstruct an opposing *Alliance Robot* that is *In the Backstage* from *Scoring* a *Pixel*. Each violation of this rule results in an immediate *Minor Penalty*.
- b) *Robots* may not *Block* access to the opposing *Alliance's Backstage* or *Backdrop*. Once a referee determines this rule is being violated, a *Major Penalty* will be applied. A *Minor Penalty* will be added for

every 5 seconds the violation continues. A *Robot* is in violation until it has moved at least 3 feet (0.9 m), approximately 1.5 *Tiles*, from the affected *Robot(s)*.

- c) A *Disabled Robot In* the opposing *Alliance's Backstage* remains eligible for all *Penalties* associated with <GS08>. This is an explicit exception to rule <G07>.
- d) *Robots located In Tile* rows 1, 2, or 3 may not *Score* into the *Backstage* or *Backdrop*. Each violation will receive a *Minor Penalty*.

<GS09> Wing Constraints –

- a) A *Robot* may not impede or obstruct an opposing *Alliance Robot* that is *In* the corresponding *Alliance's Wing*. Each violation of this rule results in an immediate *Minor Penalty*.
- b) *Robots* may not be *In* or *Block* access to the opposing *Alliance's Wing*. Once a referee determines this rule is being violated, a *Major Penalty* will be applied. A *Minor Penalty* will be added for every 5 seconds the violation continues. A *Robot* is in violation until it has moved at least 3 feet (0.9 m), approximately 1.5 *Tiles*, from the *Blocked Wing*.
- c) A *Disabled Robot In a Wing* is not considered a safety hazard, therefore *Scoring Elements* may continue to be placed. However, a *Disabled Robot In* the opposing *Alliance's Wing* remains eligible for all *Penalties* associated with <GS09> including escalation to *Yellow Cards*. This is an explicit exception to rule <G07>.
- d) There can be a maximum of six (6) *Pixels In the Wing* at any one time. A *Minor Penalty* will be assessed for each additional *Pixel* beyond the maximum. *Pixels* in the *Possession* of a *Robot* do not count towards this limit.

<GS10> Pixel Constraints – *Pixels* may not be *Propelled*. Each violation of this rule results in a *Minor Penalty*.

<GS11> Drone Constraints –

- a) *Drones* are pre-loaded onto the *Robots during Pre-Match* setup as described in section 4.4.1 or introduced into the *Playing Field* during the *Driver Controlled Period* via the *Wing*.
- b) A *Robot* may not *Possess* a *Drone* provided by another *Team*. A *Major Penalty* will be assessed for violating this rule.
- c) *Drones Launched* before the *End Game* have zero (0) *Score* value.
- d) *Drones* may be *Launched* from *Suspended Robots*.
- e) For each scoring attempt (*Launch, fly, land*), a *Launched Drone* must pass over a *Rigging* or top pole of the *Stage Door* before it is eligible to *Score* points.
- f) To *Score* a *Drone*, the *Drone* must be in a legal configuration. Altering a *Drone* after inspection or during *Match* play to better the chance of *Scoring* is not in the spirit of this rule and will not be considered a *Scored Drone*.
- g) *Drone Interference*:
 - i. A *Robot* may not affect the flight of an opposing *Alliance's Drone* that is flying at a height above the height of the *Playing Field Wall*, approximately 11.5 inches (295 mm). The *Drone* that is affected will be awarded *Landing Zone 1* points.
 - ii. Contact between two or more *Drones* in flight or *In a Landing Zone* is not penalized.

- iii. Drive Teams may not directly or indirectly affect the flight of a Drone. Affecting an opposing Alliance Drone will result in that Drone earning Landing Zone 1 points. Affecting their own Drone's flight results in no points for that Drone.
- iv. A Drone that contacts field personnel In a Landing Zone is awarded Landing Zone 1 Score value regardless of the final Parking location.
- v. A Drone that contacts field personnel that are Outside a Landing Zone or any object Outside the Playing Field has zero Score value regardless of the final Parking location.

h) Drones must be Parked Completely Outside the Playing Field Perimeter to be eligible to Score points.

<GS12> Human Player Constraints – Each violation of this rule results in a Minor Penalty.

- a) Drones and Pixels In the Pixel Storage Area may not be handled until after the Match has begun with the exception of the Pre-Load Scoring Elements.
- b) Drones and Pixels may be placed or dropped only In the Wing and only during the Driver-Controlled Period. Drones and Pixels can be in any orientation and may be in contact with other Drones or Pixels In the Wing.
- c) Human Players may place a maximum of two (2) Pixels or one (1) Drone In a Wing at a time.
- d) Once a Pixel or Drone has been placed in the Wing, a Human Player may not pick it up or reposition it.
- e) Human Players may not Propel Pixels or Drones Out of the Wing.

Human Players should take care when releasing Scoring Elements into the Wing. The final resting place of the Pixel or Drone is the responsibility of the Human Player, regardless of what the Pixel or Drone hits as it is released.

- f) The Human Player may enter the area between the Human Player Station and the adjacent Playing Field Wall while placing a Pixel or Drone In the Wing, provided that it is done safely.
- g) The Human Player may not use tools or devices (including another Pixel) to manipulate a Pixel or Drone. Accommodations and exceptions for Human Players with disabilities or extenuating circumstances will be made at the discretion of the Tournament Director.
- h) For safety reasons, a Human Player cannot break the vertical plane of the Playing Field Perimeter or hand-deliver a Pixel or Drone to the Playing Field when there is a Robot In the Wing. A Disabled Robot In an Alliance Wing is not considered a safety hazard to the Human Player, therefore Drones and Pixels may continue to be placed.
- i) A Robot cannot enter the Wing while a Human Player is In the Wing.

The intent of this rule is to prevent Robot to human contact and is meant to ensure Human Player safety.

<GS13> Truss/Stage Door Safety – Drive Teams may never step/jump over any section of the Truss and/or Stage Door. The first instance will result in a Warning to the Team. Subsequent violations at a competition will result in a Yellow Card. Further violations beyond will be addressed per <G30>.

4.6 Scoring Summary

The following table shows the possible *Scoring* achievements and their point values. The table is a quick reference guide and not a substitute for a thorough understanding of the game manual. All achievements are *Scored at Rest*, except for *Robot* location during *End Game*, which is scored at *End of the Period*.

Scoring Achievement	Autonomous Points	Driver-Controlled Points	End Game Points	Reference
<i>Navigating: Robot Parked In Backstage</i>	5			4.4.2
<i>Placement: Pixel placed On their Alliance's Backdrop</i>	5			4.4.2
<i>Placement: Pixels placed In their Alliance's Backstage</i>	3			4.4.2
<i>Randomization: Purple Pixel placed on the designated Spike Mark using white Pixel</i>	10			4.4.2
<i>Randomization: Yellow Pixel placed On their Alliance's designated Backdrop location using white Pixel</i>	10			4.4.2
<i>Randomization: Purple Pixel placed On the designated Spike Mark using Team Prop</i>	20			4.4.2
<i>Randomization: Yellow Pixel placed On their Alliance's designated Backdrop location using Team Prop</i>	20			4.4.2
<i>Placement: Pixels placed In their Alliance's Backstage</i>		1		4.4.3
<i>Placement: Pixels placed On their Alliance's Backdrop</i>		3		4.4.3
<i>Artist Bonus: Completed Mosaic</i>		10		4.4.3
<i>Set Bonus: Scored Pixel extend In a Backdrop Set Line</i>		10		4.4.3
<i>Robot Location: Robot Suspended from Rigging</i>			20	4.4.4
<i>Robot Location: Robot Parked In the Backstage</i>			5	4.4.4
<i>Drone Launch</i>				4.4.4
<i>Zone 1</i>			30	
<i>Zone 2</i>			20	
<i>Zone 3</i>			10	

4.7 Rule Summary

The following table shows the possible rule violations and their consequences. The table is a quick reference guide and not a substitute for a thorough understanding of the complete rule descriptions in section 4.5.

Rule #	Rule	Consequence	Warning Disable	Minor Penalty	Major Penalty	Card Issued
Safety Rules						
<S01>	Unsafe Robot or Damage to the <i>Playing Field</i> .	<i>Disable</i> if unsafe operation is likely to persist. Optional <i>Yellow Card</i> . Significant damage and/or delays may escalate to <i>Red Card</i> .	D*			YC* RC*
<S02>	Contact <i>Outside the Playing Field</i> .	Immediate <i>Yellow Card</i> and Optional <i>Disable</i> unless allowed by rule.	D*			YC
<S03>	<i>Drive Team</i> missing safety gear.	<i>Warning</i> and if not resolved within 30 seconds, the offending member(s) of the <i>Drive Team</i> must leave the <i>Competition Area</i> and may not be replaced.	W	1x		
<S04>	<i>Competition Area</i> entry or exit rule violated.	<i>Warning</i> and subsequent violations result in a <i>Yellow Card</i> .	W			YC*
General Rules – Further definitions, no Penalties earned						
<G01>	Autonomous to <i>Driver-Controlled Period</i> transition.					
<G02>	Certifying the Score at <i>End of the Match</i> .					
<G03>	Forcing an opponent to break a rule.	<i>Penalty</i> points not given to <i>Robot</i> or <i>Alliance</i> forced to break a rule.				
<G04>	<i>Scoring Elements Controlled or Possessed</i> are part of the <i>Robot</i> except for <i>Robot</i> location.					
<G05>	<i>Robot</i> or <i>Scoring Element</i> in two or more <i>Scoring Areas</i> .	<i>Robot</i> or <i>Scoring Element</i> eligible for two or more <i>Scoring</i> achievements earn points only for highest achievement value.				
<G06>	<i>Scoring Elements</i> in contact with <i>Robots</i> .	Points are not earned for any <i>Scoring Elements</i> in a <i>Scoring Area</i> in contact with <i>Robots</i> of the corresponding <i>Alliance</i> except as outlined in GS rules.				
<G07>	<i>Disabled Robot</i> eligibility.	<i>Disabled Robots</i> do not earn points. <i>Penalties</i> do not apply to <i>Disabled Robots</i> except as outlined in GS rules.				
<G08>	<i>Playing Field Tolerances</i> .					
<G09>	<i>Match Replay</i> .					

Rule #	Rule	Consequence	Warning Disable	Minor Penalty	Major Penalty	Card Issued
<G10>	<i>Inadvertent and Inconsequential.</i>	<i>Inadvertent and Inconsequential</i> rule violations are not <i>Penalized</i> at head referee discretion.				
General Rules – Pre-Match and Post-Match Penalties						
<G11>	<i>Drive Team</i> using disallowed electronic communication.	<i>Warning</i> followed by a <i>Minor Penalty</i> .	W	1x		
<G12>	<i>Measure, test, or adjust Game Elements. Playing Field</i> inspection to determine <i>Score</i> .	<i>Minor Penalty</i> for pre- <i>Match</i> or post- <i>Match</i> violations. <i>Major Penalty</i> if delay start of <i>Match</i> . <i>Yellow Card</i> if outside of normal <i>Match</i> play.		1x	1x	YC
<G13>e	<i>Pre-Match Robot placement.</i>	<i>Minor Penalty</i> if <i>Teams</i> delay the start of a <i>Match</i> . <i>Major Penalty</i> for a significant delay.		1x	1x*	
<G14>	<i>Robot starting volume.</i>	<i>Robot</i> is removed from the <i>Playing Field</i> if not resolved within 30 seconds.				
<G15>	<i>Robot setup alignment devices/Match delay.</i>	<i>Minor Penalty</i> for each offense.		1x		
<G16>b	<i>Drive Team member(s)</i> leaving the <i>Alliance Station</i> .	<i>Warning</i> for the first instance with any following instances resulting in a <i>Minor Penalty</i> .	W	1x		
<G16>c	<i>Drive Teams</i> distracting and/or interfering with each other or the off- <i>Field Scoring Elements</i> .	Immediate <i>Major Penalty</i> and a possible <i>Yellow Card</i> .			1x	YC*
<G16>d	<i>Drive Teams</i> may only sit, stand, or kneel in <i>Driver Station</i> .	<i>Minor Penalty</i> for each offense. Continued violations considered <i>Egregious</i> .		1x	1x*	YC* RC* DQ*
<G17>	<i>Post-Match removal of Robots</i> causes a delay or damage to the <i>Playing Field</i> .	A <i>Minor Penalty</i> will be assessed.		1x		
General Rules – Gameplay Penalties						
<G18>	Starting <i>Gameplay</i> early.	<i>Minor Penalty</i> with the option of a <i>Major Penalty</i> if the early start results in a competitive advantage for the offending <i>Alliance</i> .		1x	1x*	
<G19>	Late start of the <i>Autonomous Period</i> .	<i>Minor Penalty</i> with the option of a <i>Major Penalty</i> if the late start results in a competitive advantage for the offending <i>Alliance</i> .		1x	1x*	

Rule #	Rule	Consequence	Warning Disable	Minor Penalty	Major Penalty	Card Issued
<G20>	<i>Robot is not Parked at the end of period.</i>	<i>Minor Penalty</i> and the actions of the <i>Robot</i> that occur after the end of <i>gameplay</i> do not count towards their <i>Alliance's Score</i> . <i>Major Penalty</i> if the late stop results in a competitive advantage for the offending <i>Alliance</i> .		1x	1x*	
<G21>	<i>Robot control during Autonomous Period / early stopping of the Autonomous code.</i>	<i>Major Penalty</i> . Achievements earned during that time result in zero <i>Score</i> .			1x	
<G22>	<i>Drive Team contact with the Playing Field, Game Element, or Robot.</i>	<i>Warning</i> for the first instance with any following instances resulting in a <i>Minor Penalty</i> . Optional <i>Yellow Card</i> if contact affects <i>Scoring</i> and/or <i>gameplay</i> .	W	1x		YC*
<G23>	<i>Drive Team Coach Driver Station control.</i>	<i>Warning</i> for the first instance with any following instances resulting in a <i>Major Penalty</i> .	W		1x	
<G24>	<i>Robots deliberately detaching parts.</i>	<i>Minor Penalty</i> . <i>Major Penalty</i> and a <i>Yellow Card</i> if it affects <i>gameplay</i> .		1x	1x	YC
<G25>	<i>Robots illegally Grasping Game Elements.</i>	<i>Warning</i> for the first instance with any following instances resulting in a <i>Major Penalty</i> except as outlined in GS rules.	W		1x	
<G26>	Destruction, damage, tipping, etc.	Deliberate or chronic violations of this rule will receive a <i>Major Penalty</i> and a <i>Yellow Card</i> .			1x	YC
<G27>	Deliberately removing <i>Game Elements</i> from the <i>Playing Field</i> .	<i>Minor Penalty</i> per <i>Game Element</i> deliberately removed from the <i>Playing Field</i> except as outlined in GS rules.		1x		
<G28>	<i>Pinning, Trapping, or Blocking.</i>	Once rule is violated, a <i>Minor Penalty</i> is assessed for every five seconds the <i>Robot</i> violates this rule.		1x+		
<G29>	<i>Illegal Use of Game Elements</i> to ease or amplify <i>Scoring</i> .	<i>Major Penalty</i> will be assessed with any following instances resulting in a <i>Yellow Card</i> .			1x	YC
<G30>	Egregious behavior.	<i>Major Penalty</i> plus a <i>Yellow</i> and/or <i>Red Card</i> . Possible <i>Match Disqualification</i> . Subsequent violations may result in <i>Team Disqualification</i> for the competition.			1x	YC RC DQ
Game-Specific Rules – Gameplay Penalties						
<GS01>	General Game rule exceptions.					
<GS02>	<i>Drive Teams</i> touching <i>Robot</i> or <i>Driver Station</i> after <i>Randomization</i> .	<i>Minor Penalty</i> and <i>Robot</i> not eligible for <i>Autonomous</i> tasks.		1x		

Rule #	Rule	Consequence	Warning Disable	Minor Penalty	Major Penalty	Card Issued
<GS03>a	Interfering with opposing <i>Alliance Robot</i> <i>In the opposing Alliance's half of the Playing Field.</i>	<i>Major Penalty</i> for each offense.			1x	
<GS03>b	Interfering with <i>Randomization Task setup or Scoring.</i>	<i>Major Penalty</i> for each offense.			1x	
<GS03>c	Moving pre-placed white <i>Pixel</i> stacks in opposing <i>Alliance</i> half of the <i>Playing Field.</i>	<i>Major Penalty</i> when <i>Pixels</i> impact or impede opposing <i>Alliance's Autonomous Period Scoring</i> actions.			1x	
<GS04>a	Descoring.	<i>Minor Penalty</i> for each <i>Pixel</i> descored.		1x		
<GS04>b	Descoring <i>Pixels</i> from <i>Backdrop.</i>	Additional <i>Minor Penalty</i> assessed for each affected completed <i>Mosaic</i> and/or <i>Set Line.</i>		1x		
<GS05>a	Control of more <i>Scoring Elements</i> than allowed.	<i>Minor Penalty</i> for each <i>Scoring Element</i> above the limit plus additional <i>Minor Penalty</i> per <i>Scoring Element</i> above the limit every 5 sec.		1x+		
<GS05>b	Scoring a <i>Pixel</i> while <i>Controlling</i> more <i>Scoring Elements</i> than allowed.	<i>Minor Penalty</i> for each <i>Pixel Scored</i> while in possession of more than the allowed <i>Scoring Elements.</i>		1x		
<GS06>a	<i>R</i> obots may only <i>G</i> rasp one <i>R</i> igging for the corresponding <i>A</i> lliance.	Zero Score value for the <i>Suspend</i> task.				
<GS06>b	<i>R</i> obots may not <i>G</i> rasp or <i>S</i> uspend from any other part of the <i>T</i> russ structure.	<i>Minor Penalty</i> per occurrence.		1x		
<GS06>c	Limit of one <i>S</i> upported <i>R</i> obot per <i>R<td><i>Major Penalty</i> for the second <i>R</i>obot.</td><td></td><td></td><td>1x</td><td></td></i>	<i>Major Penalty</i> for the second <i>R</i> obot.			1x	
<GS06>d	Impeding or obstructing an opposing <i>Alliance</i> from <i>Suspending</i> during <i>End Game.</i>	Immediate <i>Major Penalty</i> . Additional <i>Minor Penalty</i> for every 5 seconds the violation continues.		1x+	1x	
<GS06>e	Contact with opposing <i>Alliance Suspended Robot.</i>	<i>Minor Penalty</i> per occurrence to offending <i>Alliance.</i>		1x		
<GS07>a	<i>G</i> rasping the <i>S</i> tage <i>D</i> oor.	<i>Major Penalty</i> for each offense.			1x	
<GS07>b	Preventing <i>S</i> tage <i>D</i> oor from normal operations.	<i>Major Penalty</i> for each offense.			1x	
<GS07>c.i	Disrupting transit of opposing <i>Alliance Robot</i> through <i>Stage Door.</i>	<i>Minor Penalty</i> is assessed for every five seconds the <i>Robot</i> violates this rule.		1x+		YC*

Rule #	Rule	Consequence	Warning Disable	Minor Penalty	Major Penalty	Card Issued
<GS07>c.ii	<i>Robots passing through Stage Door from audience side have transit priority.</i>	<i>Minor Penalty</i> is assessed for every five seconds the <i>Robot</i> violates this rule.		1x+		YC*
<GS08>a	<i>Robot impeding/obstructing opposing Alliance In Backstage/Backdrop.</i>	<i>Minor Penalty</i> for each offense.		1x		
<GS08>b	<i>Block access to opposing Alliance Backstage/Backdrop.</i>	<i>Major Penalty</i> plus an additional <i>Minor Penalty</i> for every five seconds the <i>Robot</i> continues to violate this rule.		1x+	1x	
<GS08>d	<i>Robots Scoring Pixels from Tile rows 1, 2, 3.</i>	<i>Minor Penalty</i> for each offense.		1x		
<GS09>a	<i>Robot impeding/obstructing Robot In its Alliance Wing.</i>	<i>Minor Penalty</i> for each offense.		1x		
<GS09>b	<i>Robot In or Blocking access to opposing Alliance Wing.</i>	<i>Major Penalty</i> plus an additional <i>Minor Penalty</i> for every five seconds the <i>Robot</i> continues to violate this rule.			1x+	
<GS09>d	Exceeding allowed quantity of <i>Pixels</i> in <i>Wing</i> .	<i>Minor Penalty</i> for each <i>Pixel</i> over the maximum of 6 <i>Pixels</i> in <i>Wing</i> .		1x		
<GS10>	<i>Propelling Pixels.</i>	<i>Minor Penalty</i> for each offense.		1x		
<GS11>b	<i>Robot Possess another Team's Drone.</i>	<i>Major Penalty</i> for each offense			1x	
<GS11>g.i	Affecting the flight of an opposing <i>Alliance's Drone</i> above <i>Playing Field Wall</i> .	<i>No Penalty</i> points assessed. Opposing <i>Alliance Drone</i> receives points for <i>Landing Zone 1</i> .				
<GS11>g.iii	<i>Drive Team</i> affects the flight of a <i>Drone</i> .	Affected opposing <i>Alliance Drone</i> receives <i>Landing Zone 1</i> points. Affecting own <i>Alliance's Drone</i> results in no <i>Score</i> value for the <i>Drone</i> .				
<GS11>h	<i>Drones Parked</i>	<i>Drones</i> must <i>Park Completely Outside</i> of the <i>Playing Field Perimeter</i> to <i>Score</i> .				
<GS12>a	<i>Scoring Elements</i> in <i>Pixel Storage</i> may not be handled until start of <i>Match</i> .	<i>Minor Penalty</i> for each offense.		1x		
<GS12>b	<i>Human Players</i> may only place <i>Pixels</i> or <i>Drones</i> in <i>Wing</i> during <i>Driver-Controlled Period</i> .	<i>Minor Penalty</i> for each offense.		1x		
<GS12>c	Placing more than 2 <i>Pixels</i> or more than 1 <i>Drone</i> in the <i>Wing</i> at a time.	<i>Minor Penalty</i> for each offense.		1x		

Rule #	Rule	Consequence	Warning Disable	Minor Penalty	Major Penalty	Card Issued
<GS12>d	Repositioning already placed <i>Scoring Elements</i> in <i>Wing</i> .	Minor Penalty for each offense.		1x		
<GS12>e	<i>Propelling Pixels or Drones Out of the Wing.</i>	Minor Penalty for each offense.		1x		
<GS12>g	Using tools to place <i>Pixels or Drones</i> .	Minor Penalty for each offense.		1x		
<GS12>h	<i>Human Player</i> cannot break the vertical plane of the <i>Playing Field Perimeter</i> while a <i>Robot</i> is in the <i>Wing</i> .	Minor Penalty for each offense.		1x		
<GS12>i	<i>Robot</i> enters <i>Wing</i> while <i>Human Player</i> is <i>In the Wing</i> .	Minor Penalty for each offense.		1x		
<GS13>	<i>Drive Teams</i> stepping/jumping over <i>Truss</i> or <i>Stage Door</i> .	First instance results in a <i>Warning</i> . Subsequent violations will result in a <i>Yellow Card</i> . Repeated violations may be considered <i>Egregious</i> .	W			YC RD DQ

Table Key

W: <i>Warning</i>	1x: <i>Penalty</i> at single cost
D: <i>Robot Disabled</i>	1x+: <i>Penalty</i> at single cost every 5 seconds
YC: <i>Yellow Card</i> issued	2x: <i>Penalty</i> at double cost
RC: <i>Red Card</i> issued	* Indicates optional
DQ: <i>Disqualification</i>	

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

Part 1 and 2 - <https://www.firstinspires.org/resource-library/ftc/game-and-season-info>

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.

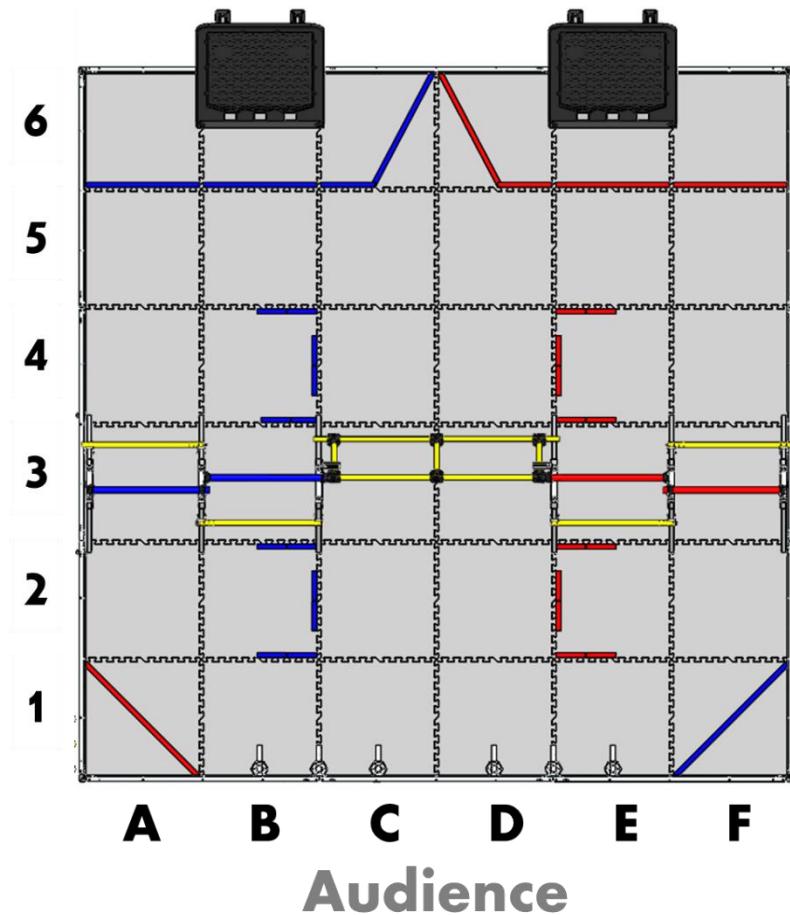
[FIRST Tech Challenge Blog](#) – Weekly articles for the FIRST Tech Challenge community, including outstanding volunteer recognition!

[FIRST Tech Challenge Team Email Blasts](#) – contain the most recent FIRST Tech Challenge news for teams.

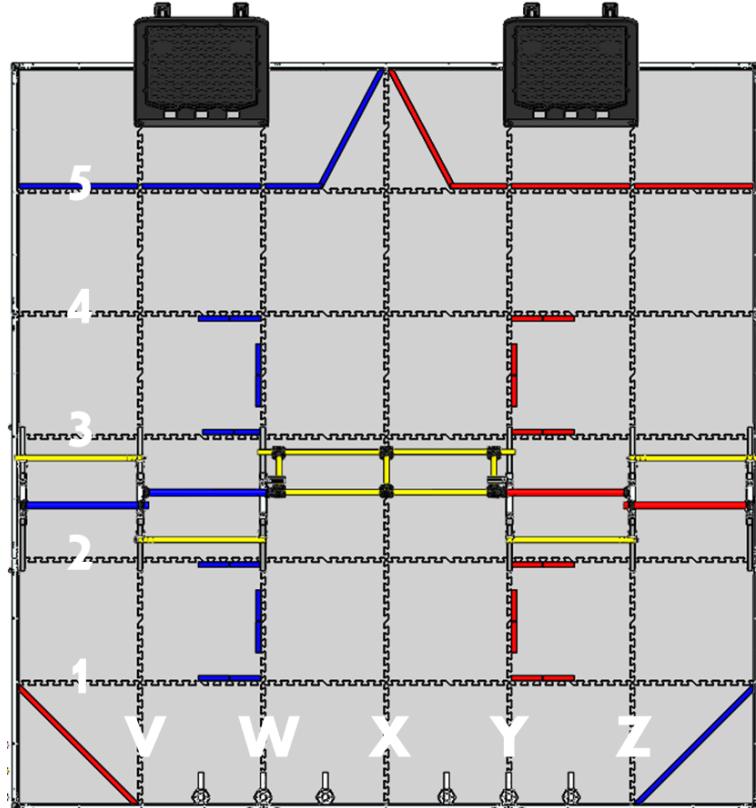
Feedback

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 – Playing Field Locations



B-1 Tile Locations

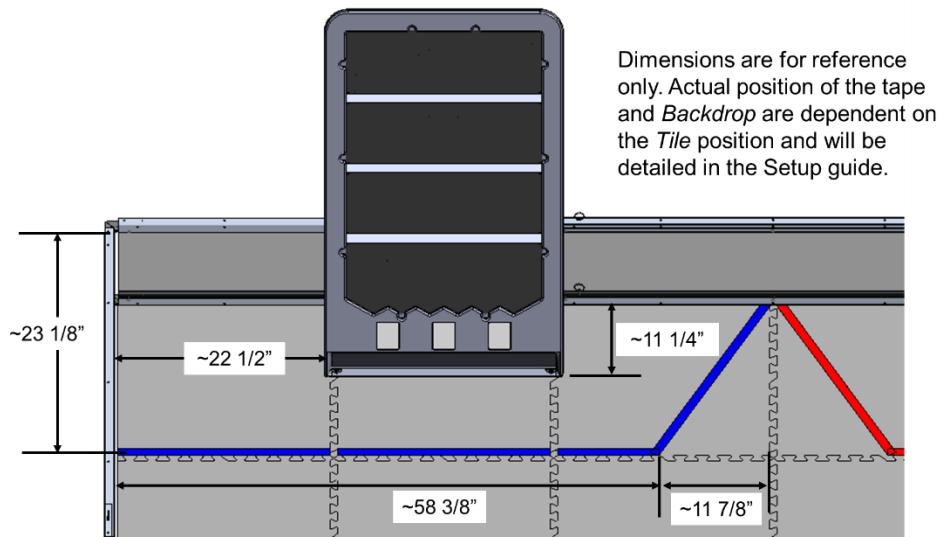


Audience

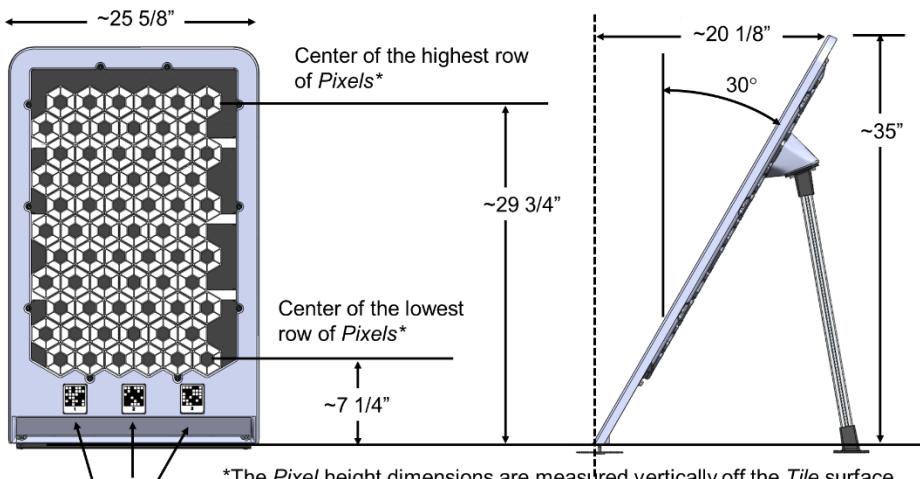
B-2 Intersection Locations

Appendix C – Playing Field Details

Important Note: The measurements in this section are nominal and may vary based on manufacturing and assembly tolerances (including *Tile* and *Playing Field Wall* variances). For critical measurements and *Game Element* placement for field setup and assembly, please reference the AndyMark Field Setup and Assembly Guide. To view individual *Game Element* component measurements, please reference the field CAD file located on AndyMark’s [website](#).

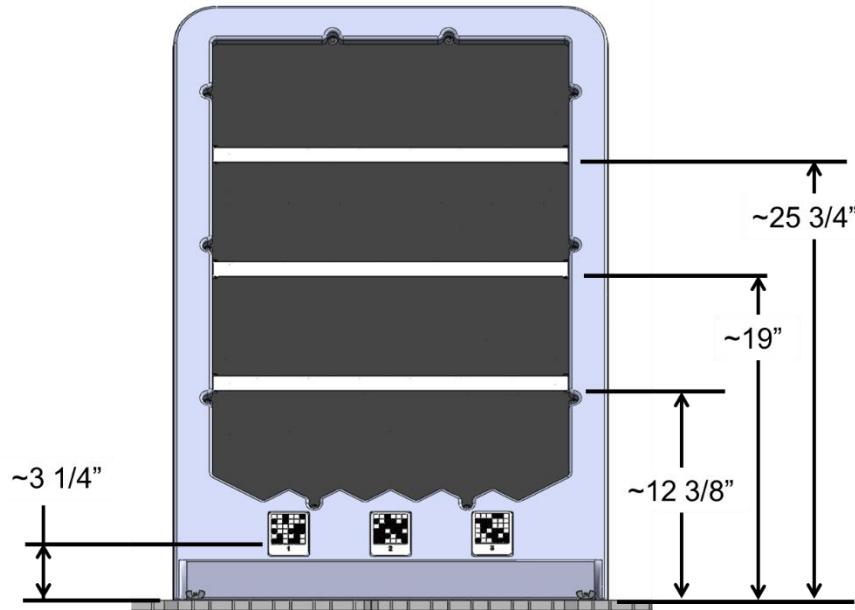


C-1 Backstage and Backdrop locations



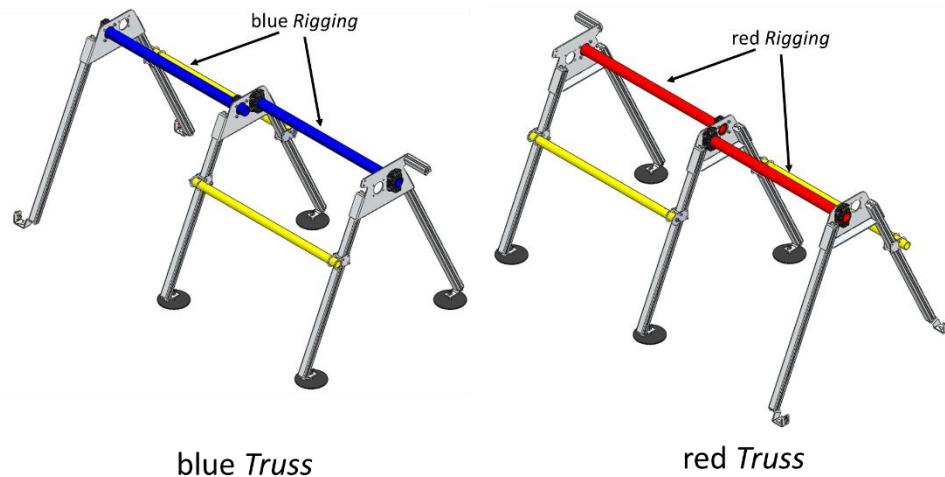
Dimensions are for reference only; actual dimensions may vary slightly from field to field

C-2 Backdrop dimensions

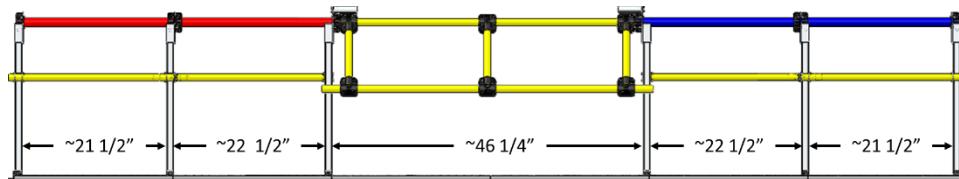


The dimensions are measured vertically off the *Tile* surface.
Dimensions are for reference only. Actual dimensions may vary slightly.

C-3 Backdrop dimensions

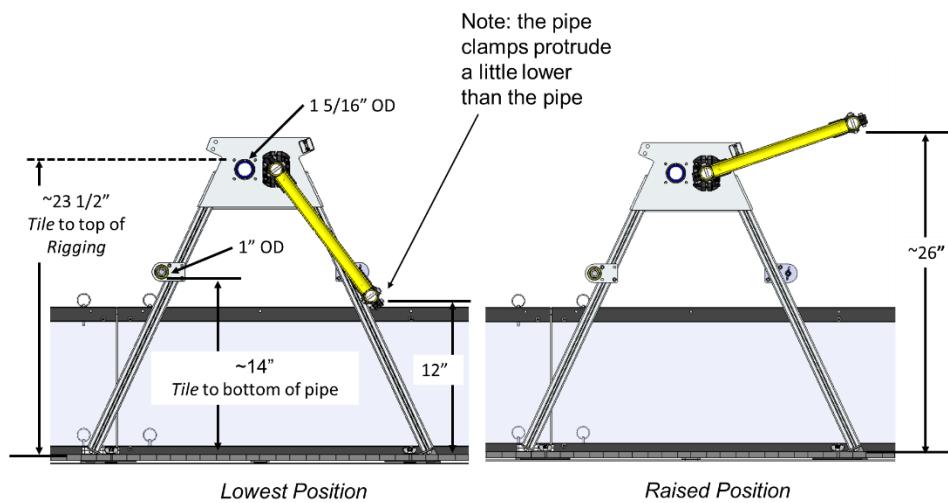


C-4 Truss and Rigging



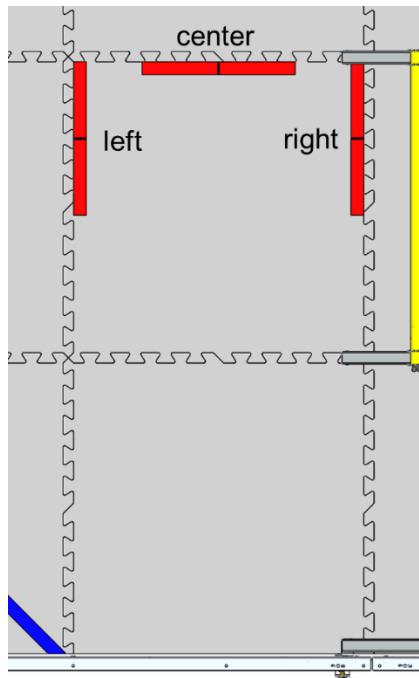
Dimensions are for reference only; actual dimensions may vary slightly from field to field.

C-5 Truss and Stage Door spacing



Dimensions are for reference only; actual dimensions may vary slightly from field to field

C-6 Truss and Rigging



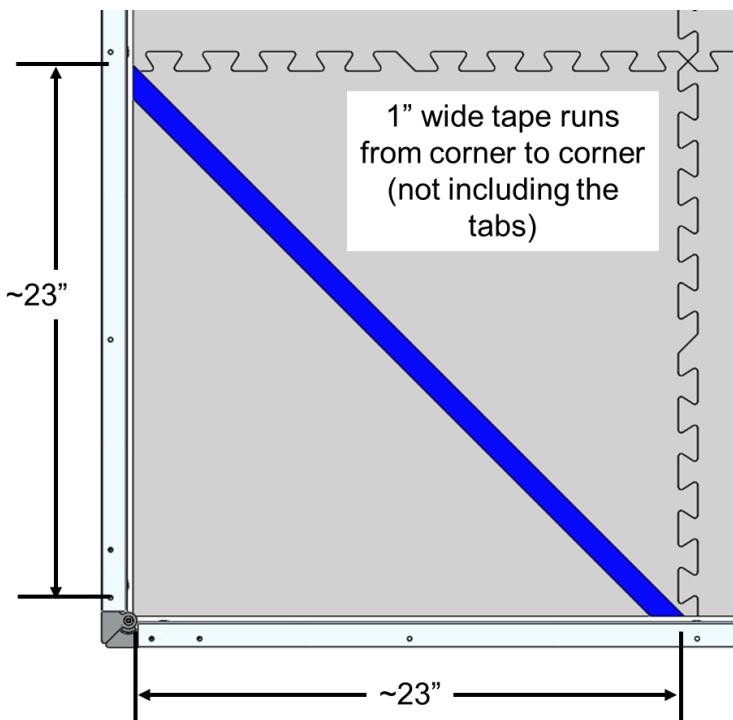
~1 inch wide by 12" long tape strips.

The strips are aligned to the *Tile*, against the root of the tabs.

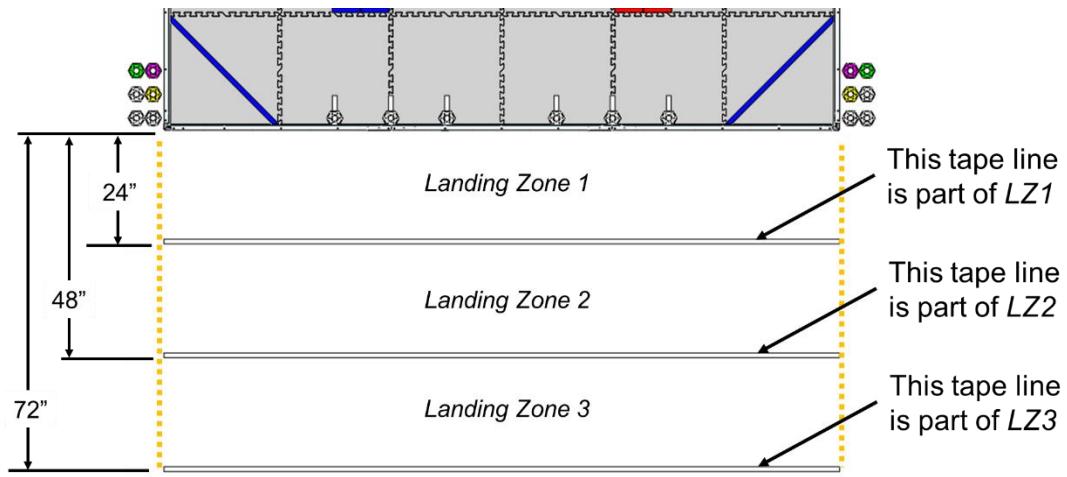
The center strip is centered on the *Tile*

There is a black mark in the center of each strip to indicate the starting position of the *Pixel* or *Team Prop*.

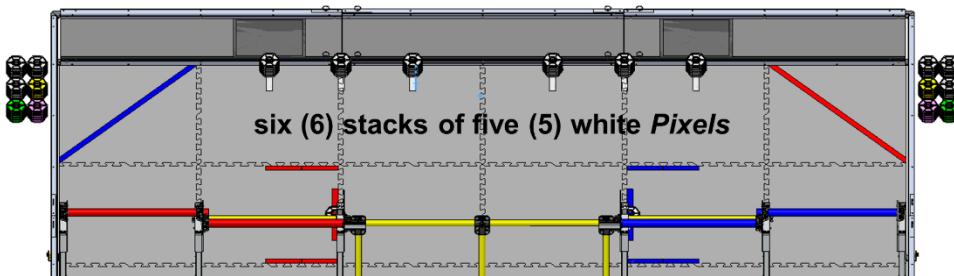
C-7 Spike Marks, typical



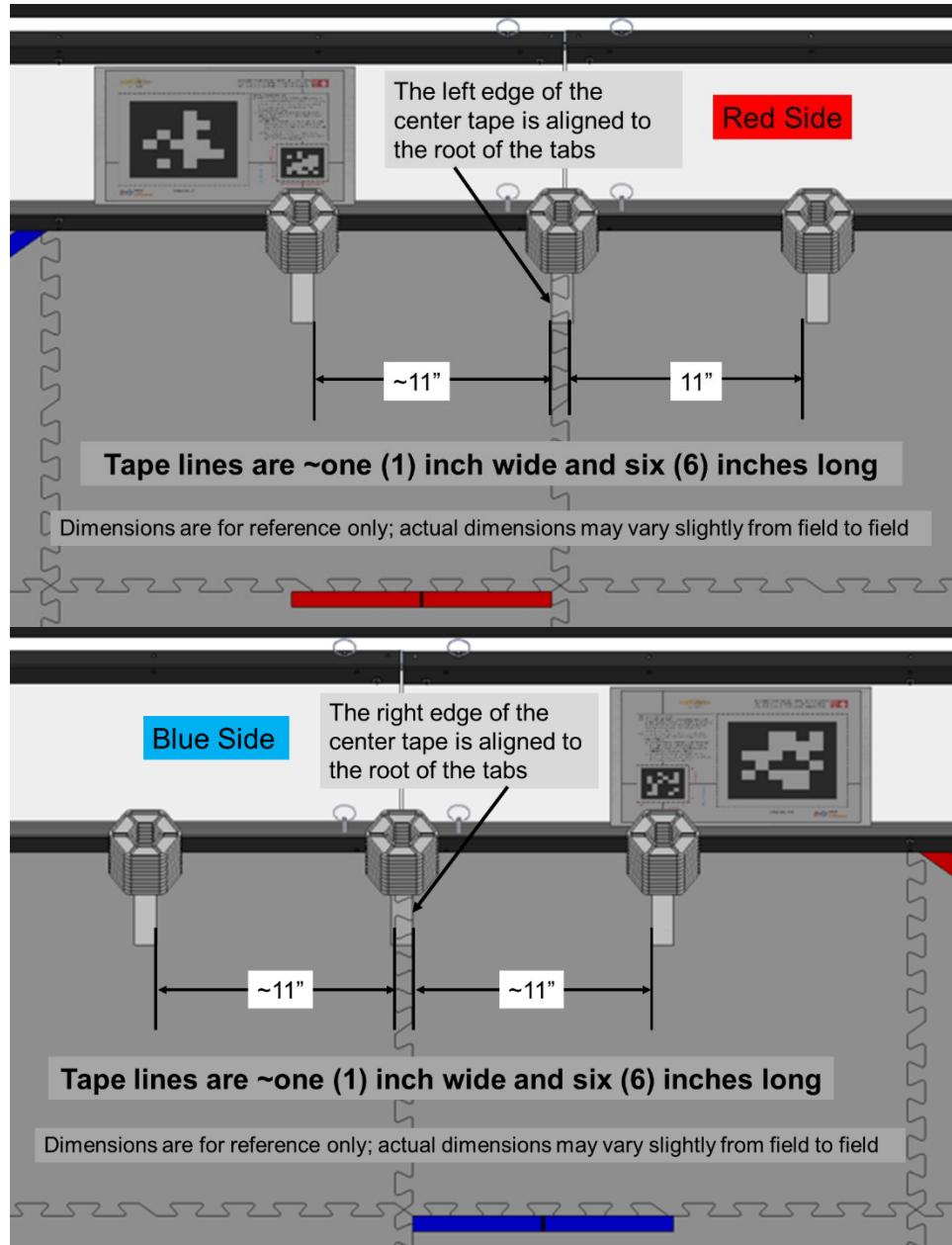
C-8 Wing typical



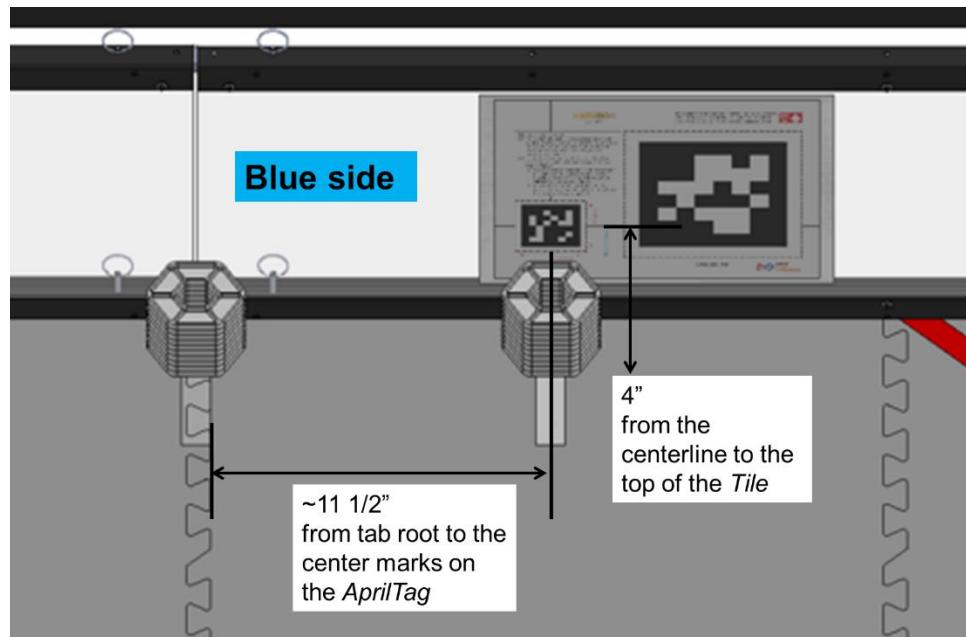
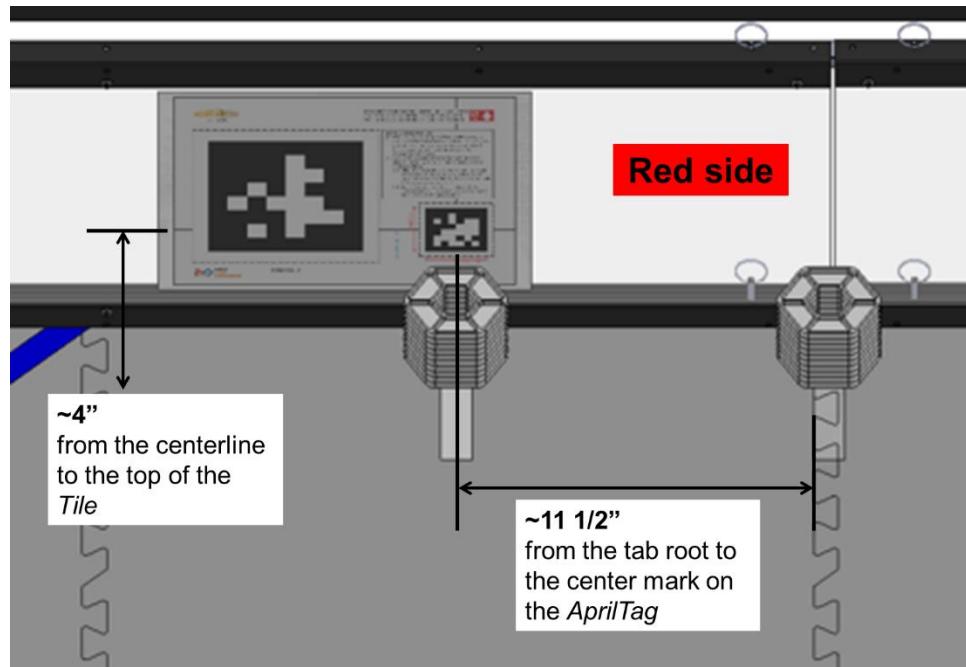
C-9 Landing Zones



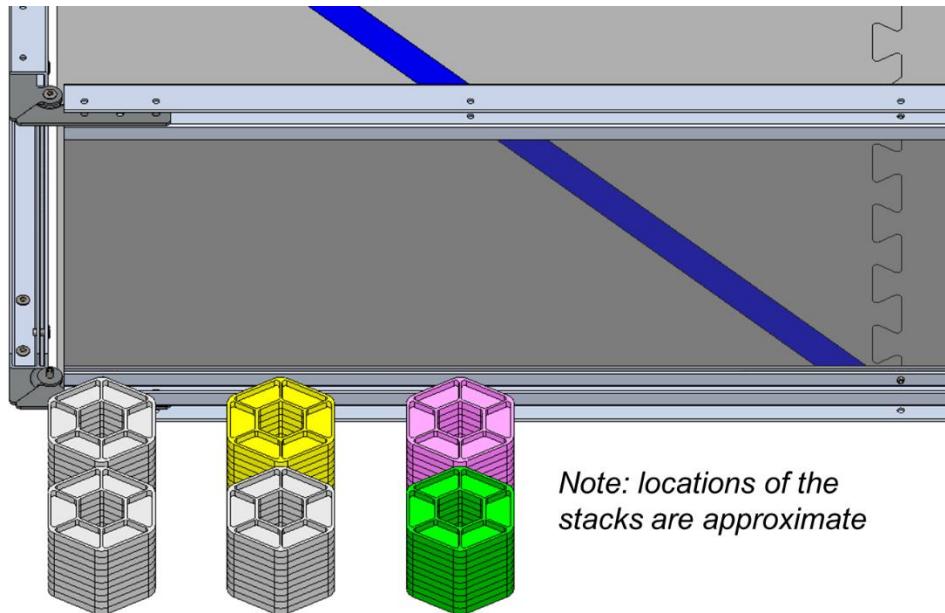
C-10 Pre-Match setup of on-field Pixels



C-11 Pre-Match setup of on-field Pixels – locations



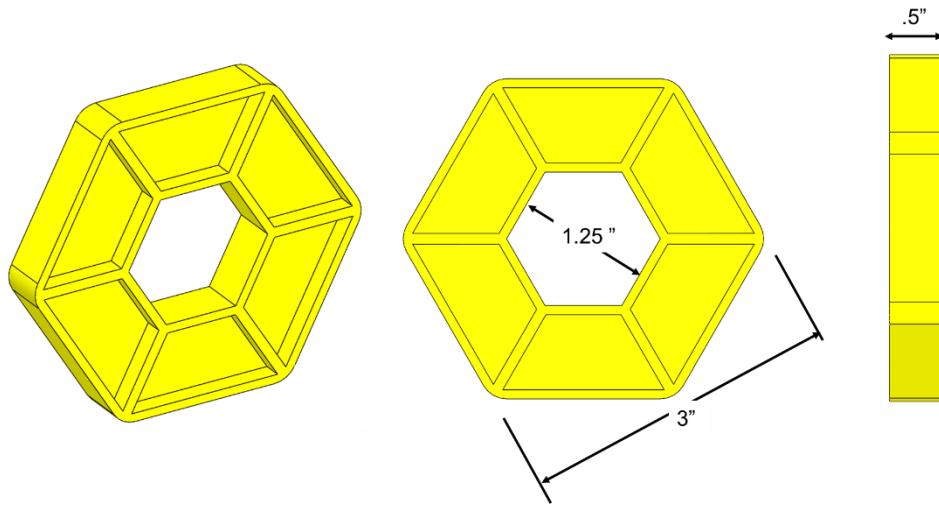
C-12 Location of Wall AprilTags



three (3) stacks of five (5) white *Pixels*
one (1) stack of five (5) purple *Pixels*
one (1) stack of five (5) yellow *Pixels*
one (1) stack of five (5) green *Pixels*

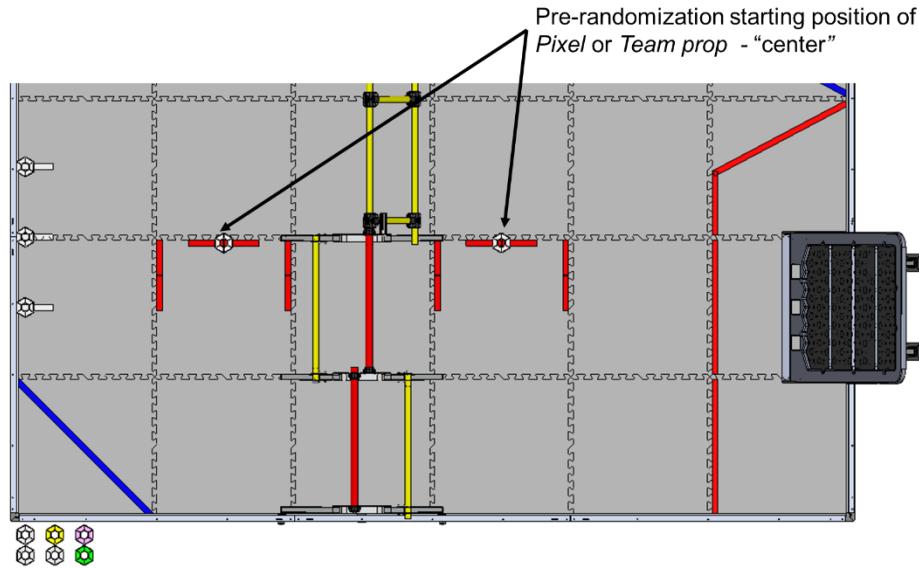
C-13 Pre-Match setup of *Pixel Storage*

Appendix D – Scoring Element

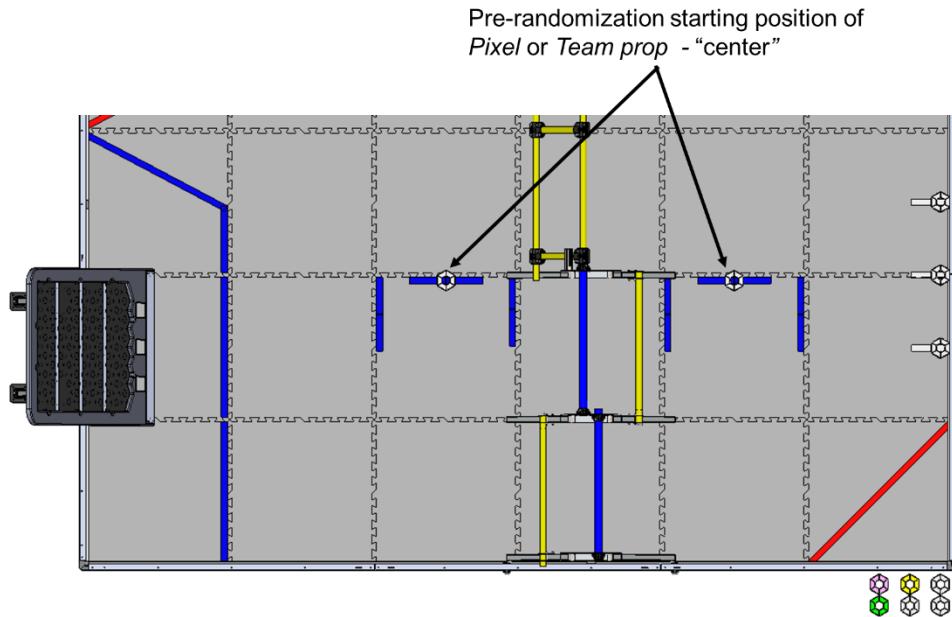


D-1 Pixel

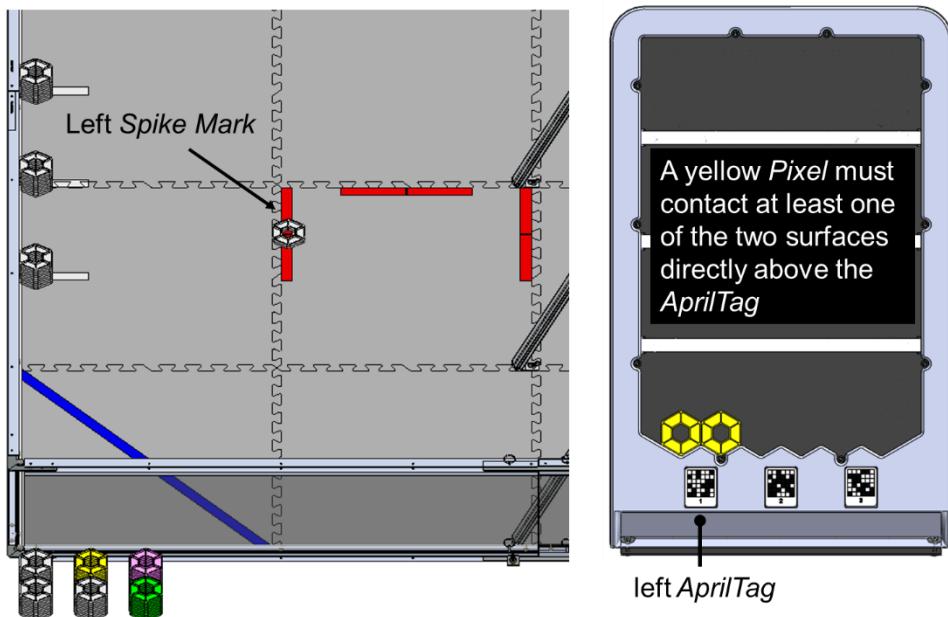
Appendix E – Randomization



E-1 – Randomization Objects – pre-randomization starting positions – red Alliance

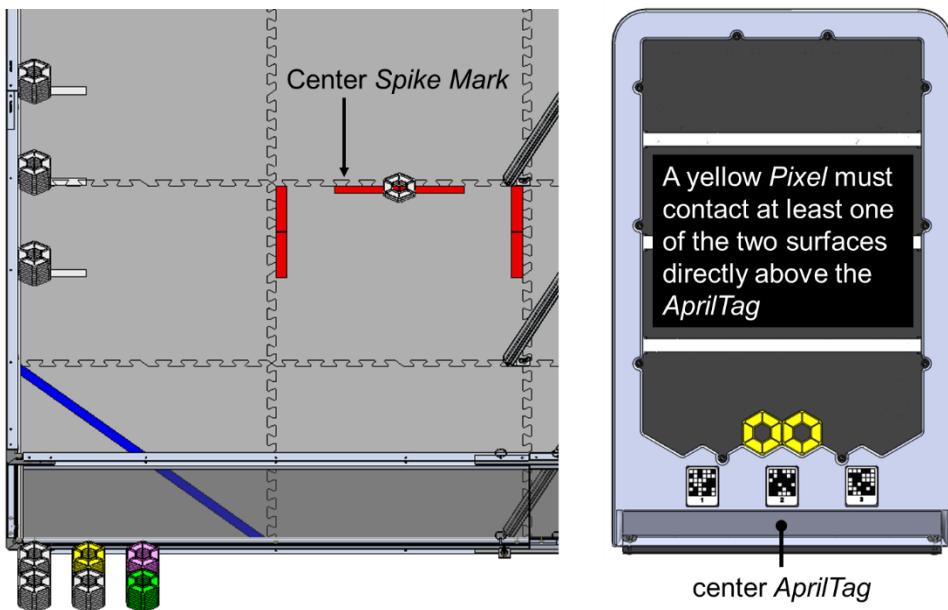


E-2 – Randomization Objects – pre-randomization starting position - blue Alliance



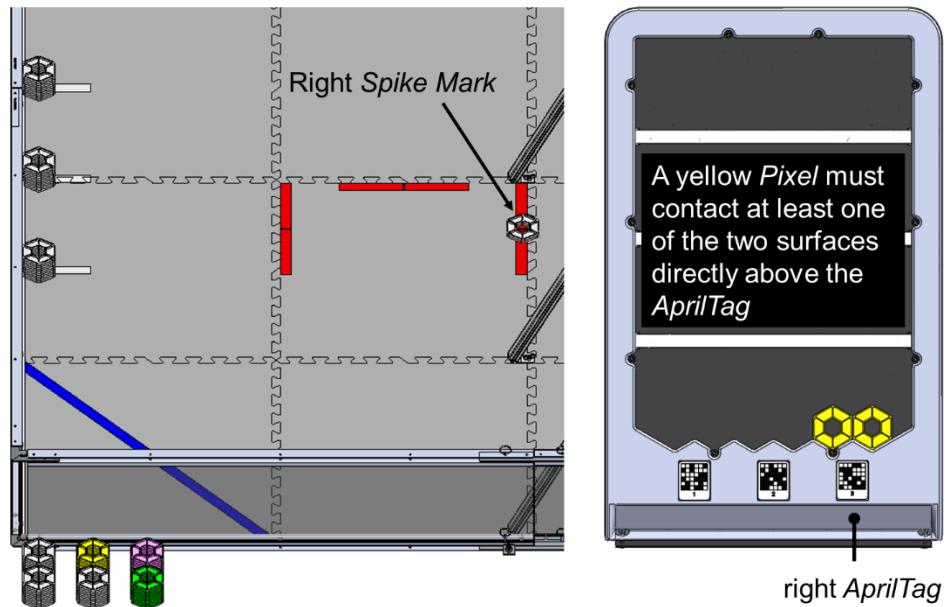
Randomization Object- left side scoring locations

E-3 – left side Scoring



Randomization Object- center scoring locations

E-4 – center Scoring

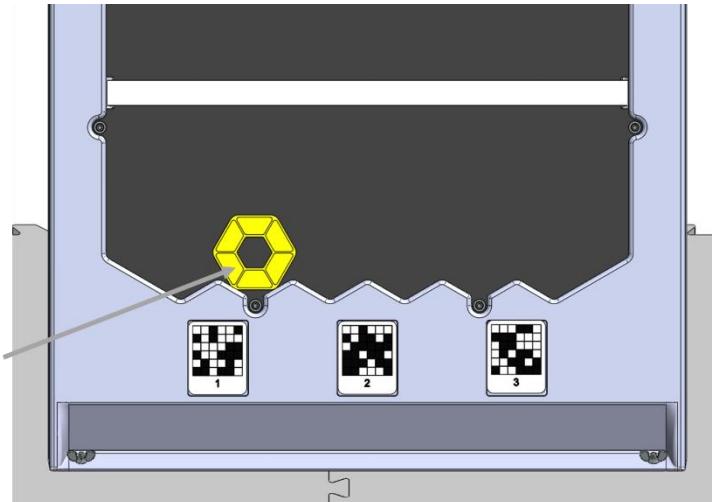


Randomization Object- right side scoring locations

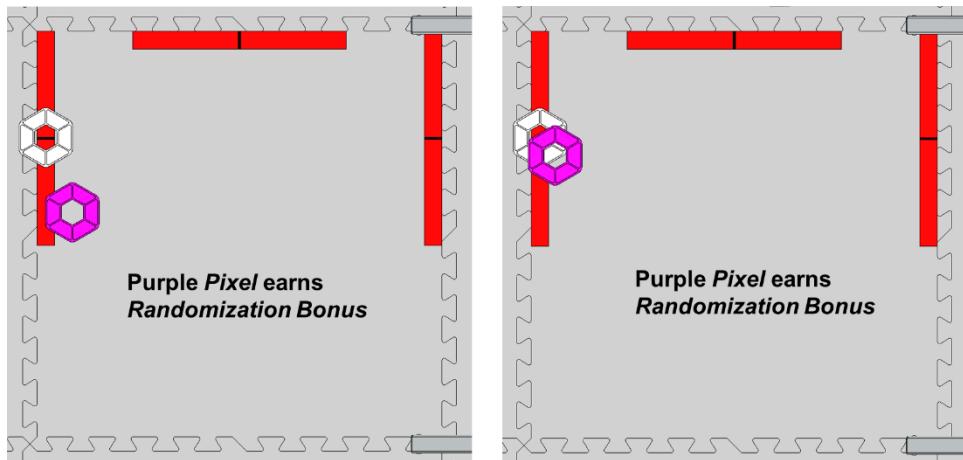
E-5 – right Scoring

During the Autonomous period, the yellow Pixel only has to touch the correct surface (in this example it is the Left randomized position)

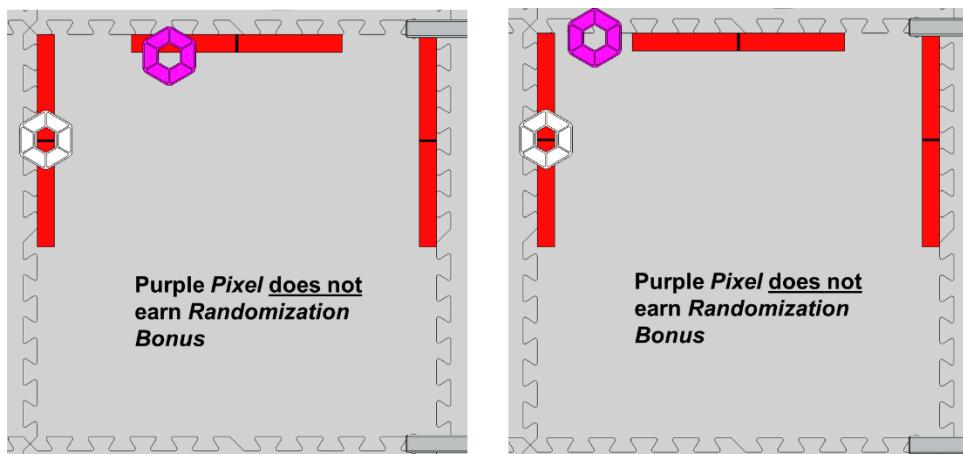
This is a legally scored Pixel and earns the autonomous points



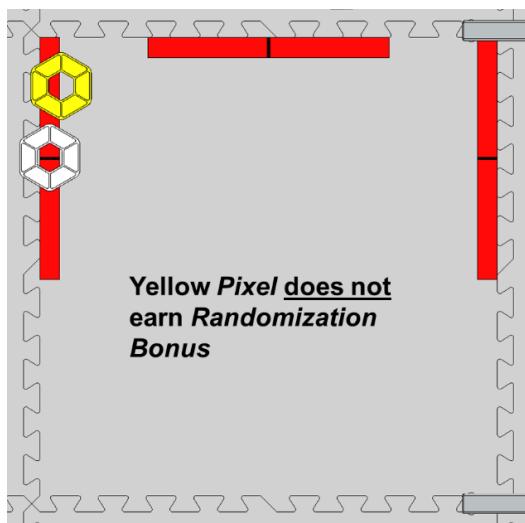
E-6 – Pixel position



E-7 – Scoring Examples

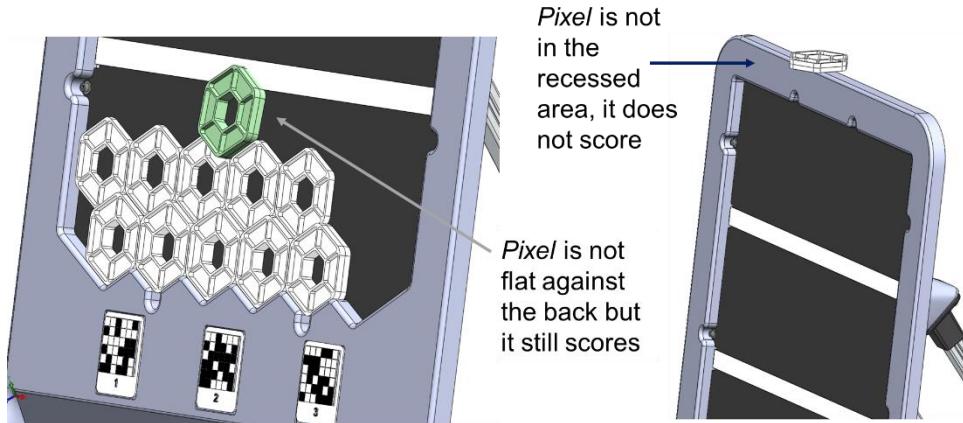


E-8 – Scoring Examples

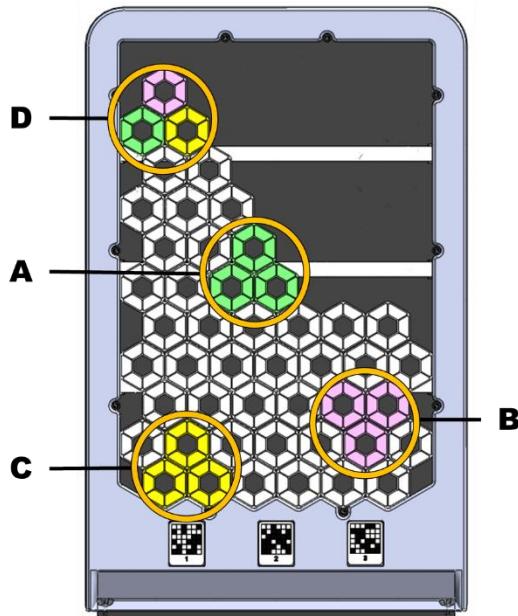


E-9 – Scoring Examples

Appendix F – Scoring Examples



F-1 Pixel Scoring

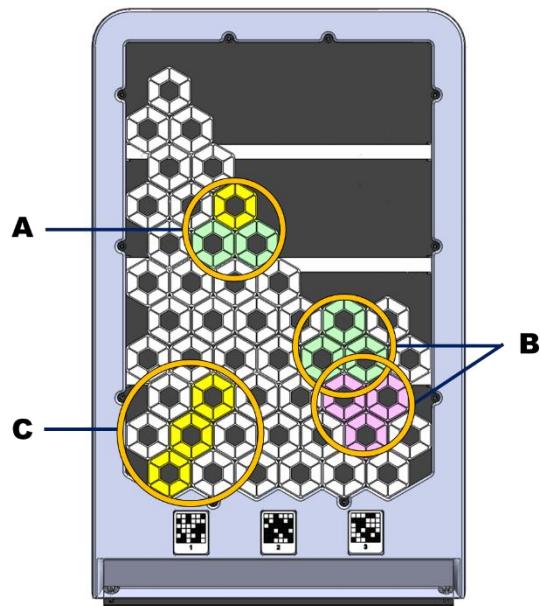


Legal Mosaics:

A, B, C *Mosaic* consists of three (3) non-white *Pixels*, all the same color (all green, all purple or all yellow) and in contact with the other two (2) *Pixels* of that *Mosaic*.

D *Mosaic* consists of three (3) non-white *Pixels*, all different colors (one (1) green, one (1) purple and one (1) yellow) and in contact with the other two (2) *Pixels* of that *Mosaic*.

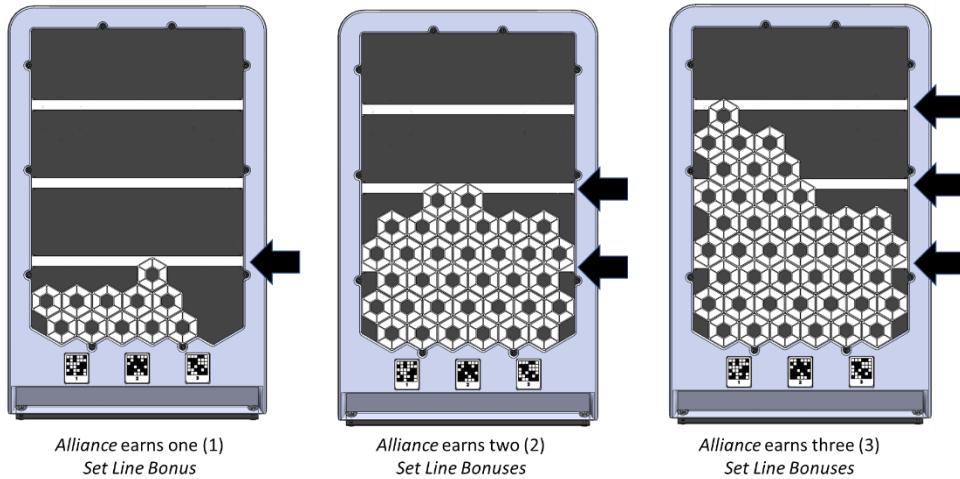
F-2 Mosaics



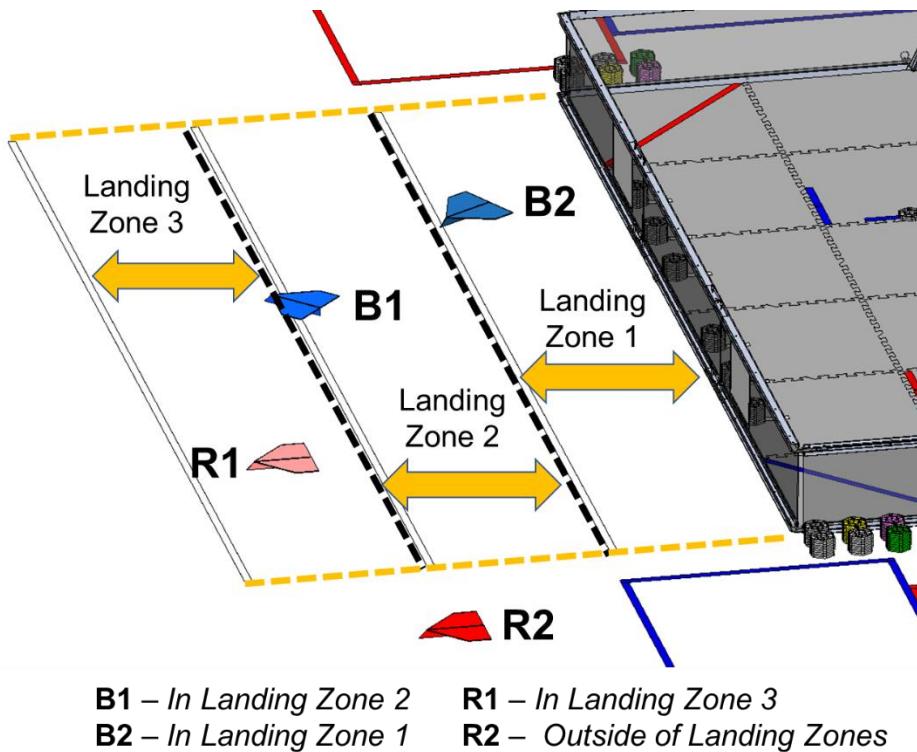
Not legal Mosaics:

- A. A *Mosaic* must consist of three (3) non-white *Pixels*, either all the same color (all green, all purple or all yellow) or each *Pixel* a different color (one (1) green, one (1) purple, and one (1) yellow).
- B. A *Mosaic* cannot be in contact with another non-white *Pixel*.
- C. Each *Pixel* in a *Mosaic* must be in contact with the other two (2) *Pixels* of that *Mosaic*.

F-3 Not Mosaics

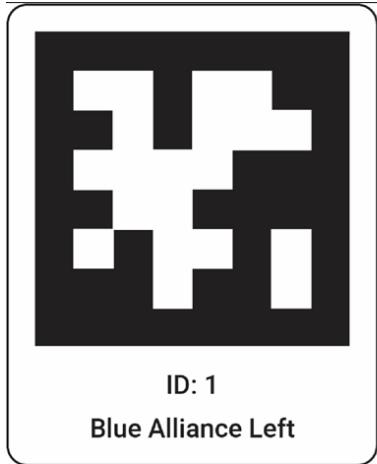


F-4 Set Bonus

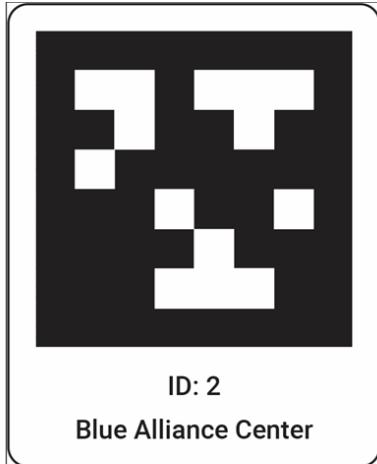


F-5 *Landing Zone Scoring*

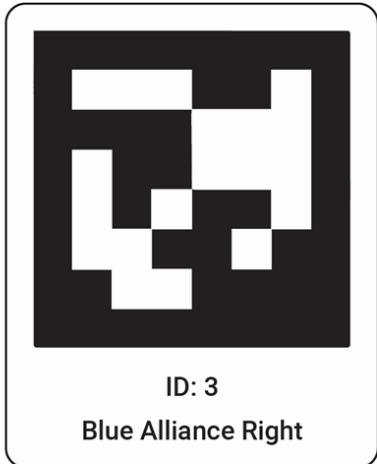
Appendix G – AprilTags



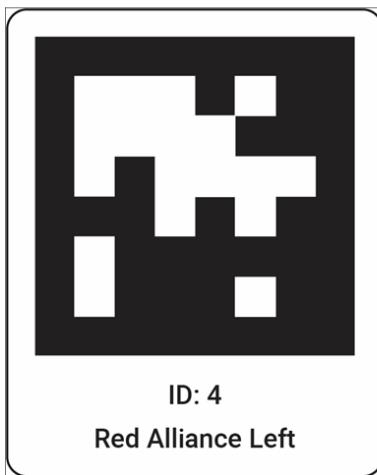
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Blue Alliance Left



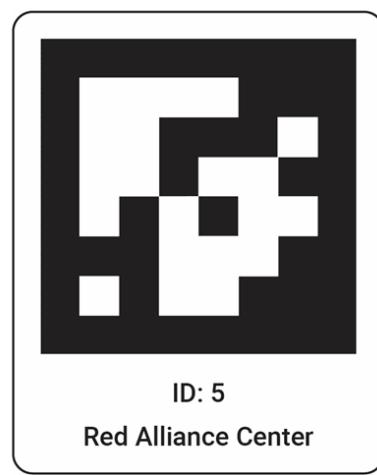
ID: 2
Blue Alliance Center



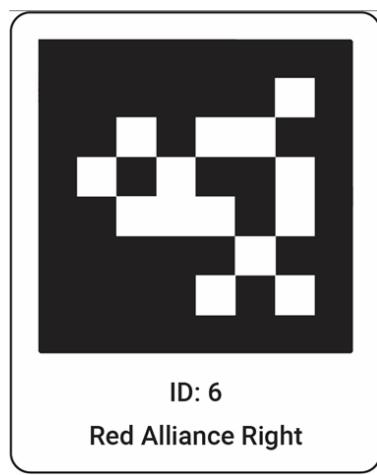
ID: 3
Blue Alliance Right



ID: 4
Red Alliance Left



ID: 5
Red Alliance Center

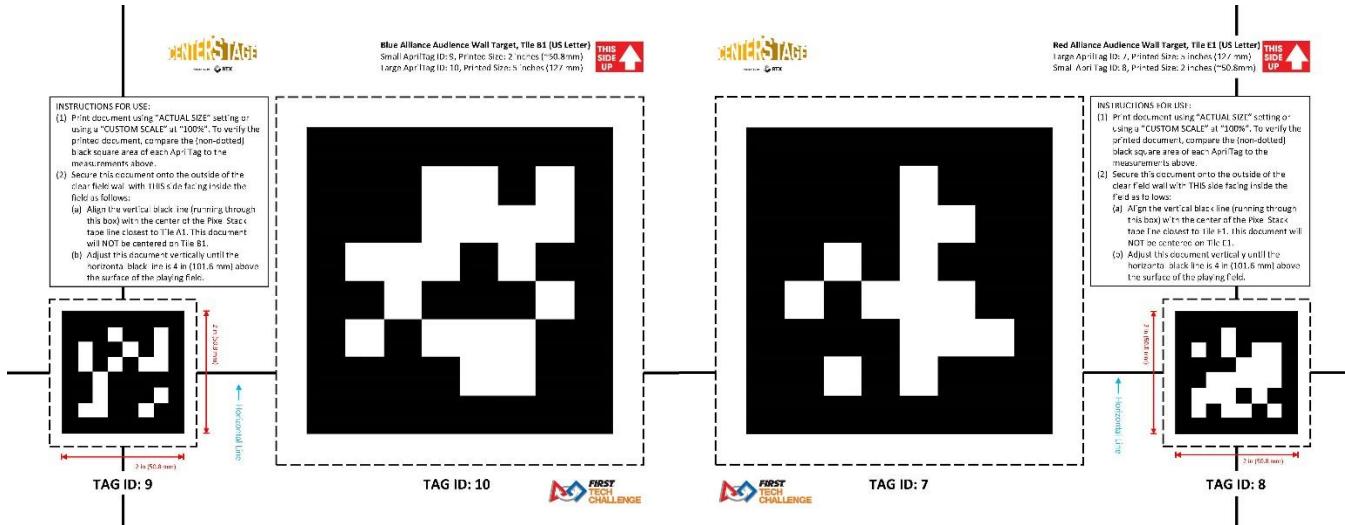


ID: 6
Red Alliance Right

G-1 *AprilTags for Backdrop*

You do not need to print these images if you are purchasing a full field kit from AndyMark. The *AprilTags for the Backdrop* are included in the full and partial field kits.

Do not print the images from this manual for practice purposes, as they are not to the same scale as *Teams* will see in actual competition. Please refer to the [FIRST Tech Challenge Game and Season page](#) for printable versions of these images.



G-2 AprilTags for Playing Field Wall

Do not print the images from this manual for practice purposes, as they are not to the same scale as Teams will see in actual competition. Please refer to the [FIRST Tech Challenge Game and Season page](#) for printable versions of these images.



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2023-2024 FIRST® Tech Challenge

Game Manual Part 1 – Traditional Events

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**Raytheon
Technologies**

Revision History		
Revision	Date	Description
1	7/11/2023	<p>Initial Release</p> <ul style="list-style-type: none"> • Section 6.1 – Clarified advancement criteria from qualifying tournaments • Section 6.2, 9.2.6, 9.5 <ul style="list-style-type: none"> ◦ Updated reference to RTX for Innovate Award ◦ Removed sponsored by Arm for Control Award • Section 7.2.1 – Vision cameras must have exactly one image sensor for stream captured images/video • Section 7.2.1 – <ul style="list-style-type: none"> ◦ Vision sensors must have exactly one image sensor not able to stream captured images/video ◦ Added examples of vision sensors
1.1	9/9/2023	<ul style="list-style-type: none"> • Section 7.3.3 – <ul style="list-style-type: none"> ◦ <RE01> secondary power switches are allowed ◦ <RE12> Added to rule that focused light sources are not allowed except those listed in <RE12>.c&g • Section 7.3.4 - <DS03> <ul style="list-style-type: none"> ◦ Removed ASIN# for Etpark Wired Controller for PS4 ◦ Clarification that electrical modifications of any gamepads are not allowed • Section 7.4 – Added Team Game Element construction rules • Section 7.5 – Added Team Scoring Element construction rules • Section 10.0 – Added Dean's List Award criteria • Appendix B – Updated robot inspection sheet to include TGE and TSE inspection rules • Appendix E – Added Control Award Submission Form
1.2	10/4/2023	<ul style="list-style-type: none"> • Section 7.3.3 – Rule <RE11>d, Voltage and/or current sensors must be powered per rule <RE05>c. • Section 7.4 – Retroreflective materials are not allowed as part of team game element construction. • Section 9.2.5 – Added sub section 9.2.5.1 – Use of AI for engineering portfolio is allowed. • Section 9.4.1.1 – Teams no longer need to request judging feedback. Feedback will be given to every team. • Appendix B – Updated Robot Inspection Checklist <ul style="list-style-type: none"> ◦ Corrected spacing ◦ Expanded <DR05> rule summary • Appendix F – Updated Award Terms and Conditions
1.3	11/15/2023	<ul style="list-style-type: none"> • Section 6.1 – Added further clarification about teams participating outside of their region • Section 7.4 - <TE01> Team Props must be inspected in their gameplay configuration • Section 7.5 <ul style="list-style-type: none"> ◦ Added link to "Is Your Drone Legal" doc ◦ <DR01> Drones must be inspected in their gameplay configuration • Section 8.4 - Inspection

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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.

***FIRST* Core Values**

The *FIRST* Core Values emphasize friendly sportsmanship, respect for the contributions of others, teamwork, learning, and community involvement and are part of our commitment to fostering, cultivating, and preserving a culture of equity, diversity, and inclusion. The *FIRST* Community expresses the *FIRST* philosophies of *Gracious Professionalism*® and *Coopertition*® through our Core Values:

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

2.0 *Gracious Professionalism*®

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

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 –Rules and Definitions

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, queueurs, 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 9/9/2023. *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, youth protection screening, 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>. The advancement criteria for moving to the next Tournament level is detailed in section 6.0.

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.

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 FIRST Championship

Hosted and managed by *FIRST*, the *FIRST* Championship, held in Houston, Texas is the culminating event for all *FIRST* programs. *FIRST* Tech Challenge *Teams* advance to the *FIRST* Championship through their regional championship *Tournament*. The *FIRST* 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

The following definitions and terms are used for a *FIRST* Tech Challenge *Competition*. Defined terms begin with a capital letter and are italicized throughout the manual (for example, *Alliance*). Competition rules mean exactly and only what it plainly says. If a word isn't given a game definition, then you should use its common conversational meaning.

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.

AprilTag – A visual fiducial system, useful for a wide variety of tasks including augmented reality, robotics, and camera calibration¹. Information about *AprilTags* may be found here: <https://ftc-docs.firstinspires.org/en/latest/apriltag-intro>.

¹ See <https://april.eecs.umich.edu/software/apriltag> accessed on 5/18/2023.

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*, scoring areas, *Alliance Stations*, scoring tables, and other *Competition* officials and tables are located.

Divisions - *Competitions* that have 36 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*. *Penalties* are further categorized into *Minor Penalties* and *Major Penalties*.

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 with 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 less than two (2) and 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/Average TBP – *TieBreaker Points* are used as the tiebreakers when *Teams* have equal average *Ranking Points*. There are two types of *TieBreaker Points*, *TBP1* and *TBP2*.

Traditional Events – For *Teams* that compete at a traditional *Competition*,

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 *FIRST* championship.

3.5 Competition Rules

<C01> Egregious Behavior - Egregious *Robot* or *Team* member behavior is not in the spirit of Gracious Professionalism and will not be tolerated at a *FIRST* Tech Challenge event. Egregious behavior includes, but is not limited to, repeated and/or flagrant violation of rules, unsafe behavior or actions, and uncivil behavior towards *Drive Team*, *Competition* personnel, or event attendees. In most cases, as determined by the referees, the offending team will result in a *Major Penalty* and issuance of a *Yellow Card* and/or *Red Card*. Subsequent violations may result in *Team* disqualification from the *Competition*.

Continued and repeated violations will be brought to *FIRST* Headquarters' attention. *FIRST* Headquarters will work with event staff to determine if further escalations are necessary, which can include removal from award consideration, and removal from the event.

In cases where the egregious behavior is deemed to be unsafe, such as physical contact or threatening behaviors to other event attendees, event staff will work with *FIRST* Headquarters to determine if the behavior warrants immediate removal of the team from the event.

<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 single *Team* member 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 single *Team* member 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 that 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 to not 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*. Violations of this rule will immediately be considered deliberate and egregious.

<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.

*Exceptions can be made for extenuating circumstances for *Teams* that need assistance from another *Team* with the operation of their *Robot*. For example, *Teams* loaning out *Drive Team* members to another *Team* whose drivers have not arrived/must leave early. In events such as this, the *Teams* involved should notify the tournament director of the extenuating circumstance.

<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 Qualification Match Timing – A *Team* playing in consecutive *Qualification 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*. *Match* timing for the *Elimination Matches* is covered in rule <C29>.

<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.

<C10> Recording of Discussions - Laws regarding recording of conversations vary state-to-state and country-to-country, and, in some cases, recording without consent may be criminal. Introducing the idea of recording a conversation with an implied reason of proving someone's error can escalate a discussion and is likely to increase its adversarial nature. Sometimes it's appropriate; often it's neither appropriate nor constructive. Please do not record head referees, referees, or judges without the person's consent and please do not challenge the decision to decline consent to be recorded.

If a head referee, referee, or judge feels they are being recorded without their consent, they may choose to stop participating in the conversation.

<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 Competition. 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, they 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. The Driver Station and Robot Controller are allowed to connect to the venue's Wi-Fi network for the purpose of performing necessary updates. 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-Competition 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, spectator's, 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* unless specified by game specific rules. 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.

<C23> 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.

<C24> 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.

<C25> 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.

<C26> Outside Food – *Teams* or individuals may not bring food or beverages to a *Competition* unless the tournament director specifically allows it.

<C27> 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.

<C28> Government and Venue Requirements – *Teams* must comply with government and venue specific requirements (for example, wearing a mask, social distancing, tornado warning procedures, etc.).

<C29> 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 of *Teams* at the *Competition*, or the number of *Teams* in a *Division* (for multiple *Division Competitions*). For multiple *Division* events, the *Team* count is based on the number of *Teams* in each *Division*:
 - i. 20 or fewer *Teams*: Two *Team Alliances* – both *Teams* play in all *Elimination Matches* in which the *Alliance* competes.
 - 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 in a timely manner as described below results in a coin toss to decide which Team(s) will compete in the Match.
 - Match 1: At least four minutes prior to the start of the Match.
 - Match 2 and higher: Within four minutes following the display of scores from the Alliance's previous Match.
- c. **Match Timing** – There are no Team requested timeouts. An Alliance has eight minutes (8:00) from the initial announcement or display of the Match results for their Robots to be set up on the Playing Field and ready for the start of their next Match. A Match may begin early if both Alliances are ready to begin a Match ahead of time.
- 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, FIRST 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.

Teams who wish to have adults present for their judges' interview should notify the tournament director prior to the Competition.

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 explain 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* at the *Competition*, or the number of *Teams* in a *Division* (for multiple *Division Competitions*). If there are 21 or more *Teams* in the *Competition* or *Division*, 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 report 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*.

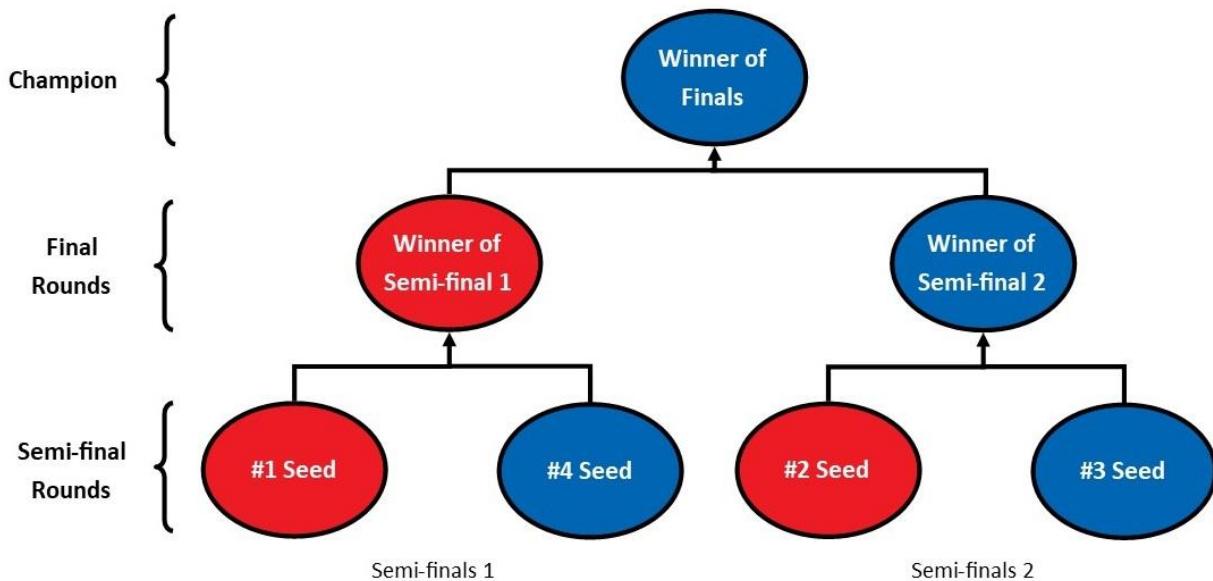
- A *Team* is available if they are not already part of an *Alliance* or has not already declined an *Alliance* invitation. If a *Team* accepts, they are moved into that *Alliance*. **If a Team declines, they CANNOT be invited to another Alliance**, but are still available to select their own *Alliance* 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 have 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* according to rule <C29>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. 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 that 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.

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

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* (including *Penalties*), 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* (including *Penalties*), 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. League Meet Ranking – A Team’s league ranking is based on their performance at all of the meets attended up until that event. 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 5.2.1 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 5.2.1 plus all *Matches* played at the league *Tournament*.

5.3 Penalties

5.3.1 Traditional Events

An *Alliance*'s *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 only eligible to advance from events within their *Home Region*.

Teams may choose to compete at *Tournaments* outside of their *Home Region*, however, do so for the opportunity of additional gameplay and to compete with other teams from outside of their area. Teams may NOT advance from *Tournaments* outside of their *Home Region*.

Teams may only compete in one league and one league *Tournament* per season.

New this season: Teams may only advance to the next level of competition from their *Home Region*.

A *Team* can participate in a league outside their region, provided that is the only league they participate in. A *Team* may not advance from a league tournament to a regional championship that is outside of their region unless the program delivery partners in both regions have agreed to move a *Team* to a new region for the entire season.

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

Tournament Type	Advances To	Special Considerations
<i>League Tournament</i>	<ul style="list-style-type: none"> • Super Qualifying <i>Tournament</i> • Regional Championship <i>Tournament</i> 	<ul style="list-style-type: none"> • A <i>Team</i> is eligible to advance to the next <i>Competition tier</i> from the <i>League Tournament</i> they attend. <i>Teams</i> can only compete in one league, and therefore only one <i>League Tournament</i>.
<i>Qualifying Tournament</i>	<ul style="list-style-type: none"> • Super Qualifying <i>Tournament</i> • Regional Championship <i>Tournament</i> 	<ul style="list-style-type: none"> • A <i>Team</i> may participate in more than one qualifying <i>Tournament</i> within their <i>Home Region</i> but are not eligible for consideration for awards nor are they eligible for advancement at <i>Tournaments</i> beyond their third.
<i>Super Qualifying Tournament</i>	<ul style="list-style-type: none"> • Regional Championship <i>Tournament</i> 	<ul style="list-style-type: none"> • <i>Teams</i> advance from their <i>Home Region</i> super qualifying <i>Tournament</i> to their <i>Home Region's</i> regional championship. • <i>Teams</i> can only compete in one super qualifying <i>Tournament</i>.
<i>Regional Championship Tournament</i>	<ul style="list-style-type: none"> • <i>FIRST</i> Championship 	<ul style="list-style-type: none"> • <i>Teams</i> advance from their <i>Home Region's</i> regional championship <i>Tournament</i> to the <i>FIRST</i> Championship.

6.1.1 Award Eligibility

Teams are eligible to be judged and considered for all awards (except for the Inspire award, see section 6.1.2 for details) at any *Tournament* they attend. *Teams* are eligible for advancement tied to the award within their *Home Region*. *Teams* may be a finalist or winner of an award when they are competing outside of their *Home Region* but are not eligible to advance.

6.1.2 Inspire Award Eligibility

Teams are only eligible to be considered for the inspire award at *Tournaments* within their own region. If a *Team* is competing outside of their *Home Region*, they cannot be considered for the inspire award, including 2nd and 3rd place inspire spots.

Teams that have won the inspire award at another qualifying *Tournament* cannot be considered for the inspire award or as an inspire award finalist at subsequent qualifying *Tournaments* within their *Home Region*.

All *Teams* are eligible to be considered for all judged awards at the *FIRST* 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 – At the discretion of the program delivery partner within a region, a qualifier host *Team* may advance to the next level of *Competition*. 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 RTX Winner
13. Finalist *Alliance*, 2nd *Team* selected.
14. Control Award 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 RTX 2nd Place.
23. Highest Ranked *Team** not previously advanced, from the Finalist *Division*.
24. Control Award Winner 2nd Place.

25. Highest Ranked *Team** not previously advanced, from the *Winning Division*.
26. Motivate Award Winner 2nd Place.
27. Highest Ranked *Team** not previously advanced, from the *Finalist Division*.
28. 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 RTX 3rd Place.
35. Highest Ranked *Team** not previously advanced, from the *Finalist Division*.
36. Control Award 3rd Place.
37. Highest Ranked *Team** not previously advanced, from the *Winning Division*.
38. Motivate Award 3rd Place.
39. Highest Ranked *Team** not previously advanced, from the *Finalist Division*.
40. 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 fewer *Teams* may select an award winner and a single award finalist. Events with 21 or more *Teams* must 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 *Smartphone 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 SPARKmini 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.

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.

Vision Camera – COTS devices with exactly one image sensor able to stream captured images and/or video. *Vision cameras* must be UVC compatible and must connect directly to a *REV Control Hub* via USB or to the *Robot Controller* through a powered USB hub. Common *Vision Cameras* are the Logitech C270 HD, Logitech C920 HD PRO, and Microsoft Lifecam HD-3000.

Vision Sensor – COTS devices with exactly one image sensor not able to stream captured images and/or video. Instead, the images and/or video is processed by on-board algorithms and only the results are communicated back to a computer or system. *Vision Sensors* must follow all sensor rules in <RE11>. Common *Vision Sensors* are the HuskyLens and Pixy2, though only the HuskyLens has included SDK support as of SDK 9.0.

7.3 Robot Rules

Anyone that has attended a *FIRST Tech Challenge Competition* knows that *Teams* think outside the kit-of-parts (TETRIX and REV *FIRST Tech Challenge Competition Sets*, REV EDU Kit, etc.) 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. The only exceptions are:

- a. Preloaded game elements may extend outside the starting size constraint.
- b. Flexible materials (i.e., zip tie, surgical tube, string, etc.) may extend up to 0.25 inches (0.635 cm) beyond the 18 inch (45.72 cm) size constraint.
- c. *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:

- d. *Robot* is placed on its drivetrain inside the robot size tool.
- e. The *Robot* must maintain the same shape/configuration as it will have at the start of a *Match*.
- f. 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*.
- g. 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.

<RG03> Team Number Display - *Robots* must prominently display their *Team* number (numerals only, for example "12345") on two separate signs. The intent of this rule is for field personnel to easily identify *Robots* by *Team* number from at least 12 feet (3.66 meters) away.

- a. *Team* number must be visible from at least **two** opposite sides of the *Robot* (180 degrees apart).
- b. The numerals must each be at least 2.5 inches (6.35 cm) high and in a contrasting color from their background.

- c. 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.
- d. If used, illuminated Team numbers must be legible when they are not powered on.

<RG04> 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. The intent of this rule is to allow field personnel to easily identify the Robot's Alliance.

- 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.

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.

An Alliance Marker template is located on the FIRST Tech Challenge game and season page
<https://www.firstinspires.org/resource-library/ftc/game-and-season-info>

<RG05> 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.

<RG06> 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.

<RG07> 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 18 ft. (5.49 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
- Pully: 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.

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

Exceptions to the single degree of freedom rule <RM02> are:

- COTS drive chassis (for example, AndyMark TileRunner, REV Mecanum Drivetrain Kit, TETRIX Flex-Build Robot Chassis, etc.) are allowed provided none of the individual parts violate any other rules.
- Holonomic wheels (omni or mecanum) are allowed.
- Dead-wheel Odometry Kit – a combination of an encoder, a free-spinning omnidirectional wheel, an optional tensioner, and an enclosure used to accurately measure the wheel's rotation.

<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 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 current or previous season's scoring elements.
- b) Team manufactured replicas of COTS current or previous season's scoring elements.
- c) AprilTag or fiducial images of any type are not allowed.

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), REV (REV-31-1387), or AndyMark (am-4969) power switch. This is the safest method for *Teams* and field personnel to shut down a *Robot*.

Beginning in the 2024-2025 competition season, the MATRIX (part #50-0030) power switch will no longer be allowed.

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).

Secondary *Robot* power switches downstream from the main power switch are allowed. It is recommended that any secondary power switch be labeled as a secondary switch in a manner dissimilar to the *Robot* Main Power Switch. Secondary switches must be one of the four allowed power switches specified in this rule.



The *Robot* main power switch should be mounted on the *Robot* so it is protected from *Robot-to-Robot* contact to avoid inadvertent actuation or damage.

<RE02> Battery Mount - Batteries must be securely attached (for example, VELCRO, hook and loop strips, cable ties, 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. The *Robot* main battery must include a replaceable in-line 20A fuse. 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, formerly 739023) 12V DC battery pack
- b. Modern Robotics/MATRIX (14-0014) 12V DC battery pack
- 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> Electronics Power – Electronics power is constrained by the following:

- a. The 12V *Robot* main battery, with the exception of power extension wire, must connect only to the *Robot* main power switch. The *Robot* main power switch regulates 12V power to the rest of the *Robot*. It is recommended to keep the path between the *Robot* main battery and *Robot* main power switch as short as possible using the largest possible diameter of wire.
- b. Only the following electronic devices may be connected to 12V power, either by connecting directly to the *Robot* main power switch, a pass-through power connector on a *REV Control Hub* or *REV Expansion Hub*, or a power distribution block:
 - i. *REV Control Hub*
 - ii. *REV Expansion Hub*
 - iii. *REV Servo Power Module*
 - iv. *REV SPARKmini Motor Controller*
 - v. Power distribution blocks (for example, *REV XT30 Power Distribution Block*, et. al.)
 - vi. Voltage/Current Sensors
 - vii. 12V Input Power LED controller/driver (for example. *REV Blinkin LED Driver*)

It is highly recommended to keep the path between the *Robot* main power switch and the *REV Control Hub* and/or *REV Expansion Hub(s)* as short as possible using the largest possible diameter of wire.

- c. Allowed sensors are only powered by the *REV Expansion Hub* or *REV Control Hub* via analog, digital, encoder, or I2C ports per <RE11>.
- d. *Vision Cameras* must be connected directly to a *REV Control Hub*, or to the *Robot* control system through a powered USB hub per <RE13>.
- e. LEDs and other light sources must be powered per <RE12>.
- f. 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. The *Robot Controller* must be the only source of control for the *Robot*. A *Robot Controller* is comprised of:

- 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 SPARKmini Motor Controllers*
- e. Any quantity of *REV Servo Power Modules*

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*.

Android smartphones will no longer be allowed to be used as part of the *Robot Controller* in the 2024-2025 season. The only legal *Robot Controller* will be the *REV Control Hub*.

<RE07> Android Devices – The only allowed *Android Devices* are:

Smartphones*:

- a. Motorola Moto G4 Play (4th Generation)/Motorola Moto G4 Play**
- b. Motorola Moto G5
- c. Motorola Moto G5 Plus
- d. Motorola Moto E4 (USA versions only, includes SKUs XT1765, XT1765PP, XT1766, and XT1767)
- e. Motorola Moto E5 (XT1920)
- f. Motorola Moto E5 Play (XT1921)

Other:

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

^tThe use of smartphones operating on Android version 6.x (Marshmallow) are no longer allowed in the 2023-2024 season. Android smartphones must use Android 7 (Nougat) or newer to be compatible with the current season's software minimum. The Moto G4 Play is no longer supported by over-the-air updates, and devices that have not yet been updated to Android 7 (Nougat) may be unable to update. Certain models might be able to be updated by the [Motorola Rescue and Smart Assistance Tool](#), but there are no guarantees.

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

**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.

<RE08> Motor and Servo Controllers – The only allowed motor and servo controllers are: *REV Expansion Hub*, *REV Control Hub*, *REV Servo Power Module*, *REV SPARKmini Motor Controller*, and *VEX Motor Controller 29*.

<RE09> 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.

<RE10> Servos – A maximum of twelve (12) servos are allowed. Any servo that is compatible with the attached servo controller is allowed. Servos may only be controlled and powered by 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. All servos must have a three-wire servo connector compatible with the *REV Control Hub* and *REV Expansion Hub* servo ports and may also have an optional additional sensor position output interface.

The VEX EDR 393 motor is considered a servo for the purposes of actuator allocation. 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.

<RE11> 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 <RE14.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 and/or current sensors are allowed, including between the main power switch and the *REV Expansion Hub* or *REV Control Hub*, except on an output port of a motor or servo controller. Voltage and/or current sensors must be powered per <RE05>.c.
- e. 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*.
- f. COTS I2C to SPI protocol converters are allowed as long as they are nonprogrammable. They may only be connected to and powered from the I2C connections available on the *REV Expansion Hub* or *REV Control Hub*.

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

- a. Focused light sources (for example: flashlights, lasers, and lenses) are not allowed unless noted in exceptions listed in <RE12>.c&g.
- b. Light sources may not interfere with or distract other *Robot* operations, *Team* members, volunteers, and spectators.
- c. Lasers are not allowed unless they meet all of the following criteria:
 - i. Must be part of a legal sensor as defined by <RE11>
 - ii. Class 1 laser
 - iii. Non-visible spectrum
- d. Light sources may be controlled by the following compatible ports on the *REV Expansion Hub* or *REV Control Hub*:
 - i. Digital I/O
 - ii. I2C
 - iii. Motor Output
 - iv. Servo Ports
- e. Commercial Off the Shelf (COTS) interface modules designed to solely control light sources are allowed between the light sources and the components listed in <RE12>.d.
- f. The only approved power sources for lights are as follows:

- i. Internal (as supplied by the COTS manufacturer) battery pack or battery holder,
 - ii. COTS USB external battery pack
 - iii. Ports on a *REV Control Hub* or *REV Expansion Hub*, including:
 - i. Motor-control ports
 - ii. Encoder ports,
 - iii. XT30 ports,
 - iv. Servo ports,
 - v. 5V auxiliary power ports,
 - vi. I2C sensor ports,
 - vii. Digital ports, and
 - viii. Analog ports.
 - iv. Power distributed off the 12V main power per <RE05>
- g. Integrated light sources within otherwise legal devices are permitted (for example, status and power LEDs on legal USB cameras).

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

For example, *Teams* may signal via LED light that they have a scoring element ready. *Teams* that choose to use flashing lights should install lights that the flash rate is 1 hertz (in other words, cannot change states more frequently than approximately once a second) or less. If *Teams* have LED's that flash more frequently, they may be asked to turn them off.

Teams that choose to install flashing lights should ensure the lights can be turned either completely off or on (not flashing). Head Referees 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.

¹ See <https://www.epilepsysociety.org.uk/photosensitive-epilepsy#.XuJbwY2ZPsE> accessed on 5/04/2023

<RE13> Video Cameras

- a. Self-contained video recording devices (GoPro or similar) are allowed providing they are used only for non-functional post-*Match* viewing and the wireless capability is turned off. Approved self-contained *Video Cameras* must be powered by an internal battery (as supplied by the manufacturer).
- b. *Vision Sensors* and *Vision Cameras* are allowed for computer vision related tasks.
 - i. *Vision Sensors* must follow all sensor rules in <RE11>.
 - ii. *Vision Cameras* must be UVC Compatible and must connect directly to a *REV Control Hub* via USB or to the *Robot Controller* through a powered USB hub.
 - iii. Only single image sensor devices are allowed (stereoscopic cameras are not allowed).

<RE14> Robot Wiring - Robot wiring is constrained as follows:

- a. USB surge protectors connected to USB cables are allowed.
- b. Ferrite chokes (beads) on wires and cables are allowed.
- c. A *Mini USB to OTG (On-The-Go) Micro Cable* or any combination of a *Mini USB* cable, a *USB hub*, and an *OTG Micro Adapter* may be used to connect the 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 COTS 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 blocks or splitters are recommended where appropriate to reduce wiring congestion. All connectors and distribution blocks or 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. Team managed 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, light sources, 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.

Teams should be prepared during *Robot* inspection to show documentation confirming the wire gauges used, particularly for multi-conductor cables.

- v. LED light source wires should be the same size recommended by the manufacturer or larger diameter. If the manufacturer does not specify a recommended size and the LED or strip has wires attached, use the same size or larger as provided by the manufacturer. If there are no attached wires and no recommended size is provided, use the following guidance:
- i. 5V LEDs - 22AWG or larger
 - ii. 12V LEDs - 18AWG or larger

- 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](#).

<RE15> Modifying Electronics - Approved electrical and electronic devices may be modified to make them more usable; they may not be modified internally or in any way that affects their safety.

Examples of modifications that are allowed:

- Shortening or extending wires
- Replacing or adding connectors on wires
- Shortening motor shafts
- Replacing 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

<RE16> 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 without being Bluetooth paired to any device)
- d. Sony DualSense Wireless Controller for PS5 (ASIN # B08FC6C75Y) operating in wired mode only (i.e., connected through USB 2.0 Type A to Type C cable without being Bluetooth paired to any device). This DOES NOT include the Sony DualSense Edge Wireless Controller in any configuration.
- e. Etpark Wired Controller for PS4
- f. Quadstick game controller in Xbox 360 Emulation Mode (any model).

No electrical modifications of any gamepads are allowed. Mechanical enhancements to the gamepad that do not involve opening the gamepad or modifying the electronics are legal.

Different color gamepads are allowed provided they are the same model as the allowed gamepad.

<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:

<https://www.firstinspires.org/resource-library/ftc/technology-information-and-resources>

<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”).

<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		
Device	Minimum Android Version	Minimum FTC Software Version
Motorola Moto G4 Play (4th Generation) / Motorola Moto G4 Play (See <RE07> for details)	7.0 (Nougat)	9.0
Motorola Moto G5	7.0 (Nougat)	
Motorola Moto G5 Plus	7.0 (Nougat)	
Motorola Moto E4 (USA versions only, includes SKUs XT1765, XT1765PP, XT1766, and XT1767)	7.0 (Nougat)	
Motorola Moto E5 (XT1920)	7.0 (Nougat)	
Motorola Moto E5 Play (XT1921)	7.0 (Nougat)	

REV Hubs			
Device	Minimum Software	Minimum Firmware Version	Minimum FTC Software Version
REV Control Hub	Control Hub OS 1.1.2	Firmware 1.8.2	Robot Controller 9.0
REV Expansion Hub		Firmware 1.8.2	
REV Driver Hub	Driver Hub OS 1.2.0		Driver Station 9.0

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>.

<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 Smartphone 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 *REV Driver Hub* or *REV 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>

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> Smartphone 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*).
- 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 Game Element Construction Rules

The *Team Game Element* is an optional *Team* designed and manufactured game element that will be used in the CENTERSTAGESM game.

The *Team Game Element* for the CENTERSTAGESM game is called the *Team Prop*.

<TE01> Inspection – Each *Team Game Element* must pass inspection in its gameplay configuration before it is allowed to be used in a *Match*.

<TE02> Color Constraint - *Teams* will need two *Team Game Elements* (one red and one blue) to play the game.

- a) The *Team Game Element* in its entirety must be red or blue (depending on the *Team's* assigned *Alliance* color for the *Match*). The *Team Game Element* may include multiple shades of the assigned color.
- b) No other coloration of the *Team Game Element* is allowed except for the *Team* number. Please see rule <TE05> for team number constraints.

<TE03> Material Constraints –

- a) The *Team Game Element* is subject to the *Robot Mechanical Parts and Materials Rules* in section 7.3.2.
- b) Fiducial markers (for example, *AprilTag*, QR code, Barcode, etc.) are not allowed.
- c) Materials with retroreflective properties (for example, retroreflective tape) are not allowed.

<TE04> Size Constraints –

- a) The maximum size of the *Team Game Element* is 4 inches (10.16 cm) by 4 inches (10.16 cm) by 4 inches (10.16 cm).
- b) The minimum size of the *Team Game Element* is 3 inches (7.62 cm) by 3 inches (7.62 cm) by 3 inches (7.62 cm).
- c) When measured, the *Team Game Element* should be placed in a self-supporting position inside a measuring tool, in the same manner that it will rest on the *Playing Field Floor*. This means it is not held at an odd angle by another object, such as the measuring tool.

<TE05> Team Number - *Team Game Elements* must be labeled with their *Team* number (numerals only, for example “12345”).

- a) The numbers must be legible when viewed from a distance of 12 inches (30.48 cm) away.
- b) The *Team* number may be no more than 0.5 inches (1.27 cm) in height.
- c) The *Team* number can only appear once on the *Team Game Element*.

The intent of this rule is to facilitate *Team Game Element* ownership identification for non-gameplay reasons.

<TE06> 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.

<TE07> COTS Scoring Elements – The *Team Game Element* may not resemble any current season's COTS game elements.

7.5 Team Scoring Element Construction Rules

The *Team Scoring Element* is an optional *Team* designed and manufactured scoring element that will be used in the CENTERSTAGESM game.

The *Team Scoring Element* for the CENTERSTAGESM game is called the *Drone*.

Teams must follow the rules outlined below when constructing their *Drone*. *Teams* may reference the document titled “Is Your Drone Legal” on the FIRST [website](#) for visual aids to assist *Teams* in building a legal *Drone* for Competition.

<DR01> Inspection – Each *Drone* design must pass inspection in its gameplay configuration before it is allowed to be used in a *Match*. *Teams* may have multiple designs and multiple *Drones* of a particular design. Only one *Drone* of each design needs to be inspected.

<DR02> Drone Configuration – *Drones* must have the general configuration of an airplane with defined fuselage and wings as determined by the inspector. The intention is that the aerodynamic surfaces cause the *Drones* to follow a non-ballistic trajectory while flying.

<DR03> Color Constraint – The predominant color of a *Drone* must match the *Team*'s assigned *Alliance* color for the *Match* (red or blue). The purpose of this rule is to ensure that field personnel, *Teams*, and the audience can easily associate *Drones* with their corresponding *Alliance*. *Teams* will need at least two *Drones* (one red and one blue) to play the game. Shades of red and blue are acceptable (e.g., pink or orange for red; aqua or light blue for blue).

<DR04> Team Number – The *Drone* 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 intent of this rule is to facilitate *Drone* ownership identification for non-gameplay reasons.

<DR05> Construction Material Constraints:

- a) The *Drone* must be made of a single, continuous sheet of paper no larger than a single sheet of 8 ½ x 11 or A4 size uncoated printer paper. The paper weight can be no more than 20lb (75 g/m²). Card stock, construction paper, cardboard, photo paper, etc. are not allowed.
- b) Graphite pencils, ink pen, and/or felt-tip markers may be used to color or apply the *Team* Number. Crayons, colored pencils, paint, chalk, and similar items are not allowed.
- c) Laser or ink jet printers, or similar technology, may be used to apply the required red or blue color, printed decorations, images, *Team* number, etc. on the paper.
- d) No other materials are allowed.

8.0 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* and any *Team* provided game and/or scoring elements. *Teams* should go through each checklist at least a week before the *Competition* to make sure their *Robot* and *Team* provided elements are made 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 element are required to pass a full inspection in their gameplay configuration 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*.

- 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 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 element(s) 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 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*.

<I09> Driver Station – The *Driver Station* and *Driver Station* carrier must pass field inspection before being used in a *Match*.

<I10> Team Supplied Elements – *Team* supplied elements (*Team Game Element* and *Team Scoring Element*) 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*.

Re-inspection is intended to accommodate *Teams* who may need to adjust their *Team* supplied element if there is damage or slight changes that would improve the *Team*'s ability to play the game. This is not intended for *Teams* to request re-inspections for *Team* supplied element's that are shared between *Teams*. We expect that each *Team* designs their own *Team* supplied element to bring to the *Competition* for use in gameplay.

9.0 Judging and Award Criteria

9.1 Overview

This section provides descriptions of:

- *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 *Teams* who submit a completed judging feedback request form. When receiving feedback, *Teams* 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>

9.1.1 Key Terms and Definitions

Engineering Notebook – Not required for award consideration, the *Engineering Notebook* is a thorough description of the *Team's* experiences throughout the season. At events, a judge may ask to review this optional resource, but a *Team* will not be penalized if there is no *Engineering Notebook*.

Engineering Portfolio – Required for award consideration, the *Engineering Portfolio* is a document that does not exceed 15 pages that summarizes the most important accomplishments of the *Team*, in the *Team's* opinion. Guidelines for what must, should, and could be included for award consideration is listed in section 9.2.6.

Home Region – The default or manually assigned region that a *Team* is a part of. These are generally geographic in nature. Special considerations can be made, at the discretion of the program delivery partner and FIRST to move a *Team* to another region, or to add a *Team* with no program delivery partner to another *Home Region*. A *Team* can only be a part of one *Home Region*.

Team Information – The *Team* name, *Team* number, a photograph of the *Robot*, a photograph of the *Team* school or club information, the *Team* City and State, *Team* motto. Please do not include the full name of any student, coach, or mentor in the *Engineering Portfolio*.

CAD drawings, business plan information, award Information, accolades, *Team* size, *Team* goals, and other ‘content’ will be viewed as *Engineering Portfolio* content and is counted as a page in the portfolio.

Team Plan – Any descriptor of *Team* goals. This could include a strategic plan that references *Student* recruitment, sponsorship, mentor recruitment, outreach efforts, fundraising goals, or *Team* learning goals.

9.2 Engineering Portfolio

9.2.1 Overview

This section describes the requirements for creating the *Engineering Portfolio*, including formatting guidelines.

9.2.2 What is an Engineering Portfolio?

An *Engineering Portfolio* is a short and concise summary of the *Team's* engineering journey throughout their season. The *Engineering Portfolio* should include 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* CV or resume.

One of the goals of *FIRST* and *FIRST* Tech Challenge is to recognize the engineering design process and the journey that a *Team* makes. This journey encompasses the phases of the problem definition, concept design, system-level design, detailed design, test and verification, and production of the *Robot*.

9.2.3 Engineering Portfolio Formats

Teams may choose to 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 choose to use any electronic programs to create their *Engineering Portfolio*.
 - For remote event judging, *Teams* must create a single PDF file of their *Engineering Portfolio*.
 - For traditional events, *Teams* must print their *Engineering Portfolio*.
- b) **Handwritten:** *Teams* can choose to create a handwritten version.
 - For remote event judging, this is discouraged due to difficulties in scanning into a readable, sharable, online version.

9.2.4 Engineering Portfolio Requirements

1. To be considered for judged awards, a *Team* **must** submit an *Engineering Portfolio*.
 - a) *Teams* who do not submit an *Engineering Portfolio* will **not** be considered for judged awards.
2. The total number of pages for an *Engineering Portfolio* must not exceed 15 pages, plus a cover sheet for a total of 16 pages.

- a) Cover sheet may include the *Team Information* and a table of contents.
 - i. Allowed *Team Information* is limited to *Team* number, *Team* name, *Team* location, *Team* school or organization, *Team* motto and an image of the *Robot* and/or the *Team*.
- b) Cover sheet may not include other *Engineering Portfolio* content.
 - i. Additional content on the cover sheet adds to the page count of the portfolio, meaning content on the last page of the portfolio will not be reviewed or considered.
- c) 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).
- d) 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.
- e) 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

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*.

reviewed or considered.

3. The *Engineering Portfolio* must **not** include links to other documents, videos, or any other additional content.
 - a) Please note that judges will **not** review linked content in the *Engineering Portfolio*, including web sites, or videos.
4. The Control Award Submission Form is not a part of the *Engineering Portfolio* and is not included in the total *Engineering Portfolio* page count.

9.2.5 Engineering Portfolio Recommendations

1. We strongly recommend the *Team* number is at the top of each page.
2. The body of the *Engineering Portfolio* **could** include:
 - a) Summary of the engineering content that includes the *Robot* design processes.
 - b) Summary of the *Team Information* that includes information about the *Team* and outreach activities.
 - c) 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.

It is a good idea to connect the award criteria to specific content in your *Engineering Portfolio*!

9.2.5.1 Artificial Intelligence in the Engineering Portfolio

Teams are permitted to use Artificial Intelligence (AI) to assist in the creation of their Engineering Portfolio and in their Robot Code. FIRST views AI resources as tools available to students in the same way that CAD programs, Programming Languages, and 3D printers are tools available for their use. Teams using AI to assist with code or content generation must provide proper credit and attribution, and respect intellectual property rights and licenses.

Proper Credit can look like this: Portfolio Content created by Team 1000 and ChatGPT.

9.2.6 Engineering Portfolio Requirements by Award

The chart below provides a quick outline of the *Engineering Portfolio* requirements by award:

Engineering Portfolio Requirements by Award	
Requirements are indicated using the word “must,” recommendations are indicated using words like “could” or “should.”	
Inspire Award	<ul style="list-style-type: none"> • <i>Team must</i> submit an <i>Engineering Portfolio</i>. The <i>Engineering Portfolio</i> must include summary information about the <i>Robot</i> design, information about the <i>Team</i>, and a <i>Team Plan</i>. The entire <i>Engineering Portfolio</i> must be high quality, thoughtful, thorough, concise, and well-organized. The <i>Engineering Portfolio</i> could inspire the judges to ask about specific information.
Think Award	<ul style="list-style-type: none"> • <i>Team must</i> submit an <i>Engineering Portfolio</i>. • The <i>Engineering Portfolio</i> 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 <i>Engineering Portfolio</i> must provide examples that show the

	<p><i>Team</i> has a clear understanding of the engineering design process including an example of lessons learned.</p> <ul style="list-style-type: none"> • The portfolio could inspire the judges to ask about specific, detailed engineering information. • Portfolio format is less important but enables the judges to understand the <i>Team's</i> design maturity, organizational capabilities, and overall <i>Team</i> structure. • Portfolio could reference specific experiences and lessons learned but should capture the summary of the status of the <i>Team</i> and their <i>Robot</i> 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 <i>Team Plan</i>. • Portfolio could contain information about the plans to develop skills for <i>Team</i> members. • Portfolio could be organized in a logical manner.
Connect Award	<ul style="list-style-type: none"> • <i>Team</i> must submit an <i>Engineering Portfolio</i>. • Portfolio must include a <i>Team Plan</i>. The <i>Team Plan</i> could the <i>Team's</i> goals for the development of <i>Team</i> member skills, and the steps the <i>Team</i> 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. • Portfolio must include a summary of how they acquired new mentors or acquired new knowledge and expertise from their mentors.
Innovate Award sponsored by RTX	<ul style="list-style-type: none"> • <i>Team</i> must submit an <i>Engineering Portfolio</i>. • The <i>Engineering Portfolio</i> must include examples of the <i>Team's</i> engineering content that illustrate how the <i>Team</i> arrived at their design solution. • The portfolio could inspire the judges to ask about specific, detailed engineering information.
Control Award	<ul style="list-style-type: none"> • The <i>Team</i> must submit an <i>Engineering Portfolio</i>. The <i>Engineering Portfolio</i> must include engineering content that documents the control components. • The <i>Team</i> must submit a control award submission form as a separate document. <i>Teams</i> should identify the control aspects of their <i>Robot</i> that they are most proud of. • The Control Award submission form must not exceed 2 pages.
Motivate Award	<ul style="list-style-type: none"> • <i>Team</i> must submit an <i>Engineering Portfolio</i>. • The <i>Engineering Portfolio</i> must include a <i>Team</i> 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 <i>Team</i> identity, fund-raising goals, sustainability goals, timelines, outreach to non-technical groups, finances, and community service goals. • The <i>Team</i> is an ambassador for <i>FIRST</i> programs. • <i>Team</i> can explain the individual contributions of each <i>Team</i> member, and how these apply to the overall success of the <i>Team</i>.

Design Award	<ul style="list-style-type: none"> • Team must submit an <i>Engineering Portfolio</i> that includes examples of Robot CAD images or detailed Robot design drawings. • The portfolio could inspire the judges to ask about specific, detailed design engineering content.
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9.3 Engineering Notebook

The *Engineering Notebook* is an optional item and could be used as a fundamental source of information for the *Team* to use to be able to create the *Engineering Portfolio*. The *Engineering Notebook* is one method of creating a 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, and obstacles.

The *Engineering Notebook* is not used when considering a *Team* for judged awards.

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).

All *Teams* are eligible to participate in the judging process. A *Robot*, a working *Robot*, or a *Robot* that has passed inspection is not a requirement to participate in judging.

- 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*, and their control award submission 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 formal *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

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 and is based on the judges' first impression of the team.

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.

Teams do not need to request feedback from the judges. Feedback will automatically be given to every *Team*. Feedback is based on the judges' first impression of the *Team* and should be used as a tool to help the *Team* improve their judging presentations and *Engineering Portfolio* content.

9.4.2 Judging Schedule

The formal 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* championship. 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 [Judge and Judge Advisor Manuals](#) 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* Tech Challenge 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.
- 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 *Team*'s 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 summary of 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 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* Tech Challenge 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 RTX

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 RTX:

- *Team* must show respect and *Gracious Professionalism*® to everyone they meet at a *FIRST* Tech Challenge 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 RTX:

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

9.5.5 Control Award:

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:

- *Team* must show respect and *Gracious Professionalism*® to everyone they meet at a *FIRST* Tech Challenge event.
- *Team* must apply for the Control Award by filling out the Control Award 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:

- 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* Tech Challenge 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.
- *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* Tech Challenge 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 2023-2024 season:

“The best thing about *FIRST* Tech Challenge is...”

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*.

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

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.

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. It is the goal of FIRST that these individuals will continue, post-award, as great leaders, student alumni, and advocates of FIRST.

In 2019, the [Woodie Flowers Memorial Grant](#) was established for Dean's List Award Winners pursuing STEAM fields of study.

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>

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 Award shall include, but not be limited to a student's:

- Demonstrated leadership and commitment to the FIRST Core Values
- Effectiveness at increasing awareness of FIRST in their school and community
- Demonstrates passion for a long-term commitment to FIRST
- The student's individual contributions to their team contribute to the overall success of the team
- Proven experience in areas of science, technology, engineering, and mathematics (STEM)

- The student is a role model and can 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

Part 1 and 2 - <https://www.firstinspires.org/resource-library/ftc/game-and-season-info>

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): **READY / NOT READY**

Team	Insp.	Robot Size Inspection	Rule #
		Robot is presented at inspection with all mechanisms (including all components of each mechanism), configurations, and decorations that will be used on the Robot.	<I06>
		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.	<I06> <RG02>
✓	✓	General Robot Rules	Rule #
		Robot does not contain any components that could damage the Playing Field or other Robots.	<RG01>a&b
		Robot does not contain materials that are hazardous.	<RG01>c
		Robot poses no obvious unnecessary risk of entanglement.	<RG01>d
		Robot does not contain sharp edges or corners.	<RG01>e
		Robot does not contain animal-based, liquid, or gel materials.	<RG01>f&g
		Robot does not contain materials that would cause a delay of game if released.	<RG01>h
		Robot does not contain elements that electrically ground the Robot frame to the Playing Field.	<RG01>i
		Robot does not contain closed gas, hydraulic, or vacuum based devices.	<RG01>j,k&l
		Team number is visible from at least 2 opposite sides and meets requirements.	<RG03>
		Alliance Markers are present and meet requirements.	<RG04>
		Energy used by the Robot shall come only from approved sources.	<RG05>
		Robot is not capable of detaching its own components.	<RG06>
✓	✓	Robot Mechanical Parts and Materials Rules	Rule #
		All components on the Robot are from allowable raw materials and Commercial Off The Shelf products.	<RM01> <RM02> <RM06>
✓	✓	Robot Electrical Parts and Materials Rules	Rule #
		Exactly one Main Power Switch is installed properly, labeled, readily accessible, and visible. The TETRIX, REV, MATRIX, and AndyMark switches are the only allowed Main Power Switch.	<RE01>
		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.	<RE02>
		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.	<RE03> <RE05>a, b(i&ii)
		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.	<RE04>
		12V Power: REV Control Hub, REV Expansion Hubs, REV Servo Power Modules, REV SPARKmini Motor Controllers, Power Distribution Blocks, Voltage/Current Sensors, 12V Input Power LED Controllers are connected to 12V power by connecting directly to the Robot main power switch, a pass-through power connector on a REV Control Hub or REV Expansion Hub, or a Power Distribution Block.	<RE05>b

	Allowed sensors only receive power from the REV Expansion Hub or REV Control Hub via analog, digital, encoder, or I2C ports.	<RE05>c
	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.	<RE05>f
	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.	<RE06>
	The only allowed Motor and Servo Controllers are: REV Expansion Hub, REV Control Hub, REV Servo Power Module, REV SPARKmini Motor Controller, and VEX Motor Controller 29.	<RE08>
	Robot contains no more than eight (8) DC motors of the allowed models.	<RE09>
	Robot contains no more than twelve (12) servos. They must be compatible with the attached REV Expansion Hub, REV Control Hub, REV Servo Power Module, or VEX Motor Controller 29 and not exceed the manufacturer specifications for the controller.	<RE10>
	Robot contains only allowed sensors and they are connected to allowed ports on the REV Expansion Hub or the REV Control Hub.	<RE11>a
	Logic Level Converters and I2C Sensor Adapter Cables are allowed to connect sensors to a compatible REV Control Hub or REV Expansion Hub port.	<RE11>b
	Simple I2C multiplexors, I2C to SPI protocol converters are allowed to connect sensors to an I2C port. COTS I2C to SPI protocol converters are allowed.	<RE11>e&f
	Focused light sources are not allowed except for a) sensors containing class 1, non-visible spectrum lasers or b) integrated light sources within otherwise legal devices. Light sources are powered by allowed methods.	<RE12>a, c, f, & g
	Video recording devices, if used, are powered by an internal battery and their wireless communication capability is turned off.	<RE13>a
	Vision Cameras must be UVC compatible and are connected directly to a REV Control Hub, or to the Robot Controller through a powered USB Hub.	<RE13>b(ii)
	Only single image sensor devices are allowed. Vision Sensors follow sensor rules in <RE11>. Stereoscopic cameras are not allowed.	<RE13>b(iii)
	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.	<RE14>f
	Power, motor control, servo, sensor, and LED wires are the correct size.	<RE14>i
	If electronics are grounded to the Robot frame, the only approved method is the REV Robotics Resistive Grounding Strap. If needed, the REV Robotics Anderson Powerpole to XT30 adapter may connect to the Resistive Grounding Strap. No other grounding straps or cables are allowed.	<RE14>k
	Approved electrical and electronic devices may be modified to make them more usable; they may not be modified internally or in any way that affects their safety.	<RE15>
✓	Wheel/Tread Playing Field Damage Test - Optional	Rule #
	Robot did not damage the Playing Field tile. [This is an optional test that is performed only when an Inspector believes that the drivetrain tread may damage a Playing Field tile.]	<I07>
✓	Team Game Element Inspection – Optional Game Element	Rule #
	Team must present all of their Alliance specific TGEs for inspection. The element must be entirely red or blue.	<TE01> <TE02>

		The TGE satisfies the Robot Mechanical Parts and Materials Rules in section 7.3.2 and does not contain any fiducial markers or retroreflective materials.	<TE03>
		Max. size of the TGE is 4 inches (10.16 cm) by 4 inches (10.16 cm) by 4 inches (10.16 cm). The min. size of the TGE is 3 inches (7.62 cm) by 3 inches (7.62 cm) by 3 inches (7.62 cm).	<TE04>
		The TGE is labeled with their Team number (numerals only) and they meet requirements.	<TE05>
		The TGE does not contain electronics, or any other part or material that violates Robot construction rules outlined in section 7.3.	<TE06>
		The TGE does not use or resemble any current season's COTS scoring elements.	<TE06>c <TE07>
✓	✓	Team Scoring Element Inspection – Optional Scoring Element	Rule #
		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).	<DR01> <DR03>
		The TSE must have the general configuration of an airplane with a defined fuselage and wings.	<DR02>
		The TSE is labeled with their Team number (numerals only). Numbers may be: a) laser or ink jet printed, or b) handwritten in either pencil, ink pen, or felt-tip marker.	<DR04> <DR05>
		The TSE must be made of a single, continuous sheet no larger than 8 ½ x 11 or A4 with a paper weight specification of no more than 20lb. No other materials (tape, paperclips, staples, etc.) are allowed.	<DR05>

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

Robot Inspector

Appendix C – Field Inspection Checklist

Team Number: _____

Field Inspection Status (circle): **READY / NOT READY**

✓	Drive Team Members Present	Rule #	
	Coach (required), Driver 1 (required); Driver 2 (optional), Human Player (optional)	<C06>	
✓	Driver Station and Robot Controller Hardware Rules	Rule #	
	Driver Station consists of only of one Android device (Circle): Motorola Moto G4 Play, Motorola Moto G5, Motorola G5 Plus, Motorola Moto E4, Motorola Moto E5, Motorola Moto E5 Play, or REV Driver Hub.	<RE07> <DS01>	
	Smartphone Robot Controller Android device (if used) is one of the following models (Circle): 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.	<RE07>	
	The touch display screen of the Driver Station is accessible and visible to field personnel.	<DS02>	
	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, Sony DualSense Wireless Controller for PS5), or Quadstick game controller in any combination.	<DS03>	
	No more than one (1) optional external battery powered or unpowered USB hub is present.	<DS04>	
	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.	<DS05>	
	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.	<DS06>	
	Driver Station Carrier (if present) meets requirements.	<DS07>	
	The Driver Station Android Device only plays allowed sounds.	<DS08>	
DS	RC	Driver Station (DS) and Robot Controller (RC) Software Rules	Rule #
	Android smartphone(s), REV Driver Hub, and REV Control Hub are named with the official team number followed by –DS or –RC as appropriate.	<RS01>	
	Android operating system satisfies the requirements – version 7.0 or higher.	<RS03>	
	DS and RC apps are version 9.0 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.	<RS03> <RS05> <RS06>	
NA	REV Driver Hub (if used) operating system is version 1.2.0 or higher.	<RS03>	
NA	REV Driver Hub (if used) has Bluetooth turned off and Wi-Fi turned on.	<RS07>	
NA	REV Control Hub (if used) operating system is version 1.1.2 or higher and the firmware version is 1.8.2 or higher.	<RS03>	
NA	REV Expansion Hub (if used) firmware version is 1.8.2 or higher.	<RS03>	
NA	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”.	<RS07>	
	Android smartphones (if used) are set to airplane mode, Wi-Fi is turned on, and Bluetooth is turned off.	<RS07>	
	Android devices are not connected to any local networks.	<RS09>	
	All remembered Wi-Fi Direct Groups and Wi-Fi connections on Android devices have been removed.		

	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	Rule #
	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	Rule #
	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.	<RG04>

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

Field Inspector

Appendix D – Control Award 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 Submission Form

****Please turn in this sheet during your judge interview along with your engineering portfolio****

Team #	Team Name:
---------------	-------------------

Autonomous objectives:

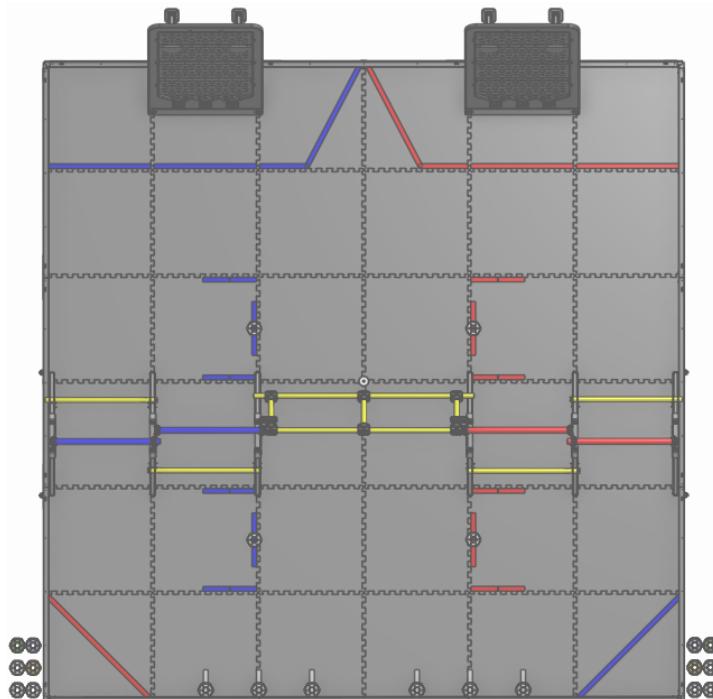
Sensors used:

Key algorithms:

Driver controlled enhancements:

Engineering portfolio references:

Autonomous program diagrams:



Appendix F – Award Terms and 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 (i.e., 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:

3. The Started team agrees that the Starting team did in fact Start them.
4. 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. The 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 as a reference for judges (e.g., 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 interviews 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 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 not all teams 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 (e.g., 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 interviews as an additional resource item.

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

- 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.

Assisted (a FIRST LEGO League / FIRST Tech Challenge / FIRST Robotics Competition team) - “A team has **Assisted** a team if they have met all 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

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. (e.g., 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 (e.g., 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**.

All provided documentation may be made available for judges during the second interviews 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 team has **Run** an event if they have met all the following requirements:

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

Running an event 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 most of the work that goes into the event.

Teams are encouraged to provide documentation (e.g., 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 interviews as an additional resource item.

Examples (but not limited to) of **Running** an event.

- Team A acts as most of the planning committee for a FIRST LEGO League event, and team members recruit and train the event volunteers.

Hosted - 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 - 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 (i.e., Team members have volunteered for the entirety of the 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 saw 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** 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 of 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 demonstrations 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**. (e.g., 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**.

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 (i.e., fundraising).

Teams are encouraged to be specific about when they started an initiative or participated in one. It should be part of their current season.

An additional resource item is defined as a resource that is shared with the judges during their team judging second interviews or pit interviews. It may be a poster, video, engineering notebook, PowerPoint, or any additional materials to enhance the team interview and provide proof on the team's process and journey through their season.