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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"> <li>• Section 4.5.2 – Rule &lt;G16&gt; added Human Player Station to the rule</li> <li>• Section 4.5.3 – Rule &lt;GS01&gt; added new &lt;GS01&gt;f., shifted following rules down</li> <li>• Section 4.6 – Corrected set bonus language in scoring summary</li> </ul>
1.2	10/11/2023	<ul style="list-style-type: none"> <li>• Section 4.3 – Corrected referenced images in Mosaic definition</li> <li>• Section 4.4.1 – Pre-Match 3.c) – Clarification that only one Drone may be brought to each match</li> <li>• Section 4.5.3 <ul style="list-style-type: none"> <li>○ Added &lt;GS03&gt;c.</li> <li>○ &lt;GS04&gt; - Added further clarification and examples to descoring</li> <li>○ Added &lt;GS11&gt;h.</li> </ul> </li> <li>• Section 4.7 – Added new rules to Rule Summary</li> </ul>

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## 1.0 Introduction

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### **What is FIRST® Tech Challenge?**

FIRST® Tech Challenge is a student-centered program that focuses on giving students a unique and stimulating experience. Each year, teams engage in a new game where they design, build, test, and program autonomous and driver operated robots that must perform a series of tasks. Participants and alumni of FIRST programs gain access to education and career discovery opportunities, connections to exclusive scholarships and employers, and a place in the FIRST community for life. To learn more about FIRST® Tech Challenge and other FIRST® Programs, visit [www.firstinspires.org](http://www.firstinspires.org).

## 2.0 Gracious Professionalism®

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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

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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 CENTERSTAGE<sup>SM</sup> presented by RTX, the *FIRST*<sup>®</sup> 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](http://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>.

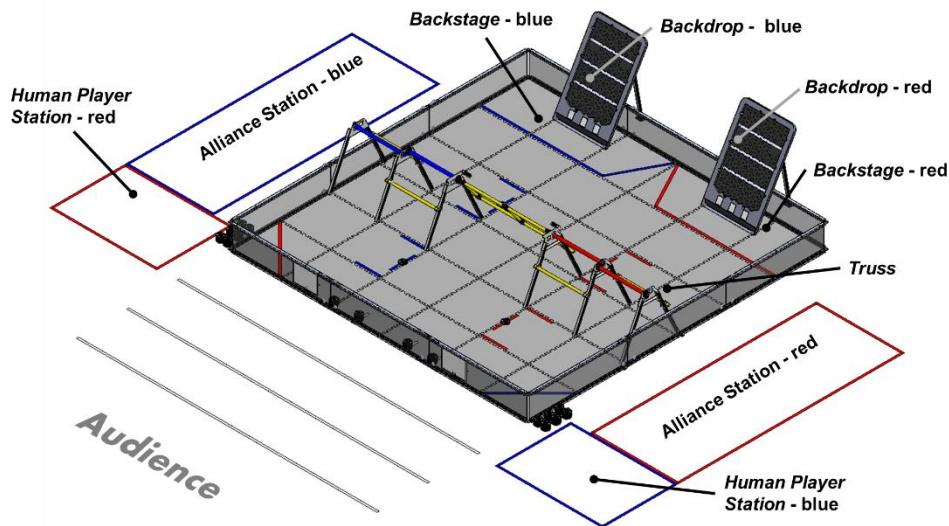
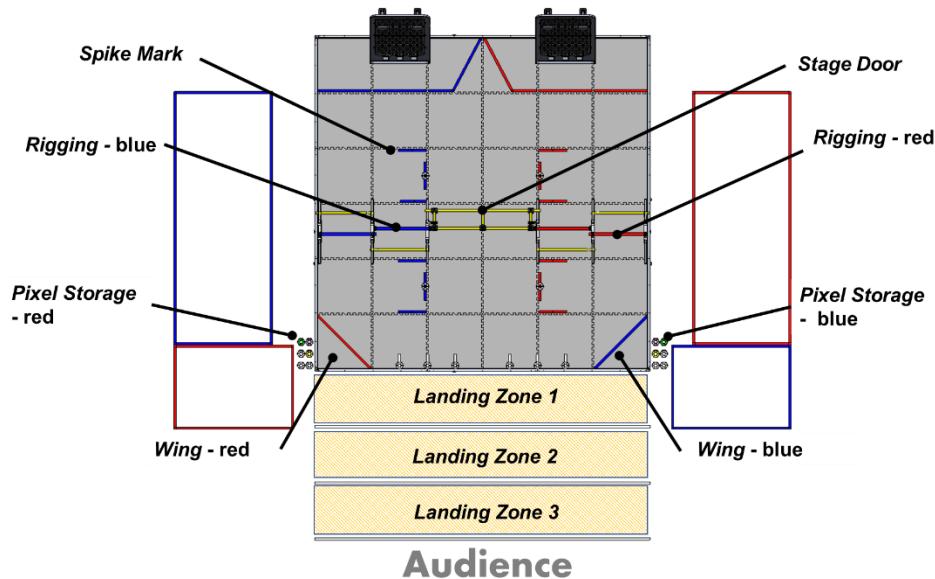


Figure 4.2-1 – Isometric view of the *Playing Field*



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

#### 4.2.2 Gameplay Overview

Welcome to CENTERSTAGE<sup>SM</sup> 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 CENTERSTAGE<sup>SM</sup> 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](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 CENTERSTAGE<sup>SM</sup>. 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*<sup>[OBJ]</sup>, 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 calibration<sup>1</sup>. 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>.

<sup>1</sup> 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 CENTERSTAGE<sup>SM</sup> 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 1<sup>st</sup> 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**

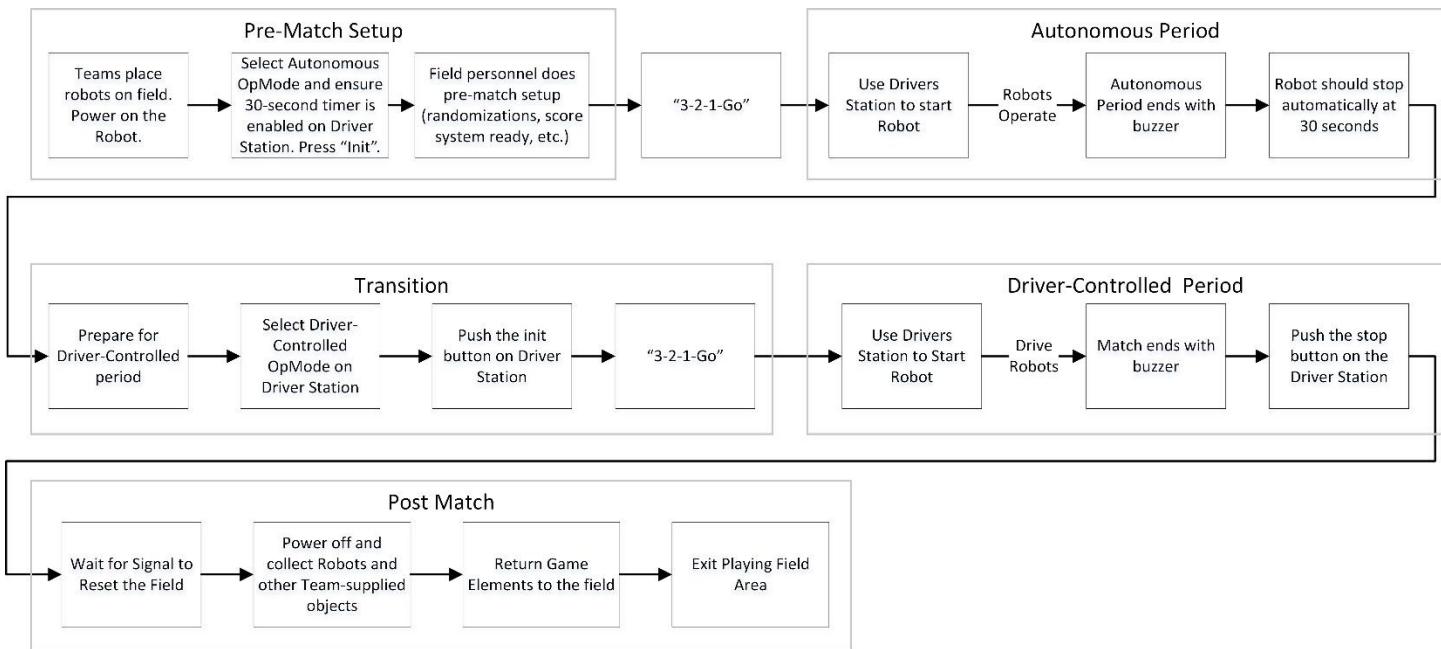
By the conclusion of the stop *Match* sound, *Drive Teams* must press the stop button on their *Driver Stations*. *Field Personnel* will then finalize the *Score*. Referees will signal for the *Drive Teams* to enter the *Playing Field* and retrieve their *Robots* and *Drones*. *Drive Teams* should return 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 3<sup>rd</sup> and 4<sup>th</sup> 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 4<sup>th</sup> seed defeats the 1<sup>st</sup> 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 2<sup>nd</sup> or 3<sup>rd</sup> 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 3<sup>rd</sup> *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:

- 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*.
- Robots* are allowed to *Grasp* the *Rigging* as an exception to rule <G25>.
- A *Robot* may *Launch* their *Drone* to the *Outside* of the *Playing Field* as an exception to rule <G27>.
- Rule <GS06>.f modifies the application of rule <G28>.
- Rule <GS07> constraints are an exception to rule <G07>.
- Consequences for violating rule <GS07>.a apply a stricter penalty than outlined in rule <G25>.
- Rule <GS08>.c is an exception to rule <G07>.
- 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*.

<b>Scoring Achievement</b>	<b>Autonomous Points</b>	<b>Driver-Controlled Points</b>	<b>End Game Points</b>	<b>Reference</b>
<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
<b>Safety Rules</b>						
<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*
<b>General Rules – Further definitions, no Penalties earned</b>						
<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.				
<b>General Rules – Pre-Match and Post-Match Penalties</b>						
<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		
<b>General Rules – Gameplay Penalties</b>						
<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
<b>Game-Specific Rules – Gameplay Penalties</b>						
<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

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### **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](mailto: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](mailto:Firsttechchallenge@firstinspires.org)

### **FIRST Websites**

FIRST homepage – [www.firstinspires.org](http://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.

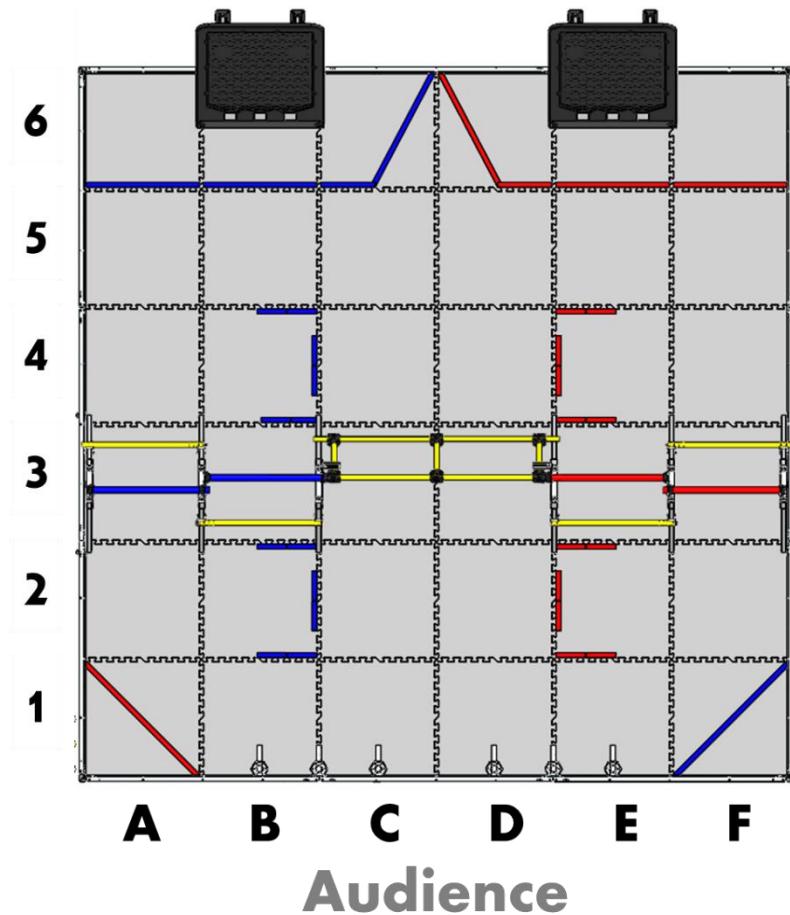
[FIRST Tech Challenge Blog](#) – Weekly articles for the FIRST Tech Challenge community, including outstanding volunteer recognition!

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

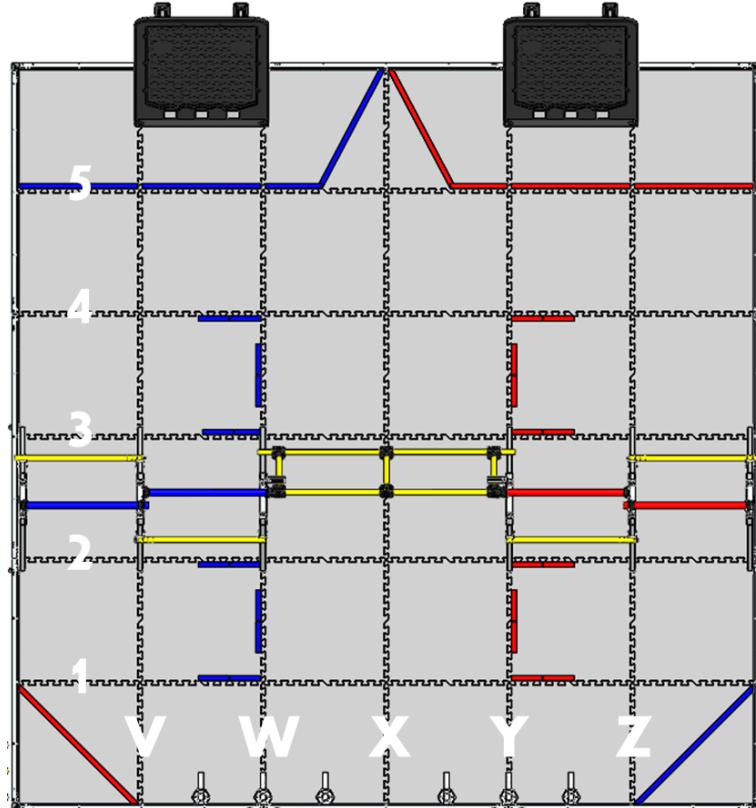
### **Feedback**

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](mailto:Firsttechchallenge@firstinspires.org). Thank you!

## Appendix B – Playing Field Locations



B-1 Tile Locations

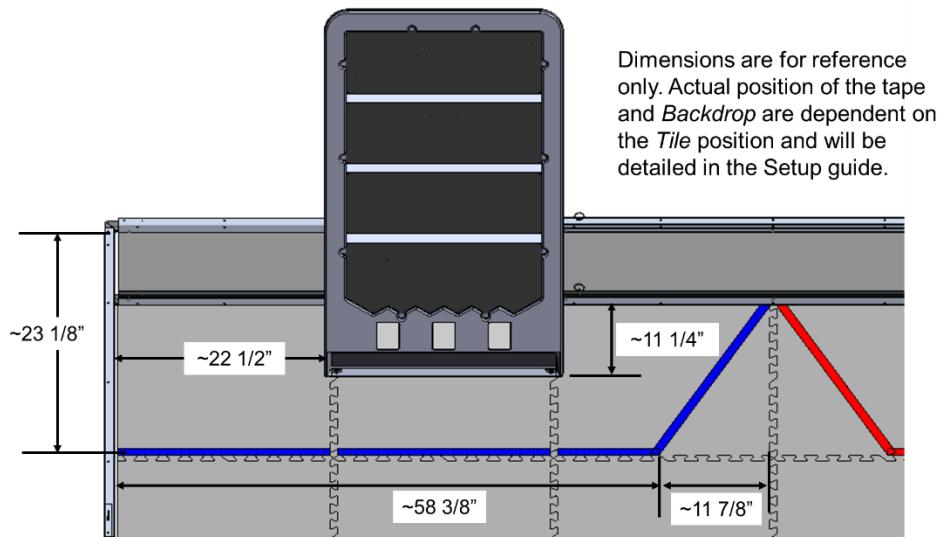


## Audience

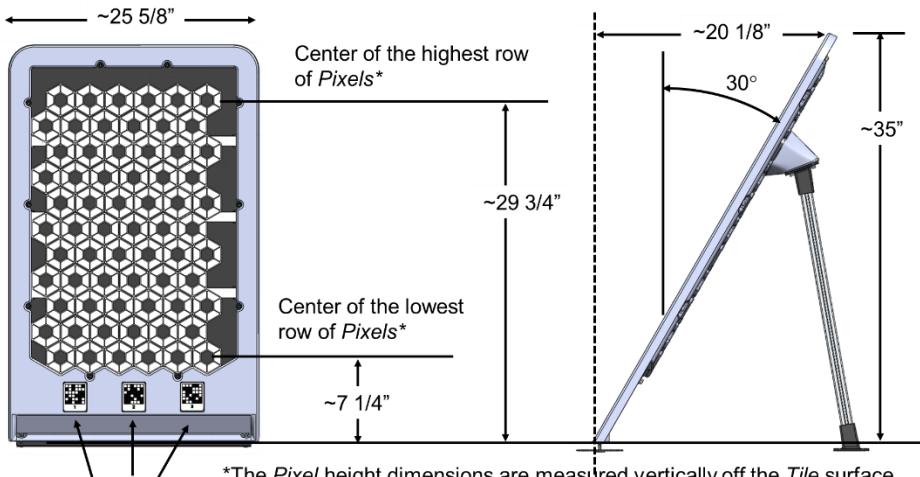
### B-2 Intersection Locations

## 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](#).

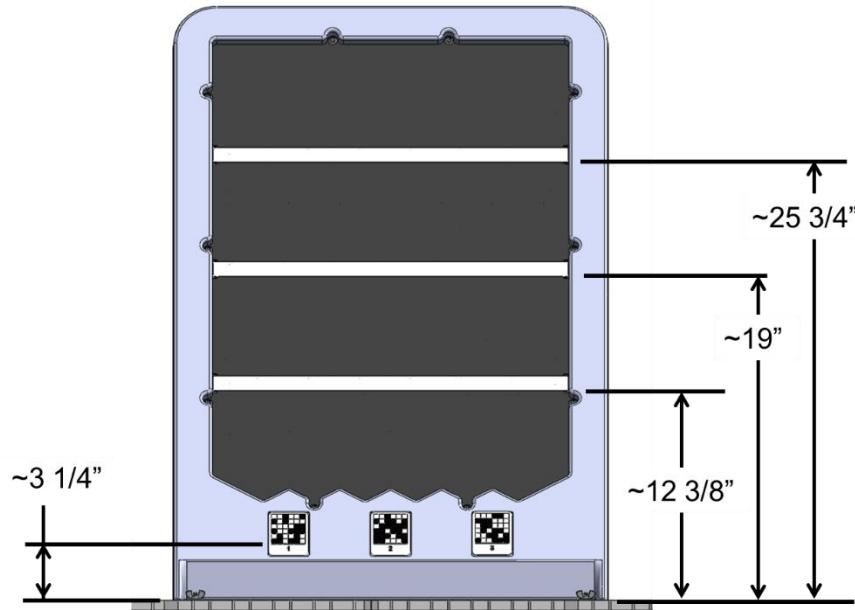


**C-1 Backstage and Backdrop locations**



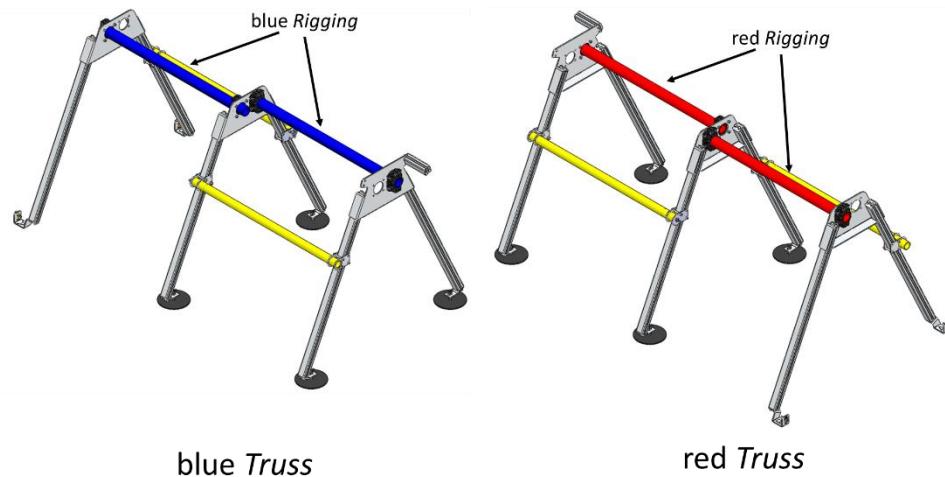
Dimensions are for reference only; actual dimensions may vary slightly from field to field

**C-2 Backdrop dimensions**

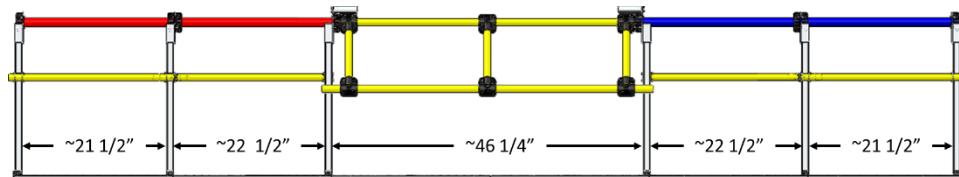


The dimensions are measured vertically off the *Tile* surface.  
Dimensions are for reference only. Actual dimensions may vary slightly.

### C-3 Backdrop dimensions

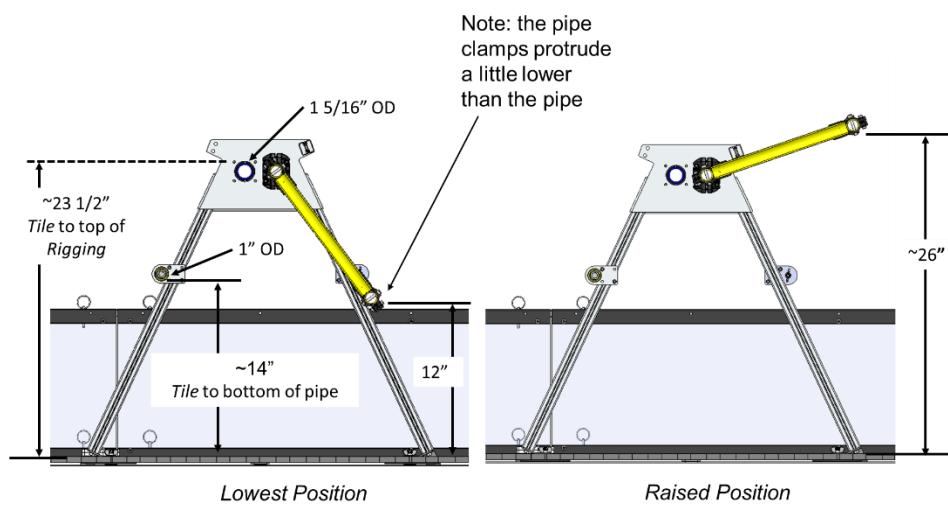


### C-4 Truss and Rigging



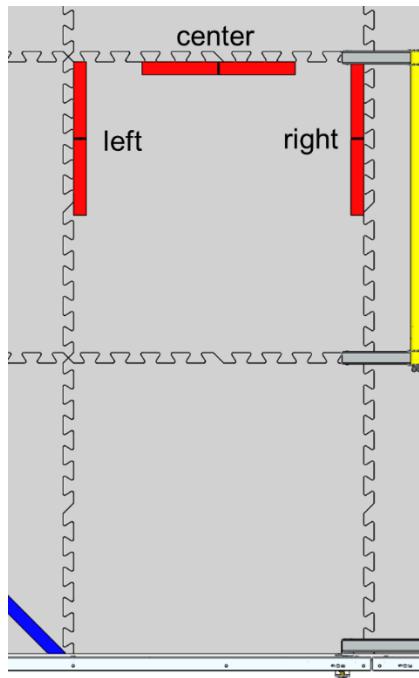
Dimensions are for reference only; actual dimensions may vary slightly from field to field.

### 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



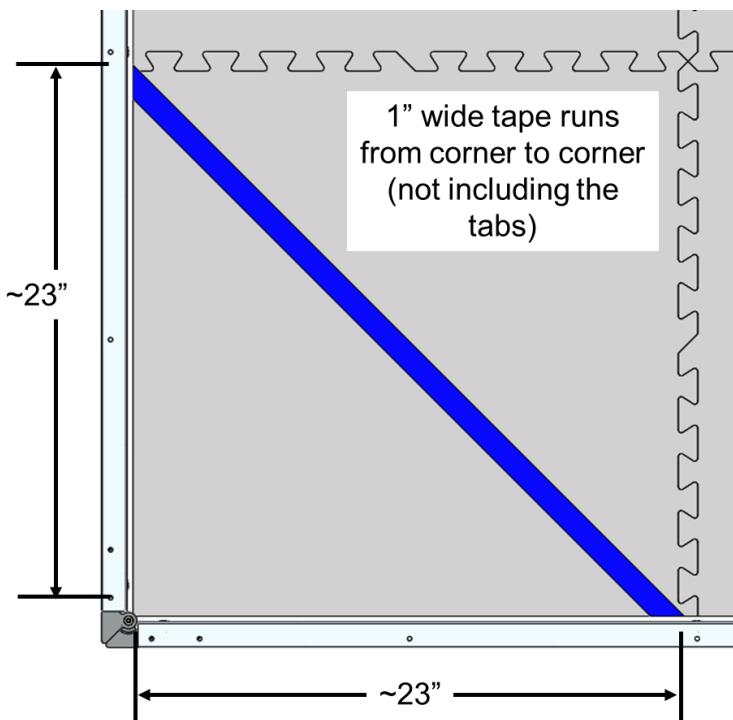
~1 inch wide by 12" long tape strips.

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

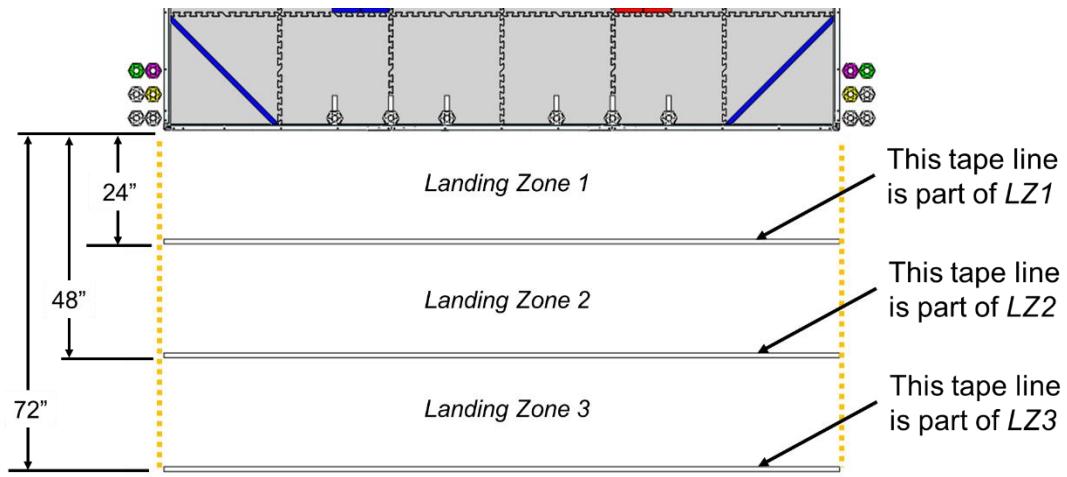
The center strip is centered on the *Tile*

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

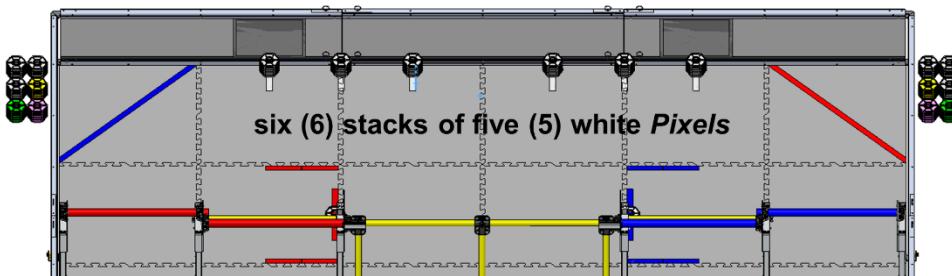
**C-7 Spike Marks, typical**



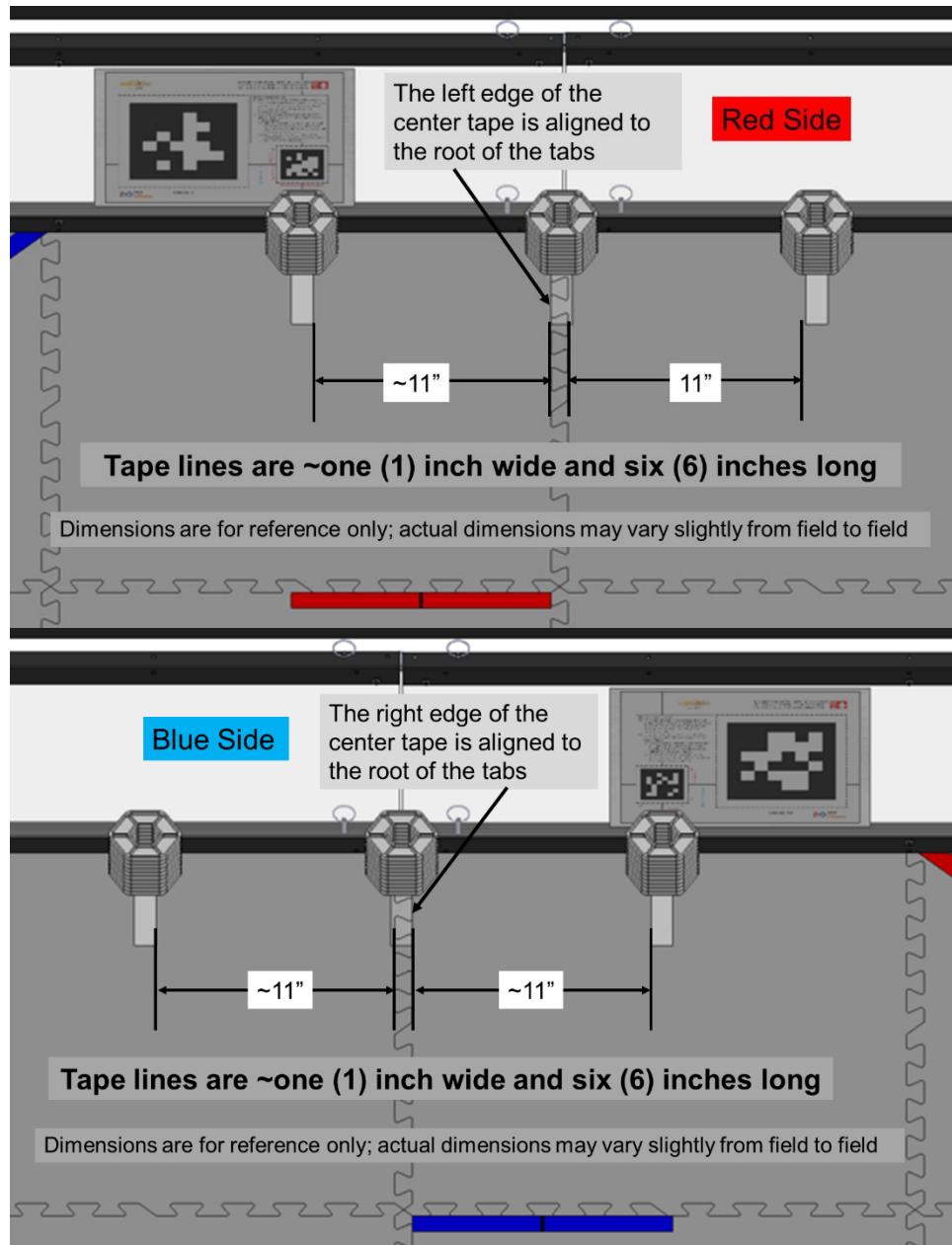
**C-8 Wing typical**



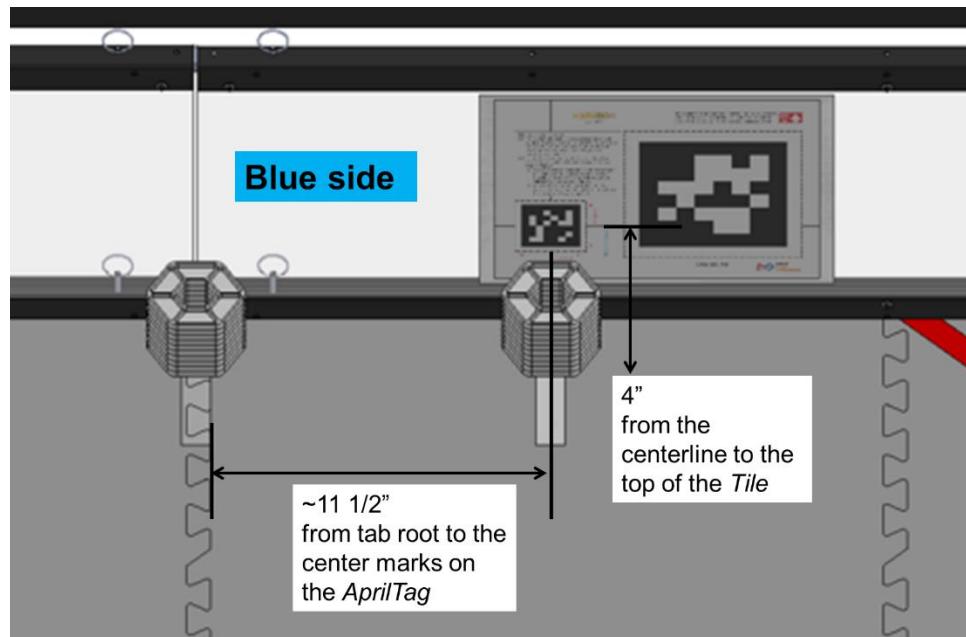
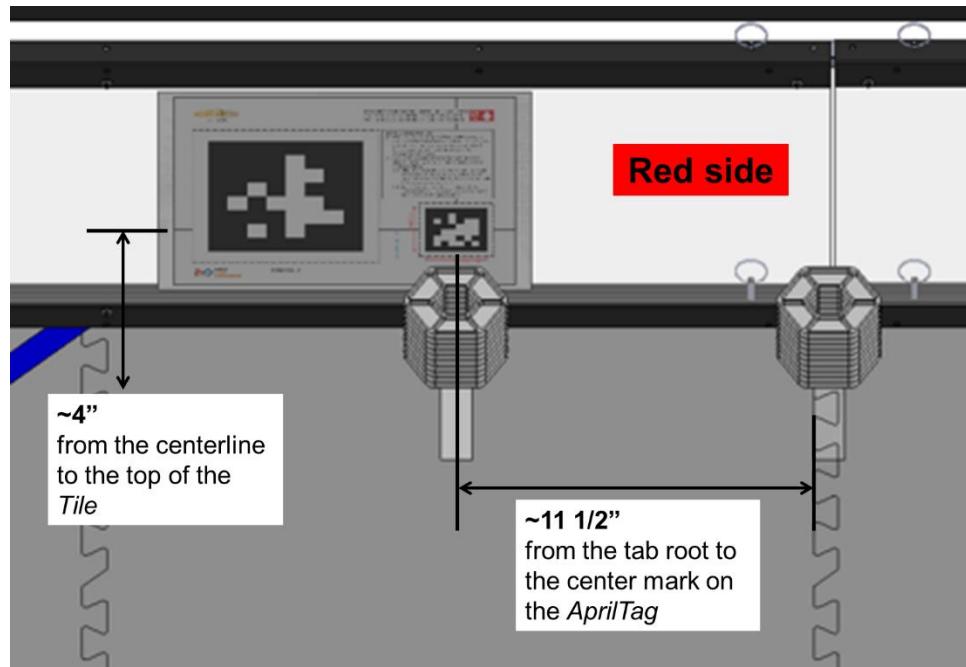
**C-9 Landing Zones**



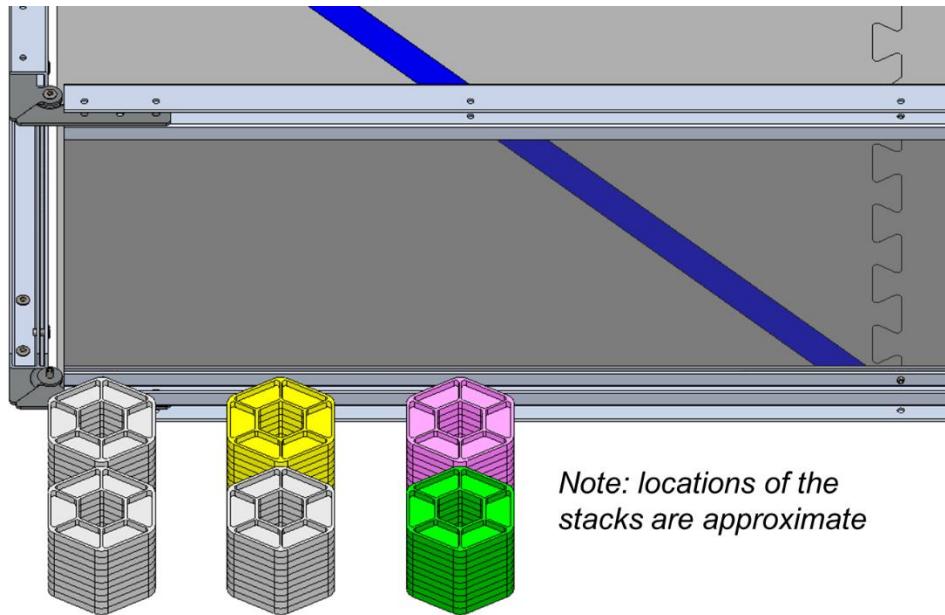
**C-10 Pre-Match setup of on-field Pixels**



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



**C-12 Location of Wall AprilTags**

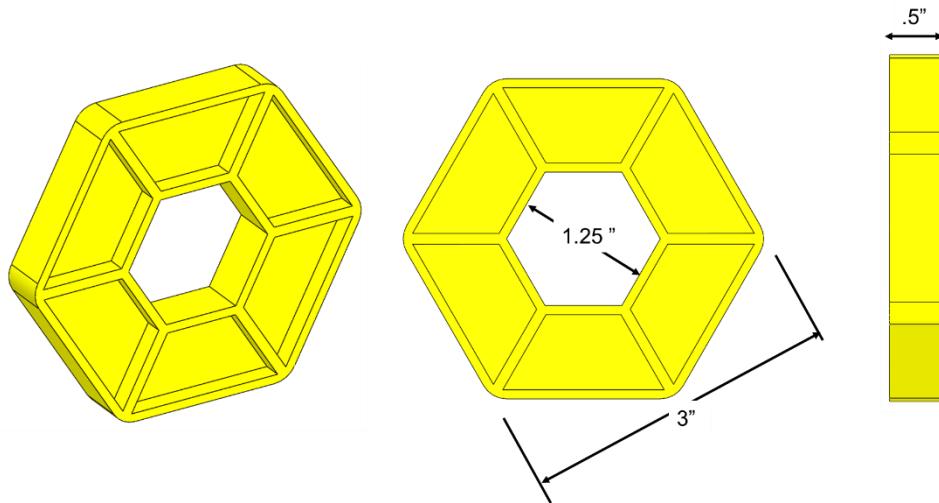


*Note: locations of the stacks are approximate*

- 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*

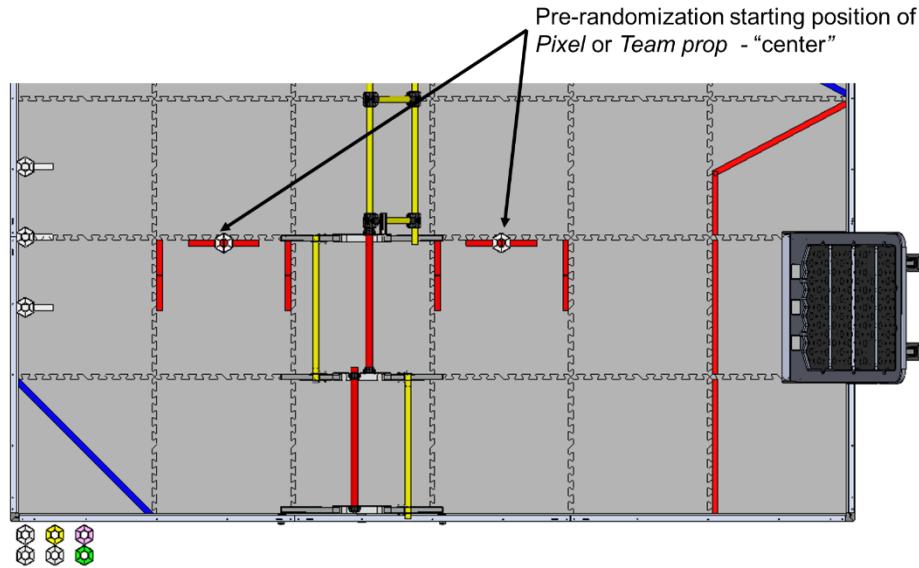
### C-13 Pre-Match setup of *Pixel Storage*

## Appendix D – Scoring Element

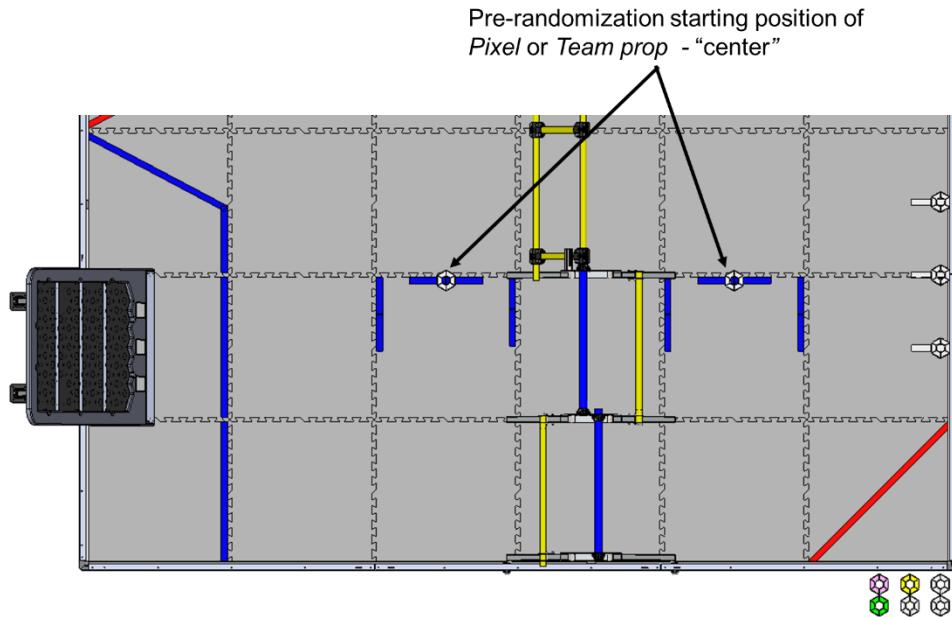


**D-1 Pixel**

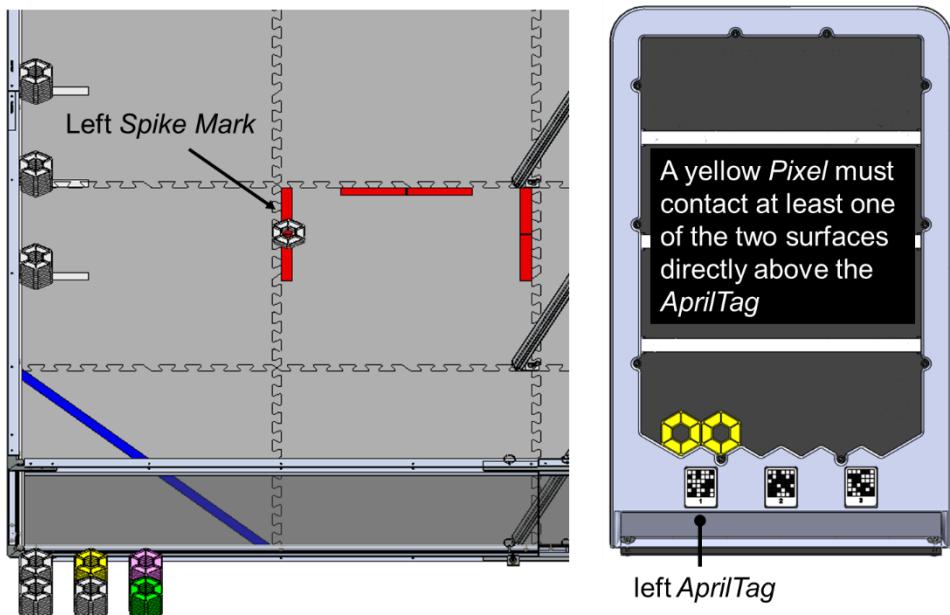
## Appendix E – Randomization



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

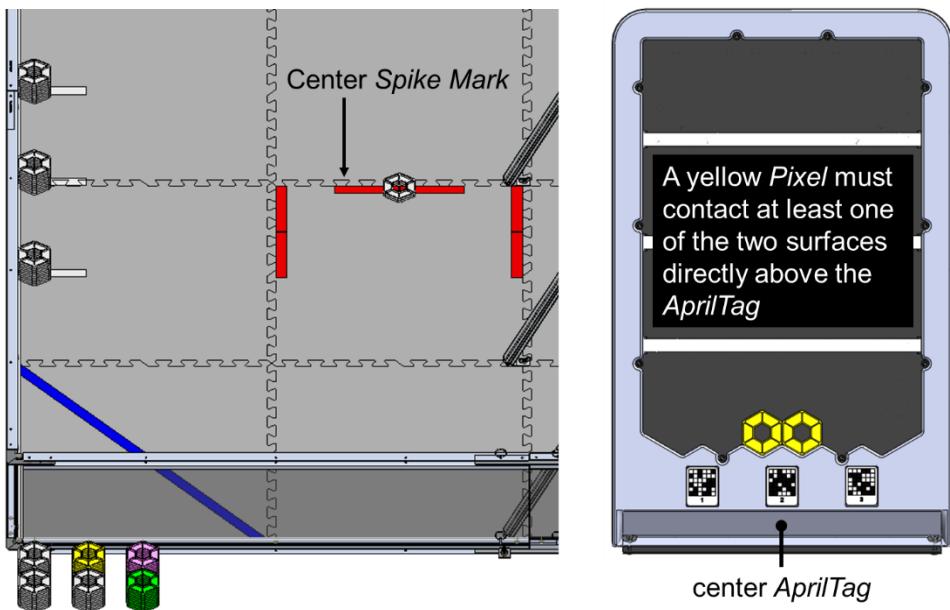


**E-2 – Randomization Objects – pre-randomization starting position - blue Alliance**



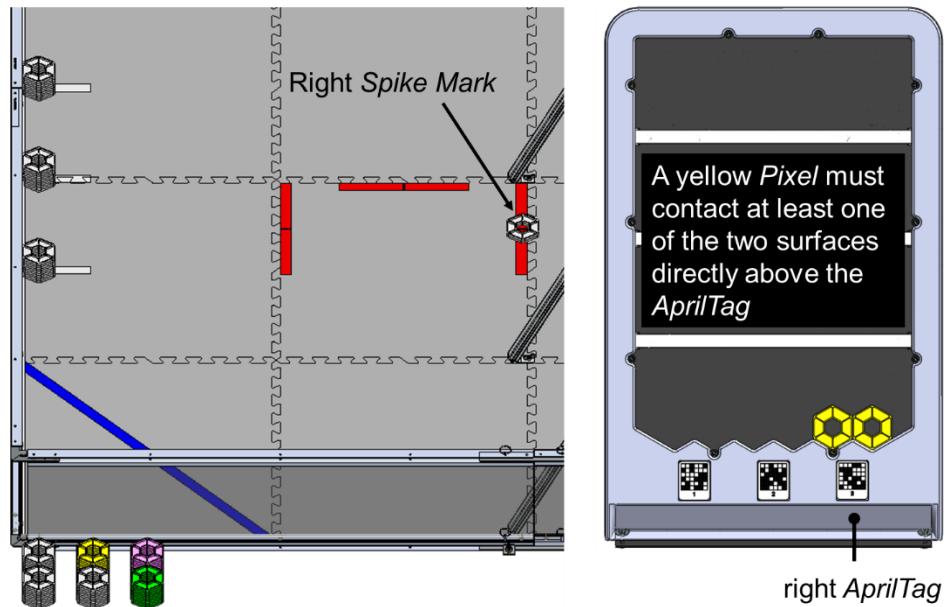
**Randomization Object- left side scoring locations**

### E-3 – left side Scoring



**Randomization Object- center scoring locations**

### E-4 – center Scoring

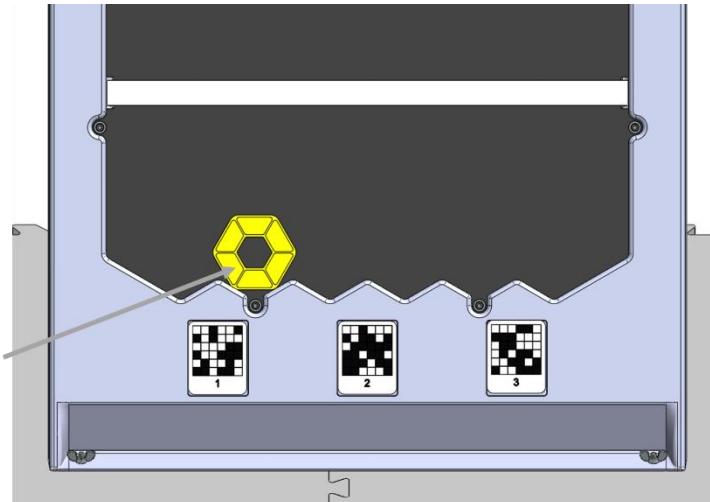


**Randomization Object- right side scoring locations**

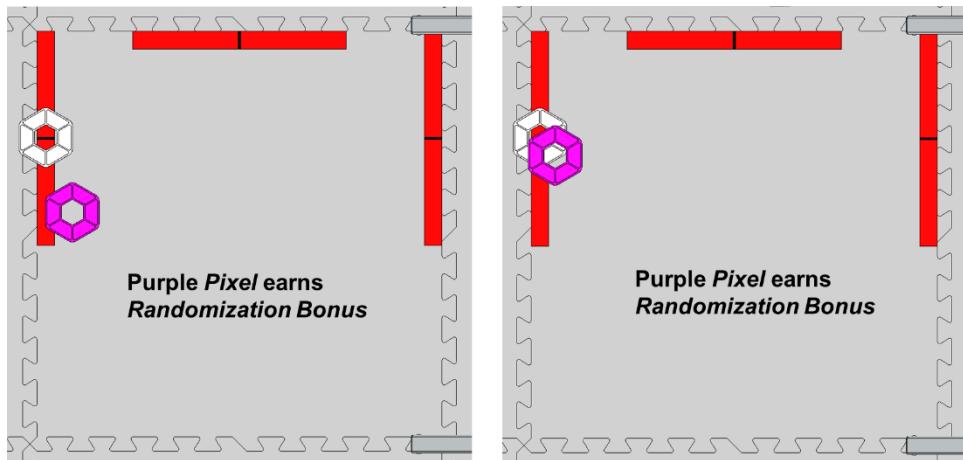
### E-5 – right Scoring

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

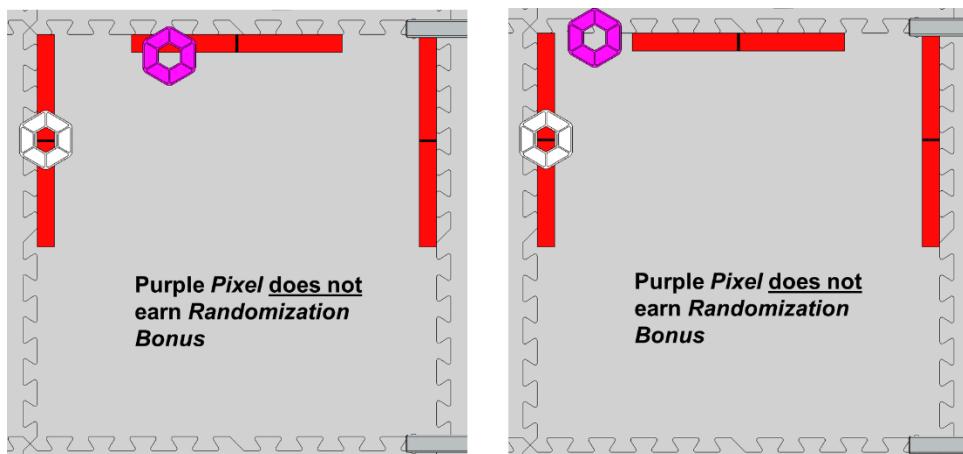
This is a legally scored Pixel and earns the autonomous points



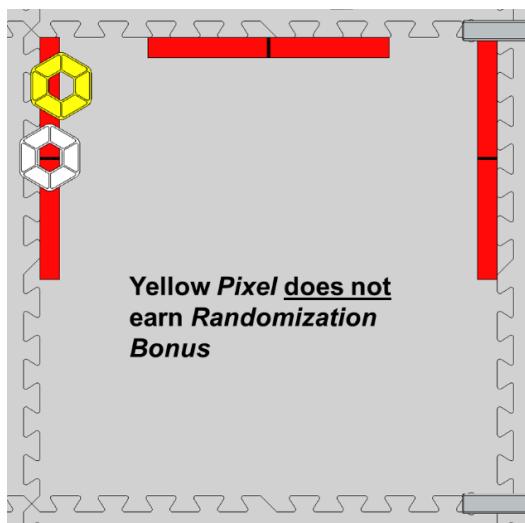
### E-6 – Pixel position



### E-7 – Scoring Examples

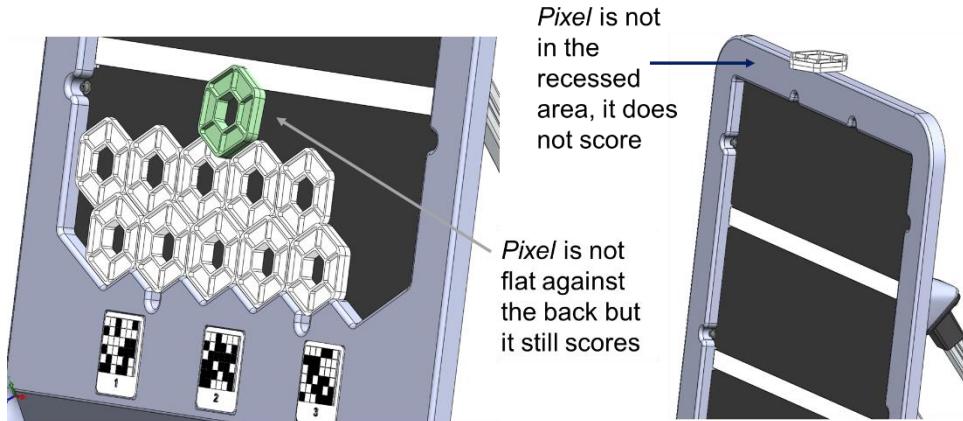


### E-8 – Scoring Examples

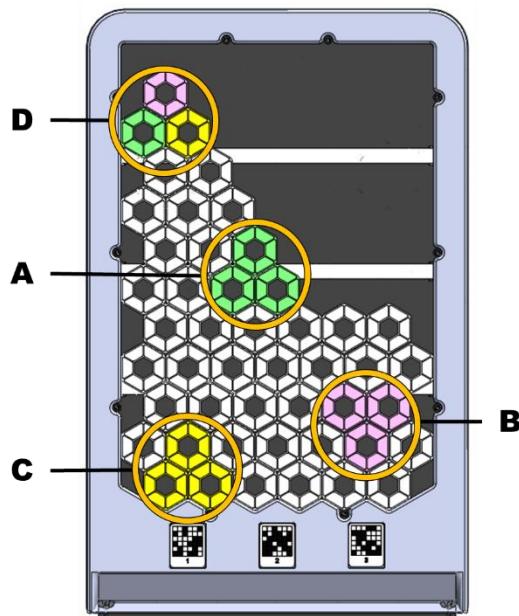


### E-9 – Scoring Examples

## Appendix F – Scoring Examples



**F-1 Pixel Scoring**

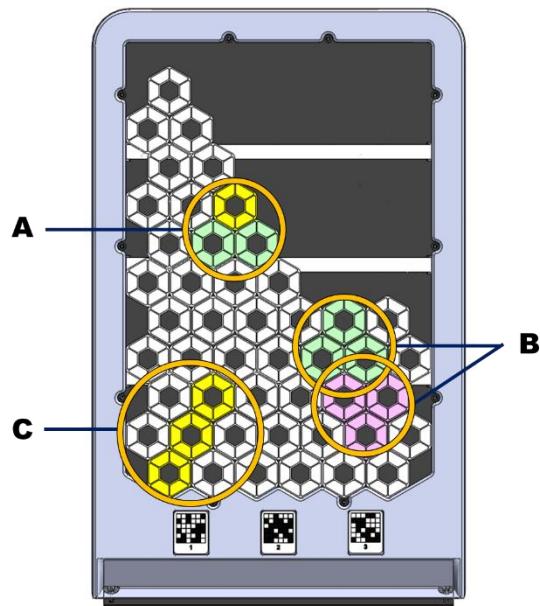


**Legal Mosaics:**

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*.

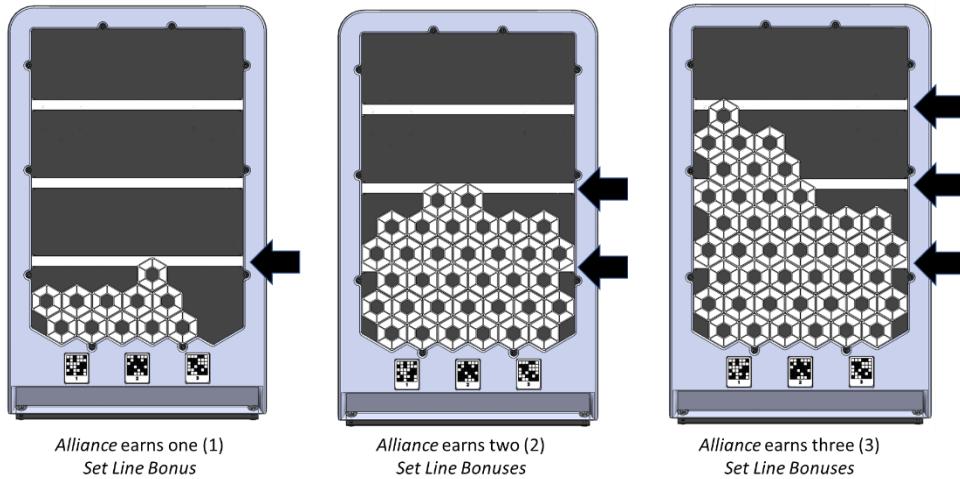
**F-2 Mosaics**



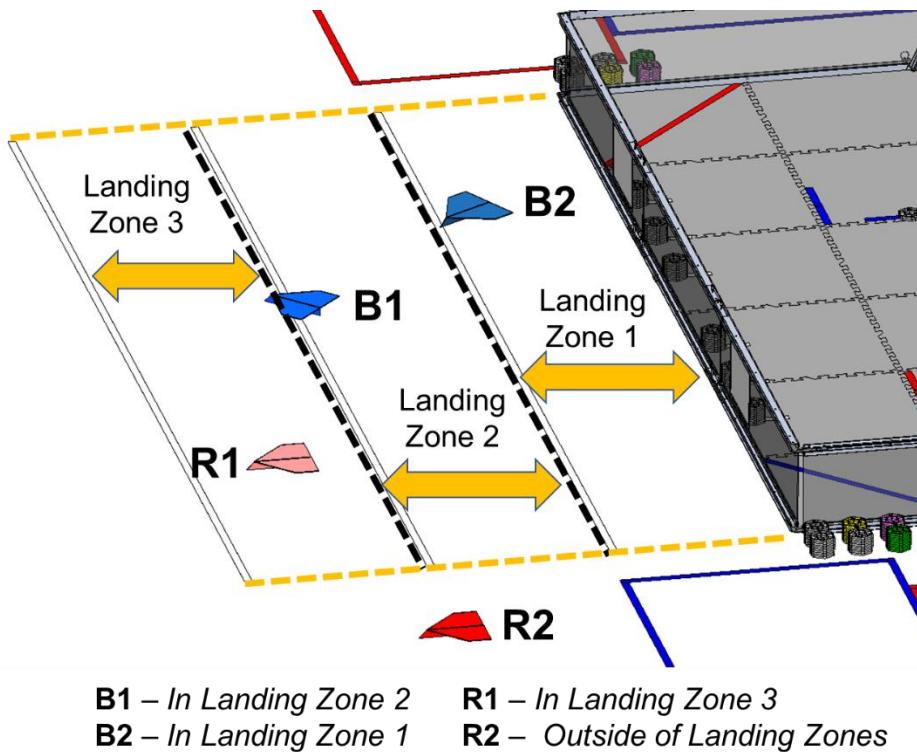
**Not legal Mosaics:**

- 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**

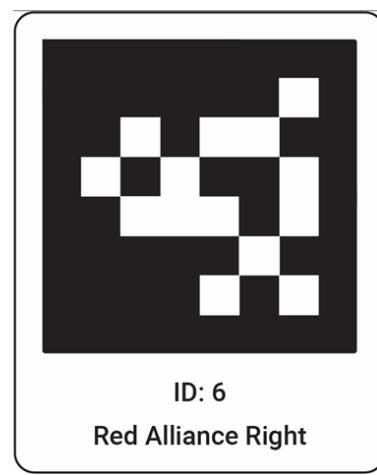
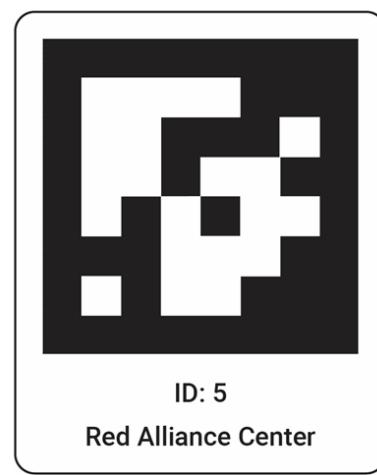
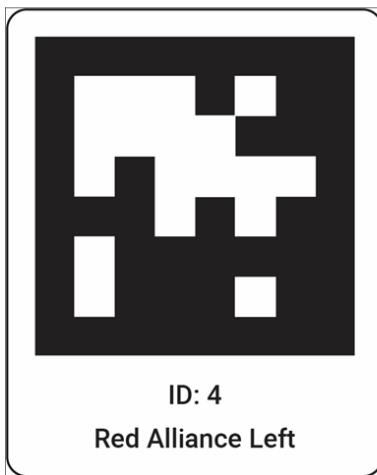
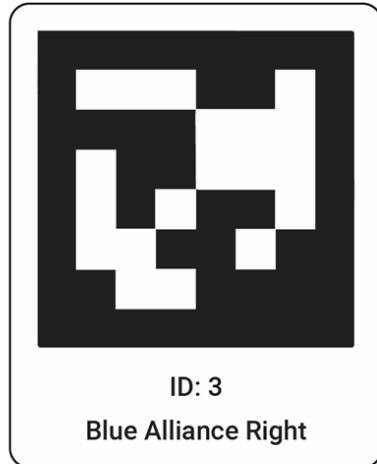
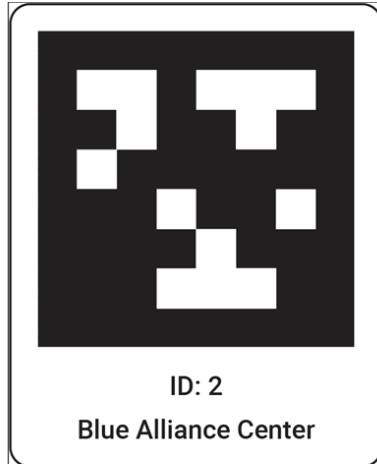
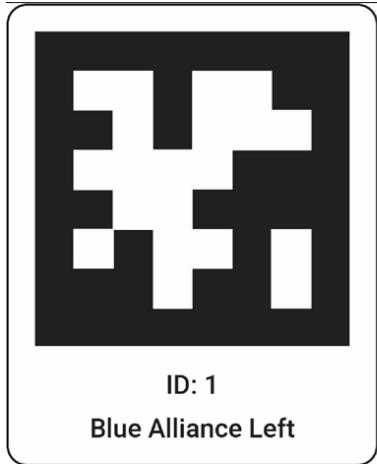


**F-4 Set Bonus**



### F-5 *Landing Zone Scoring*

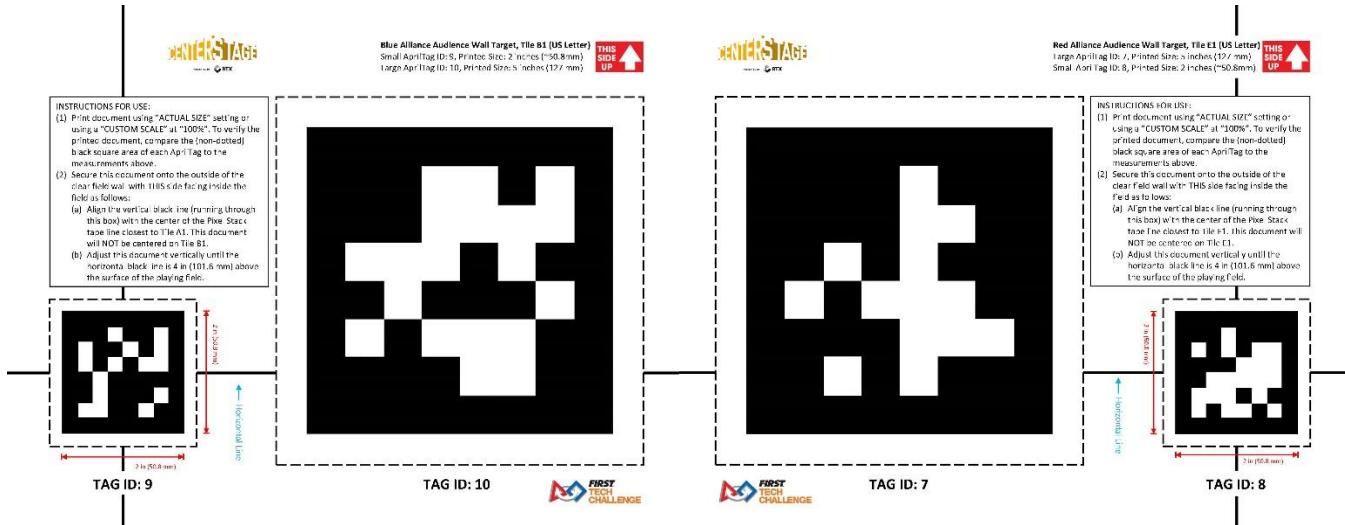
## Appendix G – AprilTags



**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.**