FIRST TECH CHALLENGE

POWER PLAY

PRESENTED BY Raytheon Technologies

FIRST® ENERGIZE℠
presented by Qualcomm

firstinspires.org/robotics/ftc

2022-2023 *FIRST*® Tech Challenge

Game Manual Part 2 – Traditional Events

Sponsor Thank You

Thank you to our generous sponsors for your continued support of the *FIRST*® Tech Challenge!

Revision History		
Revision	**Date**	**Description**
1	8/26/2022	International Program Delivery Partner release

1.1	8/31/2022	• Program Delivery Partner Release
		• Figure 4.2.1 – New image with navigation images included on field perimeter walls
		• Section 4.4.6 – Penalty points are added to the non-offending alliances score
		• Appendix C
		  ○ Updated image C-6; Junction locations
		  ○ Added image C-11; dimensions for navigation images

1.2	9/10/2022	• Kickoff Release
		• Section 4.3
		  ○ Edited definition of Penalty – points are added to the non-offending alliances score
		  ○ Updated Juntction height measurements
		• Section 4.5.3 – Added <GS1>c, exception to rule <G6>

Contents

Contents 3
1.0 Introduction 5
What is *FIRST*® Tech Challenge? 5
2.0 *Gracious Professionalism*® 5
3.0 How to Use This Document 5
4.0 The Game 6
4.1 Introduction 6
4.2 Game Description 6
4.2.1 Field Illustration 6
4.2.2 Gameplay Overview 7
4.2.3 Gameplay Technology 8
4.3 Game Definitions 8
4.4 Gameplay 14
4.4.1 Pre-*Match* 14
4.4.2 *Autonomous Period* 15
4.4.3 Driver-Controlled Period 16
4.4.4 End Game 17
4.4.5 Post Match 17
4.4.6 Penalties 17
4.4.7 Flowchart of *Match* Play 18
4.5 Rules of Gameplay 18
4.5.1 Safety Rules 18
4.5.2 General Game Rules 19
4.5.3 Game-Specific Rules 24

4.6 Scoring Summary 28
4.7 Rule Summary 29
Appendix A – Resources 36
Game Forum Q&A 36
Volunteer Forum 36
FIRST Tech Challenge Game Manuals 36
FIRST Headquarters Pre-Event Support 36
FIRST Websites 36
FIRST Tech Challenge Social Media 36
Feedback 36
Appendix B – *Playing Field* Locations 37
Appendix C – *Playing Field* Details 39
Appendix D – *Scoring* Element 44
Appendix E – Randomization 45
Appendix F – *Scoring* Examples 48
Appendix G – *Navigation Images* 55

1.0 Introduction

What is FIRST® Tech Challenge?

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

2.0 *Gracious Professionalism®*

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

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

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

3.0 How to Use This Document

The Game Manual Part 2 – Traditional Events is a resource for all *FIRST*® Tech Challenge *Teams* for information specific to the 2022-2023 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 POWERPLAY℠ presented by Raytheon Technologies, the *FIRST*® Tech Challenge game for the 2022-2023 season. We recommend viewing the game animation prior to reading this manual to gain a general understanding of the game. The animation is not intended as a replacement for 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* rules, and general competition rules.

4.2 Game Description

4.2.1 Field Illustration

The following illustrations identify the *Game Elements* and give a general visual understanding of the game. *Teams* should refer to andymark.com/FTC for the exact *Game Element* dimensions. The official *Playing Field* documents, including the official Field Setup and Assembly Guide, are available at https://www.firstinspires.org/resource-library/ftc/game-and-season-info. Please note: *Playing Field Wall* heights are different depending on the manufacturer. *Playing Field Wall* height measurements for each manufacturer are in the official Field Setup and Assembly Guide. During the season, *Teams* may attend events that use *Playing Field Walls* from different manufacturers, please incorporate that into the design of your *Robot*.

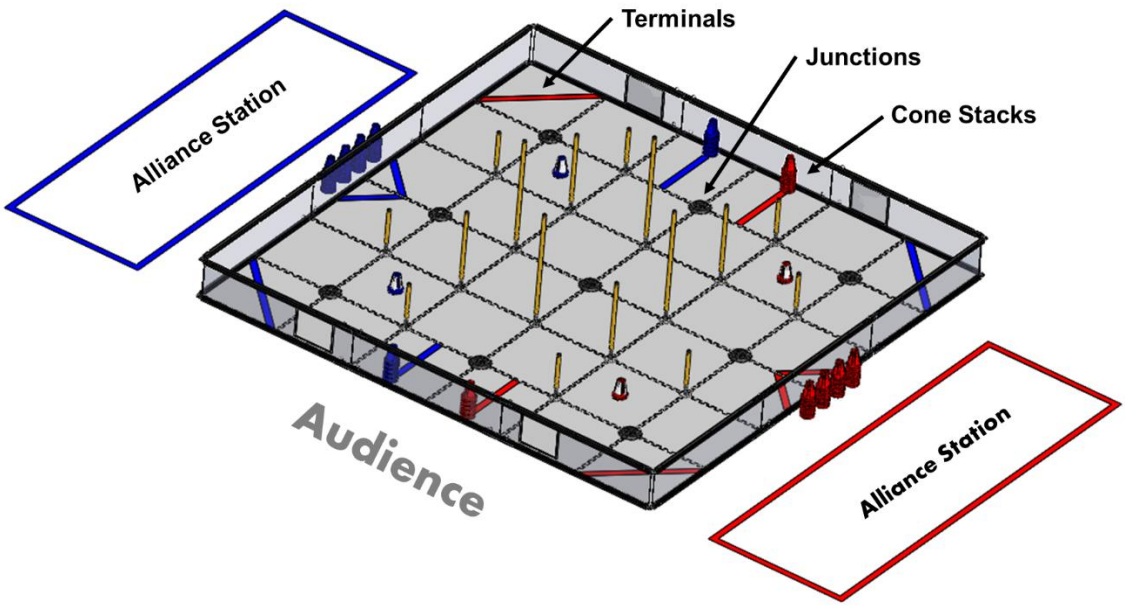


Figure 4.2-1 – Isometric view of the *Playing Field*

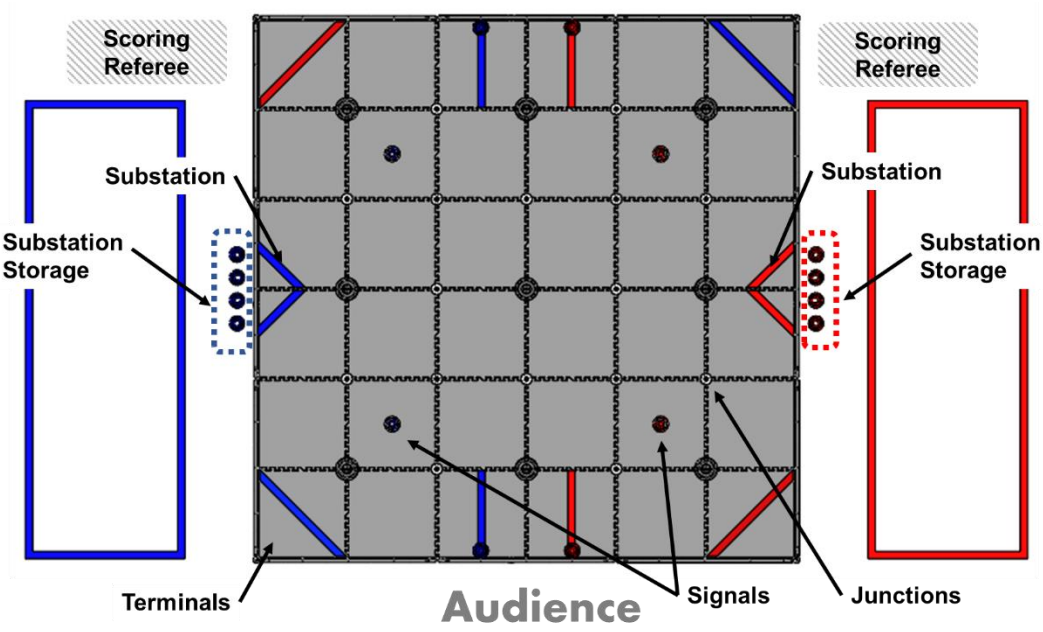


Figure 4.2-2 – Top view of the *Playing Field*

4.2.2 Gameplay Overview

Welcome to POWERPLAY℠ presented by Raytheon Technologies. *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. Each *Cone* placed in a *Terminal* or on a *Junction* earns points.
2. *Navigating* to their *Alliance Terminal* or *Alliance Substation*.
3. *Alliances* can also earn points by *Parking* in the *Signal Zone* that corresponds with the randomly selected indicator image, and *Teams* that use the *Team-supplied Signal Sleeve* earn more points for this task.

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

1. Placing *Cones* on *Junctions.*
2. *Owning* a *Junction.*
3. Creating a continuous *Circuit* of *Junctions* from one *Alliance Terminal* to the other matching *Alliance Terminal.*

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. *Capping* a *Junction.*
2. *Parking* in their *Alliance Terminal*.

4.2.3 Gameplay Technology

Each game comes with its own unique set of challenges. In POWERPLAY℠ 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) The *Robot* can use its on-board control system to identify an object.
    b) *Teams* can use the built-in TensorFlow technology to identify the images on the *Signal.*
2. Field Navigation
    a) *Robots* can use the *Navigation Images* along with the built-in vision processing software, Vuforia, and an on-board camera to help identify their location on the field. This is especially useful during the *Autonomous Period*.
    b) Tape on the *Playing Field Floor* helps *Robots* with color and/or vision sensors locate the *Cone* stacks, *Terminals*, and *Substations*.
3. Sensor Use
    a) *Teams* can add sensors to their *Robot* to help it identify the *Cones* and *Junctions.*

For resources on how to use the available technologies, please visit https://github.com/FIRST-Tech-Challenge.

4.3 Game Definitions

The following definitions and terms are used for POWERPLAY℠. Game definitions are Capitalized and *italicized* throughout the manual.

Alliance – Each *FIRST* Tech Challenge *Match* consists of two, two-*Team Alliances*. 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*. For qualifying and championship tournaments with 21 or more *Teams*, the semi-final and final *Match Alliances* consist of three *Teams* each. However, only two of those *Teams* compete during any one *Match*.

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* adjacent to the *Playing Field* where the *Drive Team* stand during a *Match*.

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.

Beacon – The *Team Scoring Element* for this season. A *Team* designed and manufactured part that may be used in the *Match*. A detailed definition of *Team Scoring Element* is in section 7.4 of the Game Manual Part 1. Compliance with construction rules will be verified during *Robot Inspection*. *Robots* use the *Beacon* to permanently *Own* a *Junction* by *Capping* the *Junction* during the *End Game.*

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*.

Brace - Stabilizing (without grasping) a *Cone* or stack of C*ones* to maintain their position while a *Robot* is attempting to *Score*.

Cap/Capping - Placing a *Beacon* on a *Junction* to indicate permanent *Ownership* and to prevent *Scoring* additional *Cones* or *Beacons* on that *Junction*. Note: *Capping may* change *Ownership* of a *Junction*. A *Junction* is successfully *Capped* when one of the following conditions is satisfied:

a) *Beacon* is *Completely On* a *Junction*.

b) *Beacon* is *Completely On* a *Scored Cone* on a *Junction*.

c) *Beacon* is *Completely* around the circumference of a *Junction* pole.

Circuit – A continuous path of *Connected Alliance Owned Junctions* that links the two (2) matched *Alliance Owned Terminals.* See Appendix F for examples.

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, 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*.

Cone – A *Game Element* that is 4 inches (10.16 cm) in diameter at the base and 5 inches (15.2 cm) tall. It weighs 2.55 oz. (72.4 grams). The game is played with sixty (60) *Cones*, thirty (30) red and thirty (30) blue.

Connect/Connection – A *Connection* is formed when two (2) adjacent *Junctions* or a *Terminal-Junction* pair are *Owned* by the same *Alliance.* See Appendix F-1.

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) *Propelling 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.

c) *Herding* of *Game Elements* is considered *Control.* See also the definition of *Herding* in this section.

d) *Trapping* one or more *Scoring Elements* against a *Game Element*, *Playing Field Wall*, or *Robot* to shield or guard them. See also the definition of *Trapping* in this section.

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

e) *Plowing* of *Game Elements* is not considered *Control.* See also the definition of *Plowing* in this section.

f) *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 S*tudent 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 period 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.

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 *Junctions*, *Cones*, *Signals*, *Signal Sleeves*, *Navigation Images*, and *Beacons.*

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.

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.

Junction – There are twenty-five (25) *Alliance Neutral Junctions*. There are four types of *Junctions*:

a) *Ground Junction:* A 6 inch (152 mm) diameter disc with a 4.25 inch (108 mm) diameter x 0.47 inch (12.7 mm) recess. There are nine (9) *Ground Junctions* on the *Playing Field.*
b) *Low Junction:* A spring-mounted 1 inch (25.4 mm) diameter pole that is 13.5 inches (343 mm) tall. There are eight (8) *Low Junctions* on the *Playing Field.*
c) *Medium Junction:* A spring-mounted 1 inch (25.4 mm) diameter pole that is 23.5 inches (597 mm) tall. There are four (4) *Medium Junctions* on the *Playing Field.*
d) *High Junction:* A spring-mounted 1 inch (25.4 mm) diameter pole that is 33.5 inches (851 mm) tall. There are four (4) *High Junctions* on the *Playing Field.*

Note: The at rest vertical angle of the pole may vary from *Match* to *Match* and during gameplay.

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.

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

Navigation Image - Four (4) unique images mounted on the *Playing Field Walls* that *Robots* can use to navigate around the *Playing Field*. Images are printed on standard letter size paper, 8 1/2 inches x 11 inches (216 mm x 279 mm) or A4 (210 mm x 297 mm) paper. Images are mounted on the outside of the *Playing Field* as described in Appendix G.

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*.

Own / Owned – An *Alliance Owns a Junction* when that *Alliance* has the top *Scored Cone* or a *Scored Beacon* on that *Junction*. A *Terminal* is O*wned* when it has at least one (1) *Scored Cone.*

Park / Parked – The condition where a *Robot* 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 4.6, *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*.

Playing Field – The part of the *Competition Area* that includes the 12 ft. x 12 ft. (3.66 m x 3.66 m) field and all the *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* will vary depending on which *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 *Herding* 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*.

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

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 a*chievement is stated in the achievement's description in Section 4.4. Individual *Scoring* achievements are determined by one of three methods:

a) ***Scored as Completed***: The achievement is considered *Scored* the moment it is successfully completed, i.e., all criteria are met.

b) ***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).*

c) ***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 the POWERPLAY[SM] are *Cones* and *Beacons*. A *Signal* is not a *Scoring Element*.

Secured – A *Cone* is *Secured* in a *Ground Junction* when the 4-inch diameter base of the *Cone* is *Completely In* the recess of the *Junction or Completely On a Secured Cone*. A *Cone* is *Secured* in a *Low, Medium,* or *High Junction* when the pole passes through the 1.25" diameter hole of the *Cone or it is Completely On a Secured Cone*. A *Cone* is *Secured* only if the large opening is facing toward the *Playing Field Floor.*

Signal – A *Game Element* that is constructed from a standard *Cone.* The *Signal* is 4 inches (10.16 cm) in diameter (base) and 5 inches (15.2 cm) tall. It weighs approximately 2.55 oz. (72.4 grams). There are four (4) *Signals*, two (2) red and two (2) blue. Each *Signal, regardless of color,* has the same set of three specific images, 120 degrees apart. The *Signal* is used only during the *Autonomous Period* to indicate the randomization state and may not be *Scored.* A *Signal* is not a *Scoring Element*.

Signal Sleeve – A *Team* designed and manufactured *Game Element* that *Teams* may choose to use in the *Match*. A detailed definition of the *Signal Sleeve* is in section 7.4 of the Game Manual Part 1 – Traditional Events. Compliance with construction rules will be verified during *Robot* Inspection. The *Signal Sleeve* is used to cover the Tournament supplied *Signal* images with *Team*-provided images that are different from the Tournament-supplied images for use during the *Autonomous Period*.

Signal Zone – A location on the *Playing Field* that *Robots Navigate* to during the *Autonomous Period*. There are three (3) distinct *Signal Zones* per *Robot*, each one corresponding to an image on the *Signal or Signal Sleeve.* See Appendix E, Figure E-3 for details.

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

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

Substation - Taped off locations on the *Playing Field* where the *Human Player* places *Cones* or *Beacons*. There are two (2) *Substations*, one (1) red and one (1) blue.

Substation Storage – The designated area outside of the *Playing Field* directly adjacent to the *Substation* (see Figure 4.2-2) where the *Teams' Beacons* and additional *Cones* are stored to be introduced by the *Human Player.* There are two (2*) Substation Storage* areas*,* one (1) red and one (1) blue*.*

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.

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

Terminals – Taped off *Scoring Areas* on the *Playing Field.* There are four (4) *Alliance Specific Terminals,* two (2) red and two (2) blue.

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.*

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.

Warning - *Warnings* apply to the entire *Team. Warnings* have no effect on an *Alliance's Score*. Individual actions of a single *Team* member will count as a *Warning* for the entire *Team*.

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*, return *Possessed 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.
    a) One (1) *Signal* is placed at each *Signal* location with image **1** facing the closest *Alliance Station.*
    b) Ten (10) red *Cones* are placed in two (2) stacks of five (5) *Cones* each *Inside* the *Playing Field.*
    c) Ten (10) blue *Cones* are placed in two (2) stacks of five (5) *Cones* each *Inside* the *Playing Field.*
    d) Twenty (20) red *Cones* are placed in four (4) stacks of five (5) *Cones* each in the red *Substation Storage Area*.
    e) Twenty (20) blue *Cones* are placed in four (4) stacks of five (5) *Cones* each in the blue *Substation Storage Area*.

2) *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 *Robots* must start *Completely In Tile* A2 or A5, red *Robots* must start *Completely In Tile* F2 or F5. 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 Cones*** – *The Drive Team* may *Pre-Load* exactly one (1) *Cone*. If used, a *Pre-Loaded Cone* is taken from *Substation Storage*.

   c) ***Beacon*** – The *Team's Beacon* corresponding to its *Alliance* color is placed in *Substation Storage*.

   d) ***Signal Sleeve*** – *Drive Teams* intending to use their *Signal Sleeve* must place it *on top of the Signal* closest to their *Robot* with "*Team* Image **1**" (see Appendix E, Figure E-7, for *Signal Sleeve* nomenclature) facing the associated *Alliance Station.*

   e) **Op Mode** – *Drive Teams* use their *Driver Station* Android device to:

      i. Select an *Autonomous* Op Mode. If the *Team* does not have an *Autonomous* Op mode, steps ii and iii can be skipped.

      ii. The thirty-second timer must remain enabled.

      iii. Press the *Driver Station* "Init" button.

      iv. *Robot* must be motionless prior to the start of the *Match*.

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

3) 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) Field personnel will rotate the *Signal* into one of three (3) orientations that is randomly chosen by the scoring system or by a die throw as specified in Appendix E. All *Signals* will have the same orientation as seen from their associated *Alliance Station*. Each *Robot* will see the same image.

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*** –
    a) A *Robot Parked In* their *Alliance's Substation* earns two (2) points.
    b) A *Robot Parked In* their *Alliance's Terminal* closest to the *Alliance Station* earns two (2) points.
2) ***Cone*** – *Robots* placing *Cones* earn points as follows:
    a) Each *Cone* placed *In* its matching color *Terminal* closest to the *Alliance Station* earns one (1) point.
    b) Each *Cone Secured* (see Appendix F) on a *Junction* earns points as follows:
        i. *Ground Junction*: two (2) points.
        ii. *Low Junction*: three (3) points.
        iii. *Medium Junction*: four (4) points.
        iv. *High Junction*: five (5) points.
3) ***Signal Bonus*** – *Robots* earn points for *Parking Completely In* their *Alliance's Signal Zone* that corresponds to the randomly selected *Signal* image (see Appendix E). An *Alliance's Signal Zones* are on the half of the field closest to/in front of their *Alliance Station*.
    a) If using the *Playing Field*-supplied *Signal*, a *Robot* will earn ten (10) points.
    b) If using the *Team*-supplied *Signal Sleeve*, a *Robot* will earn twenty (20) points.

Cones 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) ***Cone –*** *Robots* placing *Cones* earn points as follows:
    a) Each *Cone* that is placed *In* its matching color *Terminal* earns one (1) point.
    b) Each *Cone Secured* (see Appendix F) on a *Junction* earns the following points for the *Alliance* designated by the *Cone* color.
        i. *Ground Junction:* two (2) points.
        ii. *Low Junction:* three (3) points.
        iii. *Medium Junction:* four (4) points.
        iv. *High Junction:* five (5) 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*. A *Beacon* introduced into the *Playing Field* prior to the start of the *End Game* is not eligible for *Scoring*. All other achievements can be started at any time.

End Game tasks are *Scored at Rest.*

1) ***Junction Ownership –*** *Alliances* earn points for *Owning* a *Junction*. There are two mutually exclusive ways to *Own* a *Junction*:
    a) *Ownership* conveyed by the top *Scored Cone* is worth three (3) points; or
    b) *Ownership* conveyed by a *Beacon* successfully *Capping* a *Junction* earns ten (10) points.

    If both (a) and (b) are met, a *Beacon* (condition b) takes precedence over the top *Scored Cone* (condition a).

    Subsequent *Beacons or Cones* placed on the *Junction* after it is *Capped* have zero (0) *Score* value and do not change *Ownership*.
2) ***Circuit –*** A completed *Circuit* earns the *Alliance* twenty (20) points. Only one (1) *Circuit* bonus per *Alliance* can be earned per *Match.*
3) ***Navigating –*** A *Robot Parked In* either of their *Alliance's Terminals* earns two (2) points.

4.4.5 Post Match

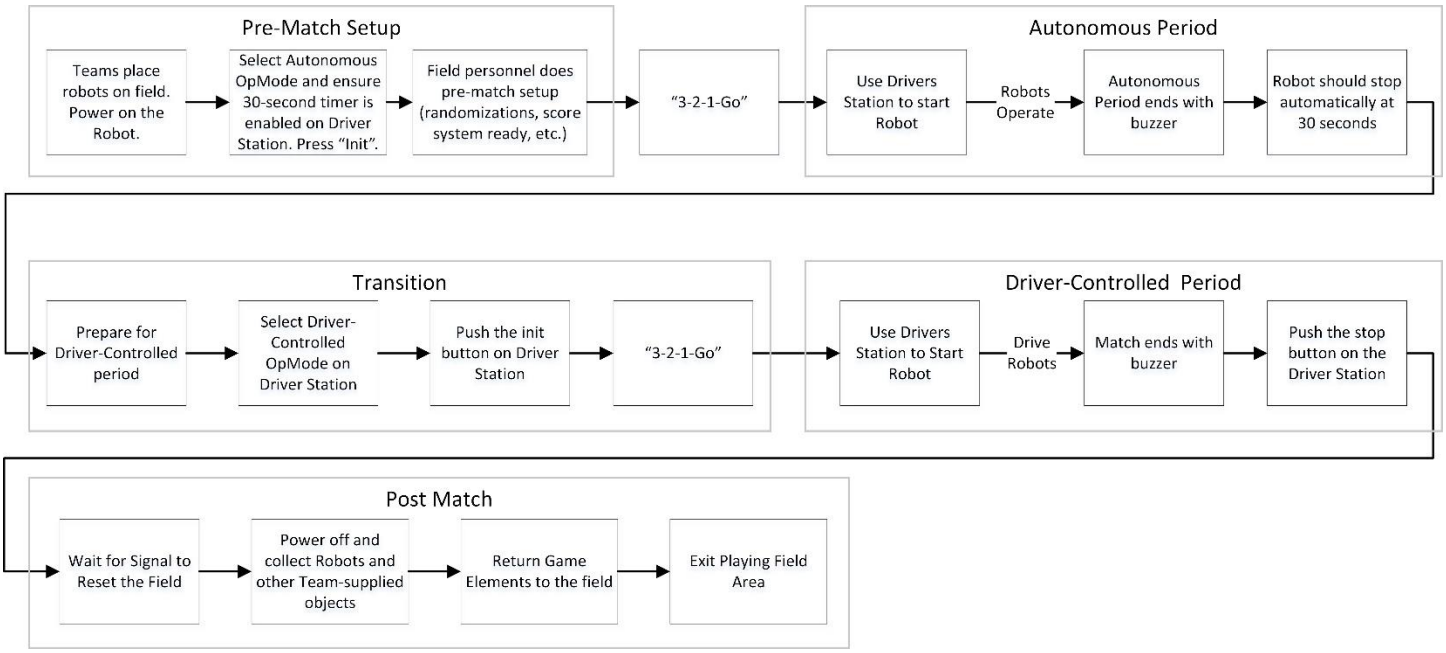
After the *Match*, *Field Personnel* will finalize the *Score*. Referees will signal for the *Drive Teams* to enter the *Playing Field* and retrieve their *Robots*, *Team Signal Sleeves* and *Beacons*. *Drive Teams* should return any *Game Elements* that are *Possessed* by the *Robot* to the *Playing 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's 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 *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

<S1> 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.*

<S2> *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 4.6.3. See the game definitions in section 4.4 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.

<S3> Safety Gear – All members of the *Drive Team* are required to wear approved eye protection and shoes with closed toed 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* member violations during the competition will escalate to a *Team Warning*. Following the *Team Warning*, subsequent violations by any member of the *Team* will result in a *Minor Penalty* for the *Alliance*.

4.5.2 General Game Rules

<G1> *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.

<G2> *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.

<G3> 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*.

<G4> *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*.

<G5> *Robot* or *Scoring Elements In* Two or More *Scoring Areas* – *Robots* or *Scoring Elements* that are *In* two or more *Scoring Areas* earn points only for the highest value achievement. If the achievement values are equal, only one achievement counts as *Scored*.

<G6> *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.

<G7> *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*.

<G8> *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.

<G9> *Match* Replay – *Matches* are replayed at the discretion of the head referee only for a failure of a non-*Team* supplied *Game* or *Field Element* or verified Wi-Fi interference that was likely to have impacted *Match Scores* for Qualification *Matches* or which *Alliance* won the *Match* for Elimination *Matches*.

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 field 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*. After *Robots* are set up on the *Playing Field*, *Drive Teams* must stand *Inside* their respective *Alliance Station*.

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

b) During the Elimination *Matches*, the 3rd and 4th seeded *Alliance Robots* are set up on the *Playing Field* first, unless the higher seeded *Alliance* waives their right to set up on the *Playing Field* second. *Alliance* color doesn't change the seeding of a *Team* during the Elimination *Matches*. If the 4th seed defeats the 1st seed in the Semi-Finals, they will still have to place their *Robot* on the field first in the finals because their seeding will be lower than the 2nd or 3rd seed.

c) During Elimination *Matches*, three *Team Alliances* may only place two *Robots* that are intended to compete in that *Match*. After the *Robots* are placed, the *Alliance* cannot swap in the 3rd *Alliance's Robot* for a *Robot* already placed.

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

e) *Teams* that unnecessarily delay the beginning of a *Match* and/or field reset will incur a *Minor Penalty* for each offense. Significant delays may escalate to a *Major Penalty* at the discretion of the head referee.

> *Drive Teams* are expected to stage their *Robots* for a *Match*, and remove it from the *Playing Field* afterwards, safely and swiftly. *Drive Team* efforts that either intentionally or unintentionally delay the start of a *Match* or the *Playing Field* reset are not allowed. Examples include, but are not limited to:
>
> - Late arrival to the *Playing Field.*
> - *Robot* maintenance once on the *Playing Field.*
>
> If the field is waiting for the *Team*, they would be subject to this *Penalty.*

<G14> *Robot* Starting Volume – Before the start of a *Match*, each *Robot* in its starting location must not exceed a volume of 18 inches (457.2 mm) by 18 inches (457.2 mm) by 18 inches (457.2 mm). 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 4.6.3.

<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 Stations* – During a *Match*, the *Drive Team* must remain *In* their *Alliance Station*.

a) *Drive Teams* may be anywhere in their respective *Alliance Station*.

b) The first instance of leaving the *Alliance Station* will result in a *Warning*, with any following instances during the *Match* resulting in a *Minor Penalty*. Leaving the *Alliance 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*.

> 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:
>
> 1) Failing to exit the *Playing Field* once instructed by a referee.
> 2) 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 following actions of the *Robot* 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 themself (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 grab, 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. Some tipping, entanglement,

and damage may occur as a part of normal gameplay. If the tipping, entanglement, or damage is ruled to be deliberate or chronic, the offending *Team* will receive a *Major Penalty* and 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*. *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*. If a referee determines this rule is violated, the offending *Alliance* will receive a *Minor Penalty* for every five seconds that they are in violation. If a referee declares *a Pinning, Trapping,* or *Blocking* violation during the *Match,* the offending *Robot* must immediately move away at least 3 feet (0.9 m), approximately 1.5 *Tiles*, from the *Pinned, Trapped, or Blocked Robot.*

A *Robot* cannot incur this type of *Penalty* during the *Autonomous Period* unless it is determined by the *Referee* to be part of a deliberate strategy and will 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*.

<G30> Egregious Behavior – Egregious *Robot* or *Team* member behavior at the *Playing Field*, as determined by the referees, will result in a *Major Penalty* and issuance of a *Yellow Card* and/or *Red Card*. Subsequent violations will result in Team disqualification from the competition. Egregious behavior includes, but is not limited to, repeated and/or flagrant violation of game rules, unsafe behavior or actions, and uncivil behavior towards *Drive Team,* competition personnel, or event attendees.

4.5.3 Game-Specific Rules

<GS1> General Rule Exceptions - The following instances of gameplay are Game-specific exceptions to General Game Rules in section 4.5.2:

a) As a part of pre-*Match Robot* placement or post-*Match Robot* retrieval*, Drive Teams* may also place or retrieve their *Team supplied Signal Sleeve* as an exception to rule <G12>*.*

b) In general, a *Disabled Robot* no longer earns *Penalties* per <G7>. However, if a *Disabled Robot Blocks* access to the *Substation*, *Penalties* will continue to apply to the *Disabled Robot* per rule <GS12>.

c) Contact with a *Cone* in a *Terminal* is allowed as an exception to rule <G6> as long as the *Cone* is not *Possessed* by the *Robot.*

<GS2> *Drive Teams* Touching *Robots* or *Driver Stations* after Randomization – *Drive Teams* are not allowed to touch or interact with their *Robots* or *Driver Station* once field personnel have begun the randomization process. If this occurs, a *Minor Penalty* will be assessed to the Alliance. The offending *Robot* is not eligible to earn the *Signal Bonus* in the *Autonomous Period*. The non-offending *Alliance* partner *Robot* remains eligible for the *Signal Bonus Scoring* achievement.

<GS3> Autonomous *Interference* - *Robots* may not *Interfere* with the opposing *Alliance's Scoring* attempts during the *Autonomous Period*. A *Major Penalty* will be assessed for each occurrence. Interactions at the centerline *Junctions* will not be considered *Interference*.

<GS4> *Launched Scoring Elements* - *Scoring Elements* may not be *Launched*. Each violation of this rule results in a *Minor Penalty*. *Rolling* or *Sliding Scoring Elements* or *Signals* is allowed.

<GS5> Descoring –

a) *Robots* may not descore opposing *Alliance Scored Cones* from *Junctions.* Each violation of this rule results in a *Minor Penalty* per *Scored Cone.*

b) *Robots* may not descore *Cones* from their opposing *Alliance's Terminals.* Each violation of this rule results in a *Major Penalty* per *Scored Cone.*

c) During the *End Game, Robots* may not descore *Scored Beacons* from *Junctions.* Each violation of this rule results in a *Major Penalty* per *Scored Beacon.*

> Descoring, whether intentional or not, may have a severe impact on an *Alliance's* ability to complete a *Circuit*.

<GS6> *Robot Control/Possession* Limits for *Scoring Elements* –

a) *Robots* may *Control* or *Possess* a maximum of one (1) corresponding *Alliance Cone* and one (1) corresponding *Alliance Beacon* at a time. *Controlling* or *Possessing* more than the allowed quantity of *Cones* and/or *Beacons* 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 this situation continues.

b) *Robots may not Control or Possess an opposing Alliance's Cone. Each violation of this rule results in an immediate Minor Penalty plus an additional Minor Penalty per opposing Alliance Cone in excess of the limit for each 5-second interval that this situation continues. For example, knocking over the opposing Alliance's unscored stack of five (5) Cones receives five (5) Minor Penalties.*

c) *Robots may not Control or Possess an opposing Alliance's Beacon. Each violation of this rule results in a Major Penalty plus an additional Minor Penalty per opposing Alliance Beacon for each 5-second interval that this situation continues.*

d) *Scoring a Cone or Beacon while in Control or Possession of more than the allowed quantity of Scoring Elements will result in a Minor Penalty per Element Scored.*

e) *Control/Possession limit exceptions:*

   i. *Robots* may temporarily *Brace Scored Cones* belonging to either *Alliance* while placing a *Scoring Element* onto those *Cones. Braced Cones* are not subject to the *Control/Possession* limit.

   ii. Knocking over your own *Alliance* stack of unscored *Cones* is allowed.

   iii. *Plowing* through any quantity of either *Alliance's Scoring Elements* is allowed. Pushing an unsecured *Cone* off of a *Junction* is considered *Plowing.*

<GS7> *Junction* and *Terminal* Constraints -

a) A *Cone* must be placed on a *Junction* with the large opening toward the *Tile Floor* to *Score*. A *Cone* placed on a *Junction* in any other orientation is not *Scored* and may be removed by either *Alliance.*

b) *A Cone* may be placed in the *Terminal* in any orientation to *Score.*

c) An *Alliance's Cone* in an opposing *Alliance's Terminal* has zero (0) *Score* value and does not convey *Ownership*.

d) A *Cone or Beacon* may not be added to a *Junction* that has *been Capped*. These *Cones or Beacons* have zero (0) *Score* value and do not convey *Ownership*.

<GS8> *Junction* and *Terminal* Defense –

a) A *Robot* may not *Block* the opposing *Alliance Robot* from *Scoring* a *Cone* on a *Junction*. Each violation of this rule results in an immediate *Minor Penalty* and additional *Blocking Penalties* per rule <G28>.

b) A *Robot* may not *Block* the opposing *Alliance Robot* from *Scoring* in their *Alliance's Terminal*. Each violation of this rule results in an immediate *Major Penalty* and additional *Blocking Penalties* per rule <G28>.

c) *Robots* may not *Block* or *Interfere* with an opposing *Alliance Robot* while it is attempting to *Score* a *Beacon* on a *Junction.* Each violation of this rule results in an immediate *Major Penalty* and additional *Blocking Penalties* per rule <G28>. *Beacon Scoring* protection starts once the *Beacon* enters the *Junction Area*.

> The intent of this rule is not to penalize opposing *Alliance Robots* from attempting to simultaneously *Score Beacons* on the same *Junction.*

<GS9> *Signal* Constraints - A *Signal* is not a *Scoring Element*.

a) *Robots* may *Herd* or *Plow* the *Signal*. Any other form of *Control* of the *Signal* is not allowed. An immediate *Minor Penalty* plus an additional *Minor Penalty* for each 5-second interval that this situation continues will be assessed to the offending *Alliance*. *Signal* damage is handled per rule <G26>. *Signal Sleeve* damage is discouraged, but will not be *Penalized. Teams* should take this into account and bring multiple *Signal Sleeves to* a *Competition.*

b) A *Signal Scores* zero (0) points if *Secured* on a *Junction or In* a *Terminal. Cones* and *Beacons* may continue to be *Scored* in those *Areas* as if the *Signal* was not there.

<GS10> Cone Constraint – *Robots* may not place their own *Alliance's Cone* or *Beacon* on top of an unscored opposing *Alliance's Cone* or *Beacon*. A *Minor* Penalty is assessed for each affected opposing *Alliance Scoring Element*. *Cones* placed in violation of this rule may be removed without penalty.

<GS11> *Scoring* while *In* a *Substation* - A *Robot* must be *Completely Outside* of a *Substation* in order to *Score* a *Cone or Beacon.* Each violation of this rule results in a *Minor Penalty*.

<GS12> *Substation Constraints* – *Robots* may not be *In* or *Block* access to the opposing *Alliance's Substation*. The first instance will result in a *Warning* with any following violations resulting in a *Major Penalty* and an additional *Minor Penalty* assessed for every five seconds that the rule violation persists. If the referee declares a *Blocking* access *Warning*, the offending *Robot* must move away at least 3 feet (0.9 m),

approximately 1.5 floor *Tiles* from the *Blocked Substation*. Failure to move the required 3 feet (0.9 m) within 5 seconds is considered an additional violation and will incur the *Penalties* described above. Additional occurrences of violations of this rule will escalate to *Yellow Cards* quickly.

Note: A *Disabled Robot In* a *Substation* is not considered a safety hazard, therefore *Scoring Elements* may continue to be placed. However, a *Disabled Robot In* the opposing *Alliance's Substation* remains eligible for all *Penalties* associated with <GS12> and in the case of extended violations will receive a *Yellow Card* due to the severe disruption to the ability of the owner of the *Substation* to play the game. This is an explicit exception to rule <G7>.

> The intent of this rule is to allow *Robot* or *Human Player* access to their *Alliance's Substation.*

<GS13> *Human Player* Constraints – Each violation of this rule results in a *Minor Penalty*.

a) *Scoring Elements In* the *Substation Storage Area* may not be handled until after the *Match* has begun with the exception of the *Pre-Load Scoring Elements*.

b) *Scoring Elements* may only be introduced onto the *Playing Field* via the *Substation*.

c) *Scoring Elements* may only be placed into the *Substation* during the *Driver-Control Period*.

d) *Human Players* may only place *Scoring Elements In* the *Substation* that is adjacent to their corresponding *Alliance Station* and may not *Propel* them *Out* of the *Substation.*

e) *Drive Teams* may not use tools or devices to handle a *Scoring Element.* Accommodations and exceptions for *Human Players* with disabilities or extenuating circumstances will be made at the discretion of the Tournament Director.

f) *Human Players* may place only one (1) *Scoring Element In* a *Substation* at a time. There is no limit to the number of *Scoring Elements* that may be *In* the *Substation* at a time.

g) A *Human Player* cannot break the vertical plane of the *Playing Field Perimeter* or hand-deliver a *Scoring Element* to the *Playing Field* when there is a *Robot In* the *Alliance Substation.*

h) A *Robot* cannot enter the *Alliance Substation* while a *Human Player* is placing *Scoring Elements* in the *Substation*.

Note: A *Disabled Robot In* an *Alliance Substation* is not considered a safety hazard to the *Human Player*, therefore *Scoring Elements* may continue to be placed.

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

<GS14> *Beacon* Constraints –

a) A *Beacon* introduced into the *Playing Field* prior to the start of the *End Game* is not eligible for *Scoring*.

b) A *Robot* may *Score* at most one *Beacon* per *Match*. Each violation of this rule results in a *Major Penalty*. The additional *Beacon* is not eligible for *Scoring.*

c) A *Beacon's* color must correspond with the *Alliance* in order to be used by that *Alliance*. If the color does not correspond, it cannot be used.

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.*

Scoring Achievement	***Autonomous Points***	***Driver-Controlled Points***	***End Game Points***	***Reference***
Navigating: Robot Parked in Terminal or Substation	2			
Placement: Cone placed in a *Terminal*	1			
Placement: Cone Secured on Junction: *Ground Junction* *Low Junction* *Medium Junction* *High Junction*	 2 3 4 5			
Signal: Robot Parked only on the *Signal Zone* that corresponds to the *Signal i*mage	10			
Signal: Robot Parked only on the two *Tiles* that corresponds to the team supplied *Signal Sleeve* image	20			
Placement: Cone Scored In Terminal		1		
Placement: Cone Secured on Junction: *Ground Junction* *Low Junction* *Medium Junction* *High Junction*		 2 3 4 5		
Navigating: Robot Parked In Terminal			2	
Ownership: Junction Owned by Cone			3	
Ownership: Junction Owned by Beacon			10	
Circuit: Completed Circuit			20	

4.7 Rule Summary

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

Rule #	Rule	Consequence	*Warning Disable*	*Minor Penalty*	*Major Penalty*	*Card* Issued
Safety Rules						
<S1>	Unsafe *Robot* or Damage to the *Playing Field*.	*Disable* if unsafe operation is likely to persist. Optional *Yellow Card.* Significant damage and/or delays may escalate to *Red Card.*	D*			YC* RC*
<S2>	Contact *Outside* the *Playing Field*.	Immediate *Yellow Card and* Optional *Disable* unless allowed by rule.	D*			YC
<S3>	*Drive Team* missing safety gear.	*Warning* and if not resolved within 30 seconds, the offending member(s) of the *Drive Team* must leave the *Competition Area* and may not be replaced.	W+	1x+		
General Rules – Further definitions, no *Penalties* earned						
<G1>	*Autonomous* to *Driver-Controlled Period* transition					
<G2>	Certifying the *Score* at *End of the Match*					
<G3>	Forcing an opponent to break a rule					
<G4>	*Scoring Elements Controlled* or *Possessed* are part of the *Robot* for *Robot* location					
<G5>	*Robot* or *Scoring Element* in two or more *Scoring*					
<G6>	*Scoring Elements* in contact with *Robots*	Points are not earned for any *Scoring Elements* in a *Scoring Area* in contact with *Robots* of the corresponding *Alliance.*				
<G7>	*Disabled Robot* eligibility					
<G8>	*Playing Field* Tolerances					
<G9>	*Match* Replay					
<G10>	*Inadvertent* and *Inconsequential*					

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

Rule #	Rule	Consequence	*Warning Disable*	*Minor Penalty*	*Major Penalty*	*Card* Issued
<G19>	Late *Start of the Autonomous Period.*	*Minor Penalty* with the option of a *Major Penalty* if the late start results in a competitive advantage for the offending *Alliance*.		1x	1x*	
<G20>	*Robot* is not *Parked* at the end of period.	*Minor Penalty* and the actions of the *Robot* that occur after the end of gameplay do not count towards their *Alliance's Score*. *Major Penalty* if the late stop results in a competitive advantage for the offending *Alliance*.		1x	1x*	
<G21>	*Robot* control during *Autonomous Period* / Early stopping of the Autonomous code.	*Major Penalty*. Achievements earned during that time result in zero *Score*			1x	
<G22>	*Drive Team* contact with the *Playing Field, Game Element*, or *Robot*.	*Warning* for the first instance with any following instances resulting in a *Minor Penalty*. Optional *Yellow Card* if contact affects *Scoring* and/or gameplay.	W	1x		YC*
<G23>	*Drive Team Coach Driver Station* control.	*Warning* for the first instance with any following instances resulting in a *Major Penalty.*	W		1x	
<G24>	*Robots* deliberately detaching parts.	*Minor Penalty. Major Penalty* and a *Yellow Card* if it affects gameplay.		1x	1x	YC
<G25>	*Robots* illegally grasping *Game Elements*.	*Warning* for the first instance with any following instances resulting in a *Major Penalty.*	W		1x	
<G26>	Destruction, damage, tipping, etc.	Deliberate or chronic violations of this rule will receive a *Major Penalty* and a *Yellow Card.*			1x	YC
<G27>	Deliberately removing *Game Elements* from the *Playing Field*.	*Minor Penalty* per *Game Element* deliberately removed from the *Playing Field.*		1x		
<G28>	*Pinning*, *Trapping, or Blocking* for more than 5-seconds in the *Driver-Controlled Period*.	*Minor Penalty* for every five seconds the *Robot* violates this rule.		1x+		

Rule #	Rule	Consequence	*Warning Disable*	*Minor Penalty*	*Major Penalty*	*Card* Issued
<G29>	Illegal Use of *Game Elements* to ease or amplify *Scoring.*	*Major Penalty* will be assessed with any following instances resulting in a *Yellow Card.*			1x	YC
<G30>	Egregious behavior.	*Major Penalty* plus a *Yellow* and/or *Red Card.* Possible *Match Disqualification*. Subsequent violations result in *Team Disqualification* for the competition.			1x	YC RC DQ
Game-Specific Rules – Gameplay *Penalties*						
<GS2>	Touching controller after *Randomization*	*Minor Penalty* for each offense. *Team* does not earn *Autonomous Bonus*		1x+		
<GS3>	*Interfering* with opposing *Alliance's Scoring* during *Autonomous Period*	*Major Penalty* for each offense			1x	
<GS4>	*Launched Scoring Elements*	*Minor Penalty* for each offense		1x		
<GS5>a	Descoring *Opposing Cones from Junctions*	*Minor Penalty* per *Scoring Element*		1x		
<GS5>b	Descoring *Cones* from opposing *Alliance Terminal*	*Major Penalty* per *Scoring Element*			1x	
<GS5>c	Descoring *Beacons* from *Junctions*	*Major Penalty* per *Scoring Element*			1x	
<GS6>a	Possession of more than the allowed quantity of elements	Immediate *Minor Penalty* for each offense plus additional *Minor Penalty* every 5 seconds		1x+		
<GS6>b	*Controlling* opposing *Alliance's Cone*	Immediate *Minor Penalty* for each offense plus additional *Minor Penalty* every 5 seconds		1x+		
<GS6>c	*Controlling* opposing *Alliance's Beacon*	*Major Penalty* per Element Scored plus additional *Minor Penalty* every 5 seconds		1x+	1x	

Rule #	Rule	Consequence	*Warning Disable*	*Minor Penalty*	*Major Penalty*	*Card* Issued
<GS6>d	*Scoring* while in *Possession* of excess quantity	Immediate *Minor Penalty* per *Element Scored*		1x		
<GS7>a	*Cone* placed on a *Junction* in any orientation that is not *Secured*	*Cone* does not *Score*				
<GS7>c	*Cone* in opposing *Alliance Terminal*	*Cone* does not *Score*				
<GS7>d	*Cone* or *Beacon* added to *Junction* with *Beacon* placed	*Does not Score and no* change *in Ownership*				
<GS8>a	*Robot* may not *Block* a *Robot* from *Scoring a Cone* on a *Junction*	*Minor Penalty* for each offense plus other *Blocking Penalties* per <G28>		1x+		
<GS8>b	*Robot* may not *Block* a *Robot* from *Scoring* a *Cone In Terminal*	*Major Penalty* for each offense plus other *Blocking Penalties* per <G28>			1x+	
<GS8>c	*Robot* may not *Block* a *Robot from Scoring* a *Beacon* on a *Junction*	*Major Penalty* for each offense plus other *Blocking Penalties* per <G28>			1x	
<GS9>a	*Robots Controlling* a *Signal*	*Immediate Minor Penalty plus additional Minor Penalty every 5 seconds*		1x+		
<GS9>b	*Signal placed On Junction*	*Signal Cone does not Score*				
<GS10>	*Placing Cone* or *Beacon* on opposing *Alliance* unscored *Cone* or *Beacon*	*Minor Penalty* for each affected *Scoring Element*		1x		
<GS11>	*Scoring* from *Inside Substation*	*Minor Penalty* for each offense.		1x		

Rule #	Rule	Consequence	*Warning Disable*	*Minor Penalty*	*Major Penalty*	*Card* Issued
<GS12>	*Robots* may not be *In* or *Block* opposing *Substation*	*Warning* for first instance, then *Major* and a *Minor* for every additional 5 seconds.	W	1x+	1x	
<GS13>a	*Scoring Elements* in *Substation Storage* may not be handled until start of *Match*	*Minor Penalty* for each offense		1x		
<GS13>b	*Cones/Beacons* may only be introduced into the *Substation*	*Minor Penalty* for each offense		1x		
<GS13>c	*Human Players* placing *Scoring Elements* before start of *Driver-Controled Period*	*Minor Penalty* for each offense		1x		
<GS13>d	*Human Players* may only place *Cones/Beacons* in *Substation* and may not *Propel* them	*Minor Penalty* for each offense		1x		
<GS13>e	Using tools to place *Cone* or *Beacon*	*Minor Penalty* for each offense		1x		
<GS13>f	Placing more than one *Cone/Beacon* in *Substation*	*Minor Penalty for each offense*		1x		
<GS13>g	*Human Player* cannot break the vertical plane of the *Playing Field Perimeter* while a *Robot* is in the *Substation*	*Minor Penalty* for each offense		1x		
<GS13>h	*Robot* enters *Substation* while *Human Player* is *In* the *Substation*	*Minor Penalty* for each offense		1x		

Rule #	Rule	Consequence	*Warning Disable*	*Minor Penalty*	*Major Penalty*	*Card* Issued
<GS14>a	*Beacon* introduced prior to *End Game*	No *Capping points* or *Ownership*				
<GS14>b	*Robot* scores more than one *Beacon*	*Major Penalty* and No *Capping* points or *Ownership* for second *Beacon*			1x	
<GS14>c	*Beacon* must correspond with *Alliance* color	No *Capping points* or *Ownership*				

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

Appendix A – Resources

Game Forum Q&A

https://ftc-qa.firstinspires.org/

Anyone may view questions and answers within the *FIRST*® Tech Challenge game Q&A forum without a password. To submit a new question, you must have a unique Q&A system user name and password for your team.

Volunteer Forum

Volunteers can request access to role specific volunteer forums by emailing FTCTrainingSupport@firstinspires.org. You will receive access to the forum thread specific to your role.

FIRST Tech Challenge Game Manuals

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

FIRST Headquarters Pre-Event Support

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

FIRST Websites

FIRST homepage – www.firstinspires.org

FIRST Tech Challenge Page – For everything *FIRST* Tech Challenge.

FIRST Tech Challenge Volunteer Resources – To access public volunteer manuals.

FIRST Tech Challenge Event Schedule – Find *FIRST* Tech Challenge events in your area.

FIRST Tech Challenge Social Media

FIRST Tech Challenge Twitter Feed - If you are on Twitter, follow the *FIRST* Tech Challenge Twitter feed for news updates.

FIRST Tech Challenge Facebook page - If you are on Facebook, follow the *FIRST* Tech Challenge page for news updates.

FIRST Tech Challenge YouTube Channel – Contains training videos, game animations, news clips, and more.

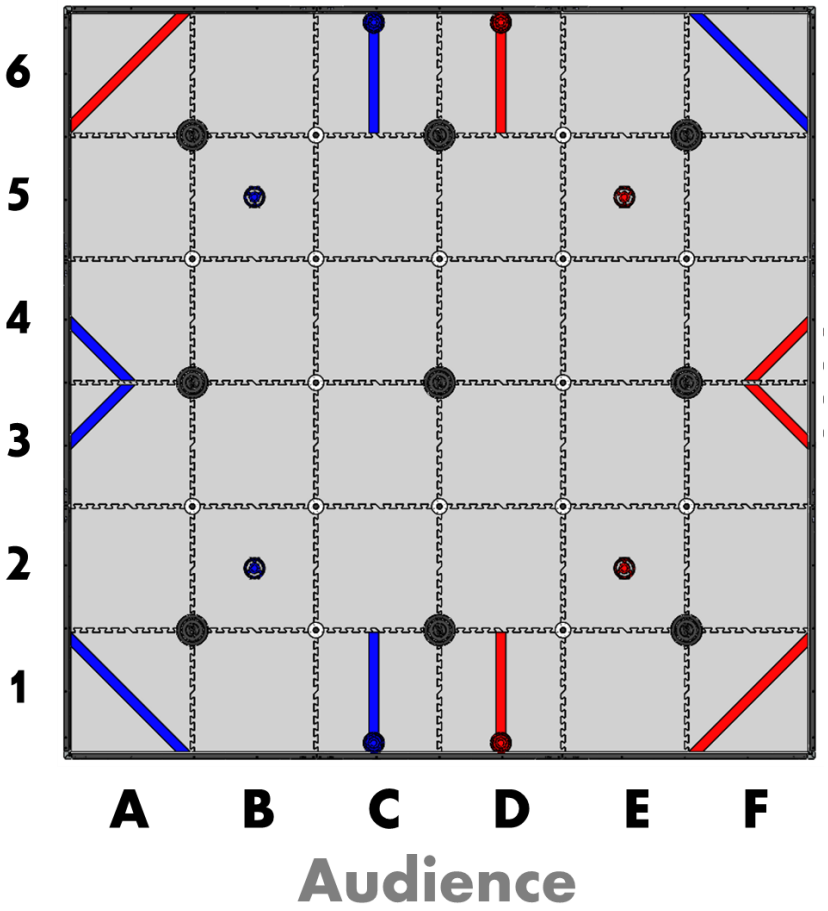
FIRST Tech Challenge Blog – Weekly articles for the *FIRST* Tech Challenge community, including outstanding volunteer recognition!

FIRST Tech Challenge Team Email Blasts – contain the most recent *FIRST* Tech Challenge news for teams.

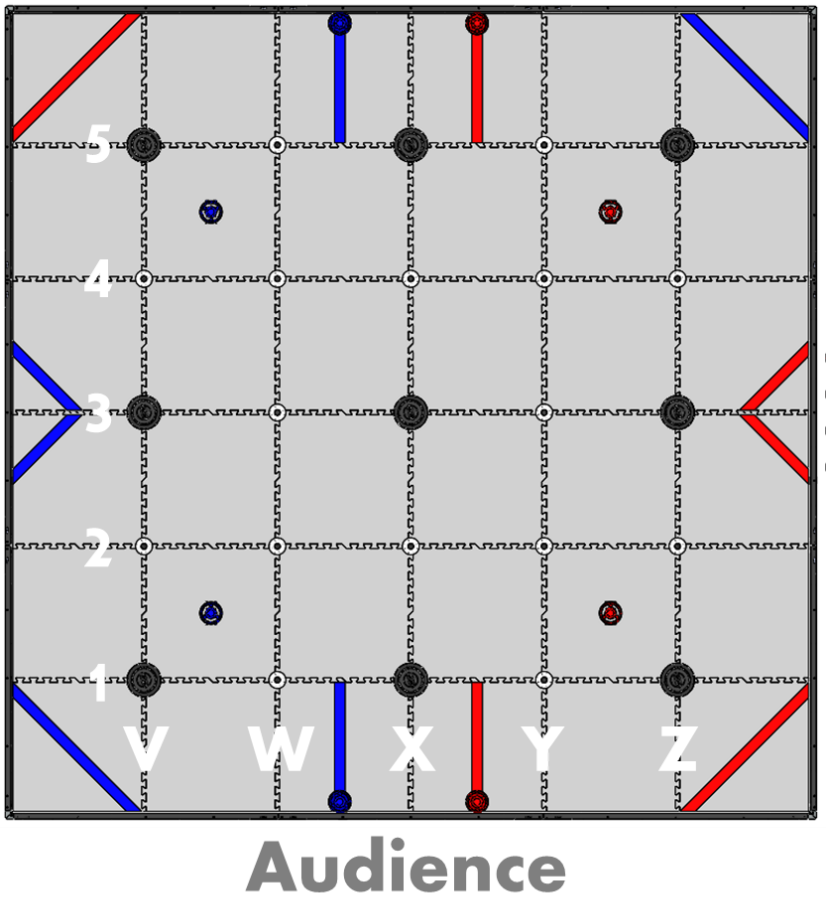
Feedback

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

Appendix B – *Playing Field* Locations

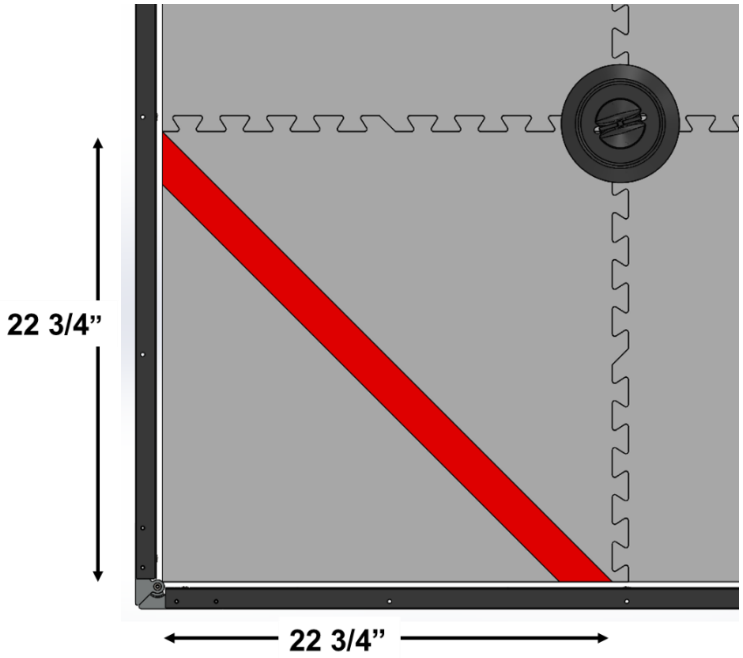


B-1 *Tile* Locations

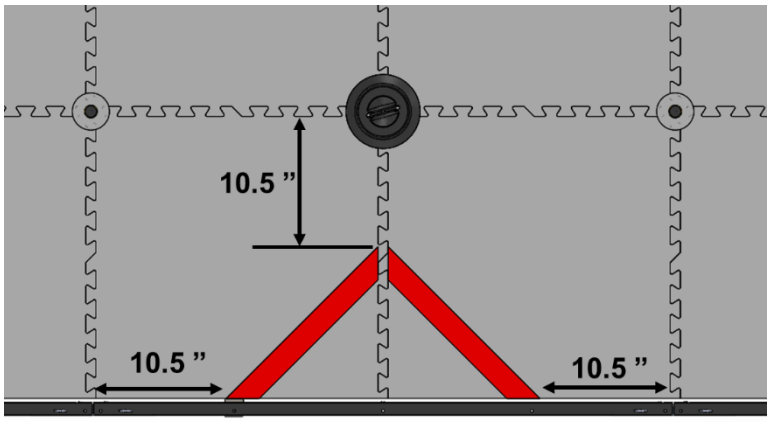


B-2 *Junction* Locations

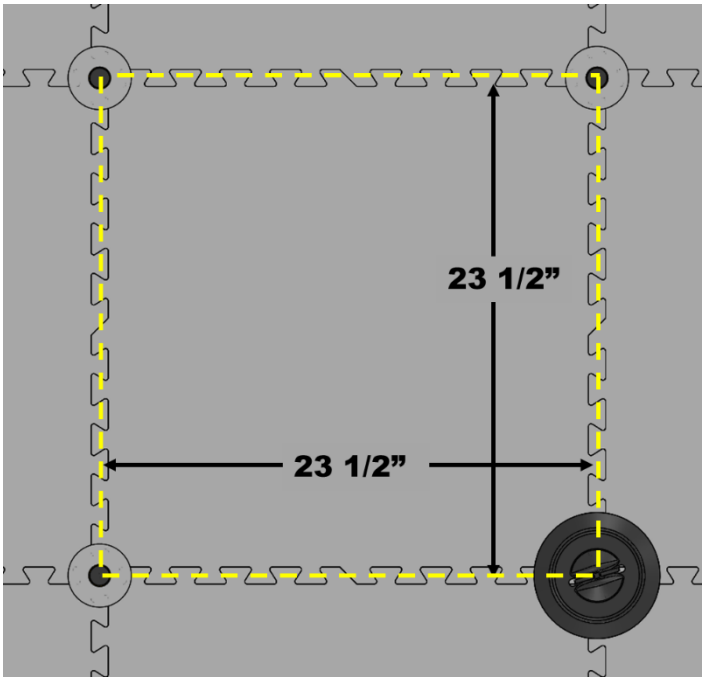
Appendix C – *Playing Field* Details



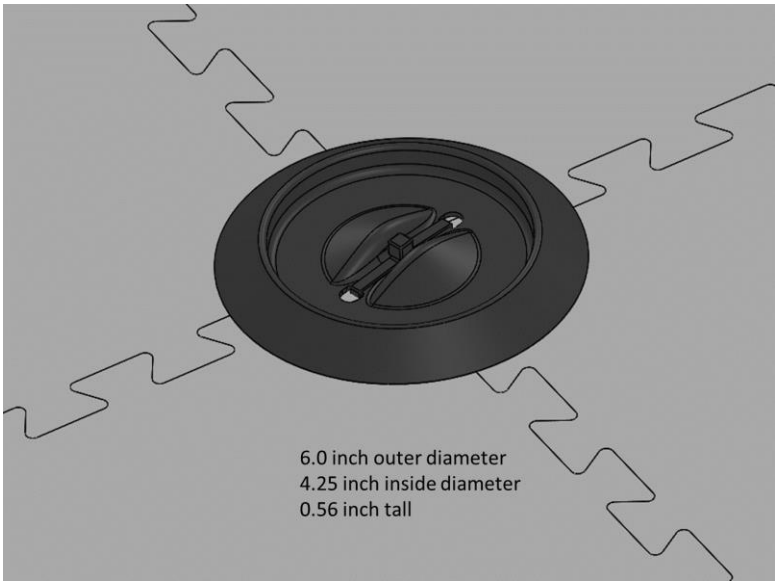
C-1 *Terminal*, Typical



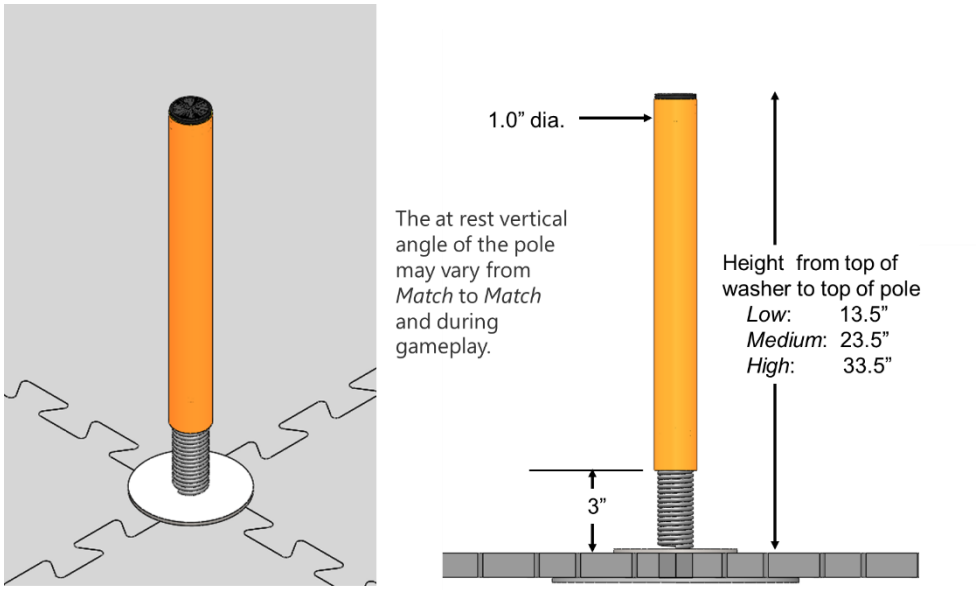
C-2 *Substation*, Typical



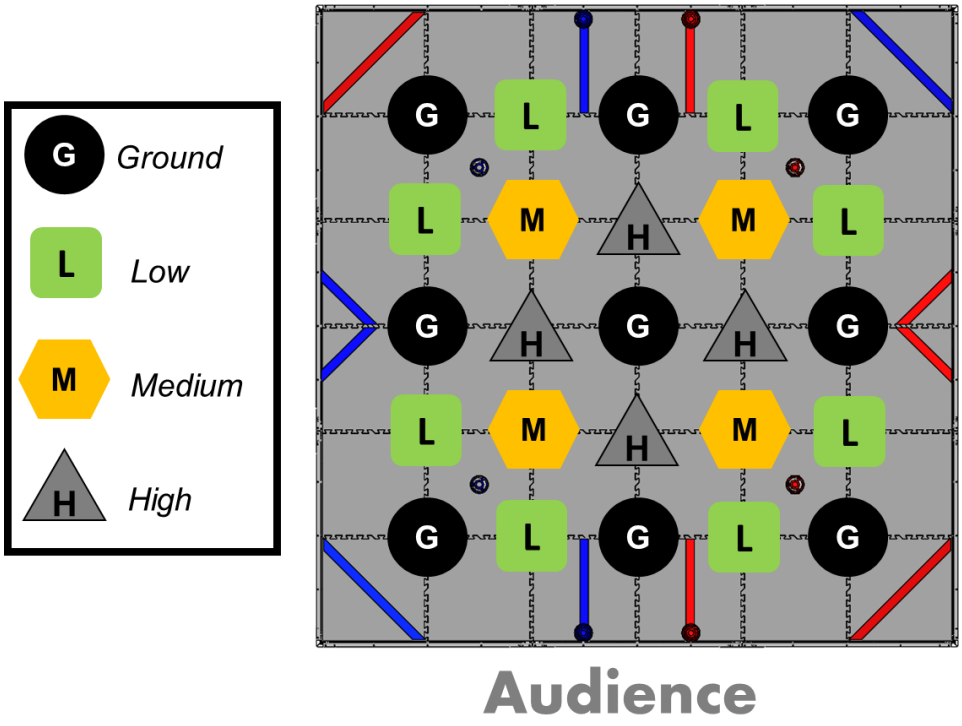
C-3 *Junction Spacing,* Typical



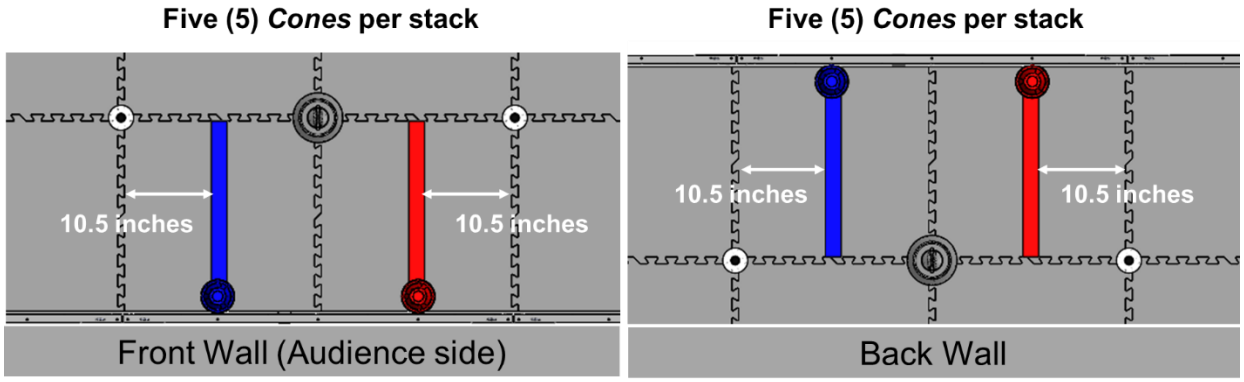
C-4 Ground Junction



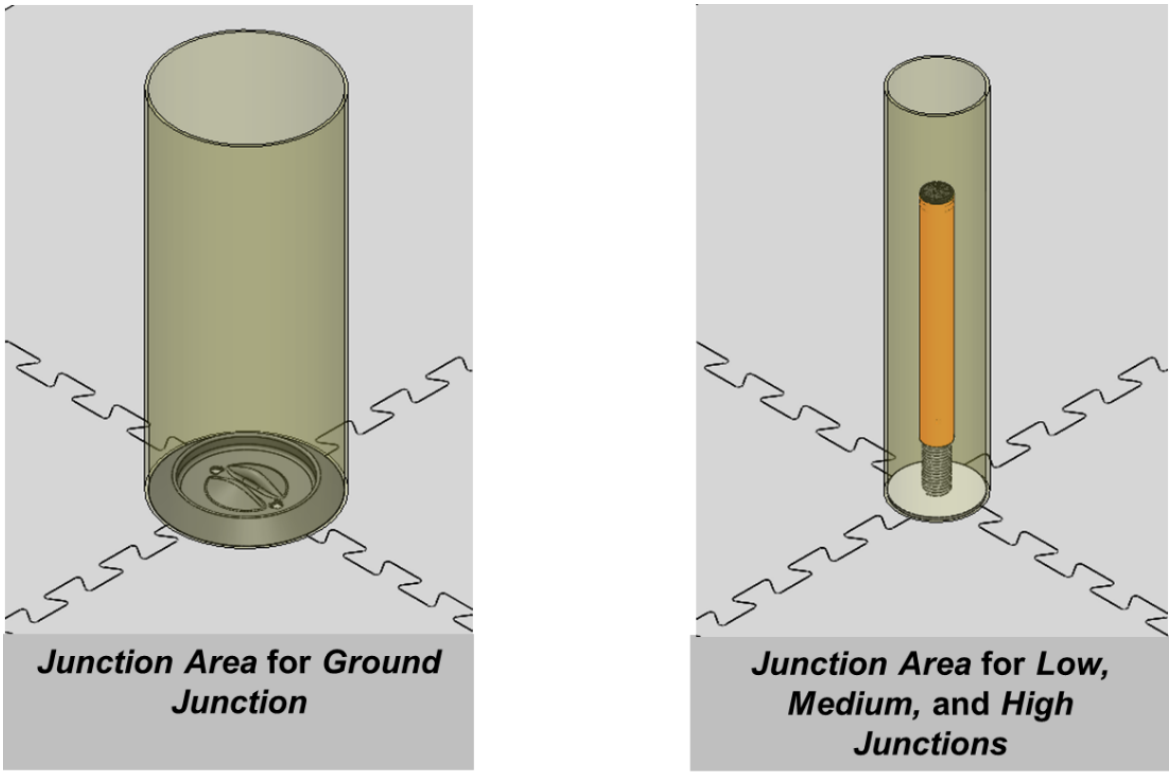
C-5 *Low, Medium, High* Junctions



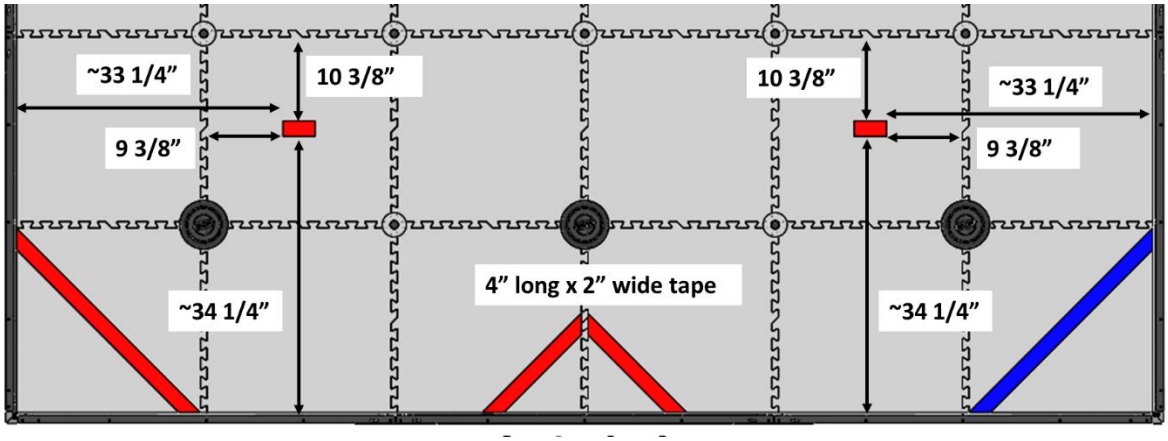
C-6 *Junction* Locations



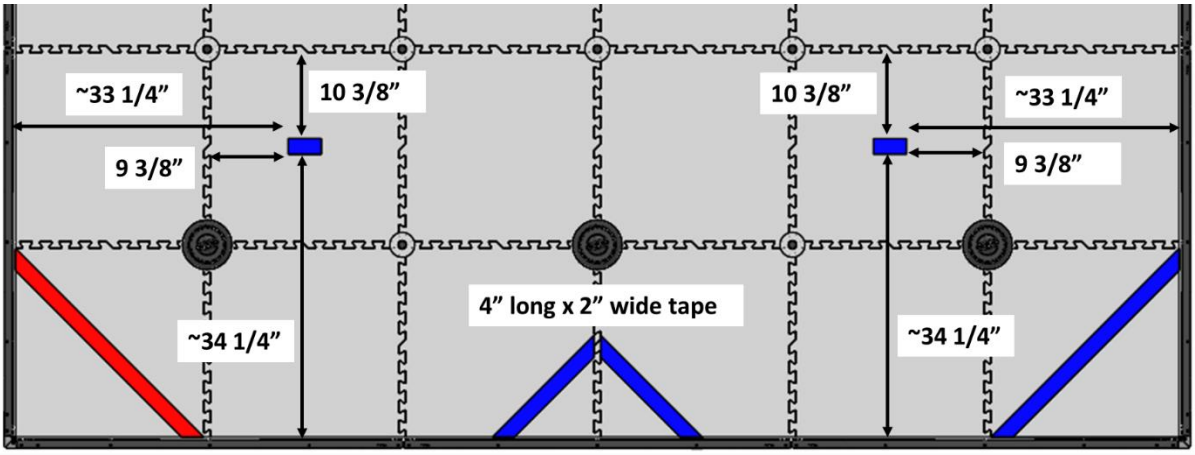
C-7 In-Field *Cone* Stacks



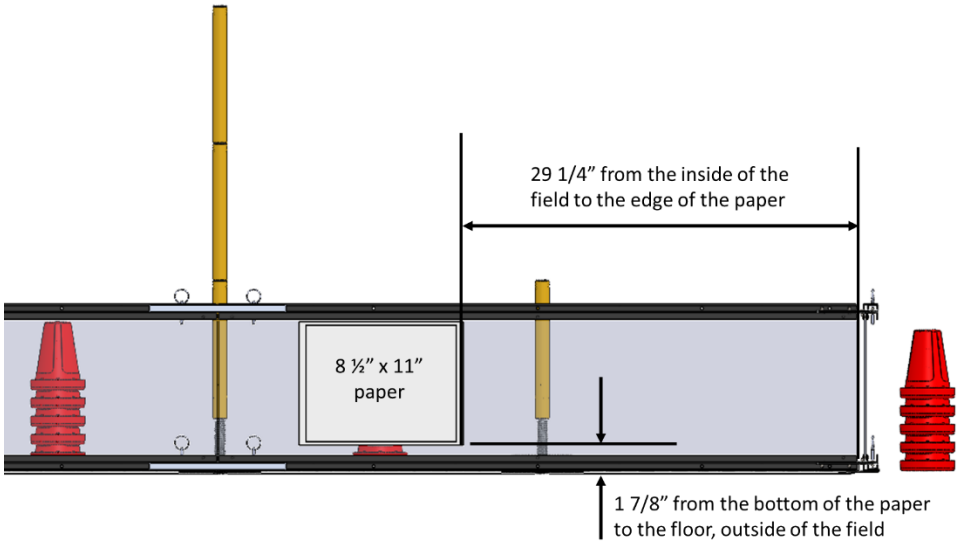
C-8 *Junction Area*



C-9 Red Signal tape locations

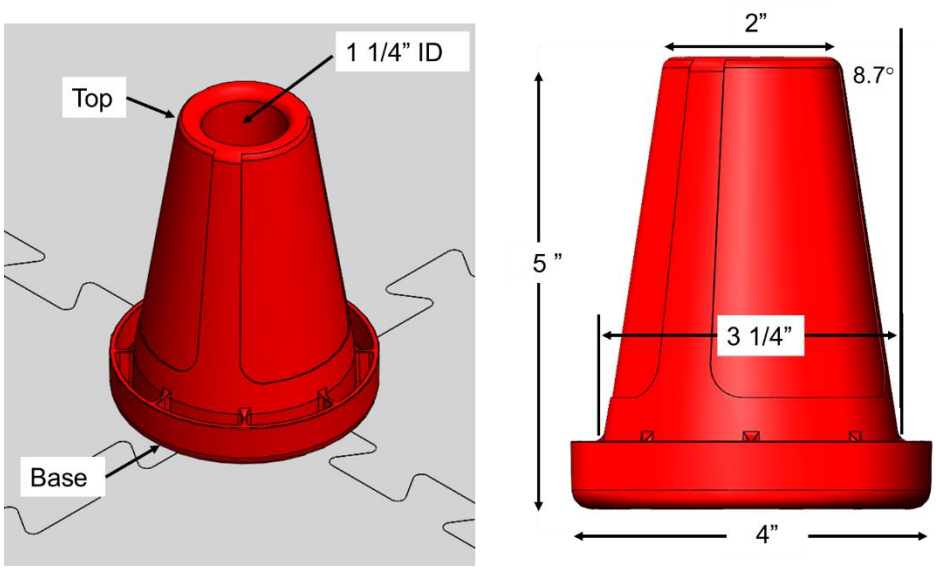


C-10 Blue Signal tape locations



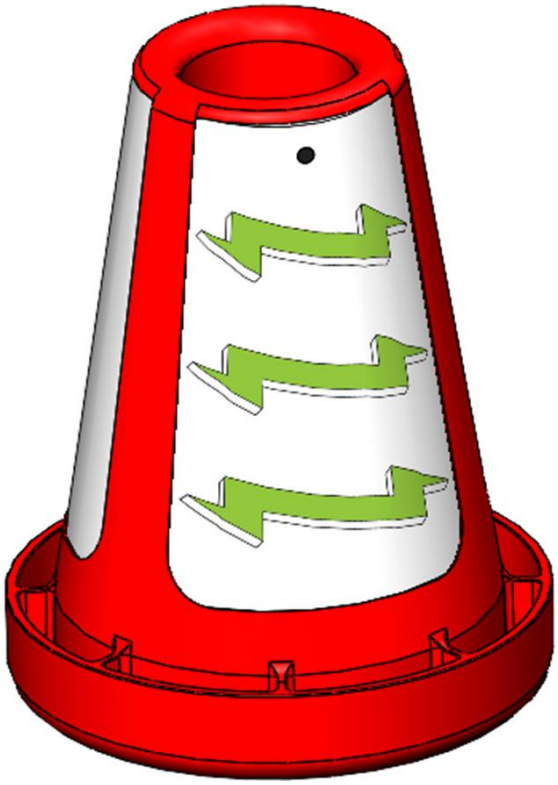
C-11 Typical dimensions for Navigation Images

Appendix D – *Scoring* Element

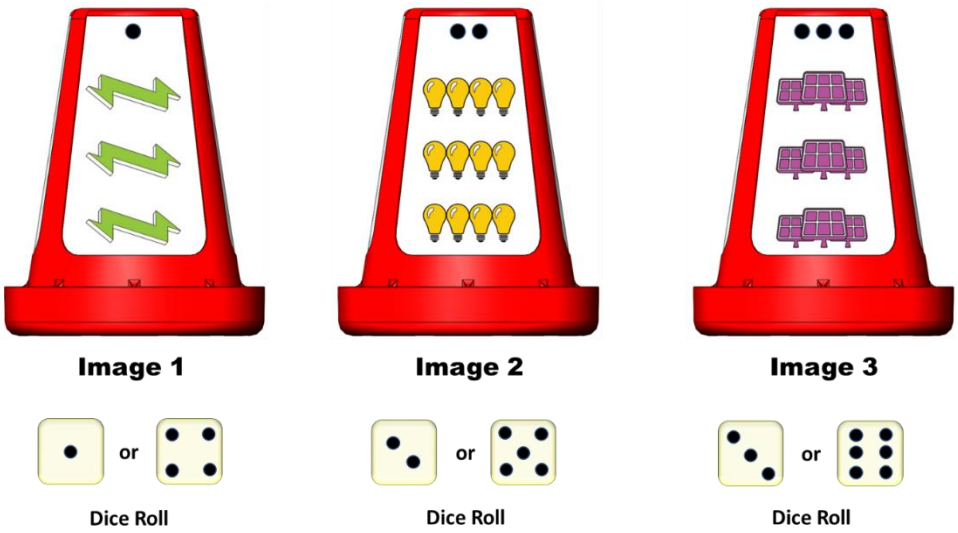


D-1 *Cone*, Approximate Dimensions

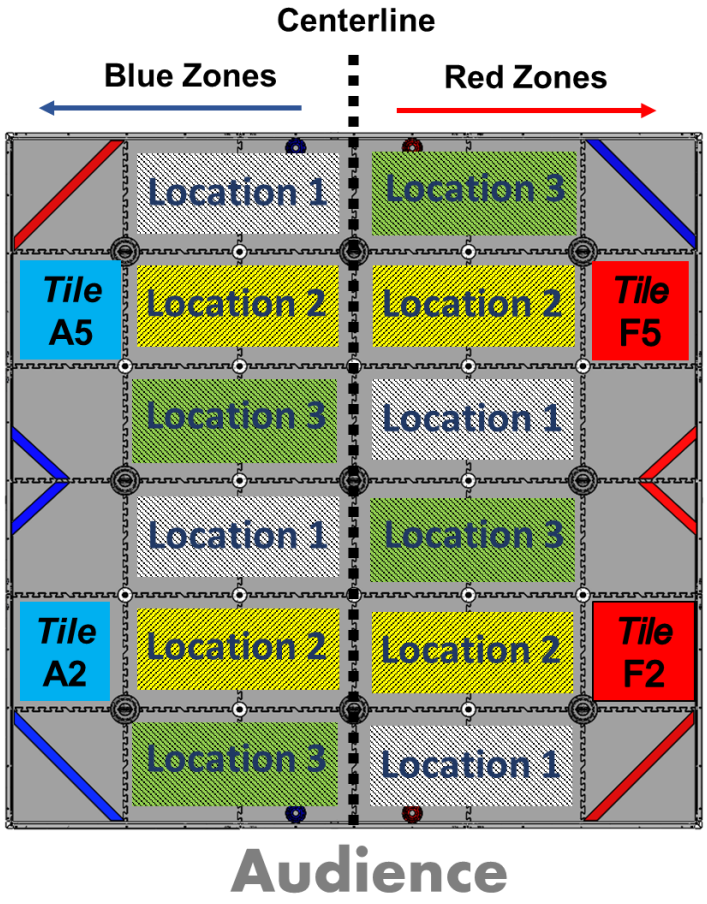
Appendix E – Randomization



E-1 – *Signal*

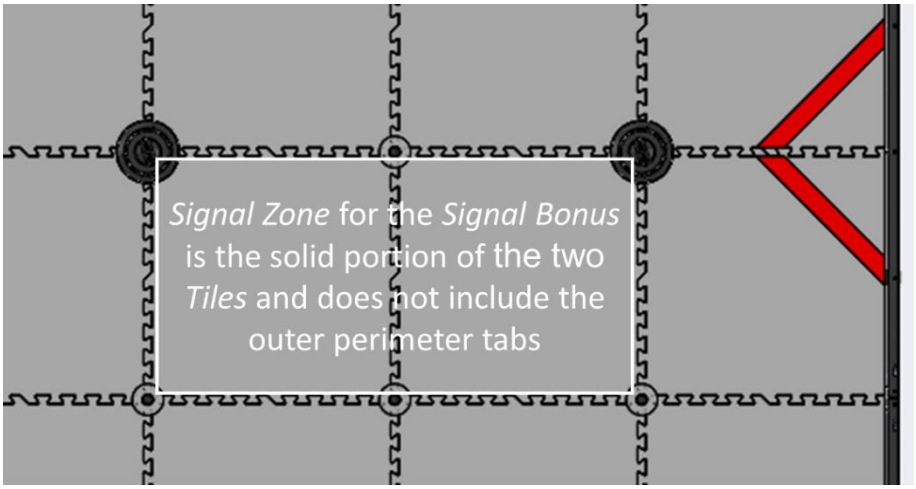


E-2 – *Signal* Patterns

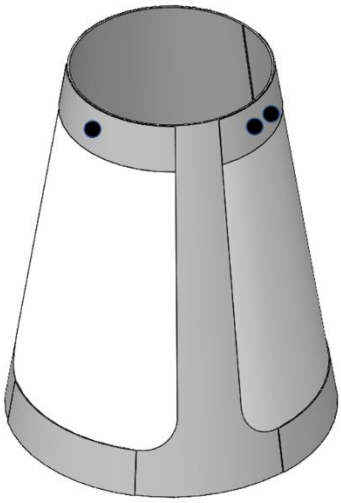


E-3 – *Signal Zone* Locations

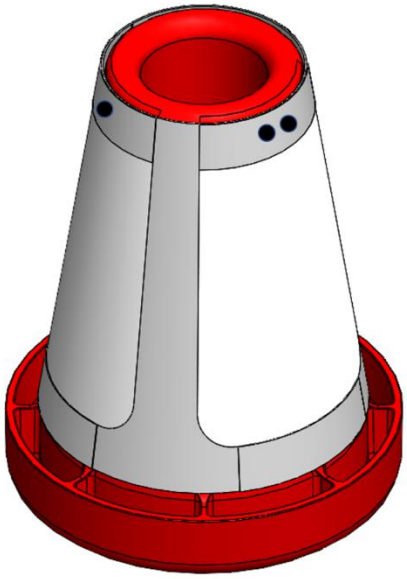
Red *Robots* start in F2 and F5, Blue *Robots* start in A2 and A5



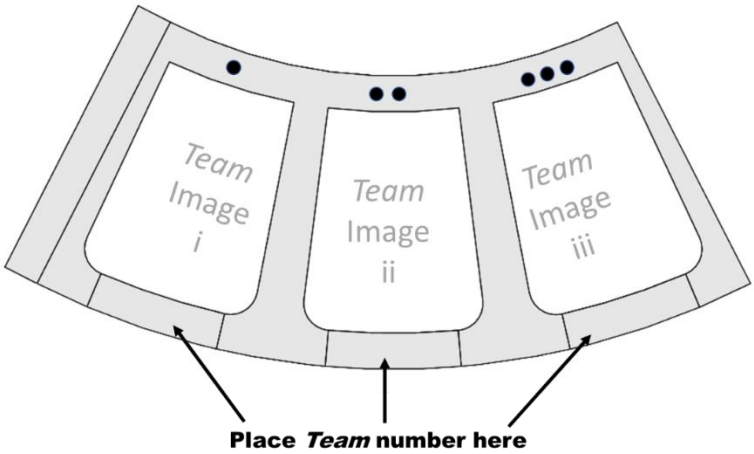
E-4 – Typical *Signal Zone* Location



E-5 – *Team* Supplied *Signal Sleeve* Template



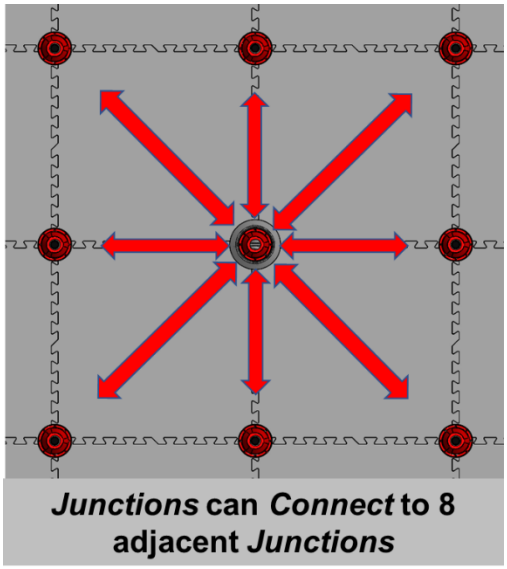
E-6 – *Team* Supplied *Signal Sleeve* Template on a *Signal*

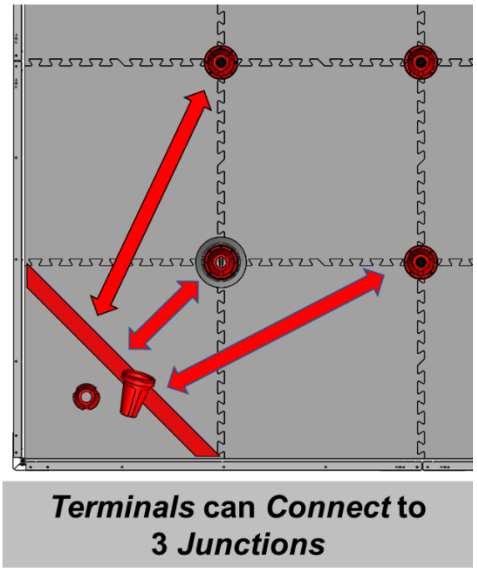


E-7 – Template for *Team* supplied *Signal Sleeve*

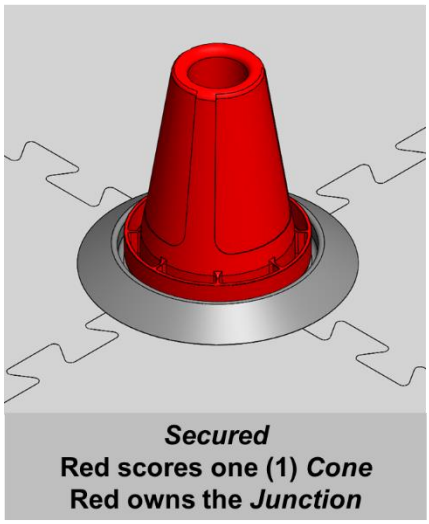
The *Signal Sleeve* template and instructions are located at https://www.firstinspires.org/resource-library/ftc/game-and-season-info.

Appendix F – *Scoring* Examples

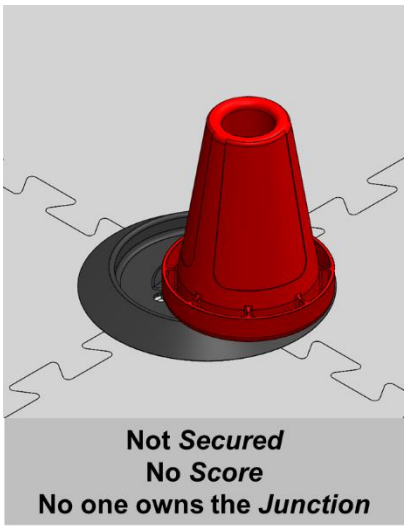




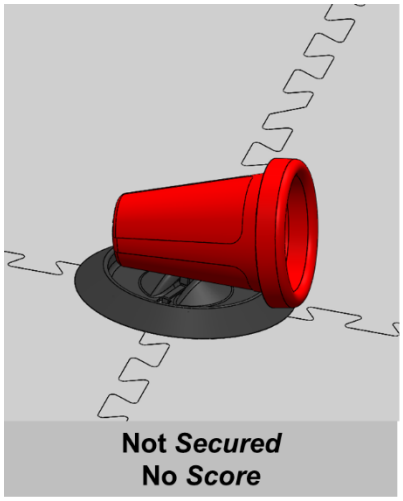
F-1 Allowable *Junction* and *Terminal Connections*



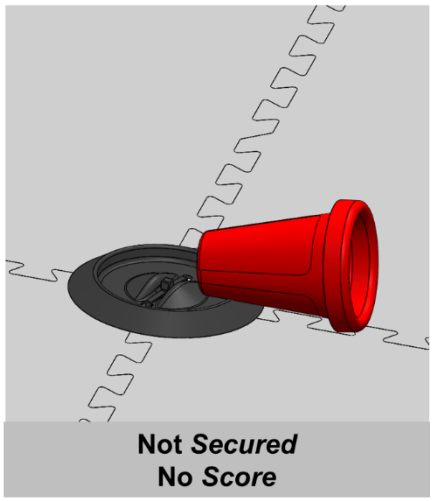
F-2



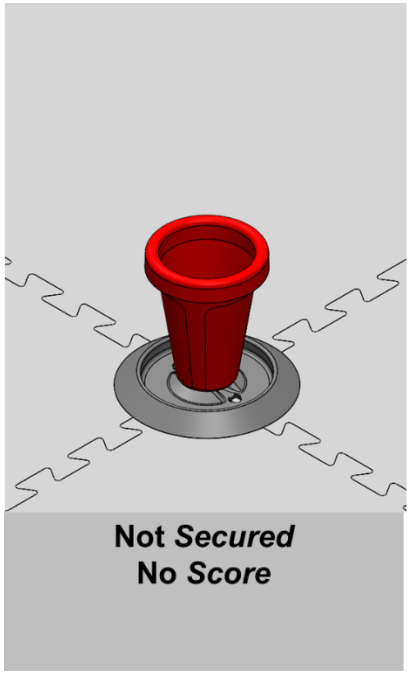
F-3


Not *Secured*
No *Score*

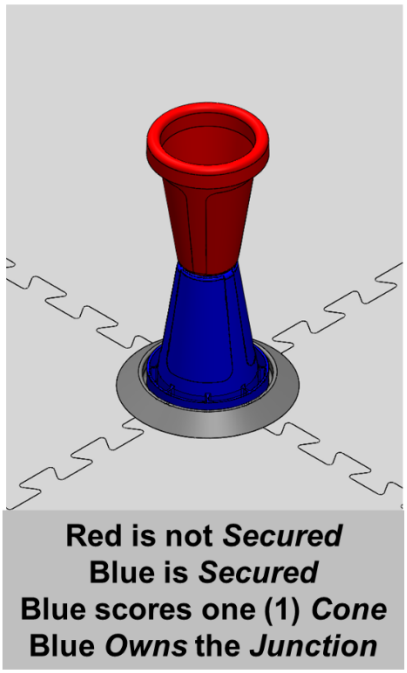
F-4


Not *Secured*
No *Score*

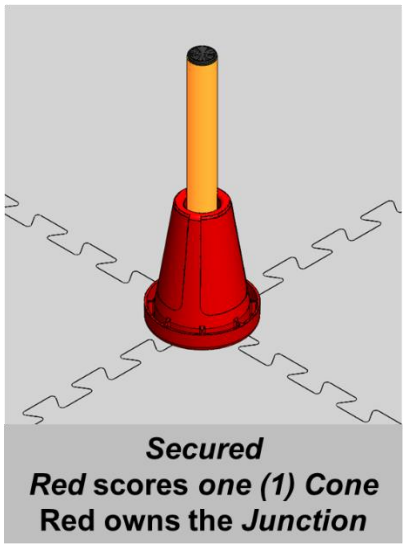
F-5


Not *Secured*
No *Score*

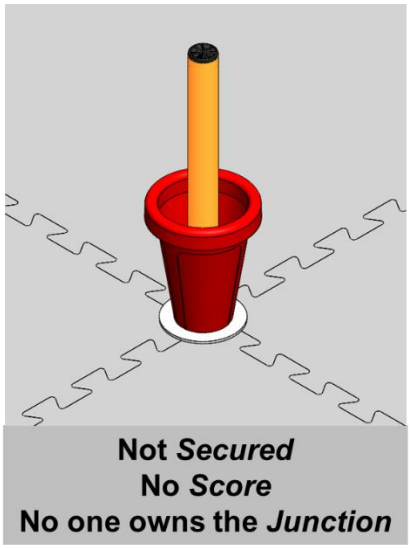
F-6


Red is not *Secured*
Blue is *Secured*
Blue scores one (1) *Cone*
Blue *Owns* the *Junction*

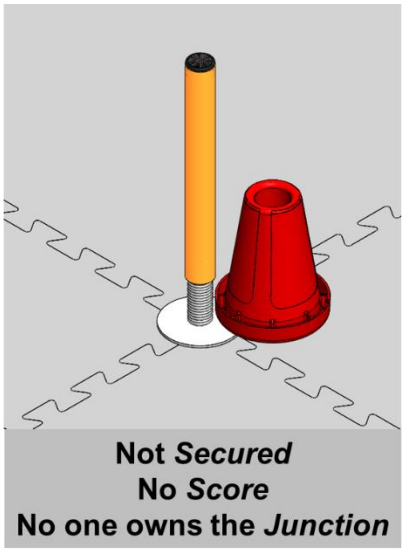
F-7


Secured
Red scores one (1) Cone
Red owns the Junction

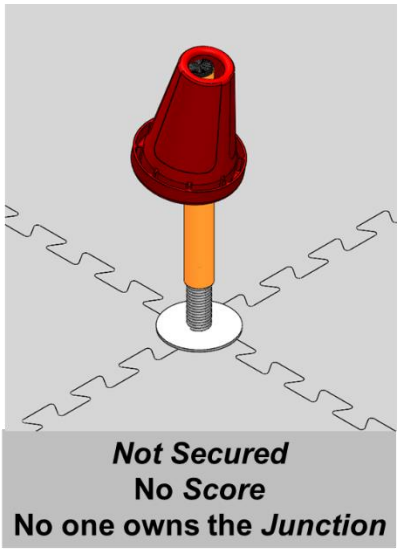
F-8


Not Secured
No Score
No one owns the Junction

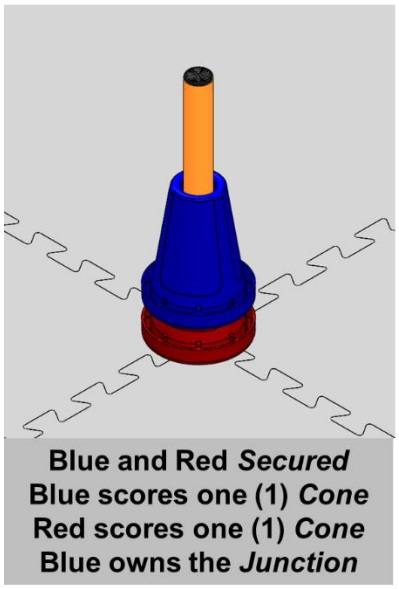
F-9


Not Secured
No Score
No one owns the Junction

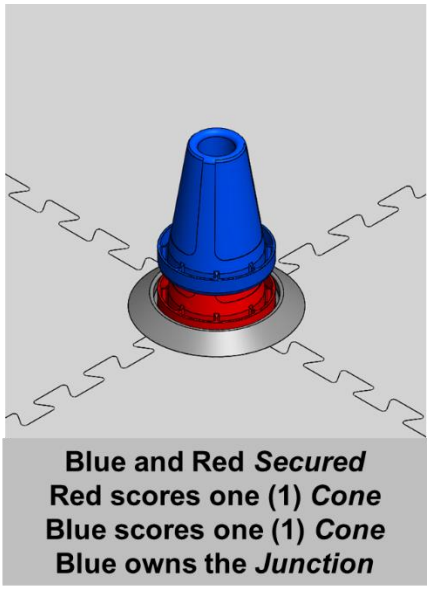
F-10


Not Secured
No Score
No one owns the Junction

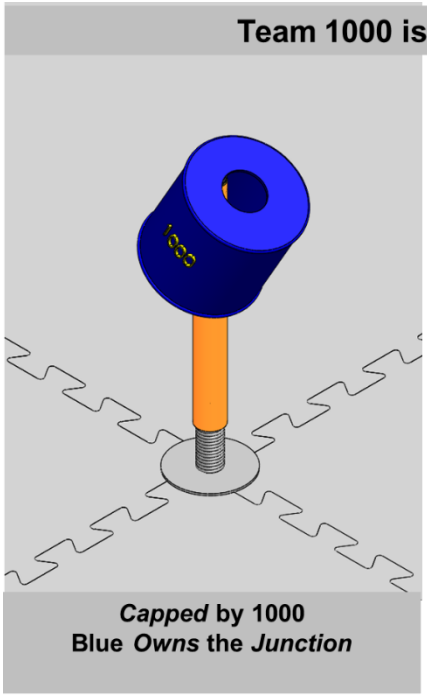
F-11



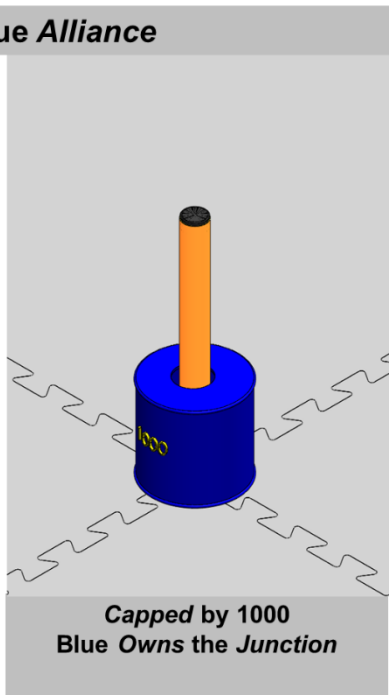
F-12



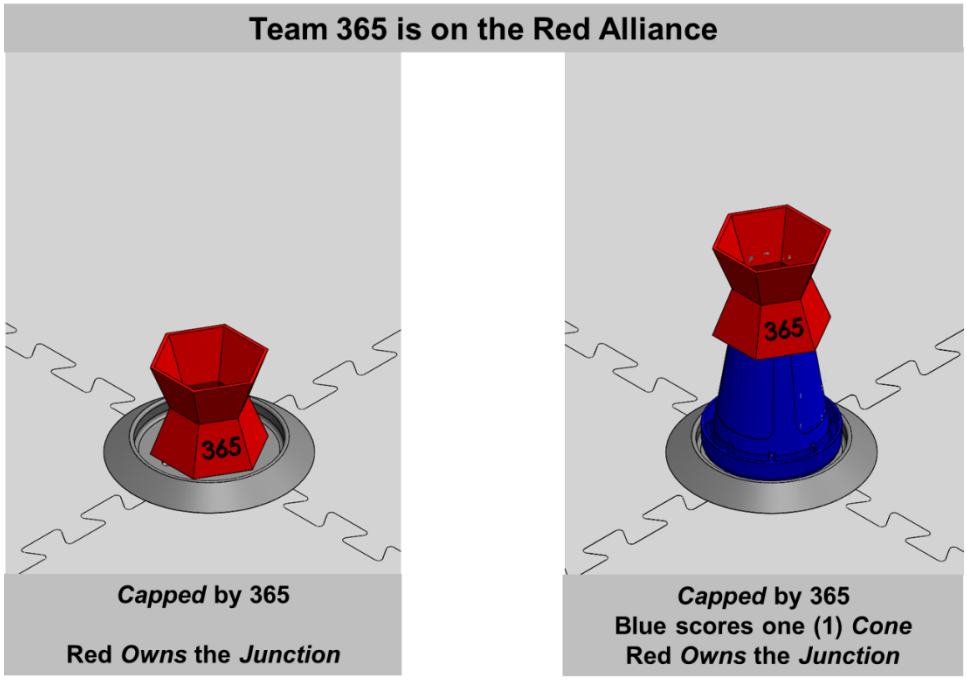
F-13



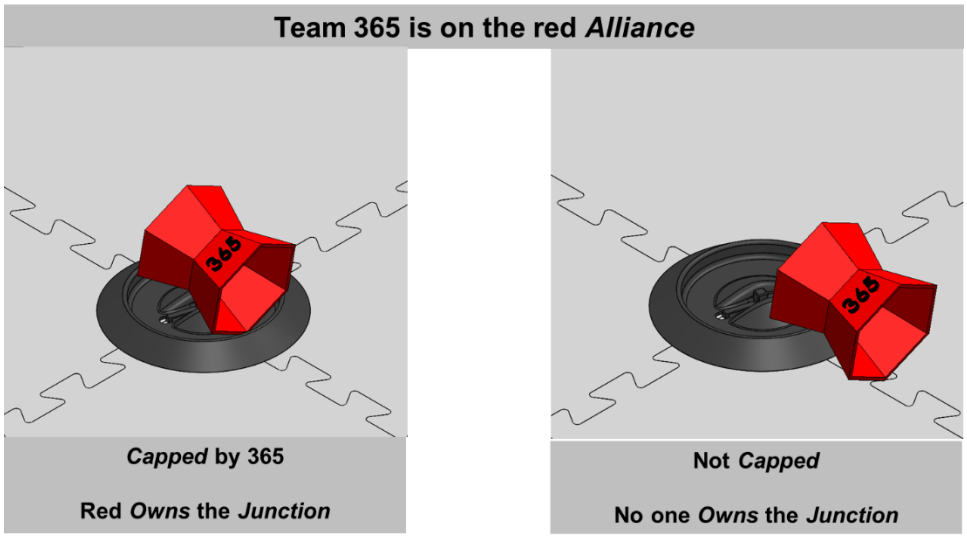
F-13



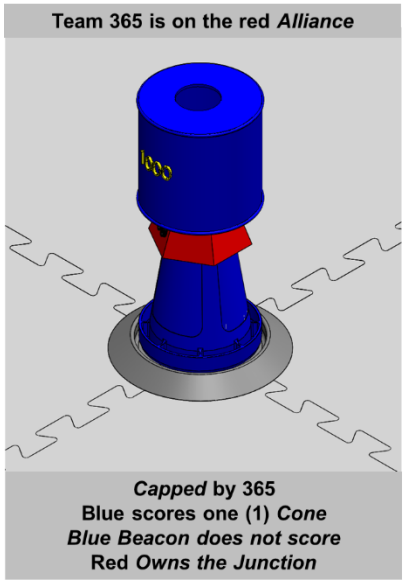
F-14



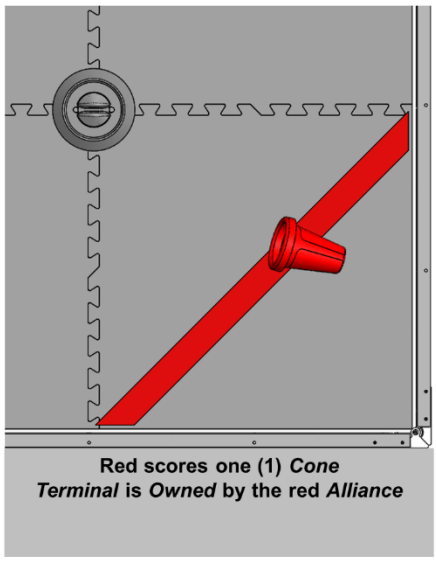
F-16 **F-17**



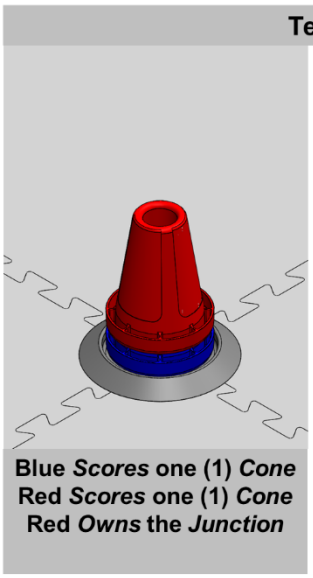
F-18 **F-19**



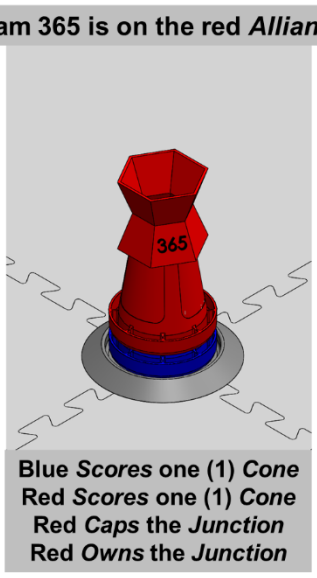
F-20



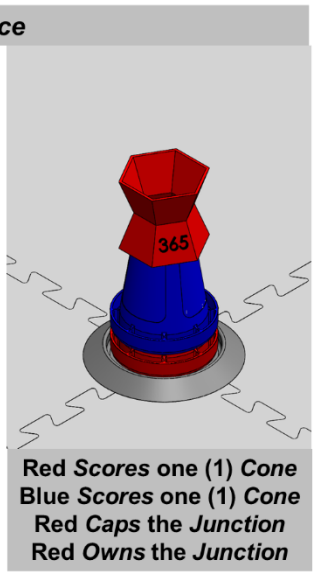
F-21



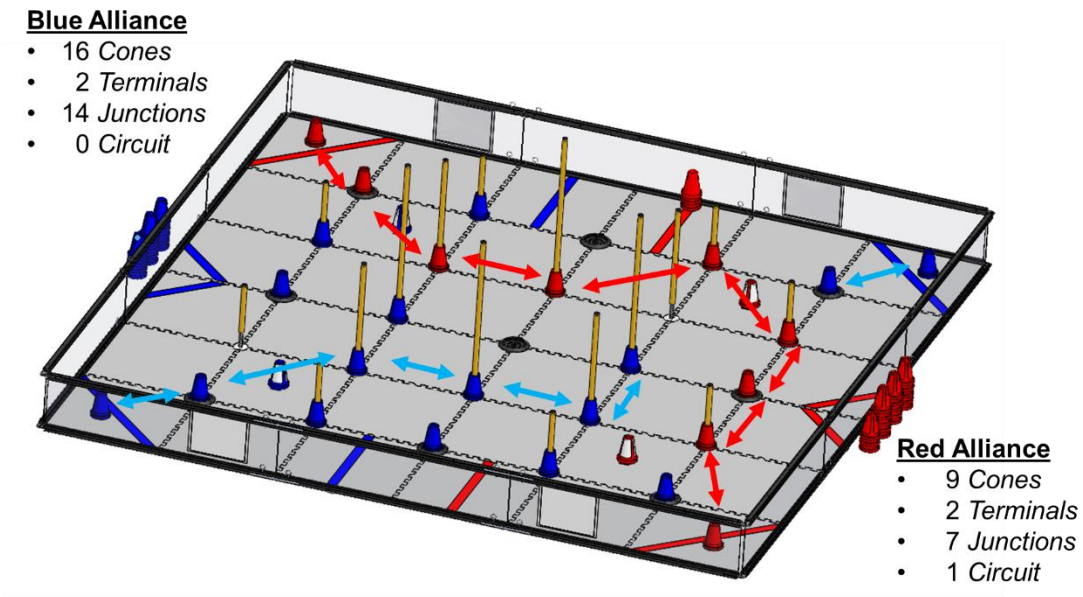
F-22



F-23



F-24



F-24 *Circuit* Example

Appendix G – *Navigation Images*

Image B6
Blue Alliance Rear Wall

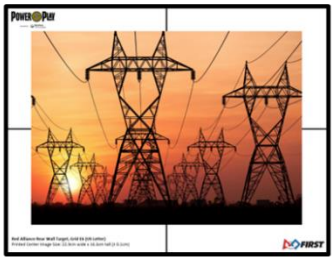


Image E6
Red Alliance Rear Wall

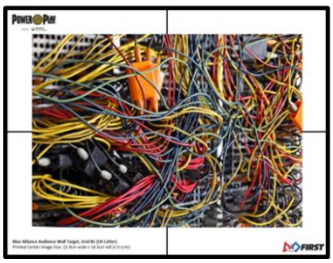


Image B1
Blue Alliance
Audience Wall

Image E1
Red Alliance
Audience Wall

Images are labeled corresponding to the centers of the tile nomenclature listed in Appendix B, figure B-1.

Image B1 – The center of the image is on the *Playing Field Wall* closest to the *Audience* and is aligned to the center of the second *Tile* in from the blue *Alliance Station.*

Image B6 – The center of the image is on the *Playing Field Wall* opposite of Image B1 and is aligned to the center of the second *Tile* in from the blue *Alliance Station.*

Image E1 – The center of the image is on the *Playing Field Wall* closest to the *Audience* and is aligned to the center of the second *Tile* in from the red *Alliance Station.*

Image E6 – The center of the image is on the *Playing Field Wall* opposite of Image E1 and is aligned to the center of the second *Tile* in from the red *Alliance Station.*

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 website for printable versions of these images.