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Revision History

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1.0 Introduction

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

2.0 Gracious Professionalism®

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

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

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

3.0 How to Use This Document

The Game Manual Part 2 – Remote Events is a resource for all FIRST® Tech Challenge Teams for information specific to the 2023-2024 season’s game. There are two types of event formats a Team might experience this season: traditional events and remote events. This manual describes the game and rules for remote events. Remote events were developed to mimic traditional FIRST Tech Challenge events, while practicing social distancing guidelines. In some Regions Teams are not able to gather and compete in the traditional head-to-head competition format, the season’s official full Playing Field and rules have been adapted to allow Teams to play Matches as a single Team. Remote Teams may order an official partial version of this season’s field or compete using a low-cost version of the field.

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

*Teams* must comply with all the rules and requirements stated in this document and in the Game Manual Part 1 - Remote 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 – Remote Events for information about the competition such as how rankings work (Ranking and TieBreaker Points), advancement, judged awards, Robot construction rules, and general competition rules.

4.2 Game Description

4.2.1 Field Illustration
The following illustrations identify the Game Elements and give a general visual understanding of the game. *Teams* should refer to andymark.com/FTC for the exact Game Element dimensions. The official Playing Field documents, including the official Field Setup and Assembly Guide, are available at https://www.firstinspires.org/resource-library/ftc/game-and-season-info. 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* that participate in Remote events may also transition to Traditional events that use Playing Field Walls from different manufacturers. Please incorporate that into the design of your Robot. The following illustrations show the Playing Field with the optional perimeter wall as the Playing Field Boundary.
Figure 4.2-1 – Isometric view of the remote Playing Field

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

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4.2.2 Gameplay Overview
Welcome to CENTERSTAGE™ presented by RTX. Remote Matches are played on a Playing Field initially set up as illustrated in Figure 4.2-1. The object of the game is to earn as many points as possible by performing the achievements outlined below.

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

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

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

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

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

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, Robots earn points by:

1. Suspending from their Rigging.
2. Parking In their Backstage.
3. Parking their Launched Drone In Landing Zone 1, 2, or 3.

4.2.3 Gameplay Technology
Each game comes with its own unique set of challenges. In CENTERSTAGE™ there are multiple ways a Team can utilize technology to assist them in solving these challenges. A Team 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) A Robot can use their on-board control system and sensors to identify Game Elements.
   b) A Robot can use the built-in TensorFlow technology to decode the randomized Autonomous task.
2. Field Navigation: Built-in AprilTag technology helps the Robot identify and navigate to important locations on the Playing Field.
3. Situational Awareness: Sensors provide situational awareness during the Autonomous Period, automate operations, and provide feedback during the Driver-Controlled Period. Cameras, IMUs, motor encoders, distance, and color sensors are useful for solving gameplay tasks.
4.3 Game Definitions

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

Alliance Station – The designated red or blue Alliance Area adjacent to the Playing Field where the Drive Team stands during a Match.

AprilTag – A visual fiducial system, useful for a wide variety of tasks including augmented reality, robotics, and camera calibration¹. Three (3) AprilTags are affixed to the Backdrop to identify target locations for the Autonomous randomization task outlined in section 4.4.2. One additional set of AprilTags is placed at the audience side of the field for assistance with field localization. Information about AprilTags may be found here: https://april.eecs.umich.edu/software/apriltag.

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

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

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

Backdrop – A structure upon which a Robot places Pixels to score points. There is one (1) Backdrop located on the Playing Field. See Appendix C-2 for specifications.

Backstage – The Area beneath a Backdrop. The Backstage is defined by nominal 1-inch (24 mm) wide tape and is approximately 72-inches (183 cm) long by 23-inches (58.4 cm) deep.

Coach – A Student Team member or adult mentor designated as the Drive Team advisor during the Match.

Competition Area – The Area where all the Playing Field, scoring areas, and other competition items relating to Match play are located.

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

a) Carrying one or more Game Elements.

b) Herding of Game Elements. See also the definition of Herding in this section.

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

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

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

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e) Inadvertent contact with a Propelled Game Element as it bounces off the Playing Field or a Robot. See also the definition of Inadvertent in this section.

Disable / Disabled – A Robot that is no longer active for the remainder of the Match due to a Robot failure.

Drive Team – Up to four (4) representatives; two (2) Drivers, one (1) Human Player and one (1) Coach from the same Team.

Driver – A Student Team member responsible for operating and controlling the Robot.

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

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 – Remote Events.

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

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

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

Field Personnel – People selected by the Team to help run an official remote competition Match. Typical activities performed by Field Personnel include preparing the Playing Field for a Match, performing the Playing Field randomization task, keeping track of the Match Score, running the cloud-based scoring system, and providing as needed technical assistance to the Drive Team during pre-Match setup. One person may fill several roles. At a Traditional competition, these activities are performed by trained volunteers. Teams may select anyone except for the Drive Team to be Field Personnel. Some Field Personnel roles require specialized knowledge. For example, the person scoring the Match should be able to recall rules and Penalties in real time while watching an official Match.

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

Grasp – Securely holding an object.

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

Human Player – A Student Team member responsible for handling Scoring Elements.

Human Player Station – The designated Area adjacent to the Playing Field where the Human Player is located during a Match.

In (Inside) / Completely In (Completely Inside) – An object that has crossed into the upwards vertical extension (i.e., at a right angle to the Playing Field Floor) of a defined Area’s boundary is Inside the Area. An object that is entirely within the upwards vertical extension of a defined Area’s boundary is Completely Inside the Area. The boundary element (tape, wall, markings, etc.) is part of the Area for the purposes of determining Inside and Outside, unless otherwise specified.
**Inadvertent** – An unintended side effect of a *Robot* action. Unforced or unexpected *Robot* actions based on software commands are not considered to be *Inadvertent*.

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

**Landing Zone** – The *Area* outside the *Playing Field Perimeter* on the audience side of the *Playing Field Boundary*. There are three (3) *Landing Zones*:

- **Landing Zone 1** – A 144-inch (3.66 m) wide x 24-inch (610 mm) deep area immediately adjacent to the audience side *Playing Field Boundary*.

- **Landing Zone 2** – A 144-inch (3.66 m) wide x 24-inch (610 mm) deep area immediately adjacent to *Landing Zone 1*.

- **Landing Zone 3** – A 144-inch (3.66 m) wide x 24-inch (610 mm) deep area immediately adjacent to *Landing Zone 2*.

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

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

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

**Match** – *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 the *Drive Team* to pick up the controllers and switch programs.

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

1. A *Mosaic* consists of three (3) non-white *Pixels*, either all the same color (all green, all purple or all yellow) or each *Pixel* a different color (one (1) green, one (1) purple, and one (1) yellow).

2. A completed *Mosaic* cannot be in contact with another non-white *Pixel*.

3. Each *Pixel* in a *Mosaic* must be in contact with the other two (2) *Pixels* of that *Mosaic*.

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

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

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

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

**Park / Parked** – The condition where a *Robot* or *Drone* is motionless.
**Penalty** – The consequence imposed for a rule or procedure violation that is identified by specified *Field Personnel*. When a Penalty occurs, points will be deducted from the *Score* of the *Robot*. Penalties are further defined as *Minor Penalties* and *Major Penalties*.

**Pixel** – A hexagonal shaped *Scoring Element*, 3-inches (76.2 mm) across by 0.5-inches (12.7 mm) thick. There are thirty-two (32) white *Pixels*, five (5) yellow *Pixels*, five (5) green *Pixels*, and five (5) purple *Pixels*.

**Pixel Storage** – The designated area outside of the *Playing Field Boundary* directly adjacent to the *Wing* (see Figure 4.2-2) where *Pixels* are stored to be introduced by the *Human Player*. There is one (1) *Pixel Storage* area.

**Playing Field** – The part of the *Competition Area* that includes the 12 ft. x 8 ft. (3.66 m x 2.44 m) field, the *Landing Zones* and all the *Game Elements* described in the official field documents. There are two equivalent official versions of the *Playing Field*: red or blue.

**Playing Field Boundary** – A taped line or a wall that marks the *Area* where a *Robot* operates.

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

**Playing Field Floor** – The top surface of the *Area* inside the *Playing Field Boundary*.

**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*. *Launching*, *Rolling*, and *Sliding* are forms of *Propelling*.

**Randomization Object** – A white *Pixel* or *Team Prop* that is placed in one of three randomly chosen locations. There are two (2) *Randomization Objects*, one (1) placed on each center *Spike Mark*.

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

**Rigging** – Part of the *Truss* from which *Robots Suspend*. There are two (2) *Riggings*, either two (2) red or two (2) blue.

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

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

**Score / Scoring** – A *Robot* earns points by interacting with *Scoring Elements* and *Navigating* to specific *Areas* of the *Playing Field*.
The specific method for each Scoring achievement is stated in the achievement’s description in Section 4.4. Individual Scoring achievements are determined by one of three methods:

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

2. **Scored at End of the Period**: The achievement’s Scoring status is determined based on the Robot or Scoring Element’s position at the End of the Period (Autonomous or Driver-Controlled).

3. **Scored at Rest**: The achievement is considered Scored based on the position of the Robot or Scoring Element when the entire field has come to rest after the Period (Autonomous or Driver-Controlled) ends.

Use of the real-time scoring system display is intended to help the Team 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 Field Personnel finalize the Score after the End of the Match.

**Scoring Elements** – Objects that a Robot manipulates to earn points for their Alliance. The Scoring Elements for CENTERSTAGE℠ are Pixels and Drones.

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

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

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

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

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

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

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

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

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

_Gracious Professionalism℠_ - “Doing your best work while treating others with respect and kindness - It’s what makes FIRST, first.”
Team Prop – A Team designed and supplied Game Element used during the Autonomous Period. The Team Prop must meet the specifications described in Game Manual Part 1 – Remote Events.

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

Truss – A structure that contains two (2) Riggings.

Wing – A Taped off location on the Playing Field Floor where a Human Player places Pixels and a Drone.

Warning – An alert given by Field Personnel to an individual or to the Team. Warnings are applied to the entire Team, and they have no effect on an Team’s Score. Warnings are used as a way to point out rule violations while not issuing formal Penalties.

4.4 Gameplay
Prior to the start of the Match, the Drive Team performs 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 the Team to pick up the controllers and switch programs. When the Match is over and Field Personnel signal, the Drive Team collects their Robot and Team Supplied Game Element, 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.
2. Pixel placement
   a) On-Field:
      i. Three (3) stacks of five (5) white Pixels
   b) Pixel Storage: there is one Pixel Storage location, either red or blue. A Pixel Storage contains the following:
      i. Three (3) stacks of five (5) white Pixels
      ii. One (1) stack of five (5) purple Pixels
      iii. One (1) stack of five (5) yellow Pixels
      iv. One (1) stack of five (5) green Pixels
   c) Randomization Task
      i. Two (2) white Pixels, one (1) for each set of Spike Marks. The Pixels will start in the center of the center Spike Marks.
3. The Drive Team sets up their Robot on the Playing Field with the following constraints:
   a) Starting Location
      i. The Drive Team selects their Robot’s starting location.
ii. Blue Alliance Robots must start Completely In Tile A2 or A4, red Alliance Robots must start Completely In Tile F2 or F4. See Appendix B for Tile nomenclature.

iii. The Drive Team must place their Robot, in any orientation, touching the Playing Field Boundary adjacent to their Alliance Station.

b) Pre-Loaded Pixels – The Drive Team may Pre-Load exactly one (1) yellow Pixel and/or one (1) purple Pixel. If used, Pre-Loaded Pixels are taken from Pixel Storage. When loaded, the Pre-Loaded Pixels must be Outside all Scoring Areas.

c) Drone – The Drive Team may either Pre-Load exactly one (1) Drone or place one (1) Drone into the Pixel storage area.

d) Team Prop – The Drive Team intending to use their Team Prop must place it centered on top of the center Spike Mark closest to their Robot. If a Team Prop is used, the white Pixel is placed into Pixel Storage.

e) Op Mode –
   i. The Drive Team use their Driver Station to select an Autonomous Op Mode. If the Team does not have an Autonomous Op mode, steps ii and f) below can be skipped.
   ii. Press the Driver Station “Init” button.

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

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

4. Once the Field Personnel signal that set-up is complete:
   a) The Drive Team may no longer touch their Robot until the conclusion of the Match.
   b) The Drive Team may not touch their Driver Station 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 Field Personnel.
   c) The Scoring System will choose one of the Spike Marks (left, center, right) as the target for the Randomization Tasks. Field Personnel will move the Randomization Object to the chosen Spike Mark as specified in Appendix E.

4.4.2 Autonomous Period

The Match starts with a thirty (30) second Autonomous Period where Robots are operated only via pre-programmed instructions. The Team is 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 the Drive Team 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. The Drive Team 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. The Drive Team is 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 Robot that Parks In the Backstage earn five (5) points.

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2. **Randomization Tasks** – There are two distinct tasks based on the *Spike Mark* location that was designated during Randomization:
   a) A purple *Pixel* placed *On* the Robot’s designated *Spike Mark* in the *Tile* immediately adjacent to the starting location, earns points depending on the *Randomization Object* used:
      i. Ten (10) points for using the white *Pixel*; or
      ii. Twenty (20) points if *Team Prop* is used.
   b) A yellow *Pixel* on the *Backdrop* in the location corresponding to the designated *Spike Mark* earns points depending on the *Randomization Object* used:
      i. Ten (10) points for using the white *Pixel*; or
      ii. Twenty (20) points if *Team Prop* is used.

3. **Pixels** – A Robot placing *Pixels* earn points as follows:
   a) All *Pixels* On the recessed Scoring area of their Backdrop earn five (5) points per *Pixel*.
   b) *Pixels* In their Backstage earn three (3) points per *Pixel*.
   c) *Pixels* that are Scored in the Autonomous Period will earn additional points at the end of the Driver-Controlled Period if they remain in place.

4.4.3 **Driver-Controlled Period**

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

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

1. **Pixel** – *Robots* placing *Pixels* earn points as follows:
   a) *Pixels* On the recessed *Scoring* area of their *Backdrop* earn three (3) points per *Pixel*.
   b) *Pixels* In the *Backstage* earn one (1) point per *Pixel*.

2. **Artist Bonus** – *Mosaics* earn ten (10) points per *Mosaic*.

3. **Set Bonus** – A Team earns ten (10) points when *Scored Pixels On a Backdrop* extend *In* a horizontal *Set Line*. Vertically crossing *In* each *Set Line* earns one (1) *Set Bonus*, regardless of the number of *Pixels* that cross it. The maximum *Set Bonus* for a *Team* is thirty (30) points.

4.4.4 **End Game**

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

1. **Robot Location** – There are two mutually exclusive location-based *Scoring* opportunities. A *Robot* may only earn points for one of these tasks. The *Team* is encouraged to make these actions obvious and unambiguous. *Robot Location* is *Scored at End of the Period*.
   a) **Suspended from the Rigging** - A *Robot Suspended* by the Rigging earns twenty (20) points.
   b) **Parked In the Backstage** – A *Robot* that *Parks In the Backstage* earns five (5) points.
2. **Drone Launching** – A Launched Drone that end up *Parked In a Landing Zone* earn points as shown below. A Launched Drone must pass over the *Truss* and/or *Stage Door* for each scoring attempt to earn points. **Drone Launching** is **Scored at Rest**.

   a) *Landing Zone 1* earns thirty (30) points.
   b) *Landing Zone 2* earns twenty (20) points.
   c) *Landing Zone 3* earns ten (10) points.

**4.4.5 Post Match**

By the conclusion of the stop *Match* sound, *Drive Teams* must press the stop button on their *Driver Stations*. *Field Personnel* will then finalize the *Score*. *Field Personnel* will signal for the *Drive Team* to enter the *Playing Field* and retrieve their *Robot* and *Drone*. The *Drive Team* 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 deducted from the *Team’s Score* at the *End of the Match*. *Minor Penalties* subtract ten (10) points per occurrence. *Major Penalties* subtract thirty (30) points per occurrence. *Warnings* have no effect on a *Team’s Score*.

**4.4.7 Flowchart of Match Play**

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

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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 and/or a Disabled Robot. Rules apply to all periods of play unless otherwise specified. If rules are in conflict, Safety rules take precedence over all rules and Game-Specific rules take precedence over General rules. The official FIRST Tech Challenge Question & Answer Forum rulings take precedence over all information in the game manuals.

4.5.1 Safety Rules
<S01> Unsafe Robot or Playing Field Damage – If at any time the Robot operation is deemed unsafe or has damaged the Playing Field, the Robot may be Disabled by Field Personnel.

<S02> Robot Extension Outside the Playing Field Perimeter – If any portion of the Robot contacts anything Outside the Playing Field Boundary, the Team will be issued a Major Penalty. See the game definitions in section 4.4 for a complete description of the Playing Field Boundary.

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

<S03> Safety Gear – Matches must not be played until all members of the Drive Team are wearing approved eye protection and shoes with closed-toes and a closed-back.

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

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

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

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

<G05> Robot or Scoring Elements In Two or More Scoring Areas – A Robot or Scoring Elements that are eligible for two or more Scoring achievements earn points only for the highest value achievement. If the achievement values are equal, only one achievement counts as Scored.
Scoring Elements in Contact with Robots – Scoring Elements in a Scoring Area that are in contact with or Controlled by a Robot for the Scoring Area have zero Score value.

Disabled Robot Eligibility – A Disabled Robot is not eligible to Score or earn points for the remainder of the Match.

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.

Match Replay – Once started, Matches are not paused or replayed. 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.

Inadvertent and Inconsequential – Robot actions that violate a rule may be ruled by Field Personnel to be Inconsequential and Inadvertent and will not be Penalized.

Playing Field Access – Team members must not enter the Playing Field for any reason other than to place/retrieve their Robot. While placing their Robot, the Team may not measure, test, or adjust Game Elements Inside or Outside of the Playing Field unless allowed by Section 4.4.1.

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.

Pre-Match Robot Placement – At the beginning of a Match, the Robot must be set up on the Playing Field according to section 4.4.1 Pre-Match. After the Robot is set up on the Playing Field, the Drive Team must stand Inside the Alliance Station.

Robot Starting Volume – Before the start of a Match, the Robot in its starting location must not exceed a volume of 18 inches (457.2 mm) by 18 inches (457.2 mm) by 18 inches (457.2 mm). Flexible materials (i.e., zip tie, surgical tube, string, etc.) may extend up to 0.25 inches (0.635 cm) beyond the 18 inch (45.72 cm) size constraint. A Pre-Loaded Scoring Element may extend Outside the 18-inch (457.2 mm) cube volume constraint. Match play must not begin until the Robot’s starting volume constraint is satisfied.

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

Robot Setup Alignment – The Team may align their Robot 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.

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volume constraint. Robot setup alignment devices that extend outside the 18-inch starting volume constraint cannot be powered. A single member of the Drive Team may also align the Robot by sight if they are next to the Robot and their action does not delay the start of a Match. A Minor Penalty will be assessed to the Alliance for violation of this rule.

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

a) The Drive Team may be anywhere in their respective Alliance Station or Human Player Station.

b) The first instance of leaving the Alliance or Human Player Station will result in a Warning, with any following instances during the Match resulting in a Minor Penalty. Leaving the Alliance or Human Player Station for safety reasons will not result in a Warning or Penalty.

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.

d) After the Robot is set up on the Playing Field, and before the Match starts, the Drive Team must stand Inside their respective Alliance or Human Player Station. Once the Match starts, the members of the Drive Teams may stand, sit, or kneel for the remainder of the Match. Violations of this rule (for example, lying down in the Alliance Station) will result in a Minor Penalty.

**<G17> Post-Match Removal of Robots** – The Robot must be designed to permit easy removal of Game Elements from the Robot after the Match. The Robot 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.

**<G18> Starting Gameplay Early** – A Robot that starts playing the game (Autonomous or Driver-Controlled Period) prior to the start of a Match Period receive a Minor Penalty.

**<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.

**<G20> Robot Actions at End of the Period** –

a) The Robot must Park at the end of the Autonomous and Driver-Controlled Periods. A Robot that is not Parked at the conclusion of the “game sound” receives a Minor Penalty and the following actions of the Robot do not count towards the Team’s Score. The Drive Team should make their best effort to stop gameplay immediately when the End of the Period game sound begins. Field Personnel 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 Team.

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, the Drive Team may not directly or indirectly control or interact with their Robot or Driver Station. 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. A Team that stops their Robot 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, their 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 with the Playing Field, a Game Element, or a Robot for safety reasons will not result in a Warning or Penalty.

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

<G23> **Drive Team Coach Driver Station Control** – During the Driver-Controlled Period, the Robot 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, the Drive Team Coach 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** – A Robot 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 per occurrence. If a deliberately detached component or mechanism affects gameplay, the offending Robot will receive a Major Penalty.

<G25> **Robots Grasping Game Elements** – A Robot may not Grasp and/or attach to any Game Element, 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.

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

<G26> **Destruction, Damage, Tipping, etc.** – Robot actions aimed at the destruction, damage, tipping over, or entanglement of Game Elements are not in the spirit of the FIRST Tech Challenge and are not allowed unless permitted by Game-Specific rules. 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.

<G27> **Removing Game Elements from the Playing Field** – A Robot may not deliberately remove Game Elements from the Playing Field during a Match unless specifically allowed by Game-Specific rule(s) listed in

**Gracious Professionalism®** - “Doing your best work while treating others with respect and kindness - It’s what makes FIRST, first.”
section 4.5.3. *Game Elements* that *Inadvertently* fall *Outside* the *Playing Field* will be returned to the *Playing Field* by *Field Personnel* at the earliest safe and convenient opportunity at a non-*Scoring* location approximately where it left the field. *Game Elements* removed from the *Playing Field* in an attempt to *Score* are also not subject to this *Penalty*. A Team 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.

<G29> **Illegal Usage of Game Elements** – A *Robot* 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.

### 4.5.3 Game-Specific Rules

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

a) *Robot* contact with a *Pixel* in a *Backstage* is allowed as an exception to rule <G06> if the *Pixel* is not *Possessed* by the *Robot*.

b) A *Robot* is allowed to *Grasp* the *Rigging* as an exception to rule <G25>.

c) A *Robot* may *Launch* their *Drone* to the *Outside* of the *Playing Field* as an exception to rule <G27>.

<GS02> **Drive Team Touching their Robot or Driver Station after Randomization** – The *Drive Team* is not allowed to touch or interact with their *Robot* or *Driver Station* once *Field Personnel* have begun the *Playing Field* randomization process. If this occurs, a *Minor Penalty* will be assessed, and the *Team* is not eligible to earn points for the *Randomization Tasks* in the *Autonomous Period*.

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

a) A *Robot* may *Control* or *Possess* a maximum of two (2) *Pixels* and one (1) *Drone* at a time. *Controlling* or *Possessing* more than the allowed quantity of *Scoring Elements* is an immediate *Minor Penalty* for each *Scoring Element* above the limit plus an additional *Minor Penalty* per *Scoring Element* in excess of the limit for each 5-second interval that the situation continues.

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

c) *Control/Possession* limit exceptions:

i. Knocking over a stack of un-scored *Pixels* is allowed.

ii. *Inadvertent* and *Inconsequential* movement of a pre-set stack of un-scored *Pixels* is allowed. Moving the stack *Completely Off* the tape is considered consequential.

iii. *Plowing* through any quantity of *Scoring Elements* is allowed.

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

v. *Pixels* *On* the *Backdrop* are exempt from the *Control/Possession* limit.
**<GS06> Truss Constraints** –

a) A Robot may only Grasp one of either Rigging of their Truss. Contact with the other parts of the Truss is allowed for stabilization of the Robot while Suspended. The intent is that the Rigging is the primary support for the Robot. Violation of this rule results in zero Score value for the Suspend task.

b) A Robot may not Grasp or Suspend from any other part of the Truss structure. Violation of this rule results in a Minor Penalty per occurrence.

**<GS07> Stage Door Constraints** –

a) A Robot may not Grasp the Stage Door. Violation of this rule results in a Major Penalty.

**<GS08> Backdrop and Backstage Constraints** –

d) A Robot located In Tile rows 1, 2, or 3 may not Score into the Backstage or Backdrop. Each violation will receive a Minor Penalty.

**<GS09> Wing Constraints** –

d) There can be a maximum of six (6) Pixels In the Wing at any one time. A Minor Penalty will be assessed for each additional Pixel beyond the maximum. Pixels in the Possession of a Robot do not count towards this limit.

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

**<GS11> Drone Constraints** –

a) A Drone is pre-loaded onto the Robots during Pre-Match setup as described in section 4.4.1 or introduced into the Playing Field during the Driver Controlled Period via the Wing.

c) A Drone Launched before the End Game have zero (0) Score value.

d) A Drone may be Launched from Suspended Robots.

e) For each scoring attempt (Launch, fly, land), a Launched Drone must pass over a Rigging or top pole of the Stage Door before it is eligible to Score points.

f) To Score a Drone, the Drone must be in a legal configuration. Altering a Drone after inspection or during Match play to better the chance of Scoring is not in the spirit of this rule and will not be considered a Scored Drone.

g) Drone Interference:

v. The Drive Team, Field Personnel, or physical structures outside of the Playing Field Boundary may not directly or indirectly affect the flight of a Drone. Affecting the Drone’s flight results in no points for that Drone. The Drone flight barrier outlined in the Remote Field Requirements guide is excluded from this rule.

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

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

a) A Drone and Pixels In the Pixel Storage Area may not be handled until after the Match has begun with the exception of the Pre-Load Scoring Elements.

b) A Drone and Pixels may be placed or dropped only In the Wing and only during the Driver-Controlled Period. A Drone and Pixels can be in any orientation and may be in contact with Pixels In the Wing.

c) The Human Player may place a maximum of two (2) Pixels or one (1) Drone In a Wing at a time.

d) Once a Pixel or Drone has been placed in the Wing, a Human Player may not pick it up or reposition it.
e) The **Human Player** may not *Propel Pixels* or the Drone Out of the Wing.

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

f) The **Human Player** may enter the area between the Human Player Station and the adjacent Playing Field Boundary while placing a Pixel or Drone In the Wing, provided that it is done safely.

g) The **Human Player** may not use tools or devices (including another Pixel) to manipulate a Pixel or Drone. Accommodations and exceptions for Human Players with disabilities or extenuating circumstances will be made at the discretion of the Field Personnel.

h) For safety reasons, a Human Player cannot break the vertical plane of the Playing Field Perimeter or hand-deliver a Pixel or Drone to the Playing Field when there is a Robot In the Wing.

i) A Robot cannot enter the Wing while a Human Player is In the Wing.

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

<GS13> **Truss/Stage Door Safety** – The **Drive Team** may never step/jump over any section of the Truss and/or Stage Door. The first instance will result in a warning to the Team. The next instance will be a Major Penalty.
## 4.6 Scoring Summary

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

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<thead>
<tr>
<th>Scoring Achievement</th>
<th>Autonomous Points</th>
<th>Driver-Controlled Points</th>
<th>End Game Points</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Navigating: Robot Parked In Backstage</td>
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<td></td>
<td></td>
<td>4.4.2</td>
</tr>
<tr>
<td>Placement: Pixel placed On the Team’s Backdrop</td>
<td>5</td>
<td></td>
<td></td>
<td>4.4.2</td>
</tr>
<tr>
<td>Placement: Pixels placed In the Team’s Backstage</td>
<td>3</td>
<td></td>
<td></td>
<td>4.4.2</td>
</tr>
<tr>
<td>Randomization: Purple Pixel placed on the designated Spike Mark using white Pixel</td>
<td>10</td>
<td></td>
<td></td>
<td>4.4.2</td>
</tr>
<tr>
<td>Randomization: Yellow Pixel placed On the Team’s designated Backdrop location using white Pixel</td>
<td>10</td>
<td></td>
<td></td>
<td>4.4.2</td>
</tr>
<tr>
<td>Randomization: Purple Pixel placed On the designated Spike Mark using Team Prop</td>
<td>20</td>
<td></td>
<td></td>
<td>4.4.2</td>
</tr>
<tr>
<td>Randomization: Yellow Pixel placed On the Team’s designated Backdrop location using Team Prop</td>
<td>20</td>
<td></td>
<td></td>
<td>4.4.2</td>
</tr>
<tr>
<td>Placement: Pixels placed In the Team’s Backstage</td>
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<td></td>
<td>4.4.3</td>
</tr>
<tr>
<td>Placement: Pixels placed On the Team’s Backdrop</td>
<td>3</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Artist Bonus: Completed Mosaic</td>
<td>10</td>
<td></td>
<td></td>
<td>4.4.3</td>
</tr>
<tr>
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<td>10</td>
<td></td>
<td></td>
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</tr>
<tr>
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<td>4.4.4</td>
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<tr>
<td>Robot Location: Robot Parked In the Backstage</td>
<td></td>
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<td>5</td>
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</tr>
<tr>
<td>Drone Launch</td>
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<td></td>
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<td></td>
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<tr>
<td>Zone 3</td>
<td></td>
<td></td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>
### 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.

<table>
<thead>
<tr>
<th>Rule #</th>
<th>Rule</th>
<th>Consequence</th>
<th>Warning Disable</th>
<th>Minor Penalty</th>
<th>Major Penalty</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;S01&gt;</td>
<td>Unsafe Robot or Damage to the Playing Field.</td>
<td>Disable if unsafe operation is likely to persist.</td>
<td></td>
<td>D*</td>
<td></td>
</tr>
<tr>
<td>&lt;S02&gt;</td>
<td>Contact Outside the Playing Field.</td>
<td>Major Penalty per offense.</td>
<td></td>
<td></td>
<td>1x</td>
</tr>
<tr>
<td>&lt;S03&gt;</td>
<td>Drive Team missing safety gear.</td>
<td>Match will not begin until resolved.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;G01&gt;</td>
<td>Autonomous to Driver-Controlled Period transition.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;G02&gt;</td>
<td>Certifying the Score at End of the Match.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;G04&gt;</td>
<td>Scoring Elements Controlled or Possessed are part of the Robot except for Robot location.</td>
<td>Robot or Scoring Element eligible for two or more Scoring achievements earn points only for highest achievement value.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;G05&gt;</td>
<td>Robot or Scoring Element in two or more Scoring Areas.</td>
<td>Points are not earned for any Scoring Elements in a Scoring Area in contact with a Robot.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;G06&gt;</td>
<td>Scoring Elements in contact with a Robot.</td>
<td>A Disabled Robot does not earn points. Penalties do not apply to Disabled Robots except as outlined in GS rules.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;G08&gt;</td>
<td>Playing Field Tolerances.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;G09&gt;</td>
<td>Match Replay.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;G10&gt;</td>
<td>Inadvertent and Inconsequential.</td>
<td>Inadvertent and Inconsequential rule violations are not Penalized at Field Person's discretion.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;G12&gt;</td>
<td>Measure, test, or adjust Game Elements. Playing Field inspection to determine Score.</td>
<td>Minor Penalty for pre-Match or post-Match violations. Major Penalty if delay start of Match.</td>
<td></td>
<td>1x</td>
<td>1x</td>
</tr>
<tr>
<td>&lt;G13&gt;</td>
<td>Pre-Match Robot placement.</td>
<td>Robot must be set up on the Playing Field according to section 4.4.1.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rule #</td>
<td>Rule</td>
<td>Consequence</td>
<td>Warning Disable</td>
<td>Minor Penalty</td>
<td>Major Penalty</td>
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</tr>
<tr>
<td>&lt;G14&gt;</td>
<td>Robot starting volume.</td>
<td>Robot is removed from the Playing Field if not resolved within 30 seconds.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;G15&gt;</td>
<td>Robot setup alignment devices/Match delay.</td>
<td>Minor Penalty for each offense.</td>
<td></td>
<td>1x</td>
<td></td>
</tr>
<tr>
<td>&lt;G16&gt;b</td>
<td>Drive Team member(s) leaving the Alliance Station.</td>
<td>Warning for the first instance with any following instances resulting in a Minor Penalty.</td>
<td>W</td>
<td>1x</td>
<td></td>
</tr>
<tr>
<td>&lt;G16&gt;d</td>
<td>Drive Teams may only sit, stand, or kneel in Driver Station.</td>
<td>Minor Penalty for each offense.</td>
<td></td>
<td>1x</td>
<td></td>
</tr>
<tr>
<td>&lt;G17&gt;</td>
<td>Post-Match removal of Robot causes a delay or damage to the Playing Field.</td>
<td>A Minor Penalty will be assessed.</td>
<td></td>
<td>1x</td>
<td></td>
</tr>
<tr>
<td>&lt;G18&gt;</td>
<td>Starting Gameplay early.</td>
<td>A Minor Penalty will be assessed.</td>
<td></td>
<td>1x</td>
<td></td>
</tr>
<tr>
<td>&lt;G19&gt;</td>
<td>Late start of the Autonomous Period.</td>
<td>A Minor Penalty will be assessed.</td>
<td></td>
<td>1x</td>
<td></td>
</tr>
<tr>
<td>&lt;G20&gt;</td>
<td>Robot is not Parked at the end of period.</td>
<td>Minor Penalty and the actions of the Robot that occur after the end of gameplay do not count towards their Team’s Score. Major Penalty if the late stop results in a competitive advantage for the offending Team.</td>
<td>1x</td>
<td>1x*</td>
<td></td>
</tr>
<tr>
<td>&lt;G21&gt;</td>
<td>Robot control during Autonomous Period / early stopping of the Autonomous code.</td>
<td>Major Penalty will be assessed. Achievements earned during that time result in zero Score.</td>
<td></td>
<td>1x</td>
<td></td>
</tr>
<tr>
<td>&lt;G22&gt;</td>
<td>Drive Team contact with the Playing Field, Game Element, or Robot.</td>
<td>Warning for the first instance with any following instances resulting in a Minor Penalty.</td>
<td>W</td>
<td>1x</td>
<td></td>
</tr>
<tr>
<td>&lt;G23&gt;</td>
<td>Drive Team Coach Driver Station control.</td>
<td>Warning for the first instance with any following instances resulting in a Major Penalty.</td>
<td>W</td>
<td>1x</td>
<td></td>
</tr>
<tr>
<td>&lt;G24&gt;</td>
<td>Robos deliberately detaching parts.</td>
<td>Minor Penalty. Major Penalty if it affects gameplay.</td>
<td></td>
<td>1x</td>
<td>1x</td>
</tr>
<tr>
<td>&lt;G25&gt;</td>
<td>Robot illegally Grasping Game Elements.</td>
<td>Warning for the first instance with any following instances resulting in a Major Penalty except as outlined in GS rules.</td>
<td>W</td>
<td>1x</td>
<td></td>
</tr>
<tr>
<td>&lt;G26&gt;</td>
<td>Destruction, damage, tipping, etc.</td>
<td>Deliberate or chronic violations of this rule will receive a Major Penalty.</td>
<td></td>
<td>1x</td>
<td></td>
</tr>
<tr>
<td>&lt;G27&gt;</td>
<td>Deliberately removing Game Elements from the Playing Field.</td>
<td>Minor Penalty per Game Element deliberately removed from the Playing Field except as outlined in GS rules.</td>
<td></td>
<td>1x</td>
<td></td>
</tr>
<tr>
<td>&lt;G29&gt;</td>
<td>Illegal Use of Game Elements to ease or amplify Scoring.</td>
<td>Major Penalty will be assessed.</td>
<td></td>
<td>1x</td>
<td></td>
</tr>
<tr>
<td>Rule #</td>
<td>Rule</td>
<td>Consequence</td>
<td>Warning Disable</td>
<td>Minor Penalty</td>
<td>Major Penalty</td>
</tr>
<tr>
<td>---------</td>
<td>---------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>-----------------</td>
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<td>---------------</td>
</tr>
<tr>
<td>&lt;GS01&gt;</td>
<td>General Game rule exceptions.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;GS02&gt;</td>
<td>Drive Team touching Robot or Driver Station after Randomization.</td>
<td>Minor Penalty and Robot not eligible for Autonomous tasks.</td>
<td></td>
<td>1x</td>
<td></td>
</tr>
<tr>
<td>&lt;GS04&gt;</td>
<td>Descoring.</td>
<td>Minor Penalty for each Pixel descored.</td>
<td></td>
<td>1x</td>
<td></td>
</tr>
<tr>
<td>&lt;GS05&gt;a</td>
<td>Control of more Scoring Elements than allowed.</td>
<td>Minor Penalty for each Scoring Element above the limit plus additional Minor Penalty per Scoring Element above the limit every 5 sec.</td>
<td>1x+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;GS05&gt;b</td>
<td>Scoring a Pixel while Controlling more Scoring Elements than allowed.</td>
<td>Minor Penalty for each Pixel Scored while in possession of more than the allowed Scoring Elements.</td>
<td></td>
<td>1x</td>
<td></td>
</tr>
<tr>
<td>&lt;GS06&gt;a</td>
<td>A Robot may only Grasp one Rigging.</td>
<td>Zero Score value for the Suspend task.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;GS06&gt;b</td>
<td>A Robot may not Grasp or Suspend from any other part of the Truss structure.</td>
<td>Minor Penalty per occurrence.</td>
<td></td>
<td>1x</td>
<td></td>
</tr>
<tr>
<td>&lt;GS07&gt;a</td>
<td>Grasping the Stage Door.</td>
<td>Major Penalty for each offense.</td>
<td></td>
<td></td>
<td>1x</td>
</tr>
<tr>
<td>&lt;GS08&gt;d</td>
<td>Robot Scoring Pixels from Tile rows 1, 2, 3.</td>
<td>Minor Penalty for each offense.</td>
<td></td>
<td>1x</td>
<td></td>
</tr>
<tr>
<td>&lt;GS09&gt;d</td>
<td>Exceeding allowed quantity of Pixels in Wing.</td>
<td>Minor Penalty for each Pixel over the maximum of 6 Pixels in Wing.</td>
<td></td>
<td>1x</td>
<td></td>
</tr>
<tr>
<td>&lt;GS10&gt;</td>
<td>Propelling Pixels.</td>
<td>Minor Penalty for each offense.</td>
<td></td>
<td>1x</td>
<td></td>
</tr>
<tr>
<td>&lt;GS11&gt;g.iii</td>
<td>Drive Team, Field Personnel, or physical structures affects the flight of a Drone.</td>
<td>Affecting own Team’s Drone results in no Score value for the Drone.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;GS11&gt;h</td>
<td>Drones Parked</td>
<td>Drones must Park Completely Outside of the Playing Field Perimeter to Score.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;GS12&gt;a</td>
<td>Scoring Elements in Pixel Storage may not be handled until start of Match.</td>
<td>Minor Penalty for each offense.</td>
<td></td>
<td>1x</td>
<td></td>
</tr>
<tr>
<td>&lt;GS12&gt;b</td>
<td>The Human Player may only place Pixels or their Drone in Wing during Driver-Controlled Period.</td>
<td>Minor Penalty for each offense.</td>
<td></td>
<td>1x</td>
<td></td>
</tr>
<tr>
<td>&lt;GS12&gt;c</td>
<td>Placing more than 2 Pixels or more than 1 Drone in the Wing at a time.</td>
<td>Minor Penalty for each offense.</td>
<td></td>
<td>1x</td>
<td></td>
</tr>
<tr>
<td>Rule #</td>
<td>Rule</td>
<td>Consequence</td>
<td>Warning Disable</td>
<td>Minor Penalty</td>
<td>Major Penalty</td>
</tr>
<tr>
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<td>---------------</td>
</tr>
<tr>
<td>&lt;GS12&gt;d</td>
<td>Repositioning already placed Scoring Elements in Wing.</td>
<td>Minor Penalty for each offense.</td>
<td></td>
<td>1x</td>
<td></td>
</tr>
<tr>
<td>&lt;GS12&gt;e</td>
<td>Propelling Pixels or a Drone Out of the Wing.</td>
<td>Minor Penalty for each offense.</td>
<td></td>
<td>1x</td>
<td></td>
</tr>
<tr>
<td>&lt;GS12&gt;g</td>
<td>Using tools to place Pixels or a Drone.</td>
<td>Minor Penalty for each offense.</td>
<td></td>
<td>1x</td>
<td></td>
</tr>
<tr>
<td>&lt;GS12&gt;h</td>
<td>Human Player cannot break the vertical plane of the Playing Field Perimeter while a Robot is in the Wing.</td>
<td>Minor Penalty for each offense.</td>
<td></td>
<td>1x</td>
<td></td>
</tr>
<tr>
<td>&lt;GS12&gt;i</td>
<td>Robot enters Wing while Human Player is In the Wing.</td>
<td>Minor Penalty for each offense.</td>
<td></td>
<td>1x</td>
<td></td>
</tr>
<tr>
<td>&lt;GS13&gt;</td>
<td>The Drive Team stepping/jumping over Truss or Stage Door.</td>
<td>First instance results in a Warning. Subsequent violations will result in a Major Penalty.</td>
<td>W</td>
<td></td>
<td>1x</td>
</tr>
</tbody>
</table>

**Table Key**

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

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Appendix A – Resources

Game Forum Q&A
https://ftc-qa.firstinspires.org/

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

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

FIRST Tech Challenge Game Manuals

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

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

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

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

B-1 Tile Locations

B-2 Intersection Locations

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Appendix C – Playing Field Details

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

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C-1 **Backstage and Backdrop locations**
C-2 Backdrop dimensions

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

C-3 Backdrop dimensions

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**C-4 Truss and Rigging**

Red Alliance Truss and Rigging

Blue Alliance Truss and Rigging

**C-5 Truss and Stage Door spacing**

Note: the pipe clamps protrude a little lower than the pipe

**C-6 Truss and Rigging**

Dimensions are for reference only; actual dimensions may vary slightly from field to field.
~1 inch wide by 12" long tape strips.

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

The center strip is centered on the *Tile*.

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

---

**C-7 Spike Marks, typical**

1" wide tape runs from corner to corner (not including the tabs)

---

**C-8 Wing typical**
C-9 Landing Zones

- **Landing Zone 1**
  - This tape line is part of LZ1

- **Landing Zone 2**
  - This tape line is part of LZ2

- **Landing Zone 3**
  - This tape line is part of LZ3

24"  
48"  
72"
C-10 Pre-Match setup of on-field Pixels – locations

The left edge of the center tape is aligned to the root of the tabs

Blue Side

The right edge of the center tape is aligned to the root of the tabs

Red Side

Tape lines are ~one (1) inch wide and six (6) inches long

Dimensions are for reference only; actual dimensions may vary slightly from field to field
C-11 Location of Boundary AprilTags

- Red side:
  - ~4" from the centerline to the top of the Tile
  - ~11 1/2" from the tab root to the center mark on the AprilTag

- Blue side:
  - ~11 1/2" from the centerline to the top of the Tile
  - 4" from the centerline to the center marks on the AprilTag
three (3) stacks of five (5) white Pixels
one (1) stack of five (5) purple Pixels
one (1) stack of five (5) yellow Pixels
one (1) stack of five (5) green Pixels

C-12 Pre-Match setup of Pixel Storage

C-13 Layout of taped field (no perimeter walls)
Use 1" wide tape

C-14 Dimensions of taped field (red side shown)
Appendix D – *Scoring* Element

D-1 *Pixel*
Appendix E – Randomization

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

E-2 – Randomization Objects – pre-randomization starting position - blue Alliance
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Randomization Object- right side scoring locations

E-5 – right Scoring

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

This is a legally scored Pixel and earns the autonomous points

E-6 – Pixel position
E-7 – Scoring Examples

Purple Pixel earns Randomization Bonus

Purple Pixel earns Randomization Bonus

E-8 – Scoring Examples

Purple Pixel does not earn Randomization Bonus

Purple Pixel does not earn Randomization Bonus

E-9 – Scoring Examples

Yellow Pixel does not earn Randomization Bonus

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Appendix F – Scoring Examples

F-1 Pixel Scoring

Pixel is not in the recessed area, it does not score

Pixel is not flat against the back but it still scores

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

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

F-2 Mosaics
Not legal Mosaics:

A. A Mosaic must consist of three (3) non-white Pixels, either all the same color (all green, all purple or all yellow) or each Pixel a different color (one (1) green, one (1) purple, and one (1) yellow).

B. A Mosaic cannot be in contact with another non-white Pixel.

C. Each Pixel in a Mosaic must be in contact with the other two (2) Pixels of that Mosaic.

F-3 Not Mosaics

F-4 Set Bonus
F-5 Landing Zone Scoring

- **R1** – In Landing Zone 2
- **R2** – In Landing Zone 1
- **R3** – In Landing Zone 3
- **R4** – Outside of Landing Zones
Appendix G – AprilTags

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

Do not print the images from this manual for practice purposes, as they are not to the same scale as Teams will see in actual competition. Please refer to the website for printable versions of these images.

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G-2 AprilTags for Playing Field Wall

Do not print the images from this manual for practice purposes, as they are not to the same scale as Teams will see in actual competition. Please refer to the website for printable versions of these images.