Team Update 00

The FIRST® Tech Challenge Competition Manual has undergone significant reorganization and modification since the 2023-2024 season. The Competition Manual is the ultimate source for rules and will be updated throughout the season to reflect any clarifications or changes. High level changes to the format of the manual were addressed in this blog post.

When reading the Competition Manual, avoid making any assumptions based on previous year's rules or prior interpretations. It's important to read the whole manual at least once and become an expert on sections of the manual that directly relate to your role and responsibilities on your team.

Teams are welcome to view existing questions and answers and to ask thoughtful and informed questions through the official Q&A system opening at September 16, 2024, 12:00p.m. ET. Before asking a question, please review section 1.10 in the Competition Manual for information on what types of questions should be asked.

Content Changes

A summary of **major content changes** made since the preview version of the manual (V0) was released in July can be found below. In addition to what is listed below, other editorial changes to verbiage, and modifications to figures and examples have been made. Be sure to read the current version of the competition manual in its entirety to see all updates and changes.

Section 1 Introduction

Added more precision to metric dimensions as described in section 1.7.

- Imperial dimensions are followed by comparable metric dimensions in parentheses to provide metric users with the approximate size, mass, etc. Metric conversions (e.g., dimensions) round to the nearest tenths, e.g., "17.5 in. (~44.5 cm)."

Section 5 Event Rules

Multiple rules have added text for clarity in this section. Make sure to read the updated section for the most current wording.

E702 ***Pit person limit during ceremonies is 5.** No more than 5 team members may be in the pits during ceremonies outside of playoff MATCHES. Each team must have at least 1 representative observing ceremonies to be responsible to relay important information to the entire team.

Section 12 ROBOT Construction Rules

R104 **There is a horizontal expansion limit.**

Horizontal expansion limit rules have been updated for clarity with:

- *revised wording to the rule text*
- *additions to the orange box text*
- *updated figure 12-1 Expansion Limits*
- *new figure 12-2 Expansion Limit Examples*

R402 ***ROBOT SIGNS indicate your ALLIANCE.**

E. cannot be powered or rely on power from any sources to illuminate/reveal ALLIANCE color

R504 ***Do not modify actuators unless explicitly allowed.**

B. the electrical leads may be trimmed to length as necessary and connectors or splices to additional wiring may be added, and purely electrical enclosures can be substituted with functionally equivalent replacements,

R505 ***All actuators must be powered from approved devices.**

Table 12 3: Power Regulators and Limits

Power Regulating Device	Part Number	Load Limit per Device
REV Robotics Servo Hub	REV-11-1855	2 Servos per Port

Additionally, references to the REV Robotics Servo Hub have been added to relevant tables in R614, R619, R713.

R609 ***Connect the ROBOT battery safely though the Main Power Switch.**

Table 0-1: Legal Power Switches

Power Switch	Part Number
Studica On/Off Power Switch Kit	70182

R702 ***Teams may not alter coprocessor software.** Modifying software on coprocessors, unless explicitly permitted in this rule or rule R703, is not allowed by teams. Firmware updates in binary form provided by the manufacturer may be applied as directed by the manufacturer.

The following are examples of allowed devices:

Example 1: The Adafruit BNO055 Absolute Orientation Sensor is an IMU package with an onboard ARM Cortex-M0 based coprocessor to crunch sensor data and produce composite output. Its coprocessor contains software that is not intended by the manufacturer to be modified by users.

Example 2: The SparkFun Optical Tracking Odometry Sensor is a laser and IMU tracking device that uses an onboard microcontroller to perform complex calculations and produce simplified results. SparkFun does provide the source code and toolchain for advanced users to modify/update the software, which is not permitted by this rule. Firmware updates provided by SparkFun are allowed to be applied to the device.

Example 3: The Digital Chicken Labs OctoQuad FTC Edition is an 8-channel encoder/PWM interface, utilizing a Raspberry Pi Pico coprocessor. Teams are not permitted to modify software running on the device, including replacing the software with their own. Updates provided in binary form by the manufacturer (Digital Chicken Labs) may be applied to the device.

R703 ***Some vision coprocessors can be programmed.** Programmable vision coprocessors that are natively supported by the FTC SDK may be programmed. The programmable vision coprocessors that are supported are:

Table 0-2: Supported programmable vision coprocessors

Device	Part Number
Limelight Vision Limelight 3A	LL_3A

Example 1: Optical Flow sensors are an example of a sensor that utilizes a vision coprocessor that is treated no differently than other coprocessors per R702.

Example 2: The DFRobot HuskyLens and the Charmed Labs Pixy2 are examples of vision coprocessors that are configurable but not programmable and are treated no differently than other coprocessors per R702.

Example 3: The OpenMV Cam, Luxonis OAK-1, and LimeLight Vision Limelight 3G are examples of programmable vision coprocessors that are prohibited.

See R715 for more information regarding vision coprocessor support.

R706 ***Bandwidth is restricted.** While in the ARENA and MATCH queue devices on the ROBOT network are limited to only the ROBOT CONTROLLER device and the DRIVER STATION device, and communication between the ROBOT CONTROLLER and the DRIVER STATION device is limited to ROBOT command data from the DRIVER STATION app, debugging data and telemetry from the ROBOT CONTROLLER app to the DRIVER STATION app, and single frame images used during ROBOT set-up pre-MATCH. When not in the ARENA or MATCH queue, additional devices (including, but not limited to, programming computers) may also communicate on the ROBOT network and teams must be careful to limit Wi-Fi streaming bandwidth between devices.

R710 ***Use assigned Wi-Fi bands and/or channels if requested.** Teams may be asked by the event director to use a specific Wi-Fi frequency band or channel on the day of competition. If requested, teams are required to do so. Teams may work with the FTA or wireless technical advisor (WTA) to find an alternate frequency band or channel if the suggested band/channel is deemed problematic by the FTA or WTA.

R710-R717 *Rules from R710 to R717 have been renumbered to make room for R710*

R715 ***Use only supported USB vision.** Only single image sensor vision devices that are natively supported by the ROBOT CONTROLLER app are allowed to connect to USB (stereoscopic cameras are not allowed). This includes the following:

A. all UVC compatible USB webcams (Logitech C270, and related), and
B. Vision coprocessors allowed per R703.

> To request support (or to provide sample drivers) for alternate USB vision devices for inclusion in future *FIRST* Tech Challenge seasons, please use the Part Suggestion Form.
>
> UVC compatible USB webcams may only use the UVC provided stream / data. No other interfaces or data provided by the webcam may be used.

Team Update 01

General

The Q&A system is now open for questions. As a reminder, each team has one account that can be used to ask questions on the Q&A. Please reference the Team Q&A Registration Instructions document to access your team's account.

Competition Manual

Section 1.10 Question and Answer System

- Moderators will answer team questions beginning each Monday, and close on Thursday at 12:00pm ET.

Section 9.7 SCORING ELEMENTS

- There are two different physical elements used in INTO THE DEEP: the SAMPLE and the CLIP. Red or blue ALLIANCE SPECIFIC SAMPLES can be combined ~~by a HUMAN PLAYER~~ with a CLIP to create a SPECIMEN. The SAMPLE and the SPECIMEN can be used to score points.

Section 9.7.2 CLIP

- The CLIP is a black plastic SCORING ELEMENT which is designed to be connected to a SAMPLE by a HUMAN PLAYER or ROBOT to create a SPECIMEN. The CLIP is a 2.5 in. (~6.4 cm) high by ~3.2 in. (~8.1 cm) long by 1 in. (~2.5 cm) wide .

Section 10.3.1 SCORING ELEMENTS

- From the SCORING ELEMENTS provided in ~~E~~ D and ~~F~~ E each ROBOT may be pre-loaded with either 1 SAMPLE or one SPECIMEN such that it is in contact with the ROBOT. SAMPLES or CLIPS not pre-loaded will remain in setup locations ~~E~~ D and ~~F~~ E.

Section 10.5.3 ROBOT Scoring Criteria

Additionally, the following conditions must be met:

- ROBOTS can only ASCEND their own ALLIANCE SPECIFIC RUNGS.
- ROBOTS must start ASCENDING from outside the SUBMERSIBLE ZONE.
- ROBOTS may not initiate contact with the HIGH RUNG while:
  - still supported by the TILES directly or transitively through another object (e.g., SCORING ELEMENTS or another ROBOT), ~~and~~ or
  - supported by any other part of the SUBMERSIBLE structure except for the LOW RUNG
- ROBOTS that are eligible for multiple ASCENTS or ASCENT and PARKING points only earn points for the highest value achievement.

If any of the above conditions are not met, it is not a valid ASCENT. If a ROBOT does not meet ASCENT criteria, the ROBOT may disengage from the SUBMERSIBLE and attempt the ASCENT again.

Section 11.4.2 TELEOP

G406 ***ROBOTS are motionless at the end of TELEOP**. ROBOTS must no longer be actively controlled after the end of the TELEOP period. This can be done by a DRIVE TEAM member pressing the (■) stop button

on the DRIVER STATION app or by discontinuing any operation of the ROBOT by the end of the ~~buzzer sound~~ MATCH period.

Violation: MINOR FOUL, MAJOR FOUL if actions result in a scoring achievement by the offending ROBOT

DRIVE TEAMS should make their best effort to stop gameplay immediately ~~when the end of the period game sound begins~~ at the end of the MATCH period. The end of MATCH period buzzer audio cue is approximately 3 seconds long and is used as an unofficial indicator to teams and REFEREES that the MATCH has ended.

Section 11.4.3 SCORING ELEMENT

G410 **1 SAMPLE or SPECIMEN at a time.** A ROBOT may not CONTROL more than 1 SAMPLE or 1 SPECIMEN at a time, either directly or transitively through other objects. There is no limit to the number of CLIPS a ROBOT may possess.

A ROBOT is in CONTROL of a SAMPLE or SPECIMEN if:

- the SAMPLE or SPECIMEN is fully supported by the ROBOT or
- it intentionally pushes a SAMPLE or SPECIMEN to a desired location or in a preferred direction (i.e., herding, often with a concave surface)

Exceptions to this rule are as follows:

- ROBOTS may MOMENTARILY exceed CONTROL limits while collecting SAMPLES that are in the SUBMERSIBLE ZONE.
- scored SAMPLES or SPECIMENS for the corresponding ALLIANCE are exempt from the CONTROL limit.

Violation: MINOR FOUL per SCORING ELEMENT, plus YELLOW CARD if excessive.

Examples of interaction with a SAMPLE or SPECIMEN that are not “CONTROL” include, but are not limited to:

A. PLOWING or “bulldozing” (inadvertent contact with a SAMPLE or SPECIMEN, typically via a flat or convex surface, while in the path of the ROBOT moving about the FIELD).

B. “deflecting” (being hit by a SAMPLE or SPECIMEN that bounces off a ROBOT).

Excessive violations of CONTROL limits include, but are not limited to, simultaneous CONTROL of 3 or more ~~SCORING ELEMENTS~~ SAMPLES and/or SPECIMENS, or frequent, greater-than MOMENTARY CONTROL (i.e., more than twice in a MATCH) of 2 or more SCORING ELEMENTS. REPEATED excessive violations of this rule do not result in additional YELLOW CARDS unless the violation reaches the level of egregious to trigger a G201 violation.

G411 **ROBOTS may not CONTROL the opposing ALLIANCE'S SPECIFIC SAMPLES or SPECIMENS.** ROBOTS may only have MOMENTARY CONTROL of opposing ALLIANCE SPECIFIC SAMPLES or SPECIMENS.

Violation: MINOR FOUL per SCORING ELEMENT, plus an additional MINOR FOUL per opposing SCORING ELEMENT for each 5-second interval that the situation continues. A MAJOR PENALTY is applied for each SCORING ELEMENT that is scored while in CONTROL.

Section 12.3 Fabrication

R307 ***COTS must be single DoF.** COTS COMPONENTS and MECHANISMS must not exceed a single degree of mechanical freedom (DoF). Examples of allowed COTS single degree of freedom MECHANISMS and COMPONENTS are as follows:

A. linear slide kit,
B. linear actuator kit,
C. single speed (non-shifting) gearboxes,
D. pulley,
E. turntable,
F. lead screw, and
G. single DoF gripper.

Allowed exceptions to this rule are:

H. ratcheting devices (wrenches, bearings, etc.),
I. holonomic wheels (omni or mecanum), and
J. dead-wheel odometry kits.

The general test for a single degree of freedom MECHANISM is whether the orientation and position of each COMPONENT in the MECHANISM can be generally predicted based on the orientation and position of a single COMPONENT (such as the input) of the system.

Example 1: A mecanum drivetrain is made up of four independent drive modules, each with a single DoF (ignoring the DoF of the mecanum wheels as allowed by this rule), attached to a common structure (e.g., chassis). The overall MECHANISM is still a single DoF.

Example 2: Dead wheel odometry modules, allowed by this rule, are typically composed of a 1 DoF wheel (ignoring the effect of the holonomic wheel) providing forward/backwards motion and a spring force providing an additional unique rotational or vertical motion, creating a two DoF system.

Example 3: Simple gripper claws, comprised of a single actuator moving two gripper jaws simultaneously or double actuators each controlling an independent gripper jaw, are by and large a single DoF. However, grippers that incorporate additional actuators providing additional twisting and/or bending actions (like a wrist) add degrees of freedom that are prohibited in COTS MECHANISMS.

Section 12.4 ROBOT SIGNS

R402 ***ROBOT SIGNS indicate your ALLIANCE.** Each ROBOT SIGN must contain a 6.5 in. by 2.5 in. (16.5 cm by 6.4 cm) rectangle with a solid red or blue opaque background to indicate their ALLIANCE color (Figure 12-4), as assigned in the MATCH schedule at the event. Visible markings on ROBOT SIGNS when installed on the ROBOT, other than the following, are prohibited:

E. those required per R403,
A. solid white *FIRST* logos no larger than 1.5 in. (3.8 cm) in height (Figure 12-5)
B. small amounts of hook-and-loop tape, hard fasteners, or functional equivalents,
C. narrow areas of differing colors exposed at corners, folds, or cutouts,
D. dark narrow markings on background solely for template purposes,
E. cannot be powered or rely on power from any sources to illuminate/reveal ALLIANCE color

Section 13.6.4 4-ALLIANCE Bracket and Typical Timing

Correction to Match 5 lower bracket, loser of M4 plays winner of M3.