

## Team Update 00

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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

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### 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.

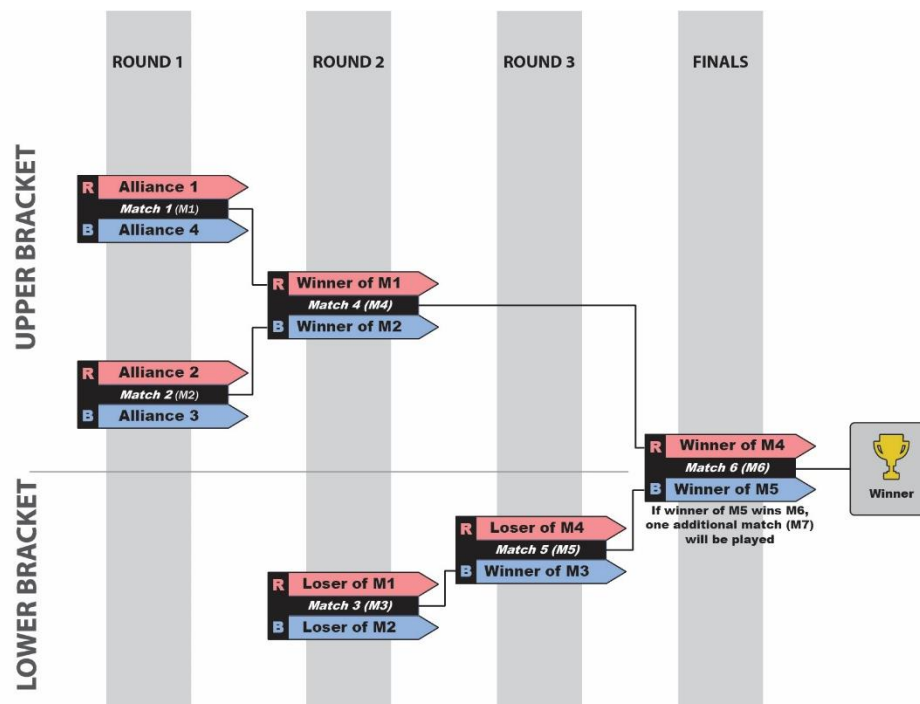
## Section 12.4 ROBOT SIGNS

**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.





## Team Update 02

### General

General formatting fixes.

### Competition Manual

#### Section 6.2.2 Think Award

Think Award Criteria		
Required	1	Team must submit a PORTFOLIO. The PORTFOLIO must include engineering content including <b>which includes at least one of the following:</b> A. evidence of use of the engineering process, B. lessons learned, C. trade off analysis /cost benefit analysis, and/or D. mathematical analysis used to make design decisions
Required	2	Team must be able to speak to the engineering content contained in their PORTFOLIO during the judging interview and/or pit interviews.
Encouraged	3	Team PORTFOLIO may include information about technical <del>skill</del> -resources including <b>which includes any number of the following examples:</b> A. how the team acquire new mentors, B. how the team learns from team mentors, and/or C. development plan for team members to learn new skills
Encouraged	4	PORTFOLIO information is organized in a clear and intuitive manner

#### Section 6.2.3 Connect Award

Connect Award Criteria		
Required	1	Team must describe, display, or document a team plan that covers <b>all of</b> the following: A. The team's goals for the development of team member skills, and B. The steps the team has taken or will take to reach those goals

### Section 6.2.4 Motivate Award

Motivate Award Criteria		
Required	1	<p>Team must describe, display, or document an organizational plan including which includes at least one of the following examples:</p> <ul style="list-style-type: none"> <li>A. team or organization goals,</li> <li>B. finances and financial sustainability plan,</li> <li>C. risk management planning,</li> <li>D. season timeline project planning, and/or</li> <li>E. outreach and service plan</li> </ul>

### Section 6.2.6 Control Award

Control Award Criteria		
Required	1	<p>Team must submit a PORTFOLIO. The PORTFOLIO must include all of the following:</p> <ul style="list-style-type: none"> <li>A. hardware and/or software control components and systems on the ROBOT,</li> <li>B. which challenges each component or system is intended to solve, and</li> <li>C. how does each component or system work</li> </ul>

### Section 9.7.1 SAMPLES

- A SAMPLE is a 3.5 in. (8.9 cm) long by 1.5 in. (3.8 cm) wide by 1.5 in. (3.8 cm) high rectangular prism shaped SCORING ELEMENT. There are forty (40) yellow SAMPLES, twenty (20) red SAMPLES, and twenty (20) blue SAMPLES. A SAMPLE with a CLIP attached is no longer a SAMPLE and is now a SPECIMEN. An ALLIANCE SPECIFIC SAMPLE with a CLIP attached is no longer a SAMPLE and is now a SPECIMEN. A neutral SAMPLE with a CLIP attached is no longer a SAMPLE.

### Section 9.7.2 CLIP

- The CLIP is a black plastic SCORING ELEMENT which is designed to be connected to an ALLIANCE SPECIFIC 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 D and E each ROBOT may be pre-loaded with either 1 SAMPLE or one SPECIMEN such that it is in contact with the ROBOT and not in the OBSERVATION ZONE or NET ZONE. SAMPLES or CLIPS not pre-loaded will remain in setup locations D and E.

### Section 10.5 Scoring

- All accomplishments are tracked live by FIELD STAFF and certified at the end of the MATCH. Accomplishments are officially scored at the end of the each MATCH period based on the status of the FIELD, when all ROBOTS and SCORING ELEMENTS have come to rest, except as follows:

### Section 10.5.1 SAMPLE Scoring Criteria

- A neutral SAMPLE with a CLIP attached in the NET ZONE or either the LOW or HIGH BASKETS have no score value.

### 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.
- for a LEVEL 3 ASCENT, 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), 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.

A ROBOT is considered ASCENDING once it is attempting to achieve an ASCENT LEVEL, and ASCENDED once it has achieved an ASCENT LEVEL.

The intent of part B of this rule is for the ROBOT to start its ASCENT outside of the SUBMERSIBLE ZONE except for minor elements used by the ROBOT to contact the RUNG. Once ROBOTS start their ASCENT, parts of the ROBOT may swing into the SUBMERSIBLE ZONE, which is not a violation of this rule.

ROBOTS attempting a LEVEL 3 ASCENT which then violate C. i or ii, may still be eligible for lower LEVEL ASCENT points as long as all other lower LEVEL ASCENT criteria are met at the end of the MATCH period. In this scenario, if a ROBOT would like to reattempt a LEVEL 3 ASCENT they must disengage from the HIGH RUNG and attempt their LEVEL 3 ASCENT again.

ROBOTS supported by an ALLIANCE partner ROBOT, SCORING ELEMENTS, other sections of the SUBMERSIBLE or the FIELD floor will not be awarded an ASCENT LEVEL 2 or 3.

### Section 11.3 Pre-MATCH

**G303** \*ROBOTS on the FIELD must be set up to play a MATCH. A ROBOT must meet all following MATCH-start requirements:

- does not pose a hazard to humans, FIELD elements, or other ROBOTS.
- has passed inspection, i.e., it is compliant with all ROBOT rules.
- if modified after initial Inspection, it is compliant with [I304](#).
- is the only team-provided item left on the FIELD.
- is fully contained within the FIELD and not in the NET ZONE or OBSERVATION ZONE.
- touching the FIELD wall adjacent to the ALLIANCE AREA.

- G. not attached to, entangled with, or suspended from any FIELD element.
- H. confined to its STARTING CONFIGURATION (see [R101](#) and [R102](#)).
- I. in contact with no more than the allowed pre-load possession limit as described in section [10.3.1 SCORING ELEMENTS](#).
- J. ROBOT SIGNS must indicate the correct ALLIANCE color (see [R402](#)).

### Section 11.4.1 AUTO

- G404 No AUTO opponent interference.** FIELD columns A, B, C constitute the blue side of the FIELD, and columns D, E, F (Figure 9-4) institute the red side of the FIELD. During AUTO ROBOTS may not:
- A. contact an opposing ALLIANCE'S ROBOT which is completely within the opposing ALLIANCE'S half of the FIELD.
  - B. contact a pre-set SAMPLE on the opposing ALLIANCE'S half of the FIELD.
  - C. move SCORING ELEMENTS onto the opposing ALLIANCE'S half of the FIELD outside of the SUBMERSIBLE ZONE.

### Section 11.4.3 SCORING ELEMENT

- G406 \*ROBOTS are motionless at the end of TELEOP.** ROBOTS must no longer be actively controlled by DRIVERS 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 MATCH period.
- 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 FOUL is applied for each SCORING ELEMENT that is scored while in CONTROL.*

### Section 11.4.4 ROBOT

- G418 Horizontal expansion limit.** After the MATCH has started, ROBOTS may expand beyond the STARTING CONFIGURATION but are still subject to sizing constraints (per. The sizing constraints are specified in [R104](#)).

*Violation: if more than MOMENTARY, MINOR FOUL, or MAJOR FOUL if the over-expansion is used for strategic benefit, including if it impedes or enables a scoring action.*

This rule is intended to limit the amount of floor area each ROBOT can cover with the maximum range of motion of all extensions. All possible movement of extensions outside the STARTING CONFIGURATION must be constrained within the horizontal size boundary assuming a stationary DRIVETRAIN resting normally on a flat surface as described in [R104](#).

During the MATCH REFEREES may use ARENA elements to help gauge ROBOT expansion during the MATCH. For example:

- A. TILES are approximately 24 in. (~61 cm)
- B. The RUNGS on the SUBMERSIBLE are 44.5 in. (~113 cm) wide

REFEREES that observe ROBOTS that are in violation of this rule may request the ROBOT be reinspected.

### Section 11.4.6 Human

- G431 HUMAN PLAYERS manipulate SCORING ELEMENTS within limits.** Only the HUMAN PLAYER may introduce SCORING ELEMENTS into or retrieve SCORING ELEMENTS from the OBSERVATION ZONE.
- A. any number of SCORING ELEMENTS can be manipulated by the HUMAN PLAYER at a time.
  - B. SCORING ELEMENTS may be placed in any orientation and/or in contact with other SCORING ELEMENTS.
  - C. HUMAN PLAYERS may only place SCORING ELEMENTS into the OBSERVATION ZONE during the AUTO and TELEOP periods of the MATCH.

### Section 11.5 Post-MATCH

- G502 \*Stop ROBOTS before entering the FIELD.** DRIVE TEAM members may not enter the FIELD to recover ROBOTS until:
- A. the head REFEREE has signaled it is okay to enter the field and
  - B. the DRIVE TEAM has pressed the (■) stop button on their DRIVER STATION app

*Violation: Verbal warning plus YELLOW CARD if subsequent violations at any point during the event.*

### Section 12.1 General ROBOT Design

- R104 There is a horizontal expansion limit.** After the MATCH has started, ROBOTS may expand beyond the STARTING CONFIGURATION but are still subject to sizing constraints. The sizing constraints are:
- A. there is no vertical height limit relative to the TILE floor for ROBOT extensions,
  - B. the horizontal size boundary is a 20 in. x 42 in. (50.8 cm x 106.7 cm) rectangle measured parallel (coplanar) to the TILE floor,
  - C. the horizontal size boundary translates and rotates with the overall configuration of parallel (coplanar) to the TILE floor, with the CHASSIS of the ROBOT, which is the structural frame or base of a ROBOT that allows it to move and maneuver.
  - D. the maximum extent of all extensions of the ROBOT must be confined to the horizontal size boundary, with the ROBOT chassis remaining in the same relative location within the horizontal size boundary at all times (the location and orientation of the chassis within the horizontal size boundary is determined by the team), and
  - E. the horizontal size boundary as described in B is always parallel (coplanar) to the TILES, so ROBOTS which change orientation (drive, tip, roll, etc.) during the MATCH are still subject to the horizontal expansion limit measured parallel (coplanar) to the TILES.

### Section 12.6 Power Distribution

- R616 \*Use specified wire colors.** All non-SIGNAL LEVEL wiring with a constant polarity (i.e., except for outputs of motor controllers, or sensors) must use consistent color-coding with different colors used for the positive (red, yellow, white, brown, or black with white stripe) and negative/common (black, blue) wires. Integrated wires originally attached to legal COTS devices or wires included/sold by the manufacturer are considered part of the device and by default legal. Such wires are exempt from this rule.

## Section 12.7 Control, Command & Signals System

**R718** \*Configure Android devices appropriately. ROBOT CONTROLLER and DRIVER STATION Android devices (smartphones, REV Control Hub, REV Driver Hub) must additionally be configured in the following ways:

- A. REV Control Hub users must [change the Wi-Fi password](#) to a non-default password,
- B. smartphone users must enable Airplane Mode,
- C. on ROBOT CONTROLLER and DRIVER STATION Android devices, Wi-Fi must be enabled and Bluetooth must be disabled,
- D. on smartphones and REV Driver Hub, remove all remembered Wi-Fi Direct Groups and Wi-Fi connections, leaving only the ROBOT CONTROLLER Wi-Fi connection.