

# Team Update 21

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## General

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- **Last One:** *Team Update 21* is the final Team Update of the 2018 *FIRST POWER UP* season.
- **Auto Plate Assignment:** As noted in [Q405](#), one pattern in the four possible patterns of switch/scale randomization appeared more frequently than desired. We have now implemented a solution that results in more uniform distribution of plate patterns, and this solution was deployed during Week 6 events.

The answer to [Q405](#) has been updated as follows:

### Updated: 4/10/18

The plates are randomized into one of four patterns, there is no consideration or compensation to guarantee that any individual pattern will appear an equal number of times. However, we too have noticed the RLR pattern appearing more frequently over the thousands of matches that have already been played this season, and we are looking into it.

**As announced in Team Update 21, as of week 6 events, a patch has been deployed that results in more uniform PLATE pattern distribution.**

- **Awards Update:** The Awards pages have been updated to reflect District Championship Divisions.
- **Q&A:** The official 2018 Q&A will close at noon (Eastern) on Wednesday, April 11, 2018.

## Rules & Expectations for *FIRST* Robotics Competition Events

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No changes.

## Game & Season Manual

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### Section 10.12.3.8

These slots are guaranteed to the Districts and populated with the following teams:

- qualifying award winners from the District Championship (Chairman's Award, Engineering Award, and Rookie All Star winners),
- teams on the **District Championship Playoff** Winning Alliance ~~from the District Championship~~ (including any Back-Up teams participating),
- qualifying award winners among district teams who traveled to Regionals,
- teams on the final District ranking list, as deep in the ranking list as the District needs to go to fill their allocation.

### Section 10.12.3.9 District Championships with Multiple Divisions

Some District Championships will have multiple divisions. In these cases:

- Division winning ALLIANCES play each other in District Championship Playoffs, employing the bracket below that corresponds to their District, until a winning ALLIANCE for the event is determined.

Figure 10-5 FIRST in Michigan District Championship Playoff Bracket

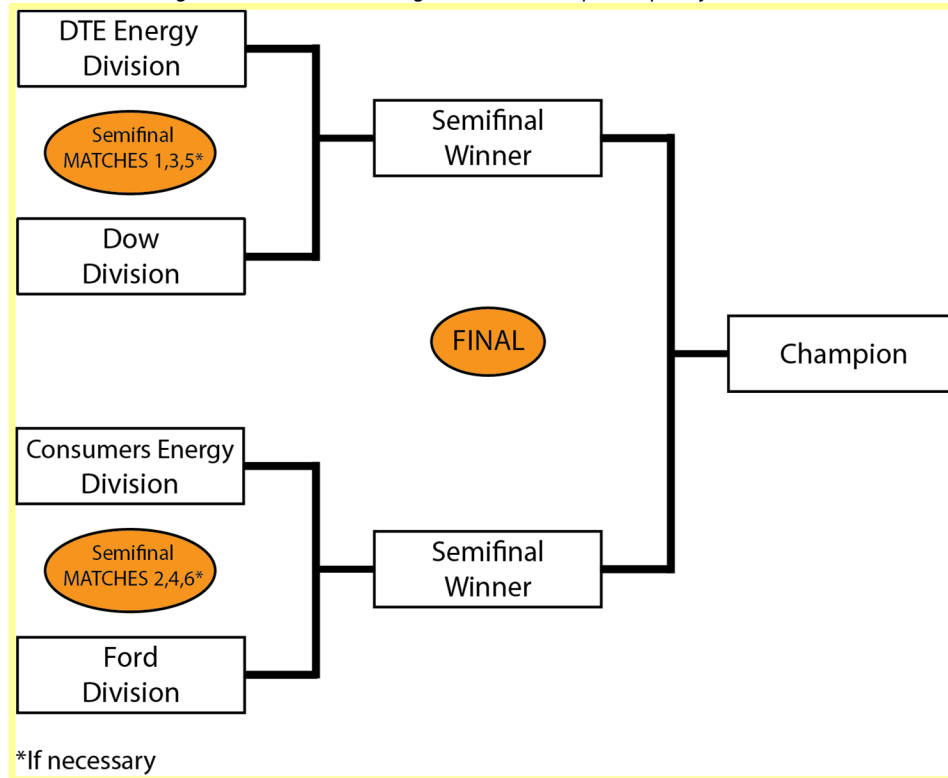
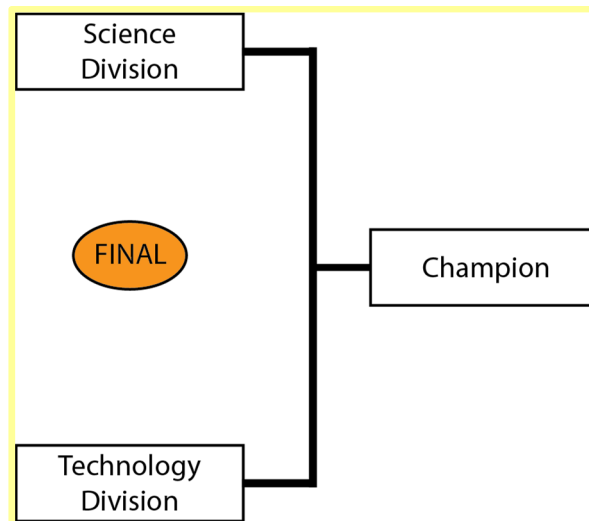


Figure 10-6 Ontario District Championship Playoff Bracket



- Teams participating in District Championship Playoffs earn Playoff round performance District points as described in Section 10.12.3.3.
- If an ALLIANCE in a District Championship Playoff has not yet adopted a BACKUP ROBOT per Section 10.5.2, the ALLIANCE CAPTAIN may bring in only the highest seeded team from their Division's pool of available teams to join its ALLIANCE.
- Team assignments to the Divisions are determined using an algorithm developed by FIRST in Michigan to balance Divisions with respect to team strengths.



# Team Update 20

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## General

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No changes.

## Rules & Expectations for *FIRST* Robotics Competition Events

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No changes.

## Game & Season Manual

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No changes.



# Team Update 19

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## General

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No changes.

## Rules & Expectations for *FIRST* Robotics Competition Events

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No changes.

## Game & Season Manual

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No changes.



# Team Update 18

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## General

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- **Inspection Checklist:** The [Inspection Checklist](#) has been edited which adds an item reflecting R78 (that the PDP CAN interface must be connected to the CAN-bus on the roboRIO) and moves items to improve process flow.
- **Shuffleboard:** Shuffleboard 1.3.0 has been released. This update contains improvements to CPU and memory usage for graphs and recording, adds a pre-loader to show loading progress, and adds some additional controls for camera streams. Teams can get the update using the auto-updater from the previous Shuffleboard release.

## Rules & Expectations for *FIRST* Robotics Competition Events

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No changes.

## Game and Season Manual

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### Section 7.3 ROBOT to ROBOT Interaction

**G16. The NULL TERRITORY is safe.** A ROBOT whose BUMPERS are breaking the plane of **or completely contained by** its NULL TERRITORY and not breaking the plane of the opponent's PLATFORM ZONE may not be contacted by an opposing ROBOT **either directly or transitively through a POWER CUBE**, regardless of who initiates the contact. A ROBOT forced into breaking the plane of an opponent's NULL TERRITORY resulting in it being wedged underneath the SCALE is not a violation of this rule.

Violation: TECH FOUL

**G18. Don't mess with opponents in their PLATFORM ZONE.** During the ENDGAME ROBOTS may not contact an opponent ALLIANCE ROBOT completely contained within their ALLIANCE'S PLATFORM ZONE, **either directly or transitively through a POWER CUBE**, regardless of who initiates the contact.

Violation: The contacted opponent ROBOT, and all partner ROBOTS it's fully supporting, are considered to have CLIMBED at the end of the MATCH.

## Section 10.12.3.7 District Championship Eligibility

Table 0-1: 2018 District Championship Capacities

District Championship	2018 Team Capacity
<i>FIRST</i> Chesapeake District Championship	60
<i>FIRST</i> Israel District Championship	45
<i>FIRST</i> Mid-Atlantic District Championship	60
<i>FIRST</i> North Carolina State Championship	32
<i>FIRST</i> Ontario Provincial Championship	80
Indiana State Championship	32
Michigan State Championship	160
New England District Championship	54 64
Pacific Northwest District Championship	64
Peachtree District State Championship	45



# Team Update 17

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## General

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No changes.

## Rules & Expectations for *FIRST* Robotics Competition Events

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No changes.

## Game and Season Manual

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No changes.



# Team Update 16

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## General

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- **Drawing Updates:** The [Field Drawings – FIRST POWER UP](#) specific drawing package has been updated with the following changes:
  - GE-18134 has been added.
  - GE-18007 and GE-18021 Have been modified to allow for gusset brace additions.
  - GE-18121 has been updated to include GE-18134 and additional hardware.Due to quality issues in the welds of the GE-18007, we will be adding gusset braces to help strengthen the plates. These pieces will likely be added over the course of week 2 and week 3 events or as soon as parts are manufactured.
- **WPILib:** Update 2018.4.1 has been released. This is a "recommended" update for teams using cameras, SmartDashboard, or Shuffleboard (as well as including some other minor fixes). A full changelog can be found on [ScreenSteps](#).

## Rules & Expectations for FIRST Robotics Competition Events

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No changes.

## Game and Season Manual

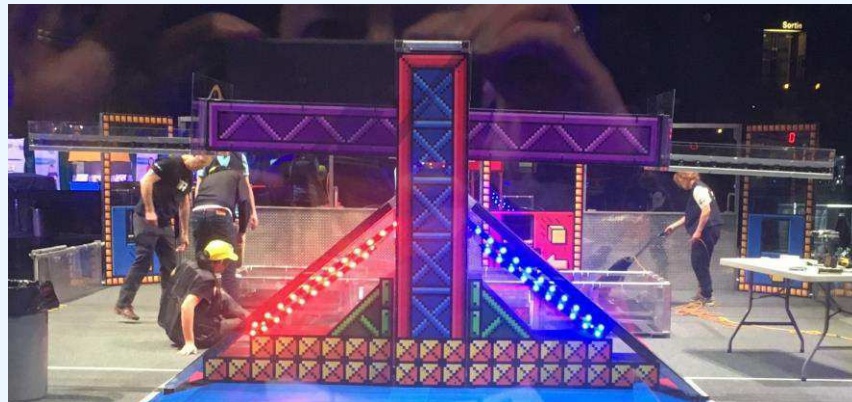
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### Section 3.5 Plate Lighting

Each PLATE is highlighted by Philips Color Kinetics Flex LED light strings.

Until further notice, events are instructed to install the SCALE light strings in the cavity below the outriggers instead of around the PLATES, approximately as shown below.

*Figure 3-17 Temporary SCALE lighting.*





# Team Update 15

## General

- **Team Update Schedule:** For the remainder of the 2018 *FIRST* Robotics Competition season, Team Updates will only be posted on Tuesdays (i.e. no more Friday Team Updates).
- **Event Coverage & Results:** Live results and video are available on the [FRC Event Results website](#). For teams in districts, live district rankings can be found on the [FRC District Ranking System website](#) and update periodically throughout the competition. If you're interested in watching live video from competitions where *FIRST* is providing a webcast, be sure to check out the brand new pages at [frc.watch](#).
- **Q&A Edit:** [Q366](#) was edited as follows:

**Q:** Our robot projects cubes from a shooter that does not extend outside of our bumpers. We are confused about how far from the switch fence we are allowed to be. If we add a "stick" that projects outward 16 inches from the bumper (legal per R04) but has no other purpose, does this legally allow us to shoot from 16 inches away? We want to know now rather than at competition and we not looking to violate the spirit of rules. We are looking for clarification not loopholes.

**A:** Thank you for thinking proactively. ROBOTS may "launch" if **they're their BUMPER is** in contact with the SWITCH FENCE or **any part of the ROBOT is** intersecting the vertical planes defined by the SWITCH FENCE (i.e. reaching over it). If you want to launch, but don't want to meet the first criteria, then you'll have to find a way to meet the 2nd criteria (or vice versa).

## Rules & Expectations for *FIRST* Robotics Competition Events

No changes.

## Game and Season Manual

### Section 10.7 YELLOW and RED CARDS

Figure 10-3 Audience Screen Graphic Showing YELLOW and RED CARD Indicators



# Team Update 14

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## General

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- **CTR Electronics Software Update:** An issue has been identified in the interaction between the roboRIO image and the CTR Electronics Phoenix software that can result in CTR Electronics CAN Motor controllers failing to properly enable, and an error being reported to the Driver Station. While the exact source of the issue has not been determined between the two components, CTR Electronics Phoenix versions 5.2.2.0 and later contain a patch that reduces the likelihood of occurrence. Teams are strongly encouraged to either update to Phoenix 5.2.2.0 or to learn how to circumvent the issue by reading the additional information found in the [CTRE Phoenix documentation](#) under *Driver Station System Watchdog -63194*.

## Rules & Expectations for *FIRST* Robotics Competition Events

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No changes.

## Game and Season Manual

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### Section 7.2 ROBOT Restrictions

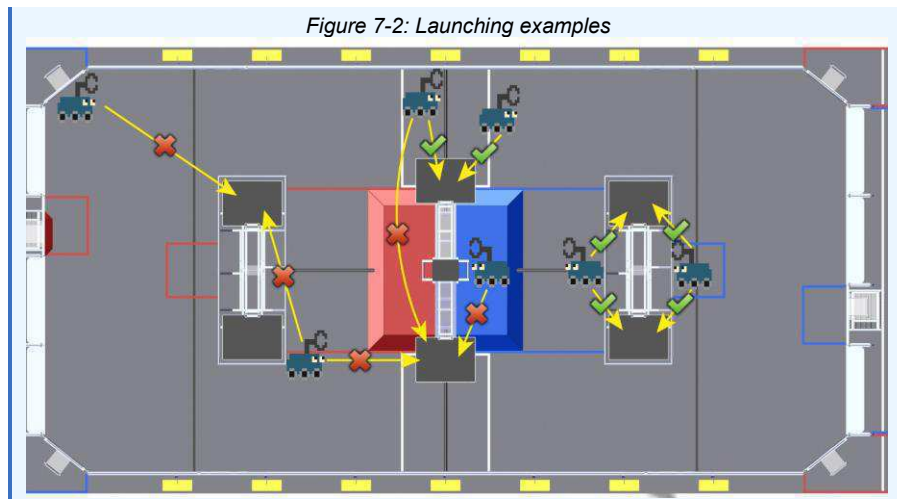
**G09. Launching POWER CUBES is okay, but keep it short.** A ROBOT is not permitted to launch POWER CUBES except:

- A. When any part of its BUMPERS are inside its ALLIANCE'S NULL TERRITORY, and it's attempting to place a POWER CUBE on the SCALE PLATE in its ALLIANCE'S NULL TERRITORY, or
- B. when any part of its BUMPERS are contacting a FENCE or any part of the ROBOT is intersecting the vertical planes defined by the SWITCH FENCE, and it's attempting to place a POWER CUBE on the nearest PLATE of that FENCE's SWITCH, or
- C. when any part of its BUMPERS are inside its ALLIANCE'S EXCHANGE ZONE, and it's attempting to place a POWER CUBE in its ALLIANCE'S EXCHANGE tunnel.

Violation: TECH FOUL per POWER CUBE. Repeated violations of this rule are likely to escalate rapidly to YELLOW or RED CARDS

Because gameplay is evaluated by human REFEREES, teams are encouraged to make compliance with G09 (e.g. if any part of the ROBOT is intersecting the vertical planes defined by the SWITCH FENCE) obvious and unambiguous.

A ROBOT in contact with a FENCE and straddling the midpoint (i.e. BUMPERS in both halves of the FIELD) may launch towards either of the corresponding SWITCH'S PLATES.



## Section 7.3 ROBOT to ROBOT Interaction

**G12. Don't collude with your partners to shut down major parts of game play.** Two or more ROBOTS may not isolate or close off any major component of MATCH play, e.g. blocking the EXCHANGE, **blocking both PORTALS simultaneously**, shutting down all access to POWER CUBES, quarantining all opponents to a small area of the FIELD, etc.

Violation: YELLOW CARD for the ALLIANCE.

A single ROBOT blocking access to a particular area of the FIELD is not a violation of G12.

Two ROBOTS independently playing defense on two opposing ROBOTS is not a violation of this rule.



# Team Update 13

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## General

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*A note from the FRC Director:*

You will note a few important changes in this Team Update. These are the result of our observations at the Week Zero event over the weekend.

We noted that occasionally Power Cubes were not sensed consistently in the Vault if the logo side of the cube was up, so we are recommending they be placed in the Vault logo side down. It's not a penalty to put them logo side up, but it also won't be considered an Arcade Fault if a cube placed logo side up is not sensed properly. Along with this manual change, we intend to remind teams during drivers' meetings at events that it's best if the put the cubes in the Vault logo side down.

Also, we are giving teams a little more leeway in G09 when it comes to where they may launch power cubes without penalty. We're trying to minimize nuisance penalties while still keeping the game safe. There is no perfect solution to this, but we think this change brings a better balance between competing desires.

## Rules & Expectations for *FIRST* Robotics Competition Events

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No changes.

## Game and Season Manual

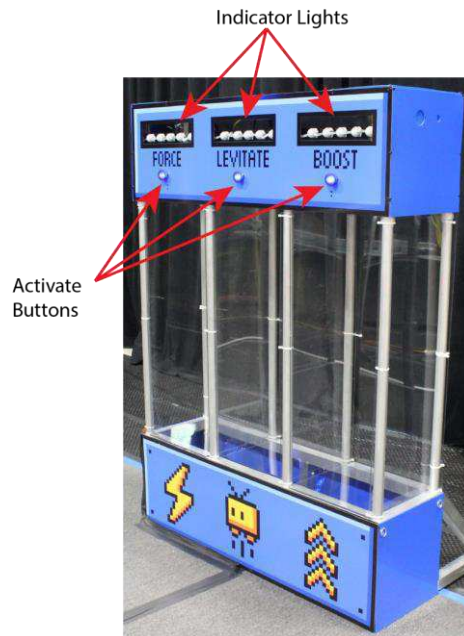
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### Section 3.6.3 VAULT

The VAULT is an aluminum and plastic structure used by HUMAN PLAYERS to turn POWER CUBES in to POWER UPS. There are three (3) columns within the VAULT. Each column is 1 ft. 1-1/2 in. (~34 cm) wide by 3 ft. 3-1/4 in. (~100 cm) tall with the bottom located 1 ft. 3-1/2 in. (~39 cm) above the carpet. Each of the three (3) columns in the VAULT correspond to a POWER UP. When standing in the ALLIANCE STATION and facing the open columns of the VAULT the column to the left is the FORCE POWER UP, the center column is the LEVITATE POWER UP and the column on the right is the BOOST POWER UP.

POWER CUBES placed logo-side-up may result in POWER CUBES not being sensed consistently by the FIELD.

Figure 3-19: Blue ALLIANCE VAULT



Caution, there may be orientations where all three (3) POWER CUBES will not fit in a VAULT column, but if HUMAN PLAYERS place POWER CUBES logo side up **down** they'll fit with room to spare.

## Section 7.2 ROBOT Restrictions

**G09. Launching POWER CUBES is okay, but keep it short.** A ROBOT is not permitted to launch POWER CUBES except:

- A. When any part of its BUMPERS are inside its ALLIANCE'S NULL TERRITORY, and it's attempting to place a POWER CUBE on the SCALE PLATE in its ALLIANCE'S NULL TERRITORY, or
- B. when any part of its BUMPERS are contacting a FENCE or any part of the ROBOT is intersecting the vertical planes defined by the SWITCH FENCE, and it's attempting to place a POWER CUBE on the nearest PLATE of that FENCE's SWITCH, or
- C. when any part of its BUMPERS are inside its ALLIANCE'S EXCHANGE ZONE, and it's attempting to place a POWER CUBE in its ALLIANCE'S EXCHANGE tunnel.

Violation: TECH FOUL per POWER CUBE. Repeated violations of this rule are likely to escalate rapidly to YELLOW or RED CARDS

## Section 7.6 Human Action Rules

**H14. POWER CUBES stay in the VAULT.** POWER CUBES may not be removed from the VAULT.

Violation: FOUL. If strategic (i.e. re-used in a different column) within the VAULT or introduced to the FIELD), RED CARD.

A POWER CUBE is considered in the VAULT when the LEDs in the corresponding column indicate its presence.

## Section 10.8 MATCH Replays

POWER CUBES not detected because of logo-side-up placement in the VAULT, per Section 3.6.3 VAULT, do not result in an ARCADE FAULT.

Note that an ARCADE FAULT that does not affect MATCH outcome in the judgement of the Head REFEREE does not lead to a MATCH replay. Examples include, but are not limited to:

- A. a piece of FIELD plastic falls into the FIELD, far away from any human or ROBOT activity, and in such a way that it does not affect MATCH outcome
- B. delay in the playing of an ARCADE sound
- C. mismatch between the timer on the Audience Screen and the FIELD Timer
- D. any adjustment or delay in assignment of a penalty (including those made after the MATCH)



# Team Update 12

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## General

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No changes.

## Rules & Expectations for *FIRST* Robotics Competition Events

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### Check-In

Upon receipt of your team's consent and release forms, each team will receive the following:

- Drive Team & Safety Captain ~~Badges~~ Buttons
- Pit Map
- Practice Match Schedule, if available
- Event Team List

## Game and Season Manual

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### Section 8.9 Pneumatic System

**R85.** Throughout an event, compressed air on the ROBOT must be provided by ~~one and only its~~ one compressor. Compressor specifications must not exceed nominal 1.10 cfm (~519 cm<sup>3</sup>/s) flow rate @ 12VDC.

A ROBOT'S compressor may be substituted by another compressor, but a ROBOT may only have one designated compressor at a time, and all compressed air on the ROBOT must be sourced from a single compressor.

For example, a team can't charge the circuit with an off-board compressor before the MATCH and then use a different on-board compressor to "top off" that circuit during the MATCH.

### Section 10.11.2 *FIRST* Championship Pit Crews

*FIRST* will distribute ~~badges~~ buttons to the ALLIANCE CAPTAINS during the ALLIANCE CAPTAIN meeting, which takes place on the Subdivision FIELDS. These ~~badges~~ buttons will provide the necessary access to the ARCADE for pit crew members.

**T01.** Only Team members wearing proper ~~badges~~ buttons are allowed on the ARCADE floor during Subdivision and Championship Playoff MATCHES

Violation: MATCH will not start until the situation is corrected. Those not displaying identification must leave the ARCADE.

Teams should assume they may be chosen for an ALLIANCE and think about the logistics of ~~badge~~ button distribution and set a plan prior to the ALLIANCE selection process. It is each ALLIANCE CAPTAIN'S responsibility to get the Team's ~~badges~~ buttons to the pit crew members.



# Team Update 11

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## General

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- **Note from the FRC Director:**

This update includes a significant change to R03. As written, it did not allow for 'minor protrusions' beyond the starting configuration, and we consistently answered Q&A questions to that effect. However, we have seen reports of group pre-inspections at which a significant percentage of teams did not realize this and built slightly oversized robots, leading to significant rework.

Many teams do not have access to these pre-inspections, and our concern is that many of them will arrive at their events with slightly oversized robots, resulting in a lot of frustration and a great deal of painstaking rework. To mitigate that, R03 now allows minor protrusions in the length and width dimensions. (Take note: not the height dimension).

This decision was not made lightly. While it does make the rule more forgiving, many teams understood the rules as written initially, and designed their robots with that understanding. Some teams caught the implications of the rule as it had been written later in the build season and invested time and resources in redesigning and reworking their robots to comply. For those teams, please accept my apologies. However, I do believe this change is better for the community because it will result in a better experience for more teams.

- **Drawing Updates:** [The Layout and Marking Diagram](#) has been updated with the following changes:
  - GE-18132 and GE-18133 have been added.
  - GE-18117 and GE-18116 have been removed.

The [Field Drawings – FIRST POWER UP specific](#) drawing package has been updated with the following changes:

- GE-18117 and GE-18116 have been removed.
- GE-18118 has been updated to accommodate the new cable protector design.
- GE-18120 has been updated to include GE-18131 and additional hardware.
- GE-18131, GE-18132 and GE-18133 have been added.

Unfortunately, the original cable protectors specified in the field drawings are prone to cracking when hit hard with non-rotating objects (anything other than wheels). To avoid field damage and delays in the match schedule, we are replacing the original cable protectors with flexible PVC cable protectors. These new cable protectors are similar in profile to the original ones, but will not crack during impact. While we feel that that these new protectors are easier for robots to cross, we apologize if they affect your robot design.

The addition of GE-18131 to GE-18120 is to help alleviate wear on the SCALE arm. The addition of this part will not alter the heights of the SCALE PLATE specified in [Section 3.3.1 SCALE PLATES](#).

- **Q&A Edits:** Answers to the following questions have been edited because of changes made in *Team Update 11*:
  - **Q139:** R01 defines the perimeter as the length of a string wrapped around the frame at the bumper zone. The answer to question 113 says "the exact size and shape of Frame Perimeter will vary from team to team. Are the measurements of 28 x 33 the hard maximum sizes? The perimeter of a 28 by 33 base would be 122 inches. Could we use a 30 inch square base which would have a perimeter of 120 inches?"



R01 defines the FRAME PERIMETER of a ROBOT. Further instances of FRAME PERIMETER in the Manual refer to this definition. R04 restricts ROBOT size in the STARTING CONFIGURATION ~~and does not refer to FRAME PERIMETER~~. A 30 in. square will not fit within the constraints of R04.

- **Q143:** Does the exclusion of minor protrusions in the starting configuration (R02) in the horizontal directions pertain to the vertical dimensions? For example, would a bolt head protruding above 55" be acceptable?  
No, the exception for minor protrusions in R02 applies to the determination of FRAME PERIMETER only ~~and does not apply to any of the dimensions in R03~~. ROBOTS must meet all STARTING CONFIGURATION size constraints in R03 with ~~no~~ **its noted** exceptions.
- **Q184:** In reference to R59, in section 8.7, it says that insulated copper wire is legal to use. Is copper clad aluminum wire legal to use?  
~~No~~ **Unless used for SIGNAL LEVEL circuits**, copper or tinned copper is the only wire permitted per R59. Aluminum and Copper Clad Aluminum wire are not capable of carrying the same current at the same gauge as copper wire.
- **Q190:** R03 doesn't say anything about Fasteners not counting in the Maximum Robot Size. So do fasteners on the outside of the frame count towards the measurement of the robot? Do the fasteners in the Kit of Parts for bumpers count against the size measurements during inspection?  
**Yes Probably not**, R03 has ~~no~~ exemptions for minor protrusions, ~~the entire ROBOT must fit in the size constraints~~. With respect to BUMPER fasteners, please see R30-G and the Blue Box below R29 for additional information about determining whether an item is part of a BUMPER or part of the ROBOT (and therefore subject to R03).
- **Q217:** If we were to go up from 6 gauge to 4 gauge using the Copper Cladded Aluminum Wire, would we be able to use it for our battery leads and main braker? This change would provide more current than the 6 gauge copper wire. The 4 gauge Copper Cladded Aluminum wire is rated at 10 amps more than the 6 gauge.  
No. Copper wire is the only wire allowed **for non-SIGNAL LEVEL circuits** per R59.
- **Q265:** If a robot has a frame perimeter of 28" x 33" and there are bolt heads that protrude beyond the 28" or 33" dimension, will a robot with the measurements listed above be allowed to compete? Will the conditions listed above cause the robot to fail inspection?  
~~A ROBOT with any part (including minor protrusions excluding BUMPERS) outside the dimensions listed in R03 when it's in STARTING CONFIGURATION does not comply with R03 and will not pass Inspection. Per R03, minor protrusions permitted in R01 and R02 (that are less than ¼ in. (~6.3 mm) such as bolt heads, fastener ends, weld beads, and rivets) are exempt from the 33 in. and 28 in. limits.~~
- **Q271:** In answer to Q265 you state "A ROBOT with any part (including minor protrusions, excluding BUMPERS) outside the dimensions listed in R03 when it's in STARTING CONFIGURATION does not comply with R03 and will not pass Inspection." This seems to contradict R02 which does allow for minor protrusions of bolt heads in the vertical perimeter. Can you please clarify? If the bolt heads on a lift mechanism extend beyond 28" frame perimeter would this fall within R02 and be allowable?  
R01 and R02 have exemptions for minor protrusions when determining FRAME PERIMETER and extension beyond the FRAME PERIMETER in STARTING CONFIGURATION. R03 **also** has ~~no such~~ **those** exemptions ~~and does not reference the FRAME PERIMETER~~. Any ROBOT part (excluding BUMPERS **and**

said minor protrusions) outside of the dimensions in R03 when in STARTING CONFIGURATION is a violation of R03.

## Rules & Expectations for *FIRST* Robotics Competition Events

No changes.

## Game and Season Manual

### Section 3.3 SCALE

There is one (1) SCALE centered in the FIELD, and oriented so that the SCALE arm is parallel to the ALLIANCE WALL. The SCALE features an arm, RUNGS, PLATES, OUTRIGGERS, PLATFORMS, and TOWER. All frame surfaces are covered in polycarbonate panels. A cable protector extends from the center of each side of the PLATFORM and is 2½ in. (~6 cm) 3 in. (~8 cm) wide and ¾ in. (~2 cm) high (Electriduct, Inc. CSX-3 Hubbell Inc. FloorTrak3 Floor Cable Cover FT3BK25, Grainger Item # 5D687, black). The cable protector is attached to the field with hook fastener, increasing the height to approximately 7⁄8 in. (~2 cm). These cable protectors extend to the GUARDRAILS and the SWITCHES.

### Section 4.6 Logistics

Once the MATCH is over, if the Head REFEREE determines that the FIELD is safe for FIELD STAFF but not safe for everyone (e.g. the SCALE is full of POWER CUBES that create a falling hazard for a DRIVE TEAM carrying a ROBOT), they will turn the LED lights on the PLATES purple. Once the FIELD is ready for DRIVE TEAM traffic, the Head REFEREE or their designee will change the LED lights to green and DRIVE TEAMS may retrieve their ROBOT in accordance with S02.

### Section 8.2 General ROBOT Design

**R03.** In the STARTING CONFIGURATION, the maximum ROBOT size (excluding BUMPERS) must be constrained to a volume of 33 in. by 28 in. by 55 in. tall (~83 cm by ~71 cm by ~139 cm tall). Minor protrusions permitted in R01 and R02 (that are less than ¼ in. (~6.3 mm) such as bolt heads, fastener ends, weld beads, and rivets) are exempt from the 33 in. and 28 in. limits.

### Section 8.7 Power Distribution

**R59.** All circuits shall be wired with appropriately sized insulated copper wire (SIGNAL LEVEL cables don't have to be copper):

Table 8-4: Wire sizes

Application	Minimum Wire Size
31 – 40A protected circuit	12 AWG (13 SWG or 4 mm <sup>2</sup> )
21 – 30A protected circuit	14 AWG (16 SWG or 2.5 mm <sup>2</sup> )
6 – 20A protected circuit	18 AWG
Between the PDP dedicated terminals and the VRM or PCM	(19 SWG or 1 mm <sup>2</sup> )
Compressor outputs from the PCM	22 AWG
Between the PDP and the roboRIO	(22 SWG or 0.5 mm <sup>2</sup> )
≤5A protected circuit	24 AWG
VRM 2A circuits	(24 SWG or .25mm <sup>2</sup> )
roboRIO PWM port outputs	26 AWG (27 SWG or 0.14 mm <sup>2</sup> )

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SIGNAL LEVEL circuits (i.e. circuits which draw  $\leq 1A$  continuous and have a source incapable of delivering  $>1A$ , including but not limited to roboRIO non-PWM outputs, CAN signals, PCM Solenoid outputs, VRM 500mA outputs and Arduino outputs)

28 AWG  
(29 SWG or .08 mm<sup>2</sup>)

Wires that are recommended by the device manufacturer or originally attached to legal devices are considered part of the device and by default legal. Such wires are exempt from R59.

**R61.** All non-SIGNAL LEVEL wiring with a constant polarity (i.e., except for outputs of relay modules, motor controllers, or sensors) shall be color-coded along their entire length from the manufacturer as follows:

- A.** Red, yellow, white, brown, or black-with-stripe on the positive (e.g. +24VDC, +12VDC, +5VDC, etc.) connections
- B.** Black or blue for the common or negative side (-) of the connections.

Wires that are originally attached to legal devices are considered part of the device and by default legal. Ethernet cable used in POE cables may use a different color standard. Such wires are exempt from R61.



# Team Update 10

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## General

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- **Award Descriptions:** The following language was added to the descriptions of Rookie All Star and Engineering Inspiration Awards on the [Awards Based on Team Attributes](#) page.

*An interview room may be used for this award at the District Championships. Please consult your district leadership with any questions.*

- **Inspection Checklist Updates:** Revision 1.1 includes the following edits:
  - A typo referencing the wrong year was fixed in *Team Compliance Statement*.
  - The *Starting Configuration* item was moved from *Mechanical* to *Initial Inspection*
  - Parenthetical references to the ¼ in. gap permitted in [Team Updates 9 & 10](#) were added to items in *Standard Bumpers* as appropriate.

## Rules & Expectations for FIRST Robotics Competition Events

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### General Rules

**E14-6.** Wireless ROBOT control is only permitted on the FIELD or Practice FIELD. ROBOTS must be operated by tether when outside the FIELD or Practice FIELD. Violations of this rule will result in a verbal warning. Repeated violations will be addressed by the Head REFEREE, the Lead ROBOT Inspector and/or Event Management.

**E14-7.** If operating wirelessly on the Practice FIELD, ROBOTS must use the provided Practice Field radio for communication. A violation of this rule will result in a verbal warning. Repeated violations will be addressed by the Head REFEREE, the Lead ROBOT Inspector and/or Event Management.

## Game and Season Manual

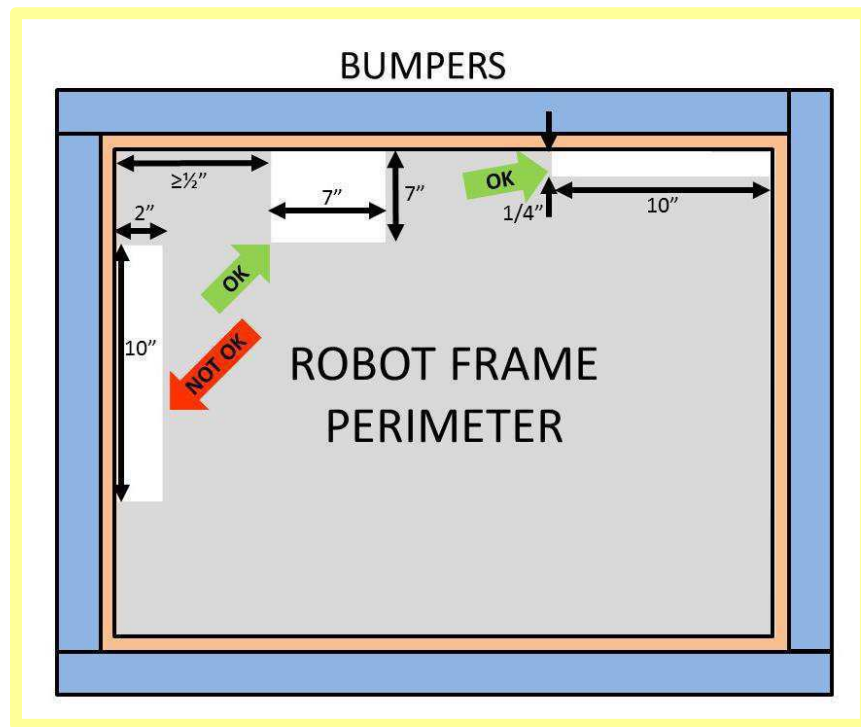
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### Section 8.5 BUMPER Rules

**R32.** BUMPERS must be supported by the structure/frame of the ROBOT (see Figure 8.8). To be considered supported, a minimum of ½ in. (~12.7 mm) at each end of each BUMPER wood segment must be backed by the FRAME PERIMETER ( $\leq \frac{1}{4}$  in. gap). “Ends” exclude hard BUMPER parts which extend past the FRAME PERIMETER permitted by R30, part B. Additionally, any gap between the backing material and the frame:

- A. must not be greater than ¼ in. (~6 mm) deep, or
- B. not more than 8 in. (~20 cm) wide

Figure 8-8: BUMPER support examples



## Section 8.9 Pneumatic System

R83.

The following devices are not considered pneumatic devices and are not subject to pneumatic rules (though they must satisfy all other rules):

- A. a device that creates a vacuum
- B. closed-loop COTS pneumatic (gas) shocks
- C. air-filled (pneumatic) wheels
- D. pneumatic devices not used with pressurized air

## Section 10.11.3 *FIRST* Championship Playoffs

Table 10-5 has been updated to include ALLIANCE color assignments and make sure that no one ALLIANCE is assigned the same ALLIANCE color throughout the Round Robin tournament.

Table 10-5: Championship MATCH order

Round	MATCH	Houston				Detroit			
		Mass		Energy		Mass		Energy	
		Red	Blue	Red	Blue	Red	Blue	Red	Blue
1	1	Carver	Turing			Archimedes	Tesla		
	2			Galileo	Roebing			Carson	Darwin
	3	Hopper	Newton			Curie	Daly		
2	4			Carver	Roebing			Archimedes	Darwin
	5	Turing	Newton			Tesla	Daly		
	6			Galileo	Hopper			Carson	Curie
3	7	Carver	Newton			Archimedes	Daly		
	8			Roebing	Hopper			Darwin	Curie
	9	Turing	Galileo			Tesla	Carson		
4	10			Carver Hopper	Hopper Carver			Archimedes Curie	Curie Archimedes
	11	Newton	Galileo			Daly	Carson		
	12			Roebing	Turing			Darwin	Tesla
5	13	Carver Galileo	Galileo Carver			Archimedes Carson	Carson Archimedes		
	14			Hopper	Turing			Curie	Tesla
	15	Newton	Roebing			Daly	Darwin		



# Team Update 09

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## General

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No changes.

## Rules & Expectations for *FIRST* Robotics Competition Events

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No changes.

## Game and Season Manual

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### Section 8.5 BUMPER Rules

**R23.** ROBOTS are required to use BUMPERS to protect all outside corners of the FRAME PERIMETER. For adequate protection, at least 6 in. (~16 cm) of BUMPER must be placed on each side of each outside corner (see Figure 8-2) and must extend to within  $\frac{1}{4}$  in. of the FRAME PERIMETER corner. If a FRAME PERIMETER side is shorter than 6 in. (~16 cm), that entire side must be protected by BUMPER (see Figure 8-3). A round or circular FRAME PERIMETER, or segment of the FRAME PERIMETER, is considered to have an infinite number of corners, therefore the entire frame or frame segment must be completely protected by BUMPER(S).



# Team Update 08

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## General

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- [Inspection Checklist](#): Published!
- [ROBOT Lockup Form](#): Published!
- [POWER CUBE Cover DIY Instructions](#): Published!

## Rules & Expectations for *FIRST* Robotics Competition Events

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No changes.

## Game and Season Manual

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### Section 8.4 Budget Constraints & Fabrication Schedule

**R11.** The total cost of all items on the ROBOT shall not exceed \$4000 USD. All costs are to be determined as explained in [Section 8.4 Budget Constraints & Fabrication Schedule](#). Exceptions are as follows:

- A. individual items that are less than \$5 USD each, as ~~purchased~~ purchasable from a VENDOR, and
- B. KOP items

### Section 8.8 Control, Command & Signals System

**R63.** ROBOTS must be controlled via one (1) programmable National Instruments roboRIO (P/N: am3000), with image version FRC\_2018\_v16 or later.





# Team Update 07

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## General

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- **Software Update:** An optional update to the NI FRC 2018 Update Suite (2018.1.0) has been released. This update contains a new roboRIO image, 2018v17, which fixes a bug for C++ and Java teams where the roboRIO would lock up when printing to the console while running rioLog. This update also contains a fix to a minor memory leak in the Driver Station.

## Rules & Expectations for *FIRST* Robotics Competition Events

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### Check-In

**E33.** An adult team member must check in no later than ~~noon on the first competition day of the event~~ ninety (90) minutes before Qualification Matches are scheduled to start.

## Game and Season Manual

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### Section 7.5 AUTO Period Rules

**A03. Disconnect or set down controllers.** During AUTO, any control devices worn or held by the DRIVERS and/or HUMAN PLAYERS must be disconnected from the OPERATOR CONSOLE.

Violation: FOUL.

For the purposes of the *FIRST* Robotics Competition, any device connected to the OPERATOR CONSOLE is considered a control device because REFEREES are not expected to differentiate between devices that can or cannot control the ROBOT.

### Section 7.6 Human Action Rules

**H08. ~~TECHNICIANS, no coaching.~~ Don't abuse ARCADE access.** ~~TECHNICIANS~~ Team members (except DRIVERS, HUMAN PLAYERS, and COACHES) who are granted access to restricted areas in and around the ARCADE (e.g. via TECHNICIAN button, event issued Media badges, etc.) may not verbally coach or use ~~non-powered~~ signaling devices during the MATCH. Exceptions will be granted for inconsequential infractions and in cases concerning safety.

Violation: YELLOW CARD



# Team Update 06

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## General

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- **Q&A Update:** [Q116](#) has been updated per edits made in [Team Update 5](#).

## Rules & Expectations for *FIRST* Robotics Competition Events

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No changes.

## Game and Season Manual

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### Section 3.10 The FIELD Management System

FMS alerts participants to milestones in the MATCH using audio cues. Please note that audio cues are intended to be a courtesy to participants and not intended as official MATCH markers. If there is a discrepancy between an audio cue and the FIELD timers, the FIELD timers are the authority.

- MATCH Start & PLATES randomized: "Startup Sound"
- MATCH-AUTO Start: "Cavalry Charge"
- T=0 for AUTO: Buzzer
- Start of TELEOP: Three (3) Bells
- T-30 seconds in TELEOP: Train Whistle
- T=0 for TELEOP/MATCH end: Buzzer
- MATCH stopped: Foghorn
- POWER UP activated: "Linear Popping"

### Section 6 Conduct Rules

**C07. Don't expect to gain by doing others harm.** Strategies clearly aimed at forcing the opposing ALLIANCE to violate a rule are not in the spirit of *FIRST*® Robotics Competition and not allowed. Rule violations forced in this manner will not result in an assignment of a penalty to the targeted ALLIANCE.

Violation: FOUL. If egregious or repeated, TECH FOUL and YELLOW CARD.

C07 does not apply for strategies consistent with standard gameplay, **for example: e.g. contacting an opponent during the ENDGAME while in your PLATFORM ZONE and attempting to CLIMB.**

- A. **contacting an opponent during the ENDGAME while in your PLATFORM ZONE and attempting to CLIMB.**
- B. **placing a POWER CUBE on a SCALE PLATE resulting in the opposite PLATE moving upwards into an opponent ROBOT such that the opponent ROBOT ends up violating G25.**

C07 requires an intentional act with limited or no opportunity for the TEAM being acted on to avoid the penalty, such as:

- C. **placing a POWER CUBE on/in an opponent who's already controlling a POWER CUBE such that they cannot help but violate G22.**

- D. forcing an opposing ALLIANCE ROBOT to become wedged under a SCALE PLATE such that they cannot help but violate G16 and/or G25.

## Section 7.3 ROBOT to ROBOT Interaction

**G10. Don't tear others down to lift yourself up.** Strategies aimed at the destruction or inhibition of ROBOTS via attachment, damage, tipping, or entanglements are not allowed.

Violation: FOUL and YELLOW CARD. If harm or incapacitation occurs as a result of the strategy, **YELLOW CARD is elevated to a RED CARD**

For example, use of a wedge-like MECHANISM to tip ROBOTS is a violation of G10.

MECHANISMS outside the FRAME PERIMETER are particularly susceptible to causing such damage, drawing this penalty, and/or drawing penalties associated with violations of G11.

Teams are encouraged to be cautious in their use of such MECHANISMS when engaging in ROBOT to ROBOT MATCH play.

**G14. There's a 5-count on pins.** ROBOTS may not pin an opponent's ROBOT for more than five (5) seconds. A ROBOT will be considered pinned until the ROBOTS have separated by at least six (6) feet. The pinning ROBOT(s) must then wait for at least three (3) seconds before attempting to pin the same ROBOT again. Pinning is transitive through other objects. If the pinned ROBOT chases the pinning ROBOT upon retreat, the pinning ROBOT will not be penalized, and the pin will be considered complete.

Violation: FOUL, plus an additional FOUL for every five (5) seconds in which the situation is not corrected. If extended and egregious, RED CARD.

There is no *FIRST*® Robotics Competition specific definition of pin, so a general definition applies; "to prevent or stop something from moving." As a result, contact is not required for pinning to occur. For example, a ROBOT parked right behind an opponent that is against its PORTAL wall could be considered pinning because the wall and the parked ROBOT prevent the opponent from moving.

Generally, pins that exceed fifteen (15) seconds are considered extended and egregious, regardless of a pinning ROBOT's mobility; however circumstances vary and the assessment is open to REFEREE discretion.

## Section 7.4 FIELD Interaction

**G20. POWER CUBES: use as directed.** With the exception of placing a POWER CUBES on PLATES, ROBOTS may not deliberately use POWER CUBES in an attempt to ease or amplify the challenge associated with FIELD elements.

Violation: TECH FOUL per additional POWER CUBE. Repeated or egregious violations of this rule are likely to escalate rapidly to YELLOW or RED CARDS.

Examples include, but are not limited to:

- A. stacking POWER CUBES underneath a PLATE
- B. climbing on POWER CUBES
- C. using POWER CUBES to explicitly impede opponent mobility
- D. Placing a POWER CUBE on the top of the SCALE to block the opponent ALLIANCE RUNGS is an egregious violation of G20.

**G21. Keep POWER CUBES in bounds.** With the exception of feeding POWER CUBES through the lower opening of the EXCHANGE, ROBOTS may not intentionally eject POWER CUBES from the FIELD.

Violation: FOUL per POWER CUBE. Repeated or extended violations of this rule are likely to escalate rapidly to YELLOW or RED CARDS.

**G25. PLATES are moved by POWER CUBES, not ROBOTS.** Except via the placement of the weight of placed POWER CUBES, ROBOTS may not affect directly or transitively cause or prevent the movement of PLATES. Incidental contact that does not result in PLATES changing scoring state Movement, or prevention of movement, of PLATES because of momentary ROBOT action resulting in minimal PLATE displacement is not a violation of this rule. A ROBOT forced to affect the position of a PLATE because of contact by an opponent ROBOT either directly or transitively through a POWER CUBE or other ROBOT (e.g. a ROBOT wedged underneath the SCALE by the opposing ALLIANCE either intentionally or accidentally) is not a violation of this rule.

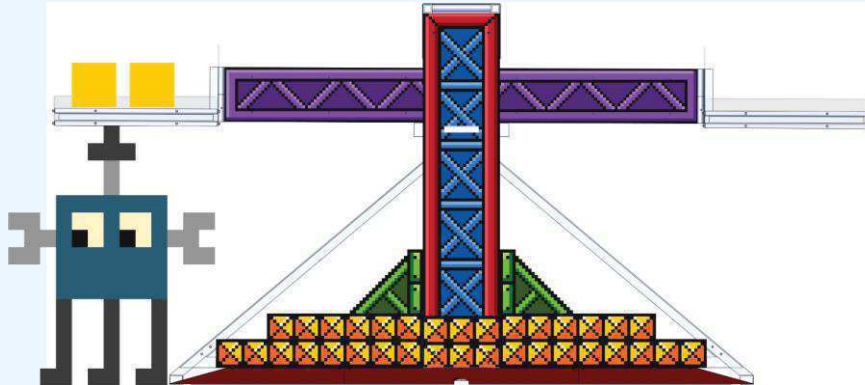
Violation: FOUL per instance plus an additional TECH FOUL for every five (5) seconds in which the situation is not corrected. Repeated or extended violations of this rule are likely to escalate rapidly to YELLOW or RED CARDS.

The intent of G25 is to make it clear that PLATES are to move solely because of POWER CUBE weight and not because of a ROBOT deliberately trying to move PLATES (either by using its own manipulator, or a POWER CUBE as an extension of the ROBOT, to push or hold a PLATE).

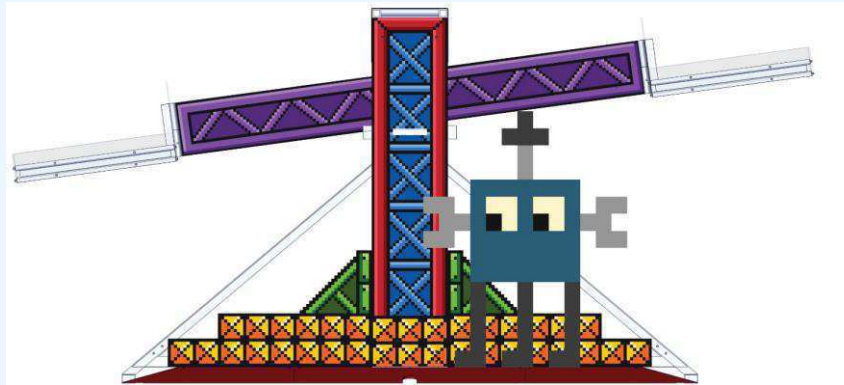
The “momentary” and “minimal” language in G25 is subjective but necessary because ROBOTS may cause PLATE movement (or prevent PLATE movement) as they place POWER CUBES and bump PLATES, get hit, etc.

Generally, “momentary” means near instantaneous, or in other words, contact for less than approximately one (1) second and “minimal” means a displacement of fewer than approximately three (3) in. However, REFEREES are not expected to measure, and be accountable to, real-time PLATE displacement or precise timing from their vantage points.

Example 1: A ROBOT may not hold the SCALE PLATE in a “balanced” state.



Example 2: A ROBOT may not hold a plate up.



## Section 8.4 Budget Constraints & Fabrication Schedule

**R11.** The total cost of all items on the ROBOT shall not exceed \$4000 USD. All costs are to be determined as explained in Section 8.4 Budget Constraints & Fabrication Schedule. Exceptions are as follows:


- A. individual items that are less than \$5 USD each, as purchased from a VENDOR, and
- B. KOP items



# Team Update 05

## General

- **Cost Accounting Worksheet (CAW) Template Published:** An example [CAW Template](#) is now linked from the [FIRST POWER UP Game & Season Materials page](#).
- **Crate Sizes:** The manufacturer of the POWER CUBE crate employs two different molds to make the standard crate for general distribution which vary in size by  $\sim\frac{1}{4}$  in. The crates shipped in/with Kickoff Kits, distributed via *FIRST* Choice, being sold by AndyMark, Innovation First, and Rev Robotics, that will be used at official *FIRST* events were all made with the smaller of the two molds. If the size variance matters to your team and you're placing an order with Farm Plast directly, please reference "for *FIRST* Robotics" in the comment section upon checkout or, if ordering over the phone (973-287-6070), let them know that the order is "for *FIRST* Robotics."
- **Kickoff Kit Checklist Update:** The [Black Tote Checklist](#) has been updated with the following edit.

☑	Item Description	Supplier	Part Number	Qty	Where to get more?	Photo
	<b>Power Cube: crate</b> White, square, HDPE, 13 in. x 13 in. x 11 in.	Farm Plast LLC	Cubecrate	1	<a href="http://www.milkcratesdirect.com/square-milk-crates-4-gallon-16-quart/white-square-milk-crate">http://www.milkcratesdirect.com/square-milk-crates-4-gallon-16-quart/white-square-milk-crate</a> (specify "for <i>FIRST</i> Robotics" in comments at checkout or verbally if via phone) <a href="http://www.andymark.com">www.andymark.com</a> <a href="http://www.revrobotics.com">www.revrobotics.com</a> <a href="http://www.vexrobotics.com">www.vexrobotics.com</a>	

- **Team Drawings Update:** TE-18001 has been corrected to fix the orientation of the TE-18001-01 piece.

## Rules & Expectations for *FIRST* Robotics Competition Events

No changes.

## Game and Season Manual

### Section 8.4 Budget Constraints & Fabrication Schedule

**R11.** The total cost of all items on the ROBOT shall not exceed \$4000 USD. All costs are to be determined as explained in [Section 8.4 Budget Constraints & Fabrication Schedule](#). Exceptions are as follows:

- individual COTS items that are less than \$5 USD each, as purchased, and
- KOP items

### Section 8.5 BUMPER Rules

**R28.** Team numbers must be displayed and positioned on the BUMPERS such that an observer walking around the perimeter of the ROBOT can unambiguously tell the Team's number from any point of view and meet the following additional criteria:

- consist of Arabic numerals at least 4 in. ( $\sim 11$  cm) high, at least  $\frac{1}{2}$  in. ( $\sim 12.7$  mm) in stroke width, and be either white in color or outlined in white with a minimum  $\frac{1}{16}$  in. ( $\sim 1.6$  mm) outline

The  $\frac{1}{2}$  in. stroke width requirement applies to the majority of the stroke.  
Font elements less than  $\frac{1}{2}$  in. such as serifs, rounded edges, small

hairlines or gaps, etc. are permitted as long as the majority of the stroke meets the sizing requirement and the numbers are unambiguous.

## Section 8.10 OPERATOR CONSOLE

**R100.** The OPERATOR CONSOLE must not

- B.** be longer than 60 in. (~152 cm)
- C.** be deeper than 14 in. (~35 cm) (excluding any items that are held or worn by the DRIVERS during the MATCH)
- D.** extend more than 6 ft. 6 in. (~198 cm) above the floor
- E.** attach to the FIELD ARCADE (except as permitted by G19)



# Team Update 04

## General

**WPILib C++\Java Update:** An optional C++\Java WPILib update has been released (2018.2.1) containing a number of minor bug fixes. A full changelog can be found [here](#).

**Q&A Updates:** The responses to questions [5](#) (to be consistent with changes made in [Team Update 3](#)) and [77](#) (original response was incorrect) have been revised (with changes noted).

## Rules & Expectations for *FIRST* Robotics Competition Events

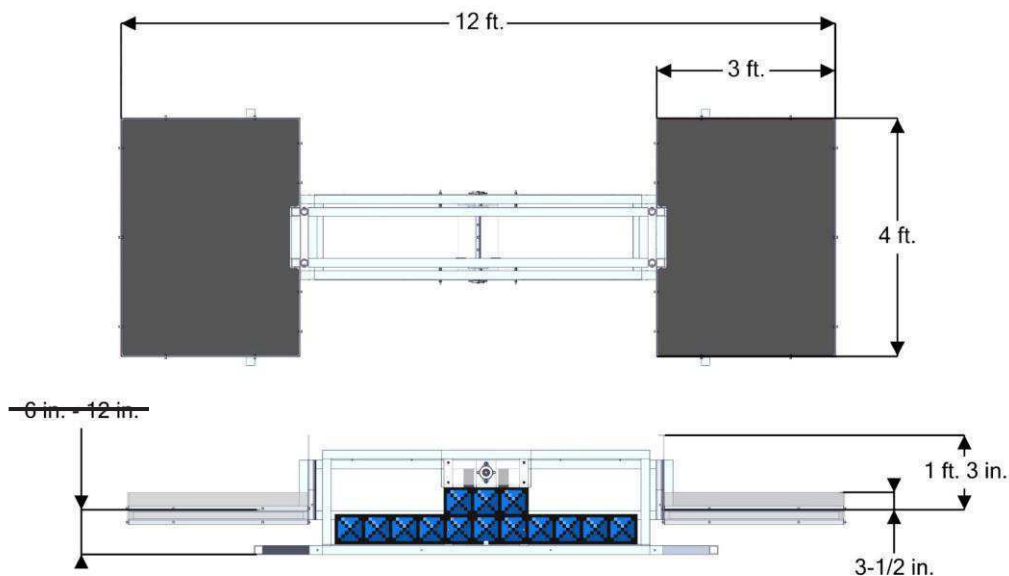
No changes.

## Game and Season Manual

### Section 3.4.1 SWITCH PLATES

Figure 3-14 has been updated to remove the lower left dimension, which doesn't add value.

Figure 3-14: SWITCH PLATE dimensions



**SOLIDWORKS**  
Modeling Solutions Partner

### Section 6 Conduct Rules

**C10. No work outside your pit.** Throughout the event, from load-in to load-out, Teams may only produce FABRICATED ITEMS during pit hours, and:

- in their pit area, or
- in other Teams' pit areas with permission from that team, or
- while Queued for a MATCH or Practice Field,



Please note that given likely tight quarters, extra scrutiny regarding safety is required.

- d. any area designated by Event Staff (e.g. Playoff Pit Area, etc.), or
- e. as permitted at provided machine shops that are available to all teams.

Violation: Verbal warning. Repeated or egregious violations will be addressed by the Head REFEREE, the Lead ROBOT Inspector and/or Event Management.

## Section 8.9 Pneumatic System

**R83.** The only pneumatic system items permitted on ROBOTS include the items listed below.

- E.** Additional pneumatic tubing, with a maximum ¼ in. (nominal, ~6 mm) outside diameter,

## Section 10.5 Playoff MATCHES

Table 10-2: Quarterfinal, Semifinal, and Overtime Tiebreaker Criteria

Order Sort	Criteria
1 <sup>st</sup>	Fewer FOUL and TECH FOUL points awarded to the other ALLIANCE (i.e. the ALLIANCE that played the cleaner MATCH)
2 <sup>nd</sup>	Cumulative PARKING and CLIMBING score
3 <sup>rd</sup>	Cumulative sum of AUTO points
4 <sup>th</sup>	Cumulative sum of OWNERSHIP points
5 <sup>th</sup>	Cumulative sum of VAULT points
6 <sup>th</sup>	MATCH is replayed

## Section 10.8 MATCH Replays

If, in the judgment of the Head REFEREE, an ARCADE FAULT occurs that affects the outcome of the MATCH and any team on the affected ALLIANCE desires a replay, the MATCH will be replayed.

The outcome of the MATCH is affected if an error occurs that, in the judgment of the Head REFEREE changes which ALLIANCE would have won the MATCH and/or the assignment of Ranking Points.

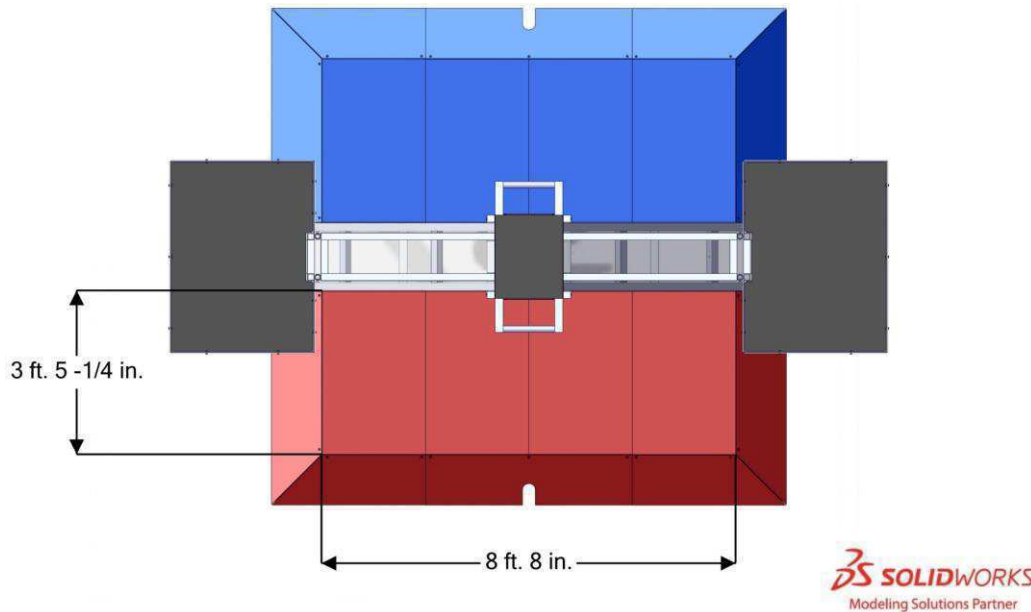




### Section 3.3.5 PLATFORM

Located at the base of the SCALE, on each side, is a PLATFORM covered with ALLIANCE colored HDPE. The TOWER and OUTRIGGERS separate one PLATFORM from the other. Each PLATFORM top is 8 ft. 8 in. (~264 cm) wide by 3 ft. 5 ¼ in. (~105 cm) deep and 3 ½ in. (~9 cm) tall. The ramps leading to the PLATFORM includes ramps with a are 1 ft. 4 ¾ in. (~33 32 cm) run and long with a 15.35 deg. angle. The ALLIANCE colored tape that abuts the PLATFORM ramps is part of the PLATFORM.

Figure 3-11: PLATFORM top length and width dimensions



### Section 3.9 Vision Targets

Vision targets are located on the SWITCH FENCE facing the ALLIANCE WALL using 2 in. (~5 cm) strips of 3M 8830 Scotchlite Reflective Material and are used to highlight the locations of the PLATES on the SWITCH.

### Section 3.10 The FIELD Management System

FMS alerts participants to milestones in the MATCH using audio cues. Please note that audio cues are intended to be a courtesy to participants and not intended as official MATCH markers. If there is a discrepancy between an audio cue and the FIELD timers, the FIELD timers are the authority.

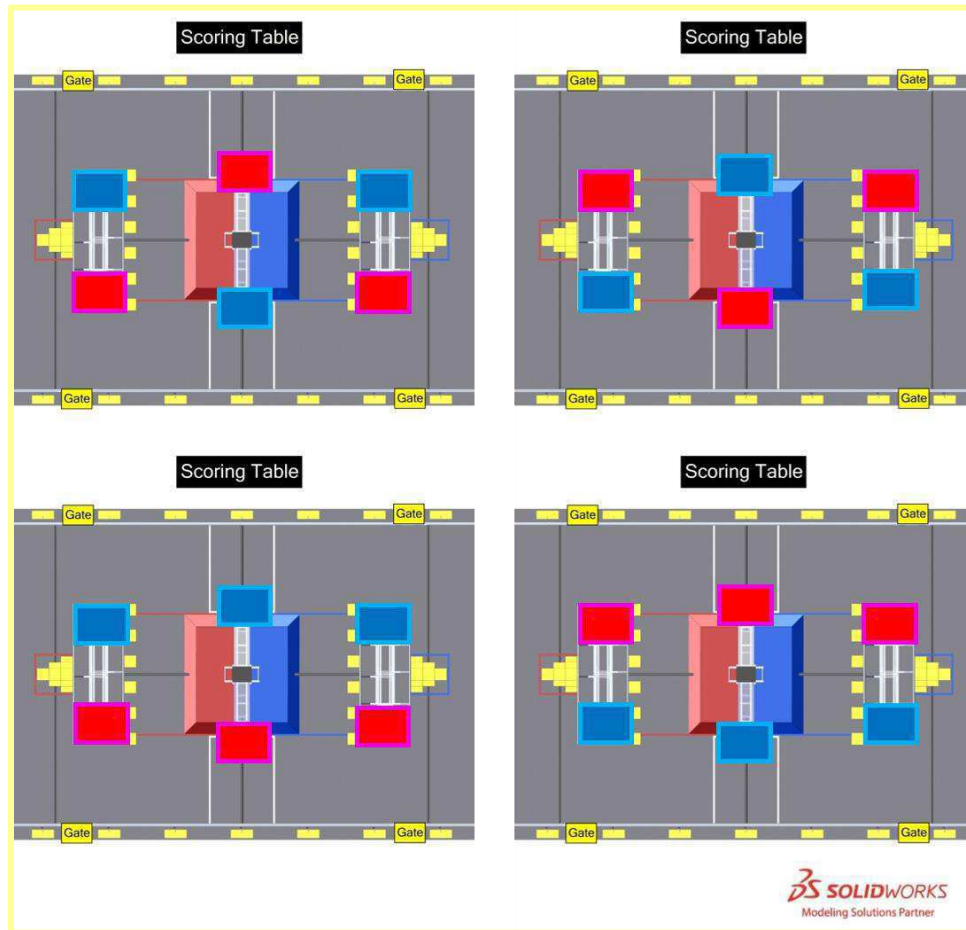
- MATCH Start: "Cavalry Charge"
- T=0 for AUTO: Buzzer
- Start of TELEOP: Three (3) Bells
- T-30 seconds in TELEOP: Train Whistle
- T=0 for TELEOP/MATCH end: Buzzer
- MATCH stopped: Foghorn
- POWER UP activated: "Linear Popping"

### Section 4.1.1 Stages

Each MATCH is divided in to two stages. The first stage, called Autonomous (AUTO), is the first fifteen (0:15) seconds of a MATCH in which ROBOTS operate without any DRIVE TEAM control or input. Prior to the start of AUTO, the assignments of ALLIANCE colors for SWITCH and SCALE

PLATES are randomized among the four states in Figure 4-1 and transmitted to the OPERATOR CONSOLE by the Field Management System (FMS). During AUTO, ROBOTS attempt to deliver preloaded POWER CUBES to PLATES, retrieve additional POWER CUBES from around the FIELD, and cross their AUTO LINE any time before the end of the stage.

Figure 4-1 Possible PLATE assignments



## Section 4.6 Logistics

There will not be an ARCADE FAULT called for MATCHES that accidentally begin with an incorrect number of, **incorrectly positioned**, or damaged POWER CUBES. Damaged POWER CUBES will not be replaced until the next FIELD reset period. DRIVE TEAMS should alert the FIELD STAFF to any missing or damaged POWER CUBES prior to the start of the MATCH.

## Section 7.1 Before the MATCH

**G04. Leave the POWER CUBES alone.** Prior to the start of the MATCH, DRIVE TEAMS may not rearrange the POWER CUBES within a PORTAL, **staged on the FIELD (that are not staged inside a ROBOT)**, or transfer POWER CUBES from one PORTAL to another.

Violation: MATCH will not start until the situation is corrected.

## Section 8.4 Budget Constraints & Fabrication Schedule

**R22.** At an **each** Event, Teams may have access to a WITHHOLDING ALLOWANCE.

## Section 8.5 BUMPER Rules

R28.

- A. consist of Arabic numerals at least 4 in. (~11 cm) high, at least ½ in. (~12.7 mm) in stroke width, and be either white in color or outlined in white with a minimum 1/16 in. (~1.6mm) outline

## Section 8.8 Control, Command & Signals System

R65. The roboRIO Ethernet port must be connected to the Wireless Bridge port labeled “18-24 vPOE,” closest to the power connector (either directly, via a network switch, or via a CAT5 Ethernet pigtail).

## Section 8.9 Pneumatic System

R83. The only pneumatic system items permitted on ROBOTS include the items listed below.

- E. Solenoid valves with a maximum ⅝ in. (nominal, ~6 mm) NPT, BSPP, or BSPT port diameter,

R89. Only the compressor, relief valve (P/N: 16-004-011 or 16-004-003), pressure switch, pressure vent plug, pressure gauge, storage tanks, tubing, pressure transducers, and connecting fittings may be in the high-pressure pneumatic circuit upstream from the regulator.

## Section 10.8 MATCH Replays

Over the course of the Tournament it may be necessary for a MATCH to be replayed. Typical causes for replays are MATCHES that end in a tie during the Playoffs or if there is an ARCADE FAULT. An ARCADE FAULT is an error in ARCADE operation that includes, but is not limited to:

- A. broken FIELD elements due to
  - i. normal, expected game play or
  - ii. ROBOT abuse of FIELD elements that affects the outcome of the MATCH for their opponents.

A broken FIELD element caused by ROBOT abuse that affects the outcome of the MATCH for their ALLIANCE is not an ARCADE FAULT.

- B. power failure to a portion of the FIELD (tripping the circuit breaker in the PLAYER STATION is not considered a power failure)
- C. improper activation by the FMS
- D. errors by FIELD staff (except those listed in Section 4.6)



# Team Update 02

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## General

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- **Drawing Updates:** The [Field Drawings - FIRST POWER UP specific](#) drawing package has been updated with the following changes:
  - GE-18020 has been updated to include a missing overall length dimension.
  - GE-18060 has been updated to fix a note with an incorrect item number called out.
  - GE-18126 has been updated to fix a note with an incorrect item number called out.
  - GE-18127 has been added. Please note the height of GE-18127 supplied by SolidWorks, Autodesk, and PTC is slightly taller than what is specified in [Section 3.6.2 EXCHANGE](#). We will be working with them to get those models updated.

The [Team Drawings](#) drawing package has been updated with the following changes:

- TE-18008 has been updated to fix BOM item number and part number agreement.
- TE-18007 has been updated to fix BOM item number and part number agreement, and to include changes to the following parts:
  - TE-18007-3 has been updated to correct overall length of part.
  - TE-18007-4 has been updated to correct overall length of part.
  - TE-18007-10 has been updated to correct overall length of part.
  - TE-18007-11 Has been updated to correct overall length of part.

The revisions to the Scale in the Team Drawings correct design mistakes that resulted in differences between the team version of the Scale and the official Scale. The width of the Rung is 1 ft. 1 in. (down from 1 ft. 2 in.), the width of the Tower is 1 ft. 5 in. (down from 1 ft. 6 in.), and the distance from the Rung to the face of the Tower is 8¼ in. (up from 6¼ in.)

While we try to ensure that critical dimensions in the wooden versions of Field elements match their official counterparts, there are always discrepancies caused from using different building materials. However, the discrepancies referenced above were due to design error and may impact Robot design. We apologize, especially if these corrections affect your Robot designs.

- **360° Images:** A link to 360° images of the *FIRST POWER UP* field taken during Field Tour filming is included on the [Game and Season webpage](#).
- **3D CAD Models:** A link to *FIRST POWER UP* DS SolidWorks models is now included on the [Game and Season webpage](#).
- ***FIRST POWER UP* Field images:** A link to field images taken during Field Tour filming is now included on the [Game and Season webpage](#).
- **Crate Construction:** Think you'll be shipping your Robot? The crate specifications are now posted [here](#).

## Rules & Expectations for *FIRST* Robotics Competition Events

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No changes.

## Game and Season Manual

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### Section 3.6.3

Caution, there are **may be** orientations where all three (3) POWER CUBES will not fit in a VAULT column, but if HUMAN PLAYERS place POWER CUBES logo side up they'll fit **with room to spare**.

## Section 3.8 POWER CUBES

Each POWER CUBE weighs  $3\frac{1}{2}$  lbs (~1.6 kg) approximately  $3\frac{1}{4}$  lbs (~1.5 kg). POWER CUBES may be purchased from AndyMark (am-3818 and am-3741), Innovation First (217-6188 and 217-6193), and Rev Robotics (REV-21-1217 and REV-21-1218).

## Section 4.2 Scoring

Points are earned for establishing OWNERSHIP, with additional points earned for each additional second of OWNERSHIP. For example, a team that establishes OWNERSHIP of their SWITCH three (3) seconds after the start of AUTO and maintains OWNERSHIP for five (5) seconds earns two (2) points + ten (10) points, for a total of twelve (12) points.

The MATCH points listed in Table 4-1 for OWNERSHIP during the TELEOP stage are increased if the BOOST POWER UP is played. See Section 4.3 for details on BOOST.

AUTO-RUN and CLIMBING are both evaluated and scored by human REFEREES. Teams are encouraged to make these actions obvious and unambiguous.

## Section 4.3 POWER UPS

An ALLIANCE plays a POWER UP by pressing the corresponding button on the VAULT. Only one (1) instance of the FORCE or BOOST POWER UP can be active at a time. If an ALLIANCE pushes the button for FORCE/BOOST while their other FORCE/BOOST is active, the button press is ignored. The LEVITATE POWER UP can be played at any time during the TELEOP stage.

## Section 7.6 Human Action Rules

### H07.

- A. the OPERATOR CONSOLE,
- B. non-powered signaling devices,
- C. reasonable decorative items,
- D. special clothing and/or equipment required due to a disability,
- E. devices used solely for planning or tracking strategy,
- F. devices used solely to record gameplay,
- G. non-powered Personal Protective Equipment (examples include, but aren't limited to, gloves, eye protection, and hearing protection)

Items brought to the ARCADE under allowances B-G must meet all of the following conditions:

- i. do not connect or attach to the OPERATOR CONSOLE
- ii. do not connect or attach to the FIELD or ARCADE
- iii. do not connect or attach to another ALLIANCE member (other than items in category G)
- iv. do not communicate with anything or anyone outside of the ARCADE.
- v. do not communicate with the TECHNICIAN
- vi. do not include any form of enabled wireless electronic communication (e.g. radios, walkie-talkies, cell phones, Bluetooth communications, Wi-Fi, etc.)



- vii. do not in any way affect the outcome of a MATCH, other than by allowing the DRIVE TEAM to
  - a. plan or track strategy for the purposes of communication of that strategy to other ALLIANCE members **or**
  - b. use items allowed per part B to communicate with the ROBOT (provided A02 is not violated).

## Section 8.3 ROBOT Safety & Damage Prevention

R07.

If the ROBOT includes protrusions that form the “leading edge” of the ROBOT as it drives and the protrusions have a surface area of less than 1 in.<sup>2</sup> (~6 cm<sup>2</sup>), it will invite detailed Inspection. For example, forklifts, lifting arms, or grapples may be carefully inspected for these hazards.

## Section 8.5 BUMPER Rules

*A note about the edit to R24: The original BUMPER ZONE did not leave any tolerance for noodle alignment, wood alignment, fabric folds, etc., if using the BUMPER brackets that shipped with the Drive Base Kit.*

**R24.** BUMPERS must be located entirely within the BUMPER ZONE, which is the volume contained between the floor and a virtual horizontal plane ~~7 in. (~17 cm)~~ **7½ in. (~19 cm)** above the floor in reference to the ROBOT standing normally on a flat floor. BUMPERS do not have to be parallel to the floor.

## Section 8.9 Pneumatic System

R81.

Any pressure specification such as “working,” “operating,” “~~proof,~~” “maximum,” “~~burst,~~” etc. may be used to satisfy the requirements of R81.

It is recommended that all pneumatic items be rated by their manufacturers for a working pressure of at least 60 psi (~414 kPa).





# Team Update 01

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## General

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### Drawing Packages

The [Field Drawings – FIRST POWER UP specific](#) drawing package has been updated with the following changes:

- GE-18130 has been added
- GE-18101 and GE18025 have been updated to include GE-18130

### Kickoff Kit Checklist: Black Tote

<input checked="" type="checkbox"/>	Item Description	Supplier	Part Number	Qty	Where to get more?	Photo
	Compliant Wheels 2 in., green	Triangle Mfg AndyMark	am-3462_35	2	<a href="http://www.andymark.com">www.andymark.com</a>	

## Safety Manual

### Section 3.5.5 Charging and Handling

- Do not short out the battery terminals. If metal tools/parts contact the terminals simultaneously, it will create a direct short circuit. This may cause high heat to develop in the battery terminal/part/tool area and the battery could explode. To avoid the possibility of shorting out the battery terminals and creating a hazardous situation it is required to cover all exposed battery terminals and connections with appropriate non-insulating material such as electrical tape or tubing.

*It surprises us that we feel the need to say this, please don't put the POWER CUBE cover on anyone's head and zip it closed; also, don't eat it.*

## Rules & Expectations for FIRST Robotics Competition Events

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No changes.

## Game and Season Manual

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### Section 1.8 Question and Answer System

The Q&A is not a resource for

- rulings on hypothetical strategies or **vague** situations,
- **challenging decisions made at past events**, or
- a design reviews of a ROBOT system for legality.

The responses in the Q&A do not supersede the text in the manual, although every effort will be made to eliminate inconsistencies between the two. While responses provided in the Q&A may be used to aid discussion at each event, per Section 10.6 REFEREE Interaction and Section 9 Inspection & Eligibility Rules, REFEREES and Inspectors are the ultimate authority on rules. If you have concerns about enforcement trends by volunteer authorities, please notify *FIRST* at [firstroboticscompetition@firstinspires.org](mailto:firstroboticscompetition@firstinspires.org).

Weak questions are overly broad, vague, and/or include no rule references. Some examples of questions that will not be answered in the Q&A are:

- Is this part/design legal?
- How would should the a REFEREE have ruled if when this specific, hypothetical game play happened?

Good questions ask generically about features of parts or designs, gameplay scenarios, or rules, and often reference one or more relevant rules within the question. Some examples of questions that will likely be answered in the Q&A are:

- A device we are considering using on the robot comes with purple AWG 40 wire, does this comply with R?? and R??
- We're not sure how to interpret how Rule G?? applies if Blue Robot A does X and Red Robot B does Y, can you please clarify?

## Section 3.1 Zones and Marking

STARTING LINE: a line of 2 in. (~5 cm), white gaffers tape that runs the width of the carpet and is 2 ft. 6 in. (~76 cm) behind the ALLIANCE WALL diamond plate, which includes the tape.

## Section 3.3 SCALE

A cable protector extends from the center of each side of the PLATFORM and is 2 ½ in. (~6 cm) wide and ¾ in. (~2 cm) high (Electriduct, Inc. CSX-3, black). The cable protector is attached to the field with hook fastener, increasing the height to approximately 1 in. (~2 cm). These cable protectors extend to the GUARDRAILS and the SWITCHES.

### Section 3.4.1 SWITCH PLATES

The PLATES are 9 in. (~23 cm) above the carpet when the SWITCH is level. Like the SCALE, the SWITCH tilts and rests in different positions based on the placement of POWER CUBES. During the MATCH, the SWITCH is in one of ~~three (3)~~ two (2) states based on the magnitude of its tilt:

1. OWNERSHIP by the Red ~~its~~ ALLIANCE, or
2. ~~OWNERSHIP by the Blue ALLIANCE, or~~
3. neither ALLIANCE has OWNERSHIP

If the outside edge of an ALLIANCE'S colored PLATE is positioned between 3 in. (~8 cm) and 6 in. (~15 cm) above the FIELD carpet then the ALLIANCE has OWNERSHIP of the ~~its~~ SWITCH. If the outside edge of an ALLIANCE colored PLATE is positioned between ~~12 in. (~30 cm)~~ 6 in. (~15 cm) and 15 in. (~38 cm) above the FIELD carpet then the opposing ALLIANCE has OWNERSHIP. When neither ALLIANCE has OWNERSHIP of the SWITCH, ~~the outside edges of the PLATES are between 6 in. (~15 cm) and 12 in. (~30 cm) above the FIELD carpet.~~ See Figure 3-15. The time required to move between states is dependent on the weight difference and the distribution of the weight on the SWITCH PLATES. Details on OWNERSHIP can be found in Section 4.2 Scoring.

## Section 3.5 PLATE Lighting

Table 3-1: PLATE Lighting

Color	Pre-MATCH	AUTO	TELEOP	Post-MATCH
Blue (pulsing) with solid red corners	N/A	Blue FORCE POWER UP is active N/A	Blue FORCE POWER UP is active	N/A

Red (pulsing)	N/A	Red OWNERSHIP of FORCE POWER UP is active	Red OWNERSHIP of FORCE POWER UP is active	N/A
Red (pulsing) with solid blue corners	N/A	Red FORCE POWER UP is active N/A	Red FORCE POWER UP is active	N/A

## Section 3.8 POWER CUBE

POWER CUBES may be purchased from AndyMark (am-3818 and am-3741), Innovation First (217-6188 and 217-6193), and Rev Robotics (REV-21-1217 and REV-21-1218). Please note that due to the use of recycled material in the manufacturing process, the batches of crates will vary slightly in color, but not such that it's perceptible with the cover in place.

### Section 4.1.2 MATCH Setup

Prior to the start of each MATCH, POWER CUBES, elements used to affect the position of the SCALE and SWITCHES and earn POWER UPS, are staged as shown in Figure 4-1. Staging details are as follows:

- A. Seven (7) in each PORTAL (on the carpet between the PORTAL wall and the STARTING LINE), minus any preloaded POWER CUBES,
- B. Six (6) next to each SWITCH. They are arranged approximately equidistant from each other along the face of the FENCE closest to the SCALE, FIRST logo facing up
- C. Ten (10) located in each ALLIANCE POWER CUBE PILE (in a pyramid formation, with six on the bottom, three in the middle, and one on top, justified toward the SWITCH, FIRST logo facing up)

## Section 4.2: Scoring

The primary method of earning points in FIRST® POWER UP<sup>SM</sup> is by placing POWER CUBES on the PLATES of the SWITCH or SCALE to establish OWNERSHIP. OWNERSHIP is a state of the ALLIANCE'S SWITCH or SCALE where it is tilted in favor of an ALLIANCE colored PLATE, such that the outside edge of the ALLIANCE colored PLATE is at or less than a specified height above the carpet. ALLIANCES earn points when OWNERSHIP is established and additional points for each additional second of OWNERSHIP.

...

An ALLIANCE has OWNERSHIP of their SWITCH when:

- A. the SWITCH is tilted in favor of their ALLIANCE colored PLATE, such that the outside edge of the ALLIANCE colored PLATE is at or less than 6 in. (~15 cm) from the floor for at least one (1) second, or
- B. they have played the FORCE POWER UP at level 1 or 3 (see Section 4.3 POWER UPS)

The Blue ALLIANCE'S SWITCH accumulates points for the Blue ALLIANCE when the PLATE illuminated and pulsing with blue lights is down.

The SWITCH does not accumulate points for either ALLIANCE when the blue PLATE is above 6 in (~15 cm).

An ALLIANCE has OWNERSHIP of the SCALE when:

- A. the SCALE is tilted in favor of their ALLIANCE colored PLATE, such that the outside edge of the ALLIANCE'S colored PLATE is at or lower than 4 ft. 8 in. (~142 cm) from the floor for at least one (1) second and there isn't an active opponent's Level 2 or 3 FORCE, or
- B. they have played the FORCE POWER UP at level 2 or 3 (see Section 4.3 POWER UPS)

Note that points for the SWITCH and SCALE are accrued over time and not a direct function of the number of POWER CUBES placed on the SWITCH or SCALE.

Points are not taken away when OWNERSHIP changes, but rather stop accumulating (if balanced) or start accumulating for the opposite ALLIANCE if they take OWNERSHIP of the SCALE.

*Note from the FRC Director on the edits to Table 4-1:*

*You will see we added a requirement in Table 4-1 requiring a ROBOT to not be in direct contact with their PLATFORM to be considered CLIMBING. We believe this was already a requirement, given our BUMPER rules, but adding the requirement in Table 4-1 was the most straightforward way of making this clear.*

Table 4-1: FIRST® POWER UP<sup>SM</sup> rewards

Action	Criteria	MATCH Points		Ranking Points
		AUTO	TELEOP	
CLIMBING	For each ROBOT fully supported by the SCALE (either directly or transitively) with BUMPERS fully above the BRICKS at T=0, not in direct contact with their PLATFORM, and not at all in the opponent's PLATFORM ZONE	-	30	-

## Section 4.3: POWER UPS

*Note from the FRC Director on the edits to Table 4-2:*

*These changes are an attempt to clarify how BOOST works. They do not significantly change the points being earned under BOOST.*

Table 4-2: POWER UPS

Name	# of POWER CUBES	Effect	Duration (seconds)
LEVITATE	3	An additional CLIMBING ROBOT, up to a maximum of three (3) ROBOTS, is credited to the ALLIANCE at the end of the MATCH	N/A
FORCE	1	ALLIANCE earns OWNERSHIP points from their SWITCH regardless of PLATE position	10
	2	ALLIANCE earns OWNERSHIP points from the SCALE regardless of PLATE position	10
	3	ALLIANCE earns OWNERSHIP points from the SWITCH and the SCALE regardless of PLATE position	10
BOOST	1	<del>Increases the points for OWNERSHIP of the ALLIANCE'S SWITCH from one (1) point per second to two (2) points per second</del> Doubles the points being earned by the ALLIANCE for OWNERSHIP of their SWITCH.	10
	2	<del>Increases the points for OWNERSHIP of the SCALE from one (1) point per second to two (2) points per second</del> Doubles the points being earned by the ALLIANCE for OWNERSHIP of the SCALE.	10
	3	<del>Increases the points for OWNERSHIP of both the ALLIANCE'S SWITCH and the SCALE from one (1) point per second to two (2) points per second</del> Doubles the points earned by the ALLIANCE for OWNERSHIP of a) their SWITCH and b) the SCALE.	10

## Section 8.3 ROBOT Safety & Damage Prevention

**R07.** Protrusions from the ROBOT and exposed surfaces on the ROBOT shall not pose hazards to the ARCADE elements (including the POWER CUBES GAME PIECES) or people.

If the ROBOT includes protrusions that form the “leading edge” of the ROBOT as it drives and have a surface area of less than 1 in.<sup>2</sup> (~6 cm<sup>2</sup>), it will invite detailed Inspection. For example, forklifts, lifting arms, or grapples may be carefully inspected for these hazards.

## Section 8.6 Motors & Actuators

**R33.**

For servos, note that the roboRIO is limited to a max current output of 2.2A on the 6V rail (12.4W of electrical input power). Teams should make sure that their total servo power usage remains below this limit at all times.

~~This is the total number of each motor a Team may use on their ROBOT, not the quantity per part number. For example, each team may use up to six (6) CIM motors on their ROBOT, regardless of the quantity or combination of each individual part number used.~~

Given the extensive amount of motors allowed on the ROBOT, Teams are encouraged to consider the total power available from the ROBOT

battery during the design and build of the ROBOT. Drawing large amounts of current from many motors at the same time could lead to drops in ROBOT battery voltage that may result in tripping the main breaker or trigger the brownout protection of the roboRIO. For more information about the roboRIO brownout protection and measuring current draw using the PDP, see [roboRIO Brownout and Understanding Current Draw](#).

R34.

- F. The wiring harness of the Nidec Dynamo BLDC Motor may be modified [as documented by FIRST in the "Nidec Dynamo BLDC Motor with Controller" Screensteps article](#).

## Section 10.12 Advancement Between Tournaments

T17.

A FIRST® Robotics Competition Team listed in the [Championship Eligibility Criteria document](#) is pre-qualified for the FIRST Championship if the Team meets one of the following criteria:

- A. member of the FIRST® Hall of Fame
- B. an original and sustaining team since 1992
- C. a 2017 FIRST Championship winner
- D. a 2017 FIRST Championship Engineering Inspiration Award winner
- E. a 2017 FIRST Championship Chairman's Award Finalist

## Section 11: GLOSSARY

Section 11: Glossary has been updated to include entries for ACTIVE DEVICE, CAW, FENCE, LRI, RSL, SCALE, SIGNAL LEVEL, SWITCH, and VENDOR.

