

Team Update 02

General

- **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

No changes.

Game and Season Manual

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.² (~6 cm²), 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

General

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	www.andymark.com	

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

No changes.

Game and Season Manual

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.

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 UPSM 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.

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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 UPSM 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	Increases the points for OWNERSHIP of the ALLIANCE'S SWITCH from one (1) point per second to two (2) points per second Doubles the points being earned by the ALLIANCE for OWNERSHIP of their SWITCH.	10
	2	Increases the points for OWNERSHIP of the SCALE from one (1) point per second to two (2) points per second Doubles the points being earned by the ALLIANCE for OWNERSHIP of the SCALE.	10
	3	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 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.² (~6 cm²), 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.

