

# 2020 Pre-Kickoff Game Manual Content: Team Update

This document combines previously published rules pertaining to the termination of Stop Build Day and Pre-Kickoff Rules published in [a recent FRC Blog](#).

While the Stop Build Day Changes section is preserved at the end of the document, the November round of the Q&A is dedicated to, and will only address, questions regarding the pre-Kickoff rules content in [the recent FRC Blog](#).

This document has several references to rules that are not yet released, but we believe the context is sufficient until Kickoff.

From this point forward, edits made since the 11/8/19 publication are highlighted in yellow (**new content**) or crossed out (~~deletions~~).

## Kit of Parts

A team's KOP will be defined as "the collection of items (*reformatted to bulleted list*)

- listed on the current season's Black Tote, Grey Tote, and Separate Items Kickoff Kit Checklists,
- listed on the current season's Drive Base Kit Checklist (if drive base kit received by team as part of the Kickoff Kit instead of the AndyMark voucher),
- distributed to the team via their *FIRST* Choice order(s) in the current season, and
- paid for completely (except shipping) with the team's Product Donation Voucher (PDV) from the current season."

More information about the Kit of Parts can be found on [the Kit of Parts webpage](#).

## Robot Cost Accounting

For the 2020 season, the total robot cost limit will be rolling back to the Kickoff 2019 total of \$5000. We are also adding new exemptions for any Inertial Measurement Units (provided they still meet the \$500 single part limit) and any Rockwell Automation sensors ever provided via the Kit of Parts (including *FIRST* Choice). Here's the full rule text:

- R11.** The total cost of all items, **including software**, on the ROBOT shall not exceed \$5000 USD. All costs are to be determined as explained in the Budget Constraints & Fabrication Schedule section. Exceptions are as follows:
- A. individual items that are less than \$5 USD each, as purchasable from a VENDOR, ~~and~~
  - B. items from the team's current year's KOP (identical functional replacements may be used to meet this criterion), up to the KOP quantity (including the rookie KOP items, and
  - C. specific exempt items:
    - i. One (1) Inertial Measurement Units (Note that R12 still applies)
    - ii. Rockwell Automation sensors available through *FIRST* Choice in any season

An item is considered an IMU if it includes "IMU" or "Inertial Measurement Unit" in the VENDOR'S product description.

Teams should be prepared to disclose to Inspectors the cost of any non-KOP item and the total cost of the ROBOT. Teams should also be prepared to show that a particular item was received from *FIRST* Choice or a voucher in the current season if necessary.

Per lxx, teams must be prepared to display a Bill of Material (BOM) to Inspectors during Inspection. The BOM may be displayed in either printed or electronic form.

Individual COMPONENTS or MECHANISMS, not excluded in R11, that are retrieved from previous ROBOTS and used on 2020 ROBOTS must have their un-depreciated cost included in the 2020 BOM and applied to the overall cost assessment.

Example 1: The Kickoff KOP checklist lists two (2) of motor controller XYZ in the Gray Tote distributed to rookie teams. Any team, including a veteran team that did not receive these items, can account for up to two (2) of them on the KOP checklist at a \$0 cost. Additional quantity of the same item would have to be accounted at the Fair Market Value.

Example 2: A team uses *FIRST* Choice credits, or a voucher, to acquire part ABC. This part, in the quantity obtained by the team via the KOP may be accounted at \$0. Additional quantity of the same item would have to be accounted at the Fair Market Value.

Example 3: Part ABC is available in *FIRST* Choice, but a team decides they have enough already on hand and does not acquire any through *FIRST* Choice. All of these items used on the ROBOT need to be accounted for at Fair Market Value as they did not come from the current year's KOP.

An "identical functional replacement" is an item which, to any reasonably astute observer, has the same form, fit, feature set, and function as the original component.

For example, any CIM motor can replace a CIM motor or a sheet of polycarbonate paid for completely by a voucher can be replaced with a sheet of polycarbonate of the same parameters (thickness, color, size, etc.). As another example, a motor controller that has the same form, fit, and function (i.e. controlling motors) as the original motor controller, but a different feature set (i.e. can communicate over CAN vs. the original controller which was PWM only) is not an identical functional replacement because the controllers' feature sets differ.

- R12.** No individual, non-KOP item or software shall have a Fair Market Value that exceeds \$500 USD. The total cost of COMPONENTS purchased in bulk may exceed \$500 USD as long as the cost of an individual COMPONENT does not exceed \$500 USD.

The Analog Devices ADIS16448 IMU Breakout Board does not have a published Fair Market Value (FMV). This device is considered to comply with R12 regardless of its true FMV.

If a COTS item is part of a modular system that can be assembled in several possible configurations, then each individual module must fit within the price constraints defined in R12.

If the modules are designed to assemble into a single configuration, and the assembly is functional in only that configuration, then the total cost of the complete assembly including all modules must fit within the price constraints defined in R12.

In summary, if a VENDOR sells a system or a kit, a team must use the entire system/kit Fair Market Value and not the value of its COMPONENT pieces.

Example 1: VENDOR A sells a gearbox that can be used with a number of different gear sets, and can mate with two different motors they sell. A team purchases the gearbox, a gear set, and a motor (which are not offered together as an assembly or kit), then assembles them together. Each part is treated separately for the purpose of BOM costing, since the purchased pieces can each be used in various configurations.

Example 2: VENDOR B sells a robotic arm assembly that the team wants to use. However, it costs \$700 USD, so they cannot use it. The VENDOR sells the “hand”, “wrist”, and “arm” as separate assemblies, for \$200 USD each. A team wishes to purchase the three items separately, then reassemble them. This would not be legal, as they are really buying and using the entire assembly, which has a Fair Market Value of \$700 USD.

Example 3: VENDOR C sells a set of wheels or wheel modules that are often used in groups of four. The wheels or modules can be used in other quantities or configurations. A team purchases four and uses them in the most common configuration. Each part is treated separately for the purpose of BOM costing, since the purchased pieces can be used in various configurations.

## Pre-Kickoff Work

In an effort to increase the ability of teams to re-use parts in order to reduce costs and environmental footprint, we are making some tweaks to the rule regarding using fabricated items created prior to Kickoff. For the 2020 season, teams will be allowed to use COTS items which have been assembled, decorated/labeled, or had minor modifications made before kickoff. We know these changes may not go as far as some in the community may hope; we wanted to be cautious and see how these changes and the stop build changes affect teams before considering additional changes for future seasons. Here's the full rule text:

**R14.** FABRICATED ITEMS created before Kickoff are not permitted. Exceptions are:

- A. OPERATOR CONSOLE,
- B. BUMPERS (a protective assembly designed to attach to the exterior of the ROBOT and constructed as specified in the BUMPER Rules section),
- C. battery assemblies per Rxx,
- D. FABRICATED ITEMS consisting of one COTS electrical device (e.g. a motor or motor controller) and attached COMPONENTS associated with any of the following modifications:
  - i. wires modified to facilitate connection to a ROBOT (including removal of existing connectors)
  - ii. connectors and any materials to secure and insulate those connectors added (Note: passive PCBs such as those used to adapt motor terminals are considered connectors)
  - iii. motor shafts modified and/or gears, pulleys, or sprockets added
  - iv. motors modified with a filtering capacitor as described in the Blue Box below Rxx
- E. COTS items with any of the following modifications:
  - i. non-functional decoration or labeling
  - ii. assembly of COTS items per manufacturer specs, unless the result constitutes a MAJOR MECHANISM as defined in I1
  - iii. work that could be reasonably accomplished in fewer than 30 minutes with the use of handheld tools (e.g. drilling a small number of holes in a COTS part)

Please note that this means that FABRICATED ITEMS from ROBOTS entered in previous *FIRST* competitions may not be used on ROBOTS in the 2020 *FIRST* Robotics Competition (other than those allowed per R14-B through -E). Before the formal start of the Build Season, teams are encouraged to think as much as they please about their ROBOTS. They may develop prototypes, create proof-of-concept models, and conduct design exercises. Teams may gather all the raw stock materials and COTS COMPONENTS they want.

Parts with precision machined (mill, CNC, etc.) features may still meet R14-E part iii if functionally equivalent features could reasonably be made within the restrictions specified.

Example 1: A team designs and builds a two-speed shifting transmission prior to Kickoff as a training exercise. After Kickoff, they utilize all the design principles they learned in the fall to design their ROBOT. To optimize the transmission design for their ROBOT, they change the transmission gear ratios and reduce the size, and build two new transmissions, and place them on the ROBOT. All parts of this process are permitted activities.

Example 2: A team re-uses a 2020-legal motor from a previous ROBOT which has had connectors added to the wires. This is permitted, per exception D, because the motor is a COTS electrical COMPONENT.

Example 3: A team re-uses a piece of aluminum tubing from a previous ROBOT which has a precision machined bearing hole in it. On

the current ROBOT, the bearing hole is not used. As the only function of the hole on the current ROBOT is material removal, which does not require precise tolerancing, a functionally equivalent hole could be made with a hand drill in under 30 minutes and the part is permitted per R14-E iii.

- R15.** Software and mechanical/electrical designs created before Kickoff are only permitted if the source files (complete information sufficient to produce the design) are available publicly prior to Kickoff.

Example 1: A team realizes that the transmission designed and built prior to Kickoff perfectly fits their need for a transmission to drive the ROBOT arm. They build an exact copy of the transmission from the original design plans and bolt it to the ROBOT. This would be prohibited, as the transmission – although made during the competition season – was built from detailed designs developed prior to Kickoff.

Example 2: A team developed an omni-directional drive system for the 2019 competition. In July 2019 they refined and improved the control software (written in C++) to add more precision and capabilities. They decided to use a similar system for the 2020 competition. They copied large sections of unmodified code over into the control software of the new ROBOT (also written in C++). This would be a violation of the schedule constraint and is not allowed.

Example 3: The same team decides to use LabVIEW as their software environment for 2020. Following Kickoff, they use the previously-developed C++ code as a reference for the algorithms and calculations required to implement their omni-directional control solution. Because they developed new LabVIEW code as they ported over their algorithms, this is permitted.

Example 4: A different team develops a similar solution during the fall and plans to use the developed software on their competition ROBOT. After completing the software, they post it in a generally accessible public forum and make the code available to all teams. Because they have made their software publicly available before Kickoff, they can use it on their ROBOT.

Example 5: A team develops a transmission during the fall. After completing the project, they publish the CAD files on a generally accessible public forum and make them available to all teams. Because they have made the design publicly available before Kickoff, they can use the design to create an identical transmission, fabricated after Kickoff, for use on their 2020 ROBOT.

## Stop Build Day Changes

The changes to the 2020 FRC documentation as a result of the retirement of Stop Build Day are described below. Please note that there are references to one (1) rule not included in this document.

- R5 defines the ROBOT weight limit and will be released at Kickoff.
  - R14 describes FABRICATED ITEMS produced before Kickoff that may be used (equivalent to R15 from 2019); we plan to release the 2020 version of this rule along with information on legal motors and controllers later this fall.
1. Content comparable to the note below will be added to the *FIRST Safety Manual*.

While you may feel you need to stay up all night before the event to finish something, it is recommended to be well rested before you show up at the event to ensure safe practices while operating machinery.

2. The *Robot Construction Rules* content has been modified as follows:
  - The ROBOT definition has been edited as follows and moved from I1 to the *Overview* part of the *Robot Construction Rules* section.

*A ROBOT is an electromechanical assembly built by the FIRST Robotics Competition team to play the current season's game and includes all the basic systems required to be an active participant in the game – power, communications, control, BUMPERS, and movement about the field.*

- R17 – R23 from the 2019 manual have been removed.
- The following rule has been added to *Budget Constraints & Fabrication Schedule*:

**R16.** During an event a team is attending (regardless of whether the team is physically at the event location), the team may not work on their ROBOT or ROBOT elements outside of the hours that pits are open, with the following exceptions:

- A. Exceptions listed in R14
- B. Software development
- C. Batteries may be charged during the designated Load-in time

For the purposes of this rule, official events begin as follows:

- Regionals, District Championships, and *FIRST* Championship: at the start of the first designated Load-in period, according to the Public Schedule. If the Public Schedule is not available or there is no designated Load-in period, the events begin at 4pm on the day prior to pits opening.

- District Events: when pits open

Examples of activity prohibited by R16 include:

- A. Working on the ROBOT at the team's shop after Load-in for the event has begun
- B. Working on ROBOT parts at night at the team's hotel.

Note that Ex and Ey impose additional restrictions on work done on the ROBOT or ROBOT materials while attending an event.

One purpose of R16 is to increase equity between teams with significant travel to an event and those nearby (close teams would otherwise have an advantage by being able to work on their ROBOT, in their shop, until it's time to go to the event).

3. The following *Inspection & Eligibility Rules* have been added/modified.

- **I1. It's your team's ROBOT.** The ROBOT and its MAJOR MECHANISMS must be built by the *FIRST* Robotics Competition team.

A MAJOR MECHANISM is a group of COMPONENTS and/or MECHANISMS assembled together to address at least one (1) game challenge: robot movement, game piece control, field element manipulation, or performance of a scorable task.

I1 requires that the ROBOT and its MAJOR MECHANISMS were built by its team, but isn't intended to prohibit or discourage assistance from other teams (e.g. fabricating elements, supporting construction, writing software, developing game strategy, contributing COMPONENTS and/or MECHANISMS, etc.)

Examples of MAJOR MECHANISMS include, but are not limited to, assemblies listed below:

- a. an assembly used to manipulate a game piece
- b. an assembly used to position a ROBOT for an end game task
- c. an assembly used to manipulate a FIELD element
- d. an assembly used to move the ROBOT around the FIELD

Examples that would generally not be considered MAJOR MECHANISMS, and thus probably aren't subject to I1 include, but are not limited to, the following:

- a. a gearbox assembly
- b. a COMPONENT or MECHANISM that's part of a MAJOR MECHANISM
- c. COTS items

Neither I1 nor the language in its Blue Box define specific thresholds for how much of a MAJOR MECHANISM must be the result of the team's effort. I1 expects and requires the team's honest assessment of whether they built the MAJOR MECHANISMS of their ROBOT.

Attempts to exploit loopholes in the definition of MAJOR MECHANISM in order to bypass this requirement are not in the spirit of I1 or the *FIRST* Robotics Competition. Examples of exploitation include:

- a. assembling pieces of a MAJOR MECHANISM provided by another team

b. receiving a mostly complete MAJOR MECHANISM from another team and providing a small piece

- **I3. Bring it all to Inspection.** At the time of Inspection, the ROBOT must be presented with all MECHANISMS (including all COMPONENTS of each MECHANISM), configurations, and decorations that will be used on the ROBOT in MATCHES without re-inspection (per I4) and may not exceed 150 lbs. (~68kg) (note that while up to 150 lbs. of ROBOT MECHANISMS may be inspected together, the ROBOT configuration used in a MATCH may not violate R5). Exceptions listed in R5 are not included in this weight.
- **I4. Unless the change is listed below, any change to a ROBOT must get re-inspected.** A ROBOT may play MATCHES with a subset of the MECHANISMS that were present during Inspection provided the reconfigured ROBOT still meets all ROBOT Rules. Only MECHANISMS that were present during the Inspection may be added, removed, or reconfigured between MATCHES without re-inspection per I4. If a ROBOT is modified after its most recent passed Inspection, it must be re-inspected before it is eligible to participate in a MATCH.

Exceptions are listed in A through F (unless they result in a significant change to the ROBOT'S size, weight, legality, or safety).

- A. addition, relocation, or removal of fasteners (e.g. cable ties, tape, and rivets)
  - B. addition, relocation, or removal of labeling or marking
  - C. revision of ROBOT code
  - D. replacement of a COTS COMPONENT with an identical COTS COMPONENT
  - E. replacement of a MECHANISM with an identical MECHANISM (size, weight, material)
  - F. additions, removals, or reconfiguration of ROBOT with a subset of MECHANISMS already inspected per I3.
- **I5. Don't exploit I4.** Teams may not use the re-inspection process in I4 to circumvent the weight limit in I3.

This restriction is not intended to prevent a team from returning to a previous configuration (e.g. due to an unsuccessful upgrade or failure of a new component). If a team is believed to be violating this rule, the LRI will discuss the situation with the team to understand the changes and, if appropriate, the LRI in conjunction with the team will select a single configuration with which the team will compete for the duration of the event.

Example 1: A ROBOT passes initial Inspection (which includes MECHANISM A). Its team then decides they want to use MECHANISM B, which was not Inspected. The weight of the ROBOT, A, and B is less than the weight limit in I3, but more than that in R5. I4 requires the ROBOT be re-inspected, and I5 allows the ROBOT, A, and B to be inspected collectively. If passed, the ROBOT may then compete in subsequent matches with A or B.

Example 2: A ROBOT passes initial Inspection (which includes MECHANISM A). Its team then decides they want to use MECHANISM



B, which was not Inspected. The weight of the ROBOT, A, and B is greater than the weight limit in I3. This requires re-inspection per I4 and A is excluded to satisfy I3. B breaks, and the team decides to switch back to A. The ROBOT must be re-inspected per I4, and the team is not violating I5.

Example 3: A team arrives at an event with a ROBOT, MECHANISM A, and MECHANISM B, which collectively weigh 175 lbs. The ROBOT passes initial Inspection with A and plays a MATCH. The team switches to B, gets re-inspected, and plays again. The team switches back to A, gets re-inspected, and plays again. The team switches back to B and asks to be re-inspected. At this point, the LRI suspects the team may be violating I5 and has a discussion with the team to understand the changes being made. The team reveals that I5 has been violated, and the LRI works with them to select A or B for use for the remainder of the event.

4. The statement at the end of the *Inspection Checklist* has been updated to the language below, and a space for the printed name of the Team Captain and Team Mentor will be added to the form under their signature lines:

#### **Team Compliance Statement**

We, the Team Mentor and Team Captain, attest by our signing below, that our team's ROBOT was built after the 2020 Kickoff, and we are not aware of any rules it violates. We confirm that it and its MAJOR MECHANISMS are products of our team's work.

5. The following *Event Rules* will be added/modified.
  - **Ex. (formerly C11, rule number TBD) Load in during Load-in.** Teams may not bring the ROBOT or ROBOT elements in to the event after the designated Load-in period. Exceptions are as follows:
    - A. Exceptions listed in R14
    - B. Raw stock
    - C. COTS items
    - D. Gearboxes attached to associated motor(s)
    - E. Assembled wheels
    - F. Exceptional circumstances that result in a team not being able to make the Load-in time and has made arrangements with Event Management.

There are no rules that explicitly restrict items that may be brought into the venue during the designated Load-in period.

If an event does not have designated Load-in period on its Public Schedule, the designated Load-in period begins when pits open and ends when opening ceremonies start.

During Load-in, teams are not limited to a single trip, and are encouraged to be as efficient and safe as possible.

*Violation: Verbal warning and item will not be permitted into venue. If repeated at any point during the event or egregious violations will be addressed by the Head REFEREE, the Lead ROBOT Inspector and/or Event Management.*

- **Ey. (Rule number TBD) Work in designated areas only.** At the event venue, teams may only produce FABRICATED ITEMS as follows:
  - A. in their pit area,
  - B. in another team’s pit area with permission from that team,
  - C. while queued for a MATCH or Practice Field (given space constraints, 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. If repeated at any point during the event or egregious violations will be addressed by the Head REFEREE, the Lead ROBOT Inspector and/or Event Management.*

- **Ez. (Rule number TBD) Some Event resources for event teams only.** Only teams registered for an event may use that event’s Competition FIELD, Practice Field, Spare Parts, Machine Shop, and Inspection. Host teams supplying Practice Field elements and/or Machine Shop resources may use them, provided priority is granted to teams registered for that event.

*Violation: Verbal warning. If repeated at any point during the event or egregious violations will be addressed by the Head REFEREE, the Lead ROBOT Inspector and/or Event Management.*

6. The following *Conduct Rules* have been modified.

- **C5. Enter only one (1) ROBOT.** Each registered *FIRST* Robotics Competition team may enter only one (1) ROBOT (or ‘Robot’, a ROBOT-like assembly equipped with most of its drive base, i.e. its MAJOR MECHANISM that enables it to move around a FIELD) into a 2020 *FIRST* Robotics Competition Event.

“Entering” a ROBOT (or Robot) into a *FIRST* Robotics Competition means bringing it to or using it at the event such that it’s an aid to your team (e.g. for spare parts, judging material, or for practice).

While “most of its drive base” is a subjective assessment, for the purposes of C5, an assembly whose drive base is missing all wheels/treads, gearboxes, and belts/chains is not considered a “Robot.” If any of those components are incorporated, the assembly is now considered a “Robot.”

This rule does not prohibit teams from bringing in Robots from other *FIRST* programs for the purposes of awards presentations or pit displays.

*Violation: Verbal warning. Egregious or repeated violations at any point during the event will be addressed by the Head REFEREE, the Lead ROBOT Inspector and/or Event Management.*