

# Team Update 00

## GENERAL

### Kit of Parts

The [Voucher Book](#) has been updated to include the following edits. We encourage teams to mark up the hard copy distributed in the Season Specific container as part of the Kickoff Kit.

- Monday.com had to suspend their support, so teams should make sure to cross them off the checklist on page 3 and x-out pages 24 and 25 (also cross off on the "Kickoff Checklist Poster").
- Please make the following markup on pages 28, 50, and 52: Access Codes: ~~Visit Team Registration Account (Lead Mentor 1 or 2)~~ **n/a**

## EVENT RULES

V4 of the [Event Rules](#) document includes the following edits.

### Section 1: General Rules

**FIRST is committed to [Equity, Diversity, and Inclusion](#) and as such, FIRST makes reasonable accommodations for persons with disabilities that request accommodation. If a participant needs an accommodation for an event, please talk to a volunteer at the event or contact your [local leadership](#) before the event so they can help ensure the accommodation is provided. Local leadership may make exceptions to event rules to allow for reasonable accommodations given the exceptions do not create an undue hardship or cause safety concerns.**

### Section 7: Ceremonies

At every event, there are Opening and Closing Ceremonies to show honor and respect for represented countries, sponsors, teams, mentors, volunteers, and award winners. Ceremonies provide everyone with the opportunity to collectively applaud the successes of all participants. They also give teams a chance to "meet" the volunteers and other people and sponsors involved with the event. **Closing Ceremony elements at the end of the event are integrated into and presented between Playoff Matches.**

### Section 8: In the Stands

**E801 \*No saving seats.** Teams are not permitted to save or designate seats for team members that are not present.

Teams may not hang banners or ribbons or otherwise designate seating. (Event staff will remove and discard any banners, roping, etc., used to designate seating.) Please take turns sitting in the bleachers/stands if seating is limited. If there is a crowding problem, we ask that you kindly leave after your team's MATCH and return later, if possible.

**Event management may reserve seats for attendees who require accommodations.**

## GAME MANUAL

The Game Manual has been updated for the 2023 season of CHARGED UP<sup>SM</sup> presented by Haas. All changes captured in this document are compared to the last published 2022 Game Manual ([updated on April 12, 2022 \[Team Update 21\]](#)). 2023 updates not detailed in Team Update 00 include:

- Styled to match the 2023 season
- Season specific references updated (e.g. game name, field & game piece names, blue box examples, etc.)
- Minor typos/formatting errors in Evergreen rules
- The Tournament Section (Section 11) has been rewritten to reflect the new double elimination tournament, removal of timeouts, reorganizing content, and adding Evergreen rules. Any changes that are derivative of the new playoff model have also been updated.
- For instances where a rule is referenced within itself, the rule number is replaced with "this rule."

Changes to [Evergreen content](#) are detailed below.

### Section 1.5 Coopertition

Includes the name of the most recent Woodie Flowers Award recipient.

### Section 1.6 Spirit of Volunteering

Updated with a new message for 2023 and includes the names of our new Chief FTAs.

### Section 1.7 This Document & Its Conventions

Imperial dimensions are followed by comparable metric dimensions in parentheses to provide metric users with the approximate size, ~~weight~~ **mass**, etc.

Rules include colloquial language, also called headlines, in an effort to convey an abbreviated ~~intent~~ **version** of the rule or rule set.

### Section 1.10 Question and Answer System

Questions from "FRC 9999**0**" represent content asked by key volunteers (e.g., REFEREES, INSPECTORS, etc.), answered by *FIRST*, and are considered relevant to teams.

### Section 6.5 Rule Violations

Upon **any instance of** a rule violation, **unless otherwise noted**, 1 or more of the penalties listed in Table 6-3 are assessed.

### Section 7.2 ROBOT to ROBOT Interaction

**G206** \***Don't tip or entangle**. A ROBOT may not deliberately, as perceived by a REFEREE, attach to, tip, or entangle with an opponent ROBOT.

*Violation: TECH FOUL and YELLOW CARD. If continuous or opponent ROBOT is unable to drive, TECH FOUL and RED CARD.*

Examples of violations of this rule include, but are not limited to:

- a. using a wedge-like MECHANISM to tip over opponent ROBOTS,
- b. making BUMPER-to-BUMPER contact with an opponent ROBOT that is attempting to right itself after previously falling over and causing them to fall over again, and
- c. causing an opponent ROBOT to tip over by contacting the ROBOT after it starts to tip if, in the judgement of the REFEREE, that contact could have been avoided.

Tipping as an unintended consequence of normal ROBOT to ROBOT interaction, as perceived by the REFEREE, is not a violation of this rule

"Unable to drive" means that because of the incident, the DRIVER can no longer drive to a desired location in a reasonable time (generally). For example, if a ROBOT can only move in circles, or can only move extremely slowly, the ROBOT is considered unable to drive.

## Section 7.4 GAME PIECES

**G401** \*Keep GAME PIECES in bounds. ROBOTS may not intentionally eject opponent GAME PIECES from the FIELD (either directly or by bouncing off a FIELD element or other ROBOT).

*Violation: FOUL per CARGO-GAME PIECE.*

## Section 8.1 General

Note the addition of H107 increments the subsequent rule numbers.

**H107** \*Throwing your own MATCH is bad. A team may not intentionally lose a MATCH or sacrifice ranking points in an effort to lower their own ranking or manipulate the rankings of other teams.

*Violation: Behavior will be discussed with team or individual. Violations of this rule are likely to escalate rapidly to YELLOW or RED CARDS and may lead to dismissal from the event (i.e. the threshold for egregious violations is relatively low.)*

The intent of this rule is not to punish teams who are employing alternate strategies, but rather to ensure that it is clear that throwing MATCHES to negatively affect your own rankings, or to manipulate the rankings of other teams (i.e. throw a MATCH to lower a partner's ranking, and/or increase the ranking of another team not in the MATCH) is incompatible with FIRST values and not a strategy any team should employ.

**H109** \*Be careful what you interact with. Team members are prohibited from the following actions with regards to interaction with ARENA elements. Temporary deformation of a GAME PIECE (e.g. to pre-load a ROBOT) is an exception to this rule.

- A. climbing on or inside,
- B. hanging from,
- C. deforming, and
- D. damaging.

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

## Section 8.2 REFEREE Interaction

**H202 \*1 STUDENT, 1 Head REFEREE.** A team may only send 1 STUDENT from its DRIVE TEAM to address the Head REFEREE with 1 STUDENT. The STUDENT may not be accompanied by more than 1 silent observer.

*Violation: The Head REFEREE will not address additional, non-compliant team members or peripheral conversations.*

Please see [Section 8.2 REFEREE Interaction](#) for more information about process and expectations. Note that some events may restrict ARENA access to members of the DRIVE TEAM.

## Section 8.3 Before/After the MATCH

**H301 \*Be prompt/safe when coming to and going from the FIELD.** DRIVE TEAMS may not cause significant or multiple delays during the event to the start of a MATCH, the FIELD reset after a MATCH, or continuation of MATCHES after a TIMEOUT. Causing a significant delay requires both of the following to be true:

A. The expected MATCH start time has passed, and

Event volunteers communicate schedule delays with teams to the best of their ability. The Pit Display (which is typically located near the Pit Administration desk) shows any event timing delay. Announcements on the FIELD and in the pits also provide information on delays, and any team uncertain of when to queue for a MATCH should communicate with queuing volunteers.

During Qualification MATCHES, the expected start time of the MATCH is the time indicated on the MATCH schedule or ~4 minutes from the end of the previous MATCH (which is reflected on the schedule on the Pit Display), whichever is later.

During Playoff MATCHES, the expected start time of the MATCH is the time indicated on the MATCH schedule or 15 minutes from either ALLIANCE'S previous MATCH, whichever is later.

A. The DRIVE TEAM is neither MATCH ready nor making a good faith effort, as perceived by the Head REFEREE, to quickly become MATCH ready.

Teams that have violated H305 or have 1 DRIVE TEAM member present and have informed event staff that their ROBOT will not be participating in the MATCH are considered MATCH ready and not in violation of this rule.

*Violation: If prior to the MATCH, the offending DRIVE TEAM'S ROBOT will be DISABLED. If after the MATCH, YELLOW CARD.*

*Violation: Verbal warning, or if a subsequent violation within the tournament phase (i.e. Qualifications or Playoffs), TECH FOUL applied to their upcoming MATCH. If the DRIVE TEAM is not MATCH ready within 2 minutes of the verbal warning/TECH FOUL and the Head REFEREE perceives no good faith effort by the DRIVE TEAM to quickly become MATCH ready, DISABLED.*

The intent of this rule is to provide an equitable amount of time for both ALLIANCES to prepare for each MATCH and give DRIVE TEAMS grace given extenuating circumstances that causes them to be late.

Once a verbal warning/TECH FOUL is issued, the Head REFEREE starts a 2-minute timer and makes a good faith effort to share the timer's status with the delaying DRIVE TEAM.

Being "MATCH ready" requires that the ROBOT is on the FIELD, in its STARTING CONFIGURATION, and turned on. Additionally, the DRIVE TEAM members must be in their starting positions.

In general, good faith efforts to quickly become MATCH ready are entirely for the purposes of transitioning the ROBOT into a MATCH ready state (i.e. not attempts to significantly alter a ROBOT's capabilities.) Examples of good faith efforts to quickly become MATCH ready include but are not limited to:

- a. walking safely towards the FIELD with a ROBOT that a team is not actively modifying,
- b. applying quick fixes such as tape or cable ties to make the ROBOT compliant with STARTING CONFIGURATION requirements,
- c. waiting for an OPERATOR CONSOLE computer to boot, and
- d. working with FIELD STAFF to get the ROBOT connected to the FIELD.

DRIVE TEAMS are expected to stage their ROBOTS for a MATCH, and remove it from the FIELD afterwards, safely and swiftly. Examples of violations include, but are not limited to: Examples that are not considered good faith efforts to quickly become MATCH ready include but are not limited to:

- e. a ROBOT not moving to the FIELD,
- f. a ROBOT moving to the FIELD but being actively modified while doing so,
- ~~g. late arrival to the FIELD (including across different MATCHES and after a FIELD or ALLIANCE TIMEOUT),~~
- ~~g. failing to exit the FIELD~~ a DRIVE TEAM member remaining on the FIELD once a MATCH is ready to begin (indicated by the green LEDs having turned off),
- h. installing BUMPERS, charging pneumatic systems, or any other ROBOT maintenance **not considered a quick fix as described in item b above** once on the FIELD, **and**
- i. time-consuming use of alignment devices that are external to the ROBOT (e.g. a DRIVE TEAM could bring and use a measuring tape, as long as there is no delay to the MATCH by doing so), **and**
- ~~j. failing to remove OPERATOR CONSOLES from the DRIVER STATIONS in a timely manner.~~

~~At the conclusion of a TIMEOUT, ROBOTS are expected to be staged on the FIELD prior to the timer displaying 0 and ready for the MATCH to start.~~

There are no rules that prohibit use of hand tools (including battery operated tools) while setting up ~~and/or removing~~ ROBOTS from the FIELD provided they do not cause significant delay or cause safety concerns.

**H302 \*Teams may not enable their ROBOTS on the FIELD.** Teams may not tether to the ROBOT while on the FIELD except in special circumstances (e.g. after Opening Ceremonies, before an immediate MATCH replay, etc.) and with the express permission from the FTA or a REFEREE.

*Violation: YELLOW CARD*

Teams are encouraged to consider this rule when developing their ROBOTS.

FMS will not enable ROBOTS after the conclusion of the MATCH.

Tethering includes any wired or wireless connection used to electrically energize and/or control elements on the ROBOT. The safety of teams and volunteers in close proximity to ROBOTS and ARENA elements on the FIELD is of the utmost importance, therefore ROBOTS or ROBOT

COMPONENTS may not be enabled in any way on the FIELD ~~once~~ before or after the MATCH has concluded.

ROBOTS need to be safely transported off the FIELD and back to the pits after the MATCH, and there may be bystanders, doorways, or height restrictions along the route.

**H303** \*You can't bring/use anything you want. The only equipment that may be brought to the ARENA and used by DRIVE TEAMS during a MATCH is listed below. Regardless of if equipment fits criteria below, it may not be employed in a way that breaks any other rules, introduces a safety hazard, blocks visibility for FIELD STAFF or audience members, or jams or interferes with the remote sensing capabilities of another team or the FIELD.

- 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, and
- G. non-powered Personal Protective Equipment (examples include, but aren't limited to, gloves, eye protection, and hearing protection)

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

- I. do not connect or attach to the OPERATOR CONSOLE, FIELD, or ARENA,
- II. do not connect or attach to another ALLIANCE member (other than items in category G),
- III. do not communicate with anything or anyone outside of the ARENA,
- IV. do not communicate with the TECHNICIAN,
- V. do not include any form of enabled wireless electronic communication with the exception of medically required equipment, and
- VI. 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 B to communicate with the ROBOT.

## Section 8.5 During the MATCH

**H502** \*No wandering. DRIVERS, COACHES, and HUMAN PLAYERS DRIVE TEAMS may not contact anything outside the area in which they started the MATCH (i.e. the ALLIANCE AREA, the SUBSTATION AREA, or the TERMINAL AREA designated TECHNICIAN space). TECHNICIANS may not contact anything outside their designated area. Exceptions are granted in cases concerning safety and for actions that are inadvertent, MOMENTARY, and inconsequential.

## Section 9 ROBOT Construction Rules

**R202** \*No exposed sharp edges. Protrusions from the ROBOT and exposed surfaces on the ROBOT shall not pose hazards to the ARENA elements (including CARGO GAME PIECES) or people.

**R206** \*Don't damage GAME PIECES. ROBOT elements likely to come in contact with a GAME PIECE shall not pose a significant hazard to the GAME PIECE.

**GAME PIECES** are expected to undergo a reasonable amount of wear and tear as they are handled by **ROBOTS**, such as scratching or marking. Gouging, tearing off pieces, or routinely marking **GAME PIECES** are violations of this rule.

**R302** \*Custom parts, generally from this year only. **FABRICATED ITEMS** created before Kickoff are not permitted. Exceptions are:

- A. OPERATOR CONSOLE,
- B. BUMPERS,
- C. battery assemblies as described in R103-B,
- D. **FABRICATED ITEMS** consisting of 1 COTS electrical device (e.g. a motor or motor controller) and attached **COMPONENTS** associated with any of the following modifications:
  - a. wires modified to facilitate connection to a **ROBOT** (including removal of existing connectors),
  - b. connectors and any materials to secure and insulate those connectors added (note: passive PCBs such as those used to adapt motor terminals to connectors are considered connectors),
  - c. motor shafts modified and/or gears, pulleys, or sprockets added, and
  - d. motors modified with a filtering capacitor as described in the blue box below R625.
- E. COTS items, or functional equivalents, with any of the following modifications:
  - a. non-functional decoration or labeling,
  - b. assembly of COTS items per manufacturer specs, unless the result constitutes a **MAJOR MECHANISM** as defined in I101, and
  - c. 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 **FABRICATED ITEMS** from **ROBOTS** entered in previous *FIRST* competitions may not be used on **ROBOTS** in the **CHARGED UP FIRST** Robotics Competition (other than those allowed per R302-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.

**Functionally equivalent items** are items that closely resemble a COTS item in both form and function. Functional equivalents should be made using similar materials to the COTS equivalents.

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

Example 1: A team designs and builds a 2-speed shifting transmission during the fall 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 2 new transmissions, and place them on the **ROBOT**. All parts of this process are permitted activities.

Example 2: A team re-uses a **CHARGED UP**-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 part E.c.

**R304** \*During an event, only work during pit hours. During an event a team is attending (regardless of whether the team is physically at the event location), the team may neither work on nor practice with their ROBOT or ROBOT elements outside of the hours that pits are open, with the following exceptions:

- A. exceptions listed in R302, other than R302-E-c and
- B. software development, and
- C. charging batteries.

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 this rule include:

- a. working on the ROBOT at the team's shop after load-in for the event has begun and
- b. working on ROBOT parts at night at the team's hotel, and
- c. running a 3D printer or other automated manufacturing process overnight producing ROBOT parts.

Note that [E108](#) and [E401](#) impose additional restrictions on work done on the ROBOT or ROBOT materials while attending an event.

This rule is intended 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).

## Section 9.4 BUMPERS Rules

**R406** \*Team number on BUMPERS. 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:

- A. consist of only white Arabic numerals at least 4 in. (~11 cm) high, at least ½ in. (~13 mm) in stroke width, and be either white in color or outlined in white with a minimum  $\frac{1}{16}$  in. (~2 mm) outline,

**R901 R408** \*BUMPER construction. BUMPERS must be constructed as follows (see Figure 9-7 is updated to reflect a more common BUMPER fastening system).

Previous Figure 9-7 with less common fastening system highlighted

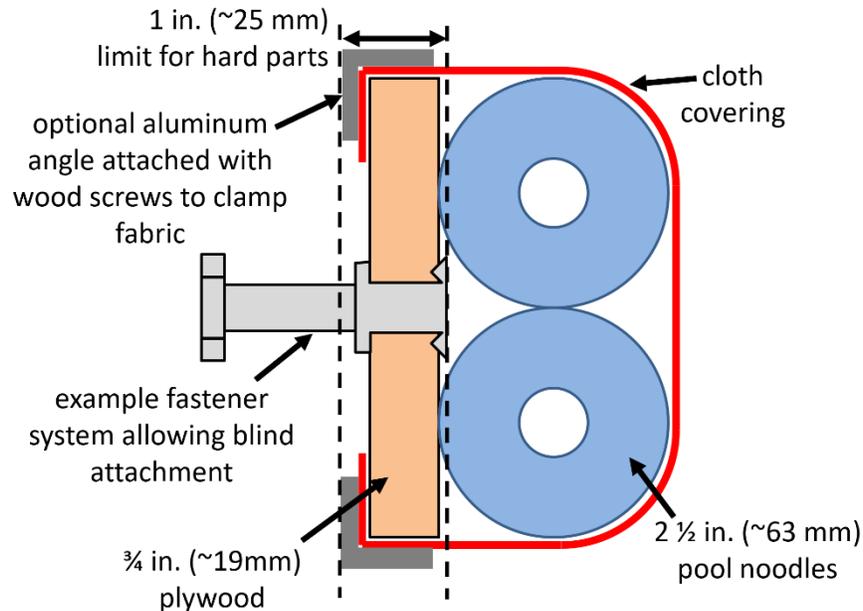


Figure 9-7):

- A. be backed by 3/4 in. thick (nominal, ~19mm) by 5 in. ± 1/2 in. (~127 mm ± 12.7 mm) tall plywood, Oriented Strand Board (OSB) or solid wood (with the exception of balsa). Small clearance pockets to accommodate minor protrusions permitted per R101 and/or access holes needed to access mounting hardware in the wood backing are permitted, as long as they do not significantly affect the structural integrity of the BUMPER.
- ...
- C. use a stacked pair of approximately 2 1/2 in. (nominal, ~63 mm) round, petal, or hex “pool noodles” (solid or hollow) as the BUMPER cushion material (see Figure 9-7). All pool noodles used in a BUMPER set (e.g. red set of BUMPERS) may not be modified (with the exception of cutting to length or cutting to facilitate mating pool noodles at the corners as required by R409) or deformed and must be the same diameter, cross section, and density (e.g. all round hollow or all hex solid). Per R409 cushion material may extend up to 2 1/2 in. (~63 mm) beyond the end of the plywood in order to fill a corner (see Figure 9-8). To assist in applying the fabric covering, soft fasteners may be used to attach the pool noodles to the wood backing, so long as the cross section in Figure 9-7 is not significantly altered (e.g. tape compressing the pool noodles).

“2 1/2 in. (~63 mm) pool noodles” are pool noodles either sold as 2 1/2 in. (~63 mm) diameter or that measure between 2 1/4 in. (~57 mm) pool noodles and 2 3/4 in. (~70 mm) diameter if not specified.

All pool noodles used on a ROBOT must be the same in order to maintain the desired interaction between ROBOTS in the cases of BUMPER-to-BUMPER contact. BUMPERS containing pool noodles of vastly different construction may cause a “ramp” effect when interacting with other BUMPERS.

Minor noodle compression as a result of smoothing BUMPER fabric or rounding a FRAME PERIMETER corner is not considered deformed. Any compression beyond that, e.g. for the purposes of flattening the pool noodle, is deformation and a violation of C.

- D. be covered with a rugged, smooth cloth- **with no additional coating applied by the team** (multiple layers of cloth and seams are permitted if needed to accommodate R405 and/or R406, provided the cross section in Figure 9-7 is not significantly altered).

Silk and bedding are not considered rugged cloths, however 1000D Cordura is. Tape (e.g. gaffer's tape) matching the BUMPER color is allowed to patch small holes on a temporary basis.

It is expected that there may be multiple layers of cloth as fabric is folded to accommodate the corners and seams of BUMPERS.

...

Figure 9-7 is updated to reflect a more common BUMPER fastening system.

*Previous Figure 9-7 with less common fastening system highlighted*

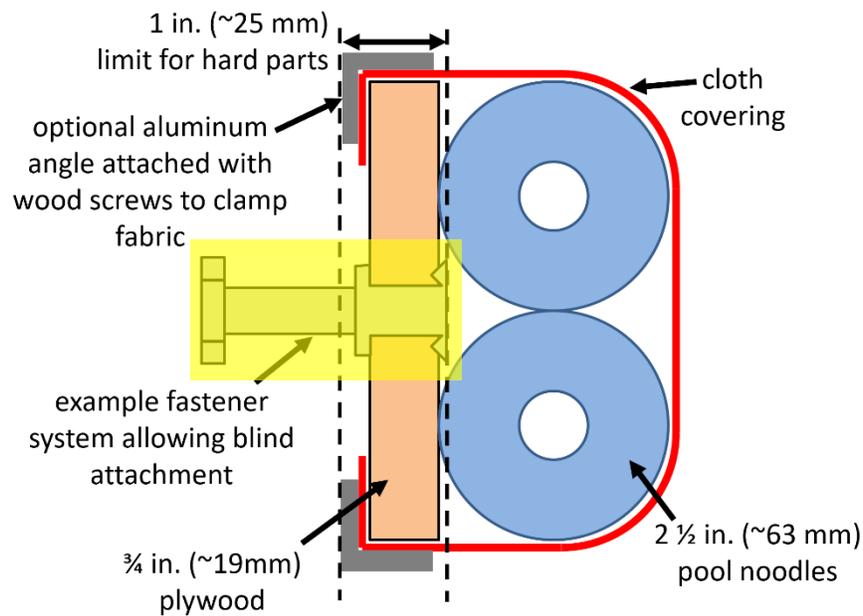
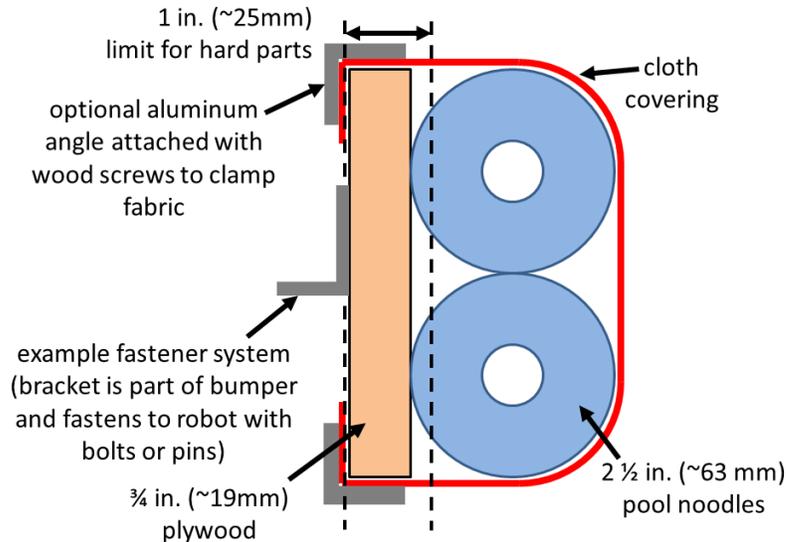


Figure 9-7 BUMPER vertical cross section



## Section 9.5 Motors and Actuators

**R501** \*Allowable motors. The only motors and actuators permitted include the following (in any quantity):

Motor Name	Part Numbers Available
Linear actuators rated for 12V and wired downstream of a breaker 20A or less	

**R504** \*Don't overload controllers. Each power regulating device may control electrical loads per Table 9-2. Unless otherwise noted, each power regulating device shall control 1 and only 1 electrical load.

Table 9-2 Power regulating device allotments

Electrical Load	Motor Controller	Relay Module	Pneumatics Controller
Linear Actuator	Yes (20A breaker max)	Yes (20A breaker max)	

## Section 9.6 Power Distribution

**R602** \*Other batteries for cameras or computers only. COTS USB battery packs with a capacity of 100Wh or less (20000mAh at 5V) and 5V, 2.5 Amp max output per port, or batteries integral to and part of a COTS computing device or self-contained camera (e.g. laptop batteries, GoPro style camera, etc.) may be used to power COTS computing devices and any peripheral COTS input or output devices connected to the COTS computing device provided they are:

- A. securely fastened to the ROBOT,
- B. connected only using unmodified COTS cables, and
- C. charged according to manufacturer recommendations.

A COTS computing device is a non-roboRIO device used to process or collect sensor information (e.g. a "smart flashlight" is not a COTS computing device).

**R611** \*The **ROBOT frame is not a wire**. All wiring and electrical devices shall be electrically isolated from the ROBOT frame. The ROBOT frame must not be used to carry electrical current.

Compliance with this rule is checked by observing a  $>3k\Omega$  **1200** resistance between either the (+) or (-) post within the APP connector that is attached to the PDP/PDH and any point on the ROBOT.

All legal motor controllers with metal cases are electrically isolated. They may be mounted directly to ROBOT frame COMPONENTS.

Note that some cameras, decorative lights, and sensors (e.g. some encoders, some IR sensors, etc.) have grounded enclosures or are manufactured with conductive plastics. These devices must be electrically isolated from the ROBOT frame to ensure compliance with this rule.

**R613** \***Electrical system must be inspectable**. The PDP/PDH, associated wiring, and all circuit breakers must be visible for inspection.

**"Visible for inspection" does not require that the items be visible when the ROBOT is in STARTING CONFIGURATION, provided the team can make the items viewable the inspection process.**

**R622** \***Use appropriately sized wire**. All circuits shall be wired with appropriately sized insulated copper wire (SIGNAL LEVEL cables don't have to be copper):

Table 9-4 Breaker and wire sizing

Application	Minimum Wire Size
6 – 20A breaker protected circuit	18 AWG (19 SWG or 1 mm <sup>2</sup> )
11-20A fuse protected circuit	
Between the PDP dedicated terminals and the VRM/RPM or PCM/PH	
Compressor outputs from the PCM/PH <b>Between the PDH and PCM/PH</b>	

## Section 9.7 Control, Command & Signal Systems

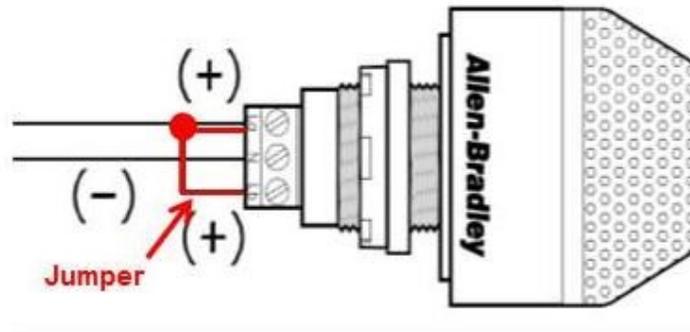
**R709** \***ROBOTS must have a signal light**. ROBOTS must use at least 1, but no more than 2, diagnostic ROBOT Signal Light (RSL) (P/N 855PB-B12ME522 and/or am-3583).

Any RSL must be:

- mounted on the ROBOT such that it is easily visible while standing 3 ft. (~ 100 cm) ~~in front~~ **away from at least one side** of the ROBOT,
- connected to the "RSL" supply terminals on the roboRIO, and
- if using the 855PB-B12ME522**, wired for solid light operation, by placing a jumper between the "La" and "Lb" terminals on the light per Figure 9-16.

Please see [How to Wire an FRC Robot](#) for connection details.

Figure 9-16 RSL 855PB-B12ME522 jumper wiring



- R714** \*Control CAN motor controllers from the roboRIO. Each CAN motor controller must be controlled with signal inputs sourced from the roboRIO and passed via either a PWM (wired per R713) or CAN bus (either directly or daisy-chained via another CAN bus device) signal, but both shall not be wired simultaneously on the same device.

As long as the CAN bus is wired legally so that the heartbeat from the roboRIO is maintained, all closed loop control features of the CAN motor controller may be used. (That is, commands originating from the roboRIO to configure, enable, and specify an operating point for all CAN motor controller closed loop modes fit the intent of R701).

"Wired directly" includes via any series of PASSIVE CONDUCTORS (i.e. star or hub configurations using only PASSIVE CONDUCTORS are permitted.)

- R715** \*Control PCM/PH(S) and ~~Servo Hubs~~ from roboRIO. Each PCM/PH must be controlled with signal inputs sourced from the roboRIO and passed via a CAN bus connection from the built-in CAN on the roboRIO (either directly or daisy-chained via another CAN bus device).

## Section 9.8 Pneumatic System

- R812** \*Pressure switch requirements. The pressure switch must be connected to the high-pressure side of the pneumatic circuit (i.e. prior to the pressure regulator) to sense the stored pressure of the circuit.

It must be either:

- A. Nason P/N SM-2B-115R/443 (wired as described) and/or

The 2 wires from the pressure switch must be connected directly to the pressure switch input of the PCM/PH controlling the compressor or, if controlled using the roboRIO and a relay, to the roboRIO. If connected to the roboRIO, the roboRIO must be programmed to sense the state of the switch and operate the relay module that powers the compressor to prevent over-pressuring the system.

- B. REV Robotics P/N REV-11-1107 (wired as described)

The analog output of the sensor must be connected directly to analog input 0 of the PH (with firmware version 22.0.2 or newer) controlling the compressor.

The REV Robotics Analog Pressure Sensor may only be used with PH compressor control and may not be used with roboRIO or PCM compressor control.