Team Update 19

GENERAL

This is the final Team Update for the 2021 season, and the Official Q&A System will close at noon (Eastern) on May 4, 2021. Thank you, and congratulations, for all the grit and growth you brought to an unforgettable season. We look forward to celebrating 2021 season successes.

2021 AT HOME CHALLENGES MANUAL

No changes.

INFINITE RECHARGE GAME MANUAL

No changes.

Team Update 18

GENERAL

No changes.

2021 AT HOME CHALLENGES MANUAL

Section 3.5 Advancement

The teams selected to advance from the second round will present remotely to members of the *FIRST* Robotics Competition Game Design Team. These Finalists participate in an interview scheduled with HQ Game Designers between ~~June 7th and June 18th~~ June 1st and June 14th, 2021.

Section 4.3.1 Additional Requirements for Semi-Finalists

- a description of the innovation impact (500-word limit)
  - How does the team's innovation improve the lives of its users and how is it measured?
- a description of the design ~~(500-word limit)~~
  - How technology has been used in the design of the innovation (500-word limit)
  - (optional) description of the user experience of the innovation. (200-word limit)
- a description of the business model ~~(500-word limit)~~
  - How does the model work? How does it include factors/resources for implementation? (500-word limit)
  - (optional) How did feedback from experts and/or users inform the value proposition of the innovation and/or business model? (150-word limit)

…

The following items are optional:

- the team ~~can~~ cannot update or refine ~~any~~ the answers to the ~~three~~ technology ~~questions~~ they made in the Executive Summary submitted earlier; the other two answers may be edited, and word counts are expanded to 350 for the problem and solution descriptions.
  (note this edit has also been made to the Requirements for FIRST Innovation Challenge Semi-Finalist Teams supplement)

INFINITE RECHARGE GAME MANUAL

No changes.

Team Update 17

GENERAL

No changes.

2021 AT HOME CHALLENGES MANUAL

Section 2.4.11 Overall Score

> Note that "third highest Computed Score" is omitted because it's moot if the Overall Score, highest Computed Score, and second highest Computed Score are tied.
>
> Teams that don't report ~~a~~ any Raw Score~~s, while they may~~ do not appear in list of ranked teams on *FIRST* Robotics Competition Events page and are not eligible for Winner or Finalist titles.

Section 4.3.1 Additional Requirements for Semi-Finalists

The following requirements are *only* for advancing Semi-Finalist teams. Teams will be contacted by *FIRST* with instructions on how to submit, and additional requirements are due by 11:59pm Eastern time, April 21, 2021.

Section 4.4.3 Judging Guidelines

The below guidelines are used by judges evaluating the submission for the *FIRST* Innovation Challenge for advancement ~~and for awards at the *FIRST* Global Innovation Awards powered by *Star Wars* Force for Change~~.

INFINITE RECHARGE GAME MANUAL

No changes.

Team Update 16

GENERAL

- [The At Home Challenges - Good to Go Guide](#) was updated to V1; edits add info on verifying that the video upload was successful and is visible to reviewers.

- **WPILib C++/Java –** A change in the location of an external online resource caused the previously posted WPILib C++\Java installers to no longer be able to install VSCode. An updated installer has been posted for the latest 2020 (2020.3.2) and 2021 (2021.2.2) releases. Any users with installers saved offline for later use prior to Wednesday, March 24th should download a new version from the [WPILib GitHub](#). There are no updates to the libraries or other software installed by these new installers.

2021 AT HOME CHALLENGES MANUAL

Section 2.4.5 Filming

Teams must showcase ROBOT performance by taking short videos of their ROBOTS completing each challenge. Scores submitted without a video will be discarded. Recommended guidelines are as follows:

- Each video should be recorded from a fixed position outside the operating space of the ROBOT. The exact distance away from the operating space will depend on the height and orientation of the camera to the field, but it's recommended that the camera always have a full-frame view of the operating space if possible. This may require a distance of up to 6 feet away from the operating space.
  - If the camera cannot be fixed (e.g. using a tripod, table, or ladder), movement of the camera during filming should be minimized.
- Each video does not need to use the same field of view but maintaining a consistent field of view whenever possible provides a more uniform viewing experience.
- Each video should be titled with the team number, a hyphen, challenge title, and omit spaces (e.g. Team0001-InterstellarAccuracyChallenge)

Review of submitted videos by *FIRST* HQ may occur after the submission deadline and through April 23, 2021. During this time, raw and computed scores and rankings for the Skills Competition are subject to change. Rankings for a GROUP are considered final when the GROUP'S Winner and Finalist are posted to the corresponding Awards page on the [FRC Events website](#), at which point *FIRST* will notify teams via *FIRST* Robotics Competition social media channels.

Section 3.1 Overview

~~Winning~~ Finalist game(s), or their elements, may inspire or be used as a future official *FIRST* Robotics Competition game! Although *FIRST* is likely to make modifications to any submitted concept, credit will be given to the associated team when the game/element is released.

Section 3.4.1 Awards

Teams are required to submit their Game Design Concept and participate in an interview with *FIRST* Robotics Competition judges to be eligible for awards. The official award guidelines can be found on the [At Home Challenges Award Guidelines](#) webpage. Interviews are virtual and hosted on Microsoft Teams. A Microsoft Teams account is

not required to join the call, but a free account can be used for remote interview practice. See Using Microsoft Teams for instructions. The awards for this challenge are as follows:

- **Designer's Award** – Celebrates a team's outstanding success with the Game Design Challenge. The winner of this award should be a strong candidate for some other awards in this challenge.
  - o   To be eligible for this award a team is not required to use the Game Design Challenge ELEMENT.
- **Concept Award** – Celebrates a team that creates an interesting, realistic game concept.
  - o   To be eligible for this award a team is required to use the Game Design Challenge ELEMENT.
- **Imagery Award *in honor of Jack Kamen*** – In honor of Jack Kamen, Dean's father, for his dedication to art and illustration and his devotion to *FIRST*. This award celebrates attractiveness in visual aesthetic integration.
- **Creativity Award *sponsored by Rockwell Automation*** – Celebrates creativity that enhances the overall game design concept.
- **Engineering Design Award** – Celebrates the team that demonstrates sound engineering in the design process.
- **Rookie Design Award (optional)** - Celebrates the rookie team's outstanding success in the Game Design Challenge.

Except for the Engineering Design Award, awards are granted to one (1) team from each GROUP; the Engineering Design Award celebrates two (2) teams from each GROUP.

Section 5.2 Awards & Judging Logistics

Table 5-1 Regions for Submitted Awards

Region Name	States/Countries included in the Region
Central Asia, Africa, and Europe Region	Afghanistan, Croatia, Germany, France, India, Kazakhstan, Libya, Lesotho, Netherlands, Norway, Poland, South Africa, Ukraine, and United Kingdom

INFINITE RECHARGE GAME MANUAL

No changes.

Team Update 15

GENERAL

No changes.

2021 AT HOME CHALLENGES MANUAL

No changes.

INFINITE RECHARGE GAME MANUAL

No changes.

Team Update 14

GENERAL

No changes.

2021 AT HOME CHALLENGES MANUAL

Section 1.11 Deadlines

The following are the important deadlines for the 2021 At Home Challenges:

- Thursday, February 4th at noon ET – Submission portal/opt-in opens
- Thursday, March 4th 5th at 3pm ET – Submission portal/opt-in closes.
  - Submissions due for the following:
    - Game Design Challenge
    - INFINITE RECHARGE℠ at Home (Judged Awards component)
    - *FIRST* Innovation Challenge presented by Qualcomm
  - INFINITE RECHARGE℠ at Home (Skills Competition component) opt-in due

> Please note that teams that have not submitted for the INFINITE RECHARGE℠ at Home Judged Awards component by the March 4th 5th deadline are ineligible to compete in the Skills Competition component.

  - Submissions temporarily closed
    - INFINITE RECHARGE℠ at Home (Skills Competition)
- Monday, March 8th at 3pm ET – Submission portal reopens for Skills Competition only (only for teams that opted in by the March 4th deadline)
- Thursday, April 8th at 3pm ET – Submission portal closes. Submissions due for Skills Competition for teams that opted into INFINITE RECHARGE at Home.

The deadlines for the Traditional Submitted Awards can be found on the Award Page.

Section 2.2.1 Additional Requirements for Skills Competition

The Skills Competition requires submission of the Judged Awards component. Teams that opt into the Skills Competition are asked to provide scores and video proof of completion for each challenge. Teams that do not submit materials for the Judged Awards component by its deadline are ineligible for the Skills Competition awards (so do not interview), the official leaderboard, and any submitted scores originally submitted by March 5th will be discarded. Scores reported by teams that opt into the Skills Competition after March 5th are posted on the *FIRST* event website in the Samarium GROUP.

> As noted in Section 1.11 Deadlines, frcathome.org is closed for submissions from March 4th 5th at 3pm to March 8th at 3pm ET. Teams participating in the Skills Competition may submit or update scores before or after that timeframe until the deadline.

See Section 1.10 How to Submit and Section 1.11 Deadlines for additional details on how to submit. The Skills Competition submission is entered independent of the Judged Awards component and does not need to be submitted at the same time. To participate in the Skills Competition part of INFINITE RECHARGE at Home, teams must provide the following:

- a score for each challenge in which they complete

> Once a score is saved in the Entry Submission System, it's added to the public leaderboard at *FIRST* Robotics Competition Events page (updates are batched a few times per day, not instantly). Scores can be updated and saved as often as the team would like before the deadline. Once a team submits and locks their score (which must be done before the April 8th, 3pm Eastern deadline for the team to be eligible for awards), it cannot be changed.

- a video for each challenge in which they complete
  - accepted video formats include flv, m4v, mov, mp4, mpeg, mpeg4, mpg, ogm, ogx, swf, wmv. Most common codecs used in these containers are accepted, for a complete list of accepted container/codec pairs Supported Input Codecs and Containers.
  - Each video may not exceed six (6) minutes

> Although the videos may be up to six (6) minutes, teams should only keep them as long as needed.
>
> Submitted video may be used to check the accuracy of a reported score or for marketing purposes and will not be made publicly available. Teams are encouraged to make sure that the recorded score is clearly represented in the video, scores which cannot be verified (except where the reported score is less favorable than the score indicated in the video) may be discarded.
>
> We recommend teams use a minimum resolution of 720p (1280x720px) when recording videos.
>
> There is no technical / theoretical limit to supported file size, however, the user's upload bandwidth is likely the limiting factor. 5GB uploads work fine on high-speed internet connections but could take several hours on an average broadband connection. The longer it takes to upload a video, the more likely there could be an interruption to network connectivity, and difficulties completing an upload.

Section 2.4.6.2 Rules

GSC4. The ROBOT must start in the Start Zone with any part of its BUMPERS breaking the vertical plane defined by B1/D1.

GSC6. Teams must stop their timer as soon as the ROBOT is in CONTROL of all three (3) POWER CELLS and any part of its BUMPERS breaks the vertical plane of the End Zone.

Section 2.4.7.2 Rules

ANC7. Teams must stop their timer as soon as the ROBOT completes the prescribed path and any part of its BUMPERS breaks the vertical plane defined by the red dashed line on the path's layout diagram.

Section 2.4.8.2 Rules

HDC9. Teams must stop their timer as soon as the ROBOT completes the prescribed path and any part of its BUMPERS breaks the vertical plane defined by the red dashed line on the path's layout diagram.

Section 2.4.9.3 Scoring

If using a 2D POWER PORT representation, a POWER CELL is considered scored if at least 50% of the POWER CELL is inside the boundary. For shots that are indeterminately close to the 50% threshold, the team may consider the POWER CELL scored accordingly. If using a 3D POWER PORT, a POWER CELL is considered scored if it

Section 2.4.10.3 Scoring

If using a 3D POWER PORT, a POWER CELL is considered scored if it passes completely through the vertical plane defined by the respective opening.

INFINITE RECHARGE GAME MANUAL

No changes.

Team Update 13

GENERAL

No changes.

2021 AT HOME CHALLENGES MANUAL

Section 2.2.1 Additional Requirements for the Skills Competition

See How to Submit and Deadlines for additional details on how to submit. The Skills Competition submission is entered independent of the Judged Awards component and does not need to be submitted at the same time. To participate in the Skills Competition part of INFINITE RECHARGE at Home, teams must provide the following:

- a score for each challenge in which they complete

> Once a score is saved in the Entry Submission System, it's added to the public leaderboard at *FIRST* Robotics Competition Events page (updates are batched a few times per day, not instantly). Scores can be updated and saved as often as the team would like before the deadline. Once a team submits and locks their score (which must be done before the April 8th, 3pm Eastern deadline for the team to be eligible for awards), it cannot be changed.

- a video for each challenge in which they complete
  - accepted video formats include flv, m4v, mov, mp4, mpeg, mpeg4, mpg, ogm, ogx, swf, wmv. Most common codecs used in these containers are accepted, for a complete list of accepted container/codec pairs Supported Input Codecs and Containers.
  - Each video may not exceed six (6) minutes

Section 2.4.4 Challenge Space Layout

The edits to Section 2.4.4 correct a discrepancy in the manual that was missed up until some astute observers made us aware of our error via Q&A question Q121. The manual had simultaneously implied that everything a team needs (except drivers and observers) can fit in the Challenge Space, encouraged use of a LOADING BAY (or LOADING BAY mockup) for safe POWER CELL delivery to the ROBOT, and stated that nothing that can help a ROBOT or human can be left in the Challenge Space.

We're so sorry for the mixed messaging about what can and cannot be in the Challenge Space!

Because of the edit to Sections 1.8 in both manuals described in Team Update 06 (to not make any changes that would impact challenge submission content), we opted to remedy the discrepancy by implementing the more permissive fix (adding an exception for a LOADING BAY to the language stating that nothing can be left in the Challenge Space). This is the same tenet we used when answering Q104, Q106, and Q107; to remedy the discrepancy with the more permissive fix.

Additional markings may be added on the floor or POWER PORT at team discretion. No other physical elements may be added within the Challenge Space for the purpose of aiding ROBOT or DRIVE TEAM performance except for a LOADING BAY or LOADING BAY mockup used in the Interstellar Accuracy and POWER PORT Challenges. Other static elements outside the Challenge Space may be placed to aid robot navigation, provided the robot does not physically interact with them.

Section 2.4.11 Overall Score

4. **Teams are ranked within their GROUP.**

Teams within a GROUP are ranked using their Overall Score and the sorting criteria defined in Table 2-2.

Table 2-2 Skills Challenge ranking criteria

Order Sort	Criteria
1st	Overall Score
2nd	Highest Computed Score
3rd	Second highest Computed Score
4th	Fourth highest Computed Score
5th	Fifth highest Computed Score
6th	Random sorting

Note that "third highest Computed Score" is omitted because it's moot if the Overall Score, highest Computed Score, and second highest Computed Score are tied.

Teams that don't report a Raw Score, while they may appear in list of ranked teams on *FIRST Robotics Competition Events page*, are not eligible for Winner or Finalist titles.

INFINITE RECHARGE GAME MANUAL

No changes.

Team Update 12

GENERAL

Using Microsoft Team for *FIRST* Robotics Competition document has been revised.

2021 AT HOME CHALLENGES MANUAL

The edits to Section 2.4.10 correct a discrepancy in the manual that was missed up until some astute observers made us aware of our error via Q&A questions Q104 and Q107.

We're so sorry for this!

Because of the edit to Sections 1.8 in both manuals described in Team Update 06 (to not make any changes that would impact challenge submission content), we opted to remedy the discrepancy by implementing the more permissive fix (updating the image to match the PPC4 dimension vs updating the PPC4 dimension to match the image). This is the same tenet we used when answering Q106; we intended to prohibit robots from starting the POWER PORT Challenge already enabled, but didn't, and it's too late to add a prohibition of that nature once the submission portal is open.

Section 2.4.10.1 Layout

Teams should mark the boundary of zones from the diagram below using at least one MARKER on the NAV POINTS along the zone boundary (e.g., any number of ~~A6-E6~~ A7-E7 and A9-E9).
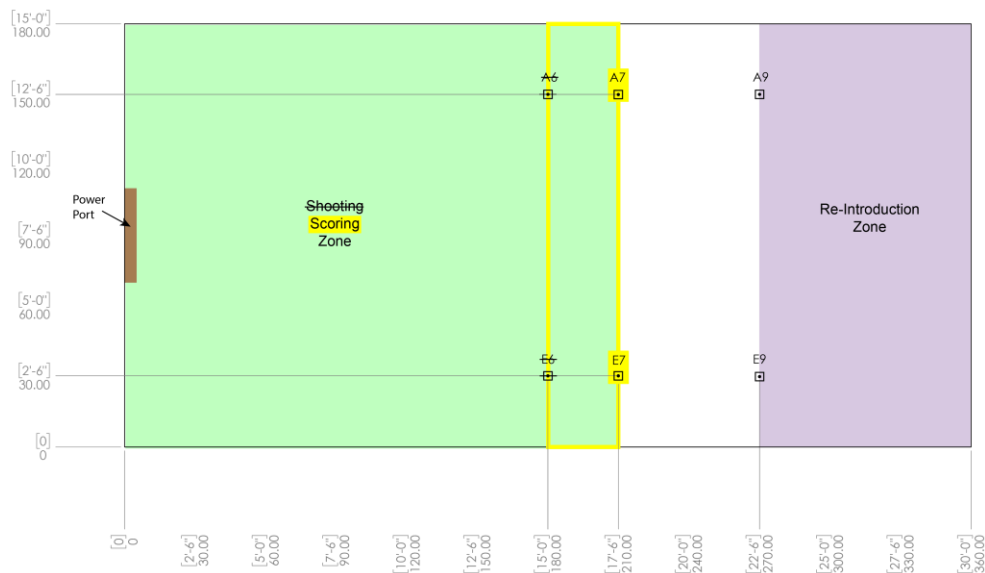
…

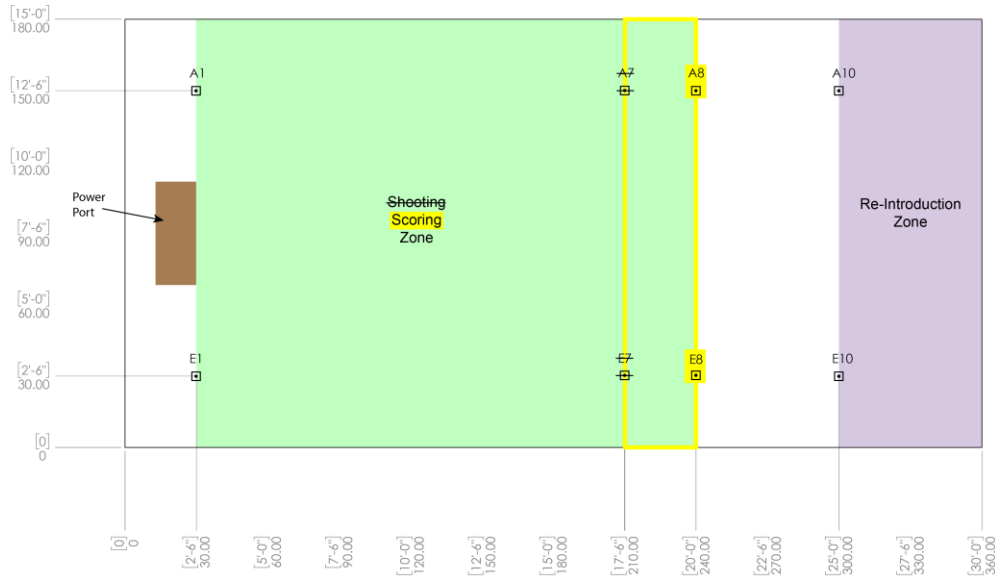*Figure 2-12 POWER PORT Challenge Layout no field element*

Figure 2-13 POWER PORT Challenge Layout with field element

Section 2.4.10.2 Rules

PPC4. The ROBOT may only attempt a shot if its BUMPERS are fully contained within the Scoring Zone which extends 17 ft. 6 in (~533 cm) from the face of the POWER PORT representation (see ~~layout below~~ Figures 2-12 and 2-13 for details).

Section 4.4.2 Judging GROUPS

Teams are assigned to a GROUP by *FIRST* Headquarters. Once assignments are made, on or around Monday, March 8th, the GROUP is shown on the FRC Events webpage. Each GROUP has between ~~20-30~~ 25-35 teams (with a target of ~~~25~~ 30 teams), pending total number of teams participating.

The process used to assign teams (who have submitted for the *FIRST* Innovation Challenge by the deadline) to their GROUP is as follows:

1. Determine initial number of groups by assessing the number of teams who have opted-in to the FIRST Innovation Challenge by the deadline, divided by ~~25~~ 30, and rounded up.
2. Rookie teams (2020 and 2021 rookies) are assigned randomly, team by team, to GROUPS (i.e. team in GROUP A, team in GROUP B, team in GROUP C, etc., returning to GROUP A if necessary)
3. Step 2 is repeated with Veteran teams.
4. If any groups contain fewer than the minimum of 20 teams, a GROUP is dissolved, and the teams are redistributed into the remaining. This is repeated until all groups contain the minimum threshold of teams.

INFINITE RECHARGE GAME MANUAL

No changes.

Team Update 11

GENERAL

No changes.

2021 AT HOME CHALLENGES MANUAL

No changes.

INFINITE RECHARGE GAME MANUAL

Section 9.6 Motors & Actuators

R29. With the exception of servos, fans, or motors integral to sensors of COTS computing devices permitted in R27, each actuator must be controlled by a power regulating device. The only power regulating devices for actuators permitted on the ROBOT include:

…

B. Relay Modules

    i.   Spike H-Bridge Relay (P/N: 217-0220 and SPIKE-RELAY-H)

    ii. Automation Direct Relay (P/N: AD-SSR6M12-DC-200D, AD-SSRM6M25-DC-200D, ~~AD-SSR6M45-DC-200D~~ AD-SSR6M40-DC-200D)

Team Update 10

GENERAL

No changes.

2021 AT HOME CHALLENGES MANUAL

Section 3.2 Submission Information

- For the purposes of a team's 2021 Game Design Challenge submission only, the *FIRST* logo may be modified to help with theming the concept.

INFINITE RECHARGE GAME MANUAL

No changes.

Team Update 09

GENERAL

The Kickoff Kit Checklist for the "Everyone Box" has been updated to include the Trash Trek FLL Challenge Set as an alternate to the Into Orbit Challenge Set.

☑	Item Description	Supplier	Part Number	Qty	Where to get more?	Photo
☐	**FLL Challenge Set LEGO Bricks** 2018, Into Orbit or 2015 Trash Trek, 29 bags of assorted LEGO bricks	*FIRST*	6236740-1 or 45801-1	1	Not Available, find details at https://www.firstlegoleague.org/past-challenges	
☐	**FLL Challenge Set Mat** 2018, Into Orbit or 2015, Trash Trek	*FIRST*	6236740-2 or 45801-2	1	Not Available, find details at https://www.firstlegoleague.org/past-challenges	

2021 AT HOME CHALLENGES MANUAL

Sections 2.3.2 Judging GROUPS

The process used to assign teams (who have submitted for the INFINITE RECHARGE at Home Judged Awards component by the deadline) to their GROUP is as follows:

Sections 3.4.2 Judging GROUPS

The process used to assign teams (who have submitted for the Game Design Challenge by the deadline) to their GROUP is as follows:

Sections 4.4.2 Judging GROUPS

The process used to assign teams (who have submitted for the *FIRST* Innovation Challenge by the deadline) to their GROUP is as follows:

INFINITE RECHARGE GAME MANUAL

No changes.

Team Update 08

GENERAL

Submitted Awards Webpage

Chairman's & *FIRST* Dean's List Award content has been updated to reflect that Quebecois teams are not required to conduct their interviews in English.

Virtual Kit of Parts

Step 8 in the Mentor Onboarding Guide for the AWS credit donation has been updated.

2021 AT HOME CHALLENGES MANUAL

No changes.

Team Update 07

GENERAL

An At Home Challenges - Quick Start Guide has been published to assist teams as they navigate the frcathome.org portal to opt-in to the At Home Challenges and submit their scores and content for judging. This portal opens on Thursday, February 4th at noon ET.

2021 AT HOME CHALLENGES MANUAL

Section 2.2 Submission Information

See How to Submit and Deadlines for additional details on how to submit. To participate in INFINITE RECHARGE at Home, teams must opt into the Judged Awards component. Teams are asked to provide the following:

- two (2) contact emails (must be mentors)
- time zone
- image(s) of the ROBOT
    - at least one (1) required, up to three (3) images permitted.
    - provided for reference to judges for Judged Awards
    - can be a photo, a CAD image, sketches of specific elements, etc.
    - accepted formats include gif, jpg, jpeg, png.
    - each file must be no larger than 10 MB.

> There are no restrictions on how many times a ROBOT may appear within each image. For example, four images of the ROBOT, saved as a single file, is considered a single image. Please note that Judges are instructed to review the quality of the content; not the quantity of information provided in an image. Judges view images within the Entry Submission System, so images should be clear and easy to see without relying on the viewer to download or zoom.

Section 2.4.6.1 Layout

Teams should mark the boundary of zones from the diagram below using at least one MARKER on the NAV POINTS along the zone boundary (e.g., any number of A1-E1 and B11-D11).

Section 2.4.10.3 Scoring

Points are awarded for each ~~scored~~ POWER CELL scored in the representation of the POWER PORT at the same values as in INFINITE RECHARGE.

If using a 2D POWER PORT, a POWER CELL is considered scored if at least 50% of the POWER CELL is inside the boundary. For shots that are indeterminately close to the 50% threshold, the team may consider the POWER CELL scored accordingly. If using a 3D POWER PORT, a POWER CELL is considered scored if it passes completely through the plane defined by the respective opening. A POWER CELL that passes through the OUTER PORT opening and then the INNER PORT opening counts as an INNER PORT score only. A POWER CELL that passes completely through an opening and then bounces back out qualifies as having been scored.

Section 3.2 Submission Information

See How to Submit and Deadlines for additional details on how to submit. For the Game Design Challenge, teams are asked to provide the following information when they submit:

- two (2) contact emails (must be mentors)
- time zone
- game name (text only, not a logo)
- image of the field
    - can be a sketch, a photo of a physical model, a CAD image, etc.
    - accepted formats include gif, jpg, jpeg, png
    - files must be no larger than 10 MB.

There are no restrictions on how many times a field design may appear within each image. For example, four images of the field, saved as a single file, is considered a single image. Please note that Judges are instructed to review the quality of the content; not the quantity of information provided in an image. Judges view images within the Entry Submission System, so images should be clear and easy to see without relying on the viewer to download or zoom.

2021 FRC GAME MANUAL

No changes.

Team Update 06

GENERAL

Submitted Awards Webpage Edits

Content specific to the Chairman's Award and Dean's List interview processes on the Submitted Awards webpage has been updated to reflect the following:

- with a few exceptions, Traditionally Submitted Award interviews are conducted in English,
- there are no restrictions on who can be a translator/interpreter (reflected in *Sections 2.3.4, 3.4.4*, and *4.4.5* below), and
- the interview time is extended if translator/interpreter is used (reflected in *Sections 2.3.4, 3.4.4*, and *4.4.5* below).

Content specific to the Autonomous Award sponsored by Ford on the At Home Challenges Award Guidelines webpage has been updated to reflect the change made in *Section 2.2*.

2021 AT HOME CHALLENGES MANUAL

Section 1.8 Team Updates

Team Updates are used to notify the *FIRST* Robotics Competition community of revisions to the official season documentation (e.g. the manuals, drawings, etc.) or important season news. Between Kickoff and February 2, 2021, Team Updates are posted each Tuesday and Friday. Starting February 9, 2021, Team Updates will be posted on Tuesdays only, and edits will be limited to only those that won't impact challenge submission content (e.g. correcting an award count error, control system updates, etc.). Additional Team Updates and their posting frequency will be announced if an in-person season is approved. Team Updates are posted on the INFINITE RECHARGE - Season Materials webpage and are generally posted before 5 pm, Eastern.

Section 2 INFINITE RECHARGE at Home

Section 2.2 Submission Information

- Optional - a video, consisting of a continuous single shot, of the ROBOT performing an autonomous routine
  - required to be considered for the Autonomous Award, otherwise optional
  - video may be of the ROBOT'S traditional autonomous routine for INFINITE RECHARGE or an autonomous routine from the Skills Competition
  - videos may not exceed three (3) minutes
  - accepted formats include flv, m4v, mov, mp4, mpeg, mpeg4, mpg, ogm, ogx, swf, wmv. Most common codecs used in these containers are accepted, for a complete list of accepted container/codec pairs see Supported Input Codecs and Containers.

Section 2.3.1 Awards

Teams are required to submit the required information by the deadline and participate in an interview with *FIRST* Robotics Competition judges to be eligible for Judged Awards. The official award guidelines can be found on the At Home Challenges Award Guidelines webpage. Interviews are virtual and hosted on Microsoft Teams. A Microsoft Teams account is not required to join the call, but a free account can be used for remote interview practice. See Using Microsoft Teams for instructions. Teams do not have to participate in the Skills Competition component of

INFINITE RECHARGE at Home to be eligible for the Judged Awards, but teams must participate in the Judged Awards to be eligible for participation in the Skills Competition.

Section 2.4.1 Overview

To participate in the Skills Competition, teams require the following:

- A legal INFINITE RECHARGE ROBOT (reference ROBOT & Inspection Rules)
- an open space, i.e. Challenge Space, to operate the ROBOT
  - ~15 ft. x ~30 ft. (~458 cm x ~915 cm) of playing space is strongly recommended. Additional space is required for drivers and observers.
  - If attempting shooting challenges, adequate height for the ROBOT to shoot POWER CELLS into the POWER PORT representation. Total POWER PORT height is ~10ft. (~305 cm).
  - Carpet is not needed, any surface on which the ROBOT can safely drive is permitted

> Omitting the requirement for carpet is intended to ease the burden on teams in establishing their Challenge Space, i.e. let teams use flooring readily available to them. The intent is not to include flooring design in the scope of the Skills Competition.

- POWER CELLS
  - three (3) POWER CELLS are needed (included in the 2021 Kickoff Kit).
- Team Version Field Elements (wooden or comparable) are not required. For the Interstellar Accuracy Challenge and the POWER PORT Challenge, a representation of the POWER PORT with approximate dimensions is required. See The INFINITE RECHARGE at Home Challenge Space Layout for recommendations.

Section 2.3.4 Interview Process

For all At Home Challenges, interviews occur between Monday, March 15th and Sunday, April 11th.

- Interviews are limited to twelve (12) minutes total; up to seven (7) minutes for a presentation by the team and the remaining time (at least five (5) minutes) for questions and answers led by the judges.
  - The interview time begins after a one (1) minute buffer to allow all team members to be on the call.
  - Recommended presentation is as follows:
    - What the ROBOT was designed to do
    - The process used to design the ROBOT
    - Why a specific ROBOT feature was chosen and how it works
- At least one (1) adult mentor **must** attend the interview.
  - Mentors are not allowed to provide any assistance during the interview. *FIRST* suggests this mentor provides feedback to the team after the interview based on observations and noting judges' questions. This feedback can be very valuable in helping teams hone their skills. If the mentor provides any assistance during the interview, the judges will respectfully remind the mentor of the rule.
  - ~~**Exception**: If necessary, the mentor may provide translation services for students needing foreign language or sign language translation.~~
- Teams are allowed to have as many team members in the interview as they believe they need but teams are encouraged to create a succinct presentation for the judges. We recommend no more than five (5) team members.

> Presenters should be ready for (and even expect!) technical difficulties; all team members should be prepared to step in (e.g. know the material, have presentation materials on hand, etc.) in case someone has internet, camera, audio, etc. issues.

> Remember to put safety first with social distancing guidelines and compliance with local regulations if team members are in the same physical location.

- Interviews are conducted in English. Teams needing a translator or sign-language interpreter may include an additional person to act as that translator/interpreter. The translator/interpreter does not need to be a team member. For these teams, the duration of the interview is increased by three (3) minutes.
- Presenters may share their screens and play video.
- Recording video, audio, or taking pictures (including screenshots) are prohibited during the interview.

> In addition to *FIRST* prohibiting recording, there may be other legal restrictions governing recording.

Section 2.4.4 Challenge Space Layout

For each challenge, a layout diagram indicates which NAV POINTS are used and the placement of MARKERS. MARKERS are physical objects with a minimal cross-section of 2.5 in (~63 mm) wide by 2.5 in (~63 mm) deep and at least 5 in (~127 mm) tall used to mark specific locations relevant to each challenge. The cross-section of a MARKER may not exceed 1 ft. 1 in. (~330 mm) wide by 1 ft. 1 in. (~330 mm) deep (there is no height limit). MARKERS are to be centered (approximately, and to the best of the team's ability, i.e. there's no specific tolerance on "centered") on their respective NAV POINTS.

Sections 2.4.6.3 Scoring, 2.4.7.3 Scoring, & 2.4.8.3 Scoring

The raw score for this challenge is the sum of completion times (in seconds) for the two (2) path runs. Teams should enter the times for the individual paths exactly as they record them, they will be rounded automatically to the nearest tenth of a second (x.x5 is rounded up to the nearest tenth, e.g. 0.15 is rounded to 0.2) before being combined into the raw score.

Section 2.4.9 Interstellar Accuracy Challenge

In the Interstellar Accuracy Challenge teams emulate the shooting challenges of INFINITE RECHARGE gameplay by scoring POWER CELLS into a representation of the BOTTOM PORT, OUTER PORT, AND INNER PORT from four (4) zones. Teams ~~will~~ attempt to score as many points as possible with their ROBOT (which is either autonomous and/or remotely controlled) in five (5) minutes.

Section 2.4.10 POWER PORT Challenge

In the POWER PORT Challenge teams emulate the teleoperated portion of INFINITE RECHARGE gameplay by collecting POWER CELLS with their ROBOT (which is either autonomous and/or remotely controlled) and scoring them into a representation of the POWER PORT. Teams attempt to score as many points as possible in the POWER PORT in one minute.

Section 3 Game Design Challenge

Section 3.4.1 Awards

Teams are required to submit their Game Design Concept and participate in an interview with FIRST Robotics Competition judges to be eligible for awards. The official award guidelines can be found on the At Home Challenges Award Guidelines webpage. Interviews are virtual and ~~held on a remote platform~~ hosted on Microsoft Teams. A Microsoft Teams account is not required to join the call, but a free account can be used for remote interview practice. See Using Microsoft Teams for instructions.

Section 3.4.4 Interview Process

For all At Home Challenges, interviews occur between Monday, March 15th and Sunday, April 11th.

- Interviews are limited to twelve (12) minutes total; up to seven (7) minutes for a presentation by the team and the remaining time (at least five (5) minutes) for questions and answers led by the judges.
    - The interview time begins after a one (1) minute buffer to allow all team members to be on the call
    - Please remember that judges review the team's submission prior to this interview. We encourage teams to present new information to the judges, rather than reiterating what was already submitted.
- Teams are allowed to share their screens and use video as part of their presentation
- Teams are allowed to have as many team members in the interview as they believe they need but teams are encouraged to create a succinct presentation for the judges. We recommend no more than 5 team members.

> We encourage all teams to be prepared to adapt to any technical difficulties by having multiple team members prepared to present all materials.
>
> Remember to put safety first with social distancing guidelines and compliance with local regulations if your students are in the same physical location.

- At least one (1) adult team mentor **must** attend the interview.
    - Mentors are not allowed to provide any assistance during the interview. *FIRST* suggests this mentor provides feedback to the team after the interview based on observations and noting judges' questions. This feedback can be very valuable in helping teams hone their skills. If the mentor provides any assistance during the interview, the judges will respectfully remind the mentor of the rule.
    - ~~**Exception**: If necessary, the mentor may provide translation services for students needing foreign language or sign language translation.~~
- Interviews are conducted in English. Teams needing a translator or sign-language interpreter may include an additional person to act as that translator/interpreter. The translator/interpreter does not need to be a team member. For these teams, the duration of the interview is increased by three (3) minutes.
- Recording video, audio, or taking pictures (including screenshots) are prohibited during the interview.

> In addition to *FIRST* prohibiting recording, there may be other legal restrictions governing recording.

Section 4 *FIRST* Innovation Challenge presented by Qualcomm

Section 4.4.1 Semi-Finalist Awards

Teams are required to submit the required information by the deadline and participate in an interview with *FIRST* Robotics Competition judges to be eligible for the award and advancement. Interviews are virtual and hosted on Microsoft Teams. A Microsoft Teams account is not required to join the call, but a free account can be used for remote interview practice. See Using Microsoft Teams for instructions.

Section 4.4.5 Interview Process

For all At Home Challenges, interviews occur between Monday, March 15th and Sunday, April 11th.

- Interviews are limited to fifteen (15) minutes total; two (2) minutes for a pitch, three (3) minutes presentation by the team and the remaining time (at least ten (10) minutes) is used for questions and answers led by the Judges.
    - The interview time begins after a one (1) minute buffer to allow all team members to be on the call
    - See Interview Details for details on what to prepare
- Teams are allowed and encouraged to share their screens and use video as part of their presentation.

- Teams are allowed to have as many team members in the interview as they believe they need but teams are encouraged to create a succinct presentation for the Judges.

> We encourage all teams to be prepared to adapt to any technical difficulties by having multiple team members prepared to present all materials.
>
> Remember to put safety first with social distancing guidelines and compliance with local regulations if team members are in the same physical location.

- At least one (1) adult team mentor **must** attend the interview.
  - Mentors are not allowed to provide any assistance during the interview. *FIRST* suggests this mentor provides feedback to the team after the interview based on observations and noting Judges' questions. This feedback can be very valuable in helping teams improve their solution and skills. If the mentor provides any assistance during the interview, the Judges will respectfully remind the mentor of the rule.
  - ~~**Exception**: If necessary, the mentor may provide translation services for students needing foreign language or sign language translation.~~
- Interviews are conducted in English. Teams needing a translator or sign-language interpreter may include an additional person to act as that translator/interpreter. The translator/interpreter does not need to be a team member. For these teams, the duration of the interview is increased by three (3) minutes.
- Recording video, audio, or taking pictures (including screenshots) are prohibited during the interview.

> In addition to *FIRST* prohibiting recording, there may be other legal restrictions governing recording.

Section 5.2 Awards & Judging Logistics

Table 5-2 # of Awards per Region

Region	# of Chairman's Award Winners	#of Dean's List Finalists	# of Woodie Flower Finalists
Caribbean + South American Region	1	2	1
Central Asia, Africa, and Europe Region	1	2	1
China Region	2	4	1
Florida Region	3	6	1
Greater Central Valley Region	~~1~~ 2	~~2~~ 4	1
Greater Los Angeles Region	4	8	1
Greater San Diego Region	2	4	1
Greater San Francisco Bay Region	3	6	1
Illinois Region	2	4	1
Mexico Region	3	6	1
Midwestern Plains Region	2	4	1
MoKan Region	3	6	1
New York & Quebec Region	4	8	1
Pacific Region	3	6	1
Rocky Mountain Region	4	8	1
Southeastern Region	2	4	1
Southern Appalachian Region	2	4	1
Southwestern Region	2	4	1
Turkish Region	3	6	1

Region	# of Chairman's Award Winners	#of Dean's List Finalists	# of Woodie Flower Finalists
Upper Midwest Region	6	12	1
Upper Ohio River Region	3	6	1
Wisconsin Region	2	4	1

2021 FRC GAME MANUAL

Section 1.8 Team Updates

Team Updates are used to notify the *FIRST* Robotics Competition community of revisions to the official season documentation (e.g. the manuals, drawings, etc.) or important season news. Between Kickoff and February 2, 2021, Team Updates are posted each Tuesday and Friday. Starting February 9, 2021, Team Updates will be posted on Tuesdays only, and edits will be limited to only those that won't impact challenge submission content (e.g. correcting an award count error, control system updates, etc.). Additional Team Updates and their posting frequency will be announced if an in-person season is approved. Team Updates are posted on the INFINITE RECHARGE - Season Materials webpage

Team Update 05

GENERAL

Control System

WPILib update: A C++/Java WPILib update (2021.2.1) has been released which fixes bugs discovered since Kickoff and adds the Infinite Recharge at Home Skills Competition layouts to Pathweaver. The download, and a complete changelog, is available on Github.

INFINITE RECHARGE^{SM} at Home Guides

Targeting with Vision, Step 2: Find the Target

Off-the-shelf solutions – This approach uses a packaged off-the-shelf solution to find the target. These solutions generally accommodate some user tunability but are often a quite different experience than attempting to design the code from scratch. Examples of this include Chameleon Vision, Limelight, Opensight, ~~and~~ PhotonVision, and Gloworm. Note that some of these solutions require specific hardware and some are designed for teams to assemble their own hardware solution. The WPI developed program, GRIP is a hybrid between this approach and traditional computer vision. GRIP provides an interface similar to some of these solutions, but then generates OpenCV code that can be further tuned by the user.

Kit of Parts

The process for redeeming your Vulcan Springs voucher has been modified. The codes provided in the Vulcan packets (Rookie Kickoff Kits and in *FIRST* Choice) are now invalid, so please use the Vulcan Springs code posted to your team's Dashboard (visible to Lead Mentors 1 and 2). Thank you!

Q&A

Please note, the answer to Q27 has been edited.

Turkish Documentation

The Turkish version of the 2021 *INFINITE RECHARGE^{SM} Game Manual* is now available on the Translated Documentation page. Please note that these translations reflect content released at the 2021 Kickoff, and do not incorporate changes made since.

2021 AT HOME CHALLENGES MANUAL

2.1 Overview

INFINITE RECHARGE^{SM} at Home brings events to teams in two (2) ways:

1. **Judged Awards:** Teams describe their ROBOT's technical qualities by sharing information with judges remotely to compete for traditional machine awards. While access to a team's INFINITE RECHARGE ROBOT is not required, access to pictures, videos, or other representation is.

> While the Judged Awards component does not require any ROBOT inspection, submitted ROBOTS should generally comply with the 2021 INFINITE RECHARGE ROBOT rules (i.e. no major, obvious violations).
>
> The ROBOT used for the Judged Awards does not need to be the same ROBOT used for the Skills Competition, but the same ROBOT must be used for all INFINITE RECHARGE at Home Judged Awards.

Section 2.4.3 ROBOT & Inspection Rules

SC7. A ROBOT attempting a challenge must comply with all ROBOT rules in the 2021 Game Manual with the exception of R21, R22 (i.e. BUMPER fabric may be any color and contain any markings), the "via the ARENA Ethernet network" clause of R62, and R92. Rules that reference the ARENA should be interpreted as referencing the Challenge Space for the At Home Challenges.

SC8. All submitted Skills Competition challenges runs should must be completed with the same ROBOT in the same configuration.

> This is not intended to prevent teams from making minor upgrades or enhancements throughout the path of the Skills Competition. The intent of this rule is to prevent teams from making substantial changes to their ROBOT between challenges (e.g. completing the POWER PORT challenge, and then removing all POWER CELL related mechanisms for completion of the Hyperdrive challenge).
>
> Please note that per the Blue Box in Section 2.1, the ROBOT used for the Skills Competition does not need to be the same ROBOT used for the Judged Awards part of INFINITE RECHARGE at Home.

Section 2.4.6 Rules (Galactic Search Challenge)

GSC4. The ROBOT must start in the Start Zone with any part of its BUMPERS breaking the plane defined by A1/B1 B1/D1.

Section 2.4.9.2 Rules (Interstellar Accuracy Challenge)

IAC2. Teams must attempt allocate at least three (3) POWER CELLS per zone. The remaining three (3) POWER CELLS may be shot from allocated to any of the four (4) zones.

> Allocate means to assign the only zone from which the POWER CELL may be shot. Teams don't have to shoot all fifteen (15) POWER CELLS.
>
> For example, a ROBOT may shoot all remaining three (3) POWER CELLS from NAV POINT A4 in the Yellow zone, or one (1) shot from B1, B4, and B6 in the Green, Yellow, and Blue zones respectively.

2021 FRC GAME MANUAL

No changes.

Team Update 04

GENERAL

No changes.

2021 AT HOME CHALLENGES MANUAL

Section 2.4.4 Challenge Space Layout

MARKERS are physical objects with a minimal cross-section of 2.5 in (~63 mm) wide by 2.5 in (~63 mm) deep and at least ~~6 in (~152 mm)~~ 5 in. (~127 mm) tall used to mark specific locations relevant to each challenge.

Section 2.4.10 POWER PORT Challenge

PPC6. Humans may only introduce POWER CELLS in the Reintroduction Zone which starts 22 ft. 6 in (~686 cm) from the face of the POWER PORT representation (see layout below for details).

> POWER CELLS may be introduced directly to the ROBOT or onto the floor.
>
> POWER CELLS which land in the Challenge Space may be fielded directly by the ROBOT anywhere in the Challenge Space; they do not need to be reintroduced by a human ~~or into the Reintroduction Zone~~. The intent of this allowance is to avoid forcing humans to field POWER CELLS in close proximity to the ROBOT. Teams should not use this allowance to attempt to create a "loop" with minimal ROBOT movement. Please note that scored POWER CELLS are only eligible to be scored again if they enter the Reintroduction Zone per Section 2.4.10.3.
>
> Use of a LOADING BAY (or LOADING BAY mockup) is recommended to minimize risk of human injury by a POWER CELL receiving ROBOT.

2021 FRC GAME MANUAL

No changes.

Team Update 03

GENERAL

2021 AT HOME CHALLENGES MANUAL

Section 1.11 Deadlines

The following are the important deadlines for the 2021 At Home Challenges:

- Thursday, February 4th at noon ET – Submission portal/opt-in opens
- Thursday, March 4th at 3pm ET – Submission portal/opt-in closes.
  - Submissions due for the following:
    - Game Design Challenge
    - INFINITE RECHARGESM at Home (Judged Awards component)
    - *FIRST* Innovation Challenge presented by Qualcomm
  - INFINITE RECHARGESM at Home (Skills Competition component) opt-in due

> Please note that teams that have not submitted for the INFINITE RECHARGESM at Home Judged Awards component by the March 4th deadline are ineligible to compete in the Skills Competition component.

  - Submissions temporarily closed
    - INFINITE RECHARGESM at Home (Skills Competition)
- Monday, March 8th at 3pm ET – Submission portal reopens for Skills Competition only (only for teams that opted in by the March 4th deadline)
- Thursday, April 8th at 3pm ET – Submission portal closes. Submissions due for Skills Competition for teams that opted into INFINITE RECHARGE at Home.

The deadlines for the Traditional Submitted Awards can be found on the Award Page.

Section 2.3.1 Awards

- **Autonomous Award *sponsored by Ford*** - Celebrates the team that has demonstrated consistent, reliable, high-performance ~~robot~~ ROBOT operation during autonomously managed actions. Evaluation is based on the ROBOT's ability to sense its surroundings, position itself or onboard mechanisms appropriately, and execute tasks.

Section 2.4.2 General Rules

SC4. While attempting a challenge, and unless challenge requires autonomy, the ROBOT may only be operated by ~~a~~ up to two (2) precollege student member(s) of the team.

Section 2.4.3 ROBOT & Inspection Rules

SC7. A ROBOT attempting a challenge must comply with all ROBOT rules in the 2021 Game Manual with the exception of R21, ~~and~~ R22 (i.e. BUMPER fabric may be any color and contain any markings), the "via the ARENA Ethernet network" clause of R62, and R92.

Section 2.4.10 POWER PORT Challenge

PPC5. No more than two (2) people may ~~feed~~ <mark>handle</mark> POWER CELLS ~~to the ROBOT~~ <mark>during the challenge attempt</mark>.

PPC6. Humans may only introduce POWER CELLS in the Reintroduction Zone which starts 22 ft. 6 in (~686 cm) from the face of the POWER PORT representation (see layout below for details).

> POWER CELLS may be introduced directly to the ROBOT or onto the floor.
>
> POWER CELLS which land in the challenge space may be fielded directly by the ROBOT anywhere in the challenge space; they do not need to be reintroduced by a human or into the Reintroduction Zone. <mark>The intent of this allowance is to avoid forcing humans to field POWER CELLS in close proximity to the ROBOT. Teams should not use this allowance to attempt to create a "loop" with minimal ROBOT movement.</mark>
>
> Use of a LOADING BAY (or LOADING BAY mockup) is recommended to minimize risk of human injury by a POWER CELL receiving ROBOT.
>
> ~~The intent of this allowance is to avoid forcing humans to field POWER CELLS in close proximity to the ROBOT. Teams should not use this allowance to attempt to create a "loop" with minimal ROBOT movement.~~

Section 2.4.10.3 Scoring (re: POWER PORT Challenge)

The raw score is the total number of points scored within the 1-minute period. Teams must record a raw score greater than 0 to have the challenge count towards calculation of Overall Scores. Points are awarded for each ~~scored~~ POWER CELL scored in the representation of the POWER PORT at the same values as in INFINITE RECHARGE. <mark>A POWER CELL is only considered scored if, as it scores, it is not in contact with a ROBOT and that POWER CELL has entered the Reintroduction Zone (via ROBOT, by human, or by rolling itself) since the last time that POWER CELL was scored.</mark>

2021 FRC GAME MANUAL

No changes.

Team Update 02

GENERAL

A Note from Frank Merrick, Director *FIRST* Robotics Competition

Hello, Teams! I hope you are having a great start to the 2021 season.

By this time, we probably don't need to point out that this is an unusual season. The rules for the At Home Challenges are unusual, too. You may find them to be more open-ended and flexible than the rules we typically have for in-person competitions. This is intentional. At the time of this writing, we expect nearly 3,000 teams from all over the world to be competing in these challenges, and each is dealing with a unique set of circumstances. We made the rules more flexible to make it easier for teams to say yes to these challenges.

But this means we need your help to make this work. More than in any other year, we are asking you to do your best to follow the spirit of the rules. If you compete in the INFINITE RECHARGE at Home skills competition, no referees will be watching. While we won't be defining every possible situation that is outside the spirit of the rules, the best advice we can give is for you to, as Woodie used to say, "behave in a way that would make your grandmother proud."

This does not mean you can't ask rules questions in the Q&A! We want to clarify the rules where we can. That's important. But our hope is that this year teams will be able to make more of their own judgments about the rules, considering their spirit, and thinking about what grandma would say.

On to another great season!

Frank

3D Printed Field Files

AutomationDirect.com has released updated files for 3D printing the 2021 INFINITE RECHARGE Field. See more information on the Playing Field webpage.

Chairman's Award Webpage Update

The Chairman's Award webpage now includes information about the 2021 Chairman's Feedback Form.

2021 AT HOME CHALLENGES MANUAL

Section 1.6 This Document & its Conventions

~~The intent of this manual is that the text means exactly, and only, what it says. Please avoid interpreting the text based on assumptions about intent, implementation of past rules, or how a situation might be in "real life." There are no hidden requirements or restrictions. If you've read everything, you know everything.~~

This document is unique from typical *FIRST* Robotics Competition manuals in that this is an unusual season; the rules for the At Home Challenges are unusual too. They are intentionally more open-ended and flexible than typical rules for in-person competitions to make it easier for teams with a wide variety of resources and restrictions to participate. For this reason, it's important to make good-faith efforts to be thoughtful about, and follow, the spirit of the rules.

Section 2 INFINITE RECHARGE at Home

Section 2.2 Submission Information

See How to Submit and Deadlines for additional details on how to submit. To participate in INFINITE RECHARGE at Home, teams must opt into the Judged Awards component. Teams are asked to provide the following:

- …
- …
- …

Do not include links or redirects to additional content outside the bullets described above (e.g. include a link to webpage with additional images or content); such references will not be reviewed.

Section 2.3.2 Judging Groups

Teams are assigned to a GROUP by *FIRST* Headquarters. After assignments have been made, on or around Monday, March 8th, the GROUP is shown on the FRC Events webpage.

Section 2.3.3

- Teams must submit all content described in the Submission Information section by the deadline as described in Deadlines.
- Judge Advisors contact teams (via the email they supplied when submitting) to schedule an interview with a panel of judges.
- Judges 'spread the wealth' within this challenge so no team wins more than one (1) judged award for INFINITE RECHARGE at Home. Skills Competition Awards are not judged awards, so a team may win a Skills Competition Award in addition to a judged award.

Section 2.3.4 Interview Process

Teams with a completed INFINITE RECHARGE at Home submission receive an interview with a panel of *FIRST* Robotics Competition judges. The default format is a video conference, but a call-in number can be provided if needed.

A Judge Advisor will contact the team's mentors identified in the team's submission with the team's assigned time slot. If that slot doesn't work for the team, they should inform the Judge Advisor as soon as possible.

For all At Home Challenges, interviews occur between Monday, March 15th and Sunday, April 11th.

Section 2.4.3 ROBOT & Inspection Rules

SC10. A ROBOT attempting a challenge must do so in a way that complies with G1-C in the 2021 Game Manual.

SC11. A ROBOT attempting a challenge must do so in a way that complies with G17 in the 2021 Game Manual.

Section 2.4.4

For each challenge, a layout diagram indicates which NAV POINTS are used and the placement of MARKERS. MARKERS are physical objects with a minimal cross-section of 2.5 in (~63 mm) wide by 2.5 in (~63 mm) deep and at least 6 in (~152 mm) tall used to mark specific locations relevant to each challenge.

> MARKERS on the field should have a contrasting color or otherwise be easily distinguishable, allowing them to be easily recognizable to the operator and throughout the video.
>
> Some examples of MARKERS include but are not limited to: 4" x 4" lumber, 2 Liter bottles, small cones, etc.

Additional markings may be added on the floor or POWER PORT at team discretion. No other physical elements may be added within the Challenge Space for the purpose of aiding ROBOT or DRIVE TEAM performance. Other static elements outside the Challenge Space may be placed to aid robot navigation, provided the robot does not physically interact with them.

> Note that per GSC2-1, teams may not use placement of static elements to signal to the ROBOT which set of paths is being run.

Section 2.4.6.2

GSC2. Teams must randomly determine (e.g. coin, die, phone app, etc.) if they run the red or blue paths.

> Teams make a single random determination and then run the same color on both paths.
>
> ~~The intent is that teams do not signal directly to the ROBOT which option has been chosen. Placement of the ROBOT is not considered signaling.~~

GSC2-1 Teams may signal neither the path (A or B) nor the GSC2 determination (red or blue) to the ROBOT. Placement of the ROBOT is not considered signaling.

Section 3 Game Design Challenge

Section 3.2 Submission Information

See How to Submit and Deadlines for additional details on how to submit. For the Game Design Challenge, teams are asked to provide the following information when they submit:

- …
- …
- …

Do not include links or redirects to additional content outside the bullets described above (e.g. include a link to webpage with additional images or content); such references will not be reviewed.

Section 3.4.2 Judging Groups

Teams are assigned to a GROUP by *FIRST* Headquarters. After assignments have been made, on or around Monday, March 8th, the GROUP is shown on the FRC Events webpage.

Section 3.4.4 Interview Process

Teams with a completed INFINITE RECHARGE at Home submission receive an interview with a panel of *FIRST* Robotics Competition judges. The default format is a video conference, but a call-in number can be provided if needed.

A Judge Advisor will contact the team's mentors identified in the team's submission with the team's assigned time slot. If that slot doesn't work for the team, they should inform the Judge Advisor as soon as possible.

For all At Home Challenges, interviews occur between Monday, March 15th and Sunday, April 11th.

Section 4 *FIRST* Innovation Challenge presented by Qualcomm

Section 4.3 Submission Information

See How to Submit and Deadlines for additional details on how to submit. For the *FIRST* Innovation Challenge, teams are asked the following questions when they submit:

- …
- …
- …

Do not include links or redirects to additional content outside the bullets described above (e.g. include a link to webpage with additional images or content); such references will not be reviewed.

Section 4.4.2 Judging Groups

Teams are assigned to a GROUP by *FIRST* Headquarters. After assignments have been made, on or around Monday, March 8th, the GROUP is shown on the FRC Events webpage.

Section 4.4.5 Interview Process

Teams who complete the *FIRST* Innovation Challenge submission receive a remote interview with a panel of Judges. We prefer team members presenting information to judging have access to a web camera and be on screen. The default format is a video conference, but a call-in number can be provided if needed.

A Judge Advisor will contact the team's mentors identified in the team's submission with the team's assigned time slot. If that slot doesn't work for the team, they should inform the Judge Advisor as soon as possible.

For all At Home Challenges, interviews occur between Monday, March 15th and Sunday, April 11th.

Section 4.6 Advancement

The table below shows how many Semi-Finalists are chosen per GROUP depending on the number of teams that applied. Please note if there are fewer than ~~100~~126 teams who submit for the *FIRST* Innovation Challenge, advancement to the Finalist level occurs directly. Semi-Finalists vie for 20 Finalist spots. Semi-Finalist teams are placed into new GROUPS of approximately 25 teams using the process described in Judging GROUPS. A panel of different judges review these teams' innovation solution submissions; there is no live remote judging at the Semi-Finalist level.

Total Number of Teams	# of Semi-Finalists per GROUP
0 – ~~150~~125	4 teams receive the *FIRST* Innovation Challenge Semi-Finalist Award and become Finalists
~~151~~126 - 1000	4
1,001 - 1900	3
1901 - 3000	2

Section 5 Traditional Submitted Awards

Section 5.2.1 Interview Process

Teams who have submitted for the Chairman's Award and/or the *FIRST* Dean's List Award receive a remote interview with a panel of *FIRST* Robotics Competition judges. The default format is a video conference, but a call-in number can be provided if needed for team members. ~~Additional details are described on the submitted awards webpage.~~

A Judge Advisor will contact the team's mentor(s) (Lead Mentors 1 and 2 for Chairman's Award submissions and the submitting Mentor for Dean's List submissions) with the team's assigned time slot. If that slot doesn't work for the team, they should inform the Judge Advisor as soon as possible.

The first round of District interviews occur as follows:

- Dean's List Award interviews are between March 5th and April 1st
- Chairman's Award interviews are between March 12th and April 1st.

The second round of District interviews occur between April 11th and Apr 25th.

Region interviews occur as follows:

- Dean's List interviews are between March 5th and April 11th.
- Chairman's Award interviews are between March 12th and April 11th.

Additional details are described on the submitted awards webpage.

2021 FRC GAME MANUAL

No changes.

Team Update 01

GENERAL

Control System

An issue was discovered with the roboRIO image version 2021_v3.1 included in the initial release of the NI Game Tools that prevents successful imaging of roboRIOs. Teams that downloaded the installer prior to the morning of January 11, 2021 should re-download and re-install the latest installer (no need to uninstall first) from NI.com/frc (choose either "Download" for the online installer of "2021 f1" from the offline installers. Users with the correct version installed will not see 2021_v3.1 as an option in the roboRIO imaging tool.

Translated Documentation

The Turkish translation of Team Update 00 is now posted on the translated documentation web page.

Broken Links

Our apologies for any broken/misdirected links! We've fixed all known link issues in all 2021 documentation. If you find any others please let us know at firstroboticscompetitionteams@firstinspires.org.

2021 AT HOME CHALLENGES MANUAL

Section 1.8 Team Updates

Team Updates are posted on the ~~Game and~~ Season Materials web page and are generally posted before 5 pm, Eastern. Users 18 years old and older may request email alerts to be notified when Team Updates are posting using this form.

Section 1.9 Question and Answer System Sponsored by Autodesk®

The Q&A sponsored by Autodesk® is a resource for clarifying *2021 INFINITE RECHARGE Game Manual*, *2021 At Home Challenge Manual*, Awards web page, Self-Inspection Checklist, official FIELD drawings, and/or *FIRST* Robotics Competition Event Experience web page content. For questions about other materials (e.g. Game Design Activities), please inquire using the 2021 Season Supplemental Resources section of the *FIRST* Forums. Teams can search for previously asked questions and responses or pose new questions. Questions can include examples for clarity or reference multiple rules to understand the relationships and differences between them.

Section 1.11 Deadlines

The following are the important deadlines for the 2021 At Home Challenges:

- Thursday, February 4th at noon ET – Submission portal/opt-in opens
- Thursday, March 4th at 3pm ET – Submission portal/opt-in closes
  - Submissions due for the following:
    - Game Design Challenge
    - INFINITE RECHARGE^{SM} at Home (Judged Award component)
    - *FIRST* Innovation Challenge presented by Qualcomm
  - Submissions temporarily closed
    - INFINITE RECHARGE^{SM} at Home (Skills Competition)

Section 2.4.10.3 Scoring

The raw score is the total number of points scored ~~with the fifteen (15) POWER CELLS~~ within the 1-minute period.

Section 2.4.11 Overall Score

d. Determine B$_{first}$ and B$_{last}$ based on the GROUP

B$_{first}$, B$_{last}$ = the first, last place Bounded Scores in the GROUP. Note that B$_{first}$ will be the lowest time in time-based challenges and the highest point total in points-based challenges.

> If B$_{first}$ and B$_{last}$ are equal, then all teams receive a computed score of C$_{max}$.

Section 4.5.1 The Business Pitch (2 min)

At the Finalist level, *FIRST* Innovation Challenge teams who advance to the *FIRST* Global Innovation Awards receive expert pitch advice from real-world entrepreneurs before their final judging and a 1:1 ~~pitch~~ coaching session with staff from one of the top social impact business incubators ~~from real-world entrepreneurs before their final judging~~.

Section 6 Glossary

ELEMENT	chain. For the purposes of this challenge, the definition of chain is "a series of links or rings connected to or fitted into one another and used for various purposes (such as support, restraint, transmission of mechanical power, or measurement). (in manual use bookmark)
OPERATOR CONSOLE	~~a pre-college student DRIVE TEAM member who acts as a POWER CELL manager~~
	the set of COMPONENTS and MECHANISMS used by the DRIVERS and/or HUMAN PLAYER to relay commands to the ROBOT

GAME DESIGN CHALLENGE ACTIVITIES

Headings in this document were reformatted to include numbering.

2021 FRC GAME MANUAL

Section 1.8 Team Updates

Team Updates are posted on the ~~Game and~~ Season Materials web page and are generally posted before 5 pm, Eastern. Users 18 years old and older may request email alerts to be notified when Team Updates are posting using this form.

Section 1.9 Question and Answer System Sponsored by Autodesk®

The Q&A sponsored by Autodesk® is a resource for clarifying *2021 INFINITE RECHARGE Game Manual*, *2021 At Home Challenge Manual*, Awards web page, Self-Inspection Checklist, official FIELD drawings, and/or *FIRST* Robotics Competition Event Experience web page content. For questions about other materials (e.g. Game Design Activities), please inquire using the 2021 Season Supplemental Resources section of the *FIRST* Forums. Teams can search for previously asked questions and responses or pose new questions. Questions can include examples for clarity or reference multiple rules to understand the relationships and differences between them.

Section 3.7 Vision Targets

An 8 ft. (~243 cm) strip of 3M 8830 ScotchliteTM Reflective Material is in each Kickoff Kit ~~and additional strips are available in *FIRST* Choice~~.

Team Update 00

Team Update 00 details the changes of consequence between the 2020 and 2021 INFINITE RECHARGE℠ Game Manual.

SUMMARY OF CHANGES

This section provides a brief and non-exhaustive summary of the changes made to INFINITE RECHARGE for the 2021 season. For full details, see the following pages of this document, and read the 2021 Game Manual.

- RENDEZVOUS POINT: The Black BOUNDARIES that bisected an ALLIANCE's RENDEVOUS POINT have been removed. The Red and Blue BOUNDARIES nearest to the TRENCH RUNS have been removed and replaced with tape lines (note the tape lines are aligned to the far edge of the Truss Bases, resulting in the RENDEVOUS POINT becoming slightly larger). See 3.2 Zones and Markings for details.
- RENDEVOUS POINT - POWER CELLS: POWER CELLS that were staged on BOUNDARIES will now be staged on the Floor Protection inside the RENDEVOUS POINT. See Figure 0-1 and Figure 0-2 for details.
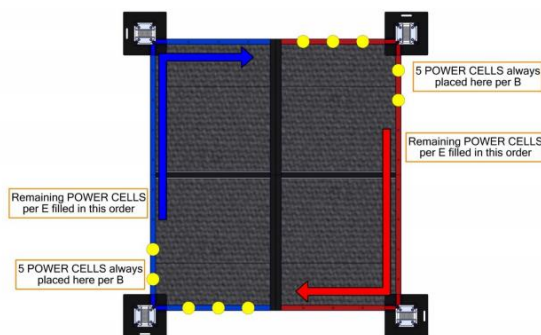
2020

Figure 4-2: POWER CELL setup on BOUNDARIES
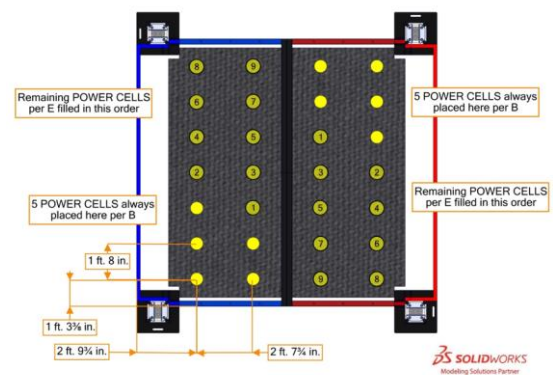
2021

Figure 4-2: POWER CELL setup inside RENDEZVOUS POINT

- SHIELD GENERATOR Scoring: Stage 2 and 3 CAPACITIES and POWER CELL ACTIVATION requirements have decreased from twenty (20) POWER CELLS scored to fifteen (15). See Table 0-3 for details.
- CONTROL PANEL Scoring: The value of ROTATIONAL CONTROL has increased from ten (10) to fifteen (15) points. See Table 0-4 for details.
- DRIVE TEAM: An adult mentor may be a COACH or TECHNICIAN. There may not be more than one (1) adult on DRIVE TEAM. See Section 4.6 DRIVE TEAM for details.
- POWER CELLS in ALLIANCE STATION: The number of POWER CELLS allowed to be held in an ALLIANCE STATION has decreased from fifteen (15) to fourteen (14). See H9 and H10 for details.
- Bill of Material, ROBOT Total Cost Limit, and Pre-Kickoff Designed or FABRICATED ITEM Requirements have been removed for the 2021 season. See Section 9.4 Budget Constraints & Fabrication Schedule for a list of removed rules. For details of the removed rules reference the 2020 Game Manual.
- BUMPERS: Bumpers are permitted to have non-alliance specific colors on their corners for the 2021 season. See R21 and R24D for details.

GENERAL

- Field Tour Videos from 2020 have been modified for 2021 to note major changes the field and scoring. 2021 Field Tour Videos can be found on the *FIRST* Robotics Competition YouTube page.
- The Game Animation has been updated and can be found on the *FIRST* Robotics Competition YouTube page..
- The Playing Field Webpage lists the CAD and VR assets that have been updated for 2021.

FIRST® Official Field Drawings

All changes captured in this section are compared to the last updated versions of the *FIRST* Official Field Drawings (updated March 3, 2020) and the Layout and marking Diagram (updated January 31, 2020). Changes were designed to improve overall functionality of the field and were reactionary based on FIELD performance throughout the brief 2020 season. *FIRST* Official Field Drawings can be found on the Playing Field webpage.

- Parts that have been modified or added for the 2021 season have been updated with a 2021 part number (e.g. the SHIELD GENERATOR was updated from GE-20000 to GE-21000). Modified parts and assemblies have revision tables that detail specific changes.
- The Layout and Marking Diagram has been updated per changes described throughout this document.
- The Field drawings – season specific package has been updated with the following changes:
  - SHIELD GENERATOR (GE-21000, previously GE-20000):
    - BOUNDARIES and floor protection have been updated per changes described in the ARENA section.
    - GENERATOR SWITCH sensor assemblies have been updated to improve reliability.
  - TRENCH (GE-21100, previously GE-20100):
    - Retaining tab bolt stack updated for consistency and reliability of performance.
  - LOADING BAY (GE-21200, previously GE-20200):
    - Flat ramps have been added to each chute to reduce the frequency of jams.
  - POWER PORT (GE-21300, previously GE-20300):
    - Subassemblies updated to improve reliability and reduce frequency of jams in the BOTTOM PORT
  - POWER CELL (GE-21500, previously GE-20500):
    - Updated to specify logo may not be present on game piece.

EVENT MANUAL

The Event Manual has not been updated for the 2021 season. It will be updated if and only if in-person events are approved.

GAME MANUAL

The Game Manual has been updated for the 2021 season of INFINITE RECHARGE. All changes captured in this document are compared to the last published 2020 Game Manual (updated on March 10, 2020 [Team Update 17]). Updates include:

- Changed document name from Game and Season Manual to Game Manual
- Styled to match the 2021 season
- Changed references from 2020 to 2021
- Updated images to reflect the 2021 FIELD

o   Select images are shown in Team Update 00 to highlight the substantive differences
- Fixed minor typos/formatting errors (these are not detailed in Team Update 00)

Section 1 Introduction

Section 1 has been updated to reflect adaptations for the 2021 season, including the addition of At Home Challenges Manual. Section 1 is identical in the At Home Challenges Manual and Game Manual, except for section 1.6, and sections beyond 1.9 (applicable only to the At Home Challenges Manual).

- Spirit of Volunteering Section has been removed due to the uncertainty surrounding in-person events for 2021. The Chief Volunteers look forward to working with all volunteers again in 2022.
- Section 1.8 Team Updates: Team Updates will be posted biweekly through Tuesday, February 2, 2021. Additional Team Updates and their posting frequency will be announced if an in-person season is approved.
- Section 1.9 Question and Answer System sponsored by Autodesk® : reorganized for readability and additional language has been added to permit hypothetical questions. The Q&A account FRC 99999 has been created to post questions related to content asked by key volunteers that are relevant to teams.
    o   Event specific language in Section 1.9 is only shown in the Game Manual

Section 2 Game Overview

Updated with the 2021 INFINITE RECHARGE FIELD.

Section 3 ARENA

3.1 FIELD

The SHIELD GENERATOR consists of the structure, the GENERATOR SWITCHES, the BOUNDARIES, and the floor protection RENDEZVOUS POINT.

3.2 Zones and Markings

RENDEZVOUS POINT: a 5 6 ft. 6 9 ¾ in. (~170 208 cm) wide, 12 ft. 63/4 in. (~383 cm) deep, infinitely tall volume formed by the ALLIANCE colored BOUNDARIES, ALLIANCE colored tape, and the black BOUNDARY pair that divides the RED and the Blue BOUNDARIES. The RENDEZVOUS POINT includes the ALLIANCE colored BOUNDARIES and ALLIANCE colored tape.

3.3 SHIELD GENERATOR

The SHIELD GENERATOR is a 14 ft. 1½ in. (~431 cm) wide, 15 ft. ¾ in. (~459 cm) deep, and 9 ft. 6½ in. (~291 cm) tall structure located in the center of the FIELD, oriented at a 22.5 degree angle relative to the guardrails. The SHIELD GENERATOR has one (1) GENERATOR SWITCH per ALLIANCE. Black BOUNDARIES divide the floor of the SHIELD GENERATOR into two sections. Spaces between BOUNDARIES include flooring protection to prevent floor damage. All flooring between The RENDEZVOUS POINTS (including ALLIANCE colored BOUNDARIES, ALLIANCE colored tape, and floor protection) are is part of the SHIELD GENERATOR.

3.3.3 BOUNDARIES

BOUNDARIES are 3 in. (~8 cm) wide, 1 in. (~3 cm) tall steel barriers that divide the area inside the SHIELD GENERATOR into four (4) two (2) equal sized rectangles areas that are 5 6 ft. 3 9¾ in. (~162 208 cm) wide by 5 12 ft. 10 7/8 ¾ in. (~180 368 cm) deep. BOUNDARIES are secured to the carpet using hook fastener which increases the height to approximately 1¹⁄₁₆ in. (~3 cm). The Red and Blue BOUNDARIES feature 1-in. (~3 cm) diameter holes spaced every 1 ft. 4½ in. (~42 cm) for staging POWER CELLS. A pair of black BOUNDARIES divide the Red and Blue RENDEZVOUS

POINTS. Each truss base has two shorter steel barriers, black with ALLIANCE colored tape, mounted to ~~them~~ it. These barriers are ALLIANCE colored BOUNDARIES.

A layer of ⅛ in. (~3 mm) thick hardboard is installed on top of the FIELD carpet and covered with another layer of carpet to protect venue flooring. This flooring protection adds approximately ⅜ in. (~10 mm) of height to the ~~this~~ area between the BOUNDARIES. The floor protection features 1-in. (~3 cm) diameter holes used for staging of POWER CELLS. Holes are placed in a rectangular pattern with 2 ft. 7¾ in. (~81 cm) wide by 1 ft. 8 in. (~51 cm) deep spacing, as seen in Figure 4-2.

3.4.1.3 POWER PORTS

~~Around the OUTER PORT a Phillips Color Kinetics LED Light String is used to indicate the progress towards CAPACITY. The string fills symmetrically starting from the top center and proceeding out, then down. The initial nodes for each Stage (staring from the center) light up in sections that differ depending on the CAPACITY of the current Stage. The bottom four nodes on either side of the OUTER PORT always fill at a rate of one (1) node per POWER CELL scored. Examples are shown in Figure 3-17.~~

A Phillips Color Kinetics LED light string around the OUTER PORT indicates CAPACITY progress. The string fills from the top center toward the ~~side~~ bottom left and right nodes symmetrically, as shown in Figure 3-17.

~~and is mirrored on the left and right. Nodes 1- 4 and 27-30 fill per POWER CELL scored. Nodes above them light up in sections that differ~~ While the node pattern differs depending on the ~~CAPACITY of the~~ current Stage, as defined in Table 3-1, the bottom four nodes on either side of the OUTER PORT always fill at a rate of one node per POWER CELL scored. A node map is shown in Figure 3-18.

Table 0-1 Node pattern per CAPACITY

CAPACITY	Stage 1 nodes ON	Stage 2 and 3 nodes ON
1	14-17	15 ~~- and~~ 16
2	11-~~13 and 18-~~20	14-17
3	9-~~10 and 21-~~22	~~14 and 17~~ 13-18
4	7-~~8 and 23-~~24	12-19
5	5-~~6 and 25-~~26	~~13 and 18~~ 11-20
6	4 ~~and~~ 27	10-21
7	3 ~~- and~~ 28	~~12 and 19~~ 9-22
8	2 ~~- and~~ 29	8-23
9	1 ~~- and~~ 30	7-24
10	N/A	~~11 and 20~~ 6-25
11	N/A	~~10 and 21~~ 5-26
12	N/A	~~9 and 22~~ 4-27
13	N/A	~~8 and 23~~ 3-28
14	N/A	~~7 and 24~~ 2-29
15	N/A	~~6 and 25~~ 1-30
~~16~~	~~N/A~~	~~5 and 26~~
~~17~~	~~N/A~~	~~4 and 27~~
~~18~~	~~N/A~~	~~3 and 28~~
~~19~~	~~N/A~~	~~2 and 29~~
~~20~~	~~N/A~~	~~1 and 30~~

Table 0-2 Additional POWER PORT light states

Light State	Criteria
Off	Outside of a MATCH: FIELD is MATCH ready In MATCH: current Stage not ACTIVATED
Green	Head REFEREE has determined FIELD is safe for humans
Green with white	Head REFEREE has determined FIELD is safe for humans. See TIMEOUTS for more details.
ALLIANCE color with yellow chase pattern	Stage has reached CAPACITY, but not ACTIVATED
Entire light string is ALLIANCE color	All Stages ACTIVATED

Section 3.5.1 Control Panel

A swatch of identical material and colors to those on the CONTROL PANEL is in each Black Gray Tote of the 20201 Kickoff Kit. The CONTROL PANEL is attached to the TRENCH via a 12 in. (~30 cm) Lazy Susan Bearing (Triangle Manufacturing PN: 12D10346). An identical Lazy Susan Bearing is in each Black Gray Tote of the 20201 Kickoff Kit. Teams that participated in the 2020 season received these items in the Black Tote of the 2020 Kickoff Kit.

3.6 POWER CELL

INFINITE RECHARGE is played with POWER CELLS. A POWER CELL is a yellow 7 in. (~18 cm) diameter Medium Bounce Dino-Skin foam ball. The *FIRST* logo is may be printed on each ball in black ink. The ball is made by Flaghouse (PN 1892 YEL) and sold by AndyMark (PN AM-4200a) without a *FIRST* logo. A Three (3) POWER CELLS is are in each Black Tote of the 20201 Kickoff Kit.

3.7 Vision Targets

Vision targets made from 2 in. (~5 cm) wide strips of 3M 8830 Scotchlite™ Reflective Material are located on the POWER PORTS and LOADING BAYS. On the POWER PORT, they target the location of the INNER and OUTER PORTS and trace the bottom perimeter of the OUTER PORT. The target has an overall height of 1 ft. 5 in. (~43 cm), and a width of 3 ft. 3¼ in. (~100 cm). The bottom of the target is 6 ft. 9¼ in. (~206 cm) above the carpet. A An 8 ft. (~243 cm) strip of 3M 8830 Scotchlite™ Reflective Material is in each Kickoff Kit and additional strips are available in *FIRST* Choice.

Section 4 MATCH Play

4.1.1 POWER CELLS

Forty-eight (48) POWER CELLS are staged as follows:

A. five (5) POWER CELLS in each of the two (2) TRENCH RUNS
   i. two (2) POWER CELLS are placed on each of the TRENCH baseplates further away from the center of the FIELD.
   ii. three (3) POWER CELLS are placed centered in the width of each TRENCH RUN, spaced at 3-ft. (~91 cm) intervals. Small rings are used to keep them in place prior to the start of a MATCH. Rings are ⅛ in. (~3 mm) thick, 1¾ in. (~4 cm) diameter O-rings (McMaster Item#: 9452K63). Rings are secured to the carpet by tape.
B. five (5) POWER CELLS placed on the BOUNDARIES floor protection inside each ALLIANCE'S RENDEZVOUS POINT as shown in Figure 4-2.
C. five (5) POWER CELLS on the racks in each ALLIANCE STATION'S LOADING BAY,

D. each of the three (3) teams may preload up to three (3) POWER CELLS in their ROBOT, such that they are fully and solely supported by that ROBOT, and

E. remaining POWER CELLS (zero (0) to nine (9) per ALLIANCE, depending on decisions made in D) ~~in the holes in the BOUNDARIES in~~ inside the corresponding ALLIANCE'S RENDEZVOUS POINT as shown in Figure 4-2.
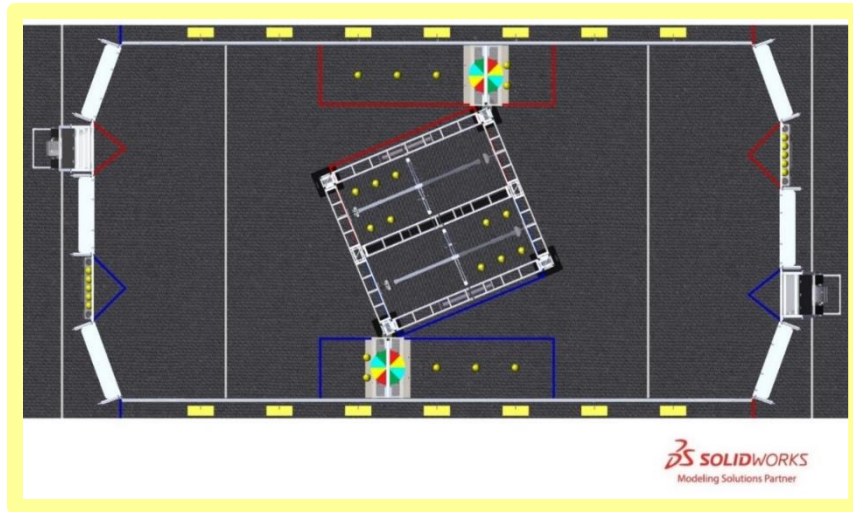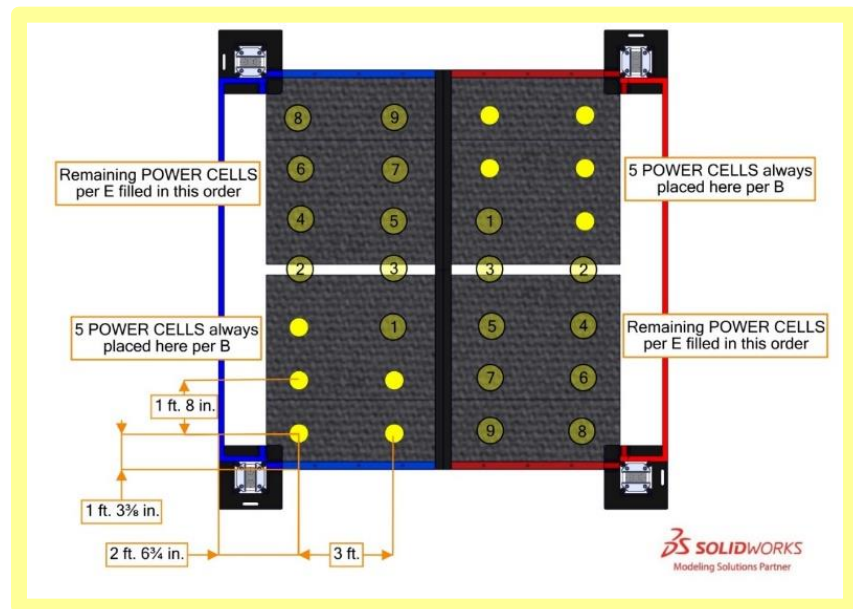

Figure 0-1: POWER CELL setup

Figure 0-2: POWER CELL setup ~~on BOUNDARIES~~ inside RENDEZVOUS POINT

4.4.2 SHIELD GENERATOR Scoring

Table 0-3: SHIELD GENERATOR ACTIVATION requirements

Stage	CAPACITY	ACTIVATED when…
1	9	nine (9) POWER CELLS are scored & TELEOP has begun
2	~~20~~15	~~twenty (20)~~ fifteen (15) POWER CELLS are scored in Stage 2 & ROTATION CONTROL is complete
3	~~20~~15	~~twenty (20)~~ fifteen (15) POWER CELLS are scored in Stage 3 & POSITION CONTROL is complete

4.4.5 Point Values

Table 0-4: Point values

Award	Awarded for…	AUTO	TELEOP	Qual.
INITIATION LINE	exit the infinite vertical volume created by the corresponding ALLIANCE'S INITIATION LINE any time before the end of AUTO (per ROBOT)	5	-	-
POWER CELLS	scored in BOTTOM PORT	2	1	-
	scored in OUTER PORT	4	2	-
	scored in INNER PORT	6	3	-
CONTROL PANEL	ROTATION CONTROL	-	~~10~~15	-
	POSITION CONTROL		20	
ENDGAME Points	HANG (per ROBOT)	-	25	-
	PARK (per ROBOT)	-	5	-
	LEVEL with 1-3 ROBOTS HANGING (per ALLIANCE)		15	
SHIELD GENERATOR OPERATIONAL	earning at least sixty-five (65) ENDGAME points			1 Ranking Point
SHIELD GENERATOR ENERGIZED	Stage 3 ACTIVATED	-	-	1 Ranking Point
Tie	completing a MATCH with the same number of points as your opponent	-	-	1 Ranking Point
Win	completing a MATCH with more points than your opponent	-	-	2 Ranking Point

4.6 DRIVE TEAM

A DRIVE TEAM is a set of up to five (5) people from the same *FIRST Robotics Competition* team responsible for team performance for a specific MATCH. There are four (4) specific roles on a DRIVE TEAM which ALLIANCES can use to assist ROBOTS with INFINITE RECHARGE. Only one (1) of the five (5) DRIVE TEAM members is permitted to be an adult mentor.

Table 0-5 DRIVE TEAM roles

Role	Description	Max./ DRIVE TEAM	Criteria
COACH	a guide or advisor	1	Pre-college student or adult mentor Must wear "COACH" button
DRIVER	an operator and controller of the ROBOT	3	Pre-college student Must wear one (1) of the three (3) "DRIVE TEAM" buttons
HUMAN PLAYER	a POWER CELL manager		
TECHNICIAN	a resource for ROBOT troubleshooting, setup, and removal from the FIELD	1	Pre-college student or adult mentor Must wear "TECHNICIAN" button

4.7 Other Logistics

An ARENA FAULT is not called for MATCHES that accidentally begin with an incorrect number of, incorrectly positioned, or damaged POWER CELLS. Damaged POWER CELLS are not replaced until the next ARENA reset period. DRIVE TEAMS should alert the FIELD STAFF to any missing or damaged POWER CELLS prior to the start of the MATCH. POWER CELLS are expected to experience wear during events and may be repaired using the guidelines detailed in this POWER CELL Guide.

Once the MATCH is over and the Head REFEREE determines that the FIELD is safe for FIELD STAFF and DRIVE TEAMS, they or their designee change the LED lights to green or green with white and DRIVE TEAMS may retrieve their ROBOT.

In addition to the two minutes and thirty seconds (2:30) of game play, each MATCH also has pre- and post-MATCH time for setup and reset of the ARENA. During ARENA reset, the ARENA is cleared of ROBOTS and OPERATOR CONSOLES from the MATCH that just ended. The ROBOTS and OPERATOR CONSOLES for the subsequent MATCH are loaded into the ARENA by DRIVE TEAMS at this time. FIELD STAFF also use this time to reset ARENA elements and POWER CELLS.

Section 5 Safety Rules

S2. Wait for the green lights. Team members may only enter the FIELD if the POWER PORT LEDs are green or green with white, unless explicitly instructed by a REFEREE or an FTA.

Violation: Verbal warning. If repeated at any point during the event, YELLOW CARD. If egregious, RED CARD.

Egregious violations of S2 include, but are not limited to:

a.   pushing past the FIELD reset person blocking an open gate to get on the FIELD

b. ignoring a warning to not go on the FIELD

Section 6 Conduct Rules

C7. Be prompt/safe when coming to and going from the FIELD. DRIVE TEAMS may not cause significant or repeated delays during the event to the start of a MATCH, the FIELD reset after a MATCH, or continuation of MATCHES after a TIMEOUT.

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

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:

a. late arrival to the FIELD (including across different MATCHES and after a FIELD or ALLIANCE TIMEOUT)
b. failing to exit the FIELD once a MATCH is ready to begin (indicated by the green LEDs have turned off)
c. installing BUMPERS, charging pneumatic systems, or any other ROBOT maintenance once on the FIELD
d. 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)
e. failing to remove OPERATOR CONSOLES from the PLAYER 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 zero (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 safety concern.

C11.   Don't trick the sensors. Teams may not interfere with any automated scoring hardware.

Violation: RED CARD for the ALLIANCE.

7 Game Rules: ROBOTS

7.1 Before/After the MATCH

G1. Know your ROBOT setup. When placed on the FIELD for a MATCH, each ROBOT must be:

A. in compliance with all ROBOT rules, ~~i.e. has passed Inspection (for exceptions regarding Practice MATCHES, see~~ Inspection & Eligibility Rules),
B. the only team-provided item left on the FIELD by the DRIVE TEAM,
C. confined to its STARTING CONFIGURATION,
D. positioned such that its BUMPERS are intersecting the infinite vertical volume created by the corresponding ALLIANCE'S INITIATION LINE, and
E. fully and solely supporting not more than three (3) POWER CELLS (as described in Setup.)

Violation: If fix is a quick remedy, the MATCH won't start until all requirements are met. If it is not a quick remedy the offending ROBOT will be DISABLED and, at the discretion of the Head REFEREE, must be re-inspected.

Teams are encouraged to position ROBOTS such that it is clear to REFEREES that G1-D is not violated.

> If a ROBOT is BYPASSED prior to the start of the MATCH, the DRIVE TEAM may not remove the ROBOT from the FIELD without permission from the Head REFEREE or the *FIRST* Technical Advisor (FTA).

G2. 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. during TIMEOUTS, after Opening Ceremonies, before an immediate MATCH replay, etc.) and with the express permission from the FTA or a REFEREE.

Violation: YELLOW CARD.

> FMS will not enable ROBOTS after the conclusion of the MATCH.
>
> Teams are encouraged to consider rule C7 when developing their ROBOTS.
>
> 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 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.

7.2.3 Zone Specific Restrictions

G11. Give opponents some space. An opponent ROBOT may not contact a ROBOT whose BUMPERS are intersecting its TARGET ZONE or LOADING ZONE, regardless of who initiates contact. ROBOTS in violation of G10 are exempt from this rule.

Violation: TECH FOUL per instance.

> The initiator of the contact is not a factor when determining violations of this rule.
>
> Teams should take note that they are putting themselves at great risk for TECH FOULS if they choose to approach an opponent ROBOT intersecting its TARGET ZONE or LOADING ZONE.
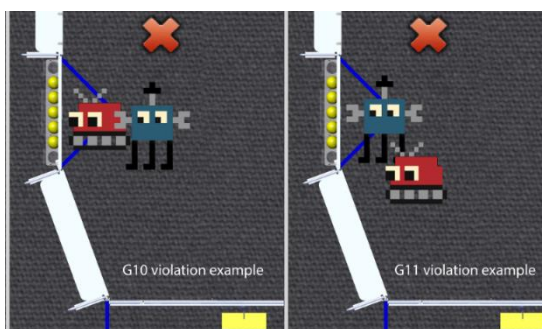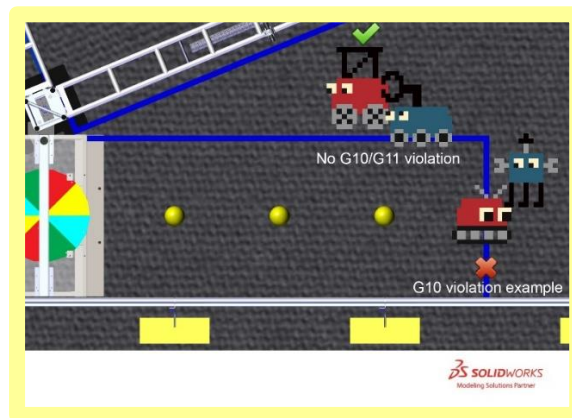
Figure 0-3 G10 and G11 examples

G12. Leave the opponent's CONTROL PANEL alone. During TELEOP, a A-ROBOT may not contact the opponent's CONTROL PANEL, either directly, or transitively through a POWER CELL, if

A. the opponent ROBOT is contacting that CONTROL PANEL, and

B. the opponent's POWER PORT has reached CAPACITY

Violation: In Qualifications MATCHES, opponents are awarded one (1) SHIELD GENERATOR ENERGIZED Ranking Point if not completed at the conclusion of the MATCH. In Playoff MATCHES, TECH FOUL.

7.2.5 ROBOT to ROBOT Interaction

G25. Damaging other ROBOTS, not allowed. Regardless of intent, a ROBOT may not initiate direct contact inside the vertical projection of an opponent ROBOT'S FRAME PERIMETER that damages or functionally impairs the opponent ROBOT.

ROBOTS with BUMPER gaps are at their own risk regarding damaging contact in these areas by ROBOTS that remain completely inside their own FRAME PERIMETER, other than BUMPERS, as they are not in violation of this rule.

Violation: TECH FOUL and YELLOW CARD.

> Some examples of violations of this rule include, but are not limited to:
>
> a. an extension damages a COMPONENT inside an opponent ROBOT'S FRAME PERIMETER
> b. an extension powers off an opponent's ROBOT
> c. an extension relieves an opponent's ROBOT'S air pressure.
> d. a ROBOT that unintentionally extends outside its FRAME PERIMETER while tipping and damages a COMPONENT inside an opponent ROBOT'S FRAME PERIMETER
>
> At the conclusion of the MATCH, the HEAD REFEREE may elect to visually inspect a ROBOT to confirm violations of G25 made during a MATCH and remove the violation if the damage cannot be verified.
>
> For the purposes of G25, "initiate direct contact" requires movement towards an opponent ROBOT.
>
> In a collision, it's possible for both ROBOTS to initiate direct contact.

8 GAME RULES: HUMANS

8.2 During the MATCH

H8. This rule has been renumbered as C11.

H9. POWER CELLS, recycle. During TELEOP, an ALLIANCE may not have more than ~~fifteen (15)~~ fourteen (14) POWER CELLS in their ALLIANCE STATION.

Violation: FOUL per POWER CELL.

> If the POWER CELL count exceeds ~~fifteen (15)~~ fourteen (14), excess POWER CELLS must be introduced into the FIELD immediately.
>
> As soon as a ~~sixteenth~~ fifteenth POWER CELL arrives in the ALLIANCE STATION, the ALLIANCE should be making a concerted ~~good will~~ effort to enter any extra POWER CELLS back on to the FIELD as quickly and as safely as possible.
>
> There is no intent to issue penalties for delays due to DRIVERS or HUMAN PLAYERS having to move around their ALLIANCE partners while attempting to clear surplus POWER CELLS or because TELEOP began with more than ~~fifteen (15)~~ fourteen (14) POWER CELLS in the ALLIANCE STATION due to scoring by opponents during AUTO. However, if a team is perceived as lagging in the judgement of a REFEREE, they will be issued a penalty.
>
> It is the HUMAN PLAYERS' responsibility to be aware of their surroundings.

H10. POWER CELLS go on the rack. POWER CELLS must be stored on the LOADING BAY racks. An ALLIANCE making a concerted, good-will effort to transport POWER CELLS from the CORRAL to a rack or Chute is not in violation of this rule.

VIOLATION: FOUL. If repeated, TECH FOUL.

> The LOADING BAY rack holds fourteen (14) POWER CELLS and enables teams and REFEREES to count POWER CELLS in an ALLIANCE STATION. ~~An ALLIANCE holding the fifteenth POWER CELL is not in violation of H10.~~
>
> H10 means that POWER CELLS may neither be stored in the CORRAL during the MATCH nor are they required to contact the LOADING BAY rack before entering the FIELD.
>
> As G4 prohibits using the rack during AUTO, an ALLIANCE that removes POWER CELLS from the CORRAL during AUTO and waits to place them on the rack until the start of TELEOP is making a "concerted good-will effort."
>
> Teams are encouraged to make it clear to REFEREES that H10 is not violated.

Section 9 Robot Rules Section

9.1 Overview

There are many reasons for the structure of the rules, including safety, reliability, parity, creation of a reasonable design challenge, adherence to professional standards, impact on the competition, and compatibility with the Kit of Parts (KOP). The KOP is the collection of items listed on the ~~current season's~~ 2020 and 2021 Kickoff Kit Checklists, distributed to the team via *FIRST* Choice in the ~~current~~ 2020 and/or 2021 season, or paid for completely (except shipping) with a Product Donation Voucher (PDV) from the ~~current~~ 2020 and/or 2021 season.

Teams may be asked to provide documentation proving legality of non-2020 or 2021 KOP items during Inspection where a rule specifies limits for a legal part (e.g. pneumatic items, current limits, COTS electronics, etc.).

9.3 ROBOT Safety & Damage Prevention

R9. ROBOTS must allow removal of game pieces from the ROBOT and the ROBOT from FIELD elements while DISABLED and powered off.

> ROBOTS will not be re-enabled after the MATCH, so teams must be sure that game pieces and ROBOTS can be quickly, simply, and safely removed.
>
> Teams are encouraged to consider rule C7 when developing their ROBOTS.

9.4 Budget Constraints & Fabrication Schedule

R11. This rule has been removed for the 2021 season.

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

> Teams should be ready to show inspectors documentation of Fair Market Value (FMV) for any COMPONENTS that appear to be in the range of the $500 USD limit.
>
> The Analog Devices ADIS16448 IMU MXP Breakout Board does not have a published Fair Market Value (FMV). This device is considered to comply with R12 regardless of its true FMV.
>
> The FMV of a COTS item is its price defined by a VENDOR for the part or an identical functional replacement. This price must be generally available to all *FIRST Robotics Competition* teams throughout the build and competition season (i.e. short-term sale prices or coupons do not reflect FMV), however teams are only expected to make a good faith effort at determining the item price and are not expected to monitor prices of ROBOT items throughout the season. The FMVis the cost of the item itself and does not include any duties, taxes, tariffs, shipping, or other costs that may vary by locality.
>
> The FMV of COTS software is the price, set by the VENDOR, to license the software (or component of the software) that runs on the ROBOT for the period from Kickoff to the end of the *FIRST* Championship. The FMV of software licensed free-of-cost, including through the Virtual KOP, for use on the ROBOT is $0.
>
> The FMV of FABRICATED parts is the value of the material and/or labor, except for labor provided by team members (including sponsor employees who are members of the team), members of other teams, and/or event provided Machine Shops. Material costs are accounted for as the cost of any purchasable quantity that can be used to make the individual part (i.e. the purchasable raw material is larger than the FABRICATED part).
>
> Example 1: A team orders a custom bracket made by a company to the team's specification. The company's material cost and normally charged labor rate apply.
>
> Example 2: A team receives a donated sensor. The company would normally sell this item for $450 USD, which is therefore its FMV.
>
> Example 3: A team purchases titanium tube stock for $400 USD and has it machined by a local machine shop. The machine shop is not considered a team Sponsor but donates two (2) hours of expended labor anyway. The team must include the estimated normal cost of the labor as if it were paid to the machine shop and add it to the $400 USD.

Example 4: A team purchases titanium tube stock for $400 USD and has it machined by a local machine shop that is a recognized Sponsor of the team. If the machinists are considered members of the team, their labor costs do not apply. The total applicable cost for the part would be $400 USD.

It is in the best interests of the teams and *FIRST* to form relationships with as many organizations as possible. Teams are encouraged to be expansive in recruiting and including organizations in their team, as that exposes more people and organizations to *FIRST*. Recognizing supporting companies as Sponsors of, and members in, the team is encouraged, even if the involvement of the Sponsor is solely through the donation of fabrication labor.

Example 5: A team purchases titanium tube stock for $400 USD and has it machined by another team. The total applicable cost for the part would be $400 USD.

Example 6: A team purchases a widget at a garage sale or online auction for $300, but it's available for sale from a VENDOR for $700. The FMV is $700.

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

R13. This rule has been removed for the 2021 season.

R14. This rule has been removed for the 2021 season.

R15. This rule has been removed for the 2021 season.

R16. 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. OPERATOR CONSOLE,
B. BUMPERS (a protective assembly designed to attach to the exterior of the ROBOT and constructed as specified in BUMPER Rules),
C. battery assemblies as described in R5-B,

    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 to connectors 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 R56

    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

    F. Software development

    G. Batteries may be charged during the designated Load-in time

> For the purposes of this rule, official events begin ~~as follows:~~ at the start of the first designated Load-in period, according to the Public Schedule. If the Public Schedule is not available or the Public Schedule does not include a Load-in period, the event begins at 6 AM local time.
>
> - ~~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 E8 and E20 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).

9.5 BUMPER Rules

R21. Each ROBOT must be able to display primarily Red or Blue BUMPERS to MATCH their ALLIANCE color, as assigned in the MATCH schedule distributed at the event (as described in MATCH Schedules). A BUMPER is considered primarily Red or Blue if all displayed BUMPER surfaces other than corners (i.e. everywhere the BUMPER is backed by the FRAME PERIMETER) displays the appropriate color. Any visible fabric other than the primary color must be a solid color. See Figure 9-4. BUMPER Markings visible when installed on the ROBOT, other than the following, are prohibited:

    A. those required per R22,

    B. hook-and-loop fastener or snap fasteners backed by the hard parts of the BUMPER, and

    C. solid white *FIRST* logos between 4¾ in. (~12 cm) and 5¼ in. wide (~13 cm) (i.e. comparable to those available in the ~~2020~~2021 Virtual Kit.

> The FRAME PERIMETER facing surfaces and short perpendicular "ends" of BUMPERS are not "displayed" and thus R21 does not apply.
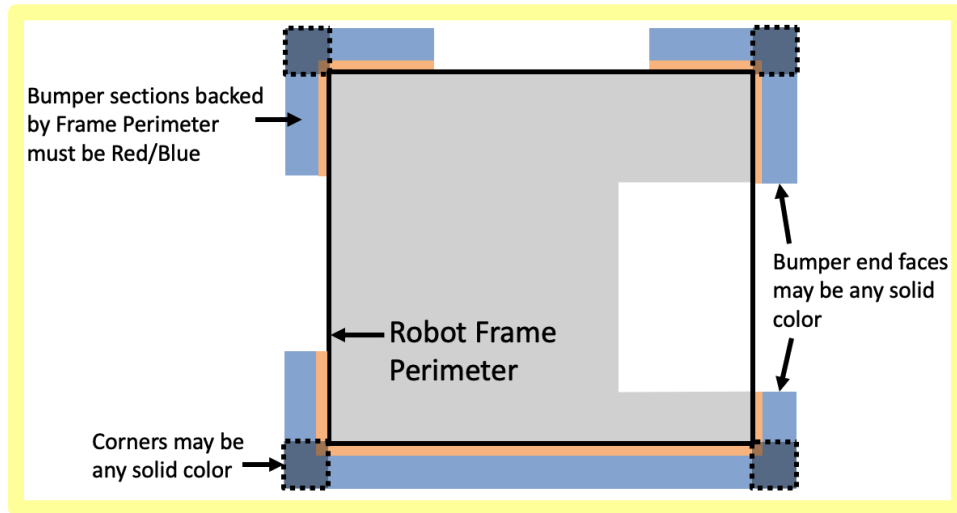
Figure 9-4 BUMPER color example

R24. BUMPERS must be constructed as follows (see Figure 9-7):

    A. …

    B. …

    C. …

    D. be covered with a rugged, smooth cloth. (multiple layers of cloth and seams are permitted if needed to accommodate R21 and/or R22, 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.

    The cloth must completely enclose all exterior surfaces of the wood and pool noodle material when the BUMPER is installed on the ROBOT. The fabric covering the BUMPERS must be solid in color.

> BUMPER corners and "ends", shown in Figure 9-4, must be solid in color, but do not need to be the same color as the rest of the BUMPER, as described in R21.

    E. …

    F. …

    G. …

9.6 Motors & Actuators

R27. The only motors and actuators permitted on 2021 ROBOTS include the following (in any quantity):

Table 0-6 Motor allowances

Motor Name	Part Numbers Available	
AndyMark 9015	am-0912	AndyMark 9015
AndyMark NeveRest	am-3104	
AndyMark PG	am-2161 (alt. PN am-2765)	am-2194 (alt. PN am-2766)
AndyMark RedLine Motor	am-3775	am-3775a
AndyMark Snow Blower Motor	am-2235	am-2235a
Banebots	am-3830 M7-RS775-18 RS775WC-8514	M5 – RS550-12 RS550VC-7527 RS550
CIM	FR801-001 M4-R0062-12 AM802-001A 217-2000 PM25R-44F-1005	PM25R-45F-1004 PM25R-45F-1003 PMR25R-45F-1003 PMR25R-44F-1005 am-0255
CTR Electronics/VEX Robotics Falcon 500	217-6515 am-6515	19-708850 am-6515_Short
Current/former KOP Automotive motors	Denso AE235100-0160 Denso 5-163800-RC1 Denso 262100-3030	Denso 262100-3040 Bosch 6 004 RA3 194-06 Johnson Electric JE-PLG-149
Nidec Dynamo BLDC Motor	am-3740	DM3012-1063
Playing with Fusion Venom	BDC-10001	
REV Robotics HD Hex Motor	REV-41-1291	
REV Robotics NEO Brushless	REV-21-1650	
REV Robotics NEO 550	REV-21-1651	
VEX BAG	217-3351	
VEX Mini-CIM	217-3371	
West Coast Products RS775 Pro	217-4347	
Electrical solenoid actuators, no greater than 1 in. (nominal) stroke and rated electrical input power no greater than 10 watts (W) continuous duty at 12 volts (VDC)		
Fans, no greater than 120mm (nominal) size and rated electrical input power no greater than 10 watts (W) continuous duty at 12 volts (VDC)		
Hard drive motors part of a legal COTS computing device		
Factory installed vibration and autofocus motors resident in COTS computing devices (e.g. rumble motor in a smartphone).		
PWM COTS servos with a retail cost < $75.		
Motors integral to a COTS sensor (e.g. LIDAR, scanning sonar, etc.), provided the device is not modified except to facilitate mounting		
One (1) compressor compliant with R79 and used to compress air for the ROBOT'S pneumatic system		

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.

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.
>
> AndyMark PG Gearmotors are sold with labeling based on the entire assembly. Assemblies labeled am-3651 through am-3656 contain legal motors specified in the table above. These motors may be used with or without the provided gearbox.

9.10 OPERATOR CONSOLE

R88. The Driver Station software provided by National Instruments (install instructions found here) is the only application permitted to specify and communicate the operating mode (i.e. Autonomous/Teleoperated) and operating state (Enable/Disable) to the ROBOT. The Driver Station software must be revision ~~20.0~~21.0 or newer.

> Teams are permitted to use a portable computing device of their choice (laptop computer, tablet, etc.) to host the Driver Station software while participating in competition MATCHES.

Section 10 Inspection Rules Section

~~ROBOTS are permitted to participate in scheduled Practice MATCHES prior to passing Inspection. However, the *FIRST* Technical Advisor (FTA), LRI, or Head REFEREE may determine at any time that the ROBOT is unsafe, per Safety Rules, and may prohibit further participation in Practice MATCHES until the condition is corrected and/or the ROBOT passes Inspection.~~

I6. This rule has been removed for the 2021 season.

Section 11 Tournaments

Each 2021 *FIRST* ® Robotics Competition event is played in a tournament format. Each tournament consists of ~~three~~ two sets of MATCHES called ~~Practice MATCHES (not necessarily played at all District Events),~~ Qualification MATCHES and Playoff MATCHES.

~~Practice MATCHES provide each team with an opportunity to operate its ROBOT on the FIELD prior to the start of the Qualification MATCHES.~~

Qualification MATCHES allow each team to earn Ranking Points which determine their seeding position and may qualify them for participation in the Playoff MATCHES.

Playoff MATCHES determine the event Champions.

11.2 REFEREE Interaction

If a DRIVE TEAM needs clarification on a ruling or score, per C9, one (1) pre-college student from that DRIVE TEAM should address the Head REFEREE after the ARENA Reset Signal (e.g. FIELD lights turn green or green with white). A DRIVE TEAM member signals their desire to speak with the Head REFEREE by standing in the corresponding Red or Blue Question Box, which are located on the floor near each end of the scoring table. Depending on timing, the Head REFEREE may postpone any requested discussion until the end of the subsequent MATCH as necessary.

11.2.1 Yellow and Red Cards

All YELLOW CARDS are cleared in FMS at the conclusion of ~~Practice,~~ Qualification~~, and Division Playoff~~ MATCHES. ~~The Head REFEREE may opt to perpetuate a YELLOW CARD earned during Practice MATCHES through to Qualification MATCHES for particularly egregious behavior.~~

11.4 Measurement

At each event, <mark>time permitting,</mark> the ARENA will be open ~~for at least thirty (30) minutes~~ prior to the start of Qualification MATCHES, during which time teams may survey and/or measure the ARENA and bring ROBOTS on the FIELD to perform sensor calibration. The specific time <mark>and duration</mark> that the FIELD is open will be communicated to teams at the event. Teams may bring specific questions or comments to the FTA.

11.5 Practice MATCHES

<mark>Information about Practice MATCHES has been removed since One Day Events will not include them. This section will be populated if/when appropriate for the 2021 season, via a Team Update. For more information, see the *FIRST* Inspire Blog, specifically "Update: 2020-2021 *FIRST* Season Extended."</mark>

11.6 Qualification MATCHES

11.6.1 Schedule

The Qualification MATCH schedule is made available as soon as possible, but no later than ~~one hour~~ <mark>thirty (30) minutes</mark> before Qualification MATCHES are scheduled to begin. Teams receive one (1) hard copy and it is <mark>also</mark> available at the *FIRST* Robotics Event Results site, except during exceptional circumstances. Each Qualification schedule consists of a series of rounds in which each team plays one (1) MATCH per round.

11.6.2 MATCH Assignment

FMS assigns each team two (2) ALLIANCE partners for each Qualification MATCH using a predefined algorithm, and teams may not switch Qualification MATCH assignments. The algorithm employs the following criteria <mark>at events with 24 or more teams</mark>, listed in order of priority:

1. maximize time between each MATCH played for all teams
2. minimize the number of times a team plays opposite any team
3. minimize the number of times a team is allied with any team
4. minimize the use of SURROGATES (teams randomly assigned by the FMS to play an extra Qualification MATCH)
5. provide even distribution of MATCHES played on Blue and Red ALLIANCE
6. provide even distribution of MATCHES played in each PLAYER STATION number.

<mark>At events with fewer than 24 participating teams, the criteria are similar, however criterion #5 is changed to minimize the number of times a team swaps between the Blue and Red ALLIANCE rather than an even distribution.</mark>

All teams are assigned the same number of Qualification MATCHES, equal to the number of rounds, unless the number of teams multiplied by number of MATCHES is not divisible by six. In this case, the FMS randomly selects some teams to play an extra MATCH. For the purpose of seeding calculations, those teams are designated as SURROGATES for the extra MATCH. If a team plays a MATCH as a SURROGATE, it is indicated on the MATCH schedule, it is always their third Qualification MATCH, and the outcome of the MATCH has no effect on the team's ranking. YELLOW and RED CARDS assigned to SURROGATES, however, do carry forward to subsequent MATCHES.

<mark>The scheduling algorithm works to minimize teams playing in back-to-back MATCHES. However, due to the limited number of teams permitted in the One Day Event structure for the 2021 season, back-to-back plays may occur. If any</mark>

team is scheduled to play in back-to-back MATCHES, the Head REFEREE will issue a FIELD TIMEOUT unless a longer break is already scheduled to occur (e.g. lunch.) See TIMEOUTS for details.

11. 7 Playoff MATCHES

In the case where the ~~Quarterfinal or~~ Semifinal MATCH scores for both ALLIANCES are equal, the Win is awarded to the ALLIANCE per criteria listed in Table 11-3. A DISQUALIFIED team, as determined by the Head REFEREE, causes their ALLIANCE to receive zero (0) MATCH points in a Playoff MATCH.

11.7.1 ALLIANCE Selection Process

- All references to eight (8) ALLIANCES being formed have been changed to four (4) ALLIANCES.
- Playoff MATCH Bracket has been updated.
- Playoff order has been updated.

Each team chooses a student team representative who proceeds to the ARENA at the designated time ~~(typically before the lunch break on the final day of the event)~~ to represent their team. The designated student representative from each ALLIANCE in a Playoff MATCH is called the ALLIANCE CAPTAIN.

11.7.2 ALLIANCE Selection Process

- All references to Quarterfinals have been removed and/or changed to Semifinals.

11.7.4 TIMEOUTS

This section has been moved to 11.8 and has been updated for One Day Events.

11.8 TIMEOUTS

A TIMEOUT is a period of up to six (6) minutes between MATCHES which is used to pause Qualification or Playoff MATCH progression. If circumstances require any team to play in back-to-back MATCHES, the Head REFEREE will issue a FIELD TIMEOUT to allow teams to prepare for the next MATCH. FIELD TIMEOUTS are the same time duration as TIMEOUTS.

During a TIMEOUT, the ARENA Timer displays the time remaining in the TIMEOUT. Both ALLIANCES enjoy the complete six (6) minute window. During Qualification MATCHES, if the ROBOT(S) who are playing in back-to-back MATCHES completes their repairs before the ARENA Time expires, the team(s) are encouraged to inform the Head REFEREE that they are ready to play. During Playoff MATCHES, ~~if I~~f an ALLIANCE completes their repairs before the ARENA Timer expires, the ALLIANCE CAPTAIN is encouraged to inform the Head REFEREE that they are ready to play. If ~~both~~ all ROBOTS/ALLIANCES are ready to play before the TIMEOUT expires, the next MATCH will start.

~~There are no TIMEOUTS for Practice or Qualification MATCHES.~~

~~If circumstances require an ALLIANCE to play in back-to-back MATCHES during the Playoff MATCHES, the Head REFEREE will issue a FIELD TIMEOUT to allow teams to prepare for the next MATCH. FIELD TIMEOUTS are the same time duration as TIMEOUTS.~~
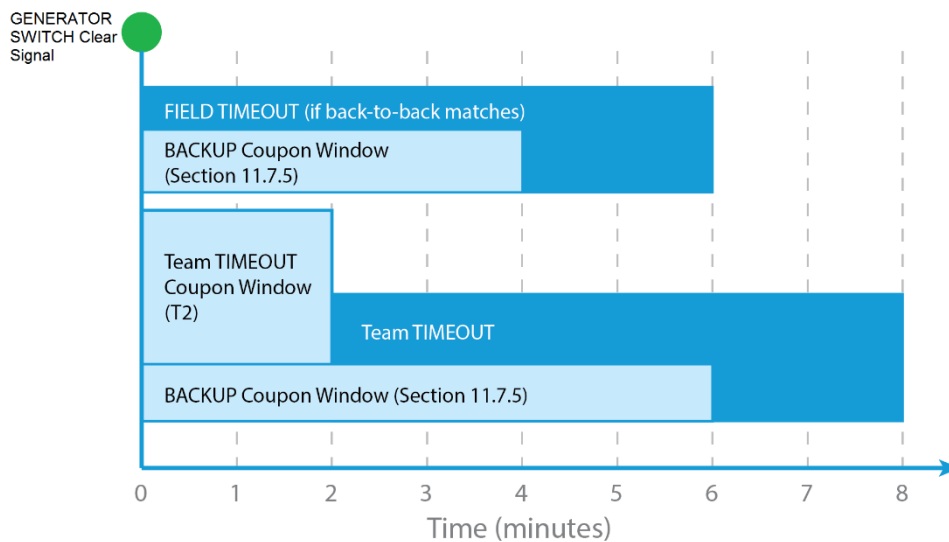
Figure 0-4 TIMEOUT and BACKUP Coupon Timeline

The GENERATOR SWITCH Clear Signal is indicated to teams with a change in the POWER PORT lights from green with white to fully green, as seen in Table 3-2 and Figure 3-19. FIELD STAFF will manually trigger the GENERATOR SWITCH Clear Signal after all ROBOTS have been removed from their GENERATOR SWITCH.

~~Each ALLIANCE in the Playoff tournament is issued (1) TIMEOUT.~~

> Teams are expected to have their ROBOTS staged on the FIELD by the end of the TIMEOUT. Teams that cause a delay to the start of a MATCH after a TIMEOUT are at risk of being in violation of C7.

11.8.1 TIMEOUTS in Playoff MATCHES

Each ALLIANCE in the Playoff tournament is issued (1) TIMEOUT.

T3. If an ALLIANCE wishes to use their TIMEOUT, the ALLIANCE CAPTAIN must submit their TIMEOUT coupon to the Head REFEREE within two (2) minutes of the GENERATOR SWITCH Clear signal preceding their MATCH. If there is no preceding MATCH, the TIMEOUT coupon must be submitted no later than two (2) minutes before the scheduled MATCH time. The TIMEOUT will begin two (2) minutes after the GENERATOR SWITCH Clear signal (i.e. at the end of the Team TIMEOUT Coupon Window depicted in Figure 0-4)

> A request presented outside the defined parameters in T2 will be denied.

There are no cascading TIMEOUTS. If an ALLIANCE calls a TIMEOUT during a FIELD TIMEOUT, the FIELD TIMEOUT will expire two (2) minutes after the GENERATOR SWITCH Clear signal and the ALLIANCE'S TIMEOUT will begin.

If an ALLIANCE wishes to call a TIMEOUT during a FIELD TIMEOUT, it must still do so within two (2) minutes of the GENERATOR SWITCH Clear signal preceding their MATCH, per 0.

TIMEOUTS are not transferrable between ALLIANCES, meaning an ALLIANCE cannot hand their designated TIMEOUT coupon to another ALLIANCE to use, however an ALLIANCE may use their own coupon for any purpose they wish.

If a Playoff MATCH is replayed because of an ARENA FAULT which rendered a ROBOT inoperable, the Head REFEREE has the option of calling a FIELD TIMEOUT.

11.9 Advancement Through the District Model

Information about advancement through the District Model has been removed. This section will be populated if/when appropriate for the 2021 season, via a Team Update. For more information, see the *FIRST* Inspire Blog, specifically "Update: 2020-2021 *FIRST* Season Extended."

11.10 Advancement to the *FIRST*® Championship

Information about advancement to the *FIRST* Championship has been removed. This section will be populated if/when appropriate for the 2021 season, via a Team Update. For more information, see the *FIRST* Inspire Blog, specifically "Update: 2020-2021 *FIRST* Season Extended."

11.11 *FIRST*® Championship: Additions and Exceptions

Information about additions and exceptions for the 2021 *FIRST* Championship events has been removed. This section will be populated if/when appropriate for the 2021 season, via a Team Update. For more information, see the *FIRST* Inspire Blog, specifically "Update: 2020-2021 *FIRST* Season Extended."

Section 12 Glossary

The Glossary has been updated. Terms that are no longer referenced in the Game Manual have been removed.