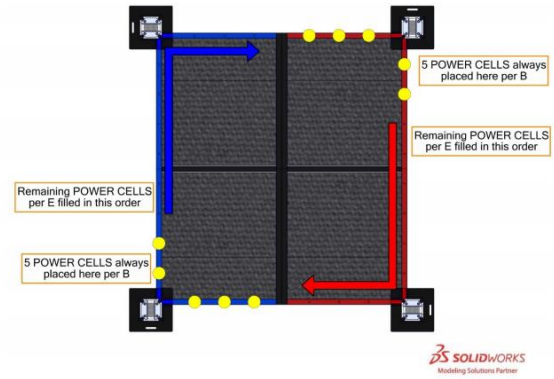
Team Update 00

团队更新 00 版（Team Update 00）列举了 2020 版和 2021 版无限充能比赛手册之间的改动.

SUMMARY OF CHANGES 改动摘要

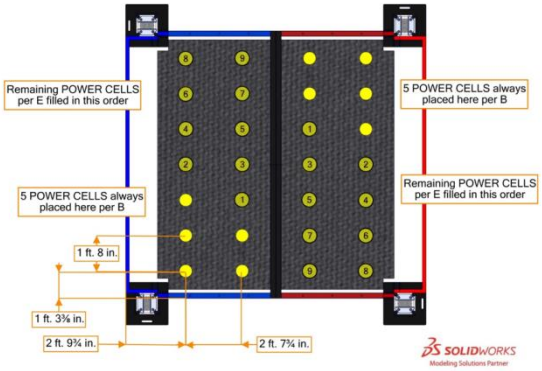
本节对 2021 赛季无限充能所做的改动提供了一个简短和非详尽的摘要。 想要详细信息，请参阅本文件的下列各页，并阅读 2021 Game Manual.

- RENDEZVOUS POINT 汇合点边界的改动: 各联盟汇合点外围的黑色边界已经移除，并以胶带线标记，这会使得汇合点看上去比原来的尺寸稍微大一点。细节见 3.2 区域与标记（ 3.2 Zones and Markings ）.
- RENDEVOUS POINT - POWER CELLS 汇合点上能量电池摆放位置的改动: 原本放在黑色边界上的能量电池更改位置放到了汇合点中，如图 4-1 和 4-2（ Figure 0-1 and Figure 0-2）.



2020

Figure 4-2: POWER CELL setup on BOUNDARIES



2021

Figure 4-2: POWER CELL setup inside RENDEZVOUS POINT

- SHIELD GENERATOR Scoring 护盾发生器计分改动: 第二阶段和第三阶段满格激活所需能量电池的需求从 20 个降低到了 15 个，见表 4-1（ Table 0-3 ）.
- CONTROL PANEL Scoring 控制圆盘计分改动: 旋转控制圆盘的得分从 10 分提升至 15 分，见表 4-2（Table 0-4）
- DRIVE TEAM 操控组成员身份改动: 成年导师可以选择成为教练或者技术员，但操控组里的成年人依然只能有一位。见章节 4.6（ 4.6 DRIVE TEAM ）.
- POWER CELLS in ALLIANCE STATION 联盟站里的能量电池保有数量变动: 联盟站里可保有的能量电池数量从 15 个减少为 14 个见规则 H9 和 H10（H9 and H10 ）.
- 材料清单（Bill of Material）, 机器人成本限制（ROBOT Total Cost Limit）,和开题仪式之前已设计或定制过的零件要求已经从 2021 赛季的规则中移除。见章节 9.4 （ 9.4 Budget Constraints & Fabrication Schedule ）. 需要知道哪些规则被移除，请翻阅 2020 版比赛手册 2020 Game Manual.
- BUMPERS 保险杠颜色识别改动: 保险杠四个角所在位置所包覆的颜色可以不是红/蓝色。见 R1 和 R24D（ R21 and R24D ）.

GENERAL 总览

- 2020 年场地介绍视频（Field Tour Videos ）已经添加了注释，标明和 2021 年的区别。2021 版可以在 FRC 的 Youtube 页面查看.
- 比赛主题视频（ Game Animation ）已经更新，可以在 FRC 的 Youtube 页面查看.
- 比赛场地页面（ Playing Field Webpage ）列举的 CAD and VR 资料已经更新为 2021 版.

FIRST® Official Field Drawings FIRST 官方场地图纸

所有改动都基于 2020 年 3 月 3 日版的 FIRST 官方场地图纸和 2020 年 1 月 31 日版的场地布局和标记图. 改变的目的是改善该场地的整体功能，并在整个短暂的 2020 赛季基于场地的性能进行调整. 详情见右侧链接 *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.
  更改的或添加的 2021 年场地零部件都更新了新编号（比如护盾发生器的编号从 GE-200000 变成了 GE-210000）。
  更改过的零部件或组装件会有回顾表来指明变更细节。
- 场地布局和标记图（ Layout and Marking Diagram ）在本文档中提高的更改都已经更新.
- 场地与赛季对应的图纸（ Field drawings – season specific ）已经做了如下更改:
  - 护盾发生器 (GE-21000, 之前是 GE-20000):
    - 边界和地面保护已经因应赛场章节而做修改.
    - 护盾开关上的传感器组装已经为了增加可靠性而更新.
  - 壕沟 (GE-21100, 之前是 GE-20100):
    - 保留标签螺栓堆栈为了持续性和可靠性表现而更新.
  - 装载站 (GE-21200, 之前是 GE-20200):
    - 平面斜坡已经添加进滑槽以减少能量电池阻塞的频率.
  - 能源港 (GE-21300, 之前是 GE-20300):
    - 子装配体已经更新为加强可靠性和减少能量电池卡在底部接口的频率
  - 能量电池 (GE-21500, 之前是 GE-20500):
    - 更新为 FIRST 标识可能不会印在比赛道具上.

EVENT MANUAL 赛事现场手册

赛事现场手册还未更新为 2021 版。当确认有线下赛的时候才会更新。

GAME MANUAL 比赛手册

比赛手册已经更新为 2021 版无限充能。所有本文档的变动都是在 2020 年 3 月 10 日版比赛手册 (updated on March 10, 2020 [Team Update 17]) 的基础上更改的。更新如下:

- 把文档名从“赛事与赛季规则”改成“比赛手册”

- 风格改成了 2021 赛季版
- 所引用的参考资料从 2020 版改成了 2021 版
- 部分图片更新以反应 2021 赛季版场地的更改
    - 在团队更新 00 版中高亮实质性的不同
- 修复了一些文字（英文）格式上的错误（不会在团队更新 00 中列举）

Section 1 Introduction 第一章介绍 的改动

第一章已经为了反映 2021 赛季的内容而更新，包含在本地挑战手册中 At Home Challenges Manual 的内容。第一章的内容和“本地挑战手册”中的第一章完全相同，除了 1.6 节和 1.9 节（本地挑战手册独有小节）.

- 由于 2021 年线下活动的不确定性，志愿者服务的精神这一节已被取消。 首席志愿者期待着在 2022 年再次与所有志愿者合作.
- 1.8 节团队更新：团队更新将每两周发布一次，直到 2021 年 2 月 2 日星期二。 如果有线下赛季被批准，那么额外的团队更新和更新频率将再宣布。
- 1.9 节 Autodesk 赞助的问答系统：为了可读性和添加了额外的语句后以允许假设的问题而重新组织。问题由“FRC 99999”用户提出的表示由关键志愿者提出来的问题，这类问题一般都与队伍相关.
    - 1.9 节赛事相关的语句只在比赛手册中收录

Section 2 Game Overview 第二章比赛概览 的改动

和 2021 年无限充能场地一起更新.

Section 3 ARENA 第三章赛场

3.1 FIELD

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

护盾发生器位于场地中央。护盾发生器由支撑框架，护盾开关，边界线，和汇合点组成。

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.

汇合点（RENDEZVOUS POINT）： 6 英尺 9¾ 英寸 (约 208 厘米) 宽，12 英尺 6¾ 英寸 (约 383 厘米) 长，空间高度无限的区域。该区域由联盟所属色的边界线，联盟所属色的胶带，和分隔红蓝方汇合点的黑色边界线所构成。汇合点面积包含了联盟所属色的胶带线。

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.

护盾发生器（SHIELD GENERATOR）是一座 14 英尺 1½ 英寸 (约 431 厘米) 宽，15 英尺 ¾ 英寸 (约 459 厘米) 长，9 英尺 6½ 英寸 (约 291 厘米) 高的建筑，放置在场地中央，护盾发生器和围栏有 22.5 度的偏差。护盾发生器共有 2 个属于各自联盟的护盾开关。黑色边界线把地面分成了两个区域。边界线所隔的区域中安置了地面保护措施防止地面损坏。汇合点（包含联盟所属色的边界线，联盟所属色的胶带和地面保护措施）都是护盾发生器的一部分

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 $1\frac{1}{16}$ 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.

边界线是 3 英寸 (约 8 厘米) 宽，1 英寸 (约 3 厘米) 高的钢制屏障（见图 3-11 最右侧部分）把护盾发生器下方的区域分成 2 个等面积的区域，区域尺寸 6 英尺 9¾ 英寸 (约 208 厘米) 宽， 12 英尺 ¾ 英寸 (约 368 厘米) 长。边界线用魔术贴紧贴在地毯上，所以会凸起约 $1\frac{1}{16}$ 英寸 (约 3 厘米)。 红蓝方边界线每 1 英尺 4½ 英寸 (约 42 厘米) 就会钻一个直径 1 英寸 (约 3 厘米) 的孔用以安放能量电池。一对黑色分界线把区域分割成蓝方汇合点和红方汇合点。每个桁架有两个更短的钢制屏障，上面贴有联盟所属色的胶带。这些屏障是联盟所属的边界线

一层⅛ 英寸 (约 3 厘米)厚的硬板安装在场地的地毯上，并又覆盖了一层地毯来保护场馆地板。这种地板保护措施让护盾发生器下的边界之内的区域又高了大约 ⅜ 英寸(约 10 毫米)。地板保护装置上打了 1 英寸（3 厘米）直径的孔用来安放能量电池。孔的位置以一个 2 英尺 7¾英寸（约 81 厘米）长 1 英尺 8 英寸（约 51 厘米）宽的矩形深间距排列，如图 4-2 所示

3.4.1.3 POWER PORTS （2021 版译为能源港，2020 版译为能量接口）

~~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

在外部接口周围有一个飞利浦彩色动力 LED 灯条用来判断满格进度。这个灯条从中部顶端向左右两侧朝下对称点亮。参考图 3-17

由于点亮模式与当前所在阶段有关，如表 3-1 中所定义的，外部接口底部每条边的 4 个点会以计一个能量电池就亮一灯的速率点亮。点亮模式见图 3-18

能量电池输送量	阶段 1 亮灯编号	阶段 2 和 3 亮灯编号
1	14-17	15-16
2	11-20	14-17
3	9-22	13-18
4	7-24	12-19

5	5-26	11-20
6	4-27	10-21
7	3-28	9-22
8	2-29	8-23
9	1-30	7-24
10	N/A	6-25
11	N/A	5-26
12	N/A	4-27
13	N/A	3-28
14	N/A	2-29
15	N/A	1-30

亮灯状态	判断标准
不亮	比赛开始前：场地准备好开始比赛了 比赛中：当前阶段还未激活
绿色	裁判长已经确认场地安全，可以进入。
绿色和白色	裁判长已经确认场地安全，可以进入。 见比赛暂停 **Error! Reference source not found.**
所属联盟的颜色和处于追逐模式的黄色	已经达到当前阶段的满格能量状态，但没有激活
整条灯带都是所属联盟的颜色	所有阶段已经激活

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 202~~0~~1 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 202~~0~~1 Kickoff Kit. Teams that participated in the 2020 season received these items in the Black Tote of the 2020 Kickoff Kit.

和控制圆盘相同颜色相同材料的一块色板放在了 2021 开题日活动套件（2021 Kickoff Kit）的灰色箱子中。控制圆盘通过一个 12 英寸 (约 30 厘米) “Lazy Susan”轴承 （制造商为 Triangle Manufacturing 编号为 PN: 12D10346）安放在壕沟上。相同的一个 “Lazy Susan”轴承也在灰色箱子中可以找到。参加 2020 赛季的队伍则是放在了 2020 年 Kit 的黑色箱子中。

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 CELL**S** ~~is~~ are in each Black Tote of the 202~~0~~1 Kickoff Kit.

“无限充能”的重要比赛道具为能量电池（POWER CELLS）。 能量电池是一个黄色 7 英寸 (约 18 厘米) 直径的具有粗糙表面的中等大小的弹性泡沫塑料球。每个球可能会印有黑色的 *FIRST* 的标识（如图）。球由 Flaghouse (PN 1892 YEL) 制造，由 AndyMark (PN AM-4200) 贩卖。注：AndyMark 版能量电池不会再印有 FIRST 标识。 2021 Kickoff Kit 的黑色箱子将装有 3 个能量电池

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.

用于视觉捕捉的视觉目标由 2 英寸 (约 5 厘米) 宽的 3M 8830 Scotchlite™ 反光条做成。贴在能量接口和装载站上。能量接口的反光条贴在外部接口的底部以定位和指示内外部接口的位置。反光条总高 1 英尺 5 英寸 (约 43 厘米)，总长 3 英尺 3¼ 英寸 (约 100 厘米)。反光条的最低位置高于地毯 6 英尺 9¼ 英寸 (约 206 厘米) 。一卷 8 英尺（约 243 里米）长的 3M 8830 Scotchlite™ 反光条将放在 Kickoff Kit 中，额外的可在 *FIRST* Choice 中拱挑选

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 Figure4-2.
   5 个能量电池放在各自联盟汇合点里的地面保护装置上的指定位置，见图 4-2 （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.
   每个联盟剩下的能量电池（依据机器人上的能量电池数量，一般为 0 到 9 个）按照图 4-2（Figure 4-2）的顺序摆放在各自联盟汇合点里

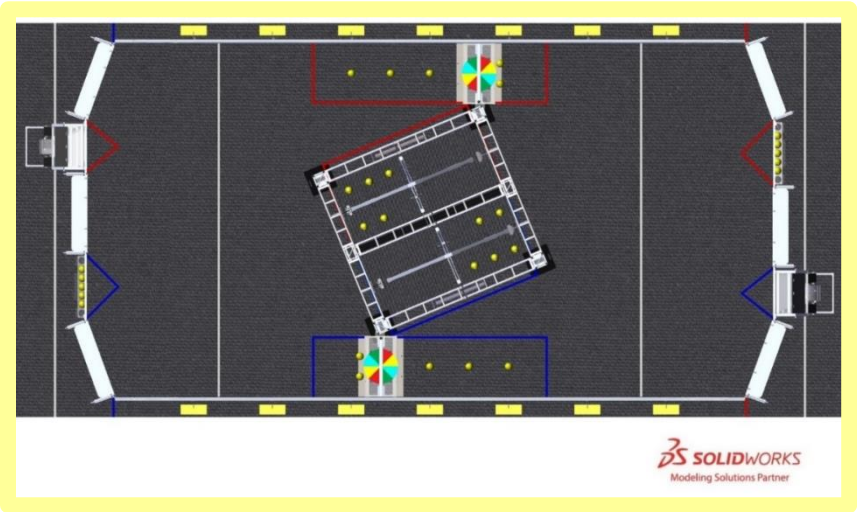


Figure 0-1: POWER CELL setup

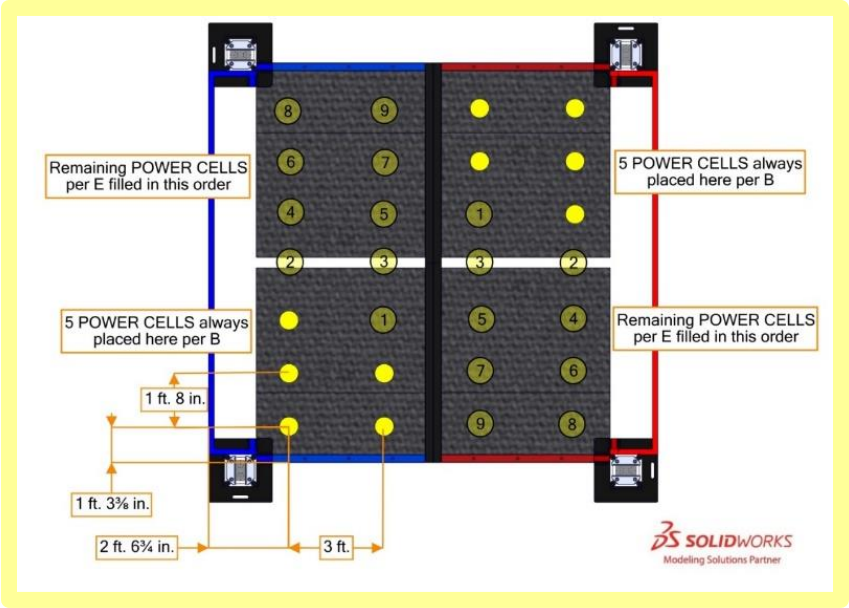


Figure 0-2: POWER CELL setup ~~on BOUNDARIES~~ inside RENDEZVOUS POINT

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

阶段	满格所需数量	激活条件
1	9	获得 9 个能量电池且手动阶段已经开始
2	15	再获得 15 个能量电池并完成旋转控制
3	15	再获得 15 个能量电池并完成位置控制

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. 添加：操控组的 5 个人中只允许有 1 个成年人

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.添加：能量电池在比赛中会磨损，修补方法见此能量电池指南

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.

当比赛结束，裁判长认为场地可以让人员安全进出了，会指示专人切换 LED 灯至绿色 或 绿色带白色（此 LED 灯装在各自的外部接口处），此时操控组才能进入场地搬走他们的机器人

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~~.
场地工作人员（场地主管，场地复原）则复原场地~~，重置能量电池位置~~。

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.
队伍成员只能等待能源港处的 LED 灯变成绿色或绿色带白色之后才能进入场地，除非被裁判或 FTA 明确指示进入

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.
添加：没有任何规则禁止使用手动工具（包含电池驱动的工具）设置和/或从场地上搬走机器人，只要这些工具不会造成延误或安全问题

C11. Don't trick the sensors. Teams may not interfere with any automated scoring hardware.
添加 C11：不要干扰传感器。队伍不得干扰任何自动计分的硬件设备

Violation: RED CARD for the ALLIANCE. 判罚：整个联盟吃红牌

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)~~,
  ~~符合所有关于机器人的规则，换言之就是通过了机检（练习赛的时候是例外，可以带未机检的机器人上场，怎么上场请参考机器检查章节（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 队伍不能在场地内启动机器人. 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.
添加：我们鼓励队伍在研发机器人的时候要考虑到规则 C7。

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.

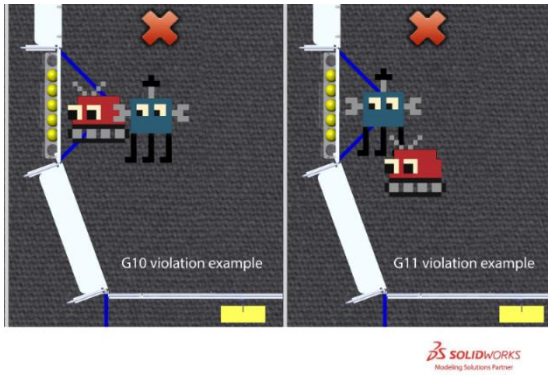
7.2.3 Zone Specific Restrictions

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.



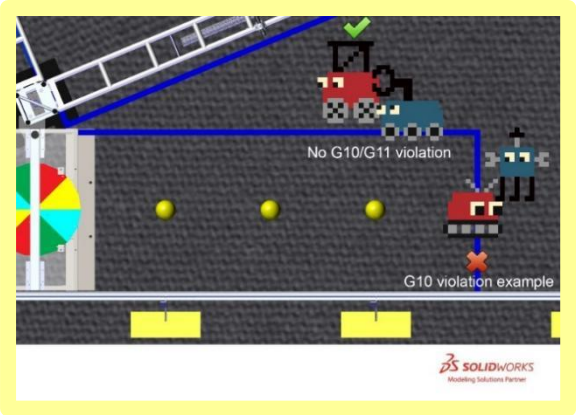


Figure 0-3 G10 and G11 examples

G12. Leave the opponent's CONTROL PANEL alone. During TELEOP, a 添加：手动阶段 ~~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,添加：而不是保险杠内 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. 此规则编号改为了 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. 第 **15** 个能量电池被联盟成员手持的时候不违反 **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.
搭建规则牵扯到很多方面，包含安全性，可靠性，对等性，挑战合理设计的创造性，对专业标准的坚持，竞争的影响，与 KOP（Kit of Parts，套件）的可兼容性。KOP 的内容包含 2020 和 2021 赛季的开题套件，FIRST Choice 提供的 2020 和/或 2021 赛季的物品，及来自 2020 和/或 2021 赛季产品的捐赠券（Product Donation Voucher，PDV）

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.).
队伍可能被要求提供文件来证明非 2020 或 2021 KOP 物品的合法性，用来机检的时候检查是否符合相关规定和限制（比如气动物品，电流限制，COTS 电气设备等）

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.
添加：我们鼓励队伍在研发机器人的时候要考虑到规则 C7。

9.4 Budget Constraints & Fabrication Schedule

R11. This rule has been removed for the 2021 season. 本规则因 2021 赛季的特殊性而被删除

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.

添加：

各小组应准备向检查员展示任何似乎在$500 美元限额范围内的成分的公平市场价值(FMV)文件。

模拟设备 ADIS16448IMUMXP 没有公布的公平市场价值(FMV)。 该装置被认为符合 R12，无论其真正的 FMV。

一个 COTS 项目的 FMV 是它的价格，由供应商为零件或相同的功能替换定义。 这个价格通常必须提供给所有 FRC 队伍在整个建设和竞争季节(比如 短期销售价格或优惠券不反映 FMV)，但队伍只需在确定项目价格方面作出真诚的努力，而不期望在整个季节监测机器人的价格。 该 FMV 是项目本身的成本，不包括任何关税、税收、关税、航运或其他可能因地点而异的成本。

COTS 软件的 FMV 是由供应商设定的价格，以授权在机器人上运行的软件（或软件的组件），从开题仪式到 FIRST 总决赛结束。 允许免费使用的软件 FMV，包括通过虚拟 KOP，在 ROBOT 上使用，成文为 0。

与织物相关部件的 FMV 是材料和/或劳动力的价值，但队伍成员（包括队伍成员的赞助员工）、其他团队成员和/或活动提供的机器商店提供的劳动力除外。 材料成本是作为任何可购买数量的成本，可用于制造个别零件(比如可购买的原材料大于织物部分)。

示例 1：队伍根据队伍的规范订购公司制作的自定义支架。 公司的材料成本和正常收取的人工费率适用。

示例 2：一个队伍接收捐赠的传感器。 该公司通常以 450 美元出售这个设备，因此这是其 FMV。

示例 3：一个团队以 400 美元购买钛管库存，并由当地的机器商店加工。 机器车间不被认为是一个队伍赞助，但捐赠了两小时的劳动力花费。 队伍必须包括估计劳动力的正常成本，假设是支付给机器商店的，并将人力成本在 400 美元的基础上添加。

示例 4：一个团队以 400 美元购买钛管库存，并由当地的一家机器商店加工，该商店是该团队的公认赞助商。 如果机械师被视为队伍成员，他们的劳动力成本不适用。 该部分的适用费用总额将为 400 美元。

与尽可能多的组织建立关系符合各小组和第一阶段的最佳利益。 团队被鼓励在招募和包括组织在他们的团队，因为这使更多的人和组织暴露在第一次。 承认支持公司是该团队的发起人和成员，是鼓励的，即使发起人的参与只是通过捐赠虚假劳动。

示例 5：一个队伍以 400 美元购买钛管库存，并由另一个队伍加工。 该部分的适用费用总额将为 400 美元。

示例 6：一个队伍在 300 美元的商店销售或在线拍卖中购买一个小部件，但它可以从供应商那里出售，售价为 700 美元。 FMV 为 700 美元。

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.本规则因 2021 赛季的特殊性而被删除

R14. This rule has been removed for the 2021 season.本规则因 2021 赛季的特殊性而被删除

R15. This rule has been removed for the 2021 season.本规则因 2021 赛季的特殊性而被删除

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 更改：操控设备
- **B.** BUMPERS (a protective assembly designed to attach to the exterior of the ROBOT and constructed as specified in BUMPER Rules), 更改：保险杠（一种保护组件，设计用于连接到机器人的外部，并按照保险杠规则的规定制作）
- **C.** battery assemblies as described in R5-B, 更改：规则 R5-B 描述的电池组件
- **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
  添加: 由一个 COTS 电气装置(例如。 马达或马达控制器)和附加组件与以下任何修改相关:
  - i. wires modified to facilitate connection to a ROBOT (including removal of existing connectors)
    修改电线，以方便连接到 ROBOT（包括拆卸现有连接器）
  - 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)
    连接器和任何材料，以确保和绝缘这些连接器添加（注：被动印刷电路板，如那些用于使马达端子适应连接器被认为是连接器）
  - iii. motor shafts modified and/or gears, pulleys, or sprockets added
    马达轴修改和/或齿轮，滑轮，或链轮添加
  - iv. motors modified with a filtering capacitor as described in the Blue Box below R56
    马达修改与滤波电容器，如下面 R56 的蓝色框所述
- **E.** COTS items with any of the following modifications:有以下任何修改的 COTS 项目
  - i. Non-functional decoration or labeling 非功能性装饰或贴标
  - ii. Assembly of COTS items per manufacturer specs, unless the result constitutes a MAJOR MECHANISM as defined in I1 每个制造商规格的 COTS 项目的组装，除非结果构成 I1 中定义的主要机制
- **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.
赛事开始于第一个公开的日程表指定的机器人搬入时间段（Load-in）。 如果公开的日程表不可用，或者日程表不包括机器人搬入时间段，则赛事算作当地时间早上 6 点开始：

- ~~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 每个机器必须主颜色是红色或蓝色的保险杠来展现他们的比赛时分配到的联盟颜色, 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.如果除四个角以外的所有可见的保险杠表面的颜色是红色或蓝色的话，这个保险杠被认为是主颜色是红色或蓝色，(假设无论哪里的保险杠都由外围框架支撑)。 除原色以外的任何可见织物必须是纯色。见图 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" 和短垂直的"末端" of BUMPERS are not "displayed" and thus R21 does not apply.

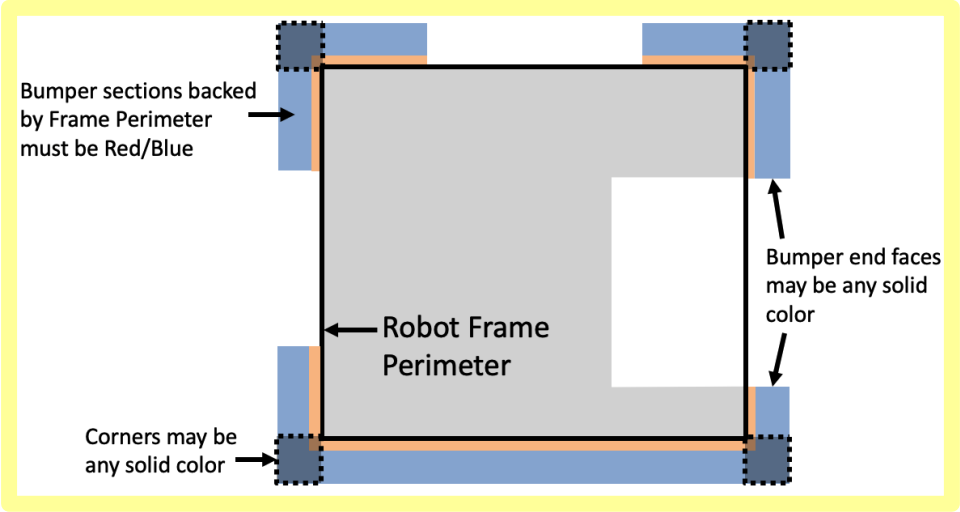


Figure 9-4 BUMPER color example

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.如图 9-4 所示，BUMPER 角和“端”必须是实心的颜色，但不需要与其余的 BUMPER 相同的颜色，如 R21 所述…

E. …

F. …

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.本规则因 2021 赛季的特殊性而被删除

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).
必须由一位初高中生及同等学力的操控组成员在场地重置信号灯亮起之后 (即外部接口的灯变绿或变绿加白)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.~~

在~~练习赛和~~资格赛结束后，所有队伍的黄牌记录将会清零。~~裁判长可能选择让队伍在练习赛时获得的黄牌持续到资格赛阶段~~。

11.4 Measurement

At each event, time permitting, 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 and duration that the FIELD is open will be communicated to teams at the event. Teams may bring specific questions or comments to the FTA.

只要时间允许，场地将在资格赛开始前~~至少 30 分钟~~开放，在此期间，队伍可以调查和/或测量场地并在场地上放置机器人以执行传感器校准。比赛场地开放的具体时间和时长将在赛事中传达给队伍。队伍可以向 FTA 提出具体问题或意见。

11.5 Practice MATCHES

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."

添加：有关"练习赛"的信息已被删除，因为单日赛事将不包含练习赛。本节将在 2021 赛季的适当情况下通过团队更新来补充。具体详情见 FIRST 博客 *FIRST* Inspire Blog, 尤其是"更新：2020-2021 FIRST 赛季扩展的博文" "Update: 2020-2021 *FIRST* Season Extended."

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~~ thirty (30) minutes before Qualification MATCHES are scheduled to begin. Teams receive one (1) hard copy and it is also 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 at events with 24 or more teams, listed in order of priority:

FMS 会按照预定算法每场比赛安排 2 个联盟对战（每个联盟 3 队），队伍不能改变资格赛的比赛安排，24 支及以上队伍的赛事，算法遵循以下优先级

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.

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.
添加：在参与团队少于 24 个的事件中，标准是相似的，但是标准 5 被更改为最小化团队在蓝色和红色联盟之间交换的次数，而不是偶数分布

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.

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 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.
添加：分组算法的作用是尽量减少队伍背靠背比赛的几率。 然而，由于在 2021 赛季的单日赛事中有限的队伍数量，背靠背的比赛还是会发生。如果任何队伍被安排到了背靠背比赛，除非已经安排了更长的休息时间(例如午餐)，不然裁判长会触发场间暂停。具体请看暂停时间 **Error! Reference source not found.**

11. 7 Playoff MATCHES

In the case where the ~~Quarterfinal or~~ Semifinal MATCH scores for both ALLIANCES are equal,
当~~四分之一决赛与~~半决赛中两个联盟的得分相同 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.
每支队伍选择一名学生作为队伍代表在指定时间~~（一般为比赛最后一天的午饭前）~~出席仪式。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. 本节已移至 11.8，并已更新为适用单日赛事。

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.~~

比赛与比赛之间可以有一个最多 6 分钟的暂停时间，用来暂时停止资格赛和淘汰赛的比赛进程。如果情况需要，任何队伍在背靠背比赛中，裁判长将发出一个场地暂停，允许队伍为下一场比赛做准备。 场地暂停与普通暂停时长相同。

在比赛暂停的时候，赛场计时器将会显示剩余暂停时间。对阵的两个联盟都可以利用 6 分钟的暂停时间。在资格赛期间，如果在背靠背比赛中，机器人在暂停时间结束前修理完毕，那么我们鼓励队伍通知裁判长他们已经准备好比赛了；在淘汰赛期间，如果一个联盟在暂停时间结束之前准备完毕，那么我们也鼓励联盟队长告知裁判长他们准备好了。如果双方机器人/联盟都在暂停时间结束前完成了准备，那么比赛就会立刻开始。

~~在练习赛以及资格赛的间隔是不能提出比赛暂停的。~~

~~如果一个联盟因为赛程原因，将连打两场淘汰赛的话，那么裁判长将叫“场地暂停”以让队伍更好地准备下一场比赛。“场地暂停”时间和队伍提出的比赛暂停时间一样，均为 6 分钟。~~

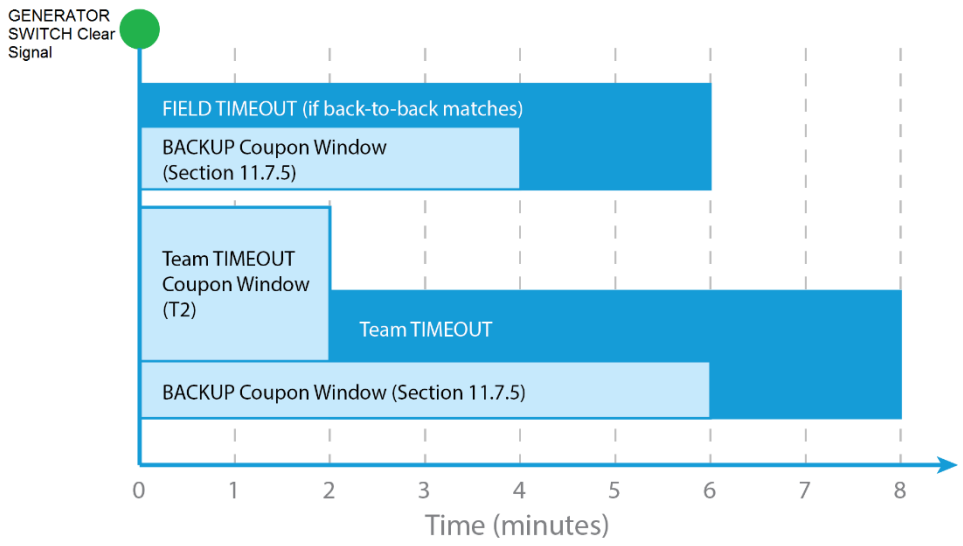


Figure 0-4 TIMEOUT and BACKUP Coupon Timeline

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.
添加: 护盾开关的清除信号会用能源港的灯光从绿色带白色变成完全绿色的变化来指示给团队，如表 3-2 和图 3-19 所示。在所有机器人被搬离它们所属的护盾开关之后，场地工作人员将手动触发护盾开关清除信号。

~~Each ALLIANCE in the Playoff tournament is issued (1) TIMEOUT.~~
~~淘汰赛中的每个联盟可提出一次暂停。~~

> 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 新添加章节

Each ALLIANCE in the Playoff tournament is issued (1) TIMEOUT.
淘汰赛中的每个联盟可提出一次暂停。

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 地方赛晋级模型

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."
有关"地方赛晋级模型"的信息已被删除。本节将在 2021 赛季的适当情况下通过团队更新来补充。具体详情见 FIRST 博客 *FIRST* Inspire Blog, 尤其是"更新：2020-2021 FIRST 赛季扩展的博文" "Update: 2020-2021 *FIRST* Season Extended."

11.10 Advancement to the *FIRST*® Championship 参加 FIRST 总决赛的条件

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."
有关"参加 FIRST 总决赛的条件"的信息已被删除。本节将在 2021 赛季的适当情况下通过团队更新来补充。具体详情见 FIRST 博客 *FIRST* Inspire Blog, 尤其是"更新：2020-2021 FIRST 赛季扩展的博文" "Update: 2020-2021 *FIRST* Season Extended."

11.11 *FIRST*® Championship: Additions and Exceptions FIRST 总决赛：新增与例外

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."
有关"FIRST 总决赛：新增与例外"的信息已被删除。本节将在 2021 赛季的适当情况下通过团队更新来补充。具体详情见 FIRST 博客 *FIRST* Inspire Blog, 尤其是"更新：2020-2021 FIRST 赛季扩展的博文" "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.
词汇表已经更新，在比赛手册中不再使用的术语已经被删除（词汇表做对照用，不会翻译）