



4 MATCH Play

During each *FIRST*[®] STEAMWORKSSM MATCH, two ALLIANCES (an ALLIANCE is a cooperative of up to four (4) *FIRST*[®] Robotics Competition Teams) rush to best prepare their AIRSHIPS for a long distance race. Well prepared AIRSHIPS have as much steam pressure stored in the STEAM TANK and as many ROTORS on the AIRSHIP activated as possible.

- STEAM Pressure: ROBOTS collect FUEL and use the FUEL to stoke their BOILERS and make STEAM Pressure (as measured in kilopascals, kPa). Each ALLIANCE has one High Efficiency BOILER and one Low Efficiency BOILER. As FUEL is loaded in to BOILERS, pressure is built at rates defined in Table 4-1, and added to the ALLIANCE'S score.
- ROTORS: ROBOTS collect GEARS from their HUMAN PLAYER stationed on the opposite end of the FIELD. ROBOTS then deliver GEARS to PILOTS on their AIRSHIP, who then install them. GEARS installed properly complete the GEAR sets used to drive ROTORS on the AIRSHIP. ALLIANCES earn extra points for any ROTOR started during AUTO.

Bonus points are awarded for ROBOTS that signify that they're ready for takeoff by latching on to their AIRSHIP via the ROPES.

4.1 Periods

Each MATCH is divided in to two periods. The first period, called AUTO, is the first fifteen (15) seconds of a MATCH in which ROBOTS operate without any DRIVE TEAM control or input. During this period, ROBOTS attempt to deliver preloaded GAME PIECES (and PILOTS race to install delivered GEARS), retrieve additional GAME PIECES, and cross their BASE LINE before the start of the next period.

TELEOP is the second period in a MATCH and is two minutes and fifteen seconds (2:15) long. During this period, DRIVERS may operate ROBOTS remotely to retrieve and deliver GAME PIECES, defend against their opponents, and climb their ROPES to prepare for the impending departure of their AIRSHIP after the MATCH.

4.2 MATCH Setup

Each MATCH consists of two (2) minutes and thirty (30) seconds of game play, as well as 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 following MATCH must be placed in position and ready to operate before the start of the next MATCH. FIELD STAFF reset the ARENA elements during this time.

Each MATCH begins with GAME PIECES, elements used to score points, staged as shown in Figure 4-1. Staging details are as follows:

- FUEL
 - A. Ten (10) available for each TEAM to preload in their ROBOT (any not preloaded are staged in the bin referenced in the next bullet, B)
 - B. Twenty (20) in each LOADING LANE (in a bin staged between the LOADING STATION and the STARTING LINE)
 - C. One hundred (100) plus or minus four (4) in each HOPPER (i.e. fifty (50) plus or minus two (2) in each HOPPER container)

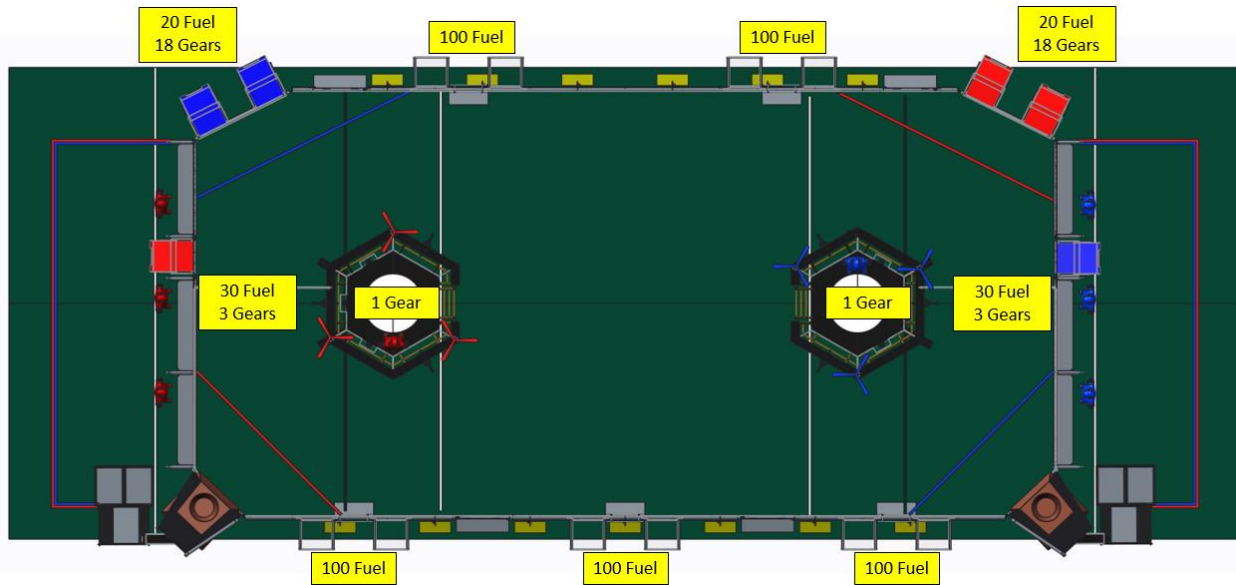




- GEARs

- D. One (1) available to each team to preload in their ROBOT (any not preloaded are staged with GEARs in E)
- E. Eighteen (18) in each LOADING LANE (staged on the carpet between the LOADING STATION and the STARTING LINE)
- F. One (1) in each AIRSHIP (as described in Section 3.4.2)

Figure 4-1: GAME PIECE staging



When a DRIVE TEAM loads their ROBOT onto the FIELD for a MATCH they may elect to:

- A. pre-load one (1) GEAR in or on their ROBOT such that it is fully and only supported by the ROBOT. Any GEARs not preloaded in a ROBOT are transferred to their LOADING LANE.
and
- B. pre-load up to ten (10) FUEL in or on their ROBOT such that they are fully and only supported by the ROBOT. Any FUEL not preloaded in a ROBOT is transferred to a RETURN BIN in their LOADING LANE.

“Support”, in reference to pre-loaded GAME PIECES, is transitive through other GAME PIECES. For example, a FUEL is “fully supported by the ROBOT” if it is resting on top of a GEAR that is in turn on a ROBOT (and thus both GAME PIECES are “fully supported” by the ROBOT).

A DRIVE TEAM may elect to switch one of the ROPES on their AIRSHIP for their own ROPE that meets the criteria defined in 104 of [Section 9 Inspection & Eligibility Rules](#) and has a serialized Inspection tag. Once the DRIVE TEAM has installed their ROPE on the AIRSHIP, it is part of the FIELD, but any issues with it will not result in an ARENA FAULT.

If order placement of ROBOTS or ROPES matters to either or both ALLIANCES, the ALLIANCE must notify the Head REFEREE during setup for that MATCH. Upon notification, the Head REFEREE will require ALLIANCES alternate placement of all ROBOTS and then all ROPES, starting with the Red



ALLIANCE and in order of PLAYER STATION assigned (i.e. Red Station 1 ROBOT, Blue Station 1 ROBOT, Red Station 2 ROBOT, Blue Station 2 ROBOT...Red Station 1 ROPE, Blue Station 1 ROPE, Red Station 2 ROPE...).

4.3 Scoring

ALLIANCES are rewarded for accomplishing various actions including autonomous movement, pressure accumulation, ROTOR engagement, getting a ROBOT ready for takeoff, and winning and tying MATCHES. Rewards are granted either via MATCH points (which contribute to the ALLIANCE'S MATCH score) or Ranking Points (which increases the measure used to rank teams in the Qualification tournament). Such actions, their criteria for completion, and their point values are listed in Table 4-1. Scores are assessed and updated throughout the MATCH.

Fractions of kilopascals accumulate as an ALLIANCE stokes the BOILER with FUEL in the High and Low Efficiency GOALS. For example, during TELEOP, an ALLIANCE scores twelve (12) FUEL in the Low Efficiency GOAL and five (5) FUEL in the High Efficiency GOAL. As a result, the ALLIANCE has generated three (3) kPa of pressure ($= 12/9 + 5/3$).

MATCH points increment as whole unit kilopascals are achieved. For example, during TELEOP, an ALLIANCE scores fourteen (14) FUEL in the Low Efficiency GOAL and five (5) FUEL in the High Efficiency GOAL. As a result, they have generated $3\frac{2}{9}$ kPa of pressure ($= 14/9 + 5/3$), and their MATCH points increment by three (3) points. They do not receive a fourth MATCH point unless and until they score enough FUEL in the high and Low Efficiency GOAL to generate four (4) kPa of pressure.

Fractions of kilopascals generated in AUTO carry over and contribute to the TELEOP pressure. For example, if an ALLIANCE scores seventeen (17) FUEL in the Low Efficiency GOAL in AUTO, the ALLIANCE receives five (5) MATCH points and has generated $5\frac{2}{3}$ kPa of pressure. Once TELEOP begins, the ALLIANCE scores another three (3) FUEL in the Low Efficiency GOAL. Their pressure is now six (6) kPa and they're awarded a sixth MATCH point.





Table 4-1: FIRST STEAMWORKS rewards

Action	Criteria	MATCH Points		Ranking Points
		AUTO	TELEOP	
AUTO mobility	For each ROBOT that breaks the BASE LINE vertical plane with their BUMPER by T=0	5		
Pressure accumulation	For every three (3) FUEL counted in the Low Efficiency GOAL by T=0	1	-	
	For every one (1) FUEL counted in the High Efficiency GOAL by T=0	+ 1 kPa		-
	For every nine (9) FUEL counted in the Low Efficiency GOAL by T=0		1	
	For every three (3) FUEL counted in the High Efficiency GOAL by T=0	-	+ 1 kPa	
	If ALLIANCE meets or exceeds a threshold pressure of 40 kPa		20 (Playoffs only)	1 (Quals only)
ROTOR engagement	For each ROTOR turning by period's T=0, that's not previously been scored	60	40	-
	If all four (4) ROTORS turning by T=0		100 (Playoffs only)	1 (Quals only)
Ready for Takeoff	For each TOUCHPAD triggered by a ROBOT at T=0		50	-
Win	ALLIANCE's final score exceeds their opponents'			2 (Quals only)
Tie	ALLIANCE's final score equals their opponents'			1 (Quals only)

Although the STEAM TANK lights as described in [Section 3.6 STEAM TANK](#) have an upper limit to the amount of Pressure they can display, there is no limit on the Pressure an ALLIANCE can accumulate.

FUEL contributes to an ALLIANCE'S pressure and MATCH score only once it is counted, which occurs after it's loaded in a BOILER. The BOILER'S rate of processing FUEL is detailed in [Section 3.11.4 BOILER](#) and should be taken in to consideration when loading FUEL in the final seconds of AUTO and TELEOP. The BOILER counters shut off at T=0, and any uncounted FUEL (i.e. FUEL that has not passed by the sensors) does not contribute to pressure accumulation or MATCH points.

Like the reduction of prepopulated GEARS for Championships described in [Section 3.4.2 GEAR Sets](#), the threshold pressure may also increase for District Championships or FIRST® Championship.





4.4 Rule Violations

Upon a rule violation, one or more of the penalties listed in Table 4-2 will be assessed.

Table 4-2: Penalty Table

Action	Penalty
FOUL	5 points credited towards the opponent's total score.
TECH FOUL	25 points credited towards the opponent's total score.
YELLOW CARD	a warning issued by the Head REFEREE for egregious ROBOT or Team member behavior or rule violations. A subsequent YELLOW CARD within the same tournament phase will lead to a RED CARD.
RED CARD	a penalty assessed for egregious ROBOT or Team member behavior, or rule violations, which results in a Team being DISQUALIFIED for the MATCH.
DISABLED	ROBOT will be commanded to deactivate all outputs, rendering the ROBOT inoperable for the remainder of the MATCH.
DISQUALIFIED	the status of a Team, as determined by the Head REFEREE, in which their Team receives zero (0) MATCH points in a qualification MATCH or causes their ALLIANCE to receive zero (0) MATCH points in a Playoff MATCH

In addition to rule violations explicitly listed in this manual and witnessed by a REFEREE, the Head REFEREE may assign a YELLOW or RED CARD as a result of egregious ROBOT actions or Team member behavior at the event. Please see [Section 10.7 YELLOW and RED CARDS](#) for additional detail.

4.5 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 during a MATCH. There are four (4) specific roles on a DRIVE TEAM which ALLIANCES can use to assist ROBOTS with race preparation.

Table 4-3: DRIVE TEAM roles

Role	Description	Max./ DRIVE TEAM	Criteria
COACH	responsible for acting as a guide or advisor	1	<ul style="list-style-type: none"> Pre-college student or adult mentor Must wear "Coach" button
DRIVER	responsible for operating and controlling the ROBOT	4	
HUMAN PLAYER	responsible for managing GAME PIECES	4	
PILOT	responsible for installing GEARS, starting ROTORS, and deploying ROPES	1	

There may be up to two (2) PILOTS per ALLIANCE per MATCH. During Qualification MATCHES, PILOTS may come from the DRIVE TEAMS assigned to Stations 1 and 2. A Team is permitted to cede their PILOT position to a PILOT from the DRIVE TEAM assigned to Station 3. During Playoff MATCHES, the ALLIANCE CAPTAIN has the authority on which two separate teams provide the ALLIANCE'S PILOTS.





PILOTS are strongly encouraged to make sure safety glasses fit properly, secure them with eyewear retainers, avoid loose fitting clothing and jewelry, and tie back long hair.

4.6 Logistics

Any GAME PIECES that leave the FIELD will not be returned to MATCH play. GAME PIECES that inadvertently bounce back in to the FIELD will be considered fair game.

Note that ROBOTS may not deliberately cause GAME PIECES to leave the FIELD (see G22).

GAME PIECES that roll, slide, or otherwise transfer from a LOADING LANE to an ALLIANCE STATION (or vice versa) are considered “owned” by the ALLIANCE in the space now occupied by the GAME PIECE.

There will not be an ARENA FAULT called for MATCHES that accidentally begin with an incorrect number of GAME PIECES, damaged GAME PIECES, or experience the failure of a Team provided ROPE.

Once the MATCH is over, if the Head REFEREE determines that the FIELD is safe for FIELD Staff but not safe for everyone (e.g. the FIELD is littered with FUEL that may cause a tripping hazard for a DRIVE TEAM carrying a ROBOT), they will turn the LED strings purple. Once the FIELD is ready for regular traffic, the Head REFEREE will change the LED strings to green and DRIVE TEAMS may retrieve their ROBOT in accordance with S04.

