

Referee Guide

Parts 1 and 2

THE GOAL

Our goal through the FLL tournament is for children to have fun showcasing their efforts of the past 6 weeks (which feels like 3 months to a child!). We want the tournament to be a positive experience which accents and reinforces all they enjoyed and learned about technology and humanity, and we want them to go out and spread this program. Your goal as the FLL referee is to be fair while trying to minimize grief.

REFEREE RESPONSIBILITIES

You are responsible for one team at a time, on your side of an 8-foot square table. Another referee will deal with a team on the other side. Here is what your role entails...

BEFORE THE TOURNAMENT

- Learn the Challenge Missions and Rules
- See the Official Rulings (Part 2 of this guide)

DURING THE TOURNAMENT

- Inspect the Field
- Apply the Rules
- Make Judgment Calls
- Record Performance

Learn the Challenge Missions and Rules

Before the tournament, you need to become an expert on the Challenge Missions and Rules (attached). They are very carefully worded to allow multiple solution methods and to allow what is not specifically prohibited, encouraging limit-pushing and novel thinking. They are also worded to help you avoid the need to make decisions. Knowing these materials in detail will enable you to apply them...

- the same way teams do.
- the same way as other referees do.
- the same way from match to match.

Knowing these materials in detail will allow you to operate with confidence, and it will remove you as a variable in the competition for the Performance Award. If you have any questions, please e-mail them directly to me at evans@usfirst.org or call 800 871 8326 x118.

See The Official Rulings

In the course of their 6 weeks of work, the teams come up with certain strategies that push the limits of what's allowable. They also encounter unique situations not anticipated, or not sufficiently covered in the missions and rules. When either of these is the case, the teams are encouraged to send questions to FLL Tech Support for official answers. Early rulings on unique strategies will be given in confidence, while rulings on frequently asked questions will be posted on the web. All official rulings will be compiled and available to you as "Referee Guide

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Inspect the Field

Your tournament will likely have a person designated to reset the field between matches, but if not, you will be doing it. Either way, you'll be inspecting the set up, and the importance of perfection here can not be overemphasized. Refer to the Field Setup Instructions (attached) for exact placement of the field objects, and settle any differences you may have with the designated field resetter before the first match begins. Also, make it very clear to the field resetter that after each match, he or she is not to touch anything until you have recorded the team's performance and given the okay for a reset.

Apply the Rules

During the match, you will watch the interaction of the team, the robot, and the field, to make sure that the rules are applied. Your two functions will be to...

- ALLOW OR NOT ALLOW ACTION (example: If the team is in violation of Rule 8, you will simply not allow them to progress until they conform).
- DETERMINE WHERE OBJECTS FROM THE FIELD ARE KEPT AFTER THEY ARE MOVED (example: If the robot does not conform to Rule 12, that will dictate that you take the object off the field, as opposed to letting the team keep it in base).

When the day is done, teams will be happy if they can at least pull off the kind of score they're used to in practice, and while there are many variables affecting the score, you must not be one of them. The vast majority of the time, you can avoid influencing the scores through correct and consistent application of the rules, but the truth is, FLL Challenges are brand new every year, so they don't enjoy a long evolution. Situations will develop which have never been dealt with before, and they will cause the need for decisions, or "judgment calls" on your part.

Make Judgment Calls

For the most part, the team gets what the team earns, and you're just an observer. But in CLOSE CALLS, and in UNIQUE SITUATIONS for which there is no Official Ruling, your decision will be seen as a factor in at least one team's score. This is by far the toughest part of your job. Your goal to be fair requires you to be correct, exact, and consistent with details to preserve the dignity of the referees, and the professionalism of the tournament, but at the same time, your goal to minimize grief requires compassion and realistic expectations of children. Though it is a carefully defined competition and people have a lot of time and effort invested, it is just a game, these are just children, and this is supposed to be fun. How will you decide when faced with conflicting goals?

CLOSE CALLS: Imagine... A team trips over a backpack on the way up to the field, their robot is smashed, and a little girl is crying. The announcer informs the crowd that the tournament will take a 10 minute break so the team can try to rebuild. Surrounding teams live up to the mutual values we're trying to foster, and they rally to help out. After every bit of 12 minutes, the team finally manages to get it together. They get up to the field, and all eyes are upon them as they place their robot in base. Unfortunately you notice that even though their robot is as far back as it can go, their essential mechanical claw is sticking out over the base line, in violation of Rule 8, by about half an inch. Just as you're noticing this, the coach from the opposite team walks up and points it out to you also. What do you do?

UNIQUE SITUATIONS: Let's say a robot is using the wooden border wall as a guide on its way to do a valuable mission with 6 seconds left in the match. As you watch, you don't think the robot will make it in time, but it will be close. Out of nowhere, the robot abruptly bumps, strays out of line, and misses the mark. With the match over, the rest of the team rushes up to the table. If they don't get these points, they don't get into the finals. The coach goes straight to the wooden border wall and finds a big splinter sticking out. He says it's obvious that the robot would have made it, were it not for the splinter, and he wants you to just give the team the points. You agree that the splinter deflected the robot, but you are quite skeptical about whether the robot would have made it. The opposite team got a score they are very happy with, and two other teams were told previously that the schedule does not permit rematches. What do you do?

Consider these stories vaccines; small doses of what can happen. They should prompt you to think in advance about the values which drive your decision making. Your goal as the FLL referee is to be fair while trying to minimize grief, but in these cases it's hard to do both, so you must decide: Are you willing to take some heat for putting a premium on compassion, or do you value fairness above all? Maybe you are into compromise, and resolve to talk it over with the other referees before deciding. If you give it some thought now, you will struggle less when the pressure is on.

Record Performance

All scores are determined at the end of the match, by the condition of the field at that time only. After the match, you will compare the positions of objects on the field with the requirements of the missions, and fill out a form called a Ref Sheet (attached). Ref Sheets serve as hard copy backup, so be sure to write the team number at the top. Some entries require a yes/no answer, and some require you to count objects. Although it looks like there are a lot of entries, most teams only perform a few of the possible tasks, and you can leave the remaining boxes blank. This part of your job should only take a minute or so, but it must be done immediately after the match ends, and before anyone touches the table. When the Ref Sheet is filled out, it is taken to the scorekeeper. The scorekeeper fills in the total; you do not need to do any math.

BACKGROUND: CHALLENGE THEME

Large populations of people for whom land, water, power, and other resources are in high demand can live happily and more efficiently in cities, but only if the cities are well planned and managed. Which mundane, dangerous, or strenuous associated tasks can be performed by robots? This Challenge symbolically prompts the team's imagination.

MISSIONS

MISSION	OBJECTIVE	POINT VALUE	MAXIMUM MISSION VALUE
BONUS OBJECTS	Four of your food loops are already in your market when the match starts. For each Robot Return Penalty you receive, one food loop will be removed, until this bonus is reduced to zero. Only the referee may remove food loops from a market.	4 each	16
Harvest Food	There are 4 food loops on the row of plants. Get as many food loops off the plants as you can.	8 each	32
Clear Soccer Field	There are 4 rocks on the soccer field. Get as many rocks off the soccer field as you can. Points awarded when the entire rock makes it completely past a perimeter line.	8 each	32
Repair Bridge	The bridge deck has been ripped up by the wind. Get the deck to drop back down.	32	32
Generate Clean Energy	The windmill needs service. Get the windmill to spin.	32	32
Clean Up Toxic Site	There are 4 barrels of a toxic substance on a rack near the river. Get as many of them to Base as you can.	10 each	40
Deliver Materials to Building Site	There are 4 bundles of materials in Base. Get as many of them to the building site as you can.		
	Bundles with any portion crossing the building perimeter line	6 each	
	Bundles one level up	7 each	
	Bundles two levels up	8 each	
	Bundles three levels up	9 each	
	Bundles four levels up	10 each	40
Establish Modular Housing	There is 1 modular housing unit in the river's floodplain, and there are 2 in Base. They are needed in the housing area, which is the white area enclosed by roads and shared by the market. Get as many of the housing units into the housing area as you can, stacking the units to make double or triple level houses if possible. Houses must be upright, and their bases must not be touching any roads.		
	Single level houses	8 each	
	A double level house	28	
	A triple level house	40	40
Deliver Food	There are 4 food loops on the row of plants and 4 in Base at the beginning of the match. Get as many of these food loops as possible into either your market or the opposite team's market. Note the compound benefits to both teams when either team shares (at the tournament, different colors will be used for identification).		
	Any color food loops in your market	4 each	
	Your food loops in the other team's market	12 each	???
Conservation	With good planning and care, cities can prosper in harmony with nature. There is a penalty for knocking down bushes, trees, and plants.	-4 each	0

TOURNAMENT TERMS AND RULES

- 1) **DOWNLOADING:** To avoid erased programs, downloading is only allowed in the pit area, download settings must be kept on short range, the process must be shielded from surrounding teams, and the RCX should be kept OFF when not in use.
- 2) **TOURNAMENT PROCEDURE:** At the tournament, two playing fields are joined together back to back, and each team is matched against another team. Each match lasts 2-1/2 minutes, and matches continue until every team has competed once. This process is known as a round. There are usually 3 rounds in a tournament, with matches being arranged to avoid repeat opponents and to preserve sequential order. During the time between a team's match in one round and that team's match in the next round, that team may go to the pit and fix or adjust the robot. Accomplishments and scores from one match do not carry over to other matches. When all rounds of regular matches are complete, each team's best score is considered for awards or advancement into final elimination matches, if eliminations are held.
- 3) **MISSION ATTEMPTS:** In any mission attempt, the team tries to accomplish whichever missions it wants, in whatever order it wants, but it does not have to try them all. A mission attempt is started when the team presses the green Run button on the RCX to start the program. While the program is running, the robot is considered to be attempting missions, whether it leaves Base or not, and the attempt is ended the instant the robot is touched, whether it's in Base or not.
- 4) **PARTICIPATION:** Only two team members at a time are allowed at the table while the robot is attempting missions. Several members may cycle through during a match, as long as there are only two up at a time. When emergency repairs are needed, extra team members may come to the table and help, but only two can remain when the robot starts again.
- 5) **ALLOWABLE PARTS:** The team may only use one robot in any match. One robot is defined as the sum of everything carried to the competition table, including the main body (the RCX and everything rigidly attached to it) and any intended add-ons, tethered units, satellites, projectiles, etc. The robot must be built entirely from LEGO elements in original factory condition, without restriction on type or quantity except as follows:
 - The robot may not contain any electrical parts other than: 1 RCX, 1 rotation sensor, 2 touch sensors, 2 light sensors, 3 motors, 1 lamp, and 6 wires.
 - The robot may not contain any non-LEGO materials or substances such as stickers, tape, glue, oil, etc.
- 6) **ALLOWABLE SOFTWARE:** The robot may only be programmed using unaltered LEGO MindStorms Robotics Invention System or RoboLab software of any release date.
- 7) **BASE:** Base is defined as the space enclosed by an imaginary box defined by the Base lines, the inside border walls, and by an invisible ceiling 50 centimeters high. Whenever the thickness of any line on the mat comes into question, the team will be given the benefit of the doubt.
- 8) **STARTING POSITION:** Every mission attempt must be started with all portions of the robot which are being used for that mission completely within Base. All portions of any deliverables intended for that mission must also be completely within Base. At the time the green Run button is pressed, that button is the only portion of the robot that may be touched, and the team must demonstrate this clearly to the referee. The specifics in this rule apply to all starts, not just at the start of the match.
- 9) **WORKING ON THE ROBOT:** When the robot is in Base and not attempting missions, the team may reposition it, repair it, load or unload it, add or remove parts, switch the program, reset mechanisms, change the batteries, and so on.
- 10) **ROBOT CONTROL:** All robot action including the lowering of arms, the launching of projectiles, and the release of any other stored energy (in weight, springs, belts, etc.) must be programmed and initiated only by pressing the green Run button on the RCX. This means it is illegal for the team to delay or cause the release of anything by hand. It is also illegal for the team to touch the robot or exert any other form of control over it while it's attempting missions. Whenever the team touches the robot, the current mission attempt is immediately ended. The team must shut the current program off and restart from completely within Base.

- 11) **ROBOT RETURN PENALTY:** If the team touches the robot while its MAIN BODY (the RCX and everything rigidly attached to it) is COMPLETELY out of Base, the referee will declare a Robot Return Penalty and remove one of the BONUS objects from the field. This happens only until the original BONUS is reduced to zero. *Note that a robot returning to Base may be touched without penalty as soon as any portion of it crosses the Base line. Note also that there is no penalty for simply being outside of Base when the match ends.
- 12) **RETRIEVALS:** Points for an object retrieved back to Base are only awarded when some portion of the object itself crosses the Base line, whether or not the robot crosses too. If the team touches a robot which is in control of a retrievable object before some portion of the object itself crosses the Base line, no points are awarded for the retrieval, and the object will be kept off the field by the referee. This is true even when there is no Robot Return Penalty. The team may unload successfully retrieved objects in Base by hand.
- 13) **DELIVERIES:** When a mission involves the delivery of objects from Base to a location on the field, the team may load the objects onto the robot by hand in Base. The objects may also be delivered in a container made of LEGO elements, but in that case all rules and scoring criteria then apply to the container. Points for an object delivered are only awarded if the robot has completely let go of the object by the end of the match. Deliverables which remain with the robot when the robot is picked up will be given back to the team for future attempts.
- 14) **SCORE DETERMINED AT END OF MATCH:** To reduce controversy about what happened during a match, the score is determined at the END of the match, based on the condition of the field at that time only. This means that points won't be awarded for successful missions that the robot accidentally trashes before the match ends.
- 15) **TOUCHING OBJECTS ON THE FIELD:** Only the referee may touch objects which are completely out of Base. If the robot moves any projectile, satellite, or loose field object to an undesirable location on the field, the team may request that the referee remove that object from the field, but it will not be reset, and it will not be given to the team. To make space in Base, the team may hand-hold deliverable objects prior to delivery and retrievable objects after retrieval.
- 16) **AIMING:** Jigs or other alignment devices may be used within Base to help aim the robot, but they must be made of LEGO elements.
- 17) **UNIQUE RULINGS:** The referee makes all judgment calls at the tournament, and can not consider protests, so if your team has a unique idea or strategy that you fear may violate either the letter or spirit of the missions or rules, you can keep it secret and risk having it declared illegal at a tournament, or you can get an early ruling preferably by e-mailing evans@usfirst.org, or by calling 1-800-871-8326, x118. In the community spirit of FLL, and in fairness, the question and the official ruling may be posted on the web, so word your question carefully. Whether using this resource for early rulings or for general questions about the Challenge, please be sure you have (truly) read the MISSIONS and the above TOURNAMENT TERMS AND RULES thoroughly first.

FIELD SETUP

FOOD LOOPS---Make them tight and symmetrical. Hook hole should face out of the loop, flower should face into the loop. Placement: (4) in Base, (4) hung from plants, and (4) in the Market or alternate Bonus Object staging area.

ROW OF PLANTS---Reconnect any plants that were knocked over, placing them on the dots colored black. Leaves should be anywhere on the back side of the row (away from the wall). Stalks should be straight and vertical; use one hand as a guide, and the other to press down on the top of the stalk to make it self-straighten. Branches should be perpendicular to the row, and must be free to pivot. To loosen a branch so it spins freely, hold the stalk in place and push the end of the branch down slightly. Hang a Food Loop from its hook hole onto each branch.

ROCKS---On the Soccer Field, align a Rock over each of the (4) squares labeled "Rock".

BRIDGE---Raise deck upright. Check model tightness.

GATE---Check model tightness. Refresh the Dual Lock fastening by firmly pushing the stationary segment against the mat and the border wall. Close the Gate so that its free end is perpendicular to the wall.

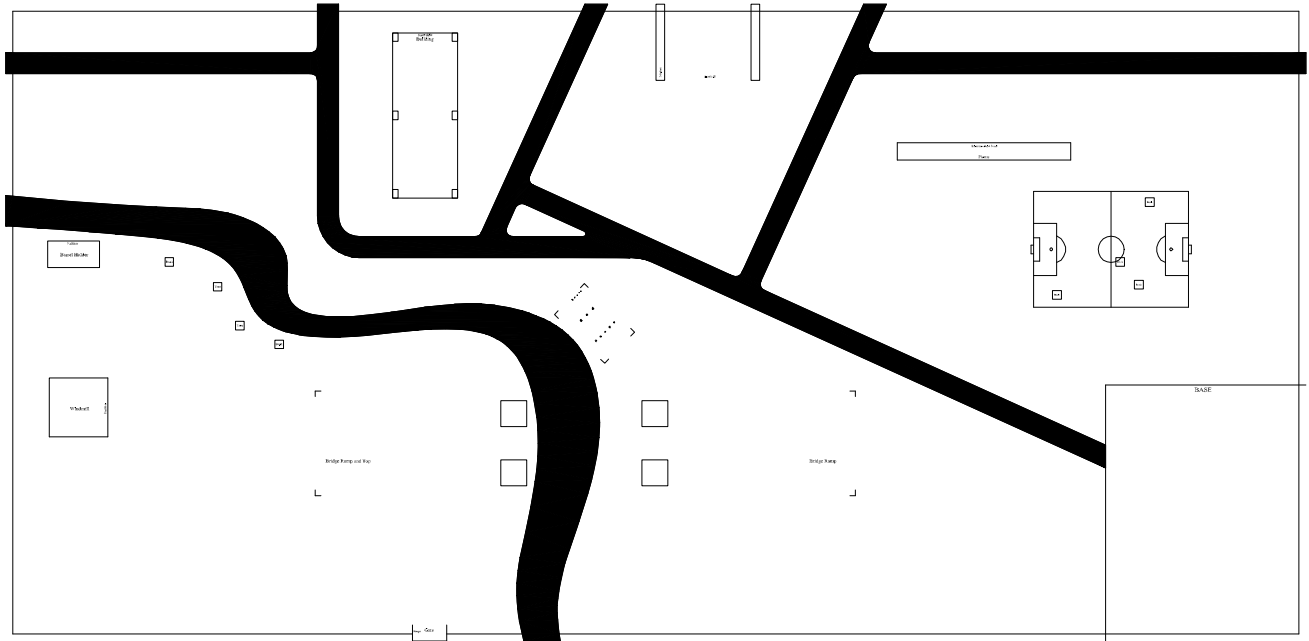
WINDMILL---To refresh the Dual Lock and LEGO base connections, firmly press the four corners of the base down. Wind the rotor 15 revolutions counter-clockwise, lightly pulling out on the pushbar, and letting go.

BARREL RACK---Level the rack by pinching the long and short beams flush. Lay the (4) Toxic Barrels down on top, such that they would roll if the rack tilted, then slide them sideways until they are all aligned against the rail nearest the Building.

BUSHES AND TREES---Press down the (2) Trees and (2) Bushes over their respective squares. The order is Bush, Tree, Tree, Bush.

RED HOUSES---Position (1) house over the rectangle labeled "Red House" with the drain tube oriented as shown on the mat. The other (2) houses may be placed anywhere in Base.

BASE---Base should now contain (4) Food Loops, (4) Bundles of Materials, and (2) Red Houses.



CITY SIGHTS REFSHEET

ROUND TEAM #

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Loops Off		(count)
Soccer Rocks Off		(count)
Bridge Down		(Y = YES, blank = NO)
Windmill Spun		(Y = YES, blank = NO)
Barrels at Base		(count)
Bundles	Ground	(count)
	1st Up	(count)
	2nd Up	(count)
	3rd Up	(count)
	4th Up	(count)
Red Houses	Singles	(count)
	Double	(Y = YES, blank = NO)
	Triple	(Y = YES, blank = NO)
Market	Ours in Ours	(count)
	They Gave Us	(count)
	We Gave Them	(count)
Bushes/Trees Down		(count)

SCORE:

Part 2: Official Rulings

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Close Calls and Unique Situations

- Teams are allowed to stick or wrap the deliverables together. They can do the work during setup, but they have to use the models provided by the tournament; they can't bring their own.
- Teams are allowed to cover the markets.
- When counting wires, the ones for the light and rotation sensors do not count against the allowable 6.
- Robots can cross the river.
- Teams can cut LEGO string, LEGO elastic rope, and the various types of LEGO tubes to adjust their length only.
- Exact alignment of the red houses doesn't matter, as long as the bottom house is completely within the housing area.
- There's no penalty for when a robot is out of base when the match ends. Penalties are only to be given when the out of base robot is TOUCHED.
- Allow jigs to extend out of base unless you think the team is using the jig for navigation as opposed to simply aiming.
- Building materials may be delivered on a stand, or on a hook. Give credit if any part of the materials or their container breaks the plane of any side of the building.
- A bundle of materials or its container must be completely on or above a given level of the building to get the points for that level.
- Teams are allowed to clear rocks by having their robot release a sweeping mechanism.
- If the field changes as a result of anything but the action of the robot, restore (not necessarily reset) it as soon as possible.
- Time will elapse between the instant the team tells you they want their robot and the instant you actually catch it...Restore anything the robot does in that span of time, good or bad.
- Wind-up motors are allowed. They may be wound by hand in base, but they must be released by the robot.
- Food Loops and Red Houses are considered deliverables, and should not be considered retrievables, even when they're being retrieved for subsequent delivery. Rule 13 applies to them and Rule 12 does not.
- Teams may request that rocks which have surely been cleared from the soccer field be removed out of the way of the robot. Sweep them to a safe, harmless place.