



RCJ Soccer Rules 2021

The RCJ Soccer Rules for RoboCup Singapore Open 2021 consists of :

- 1) RCJ Soccer Supplementary Rules 2021 for RoboCup Singapore Open 2021
- 2) RCJ Soccer_Rules_2021.



RCJ Soccer Rules 2021 (Supplementary)

(RoboCup Singapore Technical Committee)

1. Preamble

Soccer is inherently adversarial. In RoboCup Singapore Open 2021, we will only have online game. Without the presence of an adversary, we should strive to recreate an environment with variabilities to simulate the challenges they pose, rather than to focus on technicalities which can be easily set up for one-off demonstrations.

The supplementary rules are released by the RoboCup Singapore Technical committee. It focuses on the RCJ Soccer rules 2021 compliance and skill evaluations.

2. Rule Compliance

Teams are advised to familiarise themselves with the rules. Each team is responsible for verifying the latest version of the rules prior to competition.

The official rules adopted are highlighted in the table below.

Official Rule	What you should do...
2 Team	
2.1.1: A team should comprise of 1 to 4 members. Each team must have a captain, who will be responsible for communication with the referees and interaction with the robot and game elements including placement after randomisation.	Each team member should introduce their technical roles in the team.
2.1.2: Each team member needs to carry a technical role.	
3. Robot	
3.2 Interference	
3.2.1: Robots are not allowed to be coloured orange, yellow or blue to avoid interference. Orange, yellow, blue-coloured parts used in the construction of the robot must either be occluded by other parts from the perception by other robots or be taped/painted with a neutral colour.	The robot should be placed on the field, then powered on as if a kick-off is about to happen. Rotate the robot or the camera such that all angles of the robot can be seen (excluding the base, which is defined as the surface facing the field).

<p>3.2.3: Robots must not produce visible light that may prevent the opposing team from playing when placed on a flat surface. Any part of a robot that produces light that may interfere with the opposing robot's vision system must be covered.</p>	<p>The robot should not have any visible orange, yellow, or blue elements, and should not produce visible light which is may interfere with the functioning of the opposing robot. In this case, the camera used to film the task should not be significantly affected by these lights.</p>
<p>3.4 Communication</p> <p>3.4.1: Robots are not allowed to use any kind of communication during game play unless the communication between two robots is via Bluetooth class 2 or class 3 ^[1] or via any other device that communicates using the 802.15.4 protocol (e.g., ZigBee and XBee).</p> <p>[1] range shorter than 20 meters</p>	<p>Teams should declare all wireless communication devices. In addition, spec sheets from the manufacturers should be submitted where available. The onus is on the team to prove that communication devices adhere to the protocols permitted by the rules.</p>
<p>3.5 Agility</p> <p>3.5.1 Robots must be constructed and programmed in a way that their movement is not limited to only one dimension (defined as a single axis, such as only moving in a straight line). They must move in all directions, for example by turning.</p> <p>3.5.2/3: Robots must respond to the ball in a direct forward movement towards it. A robot must touch the ball that is placed no further than 20 cm from any point on its convex hull within 10 seconds.</p>	<p>For (1), the robot should move in a pattern which shows that it can move in multiple axes. One example could be for the robot to move in a square.</p> <p>For (2), the robot should be turned off initially. For each of the 8 tested angles (North, South, East, West, North East, North West, South East, South West), teams should place a 15cm ruler in the specified direction and place the ball at the end of the ruler before powering on.</p>
<p>3.6/3.7 Handle/Top Marker</p> <p>3.6.1: All robots must have a stable and easily noticeable handle to hold and to lift them. The handle must be easily accessible and allow the robot to be picked up from at least 5 cm above the highest structure of the robot</p> <p>3.6.2: The dimensions of the handle may exceed the 22 cm height limitation, but the part of the handle that exceeds this 22 cm limit</p>	<p>Teams should give a clear indication of the structure which constitutes the handle. From the handle, teams should extend a ruler down 5cm to show that it clears the tallest structure by the specified amount.</p> <p>Teams should give a clear indication of the top marker. A ruler should be placed across</p>

¹ range shorter than 20 meters



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cannot be used to mount components of the robot

3.7.1: Each robot must have a white plastic circle with a diameter of at least 4 cm mounted horizontally on top. This white circle will be used by the referee to write numbers on the robots using markers, therefore the white circles must be accessible and visible.

the marker, showing that it is of a diameter of at least 4cm.

Field



Due to the potentially prohibitive costs involved in procuring a new field, teams can use variations of the Soccer Open field that are compliant to specifications set out from previous years (2009-Present).

However, field markings MUST be taped or painted to comply with the rules set out by the official [RoboCupJunior Soccer Rules 2021](#).

Teams should use a measuring tape or equivalent measuring device capable of measuring up to the maximum field dimension of 2.4m, validating the dimensions of the white lines.

It is up to the team to situate their fields in optimal conditions (lighting, magnetic etc.). However, there must be no external aids used, such as but not limited to, markers for localisation. Teams found to be using external aids will be disqualified.

8. League Regulation

8.2A Dimensions

Robots will be measured in an upright position with all parts extended. A robot's dimensions must not exceed the following limits:

sub-league	Soccer Open	Soccer Lightweight
size / diameter	22.0 cm ^[4]	22.0 cm
height	22.0 cm ^{[1] [4]}	22.0 cm ^[1]
weight	2400 g ^{[2] [4]}	1100 g ^[2]
ball-capturing zone	2.5 cm	3.0 cm
voltage	15.0 V ^[3]	12.0 V ^[3]

[1] The handle and the top markers of a robot may exceed the height.

[2] The weight of the robot includes that of the handle. We encourage teams to include protection circuits for Lithium-based batteries

[3] Voltage limits relate to the nominal values, deviations at the power pack due to charging will be tolerated.

[4] The Technical Committee plans to decrease the diameter/height of robots in the Open sub-league to 18 cm and the weight limit to 2200g for the 2022 season. It further plans to replace the current orange ball with a standard orange golf ball.

For (1) and (3), teams should use a ruler or similar measuring device to show that the robot complies dimensionally, as clearly as possible.

For (2), teams should use a weighing scale, ensuring that the robot is turned on when weighed. Readings should be clearly shown.

For (4), teams should show the battery pack that is being used. Where manufacturer markings are available, these should be shown. For example, for LiPo batteries, robots should operate on 4s and below for the Open Category, and 3s and below for the Lightweight category. In the case where these are not available, teams should measure the voltage at the terminals with a voltmeter or similar measuring device. Readings should be clearly shown.

8.2C Limitations

8.2.C.1: A single robot can only use one camera. All commercial omnidirectional lenses/cameras are not permitted. Only omnidirectional lenses/cameras made by students are permitted, meaning that their construction needs to be primarily and substantially the original work of a team. Teams using them on their robots must prove how they made them on their presentation poster and at an interview. For the purpose of these rules omnidirectional is defined as having a field-of-view of more than 140 degrees

For (1), teams using omnidirectional lenses/cameras must attach supporting documents proving how these were made. Teams using Commercial Off The Shelf vision systems must attach spec sheets by the manufacturers, or prove otherwise, that the system does not possess a Field Of View of more than 140 degrees horizontally and 80 degrees vertically.

Where other limitations may be called into question, such as where a pneumatic kicker



horizontally and more than 80 degrees vertically (these values reflect the optical system of the human eye).	is used, the onus is on teams to prove that the rules are complied with
8.2E Programming 8.2.E.1: Robots must be programmed exclusively by student members of the team. Mentors, teachers, parents, or companies should not be involved in the programming and debugging of robots. 8.2.E.2: For the programming of the robots, any programming language, interface, or integrated development environment (IDE) may be used. The use of programs that come together with a commercial kit (especially sample programs or pre-sets) or substantial parts of such programs are not allowed. It is not allowed to use sample programs, not even if they are modified. * Also applies to hardware	<p>Teams should describe the workings of the robot (hardware and software) in its entirety.</p> <p>In addition, all source code and design files should be ready for inspection upon request.</p>
C Kicker Power Measurement * See Appendix	Each robot fitted with a kicker should be filmed undergoing the kicker power test. During which, the camera should be placed such that the side of the ramp (triangular) is visible.
Ability to play the Game	<p>Teams are to submit a video of their robots playing 1 vs 1 against each other for 5 minutes, followed by a 2 vs 0 for 5 minutes, as if they were in an actual match. Members should officiate the match, ensuring compliance with rules. Where interventions are made (goal scored, out of bounds etc.), decisions should be verbalised in a clear manner.</p> <p>Should the team have multiple strategies, they may submit multiple videos which demonstrate all strategies discussed within any other submitted material for validation.</p>

3. Skill Evaluations

Skill evaluations will be done live over a selected video conferencing platform.

Challenge	Description	Rationale
Goal scoring	<p>For this challenge, the 5 neutral points will be used, along with 2 additional points at the intersections between the line dividing the 2 halves of the field and the field boundaries, for a total of 7 points (numbered 1 to 7).</p> <p>A randomizer will be used to pick 2 points, with the first indicating the starting position of the robot, and the second indicating the starting position of the ball. The robot and the ball should be placed such that they fully cover the selected point. There are 42 such pairs.</p> <p>Once the position has been set, a stopwatch will be started, and the robot can move.</p> <p>The stopwatch is stopped either when the ball contacts the back of the goal, indicating that a goal has been scored, or when 12 seconds has elapsed without a goal scored.</p> <p>Teams may choose to reset the positions of the ball and the robot should the ball leave the boundaries of the field for more than 3 seconds.</p> <p>On scoring a goal, or if no goal is scored within the 12 seconds, teams will move on to the next random set of points, until each of the 42 points are exhausted.</p> <p>The score for this challenge will be computed based on the time taken by the team to complete the 42-point cycle. In cases where the robot is unable to score within the 12 seconds, a further 3 second penalty is added to the total time. A lower score is better.</p> <p>Samples:</p> <ol style="list-style-type: none"> 30 goals scored, averaging 4 seconds. Score: 120s + 144s + 36s (penalty) 41 goals scored, averaging 8 seconds. Score: 328s + 12s + 3s (penalty) <p>Throughout this process, teams must ensure that all rules of regular gameplay are complied with, with the necessary corrective actions or penalties applied in</p>	<p>In a soccer match, robots must score more than they concede to win.</p> <p>This challenge tests the ability of teams to have their robots score goals regardless of the relative positions of robot and ball.</p> <p>We measure the efficiency of goal scoring, giving us an idea of how many goals the robot is capable of scoring in each time without the presence of any opponent robots.</p> <p>The continuous nature of this challenge also mimics the endurance required in a regular match. Robots must operate for up to 8.4 min, which is close to the 10 min half seen in a real match, accounting for stoppages. The basic durability of the robot, and sufficiency of battery capacity is tested.</p>



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	<p>the case that a rule is broken while attempting this challenge.</p> <p>Bonus: Teams must make it known to the referees that they will be attempting the challenge with the bonus rule in place before it begins.</p> <p>If the bonus rule is being attempted, an additional random number between 1 and 3 (inclusive) will be drawn, with 1 corresponding to the left, 2 the middle, and 3 the right of the goal. The team will place their second robot in front of the goal, and within the penalty area, at the drawn position.</p> <p>At the end of the challenge, the score will be adjusted by a multiplier of 0.7 to reflect the increased difficulty of the task. This bonus rule is meant to provide a more dynamic alternative to the Precision Shooter challenge originally proposed as a Technical Challenge.</p>	
Precision Movement	<p>For this challenge, the 5 neutral points will be used, along with 2 additional points at the intersections between the line dividing the 2 halves of the field and the field boundaries, and the 4 corners of the field boundaries, for a total of 11 points (numbered 1 to 7).</p> <p>A randomizer will be used to determine the order of traversal between the points. Teams will be given 1 minute to input the sequence of points and to upload the program to their robot. Once this process has been completed, a stopwatch will be started, and the robot can move.</p> <p>The robot must visit each point sequentially. A visit is deemed successful if the robot comes to a complete stop for at least 3s, covering the point entirely.</p> <p>The stopwatch is stopped either when the team indicates the end of the attempt verbally, or when the sequence is successfully completed.</p> <p>The score for this challenge will be computed based on the time taken by the team to complete the 11-point sequence. For each point that is not visited after the stopwatch has been stopped, a further 15 second penalty is added to the total time. A lower score is better.</p>	<p>In a soccer match, most strategies would require knowledge of where the robot is within the field. This aids in tasks such as adopting a defensive formation and staying within boundaries.</p> <p>Additionally, the robot would have to be able to move to these points quickly and accurately as the robot that manages to reach the location target the quickest is usually the one which is able to dictate the strategy and play.</p> <p>This challenge tests the ability of robots to transition between points while avoiding traversal of prohibited areas such as the penalty area and the out-of-bounds regions.</p>



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	<p>Samples:</p> <ol style="list-style-type: none"> 1. 8 points visited in 48s. Score: 48s + 45s (penalty) 2. 3 points visited in 12s. Score: 12s + 120s (penalty) <p>Throughout this process, teams must ensure that all rules of regular gameplay are complied with, with the necessary corrective actions or penalties applied in the case that a rule is broken while attempting this challenge.</p>	We measure the efficiency and accuracy of this movement.
Robustness in the Presence of other Agents	<p>For this Challenge, one of the 2 corners of the field boundary along the Blue Goal will be randomly selected as the starting point of the moving robot. One of the 5 neutral points will be randomly selected, and the second (stationary) robot will be placed on this point.</p> <p>Once the randomisation is complete, teams are to place the 2 robots in the positions determined by the randomizer.</p> <p>A stopwatch is then started, and robots are then allowed to move.</p> <p>The moving robot is to move to the line of the penalty box for the Yellow Goal, stopping for 3 seconds. Once the 3 seconds are up, the robot should move to the other corner which was not randomly selected, coming to a full stop. The stopwatch is stopped when this happens.</p> <p>Throughout this process, the 2 robots on the field should not come into contact. If they do, the robots should be reset to their original positions, with the challenge continuing without the stopwatches being reset.</p> <p>The score for this challenge is simply the total time elapsed. Should the robot not complete the challenge, or take longer than 30s, the attempt will be scored at 30s.</p> <p>Throughout this process, teams must ensure that all rules of regular gameplay are complied with, with the necessary corrective actions or penalties applied in the case that a rule is broken while attempting this challenge.</p>	<p>One challenge with evaluation without an adversary would be that the field would be entirely static, without other agents. Challenges pertaining to the presence and movement of other agents will not be apparent in the challenges mentioned above.</p> <p>This challenge tries to introduce the challenges of localisation in the presence of other agents.</p>
Staying within Bounds	For this challenge, the 5 neutral spots will be used for the initial positioning of the 2 robots. 6 additional	While the field boundaries have been

	<p>points (4 in the corners of the field, 2 at the midpoints of the left and right walls) will be used for the initial positioning of the ball.</p> <p>A randomizer will be used to select the 2 points, one for the static robot, one for the moving robot, and one for the ball.</p> <p>When this is completed, start the robot.</p> <p>Start the stopwatch as soon as the robot contacts the outer boundary (white line) of the field or when the robot has reached an equilibrium position. In the latter case, the team must show that the robot continues to track the ball when it is returned into the field after the challenge is completed. In both cases, the robot must attempt to approach the ball.</p> <p>Stop the stopwatch when the entire robot leaves the boundary, or when 5 seconds has elapsed without the robot leaving the boundary.</p> <p>The score for this challenge will be 5 seconds subtract the time elapsed. A lower score is better.</p> <p>Sample: Robot leaves the outer boundary at 3.2s, resulting in a score of 1.8s.</p> <p>Note that teams are to run their robots at a speed similar to what they have presented in the other challenges. Where this is in question, the referees reserve all rights to check all material to validate that this is indeed the case.</p>	<p>introduced for several years, teams still have trouble maintaining a balance between speed and control. When travelling at high speeds, robots are either unable to respond in time to the line or are unable to detect it entirely.</p> <p>This challenge tests the ability of the robot to stay within the stipulated bounds.</p> <p>The presence of a static robot simulates an actual match more closely.</p>
Additional Skills	<p>In the description for the skill exhibited, teams should include a) the landmarks on the field that are being used b) the materials that are required (ball, 1 or 2 robots etc.). Effort should be made to ensure that these are specific. In addition, no material outside that which is required during normal gameplay should be used. Should there be a randomisation element, teams should try to build these randomisers on online IDEs such that the code can be inspected.</p> <p>Teams will also need to provide a test methodology, specifying each step of the process, as well as how the challenge will be scored.</p>	<p>Teams are encouraged to showcase any additional skills that they have developed for their robots. This is to encourage innovation beyond what has been prescribed by the rules. In addition, these skills can be considered for future skill challenges should they prove to correlate with in-game outcomes.</p>



4. Qualification Materials

1) Hardware Designs

- a. In order of preference: CAD renders of different views, images. Each stage of assembly should be showcased.
- b. Teams are to ensure that all components are visible in the submitted material, and that the relative positions of these components can be determined visually
- c. This is NOT a bill of materials. Teams should not be listing and taking photos of individual components
- d. Teams should NOT share CAD files of full designs. This is to ensure that the work is not copied. However, partial components, such as motor mounts may be shared

2) Software Designs

- a. Teams are to upload a flow chart for all algorithms utilised. This should be accompanied by descriptions of the workings of each component of the algorithm.

3) Engineering Logbook

- a. Teams should keep a detailed log of their design process, including sketches and notes, showcasing the iterative process taken to reach the final product
- b. The engineering logbook will be used to verify that the work is done by the team

4) Proof of Rule Compliance

- a. To ensure compliance with the rules, teams should submit an unedited, single-take video of the [Rule Compliance](#) tasks being done in sequence, ensuring that both the robots always remain in full view of the camera. The order of tasks can be modified such that teams can present as best as possible.
- b. Unfortunately, without physical verification, there will be room for some rules to be violated. In adherence to the spirit of the competition, teams should make the utmost effort in ensuring that the video produced is as clear as possible. While we are limited to the use of common items, teams can and should use other items of known properties (dimensions, colour etc.) to justify their claims.
- c. When in doubt, members of the Organising Committee (OC) reserve the right to request that teams redo this video at any point in the competition. Where ethical breaches are found, the OC may disqualify teams on the grounds of unsportsmanlike conduct.
- d. For tasks involving robots, teams should perform them for both robots, one at a time. Robots should be placed in different halves of the field to ensure that they are not mixed up. This also applies to teams using two robots with identical hardware configurations.

5) Notes

- a. All material submitted will be shared among all participants. This is in the spirit of the competition, and will aid in moving everyone forward



Code of Conduct

Fair Play

- a) RCJ Soccer is built upon the foundation of fairness, respect, and friendship.
- b) Mentors (teachers, parents, chaperones, translators, and other adult members) are not allowed to be involved in the programming of students' robots or perform other assistance work.

Sharing

- a) Teams are encouraged to share their programming and strategies with members after the competition.
- b) Any developments may be published on the CoSpace Robot website after the event.
- c) CoSpace Grand Prix sharing furthers the mission of RoboCupJunior as an educational initiative.

Spirit

- a) It is expected that all participants (students and mentors alike) will respect the RoboCup Asia Pacific mission.
- b) It is not whether you win or lose, but how much you learn that counts!

Conflict Resolution

Official

- a) Official from RoboCup Singapore Technical and Organising Committee and train referees will be the judges for the challenge.
- b) In any case, official will not stop the game unless any unforeseen situation appears. Official will communicate with the team leader to explain the action taken in case any interruption is carried out.
- c) During the CoSpace Grand Prix, the officials' decisions are final.

Rule Clarification

- a) If necessary, a rule clarification may be made by an official from the CoSpace Technical Committee and Organizing Committee, even during a tournament.

Competition

- a) Submission of qualification materials
 - Teams are required to submit all materials listed in section 4 before the given deadline.
- b) Live online interview
- c) Skill evaluation



Appendix

C Kicker Power Measuring Device

All robot kickers will be tested with the ball used in the sub-league they participate in.

3.1 Preamble

This Kicker Power Measuring Device can measure the power of a robot's kicker. It is easy to build with commonly accessible materials.

This device can measure the power of a robot's kicker up to a length of 22cm.



3.2 Materials

Plastic Board	A4 paper size
M3 Spacers (40mm length)	5
M3 Screw	10

3.3 Device schematics

The device schematics can be printed out from the diagram located at the end of the document. Please be advised to check that the software you use to print the schematic does not have a scale to fit option activated (i.e. check that it is configured to print at 100% or actual size scale).



The device schematics shows a straight line past the 22cm mark, while the photo shows the line at that point to be curved. Either straight or curved lines are acceptable, but a curved line will request more difficult cutting and the attached device schematic is simple enough for quick construction.

3.4 Example of device construction

- a) Print out the device schematics.
- b) Paste the paper on a plastic board. The incline line (red lines) should be straight.
- c) Cut out along the lines and drill the holes.
- d) The two boards should be connected using the 40mm spacers.

3.5 Inspection

- a) Place a ball at the bottom of the ramp run of the device, and put the robot in front of the ball, aiming the kicker towards the top of the ramp.
- b) Activate the robot's kicker for a single shot.
- c) Measure the distance that the ball travelled on the device. The distance should not exceed 22 cm.

RoboCupJunior Soccer Rules 2021

Soccer Technical Committee 2020 and 2021:

Georgia Gallant	USA
Javier E. Delgado Moreno	Mexico
Hikaru Sugiura	Japan
Marco Dankel	Germany
Felipe Nascimento Martins	Netherlands
Marek Šuppa	Slovakia (CHAIR)

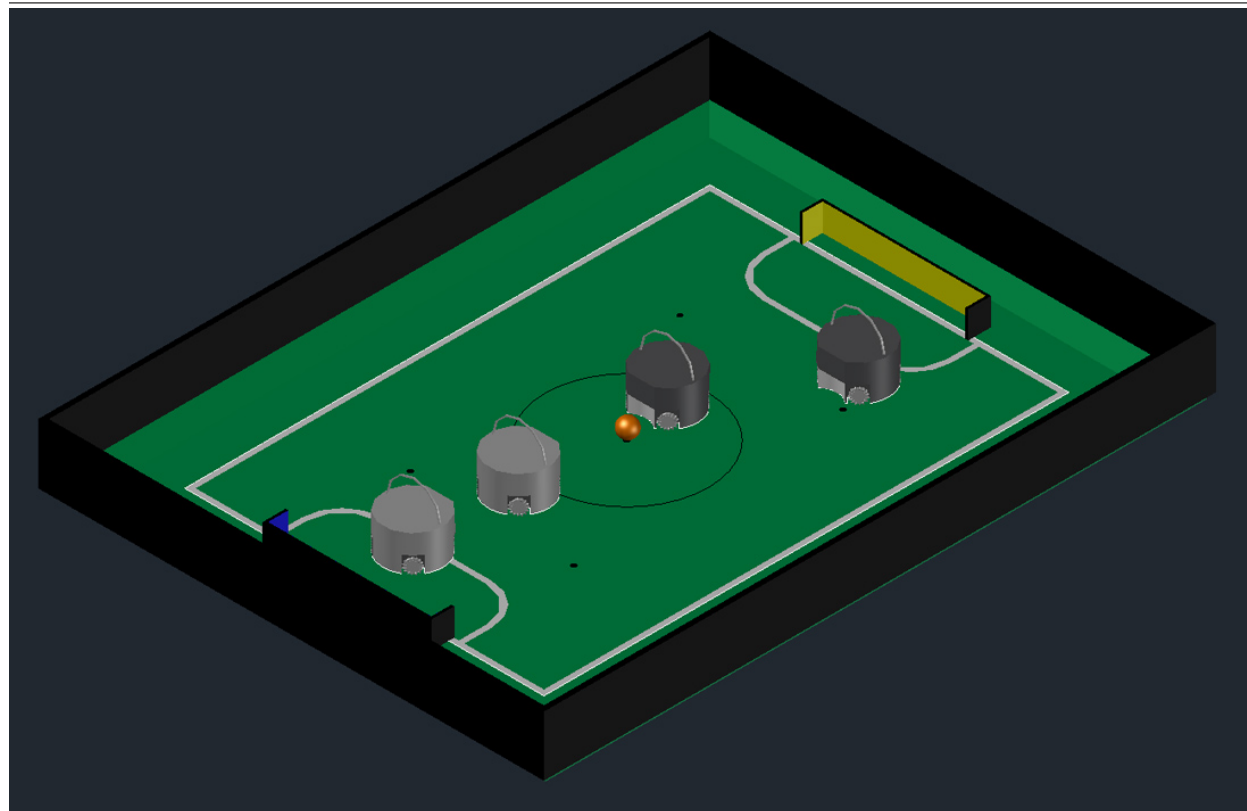
Soccer Technical Committee 2019:

Tairo Nomura	Japan
James Riley	Australia
Mikail S. Arani	Canada
Javier E. Delgado Moreno	Mexico
Felipe Nascimento Martins	Netherlands
Marek Šuppa	Slovakia (CHAIR)

These are the official Soccer rules for RoboCupJunior 2021. They are released by the RoboCupJunior Soccer Technical Committee (TC). The English version of these rules has priority over any translations.

Teams are advised to check the RoboCupJunior Soccer site <https://junior.forum.robocup.org/> for OC (Organizational Committee) procedures and requirements for the international competition. Each team is responsible for verifying the latest version of the rules prior to competition.¹

Figure 1 Two teams of two robots with an orange ball on a RoboCupJunior Soccer field.



¹ The current version of these rules can be found at <https://robocupjuniortc.github.io/soccer-rules/master/rules.html> in HTML form and at <https://robocupjuniortc.github.io/soccer-rules/master/rules.pdf> in PDF form.

Preface

In the RoboCupJunior Soccer challenge, teams of young engineers design, build, and program two fully autonomous mobile robots to compete against another team in matches. The robots must detect a ball and score into a color-coded goal on a special field that resembles a human soccer field.

To be successful, participants must demonstrate skill in programming, robotics, electronics and mechatronics. Teams are also expected to contribute to the advancement of the community as a whole by sharing their discoveries with other participants and by engaging in good sportsmanship, regardless of culture, age or result in the competition. **All are expected to compete, learn, have fun, and grow.**

RoboCupJunior Soccer consist of two sub-leagues: **Soccer Open** and **Soccer Lightweight**. These rules apply for both sub-leagues. There are two main differences between the two leagues.

- **Soccer Lightweight** is played using a special ball that emits an IR signal ball. Robots may weigh up to 1.1 kg, may have a ball-capturing zone of up to 3.0 cm, and may use batteries up to 12.0 V nominal voltage.
- **Soccer Open** is played using a passive, brightly colored orange ball. Robots may weigh up to 2.4 kg, may have a ball-capturing zone of up to 2.5 cm, and may use batteries up to 15.0 V nominal voltage.

Please see Rule 5, **BALL** for balls specifications and Rule 8, **LEAGUE REGULATIONS** for more details for specifications/regulations.

*If you would like to start with RoboCupJunior Soccer, please contact the organizer of your regional RoboCupJunior competition and ask them about Rule 9.5, **Intro League**.*

Changes from 2019 (and 2020) RoboCupJunior Soccer Rules

The changes determined by the Technical Committee for this year's rules aim to reduce the amount of "sumo-like" gameplay while making it more interesting by introducing new challenges and standard situations.

Most of the changes listed below were already present in the rules of 2020. Since the physical competition didn't take place, we decided to keep those in the list for convenience.

- Deleted "Goalie has to approach the ball in the whole penalty area."
- Deleted "Robots must be constructed in a way that they do not enter the goal. Robots are allowed to use the cross-bar in order to avoid entering the goal. This rule applies to all robots on the field. Any robot that moves into the goal 3 times during a period of 20 seconds is deemed to be damaged (see §damaged-robots, Damaged Robots§)."
- Deleted "It is recommended that the field be positioned 70 to 90 cm off the ground."
- Deleted "It has a cross-bar on top (to prevent robots from entering the goal and to allow checking if the ball scored). The height of the cross-bar is 2 +/- 1 cm."
- Deleted "The cross-bar is exactly over the white line."
- Deleted "A robot is considered inside the Penalty Area when it is completely inside."
- Added "No robots are supposed to be fully inside the penalty area. As the penalty areas are marked with a white line, the Out of Bounds rule applies to this line as well."

- Added "If an attacking and a defending robot touch each other while at least one of them is at least partially inside the penalty area, and at least one of them has physical contact with the ball, this is called "pushing" and the ball will be moved to the furthest unoccupied neutral spot immediately."
- Added "If two robots from the same team are at least partially in the penalty area, one of these robots will be moved to the furthest unoccupied neutral spot immediately. If this happens repeatedly, a robot may be deemed damaged at referee's discretion."
- Added "If a goal is scored as a result of this "pushing" situation, it will not be granted."
- Added "For specific Lightweight regulations see [regulations-inference-in-lightweight](#)"
- Added "A robot must touch the ball that is placed no further than 20 cm from any point on its convex hull within 10 seconds. If a robot does not do so within the time limit, it is deemed to be damaged."
- Added "It is recommended that the blue be of a brighter shade so that it is different enough from the black exterior."
- Added "The Technical Committee plans to decrease the diameter/height of robots in the Open sub-league to 18 cm and the weight limit to 2200g for the 2022 season. It further plans to replace the current orange ball with a standard orange golf ball."
- Added "In Lightweight, the robot must not emit infrared light."
- Added "In Lightweight, infrared light reflecting materials must not be used on the outside. If robots are painted, they must be painted matte. Minor parts that reflect infrared light could be used as long as other robots are not affected."
- Added "In Soccer, a penalty kick takes place after a grave offense happens. The aim of this technical challenge is to see whether something similar can be done within the limits of RoboCupJunior Soccer."
- Added "Since the TC plans to move to an orange golf ball in Open, this should open up new options for gameplay. Given the smaller size and weight of golf balls, it should be possible to kick them not just horizontally (as if in "2D") but also vertically (that is, to get the ball into the air)."
- Added "The task in this technical challenge is to score into the open yellow goal from the other (blue) half of the field. In order to pass the challenge, the ball can only touch the other (yellow) half of the field inside the penalty area and the goal itself. Note that a golf ball (not necessarily orange) needs to be used."
- Added "There will also be a SuperTeam competition, in which various people from around the world share their robots in one "SuperTeam" and play against other SuperTeams on a so called "Big Field". The full rules of this challenge can be found at"
- Added "In order to help newcomers experience the RoboCupJunior Soccer competition, the TC would like to encourage local regional competitions to include a so called "Intro League". Although such a league will not be part of the international competition, the TC still believes that it is worthwhile to make it part of regional and super-regional competitions. Each regional and super-regional competition will likely have its specific rules for the rules but the TC would like to suggest they contain the following:"
- Added "The Intro League should be at least to some extent based on the RoboCupJunior Soccer rules"
- Added "Only competitors that did not previously participate in an international (that is not a regional or super-regional) competition are allowed to take part."

- Added "It may be worth creating two sub-leagues: a 2v2 one where two robots from one team play against two robots from the other, and a 1v1 one where both teams play with just one robot."
- Added "The Intro League should ignore the Out of Bounds rule. When robots go out of bounds, the referee should put them back in."
- Added "The robots should be created from official Lego or Fishertechnik kits, except for sensors necessary for robots to be able to find the ball (i.e. ball detector) and the orientation of the field (i.e. compass)."
- Added "The robots should be limited in size to 22,4cm by 22,4cm by 22,4cm (all measurements +/- 1cm). There shall be no weight limit."
- Changed "When the goal difference reaches 10 the game finishes regardless of the state of the game clock." to "The final game score will be trimmed so that there is at most 10 goal difference between the losing and the winning team."
- Changed "any other" to "an opposing"
- Changed "22 +/- 2 cm of height" to "at least 5 cm above the highest structure of the robot"
- Changed "122 cm by 183 cm" to "132 cm by 193 cm"
- Changed "30 cm" to "25 cm"
- Changed "30 cm" to "25 cm"
- Changed "90 cm" to "70 cm"
- Changed "black" to "white"
- Changed "The fields should be placed in a way that the influence by external infrared light is as low as possible and that the magnetic field of the earth is disturbed as little as possible. Perfect conditions cannot be guaranteed, however. Teams must come to tournaments being prepared to calibrate their robots based on the lighting and magnetic conditions at the venue." to "The organizers will do their best to limit the amount of external lightning and magnetic interference. However, the robots need to be constructed in a way which allows them to work in conditions that are not perfect (i.e. by not relying on compass sensors or specific lightning conditions)."

Construction and Programming have to be performed exclusively by the students

Robots must be constructed and programmed exclusively by student members of the team. Mentors, teachers, parents or companies should not be involved in the design, construction, assembly, programming or debugging of robots. To avoid embarrassment and possible disqualification, it is extremely important that teams abide by Rule 8, **LEAGUE REGULATIONS**, especially Rule 8.2.D, **Construction** and Rule 8.2.E, **Programming**, and all other competitor's rules.

If in doubt, please consult with your Regional Representative before registering your team.

1 GAMEPLAY

1.1 Game procedure and length of a game

- 1.1.1 RCJ Soccer games consist of two teams of robots playing soccer against each other. Each team has two autonomous robots. The game will consist of two halves. The duration of each half is 10-minutes. There will be a 5-minute break in between the halves.

- 1.1.2 The game clock will run for the duration of the halves without stopping (except if or when a referee wants to consult another official). The game clock will be run by a referee or a referee assistant (see Rule 7.1, **Referee and referee assistant** for more information on their roles).
- 1.1.3 Teams are expected to be on the field 5 minutes before their game starts. Being at the inspection table does not count in favor of this time limit. Teams that are late for the start of the game can be penalized one goal **per 30 seconds** at the referee's discretion.
- 1.1.4 **The final game score will be trimmed so that there is at most 10 goal difference between the losing and the winning team.** ²

1.2 Pre-match meeting

- 1.2.1 At the start of the first half of the game, a referee will toss a coin. The team mentioned first in the draw shall call the coin. The winner of the toss can choose either which end to kick towards, or to kick off first. The loser of the toss chooses the other option. After the first half, teams switch sides. The team not kicking off in the first half of the game will kick off to begin the second half of the game.
- 1.2.2 During the pre-match meeting the referee or their assistant may check whether the robots are capable of playing (i.e., whether they are at least able to follow and react to the ball). If none of the robots is capable of playing, the game will not be played and zero goals will be awarded to both teams.

1.3 Kick-off

- 1.3.1 Each half of the game begins with a kick-off. All robots must be located on their own side of the field. All robots must be halted. The ball is positioned by a referee in the center of the field.
- 1.3.2 The team kicking off places their robots on the field first.
- 1.3.3 The team not kicking off will now place their robots on the defensive end of the field. All robots on the team not kicking off must be at least 30 cm away from the ball (outside of the center circle).
- 1.3.4 Robots cannot be placed {-behind the goal line or-} out of bounds. Robots cannot be repositioned once they have been placed, except if the referee requests to adjust their placement to make sure that the robots are placed properly within the field positions.
- 1.3.5 On the referee's command (usually by whistle), all robots will be started immediately by each captain. Any robots that are started early will be removed by the referee from the field and deemed damaged.
- 1.3.6 Before a kick-off, **all damaged or out-of-bounds robots** are allowed to return to the playing field immediately if they are *ready and fully functional*.
- 1.3.7 If no robots are present at a kick-off (because they have moved out-of-bounds Rule 1.9, **Out of bounds** or are damaged Rule 1.10, **Damaged robots**), the penalties are discarded and the match resumes with a Rule 1.3.A, **Neutral kick-off**.

1.3.A Neutral kick-off

- 1.3.A.1 A neutral kick-off is the same as the one described in Rule 1.3, **Kick-off** with a small change: all robots need must be at least 30 cm away from the ball (outside of the center circle).

² In previous version this said "When the goal difference reaches 10 the game finishes regardless of the state of the game clock."

1.4 Human interference

- 1.4.1 Except for the kick-off, human interference from the teams (e.g. touching the robots) during the game is not allowed unless explicitly permitted by a referee. Violating team/team member(s) can be disqualified from the game.
- 1.4.2 The referee or a referee assistant can help robots get unstuck if the ball is not being disputed near them and if the situation was created from normal interaction between robots (i.e. it was not a design or programming flaw of the robot alone). The referee or a referee assistant will pull back the robots just enough for them to be able to move freely again.

1.5 Ball movement

- 1.5.1 A robot cannot hold a ball. Holding a ball is defined as taking full control of the ball by removing all of degrees of freedom. Examples for ball holding include fixing a ball to the robot's body, surrounding a ball using the robot's body to prevent access by others, encircling the ball or somehow trapping the ball with any part of the robot's body. If a ball does not roll while a robot is moving, it is a good indication that the ball is trapped.
- 1.5.2 The only exception to holding is the use of a rotating drum (a "dribbler") that imparts dynamic back spin on the ball to keep the ball on its surface.
- 1.5.3 Other players must be able to access the ball.

1.6 Scoring

- 1.6.1 A goal is scored when the ball strikes or touches the back wall of the goal. Goals scored either by an attacking or defending robot have the same end result: they give one goal to the team on the opposite side. After a goal, the game will be restarted with a kick-off from the team who was scored against.

1.7 Inside the Penalty Area

- 1.7.1 **No robots are supposed to be fully inside the penalty area. As the penalty areas are marked with a white line, the Out of Bounds rule applies to this line as well.** (Rule 1.9, Out of bounds)
- 1.7.2 **If an attacking and a defending robot touch each other while at least one of them is at least partially inside the penalty area, and at least one of them has physical contact with the ball, this is called "pushing" and the ball will be moved to the furthest unoccupied neutral spot immediately.**
- 1.7.3 **If two robots from the same team are at least partially in the penalty area, one of these robots will be moved to the furthest unoccupied neutral spot immediately. If this happens repeatedly, a robot may be deemed damaged at referee's discretion.** (Rule 1.10, Damaged robots)
- 1.7.4 **If a goal is scored as a result of this "pushing" situation, it will not be granted.**

1.8 Lack of progress

- 1.8.1 Lack of progress occurs if there is no progress in the gameplay for a reasonable period of time and the situation is not likely to change. Typical lack of progress situations are when the ball is stuck between robots, when there is no change in ball and robot's positions, or when the ball is beyond detection or reach capability of all robots on the field.

- 1.8.2 After a visible and loud count ³, a referee will call "lack of progress" and will move the ball to the nearest unoccupied neutral spot. If this does not solve the lack of progress, the referee can move the ball to a different neutral spot.

1.9 Out of bounds

- 1.9.1 If a robot's entire body moves out beyond the white line of the field, it will be called for being out of bounds. When this situation arises, the robot is given a one-minute penalty, and the team is asked to remove the robot from the field. There is no time stoppage for the game itself. The robot is allowed to return if a kick-off occurs before the penalty has elapsed.
- 1.9.2 The one-minute penalty starts when the robot is removed from play. Furthermore, any goal scored by the penalized team while the penalized robot is on the field will not be granted. Out-of-bounds robots can be fixed if the team needs to do so, as described in Rule 1.10, **Damaged robots**.
- 1.9.3 After the penalty time has passed, robot will be placed on the unoccupied neutral spot furthest from the ball, facing its own goal.
- 1.9.4 A referee can waive the penalty if the robot was accidentally pushed out of bounds by **an opposing** ⁴ robot. In such a case, the referee may have to slightly push the robot back onto the field.
- 1.9.5 The ball can leave and bounce back into the playing field. The referee calls **out of reach**, and will move the ball to the nearest unoccupied neutral spot when one of the following condition occurs:
1. the ball remains outside the playing field too long, after a visible and loud count ⁵,
 2. any of the robots are unable to return it into the playing field (without their whole body leaving the playing field), or
 3. the referee determines that the ball will not come back into the playing field.

1.10 Damaged robots

- 1.10.1 If a robot is damaged, it has to be taken off the field and must be fixed before it can play again. Even if repaired, the robot must remain off the field for at least one minute or until the next kick-off is due.
- 1.10.2 Some examples of a damaged robot include:
- it does not respond to the ball, or is unable to move (it lost pieces, power, etc.).
 - it continually moves into the goal or out of the playing field.
 - it turns over on its own accord.
- 1.10.3 Computers and repair equipment are not permitted in the playing area during gameplay. Usually, a team member will need to take the damaged robot to an "approved repair table" near the playing area. A referee may permit robot sensor calibration, computers and other tools in the playing area, only for the 5 minutes before the start of each half. Reprogramming of robots during the gameplay can only happen when they are out of game (i.e., damaged or out of bounds), or when explicitly allowed by the referee.

³ usually a count of three, the length of the count could be decided by the OC before a competition as long as it's the same length within a sub-league

⁴ In previous version this said "any other"

⁵ usually a count of three, the length of the count could be decided by the OC before a competition as long as it's the same length within a sub-league

- 1.10.4 After a robot has been fixed, it will be placed on the unoccupied neutral spot furthest from the ball, facing its own goal. A robot can only be returned to the field if the damage has been repaired. If the referee notices that the robot was returned to the field with the same original problem, s/he may ask the robot to be removed, and proceed with the game as if the robot had not been returned.
- 1.10.5 **Only the referee decides whether a robot is damaged.** A robot can only be taken off or returned with the referee's permission.
- 1.10.6 If both robots from the same team are deemed damaged at kick-off, gameplay will be paused and the remaining team will be awarded 1 goal for each elapsed 30 seconds that their opponent's robots remain damaged. However, these rules only apply when none of the two robots from the same team were damaged as the result of the opponent team violating the rules.
- 1.10.7 Whenever a robot is removed from play, its motors must be turned off.

1.11 Interruption of Game

- 1.11.1 In principle, a game will not be stopped.
- 1.11.2 A referee can stop the game if there is a situation on or around the field which the referee wants to discuss with an official of the tournament or if the ball malfunctions and a replacement is not readily available.
- 1.11.3 When the referee has stopped the game, all robots must be stopped and remain on the field untouched. The referee may decide whether the game will be continued/resumed from the situation in which the game was stopped or by a kick-off.

2 TEAM

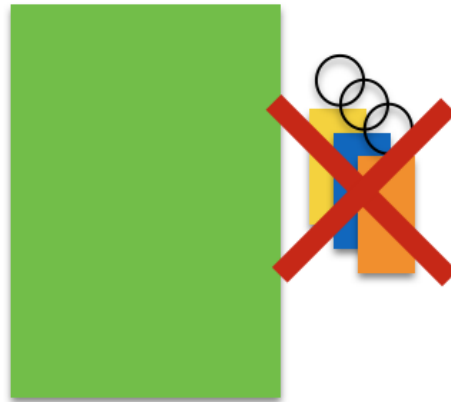
2.1 Regulations

- 2.1.1 A team must have more than one member to form a RoboCupJunior team to participate in the International event. A team member(s) and/or robot(s) cannot be shared between teams.
- 2.1.2 Each team member needs to carry a technical role.
- 2.1.3 Each team must have a **captain**. The captain is the person responsible for communication with referees. The team can replace its captain during the competition. Team is allowed to have at most two members beside the field during game play: they will usually be the captain and an assistant team member.

2.2 Violations

- 2.2.1 Teams that do not abide by the rules are not allowed to participate.
- 2.2.2 Any person close to the playing field is not allowed to wear any orange, yellow or blue clothes that can be seen by the robots (to avoid interference). A referee can require a team member to change clothes or to be replaced by another team member if interference is suspected.
- 2.2.3 The referee can interrupt a game in progress if any kind of interference from spectators is suspected (color clothing, IR emitters, camera flashes, mobile phones, radios, computers, etc.).
- 2.2.4 This needs to be confirmed by an OC member if a claim is placed by the other team. A team claiming that their robot is affected by colors has to show the proof/evidence of the interference.

Figure 2 Anyone close to the playing field is not allowed to wear orange, yellow or blue clothes



3 ROBOTS

3.1 Number of robots / substitution

- 3.1.1 Each team is allowed to have at most two robots for the full tournament. The substitution of robots during the competition within the team or with other teams is forbidden.

3.2 Interference

- 3.2.1 Robots are not allowed to be colored orange, yellow or blue in order to avoid interference. Orange, yellow, blue colored parts used in the construction of the robot must either be occluded by other parts from the perception by other robots or be taped/painted with a neutral color.
- 3.2.2 Robots must not produce magnetic interference in other robots on the field.
- 3.2.3 Robots must not produce visible light that may prevent the opposing team from playing when placed on a flat surface. Any part of a robot that produces light that may interfere with the opposing robot's vision system must be covered.
- 3.2.4 **For specific Lightweight regulations see Rule 8.2.B, Infrared interference in Lightweight**
- 3.2.5 A team claiming that their robot is affected by the other team's robot in any way must show the proof/evidence of the interference. Any interference needs to be confirmed by an OC member if a claim is placed by the other team.

3.3 Control

- 3.3.1 The use of remote control of any kind is not allowed during the match. Robots must be started and stopped manually by humans and be controlled autonomously.

3.4 Communication

- 3.4.1 Robots are not allowed to use any kind of communication during game play unless the communication between two robots is via Bluetooth class 2 or class 3 ⁶ or via any other device that communicates using the 802.15.4 protocol (e.g., ZigBee and XBee).
- 3.4.2 Teams are responsible for their communication. The availability of frequencies cannot be guaranteed.

3.5 Agility

- 3.5.1 Robots must be constructed and programmed in a way that their movement is not limited to only one dimension (defined as a single axis, such as only moving in a straight line). They must move in all directions, for example by turning.
- 3.5.2 Robots must respond to the ball in a direct forward movement towards it. For example, it is not enough to basically just move left and right in front of their own goal, it must also move directly towards the ball in a forward movement. At least one team robot must be able to seek and approach the ball anywhere on the field, unless the team has only one robot on the field at that time. ⁷
- 3.5.3 **A robot must touch the ball that is placed no further than 20 cm from any point on its convex hull within 10 seconds. If a robot does not do so within the time limit, it is deemed to be damaged.** (See **Damaged Robots**.)
- 3.5.4 ⁸

3.6 Handle

- 3.6.1 All robots must have a stable and easily noticeable handle to hold and to lift them. The handle must be easily accessible and allow the robot to be picked up from **at least 5 cm above the highest structure of the robot** ⁹.
- 3.6.2 The dimensions of the handle may exceed the 22 cm height limitation, but the part of the handle that exceeds this 22 cm limit cannot be used to mount components of the robot.

3.7 Top Markers

- 3.7.1 A robot must have markings in order to be distinguished by the referee. Each robot must have a white plastic circle with a diameter of at least 4 cm mounted horizontally on top. This white circle will be used by the referee to write numbers on the robots using markers, therefore the white circles must be accessible and visible.
- 3.7.2 Before the game, the referee will designate the numbers for each robot and will write them on the top white circle. Robots not carrying the top white circle are not eligible to play.

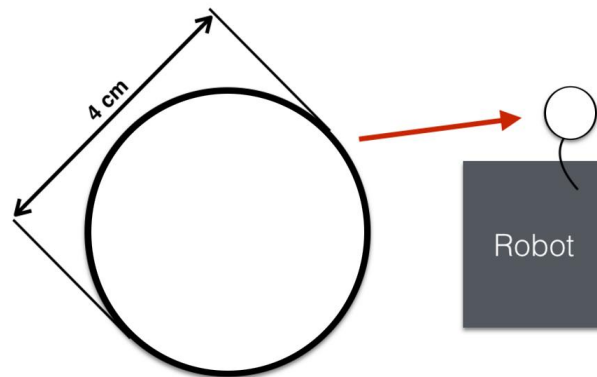
⁶ range shorter than 20 meters

⁷ In previous version this said "Goalie has to approach the ball in the whole penalty area."

⁸ In previous version this said "Robots must be constructed in a way that they do not enter the goal. Robots are allowed to use the cross-bar in order to avoid entering the goal. This rule applies to all robots on the field. Any robot that moves into the goal 3 times during a period of 20 seconds is deemed to be damaged (see **Damaged Robots**)."

⁹ In previous version this said "22 +/- 2 cm of height"

Figure 3 A visualization of the top marker



3.8 Additional regulations of the sub-leagues

- 3.8.1 A tournament may be organized in different sub-leagues. Each sub-league (e.g. **Soccer Open** and **Soccer Lightweight**) has its own additional regulations, including regulations affecting the construction of robots. They are outlined in Rule 8, **LEAGUE REGULATIONS**.

3.9 Violations

- 3.9.1 Robots that do not abide by the specifications/regulations (see Rule 8.2, **Regulations**) are not allowed to play, unless these rules specify otherwise.
- 3.9.2 If violations are detected during a running game the team is disqualified for that game.
- 3.9.3 If similar violations occur repeatedly, the team can be disqualified from the tournament.

4 FIELD

4.1 Kind of field

- 4.1.1 There is only one kind of field for all sub-leagues.

4.2 Dimensions of the field

- 4.2.1 The playing-field is **132 cm by 193 cm**¹⁰. The field is marked by a white line which is part of the playing-field. Around the playing-field, beyond the white line, is an outer area of **25 cm**¹¹ width.
- 4.2.2 The floor near the exterior wall includes a wedge, which is an incline with a 10 cm base and 2 +/- 1 cm rise for allowing the ball to roll back into play when it leaves the playing field.
- 4.2.3 Total dimensions of the field, including the outer area, are 182 cm by 243 cm.
- 4.2.4 ¹²

¹⁰ In previous version this said "122 cm by 183 cm"

¹¹ In previous version this said "30 cm"

¹² In previous version this said "It is recommended that the field be positioned 70 to 90 cm off the ground."

4.3 Walls

- 4.3.1 Walls are placed all around the field, including behind the goals and the out-area. The height of the walls is 22 cm. The walls are painted matte black.

4.4 Goals

- 4.4.1 The field has two goals, centered on each of the shorter sides of the playing field. The goal inner space is 60 cm wide, 10 cm high and 74 mm deep, box shaped. ¹³
- 4.4.2 The goal "posts" are positioned over the white line marking the limits of the field. ¹⁴ The interior walls are painted, one goal yellow, the other goal blue. The exterior (including the goal post and frame) are painted black (see [Field diagrams](#)).
- 4.4.3 **It is recommended that the blue be of a brighter shade so that it is different enough from the black exterior.**

4.5 Floor

- 4.5.1 The floor consists of dark green carpet on top of a hard level surface. All straight lines on the field should be painted and have a width of 20 mm.

4.6 Neutral spots

- 4.6.1 There are five neutral spots defined in the field. One is in the center of the field. The other four are adjacent to each corner, located 45 cm along the long edge of the field, aligned with each goal post towards the middle of the field (from the goal post). The neutral spots can be drawn with a thin black marker. The neutral spots ought to be of circular shape measuring 1 cm in diameter.

4.7 Center circle

- 4.7.1 A center circle will be drawn on the field. It is 60 cm in diameter. It is a thin black marker line. It is there for Referees and Captains as guidance during kick-off.

4.8 Penalty areas

- 4.8.1 In front of each goal there is a **25 cm** ¹⁵ wide and **70 cm** ¹⁶ long penalty area.
- 4.8.2 The penalty areas are marked by a **white** ¹⁷ line of 20 mm width. The line is part of the area.
- 4.8.3 ¹⁸

¹³ In previous version this said "It has a cross-bar on top (to prevent robots from entering the goal and to allow checking if the ball scored). The height of the cross-bar is 2 +/- 1 cm."

¹⁴ In previous version this said "The cross-bar is exactly over the white line."

¹⁵ In previous version this said "30 cm"

¹⁶ In previous version this said "90 cm"

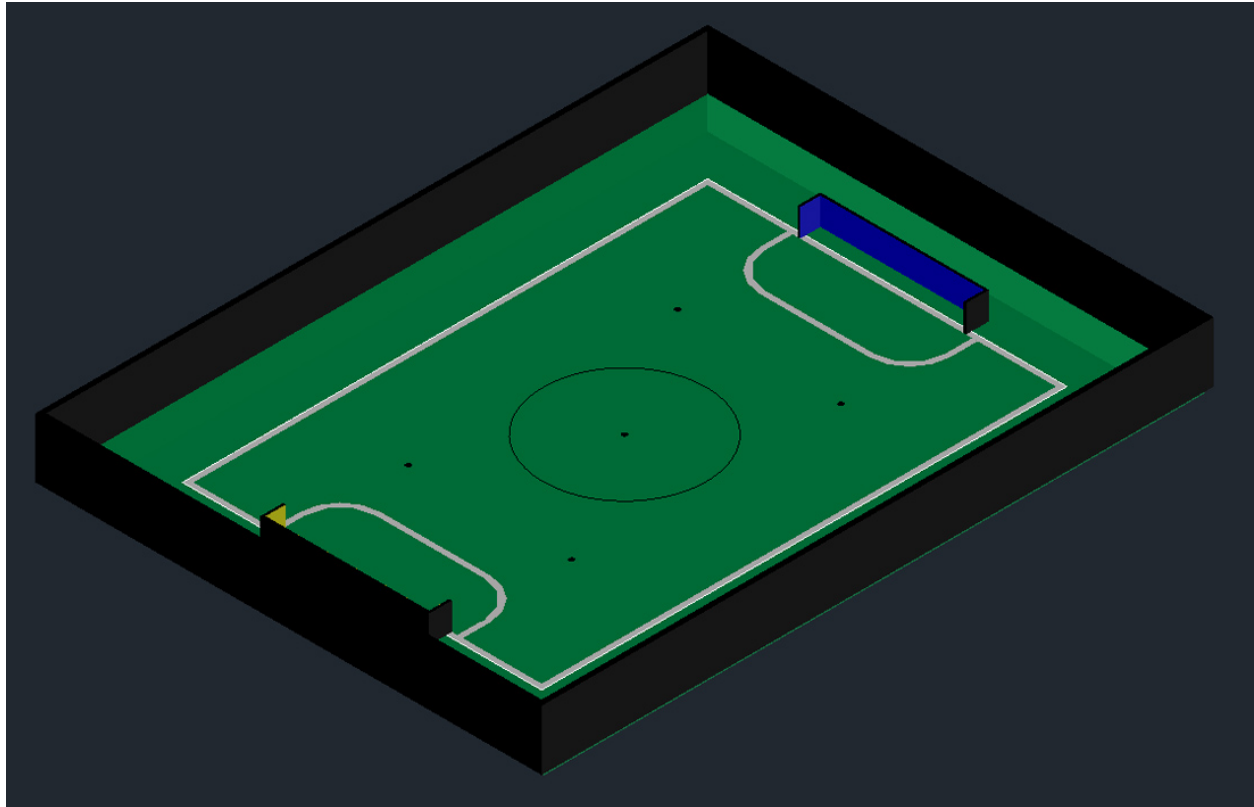
¹⁷ In previous version this said "black"

¹⁸ In previous version this said "A robot is considered inside the Penalty Area when it is completely inside."

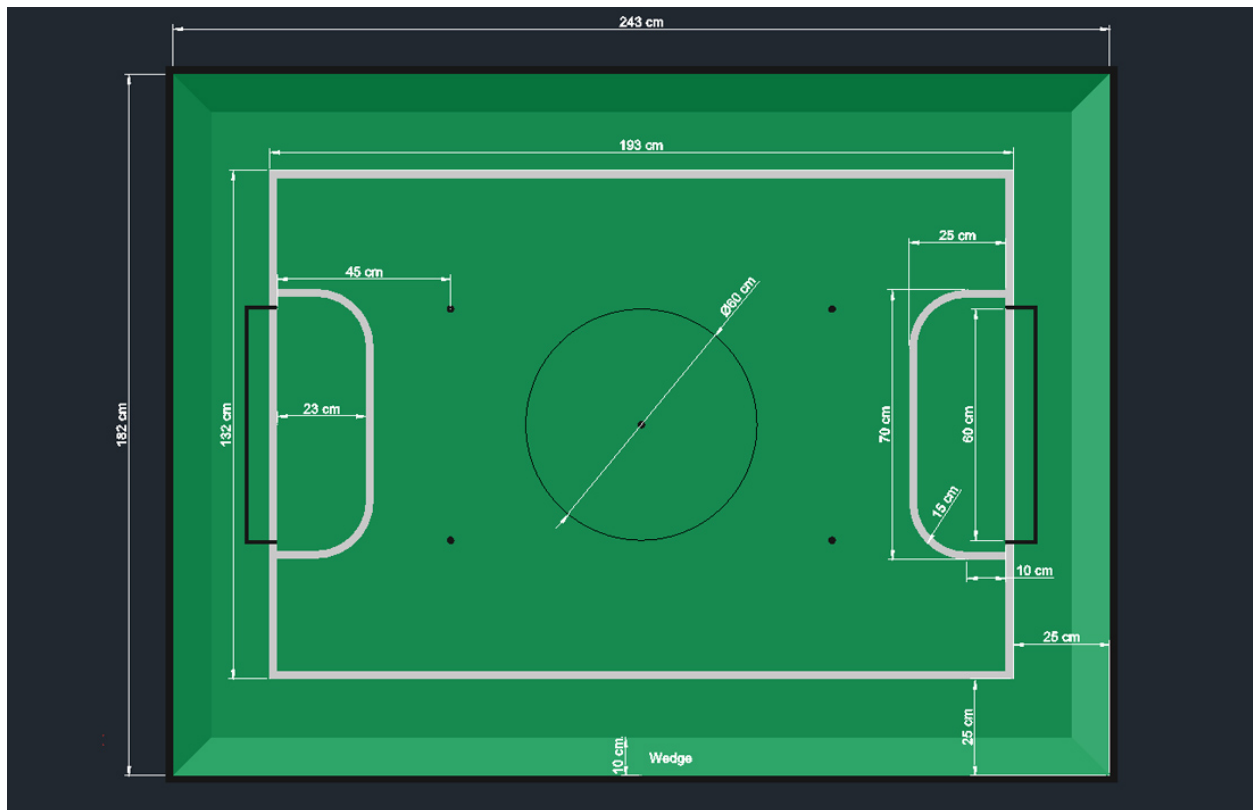
4.9 Lighting and Magnetic Conditions

- 4.9.1 The organizers will do their best to limit the amount of external lightning and magnetic interference. However, the robots need to be constructed in a way which allows them to work in conditions that are not perfect (i.e. by not relying on compass sensors or specific lightning conditions).¹⁹

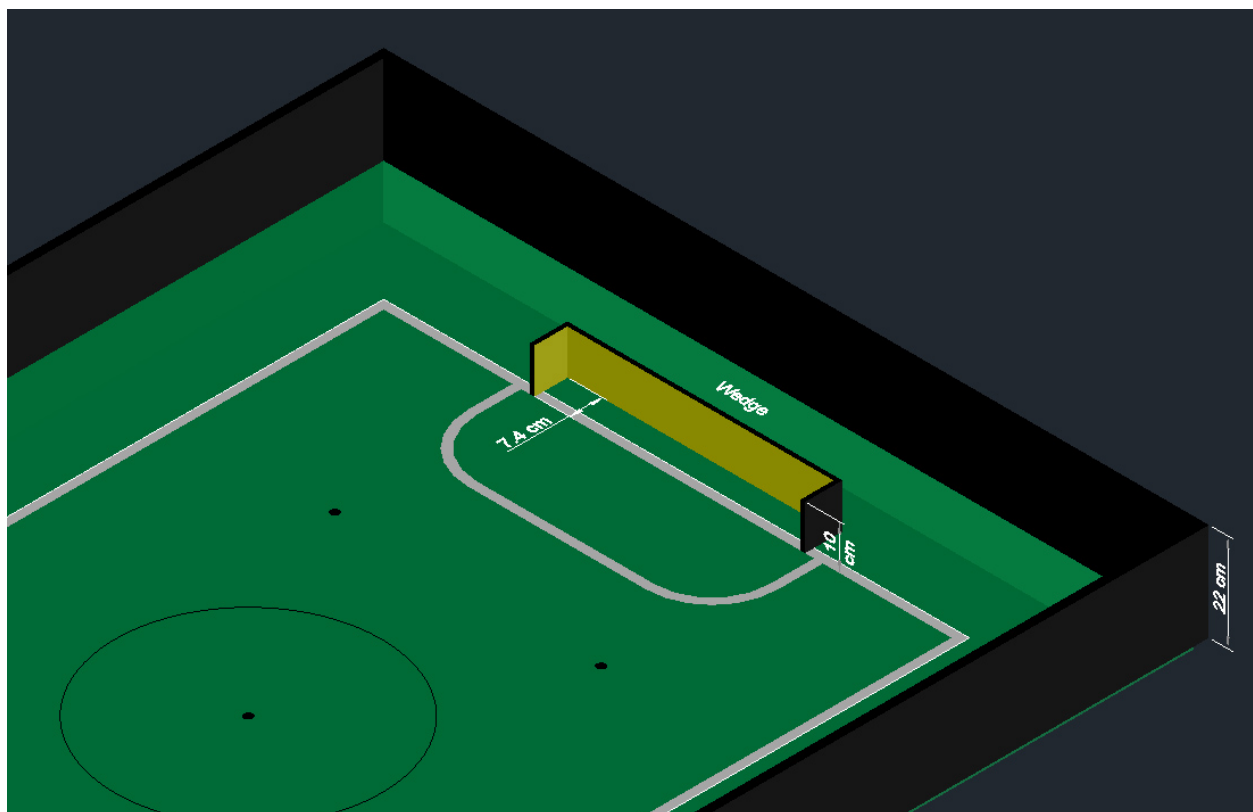
FIELD DIAGRAMS



¹⁹ In previous version this said "The fields should be placed in a way that the influence by external infrared light is as low as possible and that the magnetic field of the earth is disturbed as little as possible. Perfect conditions cannot be guaranteed, however. Teams must come to tournaments being prepared to calibrate their robots based on the lighting and magnetic conditions at the venue."



4.9.3



4.9.4

5 BALL

5.1 Specification for Soccer Lightweight Ball

- 5.1.1 See Appendix A, [Technical Specification for pulsed Soccer Ball](#).

5.2 Specification for Soccer Open Ball

- 5.2.1 See Appendix B, [Technical Specification for passive Soccer Ball](#).

5.3 Tournament balls

- 5.3.1 Balls for the tournament must be made available by the organizers. Organizers are not responsible for providing balls for practice.

6 CODE OF CONDUCT

6.1 Fair Play

- 6.1.1 It is expected that the aim of all teams is to play a fair and clean game of robot soccer. It is expected that all robots will be built with consideration to other participants.
- 6.1.2 Robots are not allowed to cause deliberate interference with or damage to other robots during normal game play.
- 6.1.3 Robots are not allowed to cause damage to the field or to the ball during normal game play.
- 6.1.4 A robot that causes damage may be disqualified from a specific match at the referee's discretion. The OC will also be informed.
- 6.1.5 Humans are not allowed to cause deliberate interference with robots or damage to the field or the ball.

6.2 Behavior

- 6.2.1 All participants are expected to behave themselves. All movement and behavior is to be of a subdued nature within the tournament venue.

6.3 Help

- 6.3.1 Mentors (teachers, parents, chaperones, and other adult team-members including translators) are not allowed in the student work area unless it is explicitly but temporarily permitted by a member of the Organizing Committee. Only participating students are allowed to be inside the work area.
- 6.3.2 **Mentors must not touch, build, repair, or program any robots.**

6.4 Sharing

- 6.4.1 The understanding that any technological and curricular developments should be shared among the RoboCup and RoboCupJunior participants after the tournament has been a part of world RoboCup competitions.

6.5 Spirit

- 6.5.1 It is expected that all participants, students, mentors, and parents will respect the RoboCupJunior mission.
- 6.5.2 ***It is not whether you win or lose, but how much you learn that counts!***

6.6 Violations / Disqualification

- 6.6.1 Teams that violate the code of conduct can be disqualified from the tournament. It is also possible to disqualify only single person or single robot from further participation in the tournament.
- 6.6.2 In less severe cases of violations of the code of conduct, a team will be given a warning by showing it a yellow card. In severe or repeated cases of violations of the code of conduct a team can be disqualified immediately without a warning by showing it the red card.

7 CONFLICT RESOLUTION

7.1 Referee and referee assistant

- 7.1.1 The referee is a person in charge of making decisions with regards to the game, according to these rules, and may be assisted by a referee assistant.
- 7.1.2 **During gameplay, the decisions made by the referee and/or the referee assistant are final.**
- 7.1.3 Any argument with the referee or the referee assistant can result in a warning. If the argument continues or another argument occurs, this may result in immediate disqualification from the game.
- 7.1.4 Only the captain has a mandate to freely speak to the referee and/or their assistant. Shouting at a referee and/or their assistant, as well as demanding a change in ruling can be directly penalized by a warning at the referee's discretion.
- 7.1.5 At the conclusion of the game, the result recorded in the scoresheet is final. The referee will ask the captains to add written comments to the scoresheet if they consider them necessary. These comments will be reviewed by the OC members.

7.2 Rule clarification

- 7.2.1 Rule clarification may be made by members of the RoboCupJunior Soccer Technical Committee and Organizing Committee, if necessary even during a tournament.

7.3 Rule modification

- 7.3.1 If special circumstances, such as unforeseen problems or capabilities of a robot occur, rules may be modified by the RoboCupJunior Soccer Organizing Committee Chair in conjunction with available Technical

Committee and Organizing Committee members, if necessary even during a tournament.

7.4 Regulatory statutes

- 7.4.1 Each RoboCupJunior competition may have its own regulatory statutes to define the procedure of the tournament (for example the SuperTeam system, game modes, the inspection of robots, interviews, schedules, etc.). Regulatory statutes become a part of this rule.

8 LEAGUE REGULATIONS

8.1 Preamble

- 8.1.1 According to rule 3.8 of the RoboCupJunior Soccer Rules, each league has its own additional regulations. They become a part of the rules.
- 8.1.2 For RoboCupJunior 2021, there are two sub-leagues as follows ²⁰:
- Soccer Lightweight
 - Soccer Open
- 8.1.3 All team members need to be within the minimum and maximum age as specified in the RoboCupJunior General Rules which can be found at <http://junior.robocup.org/robocupjunior-general-rules/>.
- 8.1.4 As described in Rule 5.1, **Specification for Soccer Lightweight Ball** and Rule 5.2, **Specification for Soccer Open Ball**, the matches in the Soccer Open sub-league are conducted using a passive ball, whereas the matches in the Soccer Lightweight sub-league are played using the IR ball.

8.2 Regulations

8.2.A Dimensions

- 8.2.A.1 Robots will be measured in an upright position with all parts extended. A robot's dimensions must not exceed the following limits:

sub-league	Soccer Open	Soccer Lightweight
size / diameter	22.0 cm ^[4]	22.0 cm
height	22.0 cm ^{[1] [4]}	22.0 cm ^[1]
weight	2400 g ^{[2] [4]}	1100 g ^[2]
ball-capturing zone	2.5 cm	3.0 cm
voltage	15.0 V ^[3]	12.0 V ^[3]



[1] The handle and the top markers of a robot may exceed the height.

²⁰ biggest differences are described in Rule 8.2.A, **Dimensions**



[2] The weight of the robot includes that of the handle.



[3] We encourage teams to include protection circuits for Lithium-based batteries



[3] Voltage limits relate to the **nominal values**, deviations at the power pack due to the fact that charged will be tolerated.



[4] **The Technical Committee plans to decrease the diameter/height of robots in the Open sub-league to 18 cm and the weight limit to 2200g for the 2022 season. It further plans to replace the current orange ball with a standard orange golf ball.**

8.2.A.2 Ball-capturing zone is defined as any internal space created when a straight edge is placed on the protruding points of a robot. This means the ball must not enter the concave hull of a robot by more than the specified depth. Furthermore, it must be possible for another robot to take possession of the ball.

8.2.B Infrared interference in Lightweight

8.2.B.1 **In Lightweight, the robot must not emit infrared light.**

8.2.B.2 **In Lightweight, infrared light reflecting materials must not be used on the outside. If robots are painted, they must be painted matte. Minor parts that reflect infrared light could be used as long as other robots are not affected.**

8.2.C Limitations

8.2.C.1 A single robot can only use one camera. All commercial omnidirectional lenses/cameras are not permitted. Only omnidirectional lenses/cameras made by students are permitted, meaning that their construction needs to be primarily and substantially the original work of a team. Teams using them on their robots must prove how they made them on their presentation poster and at an interview. For the purpose of these rules omnidirectional is defined as having a field-of-view of more than 140 degrees horizontally and more than 80 degrees vertically (these values reflect the optical system of the human eye).

8.2.C.2 Voltage pump circuits are permitted only for a kicker drive. All other electrical circuits inside the robot cannot exceed 15.0 V for Soccer Open and 12.0 V for Soccer Lightweight. Each robot must be designed to allow verifying the voltage of power packs and its circuits, unless the nominal voltage is obvious by looking at the robot, its power packs and connections.

- 8.2.C.3 Pneumatic devices are allowed to use ambient air only.
- 8.2.C.4 Kicker strength is subject to compliance check at any time during the competition. During gameplay, a referee can ask to see a sample kick on the field before each half, when a damaged robot is returned to the field, or when the game is about to be restarted after a goal. If the referee strongly suspects that a kicker exceeds the power limit, he can require an official measurement with the 'Kicker Power Measure Device'. (See Appendix C, [Kicker Power Measuring Device](#) for more details.)

8.2.D Construction



Robots must be constructed exclusively by the student members of a team. Mentors, teachers, parents or companies may not be involved in the design, construction, and assembly of robots.

- 8.2.D.1 For the construction of a robot, any robot kit or building block may be used as long as the design and construction are primarily and substantially the original work of a team. This means that commercial kits may be used but must be substantially modified by the team. It is neither allowed to mainly follow a construction manual, nor to just change unimportant parts.
- 8.2.D.2 Indications for violations are the use of commercial kits that can basically only be assembled in one way or the fact that robots from different team(s), build from the same commercial kit, all basically look or function the same.
- 8.2.D.3 Robots must be constructed in a way that they can be started by the captain without the help of another person.
- 8.2.D.4 Since a contact with an opponent robot and/or dribbler that might damage some parts of robots cannot be fully anticipated, **robots must have all its active elements properly protected with resistant materials**. For example, electrical circuits and pneumatic devices, such as pipelines and bottles, must be protected from all human contact and direct contact with other robots.



All driven dribbler gears must be covered with metal or hard plastic.

- 8.2.D.5 When batteries are transported or moved, it is recommended that safety bags be used. Reasonable efforts should be made to make sure that in all circumstances robots avoid short-circuits and chemical or air leaks.



The use of swollen, tattered or otherwise dangerous battery is not allowed.

8.2.E Programming

- 8.2.E.1 Robots must be programmed exclusively by student members of the team. Mentors, teachers, parents or companies should not be involved in the programming and debugging of robots.
- 8.2.E.2 For the programming of the robots, any programming language, interface or integrated development environment (IDE) may be used. The use of programs that come together with a commercial kit (especially sample programs or presets) or substantial parts of such programs are not allowed. It is not allowed to use sample programs, not even if they are modified.

8.2.F Inspections

- 8.2.F.1 Robots must be inspected and certified every day before the first game is played. The Organizing Committee may request other inspections if necessary, including random inspections which may happen at any time. The routine inspections include:
- Weight restrictions for the particular sub-league (see Rule 8.2.A, Dimensions).
 - Robot dimensions (see Rule 8.2.A, Dimensions).
 - Voltage restrictions (see Rule 8.2.A, Dimensions and Rule 8.2.C, Limitations).
 - Kicker strength limits, if the robot has a kicker (see Appendix C, Kicker Power Measuring Device).
- 8.2.F.2 Proof must be provided by each team that its robots comply with these regulations, for example, by a detailed documentation or log book. Teams may be interviewed about their robots and the development process at any time during a tournament.
- 8.2.F.3 See an example of the inspection sheet that members of the OC will use in Appendix D, Inspections sheet example. Note that the sheet will be updated by OC members before the competition to match this year's rules, but the important aspects which are checked will stay the same.

9 INTERNATIONAL COMPETITION

9.1 Team

- 9.1.1 Maximum team size is 4 members for RoboCupJunior 2021.
- 9.1.2 Starting in 2017, Soccer Lightweight team members can participate in the World Championship only twice. After their second participation, they need to move to Soccer Open. Note that counting starts with the 2017 World Championship.

9.2 Interviews

- 9.2.1 During the international competition, the Organizing Committee will arrange to interview teams during the Setup Day of the event. This means that the teams need to be already present early on this day. Teams must bring robots, the code that is used to program them and any documentation to the interview.
- 9.2.2 During an interview, at least one member from each team must be able to explain particularities about the team's robots, especially with regards to its construction and its programming. An interviewer may ask the team for a demonstration. The interviewer may also ask the team to write a simple program during the interview to verify that the team is able to program its robot.

- 9.2.3 All teams are expected to be able to conduct the interview in English. If this poses a problem, the team may ask for a translator to be present at the interview. If the OC is not able to provide a translator, the team is required to do so. During the interview, the team will be evaluated using so called Rubrics, which are published on the website mentioned in the beginning of these rules.
- 9.2.4 The Technical Committee recommends the implementation of interviews in regional competitions as well, but this is not mandatory.

9.3 Technical Challenges

- 9.3.1 Inspired by the major leagues and the need for further technological advancement of the leagues, the Technical Committee has decided to introduce so called **Technical Challenges**.
- 9.3.2 The idea of these challenges is to give the teams an opportunity to show off various abilities of their robots which may not get noticed during the regular games. Furthermore, the Technical Committee envisions these challenges to be a place for testing new ideas that may make it to the future rules, or otherwise shape the competition.
- 9.3.3 Any RoboCupJunior Soccer team will be eligible to try to tackle these challenges. Unless otherwise stated, any robot taking part in these challenges needs to abide by these rules in order to successfully complete it.

9.3.A Precision shooter

- 9.3.A.1 *The results in soccer are evaluated by the number of scored goals. History usually does not care how they were scored. For the spectators, however, this usually makes all the difference.*
- 9.3.A.2 This challenge consists of six rounds. In each round, the robot starts from its own penalty area oriented towards the goal. The ball is placed randomly (by rolling a die) inside this half of the field on one of the following spots:
1. Left neutral spot
 2. Right neutral spot
 3. Left corner of the penalty area
 4. Right corner of the penalty area
 5. Left corner of the field
 6. Right corner of the field
- 9.3.A.3 The robot needs to locate the ball and score a goal while staying on its own half of the field. Each round takes at most 20 seconds.
- The team is free to pick which side to kick from.
 - The same robot must be used for all rounds.
 - The robot must stay on its half of the field for the goal to count, but "out of bounds" rules do not apply.

Figure 4 Partitioning of the goal into 6 parts.



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- 9.3.A.4 Initially, the opposite goal is completely open (see Figure 4, “Partitioning of the goal into 6 parts.”). After each scored goal a member of the team rolls a die and the part of the goal that corresponds to the number on the dice will be covered with a black box. If this part of the goal is already covered, the die will be rolled again. See Figure 5, “An example state of the goal after two rounds”, where the number 3 and number 5 were rolled on a die after each round and the respective parts of the goal are covered. Note that if number 3 or 5 will get rolled in the next rounds, a new roll of a die will follow.
- 9.3.A.5 The result of this challenge is the number of scored goals.

Figure 5 An example state of the goal after two rounds



9.3.B Penalty Kick

- 9.3.B.1 **In Soccer, a penalty kick takes place after a grave offense happens. The aim of this technical challenge is to see whether something similar can be done within the limits of RoboCupJunior Soccer.**
- 9.3.B.2 The kicking procedure consists of the following steps:
1. All robots as well as the ball are removed from the field.
 2. The offending (“kicking”) team places a robot inside its own penalty area, rotated towards its own goal. A ball is placed at the central neutral spot.

3. The offending ("kicking") team turns their robot on. The robot needs to stay still for the next 5 seconds.
4. During these 5 seconds the defending team places a robot which is turned off inside its own penalty area.
5. In order to score a goal, the offending team's robot needs to move the ball inside the opponents goal. It needs to do so in at most 15 seconds and while staying within the center circle once it touches the ball.

9.3.B.3 If the offending team's robot moves before the 5 seconds pass, the result is automatically no goal. Once the penalty kick finishes, the game continues with a Rule 1.3, **Kick-off**, with the defending team kicking-off.

9.3.C Vertical kick

9.3.C.1 **Since the TC plans to move to an orange golf ball in Open, this should open up new options for gameplay. Given the smaller size and weight of golf balls, it should be possible to kick them not just horizontally (as if in "2D") but also vertically (that is, to get the ball into the air).**

9.3.C.2 **The task in this technical challenge is to score into the open yellow goal from the other (blue) half of the field. In order to pass the challenge, the ball can only touch the other (yellow) half of the field inside the penalty area and the goal itself. Note that a golf ball (not necessarily orange) needs to be used.**

9.4 Further information on International Competition

9.4.1 All teams qualified to the international competition **must** share their designs, both hardware and software, with all present and future participants. These teams are also required to send a digital portfolio before the competition. Further details on how will be provided by the Organizational Committee.

9.4.2 During the competition days of the International Competition (as well as before the event) the team members are responsible for checking all relevant information published by the Soccer Organizational Committee, General Chairs, or any other RoboCup official.

9.4.3 **There will also be a SuperTeam competition, in which various people from around the world share their robots in one "SuperTeam" and play against other SuperTeams on a so called "Big Field". The full rules of this challenge can be found at https://robocupjunior-tc.github.io/soccer-rules/master/-superteam_rules.html**

9.4.4 Teams competing in the International Competition can receive awards for their performance. These awards are decided and introduced by the Organizational Committee, which publishes all necessary details well before the actual event. In the past years they were awarded for best poster, presentation, robot design, team spirit and individual games.

9.4.5 Note that as stated in Rule 6.5, **Spirit**, *it is not whether you win or lose, but how much you learn that counts!*

9.5 Intro League

9.5.1 **In order to help newcomers experience the RoboCupJunior Soccer competition, the TC would like to encourage local regional competitions to include a so called "Intro League". Although such a league will not be part of the international competition, the TC still believes that it is worthwhile to make it part of regional and super-regional competitions. Each regional and super-regional**

competition will likely have its specific rules for the rules but the TC would like to suggest they contain the following:

- The Intro League should be at least to some extent based on the RoboCupJunior Soccer rules
- Only competitors that did not previously participate in an international (that is not a regional or super-regional) competition are allowed to take part.
- It may be worth creating two sub-leagues: a 2v2 one where two robots from one team play against two robots from the other, and a 1v1 one where both teams play with just one robot.
- The Intro League should ignore the Out of Bounds rule. When robots go out of bounds, the referee should put them back in.
- The robots should be created from official Lego or Fishertechnik kits, except for sensors necessary for robots to be able to find the ball (i.e. ball detector) and the orientation of the field (i.e. compass).
- The robots should be limited in size to 22,4cm by 22,4cm by 22,4cm (all measurements +/- 1cm). There shall be no weight limit.

9.5.2 Sample Intro League rules already in use can be found on the links below:

- <https://robocupjunior.org.au/sites/default/files/Official%202020%20RCJA%20Soccer%20Rules%20%28SSTC%29.pdf>
- <https://rcj2019.eu/sites/default/files/Soccer%201-1%20Standard%20Kit%20Rules%202019%20Final.pdf>

A Technical Specification for pulsed Soccer Ball

1.1 Preamble

- 1.1.1 Answering to the request for a soccer ball for RCJ tournaments that would be more robust to interfering lights, less energy consuming and mechanically more resistant, the RCJ Soccer Technical Committee defined the following technical specifications with the special collaboration from EK Japan and HiTechnic.
- 1.1.2 Producers of these balls must apply for a certification process upon which they can exhibit the RCJ-compliant label and their balls used in RCJ tournaments.
- 1.1.3 Balls with these specifications can be detected using specific sensors from HiTechnic (IRSeeker - information on distance and angle) but also common IR remote control receivers (TSOP1140, TSOP31140, GP1UX511QS, etc. - on-off detection with a possible gross indication of distance).

1.2 Specifications

1.2.A IR light

- 1.2.A.1 The ball emits infra-red (IR) light of wavelengths in the range 920nm - 960nm, pulsed at a square-wave carrier frequency of 40 KHz. The ball should have enough ultra-bright, wide angle LEDs to minimize unevenness of the IR output.

1.2.B Diameter

- 1.2.B.1 The diameter of the ball is required to be 74mm. A well-balanced ball shall be used.

1.2.C Drop Test

- 1.2.C.1 The ball must be able to resist normal game play. As an indication of its durability, it should be able to survive, undamaged, a free-fall from 1.5 meters onto a hardwood table or floor.

1.2.D Modulation

- 1.2.D.1 The 40 KHz carrier output of the ball shall be modulated with a trapezoidal (stepped) waveform of frequency 1.2 kHz. Each 833-microsecond cycle of the modulation waveform shall comprise 8 carrier pulses at full intensity, followed (in turn) by 4 carrier pulses at 1/4 of full intensity, four pulses at 1/16 of full intensity and four pulses at 1/64 of full intensity, followed by a space (i.e. zero intensity) of about 346 microseconds. The peak current level in the LEDs shall be within the range 45-55mA. The radiant intensity shall be more than 20mW/sr per LED.

1.2.E Battery Life

- 1.2.E.1 If the ball has an embedded rechargeable battery, when new and fully charged it should last for more than 3 hours of continuous use before the brightness of the LEDs drops to 90% of the initial value. If the ball uses replaceable batteries, a set of new high-quality alkaline batteries should last for more than 8 hours of continuous use before the brightness of the LEDs drops to 90% of the initial value.

1.2.F Coloration

- 1.2.F.1 The ball must not have any marks or discoloration that can be confused with goals, or the field itself.

1.3 Official suppliers for pulsed balls

- 1.3.1 Currently, there is one ball that has been approved by the RoboCupJunior Soccer Technical Committee:

- RoboSoccer ball operating in MODE A (pulsed) made by EK Japan/Elekit (<https://elekit.co.jp>)

- 1.3.2 Note that this ball was previously called RCJ-05. While you may not be able to find a ball with this name anymore, any IR ball produced by EK Japan/Elekit is considered to be approved by the TC.

B Technical Specification for passive Soccer Ball

2.1 Preamble

- 2.1.1 In order to push the state of the art in the Soccer competition forward, the RCJ Soccer Technical Committee has defined the following technical specifications for the "passive" ball. The chosen values and characteristics reflect the desire of the Technical Committee to make sure that the selected ball is not fundamentally different from the IR ball that was used before, and that it is close to balls used in the Soccer

leagues in the Major category, where the Junior competitors may continue to compete once they pass the age limits.

- 2.1.2 The Technical Committee has been able to identify two balls that meet the technical specifications outlined below and are available worldwide. None of these balls have been marked official. That means it is not guaranteed that one of these balls will be used at the international event. However, the official ball will not be much different. These balls are:

1. <https://www.schweikert-hundesport.de/index.php/en/Ball%2C-orange%2C-hollow%2C-plastic/c-220910/-a-93011> Note that since the e-shop may also send you a semi-glossy ball by mistake, it is safer to mention that you would like to receive a matte ball when finishing your order or in an email after you finish it.
2. <https://www.amazon.com/Mylec-Weather-Bounce-Hockey-Orange/dp/B002LBDA30>

- 2.1.3 The Technical Committee found the first ball preferable, as the second one might reflect light to some extent (for instance from camera flashes).

2.2 Specifications

2.2.A Diameter

- 2.2.A.1 The diameter of the ball is required to be 65mm +/- 5mm. A well-balanced ball shall be used.

2.2.B Drop Test

- 2.2.B.1 The ball must be able to resist normal game play. As an indication of its durability, it should be able to survive, undamaged, a free-fall from 1.5 meters onto a hardwood table or floor.

2.2.C Coloration

- 2.2.C.1 The ball shall be of orange color. Since the definition of the orange color in general is not easy, any color that a human would deem to be orange and is substantially different from the other colors used on the field is acceptable. There should be no distractive markings on the ball.

2.2.D Surface

- 2.2.D.1 The surface of the ball shall be smooth and matte. Engravings on the ball's surface are tolerated. The ball should not reflect light. The inside of the ball should be hollow.

2.2.E Weight

- 2.2.E.1 The ball should be no heavier than 80 grams and no lighter than 60 grams.

C Kicker Power Measuring Device

All robot kickers will be tested with the ball used in the sub-league they participate in.

3.1 Preamble

- 3.1.1 This Kicker Power Measuring Device can measure the power of a robot's kicker. It is easy to build with commonly accessible materials.
- 3.1.2 This device can measure the power of a robot's kicker up to a length of 22cm.



3.1.3

3.2 Materials

Plastic Board	A4 paper size
M3 Spacers (40mm length)	5
M3 Screw	10

3.3 Device schematics

- 3.3.1 The device schematics can be printed out from the diagram located at the end of the document. Please be advised to check that the software you use to print the schematic does not have a **scale to fit** option activated (i.e. check that it is configured to print at 100% or **actual size** scale).



The device schematics shows a straight line past the 22cm mark, while the photo shows the line at that point to be curved. Either straight or curved lines are acceptable, but a curved line will request more difficult cutting and the attached device schematic is simple enough for quick construction.

3.4 Example of device construction

- Print out the device schematics.
- Paste the paper on a plastic board. The incline line (red lines) should be straight.
- Cut out along the lines, and drill the holes.
- The two boards should be connected using the 40mm spacers.

3.5 Inspection

- Place a ball at the bottom of the ramp run of the device, and put the robot in front of the ball, aiming the kicker towards the top of the ramp.
- Activate the robot's kicker for a single shot.
- Measure the distance that the ball traveled on the device. The distance should not exceed 22 cm.

D Inspections sheet example

TEAM/ROBOTS INSPECTION SHEET

DATE	<input type="checkbox"/> 30th June, Thu	<input type="checkbox"/> 1st July, Fri	<input type="checkbox"/> 2nd July, Sat	<input type="checkbox"/> 3rd July, Sun
ROUND				
CATEGORY	<input type="checkbox"/> Lightweight		<input type="checkbox"/> Open	
TEAM NAME			TEAM CODE	

Basic: !! Before EVERY game, REFEREE check AGAIN !!

1.SIZE (spread all moving part then $\leq 22.0\text{cm}$, HANDLE is not included)	<input type="checkbox"/> OK
2.WEIGHT (including battery $\leq 2.4\text{kg}$ Open ≤ 1.1 Light)	<input type="checkbox"/> OK
3.BALL CAPTURE ZONE ($< 3\text{cm}$)	<input type="checkbox"/> OK
4.Top Marker	<input type="checkbox"/> OK
5.BATTERY VOLTAGE ($\leq 15\text{V O}$, $\leq 12\text{V L}$)	<input type="checkbox"/> OK
6.KICKER POWER	<input type="checkbox"/> OK
7.EMITTING LIGHT, BLUE and YELLOW colored parts (or other equipments disturbing any sensors)	OK <input type="checkbox"/> COMMENTS
8.DANGER EQUIPMENT (damage the field, ball, other robots and referees!)	OK <input type="checkbox"/> COMMENTS

Need Special Interview/TC discussion

9.Check if you think need special interview	10.COMMENTS TO TC/Interviewers
<input type="checkbox"/> Sensor issues (i.e. IR distance sensor) <input type="checkbox"/> Battery Voltage issues <input type="checkbox"/> Kicker Power issues <input type="checkbox"/> Construction issues (i.e. danger equipments, commercial kit etc)	<input type="checkbox"/> Special Interview <input type="checkbox"/> TC discussion <div style="text-align: right;">sign.....</div>