

TECHNOXIAN

WORLD ROBOTICS CHAMPIONSHIP

WRC 2022 RULES BOOK

ROBO SOCCER CHALLENGE

1.0 Competition Overview

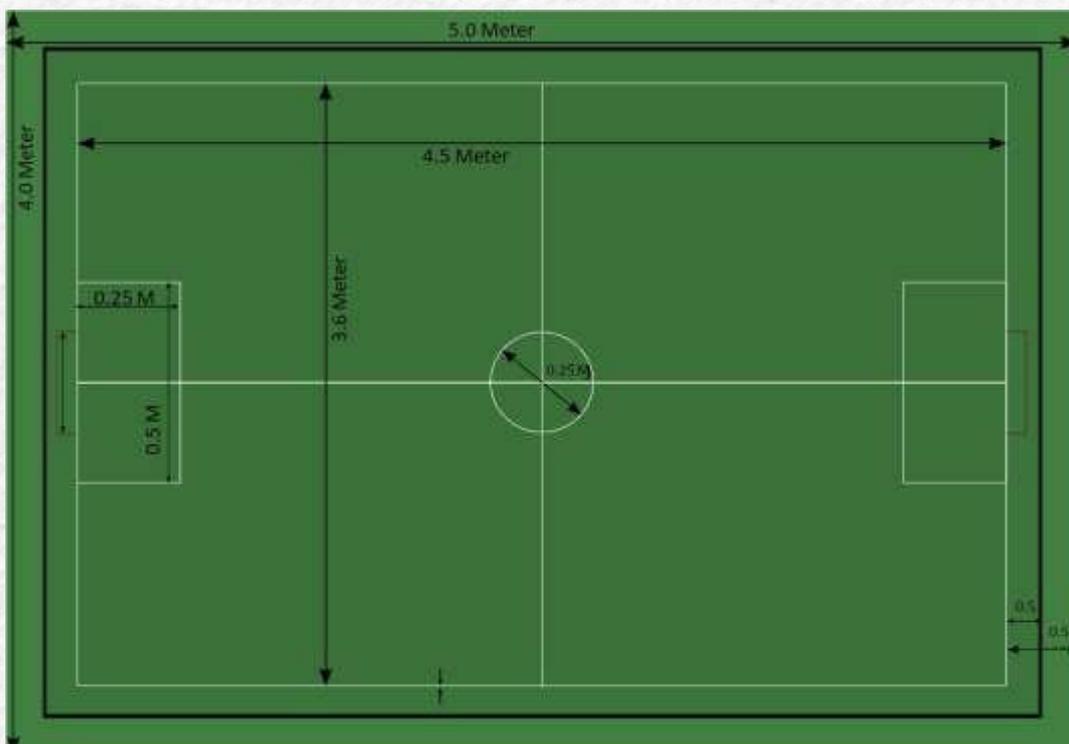
Robo Soccer is one of the most famous challenges of TechnoXian, world robotics championship series. Teams of 3 wireless bots' chase ball around a big size arena with the aim to kick more goals than the opponent. This game gives opportunity to youngsters to solve robotic challenges, build creative bots while learning science, technology, engineering and math. The most rewarding part of designing bots is that student have fun, work together as a team, and learning occurs as naturally as breathing air.

2.0 The Playing Field

2.1.0. Field Dimensions

The playing field must be rectangular and of the following size:

- Total arena size would be 5.0 meters X 4.0 meters and playing area would be 4.5 meters X 3.6 meters. The exact field dimensions and the field markings at the venue may vary by up to $\pm 10\%$ in each linear dimension.
- The figures below show the dimensions of the field, the goals and special field areas, measured in millimetres between the line centres.





2.2.0. Field Surface

The playing surface is green mat carpet. The floor under the carpet is level, flat and hard. The field surface will continue for 0.5 meter beyond the field lines on all sides. The outer 0.4 meter of this runoff area, separated from the bot area by a 0.1-meter-tall wall, is used as a designated walking area for the referee and the assistant referee. The remaining 0.1 meter are the field margin.

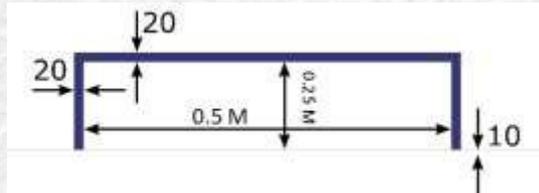
2.3.0. Field Marking

The playing field is marked with lines. All lines are 0.01 meter wide and white (Paint, Spray, White carpet or strong tape). Lines belong to the areas of which they are boundaries. Distances between lines are measured from their centers.

- **Field Lines:** The playing area is defined by four field lines. The two longer field lines are called touch lines. The two shorter field lines are called goal lines.
- **Additional Lines:** The field of play is divided into two halves by a halfway line that runs along the width of the field and through the center of the field. The halfway line is parallel to the goal lines.
- **Center Circle:** The center mark is indicated at the midpoint of the halfway line. A circle with a diameter of 1 meter is marked around it for booth divisions.
- **Défense Area:** A defence area is defined as a rectangle touching the goal lines centrally in front of both goals. The size of the defence area is 2meter X 1meter as shown in figure.
- **Penalty Mark:** For each field half the penalty mark is on the mid-line (not halfway line), 6 meters away from the opponent goal center.

2.4.0. Goals

Goals must be placed on the center of each goal line and anchored securely to the field surface. They consist of two 0.16 meters high vertical side walls joined at the back by a 0.16 meters high vertical rear wall. The inner face of the goal has to be covered with an energy absorbing material such as foam or net to help absorb ball impacts and lessen the speed of deflections. The goal walls, edges and tops are white in color. The distance between the side walls is 0.5 meter and the goal is 0.25 meter deep. The goal walls are 0.02 meter thick and touch the goal line, but do not overlap or encroach on the field lines or the field.



2.5.0. The Ball

The ball is a standard orange/white golf ball. It weights approximately 46 grams and its diameter measures 0.043 meter.



2.6.0. Communication Flags

The communication flags are used to avoid gesturing and yelling with the referee during a match. These flags are responsible for communicating various intents, such as timeouts, emergency stops, manual robot substitution and challenges.

The referee has to acknowledge the communication flag. Any gesturing and yelling will be considered unsporting behaviour and punished by a red card after the first warning.

3.0 The BOT

3.1.0. Number of Bots

A match is played by two teams, with each team consisting of 3 bots and one of which may be the keeper.

3.2.0. Bot Shape

The participating bots should be wireless and must be controlled remotely. A bot must fit inside a 30 centimetres wide and 40 centimetres high cube at any point in time. Additionally, the top of the robot must adhere to the standard pattern size and surface constraints. Dribbling devices that actively exert spin on the ball, which keep the ball in contact with the robot are permitted under certain conditions:

- The dribbling device must not elevate the ball from the ground.
- Another robot must be able to remove the ball from a Bot with the ball.
- A Bot must not take full control of the ball by removing all of its degrees of freedom.
- 80% of the area of the ball when viewed from above has to be outside the convex hull around the bot. This limitation applies as well to all kicking devices, even if such infringement is momentary.

3.3.0. Wireless Communication

Participants using wireless communications must notify the organizing committee of the method of wireless communication, power, and frequency. The organizing committee must be notified of any change after registration as soon as possible. In order to avoid interference, a team must be able to select from two carrier frequencies before the match. The type of wireless communication has to follow legal regulations of the country where the competition is held. Compliance with local laws is the responsibility of the competing team.

4.0.0 Competition Structure

During official match play, there are key positions must be filled.

4.1.0. Referee

Each match is controlled by the referee. He has full authority to enforce the rules of the match to which he has been appointed. The referee is encouraged to use the designated walking area next to the field. The decisions of the referee regarding facts connected with play are final.



The referee may only change a decision on realizing that it is incorrect or, at his discretion, on the advice of an assistant referee, provided that he has not restarted play.

The referee is not held liable for any kind of injury suffered by an official or spectator, any damage to property of any kind nor any other loss suffered by an individual, club, organization, institution or other body.

The bot handlers are the only team member that may talk to the referee.

Duties

- The referee ensures a safe match for all participants and bots
- The referee ensures a fair match according to the rules of the match.
- The referee ensures that there is no interference by unauthorized persons or team members.
- The referee or assistant referee places the ball for kick-off and penalties or after every stoppage. Subsequently, the referee resumes the match.
- The referee ensures that the match is started and resumed in time.

4.2.0. Assistant Referee

The assistant referee supports the referee wherever he can. He is encouraged to use the designated walking area next to the field, opposite the referee. No team members are allowed to talk to the assistant referee.

Duties

- The assistant referee indicates when misconduct or any other incident has occurred out of the view of the referee.
- The assistant referee discusses unclear situations with the referee
- The referee or assistant referee places the ball for kick-off and penalties or after every stoppage. Subsequently, the referee resumes the match.

4.3.0. Bot Handler

Before the start of the match, every team has to designate bot handlers and a captain.

Duties

- The captain asks the referee for timeouts if necessary
- The bot handler can substitute a bot during match play.
- The bot handler asks the referee for the permission to substitute a bot in the next stoppage and, if the referee agrees, substitutes the bot.

4.3.0. Match Preparation

All people that fill a role in the match have to be ready at least 10 minutes before the start of the match to allow the referee to make the following preparations

- **Match Result Sheet:** The referee obtains a match result sheet along with ball from the organizing committee. After the match, the referee fills in the final score, collects the required signatures and submits the sheet to the organizing committee.



- **Choosing Team Colours:** The referee asks the captain of the teams about their preferred team colour (either blue or yellow). The sticker of the same colour will be given to teams to put on their bots.
- **Choosing Side and Kick-off:** The referee tosses a coin with both captains. The winning team chooses the goal it will attack in the first half of the match. The other takes the kick-off to start the match.
- **Designating Bots:** The referee asks both captain which bot they will use as the keeper. The keeper can be changed anytime during the game with referee's permission.

4.4.0. Game Stages

The official match consists of the following stages:

Game Stage	Duration
First Half	300 seconds of playing time
Half-time Break	150 seconds of pause
Second Half	300 seconds of playing time

If the match is an elimination match (draw is not a possible outcome) and the score is even after the regular game time, the match goes into overtime and the following game stages are added

Game Stage	Duration
Pre-Overtime Break	150 seconds of pause
Overtime First Half	150 seconds of playing time
Overtime Half-Time Break	120 seconds of pause
Overtime Second Half	150 seconds of playing time

If the score is even after overtime has been played, the following stages are added:

Game Stage	Duration
Pre-Shoot-Out Break	120 seconds of pause
Shoot-Out	Unlimited

The match timer is paused whenever no team is allowed to manipulate the ball. This includes stop, halt and the preparation states of kick-off and penalty kick. Additionally, it is paused during ball placement.

4.5.0. Timeouts

The bot handler has to ask the referee for a timeout. Timeouts are handled like breaks, meaning that both teams are allowed to make modifications to their bots in case of its not functioning or damaged.



Each team is allocated 4 timeouts at the beginning of the match. A total of 150 seconds is allowed for all timeouts. Timeouts may only be taken during a game stoppage. The time is monitored and recorded by the referee.

During overtime, both teams can use 2 timeouts with a total time of 150 seconds. The number of timeouts and the time not used in regular game are not added.

No timeouts are possible in the shoot-out stage.

4.6.0. Early Termination at a Score of 10

Before the shoot-out stage, when a team manages to shoot 10 goals, the match is automatically terminated as soon as the goal difference is greater than one and the team with more goals is declared the winner.

5.0.0 Referee Commands

5.1.0. Stopping the Game

5.1.1 Stop: When the stop command is issued, all robots have to slow down (less than 1.5m/s) or stop the bot. Additionally, all robots have to keep at least 0.5 meters distance to the ball and are not allowed to manipulate the ball.

The stop command is used to pause the match after the ball crossed the field lines (including goals) or an offense occurred as well as to prepare the start or resumption of the game after halt and timeouts.

5.1.2. Halt: When the halt command is issued, no bots are allowed to move or manipulate the ball. There is a grace period of 2 seconds for the bots to break.

The halt command allows the referee to interrupt the game immediately whenever an emergency occurs (for example when a bot gets out of control). It is also used for bot substitution if referee agrees. Additionally, the referee is free to issue the halt command at will.

The halt command is always followed up by stop.

5.2.0. Ball Placement

After the game was stopped, the ball must be placed on the appropriate position, depending on the event that occurred. No ball placement is required if all of the following constraints are fulfilled:

- The ball is closer than 1m to the designated position
- The ball is inside the field
- The ball is at least 0.5m away from any Défense area.

In this case, the game can be continued as soon as all bots keep the required distance for stop.

When the ball goes out of play, the following rules decide:

- The referee has to place the ball for all kick-offs and all penalty kicks
- For a free kick, the team that brings the ball into play must place the ball
- For a force start, a team is drawn by chance and must place the ball.



- The ball must be visible and must not be inside a field corner, a goal corner or behind the goal, before the ball placement starts.
- The referee can decide to place the ball manually at any time.
- When a team placement failure counter reached 5, it's not allowed to place the ball for the rest of the game half. All free kicks that were a result of the ball leaving the field, are awarded to the opposing team. For all other rule violations or when both teams failed to place the ball, the ball is placed by the referee.

5.3.0. Resuming The Match

After the ball has been placed, the game is resumed using one the following commands.

5.3.1. Normal Start: For two-staged referee commands, when normal start is sent, an attacker may manipulate the ball. A match cannot be resumed directly via normal start. Normal start is used for kick-offs and penalty kicks.

5.3.2. Kick-Off: The ball has to be placed in the center of the field by referee. When the kick-off command is issued, all robots have to move to their own half of the field excluding the center circle. However, one robot of the attacking team is also allowed to be inside the whole center circle. This bot will be referred to as the kicker. No bot is allowed to touch the ball. When the normal start command is issued, the kicker is allowed to shoot the ball. A goal may be scored directly from the kick-off.

Additionally, after a goal has been scored, the receiving team restarts the game with a kick-off.

5.3.3. Free Kick The ball placement position for a free kick depends on the event that led to the free kick. This position is valid if there is at least 0.2 meters distance to all field lines and 1 meter distance to either defence area. If an event requires the ball to be placed at a position that contravenes this rule, it has to be placed at the closest valid position instead.

When the free kick command is issued, robots of the attacking team are allowed to approach the ball while robots of the defending team still have to stay at least 0.5 meters distance away from the ball (the same distance as in stop). One robot of the attacking team is allowed to shoot the ball. This robot will be referred to as the kicker. A goal may be scored directly from the free kick.

Free kicks are used to restart the game after a foul has occurred. Additionally, goal kicks and corner kicks are mapped to free kicks.

5.3.4. Force Start: When the force start command is issued, the game is immediately resumed and both teams are allowed to approach and manipulate the ball again. A neutral forced start is used in situations where no team is clearly in favour, such as:

- The game had to be stopped without a specific reason
- Both teams are at fault



5.3.5. Penalty Kick: The procedure of a penalty kick is as follows:

- The ball is placed by the referee on the penalty mark.
- When the penalty command is issued, the defending keeper has to move to the goal line and keep touching it and attacking bot is allowed to approach the ball but not allowed to touch the ball.
- Throughout the penalty kick procedure, all other bots have to be 1 meter behind the ball such that they do not interfere the penalty kick procedure.
- When the ball is in play, the defending keeper may move freely again.
- If the ball is still in play after 10 second, the game is stopped.

A goal is awarded if the ball touches the inner surface of a goal wall or the ground of the goal of the defending team, starting from when the normal start command is issued or the defending team commits any foul.

The game is continued with a kick-off when a goal is awarded.

A goal is not awarded if, the ball cross any field line outside the goal, or the attacking team violates any rule, or the ball is still in play after 10 seconds.

The game is continued by a goal kick for the defending team when a goal is not awarded.

Additional time is allowed for a penalty kick to be taken at the end of each half or at the end of periods of overtime.

Penalty kicks are used to punish unsporting behaviour and multiple defenders.

5.3.6. Ball In and Out of Play: When the match is stopped, the ball is considered out of play until it has been brought into play. When the match is resumed, the ball is considered in play until the next stoppage occurs. The match is resumed when.

- Force start has been issued
- The ball moved at least 0.05 meters following a kick-off, free kick or penalty kick.
- 10 seconds passed following a kick-off
- 10 seconds passed following a free kick.

5.4. Sanctions

5.4.1 Yellow Card: If the yellow card is shown as a result of unsporting behaviour, the match continues with a free kick for the other team.

Upon receipt of a yellow card, the number of robots allowed on the field for the penalized team decreases by one. If, after this decrease, the team has more bots than permitted on the field, a bot must be taken out.

A team cannot score a goal while having more than the allowed number of bots on the field.



After 120 seconds of playing time, the yellow card expires and the number of allowed bots is increased by one. The team may put a bot back in during the next opportunity. When a team has two not yet expired yellow cards and receives another yellow card, this card will be turned into a red card instead.

5.4.2. Red Card: A red card behaves like a yellow card, except it does not expire until the end of the match.

Red cards are given by the referee to punish severe fouls or unsporting behaviour.

5.4.3. Forced Forfeit: A forced forfeit means that a team instantly loses the current game with a score of 0 to 10.

A team can be forced to forfeit if it is unable to play with at least one robot that satisfies the rules.

A team can only be forced to forfeit in agreement with members of the technical committee and the organizing committee.

5.4.4. Disqualification: A disqualification means that a team immediately drops out of the tournament and places last. It will not be eligible to receive any trophies.

A team can be disqualified if members of the team don't follow safety guidelines, rules of the venue or commit similarly severe offenses.

A team can only be disqualified in agreement with members of the technical committee and the organizing committee.

6.0. Ball Leaves the Field

When the ball leaves the field by fully crossing the field line, the game will be stopped. The ball will be placed and the game will be restarted depending on the position of the field line crossing as well as on team that last touched the ball.

6.1.0. Touch Line Crossing

Touch lines are the long field lines at both sides of the playing field.

The ball has to be placed 0.2 meters perpendicular to the touch line where the ball crossed the touch line. Its distance to the goal lines must be at least 0.2 meters. After the ball has been placed, a free kick is awarded to the opponent of the team that last touched the ball before it left the field.

A throw-in is used to restart the game after the ball left the field by crossing the touch line.

6.2.0. Goal Line Crossing

Goal lines are the short field lines at both ends of the playing field.



6.2.1. Goal Kick: The ball has to be placed 0.2 meters from the closest touch line and 1 meter from the goal line. After the ball has been placed, a free kick is awarded to the opponent of the team that last touched the ball before it left the field.

A goal kick is used to restart the game after the ball left the field by crossing the goal line of the team that did not touch the ball last.

6.2.2. Corner Kick: The ball has to be placed 0.2 meters from the closest touch line and 0.2 meters from the goal line.

After the ball has been placed, a free kick is awarded to the opponent of the team that last touched the ball before it left the field. A corner kick is used to restart the game after the ball left the field by crossing the goal line of the team that touched the ball last.

6.2.3. Aimless Kick: The ball to be placed at the position from where the ball was kicked. After the ball has been placed, a free-kick is awarded to the opponent of the team that last touched the ball before it left the field.

A kick is aimless when after the ball touched a bot, it subsequently crossed the midline and then its opponent's goal line outside the goal without touching another bot.

7.0. Scoring Goals

A team scores a goal when the ball fully enters the opponent goal between the goal posts, provided that:

- The team did not exceed the allowed number of robots when the ball entered the goal.
- The height of the ball did not exceed 0.15 meters after the last touch of the teams' bots.
- The team did not commit any non-stopping foul in the last two seconds before the ball entered the goal.

If the goal is considered invalid, the game will be continued as if the ball crossed the goal line outside the goal.

8.0. Bot Substitution

Bots are substituted by the bot handler of the respective team. No other team member is allowed to take bots out or put bots in.

Additionally, bots can be taken out from any position on request using the procedure below:

- The bot handler requests bot substitution at any time.
- The referee will halt the game at the next opportunity.
- The bot handler may enter the field and touch bots now, as long as the game is still halted.
- The bot handler takes bot out.
- The bot handler informs the referee when done.
- When bot teams finished the bot substitution, the referee informs the referee starts the match.



If the match was halted due to a substitution intent by a team, at least one bot must be taken out by this team. A substitution intent can be revoked unless the match was not already halted for substitution.

9.0. Shoot-Out

Both teams alternately attempt to score a goal with a penalty kick until each team has performed 5 attempts. If both teams have the same score after those 5 attempts, each team takes another attempt in the same order as before until the score of the two teams is different.

Only up to one attacking bot and one keeper is allowed per team. During a shoot-out attempt, the attacking bot and opponent keeper are the only ones allowed to move and manipulate the ball. Other bots are not allowed to interfere.

If a team is clearly not able to prepare for a penalty kick, a goal is automatically awarded to the opposing team.

Bots may be substituted between shoot-out attempts. The new bot may be put in right away.

10.0. Rule Changes During Competition

Rule changes between years can have unforeseen consequences. If a rule is found to cause significant negative impact to the competition, the rules may be adapted under the following conditions:

- Only between phases of the competition, like round-robin and knockout
- Only for major problems, as a last resort.
- The change must be approved by all team leaders (by an unanimity vote)