



# World Robot Olympiad 2021

WRO Football

Game Description, Rules and Scoring

Version: January 15<sup>th</sup>

**There will be no International Final in 2021.**

*WRO International Premium Partners*



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### Game Description

WRO Football aims, where possible, to reflect the game of human soccer. Teams of two on two autonomous robots chase an infra-red transmitting ball around a WRO size table top field with the aim to kick more goals than the opposition.

### WRO Football Field

**Field specifications and construction hints will be included in a separate document to these rules.**

### Rule Changes

If the current WRO Football Challenge appears to be mastered, the rules will undergo minor modifications the following year. Teams cannot expect to use the same robots, programs or algorithms in consecutive years. This will encourage new teams to enter, as teams are all starting again from a base level each year. It will also encourage innovation from students looking to adapt to new challenges each year.

## Rule Change Summary (changes from 2019 to 2020)

*Note: There are no new changes from 2020 to 2021.*

### **The Double Defense Rule will be replaced with:**

4.13 A defending team can only have one robot in the penalty area being defended. If two robots are both fully within the penalty area, the non goalie robot will be treated as damaged.

*The penalty area lines will be white.*

8.9 A maximum of **three** LEGO omni or multi directional wheels, constructed purely of LEGO pieces can be used on a single robot. The omni wheel components of a single wheel must be on one position on an axle and not be separated from each other.

8.18 Batteries will be limited to the grey rechargeable LEGO battery, no. 45501 for EV3, 9798 or 9693 for NXT.

8.19 Teams are limited to two EV3's and 8 motors in the competition area. They must produce a broken motor or EV3 to the head judge to get another from their mentor. Any bags or boxes will be searched on request whenever competitors enter the hall.

8.20 Any evidence of damage or tampering of batteries, motors or EV3's will not be tolerated and could result in disqualification. Motors must be below the maximum specs outlined in <https://www.lego.com/en-us/product/ev3-medium-servo-motor-45503> and <https://www.lego.com/en-us/product/ev3-large-servo-motor-45502>. Large NXT motors must also meet the EV3 Large Motor specs.

**9.5 It is the competitor's responsibility to ensure that a robot is legal at all times. If a robot is deemed illegal after a game, that team will forfeit any points gained in that game and any games, since the last time the robot was ruled as legal by the official measurement judge, (usually the Head Judge).**

*A measurement record should be kept by the measurement judge, recording the time as well as any infringements. A robot must be repaired and re-measured if it is deemed as illegal. Repeated infringements with no substantial improvement will not be tolerated. Offending robots will be excluded from playing until they are clearly legal and have no chance of reoffending.*

## Rules and Regulations

### 1. Teams

1.1 Teams will consist of two robots, either a goalie and a forward, or two forward players.

1.2 Any substitution of robots is strictly forbidden and any team substituting robots will be disqualified from the tournament.

1.3 Teams will have either two or three human participants.

## 2. Scoring

- 2.1 A goal is scored when the ball strikes the back of the goal. ie when all of the ball crosses the goal line.
- 2.2 The team scoring the most goals will win the game.
- 2.3 A tied score will stand in non finals or pool games.
- 2.4 A penalty goal will be awarded if the judge is convinced that a ball is clearly travelling into the goal and strikes a defensive robot that has some part of it over the goal line and in the "in goal" area.
- 2.5 Own goals are treated as a goal to the opposition.

## 3. Game Time

- 3.1 Games will consist of two 5 minute halves.
- 3.2 Teams are allowed to have a maximum break of 5 minutes between halves to repair and reprogram robots.
- 3.3 The game clock will run without stopping throughout the game.
- 3.4 The judge can call a time out to explain a rule decision or to allow a robot damaged by handling or by a collision to be repaired. See Section 7: Rule Clarification.
- 3.5 It is a team's responsibility to be present before a game starts. A team will incur a goal penalty at the judges discretion, for every minute that they are late, up to 5 minutes.
- 3.6 If a team leads by 5 goals in a 5 minute half game or 10 goals in a 10 minute half game, the game will be stopped under a mercy ruling and the final scores will be recorded.
- 3.7 If time permits, finals games can be run over 10 minute halves.

## 4. Game Play

- 4.1 At the start of the game the judge will toss a coin. The team winning the toss can choose whether to kick off at the start of the first half or the start of the second half.
- 4.2 The team kicking off, will kick the ball from the centre spot on the field.
- 4.3 All other robots must have some part inside of their defensive penalty box.
- 4.4 The team kicking off will place their robots first. These cannot be moved once the team has placed them. The team kicking second can then place their robots.
- 4.5 The game will start on the judge's command. All robots must be started immediately. Robots can be running, but must be held in a stationary position above the field.
- 4.6 Any robots that are started or released before the judge's command will be removed from the field for one minute.
- 4.7 Any robots that are not on the field or started immediately, will be ruled as "damaged" and removed from the field for one minute.
- 4.8 If a goal is scored, the non-scoring team will kick off to restart play.
- 4.9 If two opposing robots are tangled with each other, the judge can choose to separate them with minimal movement.
- 4.10 The judge will call "Pushing" **immediately** when a robot is using greater power to "force" the ball past an opposing robot that is also facing the ball. The judge will then place the ball in the centre of the field and play will continue without stopping.  
*If a judge calls "Pushing" and a goal is scored as a direct result of a robot "forcing" the ball through, the goal will be disallowed.*

- 4.11 Team Captains are not permitted to touch robots at any time without the judge's permission. If a scoring opportunity has been affected by the robot's removal or incorrect replacement, that goal will be awarded.
- 4.12 If a ball strikes the end wall beside the goals, play will not be stopped and the ball will be returned immediately to the centre spot on the field. If a robot occupies that spot, the ball will be placed as close as possible to the centre, but not directly in front of a robot.
- 4.13 A defending team can only have one robot in the penalty area. If two defending robots are both fully within the penalty area, the non goalie robot will be treated as damaged. *The penalty area lines will be white.*

## 5. Play Reset

- 5.1 "Reset" will be called if the ball is stuck between multiple robots for a reasonable amount of time and has no chance of being freed, or if no robot has any chance of approaching the ball in a reasonable amount of time. A "reasonable amount of time" is any time **up to 15 seconds**.
- 5.2 Any **stuck** robots will be immediately taken to their defensive penalty box. Some part of the robot must be in the penalty box.
- 5.3 Robots are permitted to remain running and held by the handle.
- 5.4 The judge will roll the ball from the wall mid-way along the long side of the field, towards the centre of the field.
- 5.5 Robots will be released only when the ball leaves the judges hand.
- 5.6 Any robot that cannot start immediately will be considered as "damaged"
- 5.7 Any robot that is released before the ball is released will be removed from the field for one minute.

## 6. Damaged Robots

- 6.1 A robot will be considered damaged by the judge if it has serious breakages, it does not move correctly (eg. Rule 12) or respond to the ball.
- 6.2 Players can only remove robots from the field after being given the **judges permission** following the Team Captain's request. This robot will be classified as damaged.
- 6.3 A damaged robot will remain off the field for one minute or until a goal is scored.
- 6.4 If a robot is touched or removed without the judges permission a two minute time penalty will be incurred.
- 6.5 A damaged robot must be repaired before it is returned to the field. If a robot is not, or cannot be repaired, it will be excluded from the remainder of the game.
- 6.6 A damaged robot can be returned to the field after being given the judge's permission. The robot is to be placed in the team's own penalty area and not in a position that advantages that robot ie. Facing the ball.
- 6.7 If a robot turns over on its own accord or from a collision with its own team's robot, it will be considered damaged.
- 6.8 If a robot turns over as a result of a collision with an opposing robot, it will not be considered as damaged and can be righted by the judge and play will continue.

## 7. Rule Clarification

- 7.1 **The Judge's decision is considered as final during game play.**
- 7.2 If competitors require a rule clarification they must do it immediately by requesting a "Judges Time Out". The game clock will be stopped.
- 7.3 If the Team Captain is not satisfied with the judge's explanation, they can request to speak to the Head Judge.
- 7.4 **Mentors must not be involved in any rules discussion.**
- 7.5 Video evidence will not be accepted.
- 7.6 Once the Head Judge and the game judge have come to a decision, no more discussion will be accepted.
- 7.7 Any further argument will result in a **Yellow Card** being issued, followed by a **Red Card** if the Team Captain or Mentor continues to argue.
- 7.8 A **Red Card** will result in that person being required to leave the competition area for the remainder of the tournament.
- 7.9 Failure to respect a **Red Card** will result in permanent exclusion of the person from any WRO Football tournament. Any further protests can be communicated through the National Organiser.
- 7.10 The Head Judge may be required to modify rules as a result of local conditions or circumstances. Participants will be notified of this at the earliest available opportunity.

## 8. Robot Specifications

- 8.1 Construction and Programming of robots must be done exclusively by the students.
- 8.2 Robots are to be constructed using strictly LEGO brand pieces only.
- 8.3 The controller, motors and sensors used to assemble robots must be from LEGO® MINDSTORMS sets and HiTechnic (One HiTechnic IRSeeker V2 sensor. One HiTechnic Colour Sensor and One HiTechnic Compass sensor).
- 8.4 Robots can only use one NXT or one EV3 Ultra Sonic Sensor. This must be placed in the rear half of the robot with the sensor facing to the right when facing towards the goal it is kicking to.
- 8.5 WRO recommends use of Education versions of LEGO MINDSTORMS due to extended service available from LEGO Education distributors
- 8.6 LEGO pieces cannot be modified in any way.
- 8.7 No other building materials can be used, including glue, tape, screws etc. *An exception to this is the minimal use of tape to shield the IR Ball Sensor from external light sources.*
- 8.8 After market Omni directional wheels are not permitted.
- 8.9 A maximum of **three** LEGO omni or multi directional wheels, constructed purely of LEGO pieces can be used on a single robot. The omni wheel components of a single wheel must be on one position on an axle and not be separated from each other.
- 8.10 Cable ties or tape may only be used to secure wires.
- 8.11 Any control software can be used to program robots.
- 8.12 Robots will be measured in a free standing, upright position and with all parts fully extended.
- 8.13 The upright robot must fit inside an upright 22cm diameter cylinder.
- 8.14 The robot height must be less than 22cm.
- 8.15 Robots must not weigh more than 1kg.

- 8.16 If a robot has a moving part that extends in two directions, it will need to be inspected with this part operating. The robot must be able to operate without touching the measuring cylinder.
- 8.17 Robots must have a handle for judges to easily pick them up. The handle will not be included in above height and weight measurements.
- 8.18 Batteries will be limited to the grey rechargeable LEGO battery, no. 45501 for EV3, 9798 or 9693 for NXT.
- 8.19 Teams are limited to two EV3's and 8 motors in the competition area. They must produce a broken motor or EV3 to the head judge to get another from their mentor. Any bags or boxes will be searched on request whenever competitors enter the hall.
- 8.20 Any evidence of damage or tampering of batteries, motors or EV3's will not be tolerated and could result in disqualification. Motors must be below the maximum specs outlined in <https://www.lego.com/en-us/product/ev3-medium-servo-motor-45503> and <https://www.lego.com/en-us/product/ev3-large-servo-motor-45502> . Large NXT motors must also meet the EV3 Large Motor specs.
- 8.21 Competitors must mark or decorate their robots to identify them as belonging to the same team. These must not influence game play and will not be considered in the height restrictions.
- 8.22 Colors of robots, Ultra Sonic Transmission or light transmitters must not interfere with sensor readings of other robots.

## 9. Robot Assembly

WRO rules require that all robots are assembled during the assigned assembly time on the day of the competition.

- 9.1 All the parts for the robot should be disassembled and in their initial state (**not pre-built**) when the “assemble” time starts. For example, a tyre cannot be put on a wheel until assembly time begins.
- 9.2 Competitors may not use any instruction sheets/guides whether written, illustrated or pictorial no matter what format they are in (including paper-based and digital).
- 9.3 Contestants may make the program beforehand.
- 9.4 Robots can be modified during “venue open” or competition times. **ie there is no quarantine before or between games.**
- 9.5 **It is the competitor's responsibility to ensure that a robot is legal at all times. If a robot is deemed illegal after a game, that team will forfeit any points gained in that game and any other games, since the last time the robot was ruled as legal by the official measurement judge, usually the Head Judge.**

*A measurement record should be kept by the measurement judge, recording the time as well as any infringements. A robot must be repaired and re-measured if it is deemed as illegal. Repeated infringements with no substantial improvement will not be tolerated. Offending robots will be excluded from playing until they are clearly legal and have no chance of reoffending.*

9.6 **Robots must be placed in quarantine overnight and not leave the competition area at any time until they have finished competing.**

9.7 Robots should be designed to cope with field imperfections of up to 5 mm on the surface as well as the incline.

9.8 Teams should design and program their robots to cope with variations in lighting, ball intensity and magnetic conditions, as these vary from venue to venue, and with time.

## 10. Robot Control

10.1 Robots must be controlled autonomously.

10.2 Robots must be able to be started manually.

10.3 The use of remote control any kind is not allowed.

10.4 Robots must be able to move in all directions.

10.5 Bluetooth communication between robots is acceptable as long as it does not interfere with the performance of other robots.

10.6 Robots must have the ability to have their communication disabled at the request of the judge.

## 11. Ball Control

11.1 Ball Capturing Zones are defined as any internal space created when a straight edge is placed on any of the protruding points of a robot that can touch the ball.

11.2 The ball cannot penetrate the Ball Capturing Zone by more than 2 cm.

11.3 A robot cannot "hold" a ball. Holding a ball means removing the ball's degrees of freedom. For example, this could mean fixing a ball to the robot, surrounding a ball using the robot or somehow trapping the ball with any part of the robot body. If a ball stops rolling while a robot is moving, or a ball does not rebound when rolled into a stationary robot, it is a good indication that the ball is "held" and is illegal.

11.4 The ball cannot be held underneath a robot **ie no part of a robot can protrude over more than half of the ball's diameter.**

11.5 If a robot has a kicker mechanism, it will be measured at all extremes of the kickers movement as well as turned on **and** off.

## 12. Goalies

12.1 If a goalie is used, it cannot limit its movement to a single direction on the field. It must be programmed to move in all directions.

12.2 The goalie must respond to the ball in a forward direction, down the field, in an attempt to intercept the ball ahead of the goal. If required, its movement should be able to take some part of the robot outside of the penalty box (45 cm from goal).

12.3 The goalie cannot respond sideways and followed by a forward movement.

12.4 Failure to respond to the ball with forward movement will result in the robot being classified as "Damaged." (Section 6)

## 13. Authentication of Student Work

13.1 Students will be interviewed to explain the operation of their robots in order to verify that the construction and the programming of the robot is their own work.

13.2 Students will be asked questions about their preparation efforts.

13.3 Proof of a full understanding of the program must be shown.

13.4 It is expected that tournament organizers will conduct verification interviews prior to the finals of **all events**.

13.5 If the panel rules that there is excessive mentor assistance or the work on the robots is not substantially the original work by the students, then the team will be disqualified from the tournament.

## 14. Finals Selection

14.1 During Round Robin play, teams will be allocated three points for a win, one point for a tie and 0 points for a loss.

14.2 Teams will be selected for finals on the following criteria:

- Points scored
- Goals Scored
- Goal Difference
- The winning team if the two tied teams competed against each other.
- The strongest opposition, indicated by the highest ranked teams in their group.

## 15. Tied Elimination Finals

15.1 If the scores are tied in an elimination final, the game will not stop and play will continue until a “golden goal” is scored.

15.2 If a goal is not scored after 3 minutes of extra time, the goalies will be removed, or in the case of two forward players, the team can select which robot is removed.

15.3 If a goal is not scored after another 3 minutes, the higher qualifying team will be awarded the game.

## 16. WRO Ball

16.1 A well-balanced electronic ball diameter 7.5 cm shall be used.

16.2 The Hitechnic Infrared Electronic Ball(IRB 1005) in MODE T (pulsed) will be used in official WRO tournaments. In high external light conditions, it is advised to program with the IRV2 sensor block used in the “Alternating ” setting.

## 17. Code of Conduct

17.1 By competing in WRO, teams and coaches accept the WRO Guiding Principles that can be found at: <https://wro-association.org/competition/wro-ethics-code/>

17.2 Every team needs to bring a signed copy of the WRO Ethics Code to the competition and hand it to the judges before the start of the competition.

17.3 Coaches are not allowed to enter the competition area to provide any instructions and guidance during the competition. Team computers must remain in the competition area while the tournament is running.

17.4 Interference with competition tables, materials or robots of other teams could result in a team’s disqualification.

17.5 Teams will not use dangerous items or behaviours that may create or cause interference with the competition.

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- 17.6 Inappropriate words, booing and/or behaviour towards other team members, other teams, audience, judges or staff will not be tolerated. Yellow and Red Cards may be issued in these circumstances.
- 17.7 Bringing cellular/mobile phone or a medium of wire/wireless communication into the designated competition area is not allowed and will result in a Yellow and then a Red Card if it is repeated
- 17.8 Any situation which judges might consider as interference or violation of the spirit of the WRO mission will not be tolerated.
- 17.9 Any use of sensors or actions that **intentionally** affect the operation of an opposition robot will not be tolerated. The robot will be treated as damaged and must be fixed immediately. If a robot has been deemed as illegal after a game, then that team will forfeit all games where that action or behaviour were used. **If a team is trying to gain an advantage by bending the rules they stand the risk of being severely penalised.**
- 17.10 It is expected that all participants, Students and Mentors alike, will respect the WRO mission.
- 17.11 The judges and officials will act within the spirit of the event.
- 17.12 ***It is not whether you win or lose, but how much you learn that counts.***