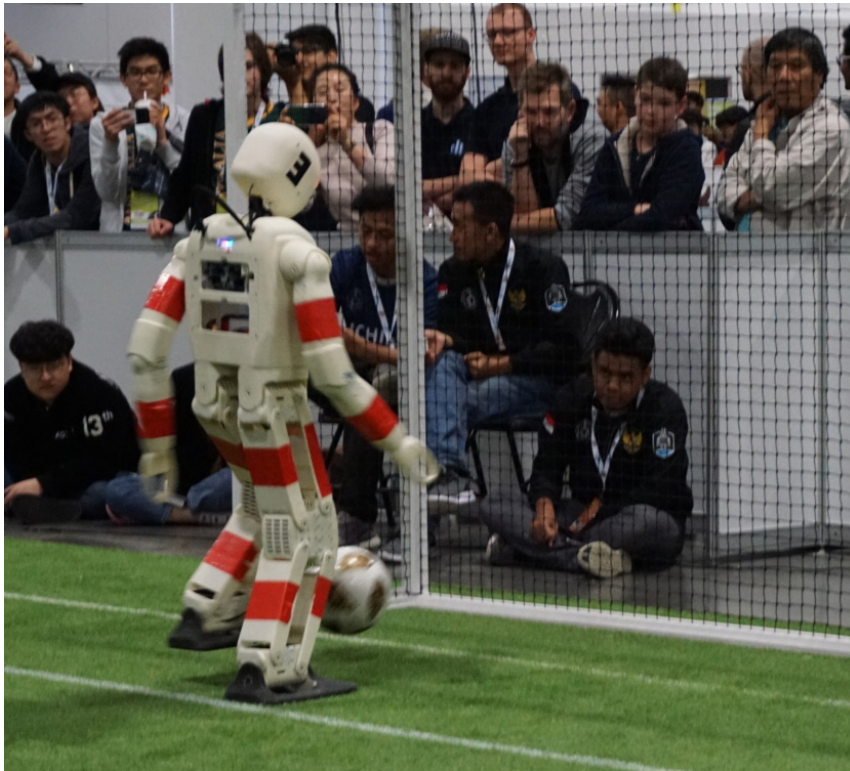




RoboCup Soccer Humanoid League Laws of the Game 2019/2020

December 23, 2019



Team NimbRo, winner of the Best Humanoid Award 2019

Changes are either **marked in magenta text colour** (for additions) or by ~~crossed-out-text~~ (for deletions).

RoboCup Humanoid League Mailing List (for important announcements):

10 <https://mailman.cc.gatech.edu/mailman/listinfo/robocup-humanoid>

RoboCup Humanoid Forum (for rule discussion and questions):

<https://hl.forum.robocup.org>

RoboCup Humanoid League Home Pages:

<https://www.robocuphumanoid.org/>

15 <https://www.robocup.org/leagues/3>

Inspired by the [Laws of the Game of the International Football Association Board](#), with amendments for the RoboCup Humanoid League.

Overview

Section I – Laws of the Game

20 Section II – RoboCup Humanoid League Competition Rules

Section III – Rules for RoboCup Humanoid League Technical Challenges

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Section I

Laws of the Game

The Laws of the Game should be updated regularly to refer to the most recent FIFA document.

Deviations from the FIFA rules are marked in the text:

'replaces': A RoboCup-specific rule temporarily replaces a FIFA rule.

'suspended': A specific FIFA rule is not yet applied.

'new': A RoboCup-specific rule is temporarily introduced.

60 NOTES ON THE LAWS OF THE GAME

Modifications

Subject to the agreement of the member association concerned and provided the principles of these Laws are maintained, the Laws may be modified in their application for regional matches.

Any or all of the following modifications are permissible:

- 65 • size of the field of play
- size, weight and material of the ball
- width between the goalposts and height of the crossbar from the ground
- duration of the periods of play
- substitutions

70 Male and Female

References in respect of referees, assistant referees and officials have been changed from the original FIFA document to a gender neutral language. The reference to players, since they refer to robots in this context, have been kept in the male gender. However, we strongly encourage the FIFA to officially change their laws of the game to fully gender neutral language in the future in respect to all participants in the game.

- 75 (replaces: References to the male gender in the Laws of the Game in respect of referees, assistant referees, players and officials are for simplification and apply to both men and women.)

Official languages

RoboCup Humanoid League Technical Committee publishes the Laws of the Game in English.

Key

- 80 A single line in the left-hand margin indicates new Law changes.

Law 1 – The Field of Play

Field surface

- 85 Matches may be played on artificial surfaces with a height of approximately 30 mm.
(replaces: Matches may be played on natural or artificial surfaces, according to the rules of the competition.)

The colour of artificial surfaces must be green.

- (suspended: Where artificial surfaces are used in either competition matches between representative teams of member associations affiliated to FIFA or international club competition matches, the surface must meet the requirements of the FIFA Quality Concept for Football Turf or the International Artificial Turf Standard, unless special dispensation is given by FIFA.)
- 90

Field markings

- 95 The field of play must be rectangular and marked with lines. These lines belong to the areas of which they are boundaries.

The two longer boundary lines are called touch lines. The two shorter lines are called goal lines.

The field of play is divided into two halves by a halfway line, which joins the midpoints of the two touch lines.

- The centre mark is indicated at the midpoint of the halfway line. A circle with a radius of 0.75 m for KidSize ~~and TeenSize~~ and 1.5 m for AdultSize is marked around it. (replaces: A circle with a radius of 9.15 m (10 yds) is marked around it.)
- 100

(suspended: Marks may be made off the field of play, 9.15 m (10 yds) from the corner arc and at right angles to the goal lines and the touch lines, to ensure that defending players retreat this distance when a corner kick is being taken.)

105 Dimensions

The length of the touch line must be greater than the length of the goal line.

KidSize ~~and TeenSize~~ matches

- 110 Length (touch line): approximately 9 m

Width (goal line): approximately 6 m

(replaces:

Length (touch line): minimum 90 m

maximum 120 m

Width (goal line): minimum 45 m

maximum 90 m)

All lines must be of the same width, which must be approximately 5 cm.

(replaces: All lines must be of the same width, which must be not more than 12 cm (5 ins).)

115 AdultSize matches

Length (touch line): approximately 14 m

Width (goal line): approximately 9 m

(replaces:

Length (touch line): minimum 100 m
maximum 110 m
Width (goal line): minimum 64 m
maximum 75 m)

The goal area

120

Two lines are drawn at right angles to the goal line, ~~1.2~~ 0.2 m from the inside of each goalpost for KidSize and 0.7 m for AdultSize. These lines extend into the field of play for a distance of 1 m and are joined by a line drawn parallel with the goal line. The area bounded by these lines and the goal line is the goal area.

125 (replaces: Two lines are drawn at right angles to the goal line, 5.5 m (6 yds) from the inside of each goalpost. These lines extend into the field of play for a distance of 5.5 m (6 yds) and are joined by a line drawn parallel with the goal line. The area bounded by these lines and the goal line is the goal area.)

The penalty area

130

Two lines are drawn at right angles to the goal line, 1.2m from the inside of each goalpost for KidSize and 0.7 m for AdultSize. These lines extend into the field of play for a distance of 2 m for KidSize and 3 m for AdultSize. They are joined by a line drawn parallel with the goal line. The area bounded by these lines and the goal line is the penalty area.

135 (replaces: Two lines are drawn at right angles to the goal line, 16.5 m (18 yds) from the inside of each goalpost. These lines extend into the field of play for a distance of 16.5 m (18 yds) and are joined by a line drawn parallel with the goal line. The area bounded by these lines and the goal line is the penalty area.)

140 Within each penalty area, a penalty mark is made at 2.1m for AdultSize and 1.5m for KidSize and ~~TeenSize~~ from the midpoint between the goalposts and equidistant to them. (replaces: Within each penalty area, a penalty mark is made 11 m (12 yds) from the midpoint between the goalposts and equidistant to them.)

(suspended: An arc of a circle with a radius of 9.15 m (10 yds) from the centre of each penalty mark is drawn outside the penalty area.)

Flagposts

145

(suspended: A flagpost, not less than 1.5 m (5 ft) high, with a non-pointed top and a flag must be placed at each corner.)

(suspended: Flagposts may also be placed at each end of the halfway line, not less than 1 m (1 yd) outside the touch line.)

The corner arc

150

(suspended: A quarter circle with a radius of 1 m (1 yd) from each corner flagpost is drawn inside the field of play.)

Goals

155

A goal must be placed on the centre of each goal line.

160 A goal consists of two upright posts equidistant from the corner flagposts and joined at the top by a horizontal crossbar. The goalposts and crossbar must be made of wood, metal or other approved material. They must be square, rectangular, round or elliptical in shape and must not be dangerous to players.

The distance between the posts is 2.6 m and the distance from the lower edge of the crossbar to the ground is 1.2 m for KidSize and 1.8m for AdultSize.

(replaces: The distance between the posts is 7.32 m (8 yds) and the distance from the lower edge of the crossbar to the ground is 2.44 m (8 ft).)

165 (suspended: figures of different goal post geometries)

(suspended: The position of the goalposts in relation to the goal line must be according to the graphics below.)

If the shape of the goalposts is square (viewed from above), the sides must be parallel or perpendicular to the goal line. The sides of the crossbar must be parallel or perpendicular to the field plane.

170 If the shape of the goalposts is elliptical (viewed from above), the longest axis must be perpendicular to the goal line. The longest axis of the crossbar must be parallel to the field plane.

If the shape of the goalposts is rectangular (viewed from above), the longest side must be perpendicular to the goal line. The longest side of the crossbar must be parallel to the field plane.

175 Both goalposts and the crossbar have the same width and depth, which is not smaller than 8 cm and do not exceed 12 cm (5 ins). The goal lines must be approximately 5 cm of width. (replaces: The goal lines must be of the same width as the goalposts and the crossbar.) Nets (new:) which must not be green or white may be attached to the goals and the ground behind the goal, provided that they are properly supported and do not interfere with the goalkeeper.

The goalposts and crossbars must be white.

Safety

180

Goals must be anchored securely to the ground. Portable goals may only be used if they satisfy this requirement.

The field of play

185

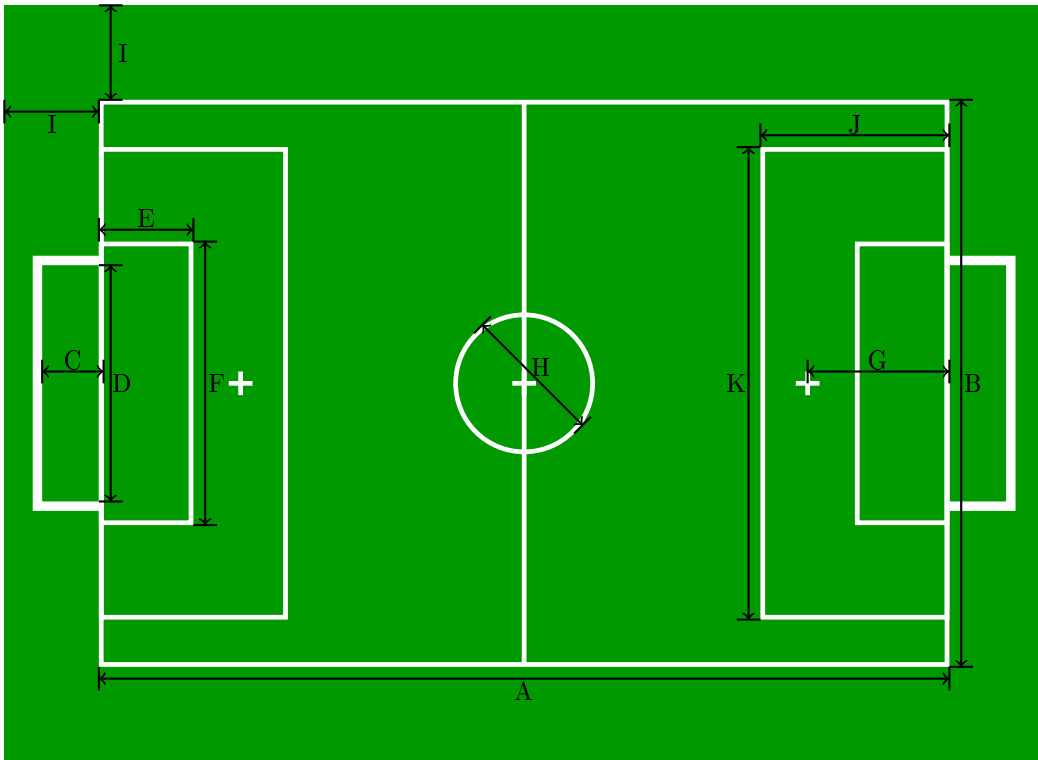


Figure 1: Humanoid robot soccer field: Kid Size (scale: 1/80)

(replaces figure of field)

Light Condition

190

The lighting could either be artificial or natural.

Corner flagpost

195

(suspended: figure of flagpost)

Metric measurements

200

(suspended: figure with metric dimensions of field)

Imperial measurements

(suspended: figure with imperial dimensions of field)

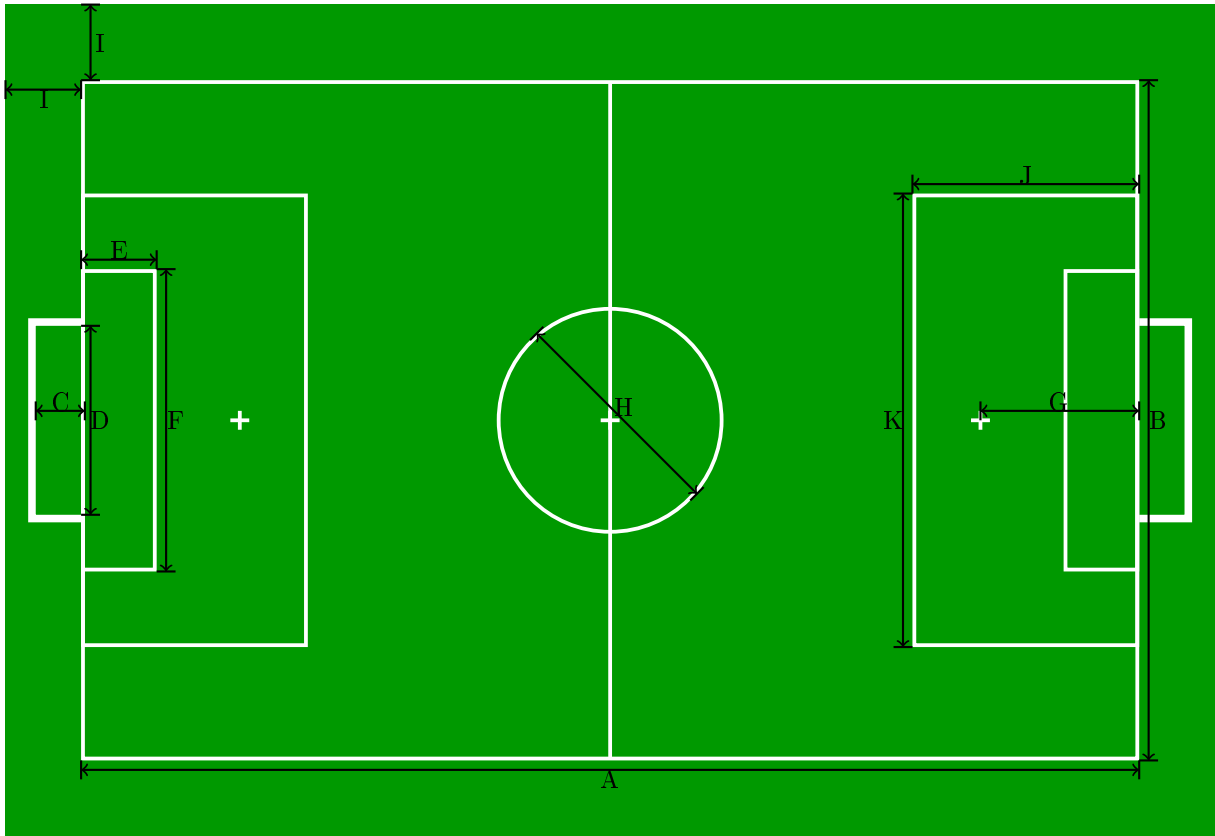


Figure 2: Humanoid robot soccer field: Adult Size (scale: 1/100)

Table 1: Approximate dimensions of the rectangular field of soccer play.

		KidSize and TeenSize	AdultSize
A	Field length	9 m	14 m
B	Field width	6 m	9 m
C	Goal depth	0.6 m	
D	Goal width	2.6 m	
	Goal height	1.2 m 1.8 m	1.8 m
E	Goal area length	1 m	
F	Goal area width	3 m 5 m	4 m 5 m
G	Penalty mark distance	1.5 m	2.1 m
H	Centre circle diameter	1.5 m	3 m
I	Border strip width (min.)	1 m 0.7 m	1 m
J	Penalty area length	2 m	3 m
K	Penalty area width	5 m	6 m

205 **Decisions of the International F.A. Board**

(suspended: Decision 1

210 Where a technical area exists, it must meet the requirements approved by the International F.A. Board, which are contained in the section of this publication entitled The Technical Area.)

(suspended: Decision 2

Where goal-line technology (GLT) is used, modifications to the goal frame may be allowed. They must be in accordance with the specifications stipulated in the FIFA Quality Programme for GLT and according to the above description, "Goals".)

215 **Law 2 – The Ball**

Qualities and measurements

The ball is:

- 220
- spherical
 - made of leather or other suitable material
 - FIFA size 1 for KidSize, ~~size 3 for TeenSize~~ and size 5 for AdultSize leagues. (replaces: of a circumference of not more than 70 cm (28 ins) and not less than 68 cm (27 ins) and: not more than 450 g (16 oz) and not less than 410 g (14 oz) in weight at the start of the match)
- 225
- (suspended: of a pressure equal to 0.6 – 1.1 atmosphere (600 – 1,100 g/cm^2) at sea level (8.5 lbs/sq in – 15.6 lbs/sq in))

Replacement of a defective ball

230 If the ball bursts or becomes defective during the course of a match:

- the match is stopped
 - the match is restarted by dropping the replacement ball at the place where the original ball became defective, unless play was stopped inside the goal area, in which case the referee drops the replacement ball on the goal area line parallel to the goal line at the point nearest to where the original ball was located when play was stopped
- 235

If the ball bursts or becomes defective during a penalty kick or during kicks from the penalty mark as it moves forward and before it touches any player or the crossbar or goalposts:

- the penalty kick is retaken

240 If the ball bursts or becomes defective whilst not in play at a kick-off, goal kick, corner kick, free kick, penalty kick or throw-in:

- the match is restarted accordingly

The ball may not be changed during the match without the authority of the referee.

Decisions of the International F.A. Board

245

(suspended: Decision 1

In addition to the requirements of Law 2, acceptance of a ball for use in matches played in an official competition organised under the auspices of FIFA or the confederations is conditional upon the ball bearing one of the following:

250

- the official “FIFA APPROVED” logo
- the official “FIFA INSPECTED” logo
- the “INTERNATIONAL MATCHBALL STANDARD” logo

255

Such a logo on a ball indicates that it has been tested officially and found to be in compliance with specific technical requirements, different for each logo and additional to the minimum specifications stipulated in Law 2. The list of the additional requirements specific to each of the respective logos must be approved by the International F.A. Board.

The institutes conducting the tests are subject to the approval of FIFA.

Member association competitions may also require the use of balls bearing any one of these three logos.

(figures...)

(suspended: Decision 2

260

In matches played in an official competition organised under the auspices of FIFA, the confederations or the member associations, no form of commercial advertising on the ball is permitted, except for the emblem of the competition, the competition organiser and the authorised trademark of the manufacturer. The competition regulations may restrict the size and number of such markings.)

(suspended: Decision 3

265

Where goal-line technology (GLT) is used, balls with integrated technology are allowed, but they must either be “FIFA APPROVED”, “FIFA INSPECTED” or “INTERNATIONAL MATCHBALL STANDARD” (see “Decision 1”).)

Law 3 – The Players

Number of Players

- 270 A match is played by two teams, each consisting of not more than four players in KidSize ~~, not more than three players in TeenSize~~ and not more than two players in AdultSize, one of whom must be designated as goalkeeper. A match may not start if either team consists of less than one player. If a team has not at least one player (who may be incapable to play) at the side of the field, it is considered a forfeit.
(replaces: A match is played by two teams, each consisting of not more than eleven players, one of whom is the goalkeeper. A match may not start if either team consists of fewer than seven players.)
- 275

Number of substitutions

Official competitions

- 280 Up to a maximum of two (replaces: three) substitutes may be used in any match played in an official competition organised under the auspices of FIFA, the confederations or the member associations.
The rules of the competition must state how many substitutes may be nominated, from two (replaces: three) up to a maximum of twelve.

(suspended: **Other matches**

- 285 In national “A” team matches, up to a maximum of six substitutes may be used.

In all other matches, a greater number of substitutes may be used provided that:

- the teams concerned reach agreement on a maximum number
- the referee is informed before the match

- 290 If the referee is not informed, or if no agreement is reached before the match, no more than six substitutes are allowed.

Substitution procedure

- 295 In all matches, the names of the substitutes must be given to the referee prior to the start of the match. Any substitute whose name is not given to the referee at this time may not take part in the match.

To replace a player with a substitute, the following conditions must be observed:

- the referee must be informed before any proposed substitution is made
- the substitute only enters the field of play after the player being replaced has left and after receiving a signal from the referee
- 300 • the substitute only enters the field of play at the penalty mark of the player’s own half (replaces: the halfway line) and during a stoppage in the match
- the substitution is completed when a substitute enters the field of play
- from that moment, the substitute becomes a player and the player he has replaced becomes a substituted player
- (suspended: the substituted player takes no further part in the match)
- 305 • all substitutes are subject to the authority and jurisdiction of the referee, whether called upon to play or not

Changing the goalkeeper

Any of the other players may change places with the goalkeeper, provided that:

- 310
- the referee is informed before the change is made
 - the change is made during a stoppage in the match

Infringements and sanctions

- 315 If a substitute or substituted player or a team official enters the field of play without the referee's permission:
- the referee stops play (although not immediately if the substitute or substituted player does not interfere with play)
 - the referee cautions him for unsporting behaviour and orders him to leave the field of play
 - if the referee has stopped play, it is restarted with an indirect free kick for the opposing team from the position of the ball at the time of the stoppage (see Law 13 – Position of free kick)
- 320

If a named substitute enters the field of play instead of a named player at the start of the match and the referee is not informed of this change:

- the referee allows the named substitute to continue the match
 - no disciplinary sanction is taken against the named substitute
 - the number of substitutions allowed by the offending team is not reduced
 - the referee reports the incident to the appropriate authorities
- 325

If a player changes places with the goalkeeper without the referee's permission before the change is made:

- the referee allows play to continue
- the referee cautions the players concerned when the ball is next out of play

- 330 In the event of any other infringements of this Law:
- the players concerned are cautioned
 - the match is restarted with an indirect free kick, to be taken by a player of the opposing team from the position of the ball at the time of the stoppage (see Law 13 – Position of free kick)

Players and substitutes sent off

335 A player who has been sent off before the kick-off may be replaced only by one of the named substitutes.

A named substitute who has been sent off, either before the kick-off or after play has started, may not be replaced.

Law 4 – The Players ('Equipment')

340 Safety

A player must not use equipment or wear anything that is dangerous to himself or another player (including any kind of jewellery).

345 The Design of the Robots (new)

Robots participating in the Humanoid League competitions must have a human-like body plan, as shown in Fig. 3. They must consist of two legs, two arms, and one head, which are attached to a trunk.

350 (new:) Robots in ~~KidSize~~ ~~kid-and-teen-size-sub-leagues~~ must be equipped with a handle, to be picked up safely and with no harm to the robot and the handler.

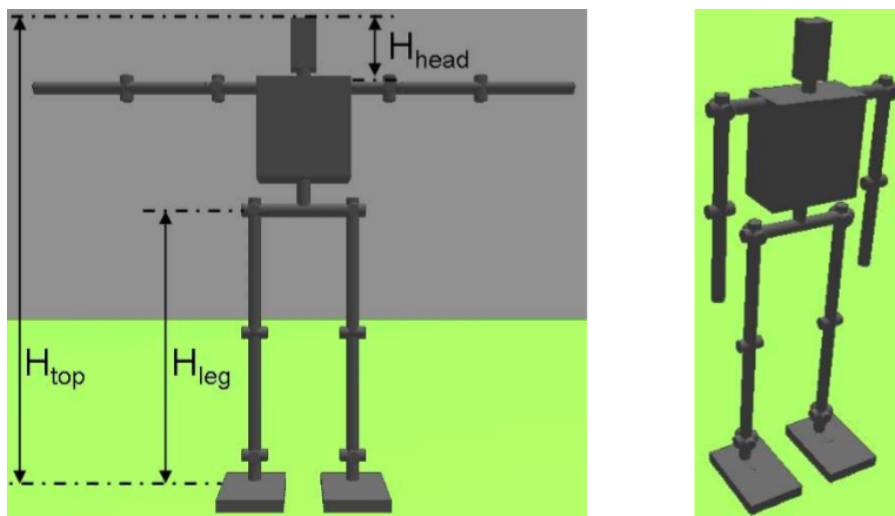


Figure 3: Example of a humanoid robot body plan (left) and standing upright pose (right)

The robots must be able to stand upright on their feet and to walk on their legs. KidSize ~~and-TeenSize~~ robots need to be able to recover from a fall (get back to a standing position). The only allowed modes of locomotion are bipedal walking, running and jumping.

355 All actions of the robots must be kinematically equivalent to humanoid motions.

Robots must be equipped with an emergency stop button that makes the robot immediately desist with all motions, or ideally go limp and/or cut power to the actuators. In addition to the emergency stop button, robots may only have up to two additional physical or virtual buttons: One to start the robot behaviour and one to stop the behaviour. The buttons must be clearly labeled. If the robot has more buttons that cannot be detached, they must be visibly masked during the games.

360

Robot Height (new)

Based on H_{top} , the following size restrictions apply:

- 365
- $40 \text{ cm} \leq H_{top} \leq 90 \text{ 100 cm}$ to play in the KidSize class,
 - ~~$80 \text{ cm} \leq H_{top} \leq 140 \text{ cm}$ to play in the TeenSize class,~~
 - ~~$130 \text{ 100 cm} \leq H_{top} \leq 180 \text{ 200 cm}$ to play in the AdultSize class.~~

H_{top} is defined as the height of the robot when standing upright (with fully extended knees, cf. Fig. 3 right) and H_{COM} denotes the height of the robot's centre of mass, measured in upright posture. H_{top} is measured with the head of the robot oriented in such a way that it is tilted to either its maximum upwards tilt angle or the horizon line, whichever is lower.

Weight Restrictions (new)

- ~~The maximum weight for robots allowed to play in the TeenSize class is 20 kg.~~
- ~~The minimum weight for robots allowed to play in the AdultSize class is 10 kg.~~

The robot's Body-Mass Index (BMI) is defined as follows: $BMI = \frac{M}{H_{top}^2}$, where M is the mass of the robot in kg and H_{top} its height in meters. The following restriction applies:

- $5 \leq BMI \leq 30$

Size Restrictions (new)

All robots participating in the Humanoid League must comply with the following restrictions:

- Each foot must fit into a rectangle of area $\frac{1}{32}(2.2 \cdot H_{COM})^2$. A foot is defined as the minimum encapsulating rectangle covering all mechanical parts below the ankle joint. The encapsulating rectangle should be in a plane parallel to the bottom contact surface of the foot.
- The ratio between the longest and the shortest side of the encapsulating rectangle should be between 1.2 and 3.5
- The robot must fit into a cylinder of diameter $0.55 \cdot H_{top}$.
- The robot does not possess a configuration where it is extended longer than $1.5 \cdot H_{top}$.
- The length of the legs H_{leg} , including the feet, satisfies $0.35 \cdot H_{top} \leq H_{leg} \leq 0.7 \cdot H_{top}$.
- The height of the head H_{head} , including the neck, satisfies $0.1 \cdot H_{top} \leq H_{head} \leq 0.3 \cdot H_{top}$
 ~~$0.05 \cdot H_{top} \leq H_{head} \leq 0.25 \cdot H_{top}$. H_{head} is defined as the vertical distance from the axis of the first arm joint at the shoulder to the top of the head.~~
- The leg length is measured while the robot is standing up straight. The length is measured from the first rotating joint where its axis lies in the plane parallel to the standing ground to the tip of the foot.
- The minimum length of the arm, measured from the first joint, is $H_{top} - H_{leg} - H_{head}$.

Sensors (new)

Teams participating in the Humanoid League competitions are encouraged to equip their robots with sensors that have an equivalent in human senses. These sensors must be placed at a position roughly equivalent to the location of the human's biological sensors. In particular,

- The only active external sensor allowed is sound ("human-like" with respect to volume and frequency) with one loudspeaker on the robot. The loudspeaker may be placed in the head, neck or trunk of the robot. Any other active sensor (emitting light, sound, or electromagnetic waves into the environment in order to measure reflections) is not allowed.
- External sensors, such as cameras and up to two microphones, may not be placed in the legs or arms or the torso of the robots. They must be placed in the robot's head and above any neck joint.
- The number of cameras is limited to a stereo vision setup (i.e., max. 2 cameras with a large overlap) only. Monocular vision is also allowed.

- The field of view of the robots is limited at any time to 180 degrees. This means that the maximum angle between any two points in the union of the field of view of all cameras mounted on the robot must be less than 180 degrees. Also the pan-tilt motion of the head and the cameras mounted on the robot's head is restricted to be more human like not only with respect to the field of view but also to the range of motion of the neck joints. Therefore, the mechanism to pan the camera is limited to 270 degree pan, which means ± 135 degrees from the position looking straight ahead. The mechanism to tilt the camera is limited to ± 90 degrees (measured from the horizontal line). Furthermore, if positioned at the centre mark the robot may not be able to see more than two goal posts in any tilt angle and in any standing or walking posture of the robot.
- Touch sensors, force sensors, and temperature sensors may be placed at any position on the robot.
- Sensors inside the robot may measure all quantities representing the local state of the system, including (but not limited to) voltages, currents, forces, movements, accelerations, and rotational speeds. They can be at any position inside the robot. Measurements from earth magnetic field sensors may not be used in the software and - in case of doubt - the code must be made available to members of the Technical Committee for inspection.

Communication and Control (new)

Robots participating in the Humanoid League competitions must act autonomously while a competition is running. No external power supply, teleoperation, remote control, or remote brain of any kind is allowed.

Robots may communicate only via the wireless network provided by the organizers, which must support the referee box. The total bandwidth of the robots belonging to one team may not exceed 1 Mbit/s. The robots must not rely on the quality of the wireless network. They must be able to play if the network is of low quality. Only robots are allowed to communicate by WLAN. Any other computers of team members are only allowed to communicate by tethered LAN. No other wireless communication is allowed onsite. All other wireless hardware must be deactivated.

A team may be disqualified if one of the team members violates this rule.

Robots in play may communicate with each other at any time during a game. ~~Robots not currently in play may only send status updates about their own internal hardware or software functionality over the network. They may not communicate any game relevant information.~~ Any kind of transmission from an external computer ~~or an out of play robot~~ to the playing robots is prohibited. This implies that any monitoring is only done by receiving UDP communication from the robots using an external computer connected by tethered LAN to the official wireless router. **Substitute robots need to be turned away from the field in order to ensure they are not accidentally or purposefully sending game-relevant information to the robots in play.**

Sending any direct or indirect transmission from an external computer to the robots has to take place during a timeout or any form of temporal absence and outside the field of play. Any time the robot handler or another team member is touching the robot, a cable is connected or another form of communication with the robot (including button clicks) take place, the robot is considered in service. The regular penalty time will start counting only after any type of communication with the robot has finished and will be reset whenever the robot handler attempts to service the robot again.

Teams may not use any type of communication, excluding verbal communication, with robots in play, in service or with robots serving their 30 seconds penalty time that contains information which reduces the need for autonomy in detecting the current game state of the robots, including the position of the ball, the location where the robot re-enters the field, the orientation of the robots own or opponents goal, and the position of team members or opponents. In case of doubt that a team violates this rule, the code must be made available to members of the Technical Committee for inspection.

During the game an official game controller/referee box will be used. It uses UDP to broadcast information to the robots like elapsed time, current score, game state (ready, set, playing, finished) and the robot-specific penalized state. The source code is open. **Teams have to be able to use the referee box in order to respect the rules.** ~~To encourage teams to use the referee box, 15 seconds advantage is given to teams using the referee box in any stoppage of the game.~~

In KidSize ~~and TeenSize~~, no humans are allowed on the field while the ball is in play. Robot handlers stay in a designated area and must receive permission from the referee prior to entering the field. Each team may designate

only one person as robot handler. The robot handler of a team may not touch a robot of another team in order to avoid any (unintentional or intentional) damage to that robot.

The source code of the game controller/referee box is available from
465 <https://github.com/RoboCup-Humanoid-TC/GameController>, see also
<https://www.robocuphumanoid.org>.

(suspended: Basic equipment

4.70 The basic compulsory equipment of a player comprises the following separate items:

- a jersey or shirt with sleeves – if undergarments are worn, the colour of the sleeve must be the same main colour as the sleeve of the jersey or shirt
- shorts – if undershorts or tights are worn, they must be of the same main colour as the shorts
- stockings – if tape or similar material is applied externally it must be the same colour as that part of the stocking it is applied to shinguards footwear)

(suspended: Shinguards

- are covered entirely by the stockings
- are made of rubber, plastic or a similar suitable material
- provide a reasonable degree of protection)

Colours

- (new) Robots must be mostly black or of dark grey colour (i.e. RAL 7011 Iron Grey or darker) and non reflective. Robots may also be coloured in aluminium-like silver, grey or white but then their feet must be coloured black. Any colour used for the field (green, white) or colours similar to the opponent team's team markers must be avoided. Arms, legs and bodies of the robot must be of solid shape appearance.
- (new) The robots must be marked with team markers. These markers are coloured red for one team and blue for the other team. The total visible area of all team markers (up to 20) on the robot's arms, legs and chest combined must be at least $0.06 \cdot H_{top}^2$. The visible area of the one to five largest team markers on each side (left, right, front and back) must be at least $0.015 \cdot H_{top}^2$. If both teams cannot agree, which team colour to use, a coin will be flipped an hour prior to the game to assign the team colours.
- (new) The robots of each team must be uniquely identifiable. They must be marked with numbers or names. The goal keeper robot must be marked uniquely that it can be easily distinguished from the other robots of a team by the referees.
- The two teams must wear colours that distinguish them from each other and also the referee and the assistant referees.
- (suspended: Each goalkeeper must wear colours that distinguish him from the other players, the referee and the assistant referees)

Infringements and sanctions

In the event of any infringement of this Law:

- play need not be stopped
- the player at fault is instructed by the referee to leave the field of play to correct his equipment
- the player leaves the field of play when the ball next ceases to be in play, unless he has already corrected his equipment
- any player required to leave the field of play to correct his equipment must not re-enter without the referee's permission

- the referee checks that the player's equipment is correct before allowing him to re-enter the field of play
- the player is only allowed to re-enter the field of play before the respective penalty time is over (replaces: when the ball is out of play)

A player who has been required to leave the field of play because of an infringement of this Law and who re-enters the field of play without the referee's permission must be cautioned.

Restart of play

If play is stopped by the referee to administer a caution:

- 520 • the match is restarted by an indirect free kick taken by a player of the opposing team from the place where the ball was located when the referee stopped the match (see Law 13 – Position of free kick)

Decisions of the International F.A. Board

525 Decision 1

Players must not reveal undergarments showing slogans or advertising. The basic compulsory equipment must not have any political, religious or personal statements. A player removing his jersey or shirt to reveal slogans or advertising will be sanctioned by the competition organiser. The team of a player whose basic compulsory equipment has political, religious or personal slogans or statements will be sanctioned by the competition organiser (new) or by

530 RoboCup Federation Humanoid League.

Law 5 – The Referee

The authority of the referee

535 Each match is controlled by a referee who has full authority to enforce the Laws of the Game in connection with the match to which they have been appointed. Decisions will be made to the best of the referees ability according to the Laws of the Game and the spirit of the game and will be based on the opinion of the referee who has the discretion to take appropriate action within the framework of the Laws of the Game.

Powers and duties

540

The Referee:

- enforces the Laws of the Game
- controls the match in cooperation with the assistant referees and, where applicable, with the fourth official
- 545 • ensures that any ball used meets the requirements of Law 2
- ensures that the players' equipment meets the requirements of Law 4
- acts as timekeeper and keeps a record of the match
- stops, suspends or abandons the match, at their discretion, for any infringements of the Laws
- stops, suspends or abandons the match because of outside interference of any kind
- 550 • stops the match if, in their opinion, a player is seriously injured and ensures that he is removed from the field of play. An injured player may only return to the field of play after the respective penalty time is over (replaces: after the match has restarted)
- allows play to continue until the ball is out of play if a player is, in their opinion, only slightly injured
- ensures that any player bleeding from a wound leaves the field of play. The player may only return on receiving a signal from the referee, who must be satisfied that the bleeding has stopped
- 555 • allows play to continue when the team against which an offence has been committed will benefit from such an advantage and penalises the original offence if the anticipated advantage does not ensue at that time
- punishes the more serious offence when a player commits more than one offence at the same time
- takes disciplinary action against players guilty of cautionable and sending-off offences. They are not obliged to take this action immediately but must do so when the ball next goes out of play
- 560 • takes action against team officials who fail to conduct themselves in a responsible manner and may, at their discretion, expel them from the field of play and its immediate surrounds
- acts on the advice of the assistant referees regarding incidents that they has not seen
- ensures that no unauthorised persons enter the field of play
- 565 • indicates the restart of the match after it has been stopped
- provides the appropriate authorities with a match report, which includes information on any disciplinary action taken against players and/or team officials and any other incidents that occurred before, during or after the match

Decisions of the referee

570

The decisions of the referee regarding facts connected with play, including whether or not a goal is scored and the result of the match, are final.

575 The referee may only change a decision on realising that it is incorrect or, at their discretion, on the advice of an assistant referee or the fourth official, provided that they have not restarted play or terminated the match.

Decisions of the International F.A. Board

Decision 1

580 A referee (or where applicable, an assistant referee or fourth official) is not held liable for:
any kind of injury suffered by a player, official or spectator
any damage to property of any kind
any other loss suffered by any individual, club, company, association or other body, which is due or which may be due
to any decision that they may take under the terms of the Laws of the Game or in respect of the normal procedures
585 required to hold, play and control a match.

Such decisions may include:

- a decision that the condition of the field of play or its surrounds or that the weather conditions are such as to allow or not to allow a match to take place
- a decision to abandon a match for whatever reason
- 590 • a decision as to the suitability of the field equipment and ball used during a match
- a decision to stop or not to stop a match due to spectator interference or any problem in spectator areas
- a decision to stop or not to stop play to allow an injured player to be removed from the field of play for treatment
- a decision to require an injured player to be removed from the field of play for treatment
- 595 • a decision to allow or not to allow a player to wear certain apparel or equipment
- a decision (where they have the authority) to allow or not to allow any persons (including team or stadium officials, security officers, photographers or other media representatives) to be present in the vicinity of the field of play
- 600 • any other decision that they may take in accordance with the Laws of the Game or in conformity with their duties under the terms of FIFA, confederation, member association or league rules or regulations under which the match is played

Decision 2

In tournaments or competitions where a fourth official is appointed, their role and duties must be in accordance with the guidelines approved by the International F.A. Board, which are contained in this publication.

605 Decision 3

Where goal-line technology (GLT) is used (subject to the respective competition rules), the referee has the duty to test the technology's functionality before the match. The tests to be performed are set out in the FIFA Quality Programme for GLT Testing Manual. If the technology does not function in accordance with the Testing Manual, the referee must not use the GLT system and must report this incident to the respective authority.

610 **Law 6 – The Assistant Referees**

Duties

Two assistant referees may be appointed whose duties, subject to the decision of the referee, are to indicate:

- 615 • when the whole of the ball leaves the field of play
- which team is entitled to a corner kick, goal kick or throw-in
- when a player may be penalised for being in an offside position
- when a substitution is requested
- when misconduct or any other incident occurs out of the view of the referee
- 620 • when offences have been committed whenever the assistant referees have a better view than the referee (this includes, in certain circumstances, offences committed in the penalty area)
- whether, at penalty kicks, the goalkeeper moves off the goal line before the ball is kicked and if the ball crosses the line
- (new) operate the game controller

625 **Assistance**

The assistant referees also assist the referee in controlling the match in accordance with the Laws of the Game. In particular, they may enter the field of play to help control the distances as defined by the laws of the game (replaces: 630 9.15 m (10 yds) distance).

In the event of undue interference or improper conduct, the referee will relieve an assistant referee of their duties and make a report to the appropriate authorities.

Law 7 – The Duration of the Match

Periods of play

635

The match lasts two equal periods of 10 minutes, unless otherwise mutually agreed between the referee and the two teams. Any agreement to alter the duration of the periods of play must be made before the start of play and must comply with competition rules. (replaces: The match lasts two equal periods of 45 minutes, unless otherwise mutually agreed between the referee and the two teams. Any agreement to alter the duration of the periods of play (e.g. to reduce each half to 40 minutes because of insufficient light) must be made before the start of play and must comply with competition rules.)

Half-time interval

645

Players are entitled to an interval at half-time.

The half-time interval must not exceed 5 minutes. (replaces: The half-time interval must not exceed 15 minutes.)

Competition rules must state the duration of the half-time interval.

The duration of the half-time interval may be altered only with the consent of the referee.

650 Allowance for time lost

Allowance is made in either period for all time lost through:

- substitutions
- 655 • assessment of injury to players
- removal of injured players from the field of play for treatment
- wasting time
- any other cause

The allowance for time lost is at the discretion of the referee.

660 Penalty kick

If a penalty kick has to be taken or retaken, the duration of either half is extended until the penalty kick is completed.

Abandoned match

665

An abandoned match is replayed unless the competition rules provide otherwise.

Law 8 – The Start and Restart of Play

A kick-off starts both halves of a match, both halves of extra time and restarts play after a goal has been scored.
670 Free kicks (direct or indirect), penalty kicks, throw-ins goal kicks and corner kicks are other restarts (see law 13-17).

If an infringement occurs when the ball is not in play this does not change how play is restarted.

Definition of kick-off

675 A kick-off is a way of starting or restarting play:

- at the start of the match
- after a goal has been scored
- at the start of the second half of the match
- at the start of each period of extra time, where applicable

680 A goal may (new:) not be scored directly from the kick-off by the team taking the kick-off. Either the ball must move entirely outside the centre circle or must be touched by another player before being kicked into the goal. If the ball is kicked directly into the goal a goal-kick is awarded to the opposing team.

Procedure

685

Before a kick-off at the start of the match or extra time

- a coin is tossed and the team that wins the toss decides which goal it will attack in the first half of the match.
- the other team takes the kick-off to start the match.
- the team that wins the toss takes the kick-off to start the second half of the match.
- 690 • in the second half of the match, the teams change ends and attack the opposite goals.

Kick-off

- after a team scores a goal, the kick-off is taken by the other team.
- all players must be in their own half of the field of play
- 695 • the opponents of the team taking the kick-off are outside the center circle until it is in play (replaces: the opponents of the team taking the kick-off are at least 9.15 m (10 yds) from the ball until it is in play)
- the ball must be stationary on the centre mark
- the referee gives a signal
- the ball is in play when it is kicked and clearly moves (new: as determined by the referee or 10 seconds after the referee gave the signal)
- 700 • (suspended) the kicker must not touch the ball again until it has touched another player

Infringements and sanctions

(suspended: If the player taking the kick-off touches the ball again before it has touched another player:

- 705 • an indirect free kick is awarded to the opposing team to be taken from the position of the ball when the infringement occurred (see Law 13 – Position of free kick)

In the event of any other infringement of the kick-off procedure:

- the kick-off is retaken

Definition of dropped ball

710

A dropped ball is a method of restarting play when, while the ball is still in play, the referee is required to stop play temporarily for any reason not mentioned elsewhere in the Laws of the Game.

Procedure

715

The game is continued at the centre mark. A goal can be scored directly from a dropped ball. The procedure for dropped ball is the same as for kick-off, except that the players of both teams must be outside the centre circle. The ball is in play immediately after the referee gives the signal. If a player moves too close to the ball before the referee gives the signal, a kick-off is awarded to the opponent team.

720

(replaces: The referee drops the ball at the place where it was located when play was stopped, unless play was stopped inside the goal area, in which case the referee drops the ball on the goal area line parallel to the goal line at the point nearest to where the ball was located when play was stopped.)

Play restarts when the ball touches the ground.)

Infringements and sanctions

725

The ball is dropped again:

- if it is touched by a player before it makes contact with the ground
- if the ball leaves the field of play after it makes contact with the ground, without a player touching it

730

(suspended: If the ball enters the goal:

- if a dropped ball is kicked directly into the opponents' goal, a goal kick is awarded
- if a dropped ball is kicked directly into the team's own goal, a corner kick is awarded to the opposing team

Law 9 – The Ball In and Out of Play

735 **Ball out of play**

The ball is out of play when:

- it has wholly crossed the goal line or touch line whether on the ground or in the air
- 740 • play has been stopped by the referee

Ball in play

The ball is in play at all other times, including when:

- 745 • it rebounds off a match official, goalpost, crossbar or corner flagpost and remains in the field of play

Law 10 – The Method of Scoring

Goal scored

750 A goal is scored when the whole of the ball passes over the goal line, between the goalposts and under the crossbar, provided that no infringement of the Laws of the Game has been committed previously by the team scoring the goal.

If the kicking robot is touched by the robot handler before the ball passes the goal line, it's a 'Removal Penalty' and the goal does not count. The restart of the play will be a goal kick for the opponents team. If another robot of a team is touched by the robot handler before the ball passes the goal line and it's not the kicker, it's a 'Removal Penalty' and the goal counts.

Winning team

760 The team scoring the greater number of goals during a match is the winner. If both teams score an equal number of goals, or if no goals are scored, the match is drawn.

Competition rules

765 When competition rules require there to be a winning team after a match or home-and-away tie, the only permitted procedures for determining the winning team are those approved by the International F.A. Board, namely:

- away goals rule
- extra time
- kicks from the penalty mark
- (new) extended kicks from the penalty mark

770 Goal-line technology (GLT)

GLT systems may be used for the purpose of verifying whether a goal has been scored to support the referee's decision. The use of GLT must be stipulated in the respective competition rules.

775 **(suspended: Law 11 – Offside**

Offside position

It is not an offence in itself to be in an offside position. A player is in an offside position if:

- 780
- he is nearer to his opponents' goal line than both the ball and the second-last opponent

A player is not in an offside position if:

- he is in his own half of the field of play or
- he is level with the second-last opponent or
- he is level with the last two opponents

785 **Offence**

A player in an offside position is only penalised if, at the moment the ball touches or is played by one of his team, he is, in the opinion of the referee, involved in active play by:

- 790
- interfering with play or
 - interfering with an opponent or
 - gaining an advantage by being in that position

No offence

795

There is no offside offence if a player receives the ball directly from:

- a goal kick
- a throw-in
- a corner kick

800 **Infringements and sanctions**

In the event of an offside offence, the referee awards an indirect free kick to the opposing team to be taken from the place where the infringement occurred (see Law 13 – Position of free kick.)

Law 12 – Fouls and Misconduct

805 Direct and indirect free kicks and penalty kicks can only be awarded for offences and infringements committed when the ball is in play.

Direct free kick

810 A direct free kick is awarded to the opposing team if a player commits any of the following offences to a player of the opposing team:

- uses forceful contact that significantly destabilizes a player, such that walking and/or kicking is impeded. Examples for forceful contacts include falling into another player or walking carelessly into another player at significant speed.
- 815 • walks into another player for 4 to 5 seconds (even a fallen or getting up player), even if the 'force to push' is minimal.

A free kick is not awarded if one of the following exceptions occurs:

- The player committing the offence is stationary, including a player that is kicking, provided that the ball was close enough where a kick could have succeeded at the start of the kick motion.
- The player committing the offence is currently getting up.
- 820 • The player committing the offence is the current goal keeper and is currently looking at or chasing the ball in it's own penalty area.
- Front to front contact between players with the ball between them does not lead to a free kick, unless one player walks at a significantly higher speed or with significantly more force that is impossible to stand for the other player.
- 825 • Any player proceeding to the ball whose side (i. e. arm, shoulder etc.) makes contact with another player is not committing an offence, even if the second player is not proceeding to the ball.
- A player that had an offence committed against himself can not simultaneously be called for a free kick offence himself.

830 (replaces: A direct free kick is awarded to the opposing team if a player commits any of the following seven offences in a manner considered by the referee to be careless, reckless or using excessive force:

- kicks or attempts to kick an opponent
- trips or attempts to trip an opponent
- jumps at an opponent
- charges an opponent
- 835 • strikes or attempts to strike an opponent
- pushes an opponent
- tackles an opponent)

A direct free kick is also awarded to the opposing team if a player commits any of the following four (replaces: three) offences:

- 840 • holds an opponent
- spits at an opponent
- handles the ball deliberately (except for the goalkeeper within his own penalty area)

- (new:) holds the ball for more than 1 second in a way that the ball cannot be removed from the player (a goal keeper may hold the ball up to 6 seconds on the ground or 10 seconds lifted up with one or both hands). More than half of the ball's volume must be outside the convex hull of the player, projected to the ground, for the ball to be considered removable. If the ball enters the convex hull repeatedly, it must be removable in between for the majority of the time. If more than one player of a team is in the vicinity of the ball, the convex hull is taken around all the player of a team, which prevent removal of the ball.

(new:) If an offense did not happen within a radius of approx. 1 m around the current ball position, the direct free kick is replaced by a removal penalty.

A direct free kick is taken from the place where the offence occurred (see Law 13 – Position of free kick). (new:) If moving the ball to the place where the offence occurred would be to the disadvantage of the team to which the free kick is awarded, the referee allows play to continue.

Penalty kick

A penalty kick (new) as defined by Law 14 is awarded if any of the above six (replaces: ten) offences is committed by a player inside his own penalty area, irrespective of the position of the ball, provided it is in play.

Indirect free kick

An indirect free kick is awarded to the opposing team if a goalkeeper, inside his own penalty area, commits any of the following four offences:

- controls the ball with his hands for more than ten seconds before releasing it from his possession
- touches the ball again with his hands after he has released it from his possession and before it has touched another player
- touches the ball with his hands after it has been deliberately kicked to him by a team-mate
- touches the ball with his hands after he has received it directly from a throw-in taken by a team-mate

An indirect free kick is also awarded to the opposing team if, in the opinion of the referee, a player:

- plays in a dangerous manner
- impedes the progress of an opponent
- prevents the goalkeeper from releasing the ball from his hands
- commits any other offence, not previously mentioned in Law 12, for which play is stopped to caution or send off a player

(new:) If an offense did not happen within a radius of approx. 1 m around the current ball position, the indirect free kick is replaced by a removal penalty.

The indirect free kick is taken from the place where the offence occurred (see Law 13 – Position of free kick). (new:) If moving the ball to the place where the offence occurred would be to the disadvantage of the team to which the free kick is awarded, the referee allows play to continue.

Disciplinary sanctions

The yellow card is used to communicate that a player, substitute or substituted player has been cautioned.

The red card is used to communicate that a player, substitute or substituted player has been sent off.

885 Only a player, substitute or substituted player may be shown the red or yellow card.

The referee has the authority to take disciplinary sanctions from the moment he enters the field of play until he leaves the field of play after the final whistle.

A player who commits a cautionable or sending-off offence, either on or off the field of play, whether directed towards an opponent, a team-mate, the referee, an assistant referee or any other person, is disciplined according to the nature of the offence committed.

Cautionable offences

A player is cautioned and shown the yellow card if he commits any of the following seven offences:

- 895 • unsporting behaviour
- dissent by word or action
- persistent infringement of the Laws of the Game
- delaying the restart of play
- 900 • (suspended: failure to respect the required distance when play is restarted with a corner kick, free kick or throw-in)
- entering or re-entering the field of play without the referee's permission
- (suspended: deliberately leaving the field of play without the referee's permission)

A substitute or substituted player is cautioned if he commits any of the following three offences:

- unsporting behaviour
- 905 • dissent by word or action
- delaying the restart of play

Sending-off offences

910 A player, substitute or substituted player is sent off if he commits any of the following seven offences:

- serious foul play
- violent conduct
- spitting at an opponent or any other person
- 915 • denying the opposing team a goal or an obvious goalscoring opportunity by deliberately handling the ball (this does not apply to a goalkeeper within his own penalty area)
- (suspended: denying an obvious goalscoring opportunity to an opponent moving towards the player's goal by an offence punishable by a free kick or a penalty kick)
- using offensive, insulting or abusive language and/or gestures
- receiving a second caution in the same match

920 A player, substitute or substituted player who has been sent off must leave the vicinity of the field of play and the technical area.

Law 13 – Free Kicks

Types of free kick

925

Free kicks are either direct or indirect.

The direct free kick

930 Ball enters the goal:

- if a direct free kick is kicked directly into the opponents' goal, a goal is awarded
- if a direct free kick is kicked directly into the team's own goal, a corner kick is awarded to the opposing team

The indirect free kick

935

(suspended: Signal

The referee indicates an indirect free kick by raising his arm above his head. He maintains his arm in that position until the kick has been taken and the ball has touched another player or goes out of play.)

Ball enters the goal

940 A goal can be scored only if the ball is either kicked and clearly moves as determined by the referee or has been touched by another player before being kicked into the goal (replaces: subsequently touches another player before it enters the goal):

- if an indirect free kick is kicked directly into the opponents' goal, a goal kick is awarded
- if an indirect free kick is kicked directly into the team's own goal, a corner kick is awarded to the opposing team

945

Procedure

All free kicks are taken from the place where the offence occurred, except:

- 950
- indirect free kicks to the attacking team for an offence inside the opponents' goal area are taken from the nearest point on the goal area line which runs parallel to the goal line
 - free kicks to the defending team in their goal area may be taken from anywhere in that area

The ball:

- 955
- must be stationary (suspended: and the kicker must not touch the ball again until it has touched another player)
 - is in play when it is kicked and clearly moves as determined by the referee except for a free kick to the defending team in their penalty area where the ball is in play when it is kicked directly out of the penalty area. (new): In both cases the the ball is also considered in play 10 seconds after the referee gave the signal.

Until the ball is in play all opponents must remain:

- 960
- at least 0.75m for KidSize and TeenSize and 1.5m for AdultSize (replaces: 9.15 m (10 yds)) from the ball until it is in play, unless they are on their own goal line between the goalposts
 - outside the penalty area for free kicks inside the opponents' penalty area

The referee blows the whistle, announces 'Free-Kick' blue or red and then places the ball depending on the call. The assistant referee who operates the game controller clicks on "Direct / Indirect Free Kick" Blue/Red. During this phase robots may move their head to track the ball but must otherwise remain stationary. Robots which are significantly moving during this phase are removed from the field. The referee places the ball depending on the call and announces "Free Kick Ready" and the assistant referee clicks on "Prepare Direct / Indirect Free Kick" Blue/Red. The player taking the free kick has up to 30 seconds to position themselves for the free kick. The team taking the free kick may announce that the player is ready to take the free kick at any point.

965

970 Players are guaranteed at least 15 seconds to move away from the ball. They may take up to 30 seconds if the team taking the free kick has not announced their robot is ready to take the kick off. Any opponent robot still illegally positioned is considered as an incapable player and must be removed from the field for 30 seconds removal penalty. The referee may decide to execute the free kick before 15 seconds have passed if the team taking the free kick have announced their robot is ready and if no opponent is illegally positioned. Once the free kick can be executed, the referee blows the whistle and the assistant referee clicks on "Execute Direct / Indirect Free Kick" Blue/Red.

975

Infringements and sanctions

If, when a free kick is taken, an opponent is closer to the ball than the required distance:

- 980 • the opponent receives a 30 second removal penalty (replaces: the kick is retaken)

If, when a free kick is taken by the defending team from inside its own penalty area, the ball is not kicked directly out of the penalty area:

- the kick is retaken (new:) if the goal keeper managed to reach the ball within the time frame. Otherwise, the ball is in play again.

985 (suspended:) **Free kick taken by a player other than the goalkeeper**

If, after the ball is in play, the kicker touches the ball again (except with his hands) before it has touched another player:

- an indirect free kick is awarded to the opposing team, to be taken from the place where the infringement occurred (see Law 13 – Position of free kick)

990 (suspended:) If, after the ball is in play, the kicker deliberately handles the ball before it has touched another player:

- a direct free kick is awarded to the opposing team, to be taken from the place where the infringement occurred (see Law 13 – Position of free kick)
- a penalty kick is awarded if the infringement occurred inside the kicker's penalty area

(suspended:) **Free kick taken by the goalkeeper**

995 If, after the ball is in play, the goalkeeper touches the ball again (except with his hands), before it has touched another player:

- an indirect free kick is awarded to the opposing team, to be taken from the place where the infringement occurred (see Law 13 – Position of free kick)

1000 (suspended:) If, after the ball is in play, the goalkeeper deliberately handles the ball before it has touched another player:

- a direct free kick is awarded to the opposing team if the infringement occurred outside the goalkeeper's penalty area, to be taken from the place where the infringement occurred (see Law 13 – Position of free kick)
- an indirect free kick is awarded to the opposing team if the infringement occurred inside the goalkeeper's penalty area, to be taken from the place where the infringement occurred (see Law 13 – Position of free kick)

1005 (new) If a free kick was awarded to team A and any player of team A touches the ball before the referee announced the execution of the free kick:

- The ball is in play.
- The player touching the ball received a warning. For the second warning, the player received a yellow card. For the fourth warning, the player receives a second yellow card.

1010 (new) If a free kick was awarded to team A and any player of team B touches the ball before the referee announced the execution of the free kick:

- The free kick is retaken.
- The player touching the ball received a warning. For the second warning, the player received a yellow card. For the fourth warning, the player receives a second yellow card.

1015 **Law 14 – The Penalty Kick**

A penalty kick is awarded against a team that commits one of the six (replaces: ten) offences for which a direct free kick is awarded, inside its own penalty area and while the ball is in play.

A goal may be scored directly from a penalty kick.

1020 (suspended: Additional time is allowed for a penalty kick to be taken at the end of each half or at the end of periods of extra time.)

Position of the ball and the players

The ball:

- 1025
- must be placed on the penalty mark.

(new:) During penalty shoot-out, the player taking the penalty kick:

- must be properly identified

The defending goalkeeper:

- must remain on his goal line, facing the kicker, between the goalposts until the ball has been kicked

1030 The players other than the kicker must be:

- inside the field of play
- (suspended: outside the penalty area)
- behind the penalty mark
- at least 0.75m for KidSize and TeenSize and 1.5m for AdultSize from the penalty mark (replaces: 9.15m)

1035 **Procedure**

If a penalty kick is taken during the normal course of play the same procedure as in regular direct free kicks is applied.

During penalty shoot-out:

- 1040
- After the players have taken positions in accordance with this law, the referee signals for the penalty kick to be taken
 - The player taking the penalty kick must kick the ball forward
 - (suspended: He must not play the ball again until it has touched another player)
 - The ball is in play when it is kicked and moves forward

1045 (replaces:) When a penalty kick is taken during the normal course of play, or time has been extended at half-time or full time to allow a penalty kick to be taken or retaken, a goal is awarded if, before passing between the goalposts and under the crossbar:

- the ball touches either or both of the goalposts and/or the crossbar and/or the goalkeeper

1050 The trial ends after 60 seconds. It may be extended until the ball comes to a complete stop if the ball is still moving at the time the 60 seconds are over. The trial also ends if the ball stops being entirely inside the goal area or leaves the field.

(replaces:) The referee decides when a penalty kick has been completed.)

Infringements and sanctions

1055

The same infringements and sanctions as in regular direct free kicks are applied.

(replaces:) If the referee gives the signal for a penalty kick to be taken and, before the ball is in play, one of the following occurs:

the player taking the penalty kick infringes the Laws of the Game:

1060

- the referee allows the kick to be taken
- if the ball enters the goal, the kick is retaken
- if the ball does not enter the goal, the referee stops play and the match is restarted with an indirect free kick to the defending team from the place where the infringement occurred

the goalkeeper infringes the Laws of the Game:

1065

- the referee allows the kick to be taken
- if the ball enters the goal, a goal is awarded
- if the ball does not enter the goal, the kick is retaken

a team-mate of the player taking the kick infringes the Laws of the Game:

1070

- the referee allows the kick to be taken
- if the ball enters the goal, the kick is retaken
- if the ball does not enter the goal, the referee stops play and the match is restarted with an indirect free kick to the defending team from the place where the infringement occurred

a team-mate of the goalkeeper infringes the Laws of the Game:

1075

- the referee allows the kick to be taken
- if the ball enters the goal, a goal is awarded
- if the ball does not enter the goal, the kick is retaken

a player of both the defending team and the attacking team infringe the Laws of the Game:

- the kick is retaken

If, after the penalty kick has been taken:

1080

the kicker touches the ball again (except with his hands) before it has touched another player:

- an indirect free kick is awarded to the opposing team, the kick to be taken from the place where the infringement occurred (see Law 13 – Position of Free Kick)

the kicker deliberately handles the ball before it has touched another player:

- 1085 • a direct free kick is awarded to the opposing team, to be taken from the place where the infringement occurred (see Law 13 – Position of free kick)

the ball is touched by an outside agent as it moves forward:

- the kick is retaken

the ball rebounds into the field of play from the goalkeeper, the crossbar or the goalposts and is then touched by an outside agent:

- 1090 • the referee stops play
- play is restarted with a dropped ball at the place where it touched the outside agent, unless it touched the outside agent inside the goal area, in which case the referee drops the ball on the goal area line parallel to the goal line at the point nearest to where the ball was located when play was stopped)

Law 15 – The Throw-In

1095 A throw-in is a method of restarting play.

A throw-in is awarded to the opponents of the player who last touched the ball when the whole of the ball crosses the touch line, either on the ground or in the air.

A goal cannot be scored directly from a throw-in:

- if the ball enters the opponents' goal - a goal kick is awarded
- 1100 • if the ball enters the thrower's goal - a corner kick is awarded

Procedure

1105 If the ball leaves the field it will be replaced on the field by the referee or an assistant referee. If the whole of the ball passes over a touch line the ball is placed on the touch line directly at the point at which the ball left the field.

Balls are deemed to be out based on the team that last touched the ball, irrespective of who actually kicked the ball.

After placing the ball, the same procedure and rules of executing an indirect free kick apply. Robots are also allowed to perform the throw-in with their hands, in this case: (replaces: At the moment of delivering the ball, the thrower:)

- faces the field of play
- 1110 • has part of each foot either on the touch line or on the ground outside the touch line
- holds the ball with both hands
- delivers the ball from behind and over his head
- (suspended: delivers the ball from the point where it left the field of play)

All opponents must stand no less than 2 m (2 yds) from the point at which the throw-in is taken.

1115 The ball is in play when it enters the field of play.

After delivering the ball, the thrower must not touch the ball again until it has touched another player.

Infringements and sanctions

1120 (suspended: Throw-in taken by a player other than the goalkeeper

If, after the ball is in play, the thrower touches the ball again (except with his hands) before it has touched another player:

- an indirect free kick is awarded to the opposing team, to be taken from the place where the infringement occurred (see Law 13 – Position of free kick)

1125 If, after the ball is in play, the thrower deliberately handles the ball before it has touched another player:

- a direct free kick is awarded to the opposing team, to be taken from the place where the infringement occurred (see Law 13 – Position of free kick)
- a penalty kick is awarded if the infringement occurred inside the thrower's penalty area

Throw-in taken by the goalkeeper

1130 If, after the ball is in play, the goalkeeper touches the ball again (except with his hands), before it has touched another player:

- an indirect free kick is awarded to the opposing team, to be taken from the place where the infringement occurred (see Law 13 – Position of free kick)

If, after the ball is in play, the goalkeeper deliberately handles the ball before it has touched another player:

- 1135 • a direct free kick is awarded to the opposing team if the infringement occurred outside the goalkeeper's penalty area, to be taken from the place where the infringement occurred (see Law 13 – Position of free kick)
- an indirect free kick is awarded to the opposing team if the infringement occurred inside the goalkeeper's penalty area, to be taken from the place where the infringement occurred (see Law 13 – Position of free kick)

If an opponent unfairly distracts or impedes the thrower:

- 1140 • he is cautioned for unsporting behaviour

For any other infringement of this Law:

- the throw-in is taken by a player of the opposing team)

Law 16 – The Goal Kick

A goal kick is a method of restarting play.

1145 A goal kick is awarded when the whole of the ball passes over the goal line, either on the ground or in the air, having last touched a player of the attacking team, and a goal is not scored in accordance with Law 10.

A goal may be scored directly from a goal kick, but only against the opposing team. If the ball directly enters the kicker's goal a corner kick is awarded to the opponents if the ball left the penalty area.

Procedure

1150

If the ball leaves the field it will be replaced on the field by the referee or an assistant referee. If the whole of the ball passes over the goal line the ball is placed on the touch line at the intersection with the centre line on the side of the field the ball went out.

1155 Balls are deemed to be out based on the team that last touched the ball, irrespective of who actually kicked the ball.

After placing the ball, the same procedure and rules of executing a direct free kick apply.

(replaces:

- The ball is kicked from any point within the goal area by a player of the defending team
- Opponents remain outside the penalty area until the ball is in play
- 1160 • The kicker must not play the ball again until it has touched another player
- The ball is in play when it is kicked directly out of the penalty area)

Infringements and sanctions

1165 (suspended: If the ball is not kicked directly out of the penalty area from a goal kick:

- the kick is retaken

Goal kick taken by a player other than the goalkeeper

If, after the ball is in play, the kicker touches the ball again (except with his hands) before it has touched another player:

- 1170 • an indirect free kick is awarded to the opposing team, to be taken from the place where the infringement occurred (see Law 13 – Position of free kick)

If, after the ball is in play, the kicker deliberately handles the ball before it has touched another player:

- a direct free kick is awarded to the opposing team, to be taken from the place where the infringement occurred (see Law 13 – Position of free kick)
- 1175 • a penalty kick is awarded if the infringement occurred inside the kicker's penalty area

Goal kick taken by the goalkeeper

If, after the ball is in play, the goalkeeper touches the ball again (except with his hands) before it has touched another player:

- 1180 • an indirect free kick is awarded to the opposing team, to be taken from the place where the infringement occurred (see Law 13 – Position of free kick)

If, after the ball is in play, the goalkeeper deliberately handles the ball before it has touched another player:

- a direct free kick is awarded to the opposing team if the infringement occurred outside the goalkeeper's penalty area, to be taken from the place where the infringement occurred (see Law 13 – Position of free kick)
- an indirect free kick is awarded to the opposing team if the infringement occurred inside the goalkeeper's penalty area, to be taken from the place where the infringement occurred (see Law 13 – Position of free kick)

In the event of any other infringement of this Law:

- the kick is retaken)

Law 17 – The Corner Kick

A corner kick is a method of restarting play.

1190 A corner kick is awarded when the whole of the ball passes over the goal line, either on the ground or in the air, having last touched a player of the defending team, and a goal is not scored in accordance with Law 10.

A goal may be scored directly from a corner kick, but only against the opposing team; if the ball directly enters the kicker's goal a corner kick is awarded to the opponents.

Procedure

1195

If the ball leaves the field it will be replaced on the field by the referee or an assistant referee. If the whole of the ball passes over the goal line the ball is placed on the corner on the side of the field the ball went out.

Balls are deemed to be out based on the team that last touched the ball, irrespective of who actually kicked the ball.

1200 After placing the ball, the same procedure and rules of executing a direct free kick apply.

(replaces:

- The ball must be placed inside the corner arc nearest to the point where the ball crossed the goal line
- The corner flagpost must not be moved
- 1205 • Opponents must remain at least 1 m from the corner arc until the ball is in play (replaces: Opponents must remain at least 9.15 m (10 yds) from the corner arc until the ball is in play)
- The ball must be kicked by a player of the attacking team
- The ball is in play when it is kicked and moves
- The kicker must not play the ball again until it has touched another player)

Infringements and sanctions

1210

(suspended: Corner kick taken by a player other than the goalkeeper

If, after the ball is in play, the kicker touches the ball again (except with his hands) before it has touched another player:

- 1215 • an indirect free kick is awarded to the opposing team, to be taken from the place where the infringement occurred (see Law 13 – Position of free kick)

If, after the ball is in play, the kicker deliberately handles the ball before it has touched another player:

- a direct free kick is awarded to the opposing team, to be taken from the place where the infringement occurred (see Law 13 – Position of free kick)
- 1220 • a penalty kick is awarded if the infringement occurred inside the kicker's penalty area

Corner kick taken by the goalkeeper

If, after the ball is in play, the goalkeeper touches the ball again (except with his hands) before it has touched another player:

- 1225 • an indirect free kick is awarded to the opposing team, to be taken from the place where the infringement occurred (see Law 13 – Position of free kick)

If, after the ball is in play, the goalkeeper deliberately handles the ball before it has touched another player:

- a direct free kick is awarded to the opposing team if the infringement occurred outside the goalkeeper's penalty area, to be taken from the place where the infringement occurred (see Law 13 – Position of free kick)
- an indirect free kick is awarded to the opposing team if the infringement occurred inside the goalkeeper's penalty area, to be taken from the place where the infringement occurred (see Law 13 – Position of free kick)

In the event of any other infringement:

- the kick is retaken)

PROCEDURES TO DETERMINE THE WINNER OF A MATCH OR HOME-AND-AWAY

1235 Away goals, extra time, kicks from the penalty mark and extended kicks from the penalty mark are the four methods approved for determining the winning team where competition rules require there to be a winning team after a match has been drawn.

Away goals

Competition rules may provide that where teams play each other home and away, if the aggregate score is equal after the second match, any goals scored at the ground of the opposing team will count double.

1240 Extra time

Competition rules may provide for two further equal periods, not exceeding 5 minutes each, to be played. The conditions of Law 8 will apply. (replaces: Competition rules may provide for two further equal periods, not exceeding 15 minutes each, to be played. The conditions of Law 8 will apply.)

Kicks from the penalty mark

1245 Procedure

- The referee chooses the goal at which the kicks will be taken
- 1250 • The referee tosses a coin and the team whose captain wins the toss decides whether to take the first or the second kick
- The referee keeps a record of the kicks being taken
- Subject to the conditions explained below, both teams take five kicks
- The kicks are taken alternately by the teams
- 1255 • If, before both teams have taken five kicks, one has scored more goals than the other could score, even if it were to complete its five kicks, no more kicks are taken
- (suspended: If, after both teams have taken five kicks, both have scored the same number of goals, or have not scored any goals, kicks continue to be taken in the same order until one team has scored a goal more than the other from the same number of kicks)
- 1260 • A goalkeeper who is injured while kicks are being taken from the penalty mark and is unable to continue as goalkeeper may be replaced by a named substitute provided his team has not used the maximum number of substitutes permitted under the competition rules
- With the exception of the foregoing case, only players who are on the field of play at the end of the match, which includes extra time where appropriate, (new) or which are serving their 30 second penalty time or are currently in service, are eligible to take kicks from the penalty mark
- 1265 • (suspended: Each kick is taken by a different player and all eligible players must take a kick before any player can take a second kick)
- An eligible player may change places with the goalkeeper at any time when kicks from the penalty mark are being taken
- 1270 • Only the eligible players and match officials are permitted to remain on the field of play when kicks from the penalty mark are being taken
- suspended: The goalkeeper who is the team-mate of the kicker must remain on the field of play, outside the penalty area in which the kicks. All players, except the player taking the kick and the two goalkeepers, must remain within the centre circle)
- 1275 • suspended: The goalkeeper who is the team-mate of the kicker must remain on the field of play, outside the penalty area in which the kicks are being taken, on the goal line where it meets the penalty area boundary line)
- Unless otherwise stated, the relevant Laws of the Game and International F.A. Board Decisions apply when kicks from the penalty mark are being taken

- 1280 • (suspended: If at the end of the match and before the kicks start to be taken from the penalty mark, one team has a greater number of players than its opponents, it must reduce its numbers to equate with that of its opponents and the team captain must inform the referee of the name and number of each player excluded. Any player thus excluded may not participate in kicks from the penalty mark.
- (suspended: Before the start of kicks from the penalty mark, the referee must ensure that an equal number of players from each team remains within the centre circle and they shall take the kicks

Extended kicks from the penalty mark (new)

1285 Procedure

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- All penalty shoots are taken on an empty goal.
- The player performing the penalty kick may enter the goal area.
- 1290 • The team wins which...
 1. ... kicked the ball into the goal / scores more often. If this is a tie:
 2. ... kicked the ball into the goal area more often. If this is a tie:
 3. ... touched the ball more often. If this is a tie:
 4. ... in sum needed less time to score the goals. If this is a tie:
 - 1295 5. ... in sum needed less time to kick the ball into the goal area. If this is a tie:
 6. ... in sum needed less time to touch the ball
- If this is a tie a coin is flipped

THE TECHNICAL AREA

1300 The technical area relates to matches played in stadiums with a designated seated area for technical staff and substitutes as described below.

While the size and position of technical areas may differ between stadiums, the following notes are issued for general guidance:

- the technical area extends 1 m (1 yd) on either side of the designated seated area and extends forward up to a distance of 1 m (1 yd) from the touch line
- 1305 • it is recommended that markings are used to define this area
- the number of persons permitted to occupy the technical area is defined by the competition rules
- the occupants of the technical area are identified before the beginning of the match in accordance with the competition rules
- only one person at a time is authorised to convey tactical instructions from the technical area
- 1310 • the coach and other officials must remain within its confines except in special circumstances, e.g. a physio-therapist or doctor entering the field of play, with the referee's permission, to assess an injured player
- the coach and other occupants of the technical area must behave in a responsible manner

THE FOURTH OFFICIAL AND THE RESERVE ASSISTANT REFEREE

- 1315 • A fourth official may be appointed under the competition rules and officiates if any of the three match officials is unable to continue, unless a reserve assistant referee is appointed. They assist the referee at all times
- Prior to the start of the competition, the organiser states clearly whether, if the referee is unable to continue, the fourth official takes over as the referee or whether the senior assistant referee takes over as referee with the fourth official becoming an assistant referee
- 1320 • The fourth official assists with any administrative duties before, during and after the match, as required by the referee
- They are responsible for assisting with substitution procedures during the match
- They have the authority to check the equipment of substitutes before they enter the field of play. If their equipment does not comply with the Laws of the Game, they inform the referee
- 1325 • They supervise the replacement balls, where required. If the match ball has to be replaced during a match, they provide another ball, on the instruction of the referee, thus keeping the delay to a minimum
- They assist the referee to control the match in accordance with the Laws of the Game. The referee, however, retains the authority to decide on all points connected with play.
- 1330 • After the match, the fourth official must submit a report to the appropriate authorities on any misconduct or other incident that occurred out of the view of the referee and the assistant referees. The fourth official must advise the referee and their assistants of any report being made
- They have the authority to inform the referee of irresponsible behaviour by any occupant of the technical area
- A reserve assistant referee may also be appointed under competition rules. Their only duty shall be to replace an assistant referee who is unable to continue or to replace the fourth official, as required

THE ADDITIONAL ASSISTANT REFEREE

1335 Additional assistant referees may be appointed under the competition rules. They must be active referees of the highest category available. The competition rules must state the procedure to be followed when a referee is unable to continue, and whether:

1. the fourth official takes over as the referee, or
- 1340 2. the senior additional assistant referee takes over as the referee, with the fourth official becoming an additional assistant referee

Duties

Where appointed, the additional assistant referees, subject to the decision of the referee, are to indicate:

- 1345
 - when the whole of the ball leaves the field of play over the goal line
 - which team is entitled to a corner kick or goal kick
 - when misconduct or any other incident occurs out of the view of the referee
 - when offences have been committed whenever the additional assistant referees have a better view than the referee, particularly inside the penalty area
- 1350
 - whether, at penalty kicks, the goalkeeper moves off the goal line before the ball is kicked and if the ball crosses the line

Assistance

1355 The additional assistant referees also help the referee to control the match in accordance with the Laws of the Game but the final decision will always be taken by the referee. In the event of undue interference or improper conduct, the referee will relieve an additional assistant referee of their duties and make a report to the appropriate authorities.

Interpretation of the Laws of the Game and Guidelines for Referees

¹³⁶⁰ Please see the respective FIFA documents.

(e.g. pp. 60 of http://resources.fifa.com/mm/document/footballdevelopment/refereeing/02/36/01/11/lawsofthegameweben_neutral.pdf)

Section II

RoboCup Humanoid League Competition Rules

1365 The Competitions and Trophies

Setup and Inspections

1370 The competitions in the Humanoid League are preceded by a setup and inspection period of at least 24 h. During this time, every robot will be inspected by the league organizing committee for compliance with the design rules detailed in Law 4. Robots need to demonstrate the ability to walk (all sub-leagues) and stand up from front and back (~~KidSize kid and teen size~~). The teams must be able to demonstrate at least one successful stand-up action from each side during the robot inspection. All robots will be photographed during the inspection. A re-inspection becomes necessary after any change that could affect the compliance to the design rules. A re-inspection might be
1375 requested by any team leader up to 1 hour prior to a game.

Referee Duty

1380 Each team must name at least one person who is familiar with the rules and who might be assigned for referee duties and for the technical inspection by the league organizing committee.

Competitions

The competitions consist of:

- 1385 1. ~~Soccer games~~ Regular tournament for KidSize (4 vs. 4),
2. ~~Soccer games for TeenSize (3 vs. 3);~~
3. ~~Soccer games~~ Regular tournament for AdultSize (2 vs. 2),
4. Drop-In games for KidSize, ~~Teen~~ and AdultSize
5. Technical challenges.

1390 While teams do require only 1 robot to participate to the Drop-In, they need to present a full roster of robots for the soccer games¹. During robot inspection, teams have to announce how many robots they can provide.
After Drop-In:

- Teams which cannot provide a full roster have to form a full team with one or more other teams from the same league to present a full roster.
- 1395 • Teams which can provide a full roster are allowed to play as a full team on their own, but can also join other teams to form a combined team.

In case one or more teams are left and the total number of their robots is not sufficient to form a full roster, they are still allowed to play as a full team.

This ensures that:

- 1400 • any team who registers can compete in the regular tournament, independently of the number of robots they bring.
- any team who brings a full roster is not required to merge with another team for the regular tournament.

1405 The competition starts with the Drop-In tournament. The scores of the teams during the Drop-In tournament are used to establish a preliminary ranking used for seeding teams in the different round robins groups. If multiple teams join to form a full team, only the best score of the teams composing the full team is used².

If at least 16 full teams participate in a league, the teams are separated in two different divisions for the regular tournament:

¹4 in KidSize, 2 in AdultSize

²If the three teams A,B and C participate in the drop-in tournament, receive respectively 3.2, 4.5 and -1.6 points and form a full team, the score of their full team will be 4.5.

- The best N full teams are qualified for the first round robin of division A ³.
- The other full teams are qualified for the first round robin of division B.

1410 Both divisions plays separate round robins. The lowest ranked teams per group in division A will have a playoff with the highest ranked teams per group in division B. The winners of the playoff games are qualified for the second round robin of division A, the losers will play the second round robin in division B. Thereafter, division A and division B proceed independently of each other and each will normally consist of a round robin stage, followed by a number of knockout matches.

1415 In case there is less than 16 full teams, there is only one division with a first round robin and a number of knock-out games.

1420 ~~Soccer games are organized in one or more round robins and playoffs. For the first round robin, the teams are assigned to groups at random.~~ All teams of a group play once against each other. The round robin games may end in a draw. In this case, both teams receive one point. Otherwise, the winning team receives three points and the not winning team receives zero points.

For the AdultSize soccer games, a specific rule for robot handlers applies. For every robot, one robot handler is allowed to stay near the robot such that the robot handler does not interfere with the game. Specifically, the robot handler:

- 1425 • should position himself behind the robot at a distance of at least an arm length away from the robot's convex hull.
- must not block the vision of any of the robots on the ball or goals.
- must not block the path of any robot.
- must not touch any robot. Touching a robot is considered an offence that is penalised by a removal penalty of the robot handler's own robot according to the laws of the game.
- 1430 • must not enter the radius of one arm length around the robot unless the robot is to be picked up or to avoid interference with the game. Violation of this rule results in a warning to the respective robot handler. After two warnings, the robot handler needs to be replaced similarly to the rule specified under "Request for Pick-up".
- has to be dressed in black clothes.
- may not communicate with the robot in any way, including verbally, while the robot is in play.

1435 After games of a round robin have been played, the teams of a group are ranked based on (in decreasing priority):

1. the number of earned points,
2. the goal-difference,
3. the absolute number of goals,
4. the result of a direct match,
- 1440 5. the time needed to score a penalty kick into an empty goal (up to five alternating attempts to score, until at least one team scored),
6. the drawing of a lot.

At least two teams of every group will enter the next round robin or the playoffs.

1445 In the knock-out games of a tournament two further equal periods of 5 minutes each are played if the game is not decided after the regular playing time. After consulting the team captains, the referee can decide to skip the extra time and continue the game immediately with the five alternating penalty kick trials. If both teams agree, the regular penalty kick trials may be skipped and the extended penalty kick procedure applies instead.

³ N is either 8 or 12 depending on the number of full teams and has to be announced before the beginning of the Drop-In.

The game plan needs to be announced prior to the ~~random assignment of teams to groups~~ Drop-In games.

1450 ~~Participation in the drop-in challenge is mandatory to advance to the quarter final. If a team advances to the quarter final without participating in the drop-in challenge it is replaced by the team that would have had the next best prospects to reach the quarter finals in direct comparison.~~

Forfeits

1455 A team that forfeits is disqualified from the competition. Forfeiting is defined as refusing to make a good faith effort to participate in a scheduled game⁴.

- If a team chooses to forfeit a match in the round robin games the other team plays on an empty goal.
- If a team chooses to forfeit in a knock-out game before the quarter final, the other team continues in the competition.
- 1460 • If a team chooses to forfeit in the quarter finals, it will be replaced by the runner up team in the round robin group that included the forfeiting team.
- If a team chooses to forfeit in the semi finals or the game for 3rd and 4th place, it will be replaced by the team that lost to the forfeiting team in the quarter finals.
- 1465 • A team forfeiting the final match should announce its decision at least 30 minutes before the start of the 3rd vs 4th final. The league organization committee may impose a one year disqualification of the team and its members in case of avoidable delayed announcements.
- If a team chooses to forfeit the final after the game for 3rd and 4th place began, it will be replaced by the 3rd place winner, and the 4th place winner will be 3rd place. No new 4th place will be selected.
- 1470 • If a team chooses to forfeit the final before the game for 3rd and 4th place, it will be replaced by the team that lost to the forfeiting team in the previous semi-finals. The team that lost to the forfeiting team in the previous semi-finals (i.e. the one initially being qualified for the game for 3rd and 4th place) will be replaced for the game for 3rd and 4th place by the team that lost to it in the respective quarter final.

⁴If robots are broken, then they should be placed on the field anyway as an indication that the team is willing to participate.

Gameplay

1475

Kick-off procedure

- The referee gives the signal "READY" that all robots have to reach their own half of the field. **During this phase, handlers are not allowed to interfere with the robots.**
 - After a period between 15 and 45 seconds the referee gives the signal "SET". The referee calls robots illegally positioned to be removed. **Handlers are not allowed to remove or touch the legally positioned robots, with exception of the goal keeper and a striker for the team having kick-off that may be placed manually by the respective robot handler.** The robot playing the goal keeper has to be announced before the beginning of the game. ~~The striker can be chosen after the end of the "READY" phase among all robots of the team (even those being called for illegal positioning). A manually placed goal keeper has to be within the team's own goal area touching the goal line. A manually positioned striker can take any legal position within the team's own half. Removed players and all other players outside the field of play are placed on the touch line close to the penalty mark of the respective team's side, facing the opposite touch line, to enter the field from there upon the "PLAY" signal.~~ Illegally positioned players do not suffer a removal penalty and are allowed to enter the field as soon as the game starts.
 - The opponents of the team taking the kick-off are outside the centre circle until the ball is in play.
 - The ball is stationary on the centre mark.
 - The referee gives the signal "PLAY" or whistles.
 - The ball is in play when it is kicked and clearly moves as determined by the referee or 10 seconds elapsed after the signal.
- 1495 Robots ~~being able to autonomously reposition themselves~~ can take any position on the field that is consistent with the above requirements. ~~It is not allowed to manually (re-)position an autonomously positioned robot that took a legal position, except for the goal keeper and the striker for kick-off or dropped ball, if applicable.~~

For initial kick-off (to initially start or restart after a half-time interval), robots can be placed anywhere on the touch lines or goal lines on the respective team's own side outside of the goal, facing the opposite touch line or goal line, to autonomously enter the field from there. For other kick-off situations **and for dropped ball** robots need to position themselves from the the position they were when the game was stopped.

~~Similar to a kick-off situation, one striker robot for each team may be placed manually for a dropped ball, if both teams can not position themselves automatically. The striker for dropped ball may be positioned at any legal position within the team's own half outside of the centre circle.~~

- 1505 ~~If one or both of the teams in a match have permission to use a manual startup procedure, the referee gives the two signals "SET" and "PLAY" with an interval of exactly 10 seconds. Robot players without remote start capability may be started on the field after the "SET" signal. They may not move before the "PLAY" signal was given by the referee.~~ Robots with autonomous positioning ability are given between 15 and 45 seconds for re-positioning after a goal has been scored by one of the teams before the "SET" signal for kick-off is given by the referee. All human team members must leave the field of play immediately after the "SET" signal and before the "PLAY" signal.
- 1510 ~~A team which uses manual kick-off and not kick-off with the referee box is punished by a penalty of having to wait for 15 seconds after the signal "PLAY" before they are allowed to locomote. If such a team has kick-off then at the signal "PLAY" the referee immediately moves the ball from the kick-off position to a position somewhere on the centre line and outside of the centre circle and the ball is in play. This rule does not apply if the referee box is out of commission.~~
- 1515

Free-kick procedure

1. The referee blows the whistle, announces the offence and the free kick (e.g 'Pushing Red - Direct Free-Kick Blue')
2. The assistant referee who operates the game controller clicks on "Direct / Indirect Free Kick" Blue/Red.

- 1520 3. The referee places the ball depending on the call and announces "Free Kick Ready". Until the referee announced the free kick to be ready robots may move their head to track the ball but must otherwise remain stationary. Robots which are significantly moving during this phase are removed from the field.
4. The assistant referee who operates the game controller clicks on Prepare Direct / Indirect Free Kick" Blue/Red. The player taking the free kick has up to 30 seconds to position themselves for the free kick. The team taking
1525 the free kick may announce that the player is ready to take the free kick at any point. Opponent robots must move to a position at least 0.75 m for KidSize and ~~TeenSize~~ and 1.5m for AdultSize away from the ball. They are guaranteed at least 15 seconds to move away from the ball. They may take up to 30 seconds if the team taking the free kick has not announced their robot is ready to take the kick off.
5. The assistant referee announces that 15 seconds and, if applicable, 30 seconds are over.
- 1530 6. The referee may decide to execute the free kick any time between 15 and 30 seconds have passed depending on the call of the team taking the free kick and the position of the opponent robots. The referee may also allow the free kick to be executed before 15 seconds have passed if the team taking the free kick have announced their robot is ready and if no opponent is illegally positioned.
7. Any opponent robot still illegally positioned is considered as an incapable player and must be removed from
1535 the field for 30 seconds removal penalty.
8. When the referee decides to execute the free kick and all opponent robots are legally positioned or have been removed from the field, the referee blows the whistle. Then the assistant referee who operates the game controller clicks on "Execute Direct / Indirect Free Kick" Blue/Red. The team that was awarded the free-kick can kick now.
- 1540 9. The ball is in play after it has been kicked and clearly moves as determined by the referee or after 10 secs.

The distance between the ball and the player of the opponent team is measured between the point on the convex hull of the robot and the point on the outside of the ball which are most close together.

The referee blows the whistle, announces 'Free-Kick' blue or red and then places the ball depending on the call. The assistant referee who operates the game controller clicks on "Direct / Indirect Free Kick" Blue/Red. The referee
1545 places the ball depending on the call and announces "Free Kick Ready" and the assistant referee clicks on " Prepare Direct / Indirect Free Kick" Blue/Red. The player taking the free kick has up to 30 seconds to position themselves for the free kick. The team taking the free kick may announce that the player is ready to take the free kick at any point.

Players are guaranteed at least 15 seconds to move away from the ball. They may take up to 30 seconds if the team
1550 taking the free kick has not announced their robot is ready to take the kick off. Any opponent robot still illegally positioned is considered as an incapable player and must be removed from the field for 30 seconds removal penalty. The referee may decide to execute the free kick before 15 seconds have passed if the team taking the free kick have announced their robot is ready and if no opponent is illegally positioned.

Once the free kick can be executed, the referee blows the whistle and the assistant referee clicks on "Execute Direct
1555 / Indirect Free Kick" Blue/Red.

Request for Pick-up

A robot handler may request to pick-up a robot if and only if a robot is in a dangerous situation that is likely to lead to physical injuries. If a robot handler touches a robot without the allowance of the referee, the respective robot receives a yellow card and the robot handler an official warning. In AdultSize, a request for pick-up is implicitly
1560 granted if the robot is visible unstable or about to fall. After two warnings for robot touching, the robot handler may not serve as a robot handler again for the rest of the game and needs to be replaced by a different person from the team immediately. In case of repeated violations throughout the tournament, the Technical Committee can decide to permanently disallow a certain person from serving as a robot handler for the rest of the tournament.

Incapable Players

1565 Players not capable of play (e.g. players not able to walk on two legs, players not able to stand, or players with obvious malfunctions) are not permitted to participate in the game. They must be removed from the field. It is up to the referee to judge whether a player is capable of play. The referee may ask the team leader of a player suspected to be incapable of play to demonstrate playing ability at any time. A field player that is not able to get back into a stable standing or walking posture from a fall within 20 seconds will be removed from the field for 30 seconds removal
1570 penalty. It has to enter the field from the team's own half of the field close to the penalty mark facing the opposite touch line, as indicated by the referee. If the ball is within a radius of 0.5 m around the goal keeper inside the goal

area, the goal keeper has to show active attempts to move the ball out of this radius. If no attempt is shown for 20 seconds, the goal keeper is considered to be an inactive player and receives a 30 second removal penalty.

Substitutions

1575 Up to two players per game can be substituted by other players of the same team. A substituted robot can come back in play but it counts as an additional substitution. The referee must be informed prior to the substitution. A substitute only enters the field after the player being replaced left the field and after receiving a signal from the referee. Any of the other players may change places with the goalkeeper, provided that the referee is informed before the change is made and that the change is made during a stoppage of the match. Changing places/roles between a
1580 field player and a goalie does not count as substitution.

Temporal Absence

1585 Servicing robots on the playing field is not permitted. A robot may be taken out of the field for service, after receiving permission from the referee. Taking out a robot for service does not count as a substitution. A serviced robot may not come into play again before 30 seconds elapsed after it was taken out. It has to enter the field from the team's own half of the field close to the penalty mark facing the opposite touch line, as indicated by the referee. The same rules as for *Removal Penalty* apply.

Manual Untangle of Robots

1590 If entangled robots fail to untangle themselves, the referee might ask designated robot handlers of both teams to untangle the robots. Untangling must not make significant changes to robot positions or heading directions. Untangled robots must be laid on the ground not closer than 50cm to the ball and in a way not gaining an advantage.

Removal Penalty

- Time penalties of 30 seconds for players are called by the referee. When a penalty is called, the designated robot handler has to remove the robot as soon as possible and by that interacting as little as possible with the game.
- 1595 • The referee and assistant referees are in charge of timing the penalties and notifying the teams to put back their robots to play.
- A field player or goal keeper suffering a time penalty will be removed from the field and is only allowed to re-enter the field from the team's own half of the field close to the penalty mark facing the opposite touch line, as indicated by the referee.
- 1600 • After the robot has been placed at the position indicated by the referee and with both feet entirely outside the field of play the robot handler announces to the assistant referee that the robot is ready to get back in. The 30 seconds penalty start counting from the point of announcement. From this point onwards the robot handler may not touch or interfere with the robot in any other way (including button presses). If any part of the robot touches the field of play (including touch lines) or the robot handler touching the robot before the 30 seconds
1605 expired, the time is reset.
- The assistant referee operating the GameController will:
 - Penalize the robot as soon as the referee calls the penalty.
 - Marks the penalty time counting down as soon as the robot handler announced the robot being ready to walk in
 - 1610 – Resets the penalty time whenever the robot handler touches the robot or the robot touches the field of play
- The penalty is automatically removed after 30 seconds of penalty have expired.

Timeouts

1615 A team may call for a timeout before kick-off after a goal was scored, the start of a new half, or a drop ball was called and before a penalty shoot-out. During a timeout robots may be serviced. Each team may take at most one timeout per period during regular game time and one additional timeout during all of the extended time and penalty shoot-out. If a team is not ready to resume the game when the referee wants to start the game, it has to take a timeout. If there is no timeout left, the referee will start the game anyway. A timeout ends automatically after 120 s. A timeout also ends when the team signals its end to the referee.

1620 **Referee Timeouts**

The head referee may call a timeout before kick-off after a goal was scored, the start of a new half, or a drop ball was called and before a penalty shoot-out if they deem it necessary. A referee timeout should only be called in dire circumstances - one example might be when the power to the wireless router is down. However, when and whether to call a referee timeout is left up to the head referee.

1625 Referees may call multiple timeouts during a game if needed. Teams may do anything during these timeouts, but they must be ready to play 2 minutes after the referee begins a timeout. The referee should end the timeout once they believe the circumstance for which the timeout was called has been resolved. In cases where the circumstance for which the timeout was called is not resolved within 10 minutes, the Technical Committee should be consulted regarding when/if play should continue.

1630 The team who would have kicked off if the timeout had not been called shall kickoff when the game resumes.

Disciplinary sanctions

Yellow and red cards given to robots only accumulate for the current game and are cleared again after the end of each game. Warnings against robot handlers and/or teams have to be reported to the Technical Committee after each game. They are recorded and accumulated for the whole tournament.

1635 **Drop-In Games**

Organisation

1640 Each participating team will contribute one drop-in player for each drop-in game. The drop-in player may be chosen from all available robots of the team and does not have to be the same in all drop-in games. Each drop-in player will compete in games with many different teams composed of randomly chosen drop-in players. In each game, the opponent will be a similarly composed team of randomly selected drop-in players. The exact number of games played by each drop-in player depends on the number of teams that participate in the competition. A minimum of 3 4 drop-in games will be played by every team.

1645 The drop-in players will be allocated to teams randomly at least 24 hours before the first game takes place. The allocation to teams for the individual games is randomly chosen and changes for every single game. **Some teams might play one more Drop-In game than others.** ~~Drop-in players that reached the minimum number of games will not be considered for drawing unless needed to fill up a team, to have games for remaining players with less than 3 games.~~

1650 **Rules**

All normal game rules apply to this competition. The only exceptions are:

1. The games are played with 5 players in a KidSize team ~~, 4 players in a TeenSize team~~ and 3 players in an AdultSize team. If there is an insufficient number of participants, games may be played 4 vs. 4 or 3 vs. 3 for KidSize ~~, 3 vs. 3 or 2 vs. 2 for TeenSize,~~ or 2 vs. 2 for AdultSize.
- 1655 2. Games may end in a draw.
3. Each of the players has a jersey number from the set 1, 2, 3, 4, 5, ~~resp. 1, 2, 3, 4~~ resp. 1, 2, 3.
4. Drop-in teams will wear the blue and red team colours.
5. In AdultSize, one robot handler per competing robot is allowed. In KidSize ~~and TeenSize~~, the teams have to agree on one robot handler per team.

1660 Removal of incapable players has to be enforced strictly.

Communication

Teams are strongly encouraged to implement the mitecom team communication protocol which is available at <https://github.com/RoboCup-Humanoid-TC/mitecom> or the **Protobuf-based communication protocol which can be found at** <https://github.com/RoboCup-Humanoid-TC/RobocupProtocol>

1665 **Selection of the Referees**

Referees will be drawn from the remaining participating teams, or if needed, due to a low number of teams, the TC and OC will provide referees. Referees for a match may be picked among the pool of available referees from any size class.

Scoring

1670 When a goal is scored, all players of the scoring team on the field receive 1 point and the player who scored the goal receives an additional 1 point if it was not an own goal. A robot is considered to be on the field if both feet of the robot are fully inside the field area. The player who scored the goal receives the points regardless of its position on the field. Incapable players, penalized players, players outside the field or players having been removed for any other reason, e.g. service, will receive no point. When a goal is suffered, all players of the team suffering the goal receive
1675 -1 points, including incapable players, penalized players or players having been removed for any other reason, e.g. in service. Points from all games are summed up. For players who played one or more games more than the others, only the points of those games with the higher scores are considered.
Drop-in players are initially ranked according to the **arithmetic mean accumulated points**. If there are ties, the tied players are ranked according to ~~the arithmetic mean~~, the number of games played, the maximum points awarded in
1680 a single game and the number of goals scored (in this order). The three most highly ranked players of a sub-league receive a 'Best Player' certificate.
If the three best drop-in players can not be identified with the scheme provided above, an additional game with players drawn group wise (from the groups of equally high ranked players with a total number of points greater than zero) from the highest-ranked players is to be played.
1685 If there are still ties a penalty shoot out among the equally high ranked drop-in players with a total number of points greater than zero takes place.

Example

There are 20 participating players for 4 KidSize Drop-In teams (A, B, C, D). Games shall be A-B, A-C, A-D, B-C, B-D, C-D. For the first game (A-B), Player 1 is randomly drawn for Team B and plays the game with the other team
1690 members. For the second game (A-C), player 1 is not drawn. For the third game (A-D), player 1 is drawn for team A and plays the game. For the fourth game (B-C), player 1 is drawn to team C and plays the game. Now player 1 will be removed from the drawing, because the number of 3 games was reached. If there would be only 19 participants, player 1 may be drawn for the final game.
Assuming teams with player 1 to score a single goal in every game (with player 1 on the field), then player 1 will
1695 have a score of 3 and an arithmetic average of 1.

Technical Challenges

The technical challenges consist of:

- 1700 1. Push Recovery (~~KidSize, TeenSize and~~ AdultSize)
2. Collaborative Localization (KidSize)
3. Goal Kick from Moving Ball (KidSize, ~~TeenSize and~~ AdultSize)
4. Parkour (KidSize and AdultSize) ~~High Jump (KidSize and TeenSize and AdultSize)~~
5. High-Kick (KidSize, ~~TeenSize and~~ AdultSize)

1705 For details on the technical challenges, please refer to Section III of this document.

Best Humanoid Award

1710 The teams of the Kid, ~~Teen~~ and Adult size classes that have participated in the drop-in competition are ranked in separate lists to determine the overall best humanoid.

The ranking is based on the aggregated number of points earned in the individual competitions.

The points earned in the technical challenge are used directly.

For the Drop-In challenge the winner receives 30 points. The second best team receives 21 points. The third best team receives 15 points.

1715 For the soccer games the winner receives 60 points. The second best team receives 42 points. The third best team receives 30 points.

The teams ranked first in the KidSize, ~~TeenSize~~ and AdultSize lists are candidates for the best humanoid. The final ranking between the three candidates is determined by the points earned in the individual competitions as stated above. The best KidSize, ~~TeenSize~~ or AdultSize team with the most overall points wins the best humanoid award.

1720 If there are ties, the average goals scored per game is used to determine the ranking of the three eligible candidates. If there are still ties, the president of the RoboCup Federation breaks the tie.

Trophies

1725 A trophy is awarded to the winner of the soccer tournament in each of the individual size classes and technical challenges. In case of less than 3 teams participating in a size class no trophies will be given in this class.

A trophy is awarded to the teams second and third in the KidSize 4-4 soccer game, ~~the TeenSize 3-3 soccer games~~ and the AdultSize 2-2 soccer game. In case of less than 5 teams participating in a size class the team ranked third will be awarded a certificate instead of a trophy. In case of less than 4 teams participating in a size class the team ranked second will also be awarded a certificate instead of a trophy. The final number of trophies awarded will be decided by the RoboCup Federation based on the number of actually participating teams.

1730 Certificates are awarded to the teams second and third in the technical challenges, to the teams ranked second ~~and third~~ in the Best Humanoid list and a 'Best Player' certificate to the three most highly ranked Drop-in players. A team can only receive a 'Best Player' certificate if their total amount of points is greater than 0.

1735 The Best Humanoid Award is awarded to the team ranked first in the Best Humanoid list, it can either be a trophy or a certificate.

Conflict Resolution

1740 It is the responsibility of the team leader to inspect the other team's robot an hour in advance of a game. Any concern regarding the rule compliance of any of the robots, including the amount, size and colour of the team markers, must be brought to the attention of the referee an hour in advance of the game. If the referee is unavailable, they have to be brought to the attention of the Technical Committee instead.

1745 Doubts concerning a serious violation of any rule during a specific game must be brought up to a member of the Technical Committee and investigated before signing the result sheet. By signing the result sheet, a team agrees that the result came off in a fair game. If a team brings up an official concern to the Technical Committee, a meeting of the Technical Committee must be called as soon as possible. If the team of a member of the Technical Committee is directly involved in the game in question, the respective member is excluded from the meeting. At least three members of the Technical Committee need to be part of the meeting and the decision process. If less than three members of the Technical Committee are available, members of the Organizing committee or, if necessary, Trustees or members of committees from other leagues have to be called into the meeting. Members of these meetings may request to inspect the hardware and software of any team involved in the issue. If serious violations of rules are detected, the committee may, among others, decide to invalidate the result of the game in question or take

disciplinary actions against a team as defined in Law 5, depending on the severity of the rule violation. The decision
1755 of the committee meeting need to be announced to the whole league.

Acknowledgements

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1770 several figures and to Philipp Allgeuer for his contributions to the 2019 version of the rules.

Section III

Rules for RoboCup Humanoid League Technical Challenges

General Rules for Technical Challenges

1775 The technical challenges consist of the following individual challenges:

- Part A: Push Recovery (AdultSize)
- Part B: Collaborative Localization (KidSize)
- Part C: Goal Kick from Moving Ball
- Part D: Parkour High Jump
- 1780 • Part E: High Kick

Only the robots ~~used for the soccer games~~ that passed the robot inspection are allowed to participate in the technical challenges. At any point, two robots are considered active during the technical challenges. One player can be substituted by another player of the same team. No hardware modifications of the robots are allowed for the Technical Challenge (i.e., a robot cannot be modified from the configuration it had in the soccer games).

1785 The team scheduled for the Technical Challenge must have access to the field five minutes prior to the scheduled starting time. The referee will give the start signal at the scheduled time.

Method of scoring

1790 The Technical Challenge consists of four parts: B, C, D and E for KidSize and A, C, D and E for AdultSize. Each of the parts can be attempted multiple times, in any order. The team might terminate a trial at any time, in order to reattempt the same part or switch to another part of the challenge. A trial terminates automatically when 25 minutes elapsed after the referee gave the start signal. This concludes the Technical Challenge for the team. The time is taken for each of the trials, if completed successfully. Ranking in the individual challenges is determined according to the rules defined for each individual challenge. For each part, the highest ranked fully successful team receives 10 points. The second fully successful team receives 7 points. The third fully successful team receives 5 points. All other teams who were fully successful in who successfully managed this part of the challenge receive 3 points. In case a team with only partial success has been ranked first, second or third in a challenge, they receive 5, 3 or 2 points respectively. Teams with only a partial success ranked fourth or lower do not receive any points.

1800 Robot Handlers During the Technical Challenge

1805 During an ongoing trial of a technical challenge the robot handler is not allowed to interact with the robot's sensors in any way. In the moment the handler either touches the robot or interacts with the robot in any way, the trial is finished and counted as unsuccessful.

- In KidSize and TeenSize robot handlers are not allowed to enter the field vicinity of the robot during a trial, unless the referee asks them to remove a robot.
- In AdultSize one robot handler is permitted to stay on the field near the robot during a trial.

Part A: Push Recovery (AdultSize only)

1810 The goal of the push recovery challenge is to withstand a strong push while walking.
 Cushioned plastic bottles partially filled with sand (or similar) will be suspended on a rope of fixed length, and swung
 into the robot as a pendulum to apply the push. Bottles of mass 1 kg, 2 kg, 3 kg, 5 kg and 10 kg will be available,
 where the default mass to use in each size class will be 1 kg in KidSize, 2 kg in TeenSize and 3 kg in AdultSize. If a
 robot completes a fully successful trial with the default mass for its size class, then a larger bottle may be used in
 1815 further trials.

The length of the rope L (between 1.5 and 2 meters, measured from the point of attachment to the centre of mass
 of the bottle) will remain fixed for all trials of a particular size class. The rope is attached to a frame of adjustable
 height, which is used to adjust the centre of mass of the bottle at the moment of impact to be as close as possible
 to the height of the centre of mass of the robot. Where this is not possible, the centre of mass of the bottle should
 1820 strike a solid part of the centre of the hips of the robot. For this and other purposes, the centre of mass of the bottle
 should be clearly marked.

Each trial consists of three pushes—a push from the front, a push from the back, and a push from either the front or
 the back, in any order. To apply a push, the bottle is released from a particular position, and allowed to swing into
 the robot in such a way that the impact occurs when the rope is vertical. The amount of retraction of the bottle
 1825 is measured by the ground projected distance D from the centre of mass of the bottle, to the attachment point of
 the rope. Before each trial (set of three pushes), the team must declare what value of D should be used (limited to
 $0.75L$ for practical implementation concerns). A push is successfully absorbed if after receiving the push the robot
 returns to a stable walking cycle, as perceived by the referee. The robot must be walking in place (with a normal
 step frequency) both before the push, and after it has stabilised itself again.

For a complete trial to be fully successful, the robot needs to successfully absorb all three pushes. For a trial to be
 partially successful, the robot needs to successfully absorb two of the three pushes. The robots are ranked by the
 following metric (higher is better):

$$M = \frac{\sqrt{H}}{h_c} \cdot \frac{m_B}{m_R} \cdot \frac{h_i}{h_c}$$

1830 where we have the following:

M	Ranking metric	H	Vertical height fallen by the bottle = $L - \sqrt{L^2 - D^2}$
m_B	Mass of the bottle	h_i	Height of the centre of mass of the bottle at impact
m_R	Mass of the robot	h_c	Height of the centre of mass of the robot

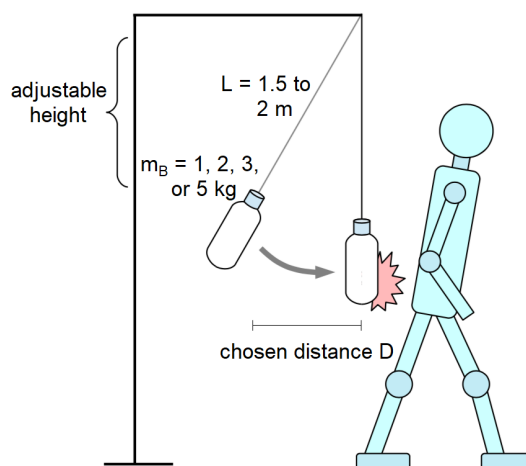


Figure 4: Setup for the push recovery challenge.

Part B: Collaborative Localization (KidSize only)

The goal of the collaborative localization challenge is to have a robot without a working vision system (R_K) to kick a ball into the goal with the help of another robot (R_H), which is able to see the ball and guide R_K in this task. Results of the technical challenge are based on a batch of three runs.

Run Setup

The initial setup of a run is as follows:

1. The vision-less robot R_K is placed inside the centre circle by the team taking the technical challenge.
2. The helper robot R_H is placed anywhere inside the field by the team taking the technical challenge.
- 1840 3. The ball is placed roughly on the segment parallel to the goal line passing through the penalty mark, between the two goal posts, by the referee, after the two robots were positioned (Fig. 5).
4. The referee blows the whistle to start the run.
5. Teams may start the robots manually by pressing a button when the run starts. But robots must not be touched after the referee blew the whistle.
- 1845 6. A chronometer is started when the referee blows the whistle.

Run evaluation

The chronometer is stopped when the run ends. The causes for the end of a run and the possible results are as following:

- *Failure*
 - 1850 – The ball has not been touched by R_K after 2 minute.
 - The ball is touched by the helper robot R_H , at any moment.
- *Partial success*
 - The ball was kicked by R_K but leaves the field without scoring a goal.
 - The ball was kicked by R_K , stopped rolling inside of the field, and has not been touched again by R_K after 2 minute.
- 1855 1855 • *Success*
 - The ball was kicked by R_K and a goal was scored.

Trials and ranking

A trial consists of three different runs.

1860 During a run both robots R_K and R_H can move, but if the ball is touched by R_H the run ends in Failure. A trial is considered as successful if at least 2 runs from the batch resulted in *Success*. A trial is considered as partially successful if at least 2 runs resulted in *Success* or *Partial success*.

The teams are ranked according to the following criteria on their best batch:

1. Number of *Success*.
- 1865 2. Number of *Partial success*.
3. Average time for *Success* runs.
4. Average shortest distance of the ball to the goal line for *Partial success* runs.

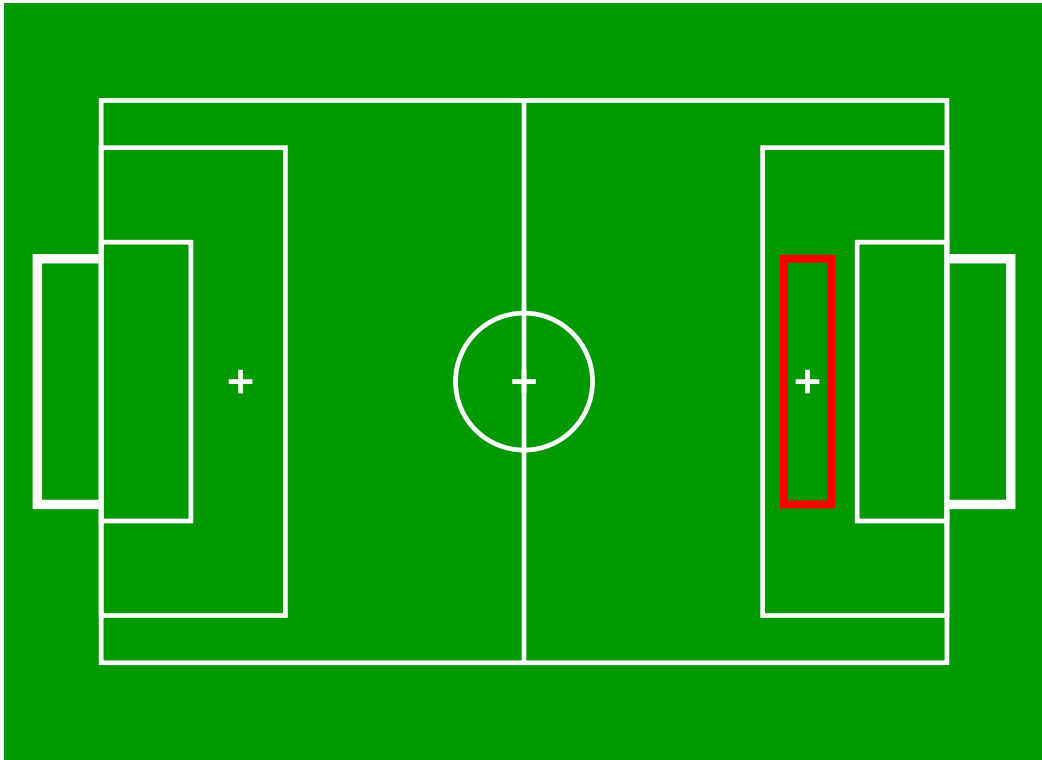


Figure 5: Ball initial location for the collaborative localization challenge.

Part C: Goal-Kick from Moving Ball

1870 The goal of the goal-kick from a moving ball challenge is to kick a moving ball into the goal. Results of the technical challenge are based on a batch of three runs.

Run Setup

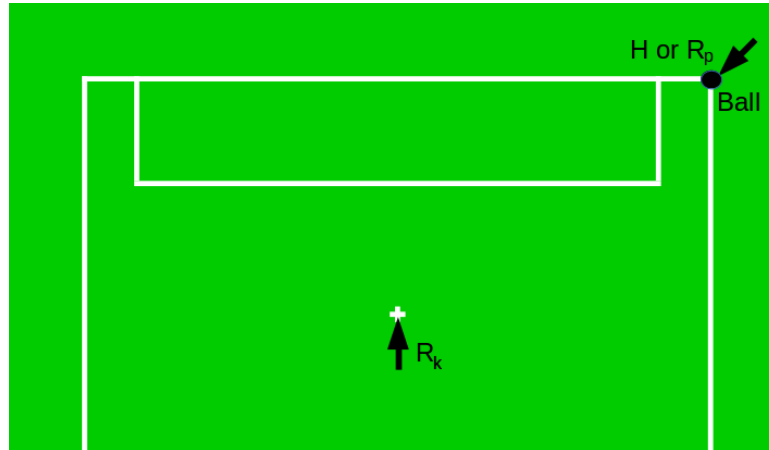


Figure 6: Setup for the moving ball challenge.

The initial setup of a run is presented in Fig. 6, procedure is as follows:

1. The ball is placed on one corner of the field as chosen by the team taking the technical challenge.
2. The robot R_K is placed on the penalty mark.
- 1875 3. The pass of the ball may either be performed by a human member from the team H or another robot, R_P . If the pass is performed by a robot, the team may place R_P after the referee has placed the ball. R_P can be placed anywhere on the field, at least 1m away from the ball.
4. The referee blows the whistle to start the run.
- 1880 5. Teams may start the robot R_P manually by pressing a button when the run starts. But R_K must not be touched after the referee blew the whistle. If the pass is performed by a human, then the human is not allowed to wait before kicking. Once the whistle is blown the human has 2 seconds to kick the ball, otherwise the run is retaken.
6. A chronometer is started when R_P or H kicks the ball.

Run evaluation

1885 The chronometer is stopped when the run ends. The causes for the end of a run and the possible results are as following:

- *Failure*

- The ball has been touched twice by R_P , H or R_K .
- R_k executed the kick motion but failed to kick the ball.
- 1890 – The ball was kicked by R_k but leaves the field without scoring a goal.

- *Retake*

- The ball stops rolling or leaves the field before R_k attempted to kick.
- The ball *bounces* on R_k rather than being kicked by R_k and R_k did not try to execute the kick motion before.
- 1895 – The pass is performed by a human and the human did not kick 2 seconds after the whistle was blown.

- *Partial success*
 - Ball was kicked by R_k but stopped rolling inside of the field.
- *Success*
 - Ball was kicked by R_k and a goal was scored.

1900 **Trials and ranking**

A trial consists of three different runs, each run ending with a *Retake* is restarted and do not count. A trial is considered as successful if at least 2 runs from the batch resulted in *Success*. A trial is considered as partially successful if at least 2 runs resulted in *Success* or *Partial success*.

The teams are ranked according to the following criteria on their best batch:

- 1905
1. Number of *Success* where the pass of the ball was executed by a robot
 2. Number of *Success* where the pass of the ball was executed by a human
 3. Number of *Partial success* where the pass of the ball was executed by a robot
 4. Number of *Partial success* where the pass of the ball was executed by a human
 5. Average time for *Success* runs, from first touch by R_p or H until goal is scored
- 1910
6. Average shortest distance to the goal line for *Partial success* runs

Part C: Parkour

The goal of the Parkour TC is to have a robot going up one platform, staying on top of it, and going down without falling on the ground.

The minimum height must be at least $1/5^{th}$ of the robot height and must be a multiple of 5 cm.

1915 The robot can touch the platform with its limbs (arms and legs), but no other part of the robot is allowed to touch it.

The platform will have an area of approximately 60×60 cm.

Run Setup

The initial setup of a run is as follows:

- 1920
1. The robot is placed in front of the platform as high as chosen by the team taking the technical challenge.
 2. The referee blows the whistle to start the run.
 3. Teams may start the robot manually by pressing a button when the run starts. But the robot must not be touched after the referee blew the whistle.
 4. A chronometer is started when the referee blows the whistle.

1925 Run evaluation

The chronometer is stopped when the run ends. The causes for the end of a run and the possible results are as following:

- *Failure*

- The robot is not able to go up the platform.
- 1930 – The robot falls without going up the platform.
- The robot touches the platform with a part of the body that is not a limb.

- *Partial success*

- The robot is able to go up the platform, with both the feet touching thread (the top of the platform), but falls before being able to go down.
- 1935 – The robot is able to go up the platform, with both the feet touching thread (the top of the platform), and, to prevent the robot from falling, a human handler touches the robot at this moment.

- *Success*

- The robot goes up and down the platform, without falling, and stays up, without moving, for 5 seconds.

Trials and ranking

1940 Teams are ranked based on their best 2 consecutive results.

A trial is considered as successful if at least 2 runs in a row resulted in *Success*. A trial is considered as partially successful if at least 2 runs in a row resulted in *Success* or *Partial success*.

The teams are ranked according to the following criteria on their best batch:

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1. The maximum height the robot successfully managed to achieve on a *Successful* trial divided by the height of the robot.
 2. The maximum height the robot managed to achieve on a *Partially Successful* trial divided by the height of the robot.
 3. Average time of a *Successful* trial.
 4. Average time of a *Partially Successful* trial.

1950 **Part E: High-Kick Challenge**

The goal of the high-kick challenge is to kick the ball in the goal at maximum height. At each attempt, the team announces the minimum height their robot tries to achieve. The minimum height must be at least $\frac{2}{3}$ rd of the ball's diameter and must be a multiple of 1cm.

1955 The ball is then placed on the penalty mark and the team may position the robot freely but at least 30cm away from the ball. After the start signal, the robot may move the ball to any position before attempting a kick from the ground. Only kicks count that score a goal of at least the minimum height. The trial ends unsuccessfully when the ball leaves the field, or when the robot touches the goal obstacle or the ball touches the front of the goal obstacle. The robots are ranked by the maximum height they successfully managed to kick the ball into the goal.