

Middle Size Robot League Rules and Regulations for 2006

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MSL Technical Committee 1997–2006

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Document Status

This is the draft version (ver. 10.0) of the rules that will be used for the 10th robot soccer world championships, to be held in Bremen 2006 and for MSL competitions in 2006.

Please note: The MSL Technical Committee has not yet revised the part *Challenges* and will do so in a short time.

Middle Size Robot League

– Rules and Regulations –

Preamble

Rules Philosophy:

1. RoboCup rules should not in any way describe the behaviour of how the game is played. Rules should only ensure that a fair competition takes place, and encourage both technical and creative development.
2. RoboCup rules should avoid to constrain the design of robots, including their mechanical construction, their use of sensory systems, communication equipment, etc., **unless** the constraints seem necessary to foster scientific progress or to ensure a fair competition.

Example constraint: Global vision systems are not permitted in the middle size league.

Design Philosophy:

1. Each team should design their robots without making interpretations or placing expectations on how the environment around the field will look like, about spectators, what other teams will do, what robots should look like, or how they will behave. Expecting the environment around the field, spectators or other teams to comply with your own interpretations should be avoided.
2. Each team is under no obligation to accommodate modifications to their own robots to suit other teams. Any such modification is by mutual consent only.

Organisation of Rules:

Rules and regulations for RoboCup middle size robot league are given in three major sections:

1. Official FIFA Laws.
They are reproduced in this document. FIFA Laws are annotated with RoboCup Changes and Comments as appropriate.
2. Competition Rules, which define issues like team qualification etc. for a specific tournament like the annual RoboCup Robot Soccer World Championships.

Conflict Resolution Rules:

In case of any conflict between Laws and Rules:

1. Regulations specified as RoboCup Changes and Comments in the FIFA Laws section override FIFA Laws.
2. Regulations specified in Competition Laws override any FIFA Laws, including RoboCup Changes and Comments.

Download Sites

The current version of the rules can be downloaded as PDF document (approx. 700KB) at

www.er.ams.eng.osaka-u.ac.jp/robocup-mid.

The original FIFA Laws can be found at

www.er.ams.eng.osaka-u.ac.jp/rc2004msl/LOTG2003_e.pdf.

Rule Change Proposals and Corrections

If you have found any contradictions or inconsistencies please contact the RoboCup Middle Size League mailing list

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or the MSL Technical Committee

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For subscription to the RoboCup Middle Size League mailing list please send an email to

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For further information about the RoboCup Middle Size League mailing list please send an email to

robocup-mid-help@robocup.biglist.com.

For general information about BIGLIST mailing lists please see

<http://www.biglist.com/>.

Contents

FIFA LAW 1 – The Field of Play	2
RC-1.0: The Field	2
RC-1.0.1: Surface	2
RC-1.0.2: Lighting	2
FL 1.1 Dimensions	2
RC-1.1: Dimensions	2
FL 1.2 Field Markings	3
RC-1.2: Field Markings	3
RC-1.2.1: Safety Boundary	3
RC-1.2.2: Ad Panels	3
RC-1.2.3: Restart Spots	3
FL 1.3 The Goal Area	3
RC-1.3: Goal Area	3
FL 1.4 The Penalty Area	3
RC-1.4: Penalty Area	4
FL 1.5 flagposts	4
RC-1.5: flagposts	4
RC-1.5.1: Corner flagposts	4
FL 1.6 The Corner Arc	4
RC-1.6: Corner Arc	4
FL 1.7 Goals	4
RC-1.7: Goals	5
FL 1.8 Safety	5
Decisions of the International F.A. Board	5
RC-Decision 3:	5
RC-Decision 4:	6
RC-Decision 5:	6
FIFA LAW 2 – The Ball	7
FL 2.1 Qualities and Measurements	7
RC-2.1: Qualities and Measurements	7
FL 2.2 Replacement of a Defective Ball	7
Decisions of the International F.A. Board	7
RC-Decision 2:	8
FIFA LAW 3 – The Number of Players	9
FL 3.1 Players	9
RC-3.1: Players	9
RC-3.1.1: Incapable Players	9
FL 3.2 Official Competitions	9
RC-3.2: Official Competitions	9
FL 3.3 Other Matches	9
RC-3.3: Other Matches	9
FL 3.4 All Matches	10
RC-3.4: All Matches	10
FL 3.5 Substitution Procedure	10
FL 3.6 Infringements/Sanctions	10
FL 3.7 Restart of Play	11

FL 3.8	Players and Substitutes Sent Off	11
FL 3.9	Decisions of the International F.A. Board	11
	RC-Decision 2:	11
FIFA LAW 4	– The Players’ Equipment	12
	RC-4.0.1: Design Guideline	12
FL 4.1	Safety	12
	RC-4.1: Safety	12
	RC-4.1.1: Jamming	12
	RC-4.1.2: Exclusion	12
FL 4.2	Basic Equipment	12
	RC-4.2.0: Space occupied by a Robot	13
	RC-4.2.1: Robot Size	13
	RC-4.2.2: Robot Shape	13
	RC-4.2.3: Robot Weight	13
	RC-4.2.3.1: Overweight Robots	13
	RC-4.2.4: Robot Colors	14
	RC-4.2.5: Robot Markers	14
	RC-4.2.5.1: Color Markers	14
	RC-4.2.5.2: Number Markers	14
	RC-4.2.5.1: Top Markers	15
	RC-4.2.6: Communications	16
	RC-4.2.7: Sensing Systems	17
	RC-4.2.8: Ball Handling Mechanisms	17
	RC-4.2: Technical Inspection	17
FL 4.3	Shin-guards	17
	RC-4.3.1: Robustness	17
FL 4.4	Goalkeepers	18
	RC-4.4: Goalkeepers	18
FL 4.5	Infringements/Sanctions	18
	RC-4.5.1: Repair of Robots	18
FL 4.6	Restart of Play	19
FIFA LAW 5	– The Referee	20
FL 5.1	The Authority of the Referee	20
FL 5.2	Powers and Duties	20
	RC-5.3: Powers and Duties	20
	RC-5.3.1: Referee Box	21
	RC-5.3.2: Play Without Referee Box	21
	RC-5.3.3: Permission to send ”Stop” signal	21
FL 5.3	Decisions of the Referee	21
	Decisions of the International F.A. Board	21
FIFA LAW 6	– The Assistant Referees	23
FL 6.1	Duties	23
	RC-6.1: Duties	23
FL 6.2	Assistance	23
FIFA LAW 7	– The Duration of the Match	24
FL 7.1	Periods of Play	24
	RC-7.1: Periods of Play	24
FL 7.2	Half-Time Interval	24
	RC-7.2: Half-Time Interval	24
FL 7.3	Allowance for Time Lost	24
FL 7.4	Penalty Kick	24
FL 7.5	Extra Time	24
FL 7.6	Abandoned Match	24
FIFA LAW 8	– The Start and Restart of Play	25
FL 8.1	Preliminaries	25
	RC-8.1.1: Start Delay	25
	RC-8.1.2: Remote Start	25

FL 8.2 Kick-off	25
RC-8.2: Kick-off	25
FL 8.3 Procedure (for kick-off)	25
RC-8.3: Procedure (for Kick-Off)	26
RC-8.3.1: Positioning of Robots	26
RC-8.3.2: Manual Start	26
FL 8.4 Infringements/Sanctions (for kick-off)	26
RC-8.4.1: Kicking Directly to the goal	26
FL 8.5 Dropped Ball	27
RC-8.5.1: Game Stuck	27
FL 8.6 Procedure (for dropped ball)	27
RC-8.6: Procedure (for Dropped Ball)	27
FL 8.7 Infringements/Sanctions (for dropped ball)	27
RC-8.7: Infringements/ Sanctions	27
FL 8.8 Special Circumstances	28
FIFA LAW 9 – The Ball In and Out of Play	29
FL 9.1 Ball Out of Play	29
RC-9.1.1: Dead Call	29
RC-9.1.2: Continuation after Dead Call	29
FL 9.2 Ball In Play	29
FIFA LAW 10 – The Method of Scoring	30
FL 10.1 Goal Scored	30
FL 10.2 Winning Team	30
FL 10.3 Competition Rules	30
FIFA LAW 11 – Offside	31
RC-11: Offside	31
FL 11.1 Offside Position	31
FL 11.2 Offence	31
FL 11.3 No Offence	31
FL 11.4 Infringements/Sanctions	31
FIFA LAW 12 – Fouls and Misconduct	32
RC-12.0: General Principles	32
RC-12.0.1: Stopping the Ball	33
RC-12.0.2: Dribbling the Ball	34
RC-12.0.3: Kicking the Ball	34
FL 12.1 Direct Free Kick	35
FL 12.2 Penalty Kick	35
RC-12.2: Penalty Kick	35
FL 12.3 Indirect Free Kick	35
RC-12.3: Indirect Free Kick	36
RC-12.3.1: Ball Holding	36
RC-12.3.2: Pushing	37
RC-12.3.3: Kicking	37
RC-12.3.4: Illegal Defense	38
RC-12.3.5: Illegal Attack	38
RC-12.3.6: Manual Interference	38
RC-12.3.7: Remote Interference	38
RC-12.3.8: delay of game	38
RC-12.3.9: Unsportsmanlike Behavior	39
FL 12.4 Disciplinary Sanctions	39
FL 12.5 Cautionable Offences	39
RC-12.5: Cautionable Offences	39
RC-12.5.1: Yellow Cards	39
FL 12.6 Sending-Off Offences	40
RC-12.6: Temporary Sent-Off	40
RC-12.6: Sending-Off Offences	40
Decisions of the International F.A. Board	40

RC-Decision 1-4:	41
FIFA LAW 13 – Free Kicks	42
FL 13.1 Types of Free Kicks	42
RC-13.1.1: Free kicks	42
RC-13.1.2: Touching	42
FL 13.2 The Direct Free Kick	42
FL 13.3 The Indirect Free Kick	42
FL 13.4 Position of Free Kick	42
RC-13.4: Position of the Free Kick	43
RC-13.4.1: Procedure	43
FL 13.5 Infringements/Sanctions	43
RC-13.5: Infringements/ Sanctions	44
FIFA LAW 14 – The Penalty Kick	45
FL 14.1 Position of the Ball and the Players	45
RC-14.1: Position of Ball and Players	45
FL 14.2 The Referee	45
RC-14.2: The Referee	45
FL 14.3 Procedure	46
RC-14.3: Procedure	46
FL 14.4 Infringements/Sanctions	46
RC-14.4: Infringements/ Sanctions	47
FIFA LAW 15 – The Throw-In	48
FL 15.1 Procedure (The Throw-In)	48
RC-15.1: Procedure	48
FL 15.2 Infringements/Sanctions	49
RC-15.2: Infringements/ Sanctions	49
FIFA LAW 16 – The Goal Kick	50
FL 16.1 Procedure (for Goal Kick)	50
RC-16.1: Procedure	50
FL 16.2 Infringements/Sanctions	50
RC-16.2: Infringements/ Sanctions	51
FIFA LAW 17 - The Corner Kick	52
RC-17: Throw-In	52
FL 17.1 Procedure (for Corner Kick)	52
RC-17.1: Procedure	53
FL 17.2 Infringements/Sanctions	53
RC-17.2: Infringements/ Sanctions	54
Competition Rules	55
COMPETITION RULE 1 - Team Qualification	56
CR 1.0 Admissibility of Team Qualification Procedures	56
CR 1.1 Team Qualification for RoboCup-2006	56
CR 1.2 Scientific Papers	56
CR 1.3 Team Description Paper	56
CR 1.4 Player Capability Video	57
CR 1.5 Due Date, Submission, and Review of Team Qualification Material	57
CR 1.6 Agreement on Open Source Development	57
COMPETITION RULE 2 - Referee Recruitment and Assignment	57
CR 2.1 Selection of Referees	57
CR 2.2 Referee Assignment	57
CR 2.3 Referees during Match	57
CR 2.4 Infringements/Sanctions	58
COMPETITION RULE 3 - Tournament Regulations	58
CR 3.0 Preliminary Remarks	58
CR 3.1 Parts of the Competition	58
CR 3.2 Team Registration, Setup, and Technical Inspection	58
CR 3.3 Technical Challenge	59


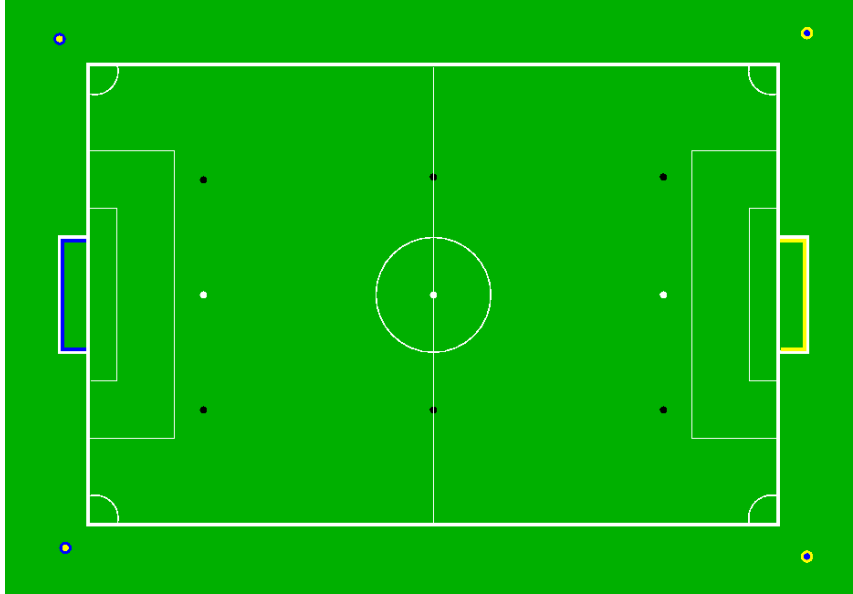
CR 3.4 Preliminary Rounds	59
CR 3.5 Playoffs	60
Penalty Shoot-Out	60
COMPETITION RULE 4 - Summary of Object Colourings	60
COMPETITION RULE 5 - Referee Box	60
F-2000 Challenges	61
Challenge 1 - Ball Control and Planning	61
Challenge 2 - Cooperative behaviour	61
Challenge 3 - Cooperative Mixed-Team Play	61
Challenge 4 - Play with an arbitrary FIFA ball	61
Challenge 5 - Play with arbitrary goals	62
Challenge 6 - Show scientific or engineering achievements	62
Challenge 7 - Passing	62
Tables	63
A 1 Circumference Method Table	63
A 2 Min Box Method Table	64

FIFA Laws and RoboCup Modifications

Official FIFA Laws include:

- FIFA Law 1 - The Field of Play
- FIFA Law 2 - The Ball
- FIFA Law 3 - The Number of Players
- FIFA Law 4 - The Players' Equipment
- FIFA Law 5 - The Referee
- FIFA Law 6 - The Assistant Referees
- FIFA Law 7 - The Duration of the Match
- FIFA Law 8 - The Start and Restart of Play
- FIFA Law 9 - The Ball In and Out of Play
- FIFA Law 10 - The Method of Scoring
- FIFA Law 11 - Offside
- FIFA Law 12 - Fouls and Misconduct
- FIFA Law 13 - Free Kicks
- FIFA Law 14 - The Penalty Kick
- FIFA Law 15 - The Throw-In
- FIFA Law 16 - The Goal Kick
- FIFA Law 17 - The Corner Kick

FIFA LAW 1 – The Field of Play

 RoboCup Changes and Comments	
	
RC-1.0: The Field	
RC-1.0.1: Surface	Choosing a material for the floor is the responsibility of the local organisers of an event. The color of the field surface must be green.
RC-1.0.2: Lighting	Artificial light sources may be hung over the field. The brightness of the lighting on the field is between 300 and 1200 lux. The difference between maximum and minimum brightness values measured within a field should not exceed 300 lux.

FL 1.1 Dimensions

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

National Matches


Length: minimum 90m (100yds), maximum 120m (130yds)

Width: minimum 45m (50yds), maximum 90m (100yds)

International Matches


Length: minimum 100m (110yds), maximum 110m (120yds)

Width: minimum 64m (70yds), maximum 75m (80yds)

 RoboCup Changes and Comments	
RC-1.1: Dimensions	RoboCup Matches Length: minimum 8m, maximum 16m. Width: minimum 6m, maximum 12m. The dimensions for RoboCup-2006 are 12m × 8m.

FL 1.2 Field Markings


The field of play is 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. All lines are not more than 12.5cm (5ins) wide. The field of play is divided into two halves by a halfway line. The center mark is indicated at the midpoint of the halfway line. A circle with a radius of 9.15m (10yds) is marked around it.

 RoboCup Changes and Comments	
RC-1.2: Field Markings	The width of touch and goal lines is 12.5cm. The radius of the center circle is 1m. For RoboCup, the width of all internal lines, like center circle, goal area, and penalty area, is 5cm.
RC-1.2.1: Safety Boundary	The field is surrounded by a green or black safety boundary, the height of which is between 5cm and 15cm. It is placed 1m outside of each field border. The only purpose for this boundary is to prevent robots from running into the audience. All teams are expected to make no assumptions about this boundary. Thus the above two constraints might be changed by the organizer within their limits without prior notice.
RC-1.2.2: Ad Panels	The organizer may decide to add up to three advertising panels on each long side of the field. The length of a panel may not exceed 150 cm and the height may not exceed 50 cm. Panels must be placed on top or outside of the safety boundary. There may be no further panels outside this field boundary.
RC-1.2.3: Restart Spots	<p>The RoboCup field defines 9 places used for game restart. In addition to the white center marking and the white penalty marks, there are 6 extra spots on the field, optionally marked with black color, which will be used for this purpose. The positions of the extra markers (see field drawing above) are specified as follows:</p> <ul style="list-style-type: none"> • 2 spots on the center line, one each halfway between touch line and center mark. • 2 spots each on a line parallel to the goal line through each penalty mark, one each halfway between touch line and the penalty mark. <p>The penalty marks are not used for game restarts, unless a penalty was called by the referee. The diameter of the center mark, white penalty marks, and extra spots is 10cm.</p>

FL 1.3 The Goal Area

A goal area is defined at each end of the field as follows:

Two lines are drawn at right angles to the goal line, 5.5m (6yds) from the inside of each goalpost. These lines extend into the field of play for a distance of 5.5m (6yds) 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.

 RoboCup Changes and Comments	
RC-1.3: Goal Area	For RoboCup, replace “5.5m” by “0.5m”.


FL 1.4 The Penalty Area

A penalty area is defined at each end of the field as follows:

1. Two lines are drawn at right angles to the goal line, 16.5m (18yds) from the inside of each goalpost. These lines extend into the field of play for a distance of 16.5m (18yds) and are joined by a line


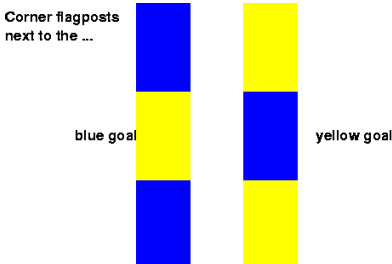
drawn parallel with the goal line. The area bounded by these lines and the goal line is the penalty area.

2. Within each penalty area a penalty mark is made 11m (12yds) from the midpoint between the goalposts and equidistant to them. An arc of a circle with a radius of 9.15m (10yds) from each penalty mark is drawn outside the penalty area.

 RoboCup Changes and Comments	
RC-1.4: Penalty Area	For RoboCup, replace “16.5m” by “1.5m”, and “11m” by “2m”. No circle arc is used in RoboCup.


FL 1.5 flagposts

A flagpost, not less than 1.5m (5ft) high, with a non-pointed top and a flag is placed at each corner. flagposts may also be placed at each end of the halfway line, not less than 1m (1yd) outside the touch line.

 RoboCup Changes and Comments	
RC-1.5: flagposts	Instead of flagposts, cylinders with a diameter of 20cm and height of 1m are used.
RC-1.5.1: Corner flagposts	<p>The centers of corner cylinders are placed 50cm outside of goal lines and touch lines, as indicated in the field drawing. The corner cylinders are painted in the same color as the nearest goal, with the exception of 1/3 of the area at the center of the cylinder, which has the color of the opposite goal.</p>  <p>Corner flagposts next to the ...</p> <p>blue goal yellow goal</p>

FL 1.6 The Corner Arc

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

 RoboCup Changes and Comments	
RC-1.6: Corner Arc	For RoboCup, replace “1m” with “0.5m”.


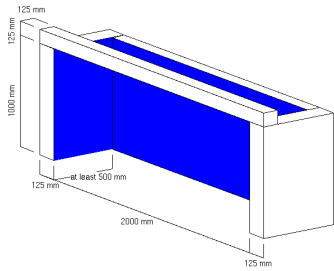
FL 1.7 Goals

Goals must be placed on the center of each goal line. They consist of two upright posts equidistant from the corner flagposts and joined at the top by a horizontal crossbar. The distance between the posts is 7.32m (8yds) and the distance from the lower edge of the crossbar to the ground is 2.44m (8ft).

Both goalposts and the crossbar have the same width and depth which do not exceed 12.5cm (5ins). The goal lines are the same width as that of the goalposts and the crossbar. Nets 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.

 RoboCup Changes and Comments	
<p>RC-1.7: Goals</p>	<p>For RoboCup, replace “7.32m” with “2m” and “2.44m” with “1m”. Instead of a net, a wall is placed around and behind the goal. The depth of the goal is at least 0.5m. The interior of one goal is blue, the other is yellow. The exterior of the goal, the goalposts and the crossbar are painted white. The organizer may decide to have sponsor logos on the backside of the goal wall.</p> 

FL 1.8 Safety

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

Decisions of the International F.A. Board


Decision 1: If the crossbar becomes displaced or broken, play is stopped until it has been repaired or replaced in position. If a repair is not possible, the match is abandoned. The use of a rope to replace the crossbar is not permitted. If the crossbar can be repaired, the match is restarted with a dropped ball at the place where the ball was located when play was stopped (see FIFA LAW 8).


Decision 2: Goalposts and crossbars must be made of wood, metal or other approved material. Their shape may be square, rectangular, round or elliptical and they must not be dangerous to players.

Decision 3: No kind of commercial advertising, whether real or virtual, is permitted on the field of play and field equipment (including the goal nets and the areas they enclose) from the time the teams enter the field of play until they have left it at half-time and from the time the teams re-enter the field of play until the end of the match. In particular, no advertising material of any kind may be displayed on goals, nets, flagposts or their flags. No extraneous equipment (cameras, microphones, etc.) may be attached to these items.

Decision 4: The reproduction, whether real or virtual, of representative logos or emblems of FIFA, confederations, national associations, leagues, clubs or other bodies, is forbidden on the field of play and field equipment (including the goal nets and the areas they enclose) during playing time, as described in Decision 3.

Decision 5: A mark may be made off the field of play, 9.15 meters (10 yds) from the corner arc and at right angles to the goal lines to ensure that this distance is observed when a corner kick is being taken.

 RoboCup Changes and Comments	
<p>RC-Decision 3:</p>	<p>FIFA Decision 3 applies to RoboCup with the exception that markings, logo, and advertisement may be allowed above the height of 50 cm and above the goals.</p>


 RoboCup Changes and Comments	
RC-Decision 4:	FIFA Decision 4 applies to RoboCup with the exception specified in RC-Decision 3.
RC-Decision 5:	FIFA Decision 5 does currently not apply to RoboCup.

FIFA LAW 2 – The Ball

FL 2.1 Qualities and Measurements

The ball is

- spherical,
- made of leather or other suitable material,
- of a circumference of not more than 70cm (28ins) and not less than 68cm (27ins),
- not more than 450g (16oz) in weight and not less than 410g (14oz) at the start of the match,
- of a pressure equal to 0.6–1.1 atmosphere (600 - 1100g/cm²) at sea level (8.5lbs/sqin – 15.6 lbs/sqin).

 RoboCup Changes and Comments	
RC-2.1: Qualities and Measurements	The official tournament ball used in matches is any orange FIFA standard size 5 football. The color is orange.

FL 2.2 Replacement of a Defective Ball

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 first ball became defective (see FIFA LAW 8).

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

Decision 1: In competition matches, only footballs which meet the minimum technical requirements stipulated in FIFA LAW 2) are permitted for use. In FIFA competition matches, and in competition matches organized under the auspices of the confederations, acceptance of a football for use is conditional upon the football bearing one of the following three designations: The official "FIFA APPROVED" logo, or the official "FIFA INSPECTED" logo, or the reference "INTERNATIONAL MATCHBALL STANDARD". Such a designation on a football indicates that it has been tested officially and found to be in compliance with specific technical requirements, different for each category and additional to the minimum specifications stipulated in FIFA LAW 2). The list of the additional requirements specific to each of the respective categories must be approved by the International F.A. Board. The institutes conducting the tests are subject to the approval of FIFA. National association competitions may require the use of balls bearing any one of these three designations. In all other matches the ball used must satisfy the requirements of FIFA LAW 2.


Decision 2: In FIFA competition matches and in competition matches organized under the auspices of the confederations and national associations, no kind of commercial advertising on the ball is permitted, except for the emblem of the competition, the competition organizer and the authorized trademark of the manufacturer. The competition regulations may restrict the size and number of such markings.

 RoboCup	RoboCup Changes and Comments
RC-Decision 2:	The organizing committee of a tournament is responsible for approving the balls to be used, including any kind advertisement, logo, or emblem on the ball.

FIFA LAW 3 – The Number of Players


FL 3.1 Players

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.

 RoboCup Changes and Comments	
RC-3.1: Players	<p>A match is played by two teams, each consisting of not more than six players, one of whom is the goalkeeper. The maximum difference of number of players between the two teams starting a match is defined as 1, if the team with less robot has 4 or more players. For example, if team A can hold 6 players, only 5 players can be played if the other team B has only 4 players.</p> <p>If team A can only hold 2 or 3 players, team B may have at most 4 players.</p> <p>The number of players in a team is further constrained by the total space occupied by all players of a team, which may not exceed 10,000cm². The total space occupied by a team is the sum of the space occupied by each active player of a team. The space occupied by a player is defined in RoboCup Changes and Comments to FIFA Law 4).</p> <p>A match may not start if either team consists of fewer than two players.</p>
RC-3.1.1: Incapable Players	<p>Players not capable of play, e.g. players not able to move, or players with defective or malfunctioning sensing and/or actuating systems, are not permitted to participate in the game. 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, in particular before and after a game, during halftime, and during any stoppage of the game.</p>

FL 3.2 Official Competitions

Up to a maximum of three substitutes may be used in any match played in an official competition organized under the auspices of FIFA, the confederations or the national associations. The rules of the competition must state how many substitutes may be nominated, from three up to a maximum of seven.


 RoboCup Changes and Comments	
RC-3.2: Official Competitions	<p>In official competitions, an arbitrary number of substitute players may be used in RoboCup.</p>

FL 3.3 Other Matches

In other matches, up to five substitutes may be used, provided that:


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

If the referee is not informed, or if no agreement is reached before the start of the match, no more than three substitutes are allowed.

 RoboCup Changes and Comments	
RC-3.3: Other Matches	<p>In RoboCup, an arbitrary number of substitute players may be used in all other matches.</p>

FL 3.4 All Matches

In all matches the names of the substitutes must be given to the referee prior to the start of the match. Substitutes not so named may not take part in the match.

 RoboCup Changes and Comments	
RC-3.4: All Matches	In all matches the numbers and names of all substitutes must be given to the referee and the assistant referees prior to the start of the match. Substitutes not so named may not take part in the match.

FL 3.5 Substitution Procedure

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

- The referee is informed before any proposed substitution is made.
- A substitute only enters the field of play after the player being replaced has left and after receiving a signal from the referee.
- A substitute only enters the field of play at the halfway line and during a stoppage in the match.
- A 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 ceases to be a player.
- A player who has been replaced takes no further part in the match.
- All substitutes are subject to the authority and jurisdiction of the referee, whether called upon to play or not.

subsectionChanging the Goalkeeper

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

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

FL 3.6 Infringements/Sanctions

If a substitute enters the field of play without the referee's permission:

- Play is stopped.
- The substitute is cautioned, shown the yellow card and required to leave the field of play.
- Play is restarted with a dropped ball at the place it was located when play was stopped (see FIFA LAW 8).

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

- Play continues.
- The players concerned are cautioned and shown the yellow card when the ball is next out of play.

For any other infringements of this Law:

- The players concerned are cautioned and shown the yellow card.

FL 3.7 Restart of Play

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

- The match is restarted by an indirect free kick, to be taken by a player of the opposing team from the place where the ball was located when play was stopped (see FIFA LAW 8).


FL 3.8 Players and Substitutes Sent Off

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.


FL 3.9 Decisions of the International F.A. Board

Decision 1: Subject to the overriding conditions of FIFA LAW 3, the minimum number of players in a team is left to the discretion of national associations. The Board is of the opinion, however, that a match should not continue if there are fewer than seven players in either team.

Decision 2: The coach may convey tactical instructions to the players during the match. He and the other officials must remain within the confines of the technical area, where such an area is provided, and they must behave in a responsible manner.


 RoboCup Changes and Comments	
RC-Decision 2:	RoboCup players must play autonomously. Coaching and any kind of human interference with robots, with or without technical means, is not allowed, except where otherwise specified in the Laws. Coaching and human interference is only allowed for substitutes and robots outside of the playground, and only if the robots are inactive, in particular, if they do not send any kind of signals, including wireless communications.

FIFA LAW 4 – The Players’ Equipment

 RoboCup Changes and Comments	
RC-4.0.1: Design Guideline	Robots for playing soccer must be designed such that they are both robust and safe . Both terms are subsequently explained.

FL 4.1 Safety


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


 RoboCup Changes and Comments	
RC-4.1: Safety	Robot soccer players must be built such that they are safe . Safe means that robots do not damage other robots or any objects of the playground, or pose a threat to the audience, or the referees, or human team members. In particular, the design of the robots should ensure that "Fouls and Misconduct" are avoided. Anyone is allowed to take whatever action seems necessary to prevent a robot from causing urgent danger. This includes lifting the robot and/or switching it off. Teams are advised to provide an emergency stop button on their robot that interrupts all actuation.
RC-4.1.1: Jamming	Robots must be designed and programmed such that they try to avoid interference concerning the operation of sensor systems and/or communication devices. The use of particular equipment which may cause interference of communication and/or sensors must be reported to the league organizing committee of a tournament, and eventually negotiated between two teams before a match. If a team uses communications and sensors other than those previously declared to the tournament committee and/or the opponent, the game may be forfeited, and the league organizing committee may exclude the robots from further participation.
RC-4.1.2: Exclusion	Robots that violate the above conditions, in particular if they threaten to seriously damage opponents or pose a threat to the audience and/or referees and human team members, may be excluded from play in a tournament by the league organizing committee.

FL 4.2 Basic Equipment

The basic compulsory equipment of a player is:

- a jersey or shirt,
- shorts - if thermal undershorts are worn, they are of the same main color as the shorts,
- stockings,
- shin-guards,
- footwear.

 RoboCup	RoboCup Changes and Comments
RC-4.2.0: Space occupied by a Robot	<p>The space occupied by a robot is the area occupied by the convex hull around the projection of the robot’s shape onto the floor, when the robot assumes a configuration used for moving around the field.</p> <p>For simplification, measuring the space occupied by a robot player is performed using one of the following two methods:</p> <ol style="list-style-type: none"> 1. The smallest rectangular box enclosing the robot is determined. The space occupied by the robot is the area of the box: $area(Robot) = length(box) \times width(box)$ 2. The smallest circle enclosing the robot is determined by measuring the circumference of the convex hull, using a rope around the robot. The space occupied by the robot is the area of the circle with the same circumference: $area(robot) = \frac{circumference^2}{4\pi}$ <p>The team leader of a team is asked to decide which method should be applied. For both methods, tables for a quick lookup of robot sizes given the respective measurements are provided in Appendices A 1 and A 2.</p>
RC-4.2.1: Robot Size	<p>The size of each robot player must obey the following constraints:</p> <ol style="list-style-type: none"> 1. Each robot must possess a configuration of itself and its actuators, where the projection of the robot’s shape onto the floor fits into a square of size at least 30cm × 30cm and at most 50cm × 50cm. 2. Every robot may not have configurations of itself and its actuators, where the projection of the robot’s shape onto the floor exceeds a square of size 60cm × 60cm. 3. The robot should be in the configuration that fits within the 50cm × 50cm square for the majority of play time, in particular when moving around the field, and only occasionally, e.g. when kicking or dribbling, extend to the 60cm × 60cm limit. 4. The robot height must be at least 40 cm and at most 90 cm. 5. The keeper should be in the configuration that its height is at most 80 cm for the majority of play time, and only occasionally, e.g. when blocking a ball, extend to the 90 cm limit. The extension time is limit to 2 seconds. 6. The field players may not exceed the 80 cm height limit.
RC-4.2.2: Robot Shape	<p>Any shape is allowed as long as the size restrictions are not violated. Robots may exhibit concavities in their shape or may dynamically change shape, provided that the Laws concerning Fouls and Misconduct are not violated.</p>
RC-4.2.3: Robot Weight	<p>The maximum weight of a robot is 40 kg.</p>
RC-4.2.3.1: Overweight Robots	<p>Exceptions to weight restrictions may be made for robots who have already participated in official tournaments. The team must get permission to use overweight robots from the organizing committee prior to the tournament.</p>

 RoboCup	RoboCup Changes and Comments
RC-4.2.4: Robot Colors	<p>The base color of a robot's body must be black. The paint or used material must be matte in order to minimize reflectivity.</p> <p>Note 1: This law does not mean that your robot must be completely black; for example, one cannot paint the lens of a camera. However, every team is expected to try hard to hide non-black parts of the robot as much as possible, especially parts that have colors used for the ball or the field of play.</p> <p>Note 2: Teams should avoid using any kind of shiny material for robot surfaces. The league committee may exclude robots that do not conform with coloring laws.</p>
RC-4.2.5: Robot Markers	<p>A robot must have markings in order to be recognized by other robots and to be distinguished by the referee. Each robot must carry color markers, number markers, and top markers. Robots not carrying all markers ARE NOT ELIGIBLE TO PLAY.</p>
RC-4.2.5.1: Color Markers	<p>Color markers should be designed as follows:</p> <ul style="list-style-type: none"> • Above 30cm and below 60cm, color markers must be present and visible from all sides. • A color marker can be any shape. • The height and width of a color marker must be greater than or equal to 10 cm in any direction. • The marker color must be one of the two predetermined official colors. The official colors are purple/magenta and light blue. <p>Samples of marker colors are available from the League Committee Chairs. It is the responsibility of team leaders to obtain samples of marker colors and to ensure that their team color markers are as close as possible to the official colors. The Middle Size League Technical Committee may request to build new color markers on site, if the team's color markers do not sufficiently comply with the official colors.</p> <ul style="list-style-type: none"> • Every team must provide the markers in each team color and attach one of them prior to each game.
RC-4.2.5.2: Number Markers	<p>A number marking should be designed as follows:</p> <ul style="list-style-type: none"> • Each robot must carry a number (consisting of two digits at most), in black digits of height no smaller than 8 cm. • The number will be fixed on the color markers and must at least be visible from all four major sides (front, back, left and right) of the robot. • The number 1 is reserved for goal keepers. • The number marking must be easily visible for the referee and other humans and robots from all sides.

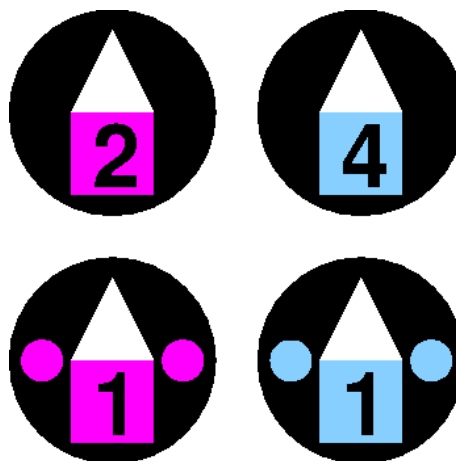



RoboCup Changes and Comments


**RC-4.2.5.1:
Top Markers**

Each robot must carry a top marker as follows (see figure below):

- The top marker is a black circle of 20cm diameter.
- On one half of the circle, a square in the respective team color and of at least 8cm side length must be present.
- On top the colored square a robot’s number marker must be present.
- On the other half of the circle must be a white triangle of side length 8cm, with one side going through the center of the black circle and the opposite edge pointing into the preferred forward movement direction of the robot. For robots with omni-directional drives, the triangle should point into the direction of a kicking device, if present.
- The top markers of goal keepers carry two additional circles of 4cm diameter in the respective team color, and located as indicated in the figure.




	RoboCup Changes and Comments
<p>RC-4.2.6: Communications</p>	<p>Communication between the robots of a team is allowed. Communication between the robots and remote computer systems is allowed provided that human interference is excluded. In particular, such communication is allowed under the following constraints:</p> <ul style="list-style-type: none"> • Robots may send arbitrary kinds and amounts of data to remote computers. However, bandwidth restrictions may apply in order to ensure safe and robust game operation. Teams must be able to immediately disable such communications when requested by the referee. • Robots may receive data from remote computers, if the data is sent by an autonomous remote program (without any means of human interaction). • Robots may receive data from remote computers, if the data are commands resulting in starting and/or stopping the robot, and/or changes to the communication with remote computers. Such commands must not include any further information, such as the position of the robot itself, or teammates, or opponents, or the ball on the field. Teams must be prepared to demonstrate and explain their communication setup and software to the referees and/or the MSL Technical Committee in order to ensure that human interference is excluded. <p>Wireless communication equipment shall follow legal regulations of the country where the tournament is held. Wireless communication equipment satisfying IEEE 802.11a and/or 802.11b specifications is allowed. IEEE 802.11g and BlueTooth are forbidden. Radio communication in the 418 MHz or 433 MHz bands is explicitly disallowed. Exceptions would be given only to those who have used the equipment in the past official RoboCup competition (including GermanOpen and JapanOpen), and who commit to switch to the "standard" technology with their next hardware update. The teams that need exception must request it to the TC and OC two months before the competition.</p> <p>Note: A team using wireless communication equipment is recommended to contact the league organizing committee of a tournament. A team must be prepared to change their communication setup, e.g. to select different carrier frequencies before the match in order to avoid interference.</p> <p>The organizing committee may exclude the use wireless communication equipment such as access points and require the use of access points provided by the organizers instead. Teams must be prepared to change and adapt wireless communication equipment and setup according to the restrictions and needs of tournament organization. The organizing committee may use equipment to produce logs of all communications between robots and/or remote computers and enforce all measures necessary for their correct operation.</p>

 RoboCup Changes and Comments	
RC-4.2.7: Sensing Systems	<p>Any sensing system (including vision system) is allowed as long as the following constraints are met:</p> <ol style="list-style-type: none"> 1. All parts of the sensing system (i.e .the actual sensing device and, if applicable, a signal emitting device) must be on the robots. 2. There may be no manipulation of the environment, such as placing specific markers as landmarks.
RC-4.2.8: Ball Handling Mechanisms	<p>Robots may have special devices for ball handling. Ball handling devices must be designed such that they are safe. The robot’s use of ball handling devices must comply with the Laws set forth in Fouls and Misconduct.</p>
RC-4.2: Technical Inspection	<p>Teams have to allow technical inspection of robots by team leaders and/or the MSL Technical Committee at the following times:</p> <ul style="list-style-type: none"> • Within the last 24 hours and at least 4 hours before the first match of a tournament. • At least 1 hour before a scheduled match. <p>If a team leader believes that an opponent robot does not comply with the technical specifications set forth in this Law, he submits a formal complaint to the MSL Technical Committee and/or the League Organizing Committee. The MSL Technical Committee will investigate a complaint and decide whether the complaint is justified or not. If a complaint is justified, the MSL Technical Committee can ask the team to change the robot such that it complies with the Law. The Technical Inspection Committee may exclude robots from participation in the tournament, if they do not comply with the Law, in particular with requirements defined for the design of robots, or if they present a potential threat to spectators or team members. In exceptional cases only, the organizing committee may permit robots violating particular constraints, provided that the majority of team leaders agrees.</p>


FL 4.3 Shin-guards

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

 RoboCup Changes and Comments	
RC-4.3.1: Robustness	<p>Robot soccer players must be built such that they are robust. Robust means that the physical integrity of the robot is not endangered by incidental, accidental, or intentional collisions with the ball or objects of the field or other robots, and that the robot’s sensing systems and software can handle potentially significant levels of noise caused by other sources, such as other robots, game officials, team members, spectators, or the media. Robots are allowed to kick a ball upward with no penalty. This means that the robots should be build strong enough to tolerate it.</p>

FL 4.4 Goalkeepers

- wear colors which distinguish them from the other players, the referee and the assistant referees


 RoboCup Changes and Comments	
RC-4.4: Goalkeepers	Goalkeepers must obey the same coloring and marker constraints as the other robots in their team. The design of the top marker must indicate that a player is a goal keeper. If the normal player is substituted as a goal keeper, the player must wear the top marker of the substituted goal keeper in order to clarify that the player is goal keeper. The substituted goal keeper do not have to wear the color marker of the regular goal keeper.

FL 4.5 Infringements/Sanctions

For 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 does 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 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 enters (or re-enters) the field of play without the referee's permission is cautioned and shown the yellow card.

 RoboCup Changes and Comments	
RC-4.5.1: Repair of Robots	<p>Team leaders may ask the referee for permission to remove a player from the field, if there is a problem with the player's hardware and/or software.</p> <p>If the referee gives permission to remove a player, one human team member (for overweight robots: two), who must be properly dressed and who has been identified to the referee before the start of the game, may enter the field and remove a robot only during a game stoppage.</p> <p>Robots must be repaired outside of the safety boundary around the field.</p> <p>Checking that the player's equipment is correct may also be done by assistant referees.</p> <p>For re-entering the field after a player has been repaired or a player's equipment has been corrected the player is allowed to enter the field only during a game stoppage.</p> <p>The referee shall give permission to re-enter the field only if at least 30 seconds have passed since the robot has been removed from the field, and only if no immediate interference with the game process will occur.</p>

FL 4.6 Restart of Play

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

- the match is restarted by an indirect free kick taken by a player of the opposing side, from the place where the ball was located when the referee stopped the match.

FIFA LAW 5 – The Referee


FL 5.1 The Authority of the Referee


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 he has been appointed.

FL 5.2 Powers and Duties

The Referee:

- enforces the Laws of the Game.
- controls the match in co-operation with the assistant referees and, where applicable, with the fourth official.
- ensures that the ball meets the requirements of FIFA LAW 2.
- ensures that the players' equipment meets the requirements of FIFA LAW 4.
- acts as timekeeper and keeps a record of the match.
- stops, suspends or terminates the match, at his discretion, for any infringements of the Laws.
- stops, suspends or terminates the match because of outside interference of any kind.
- stops the match if, in his opinion, a player is seriously injured and ensures that he is removed from the field of play.
- allows play to continue until the ball is out of play if a player is, in his 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.
- allows play to continue when the team against which an offence has been committed will benefit from such an advantage and penalizes 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. He is not obliged to take this action immediately but must do so when the ball next goes out of play.
- takes action against team officials who fail to conduct themselves in a responsible manner and may at his discretion, expel them from the field of play and its immediate surrounds.
- acts on the advice of assistant referees regarding incidents which he has not seen.
- ensures that no unauthorized persons enter the field of play.
- restarts 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 which occurred before, during or after the match.

	RoboCup Changes and Comments
RC-5.3: Powers and Duties	In RoboCup, some referee duties like time keeping and keeping a record of the match may be delegated to one of the assistant referees.

 RoboCup Changes and Comments	
RC-5.3.1: Referee Box	In RoboCup, assistive technology is used to support the referee, in particular for conveying referee decisions to robot players and for maintaining a record of the game. Such assistive technology includes a referee box and possibly cameras mounted on the ceiling or lighting structure. In particular, whenever the Laws of the Game specify that the referee is giving a signal, the referee box protocol specifies the (wireless) communication of one or more messages to robot players. Operation of the referee box is delegated to an assistant referee.
RC-5.3.2: Play Without Referee Box	If a referee box is not available, or if an available referee box cannot be used, e.g. because some wireless communication problems cannot be resolved, operators of the teams will send the start/stop instruction by themselves.
RC-5.3.3: Permission to send "Stop" signal	Teams are allowed to send "Stop" signals to their robots without any permission of a referee whenever they regard the behavior as dangerous one against the opponent robots or spectators. Sending any other command by the human team-member to the robots is absolutely forbidden.

FL 5.3 Decisions of the Referee

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

Decisions of the International F.A. Board

Decision 1: 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 which he may take under the terms of the Laws of the Game or in respect of the normal procedures required to hold, play and control a match.

This 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,
- a decision as to the condition of the fixtures or equipment used during a match including the goalposts, crossbar, flagposts and the ball,
- a decision to stop or not to stop a match due to spectator interference or any problem in the spectator area,
- 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 request or insist that an injured player be removed from the field of play for treatment,
- a decision to allow or not to allow a player to wear certain apparel or equipment,
- a decision (in so far as this may be his responsibility) 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,
- any other decision which he may take in accordance with the Laws of the Game or in conformity with his duties under the terms of FIFA, confederation, national association or league rules or regulations under which the match is played.

Decision 2: In tournaments or competitions where a fourth official is appointed, his role and duties must be in accordance with the guidelines approved by the International F.A. Board.


Decision 3: Facts connected with play shall include whether a goal is scored or not and the result of the match.

FIFA LAW 6 – The Assistant Referees

FL 6.1 Duties

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

- when the whole of the ball has passed out of the field of play,
- which side is entitled to a corner kick, goal kick or throw-in,
- when a player may be penalized for being in an offside position,
- when a substitution is requested,
- when misconduct or any other incident has occurred out of the view of the referee.

 RoboCup Changes and Comments	
RC-6.1: Duties	In RoboCup, one or more assistants may be appointed for a match. The recommendation is to have three assistant referees. One of the assistant referees should be responsible for time keeping and keeping a game record. The referee may assign assistant referees additional duties aside of those specified in the FIFA Law.

FL 6.2 Assistance

The assistant referees also assist the referee to control the match in accordance with the Laws of the Game.


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

FIFA LAW 7 – The Duration of the Match

FL 7.1 Periods of Play


The match lasts two equal periods of 45 minutes, unless otherwise mutually agreed between the referee and the two participating teams.

Any agreement to alter the periods of play (for example 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.

 RoboCup Changes and Comments	
RC-7.1: Periods of Play	<p>In RoboCup, a match lasts two equal periods of 15 minutes.</p> <p>For friendly games, referee and both teams may decide on different periods of play.</p> <p>In official tournaments, modifications of periods of play may be specified by the organizing committee.</p>

FL 7.2 Half-Time Interval

Players are entitled to an interval at half-time. 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.

 RoboCup Changes and Comments	
RC-7.2: Half-Time Interval	<p>In RoboCup, the half-time interval must not exceed 5 minutes.</p>

FL 7.3 Allowance for Time Lost

Allowance is made in either period for all time lost through

- substitution(s),
- 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.

FL 7.4 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.

FL 7.5 Extra Time

Competition rules may provide for two further equal periods to be played. The conditions of FIFA LAW 8 will apply.

FL 7.6 Abandoned Match

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

FIFA LAW 8 – The Start and Restart of Play


FL 8.1 Preliminaries

A coin is tossed and the team which 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 which wins the toss takes the kick-off to start the second half of the match.

In the second half of the match the teams change ends and attack the opposite goals.


 RoboCup Changes and Comments	
RC-8.1.1: Start Delay	For RoboCup, a match must start at the scheduled time. In exceptional situations only, the referee may re-adjust the time for starting the game in accordance with both team leaders.
RC-8.1.2: Remote Start	All robots of a team are started (and stopped) by receiving a signal through wireless communication from outside the field. In exceptional cases, starting and stopping robots manually may be allowed by the referee.

FL 8.2 Kick-off

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.


A goal may be scored directly from the kick-off.

 RoboCup Changes and Comments	
RC-8.2: Kick-off	In RoboCup, a goal may be scored after kick-off only if the ball touched a second player before crossing the goal line.

FL 8.3 Procedure (for kick-off)

- All players are in their own half of the field.
- The opponents of the team taking the kick-off are at least 9.15m (10yds) from the ball until it is in play.
- The ball is stationary on the center mark.
- The referee gives a signal.
- The ball is in play when it is kicked and moves forward.
- The kicker does not touch the ball a second time until it has touched another player.

After a team scores a goal, the kick-off is taken by the other team.

 RoboCup Changes and Comments	
RC-8.3: Procedure (for Kick-Off)	<p>For RoboCup, the following procedure is followed for kick-off:</p> <ul style="list-style-type: none"> • All players are in their own half of the field. • The opponents of the team taking the kick-off are at least 1m from the ball until it is in play. • The ball is stationary on the center mark. • The referee gives a signal. • The ball is in play when it is kicked and moves, or 10 seconds after the referee has given the signal. • The kicker may play the ball more than once before the ball is touched by another player. A goal may be scored only after the ball was touched by another player. • If the kicker cannot play the ball and, after 10 seconds an opponent gets the ball, this cannot score the goal before the ball is touched by another player. <p>The referee must restart the game within 10 seconds after game stops.</p>
RC-8.3.1: Positioning of Robots	<p>Robots being able to autonomously reposition themselves can take any position on the field that is consistent with the FIFA Law 8.</p> <p>Robots not able to autonomously reposition themselves, e.g. robots being pushed or joysticked around manually by human team members, have to start from the game restart points or behind the game restart points. If all robots of the team executing the kick-off cannot autonomously reposition themselves, then one robot may be placed into the center circle.</p>
RC-8.3.2: Manual Start	<p>If one or both of the teams in a match have permission to use a manual startup procedure, the referee gives a sequence of two signals with an interval of 10 seconds. Robot player's without remote start capability may be started on the field after the first signal. They may not move before the second signal was given by the referee. All human team members must leave the field of play immediately after the first signal and before the second signal.</p>


FL 8.4 Infringements/Sanctions (for kick-off)

If the kicker touches the ball a second time 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.


For any other infringement of the kick-off procedure:

- The kick-off is retaken.

 RoboCup Changes and Comments	
RC-8.4.1: Kicking Directly to the goal	<p>In RoboCup, if the ball enters the goal without a touch of a second player crossing the goal line, the goal is not scored and the kick-off is awarded to the opposing team.</p>


FL 8.5 Dropped Ball

A dropped ball is a way of restarting the match after a temporary stoppage which becomes necessary, while the ball is in play, for any reason not mentioned elsewhere in the Laws of the Game.

 RoboCup Changes and Comments	
RC-8.5.1: Game Stuck	In RoboCup, the referee may call a game stuck situation if there is no progress of the game. The game is continued using the dropped ball procedure at the center mark. A goal can be scored directly from a dropped ball in RoboCup.

FL 8.6 Procedure (for dropped ball)


The referee drops the ball at the place where it was located when play was stopped. Play restarts when the ball touches the ground.

 RoboCup Changes and Comments	
RC-8.6: Procedure (for Dropped Ball)	<p>In RoboCup, the following procedure is followed for dropped ball:</p> <ul style="list-style-type: none"> • The referee gives a "stop" signal. • All players have to stop their movement. • The ball is stationary positioned in the place where the referee located the ball. • The referee gives a "dropped ball" signal. • All players remain 1m away from the ball. • The referee gives a "start" signal. • The ball is in play immediately after the referee gives the signal. <p>It is forbidden to reposition robots by hand or remote control unless the referee instructs the team leader to do so. Referee may show a yellow card to the robot that doesn't leave from the ball or follow the referee instructions more than twice consecutively. After that, referee may instruct the teams to move the robots to the right position only if the robots don't follow the position restrictions of the procedure.</p> <p>The referee must restart the game within 10 seconds after game stops.</p>

FL 8.7 Infringements/Sanctions (for dropped ball)

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.

 RoboCup Changes and Comments	
RC-8.7: Infringements/ Sanctions	If a player moves into within 1m from the ball before the referee gives the signal, an indirect free kick is awarded to the opponent.

FL 8.8 Special Circumstances

A free kick awarded to the defending team inside its own goal area is taken from any point within the goal area.

An indirect free kick awarded to the attacking team in its opponents' goal area is taken from the goal area line parallel to the goal line at the point nearest to where the infringement occurred.


A dropped ball to restart the match after play has been temporarily stopped inside the goal area takes place on the goal area line parallel to the goal line at the point nearest to where the ball was located when play was stopped.

FIFA LAW 9 – The Ball In and Out of Play

FL 9.1 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.
- Play has been stopped by the referee.

 RoboCup Changes and Comments	
RC-9.1.1: Dead Call	In RoboCup, a special “ <i>dead call</i> ” signal may given by the referee, upon which all robots immediately have to cease operating any kind of actuator. The referee may signal a dead call at any time upon his discretion. In particular, the referee may signal a dead call whenever he considers it necessary to maintain and ensure safety and security of players, team members, referees, and spectators.
RC-9.1.2: Continuation after Dead Call	After a dead call, game continues with dropped ball at the restart spot nearest to the ball location when the game was interrupted, except when the referee issued a different call prior to the dead call.

FL 9.2 Ball In Play

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

- It rebounds from a goalpost, crossbar or corner flagpost and remains in the field of play.
- It rebounds from either the referee or an assistant referee when they are on the field of play.

FIFA LAW 10 – The Method of Scoring

FL 10.1 Goal Scored

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.


FL 10.2 Winning Team

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.

FL 10.3 Competition Rules

For matches ending in a draw, Competition Rules may state provisions involving extra time, or other procedures approved by the International F.A. Board to determine the winner of a match.

FIFA LAW 11 – Offside

 RoboCup Changes and Comments	
RC-11: Offside	This law does currently not apply in RoboCup matches.

FL 11.1 Offside Position

It is not an offence in itself to be in an offside position.

A player is in an offside position if:

- 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.

FL 11.2 Offence

A player in an offside position is only penalized 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:

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

FL 11.3 No Offence


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


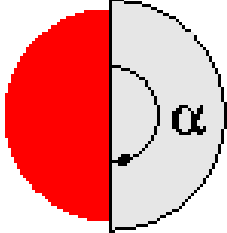
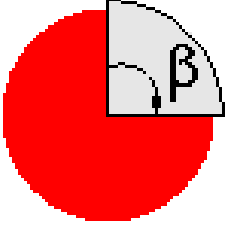
- a goal kick,
- or a throw-in,
- or a corner kick.


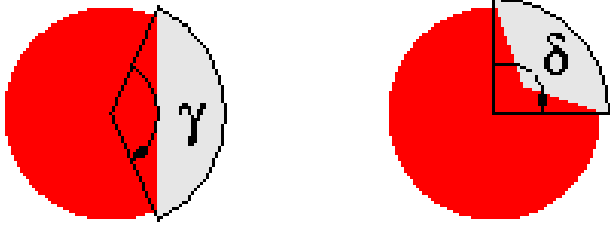
FL 11.4 Infringements/Sanctions

For any offside offence, the referee awards an indirect free kick to the opposing team to be taken from the place where the infringement occurred.

FIFA LAW 12 – Fouls and Misconduct

 RoboCup Changes and Comments	
Definition of Permissible Actions for Robot Soccer Players	
RC-12.0: General Principles	<p>Manipulation of the ball by robot soccer players is guided by the following principles:</p> <ul style="list-style-type: none"> • Robot players may exert force onto the ball only by direct physical contact with one of their body parts or a specially designed, actuated kicking device. • In principle, the physical contact must be instantaneous and limited to very short periods. Physical contact lasting longer than 1 second is considered to be not instantaneous. • In principle, physical contact can be exerted repeatedly by the same player, if contact is not continuous. A period of less than 1 second between two contacts is considered continuous. • Exceptions to these principles may be temporarily defined for particular methods of ball manipulation, e.g. for dribbling. • Whenever a robot maintains physical contact with ball, it must be possible for other robots to take possession of the ball. In order to ensure this, geometrical limitations are defined for the contact area, which at any time is defined as the convex hull (in 3D) around all contact points between the ball and the robot.

 RoboCup	RoboCup Changes and Comments
RC-12.0.1: Stopping the Ball	<p>The robot may stop the ball by making instantaneous contact, if the robot</p> <ul style="list-style-type: none"> • is not moving • or moving at very slow speed • or moving backward • or decelerating upon contact with the ball <p>and if the robot is not turning after making contact with the ball. If any of these conditions is not met, the robot's action is not considered as stopping the ball. (Another motion may apply.) During a stopping motion, the following constraints apply to the contact area (i.e. the area at least one of which points may be in contact with the ball – see figure below):</p> <ul style="list-style-type: none"> • For any arbitrary view direction onto the contact area, the contact area covers no more than half of the circumference of the ball, i.e. the angle α is no more than 180 degrees. • For any arbitrary view direction perpendicular to the previous one, the contact area covers no more than a quarter of the circumference of the ball, i.e. the angle β is no more than 90 degrees. <div style="display: flex; justify-content: space-around; align-items: center;">   </div> <p>The duration of a stopping motion begins upon making initial contact with the ball and ends either if physical contact with the ball is lost or the contact area with the ball is reduced to comply with other motions. Violating any of the above constraints at any time during a stopping motion is considered ball holding.</p>

 RoboCup Changes and Comments	
RC-12.0.2: Dribbling the Ball	<p>The robot may dribble the ball either by making repeated or continuous physical contact with the ball.</p> <p>When maintaining continuous physical contact with ball, the following conditions must be met at all times:</p> <ul style="list-style-type: none"> • All contact points of the ball with the robot are continuously changing on the ball's surface. • The contact point of the ball with the floor is continuously changing on the ball's surface. <p>These two conditions are usually met if the ball is rolling while dribbling. While dribbling the ball, the robot may use, by no more than 4 seconds, any kind of device designed to actively keep the ball in contact with the robot by preventing its natural rolling direction; e.g., if the robot is going forward the ball should roll in the same direction as if it is pushed by the robot. The robot must wait at least 4 seconds before using again this special device.</p> <p>During a dribbling motion, the following constraints apply to the contact area (i.e. the area at least one of which points may be in contact with the ball – see figure below):</p> <ul style="list-style-type: none"> • For any arbitrary view direction onto the contact area, the contact area covers no more than one 14/36 of the circumference of the ball, i.e. the angle γ is no more than 140 degrees. • For any arbitrary view direction perpendicular to the previous one, the contact area covers no more than a quarter of the circumference of the ball, i.e. the angle δ is no more than 90 degrees. <div style="text-align: center;">  </div> <p>Violating any of the above constraints at any time during a dribbling motion is considered ball holding.</p>
RC-12.0.3: Kicking the Ball	<p>The robot may kick the ball by making a single, short physical contact with the ball.</p> <p>During a kick motion, the same constraints as for dribbling the ball apply to the contact area.</p> <p>Violating any of the defined constraints at any time during a kick motion is considered ball holding.</p>

Fouls and misconduct are penalized as follows:

FL 12.1 Direct Free Kick

A direct free kick is awarded to the opposing team if a player commits any of the following six 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
- strikes or attempts to strike an opponent
- pushes an opponent


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

- tackles an opponent to gain possession of the ball, making contact with the opponent before touching the ball
- holds an opponent
- spits at an opponent
- handles the ball deliberately (except for the goalkeeper within his own penalty area)

A direct free kick is taken from where the offence occurred.

FL 12.2 Penalty Kick

A penalty kick is awarded if any of the above ten offences is committed by a player inside his own penalty area, irrespective of the position of the ball, provided it is in play.

	RoboCup Changes and Comments
RC-12.2: Penalty Kick	In RoboCup, penalty kicks are currently not awarded during the two periods of play in a match. The competition rules may specify the execution of penalty kicks to decide the winner of a game which ends in a draw after two periods of play.

FL 12.3 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 five offences:


- takes more than four steps while controlling the ball with his hands, before releasing it from his possession
- touches the ball again with his hands after it has been released from his possession and has not touched any other 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
- wastes time


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


- 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 dismiss a player

The indirect free kick is taken from where the offence occurred.

 RoboCup Changes and Comments	
RC-12.3: Indirect Free Kick	<p>An indirect free kick is awarded to the opposing team, if a player, in the opinion of the referee, commits any of the following offences:</p> <ul style="list-style-type: none"> • holding the ball • pushing an opponent • kicking an opponent • performing illegal defense • performing illegal attack • delay of game <p>The referee may stop the game and give a yellow card to the player committed one of those offence.</p> <p>The indirect free kick will be started from where the ball was when the offences occurred if the ball was not inside a penalty areas and from the closest restart point if the ball was inside of a penalty area.</p> <p>An indirect free kick is awarded to the opposing team, if a human member of a team, in the opinion of the referee, commits any of the following offences:</p> <ul style="list-style-type: none"> • interfering with the game on the field, e.g. through touching the ball while removing a robot • interfering with the game remotely through wireless communication, e.g. by remotely joysticking a robot, or send commands to robots from a machine not on the robots that convey information about the position of objects on the field or activate particular patterns of actions on the robots. • behaving otherwise in an unsportsmanlike manner <p>In this case, the indirect free kick will be started from the penalty mark position in the half of the opponent of the awarded team.</p> <p>The offences are described and clarified subsequently.</p>
RC-12.3.1: Ball Holding	<p>If a player commits any violation of the clauses on stopping, dribbling, or kicking the ball, a ball holding foul will be called.</p>

	RoboCup Changes and Comments
RC-12.3.2: Pushing	<ul style="list-style-type: none"> • Robots must play such that they try to avoid physical contact. However, physical contact <i>per se</i> does not represent an offence. • All robots must be equipped to detect situations of physical contact with other robots (direct pushing situations). The obligation to detect pushing situations includes also indirect contact with another robot through the ball (i.e. the ball is between the player and an opponent). • If physical contact with other robots cannot be avoided, it must be soft, i.e. at slow speed and with as small physical impact as possible, in order to avoid damage to itself and other robots. Robots moving at high speed must significantly decelerate before a collision with another robot. • Whenever a robot produces direct or indirect physical contact with another robot while moving, it must stop movement immediately and choose a new direction for movement. • If pushing occurs between a moving and a standing robot, the moving robot causes the pushing situation and is responsible for resolving it. • If pushing occurs between two moving robots, both robots are responsible for resolving the pushing situation. If one robot continues pushing by moving in its initial direction, while the other robot is recognizably reacting and trying to take another direction, the foul will be called on the pushing robot. • If two robots encounter physical contact and cannot resolve the situation because they get entangled, the referee may order robot attendants to enter the field and slightly separate the entangled robots. • If, in the opinion of the referee, physical contact between two robots is not soft, or if one or both of the robots do not change direction after encountering physical contact, a pushing foul will be called.
RC-12.3.3: Kicking	<p>The pushing clauses above apply in a similar manner to kicking motions:</p> <ul style="list-style-type: none"> • Robots must avoid kicking each other. However, physical contact through an actuated kicking device does not <i>per se</i> represent an offence. • All robots must be equipped to decide whether they can execute a kick without threatening or damaging other robots. • If physical contact with other robots cannot be avoided, it must be soft, i.e. with small force. The stronger a kicking device is designed, the more fine-grained control of its activation is required. • If, in the opinion of the referee, physical contact through a kicking device is not soft, a kicking foul will be called.

 RoboCup	RoboCup Changes and Comments
RC-12.3.4: Illegal Defense	<ul style="list-style-type: none"> • An illegal defense foul is applied only when a ball is in the defending team's half of the field. • Only the goal keeper may stay permanently in the own penalty area of a team. • A time limit of 10 seconds is allowed for a defending robot to leave its own penalty area. The referee may extend the time limit at his own discretion, if the robot is actively making progress to leave the penalty area, or if it is prevented from leaving the penalty area by other robots. • If, in the opinion of the referee, a defending robot is not taking appropriate action to leave its own penalty area, or if a second defending robot is the penalty area, an illegal defense foul will be called.
RC-12.3.5: Illegal Attack	<ul style="list-style-type: none"> • An illegal attack foul is applied only when a ball is in the defending team's half of the field. • A time limit of 10 seconds is allowed for an attacking robot to (possibly execute a kick motion and) leave the opponent's penalty area. The referee may extend the time limit at his own discretion, if the robot is actively making progress to leave the opponent's penalty area, or if it is prevented from leaving the penalty area by other robots. • If, in the opinion of the referee, the attacking robot is not taking appropriate action to leave the opponent's penalty area, or if a second attacking robot enters the opponent's penalty area, an illegal attack foul will be called.
RC-12.3.6: Manual Interference	<ul style="list-style-type: none"> • Robot attendants must at all times try to avoid any interference with the game process. • If, in the opinion of the referee, a human team member is interfering with the game process on the field, a manual interference foul will be called.
RC-12.3.7: Remote Interference	<ul style="list-style-type: none"> • No remote human interference of any kind with the game process is allowed. • If, in the opinion of the referee, a human team member is remotely interfering with the game process, a remote interference foul will be called.
RC-12.3.8: delay of game	<ul style="list-style-type: none"> • If a player removes (for the second time) the ball from its position during a game-stoppage, a delay of game foul can be called.

 RoboCup Changes and Comments	
RC-12.3.9: Unsportsmanlike Behavior	<ul style="list-style-type: none"> ● Human team members must at all times during the match behave in an appropriate manner. ● At least the following behaviors are considered unsportsmanlike: <ul style="list-style-type: none"> – not following instructions of the referee and the assistant referees – yelling at or insulting the referees, or the opponent, or the audience ● If, in the opinion of the referee, a human team member is behaving in an inappropriate manner, an unsportsmanlike behavior foul will be called.


FL 12.4 Disciplinary Sanctions

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

FL 12.5 Cautionable Offences

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


- is guilty of unsporting behaviour
- shows dissent by word or action
- persistently infringes the Laws of the Game
- delays the restart of play
- fails to respect the required distance when play is restarted with a corner kick or free kick
- enters or re-enters the field of play without the referee’s permission
- deliberately leaves the field of play without the referee’s permission

 RoboCup Changes and Comments	
RC-12.5: Cautionable Offences	<p>In RoboCup, a robot player or human team member is cautioned and shown the yellow card if he commits any of the following offences:</p> <ul style="list-style-type: none"> ● is guilty of unsporting behaviour ● persistently infringes the Laws of the Game ● delays the restart of play ● fails to respect the required distance when play is restarted with a corner kick or free kick ● enters the field of play without the referee’s permission
RC-12.5.1: Yellow Cards	<p>The assistant referees will maintain a count of yellow cards given to each player.</p>

FL 12.6 Sending-Off Offences

A player is sent off and shown the red card if he commits any of the following seven offences:

- is guilty of serious foul play
- is guilty of violent conduct
- spits at an opponent or any other person
- denies the opposing team a goal or an obvious goal-scoring opportunity by deliberately handling the ball (this does not apply to a goalkeeper within his own penalty area)
- denies an obvious goal-scoring opportunity to an opponent moving towards the player's goal by an offence punishable by a free kick or a penalty kick
- uses offensive, insulting or abusive language
- receives a second caution in the same match

 RoboCup Changes and Comments	
RC-12.6: Temporary Sent-Off	A player is temporarily sent off the field after receiving its second yellow card. The player may return to the game on the next game interrupt, but no less than 2 minutes after being temporarily sent off.
RC-12.6: Sending-Off Offences	<p>A robot player or human team member is shown the red card and sent off for the remainder of the game if it commits any of the following offences:</p> <ul style="list-style-type: none"> • is guilty of serious foul play, especially when exhibiting behavior considered to be reckless and rude, or presenting a threat to other robots, human team members, the referees, and the audience, • spits at an opponent or any other person • denies the opposing team a goal or an obvious goal-scoring opportunity by deliberately handling the ball (this applies only to human team members) • is guilty of violent conduct • uses offensive, insulting or abusive language • receiving the fourth yellow card in the same match

Decisions of the International F.A. Board

Decision 1: A penalty kick is awarded if, while the ball is in play, the goalkeeper, inside his own penalty area, strikes or attempts to strike an opponent by throwing the ball at him.

Decision 2: 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.

Decision 3: The goalkeeper is considered to be in control of the ball by touching it with any part of his hand or arms. Possession of the ball includes the goalkeeper deliberately parrying the ball, but does not include the circumstances where, in the opinion of the referee, the ball rebounds accidentally from the goalkeeper, for example after he has made a save. The goalkeeper is considered to be guilty of time-wasting if he holds the ball in his hands or arms for more than 5-6 seconds.


Decision 4: Subject to the terms of Law 12, a player may pass the ball to his own goalkeeper using his head or chest or knee, etc. If, however, in the opinion of the referee, a player uses a deliberate trick

while the ball is in play in order to circumvent the Law, the player is guilty of unsporting behaviour. He is cautioned, shown the yellow card and an indirect free kick is awarded to the opposing team from the place where the infringement occurred.

A player using a deliberate trick to circumvent the Law while he is taking a free kick, is cautioned for unsporting behaviour and shown the yellow card. The free kick is retaken.

In such circumstances, it is irrelevant whether the goalkeeper subsequently touches the ball with his hands or not. The offence is committed by the player in attempting to circumvent both the letter and the spirit of Law 12.

Decision 5: A tackle from behind, which endangers the safety of an opponent, must be sanctioned as serious foul play.


 RoboCup	RoboCup Changes and Comments
RC-Decision 1-4:	The Intl. F.A. Board Decisions 1 to 4 do currently not apply to RoboCup.

FIFA LAW 13 – Free Kicks

FL 13.1 Types of Free Kicks

Free kicks are either direct or indirect.

For both direct and indirect free kicks, the ball must be stationary when the kick is taken and the kicker does not touch the ball a second time until it has touched another player.

 RoboCup Changes and Comments	
RC-13.1.1: Free kicks	In RoboCup, an indirect free kick is awarded in all situations where the Laws of the Game specify a direct free kick.
RC-13.1.2: Touching	In RoboCup, the kicker may touch the ball arbitrary many times after an indirect free kick. A goal may be scored only after the ball was touched by another player.

FL 13.2 The Direct Free Kick

- 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.

FL 13.3 The Indirect Free Kick

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 A goal can be scored only if the ball 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.

FL 13.4 Position of Free Kick

Free Kick Inside the Penalty Area

Direct or indirect free kick to the defending team:


- all opponents are at least 9.15m (10yds) from the ball.
- all opponents remain outside the penalty area until the ball is in play.
- the ball is in play when it is kicked directly beyond the penalty area.
- a free kick awarded in the goal area is taken from any point inside that area.

Indirect free kick to the attacking team:

- All opponents are at least 9.15m (10yds) from the ball until it is in play, unless they are on their own goal line between the goalposts.
- the ball is in play when it is kicked and moves
- an indirect free kick awarded inside the goal area is taken from that part of the goal area line which runs parallel to the goal line, at the point nearest to where the infringement occurred.

Free Kick Outside the Penalty Area

- All opponents are at least 9.15m (10yds) from the ball until it is in play.
- The ball is in play when it is kicked and moves.
- The free kick is taken from the place where the infringement occurred.

 RoboCup Changes and Comments	
RC-13.4: Position of the Free Kick	For RoboCup, replace “9.15m” with “ 2m or within their own penalty area ”.
RC-13.4.1: Procedure	The ball is in play when it is kicked and moves, or 10 seconds after the referee has given the signal.

FL 13.5 Infringements/Sanctions

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

- 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 into play:

- the kick is retaken.

Free kick taken by a player other than the goalkeeper

If, after the ball is in play, the kicker touches the ball a second time (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 .

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, the kick to be taken from the place where the infringement occurred.
- a penalty kick is awarded if the infringement occurred inside the kicker’s penalty area.


Free kick taken by the goalkeeper

If, after the ball is in play, the goalkeeper touches the ball a second time (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.

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, the kick to be taken from the place where the infringement occurred.
- an indirect free kick is awarded to the opposing team if the infringement occurred inside the goalkeeper’s penalty area, the kick to be taken from the place where the infringement occurred.

 RoboCup	RoboCup Changes and Comments
RC-13.5: Infringements/ Sanctions	In RoboCup, all clauses referring to situations, where the player taking the free kick is touching the ball a second time, do currently not apply.

FIFA LAW 14 – The Penalty Kick

A penalty kick is awarded against a team which commits one of the 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.

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.

FL 14.1 Position of the Ball and the Players

The ball:

- is placed on the penalty mark.

The player taking the penalty kick:


- is properly identified.

The defending goalkeeper:

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


The players other than the kicker are located:

- inside the field of play.
- outside the penalty area.
- behind the penalty mark.
- at least 9.15m (10yds) from the penalty mark.

 RoboCup Changes and Comments	
RC-14.1: Position of Ball and Players	In RoboCup, the following modification apply: <ul style="list-style-type: none"> • The defending goal keeper stays within his own goal area until the ball is kicked. • The kicker is located inside the center circle. • The players other than the kicker are located inside the field of play, outside the center circle, and behind the center line on the opposite side of the defending goal keeper.

FL 14.2 The Referee

- does not signal for a penalty kick to be taken until the players have taken up position in accordance with the Law.
- decides when a penalty kick has been completed.


 RoboCup Changes and Comments	
RC-14.2: The Referee	The Procedure specifies additional criteria for deciding when a penalty kick has been completed.

FL 14.3 Procedure

- The player taking the penalty kicks the ball forward.
- He does not play the ball a second time until it has touched another player.
- The ball is in play when it is kicked and moves forward.

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.

 RoboCup Changes and Comments	
RC-14.3: Procedure	<p>In RoboCup, the following procedure is followed for a penalty kick:</p> <ul style="list-style-type: none"> • All players take their positions. The ball is placed on the penalty mark by the referee or one of the assistant referees. • The referee gives a signal. • The player taking the penalty kicks the ball forward. • The ball is in play when it is kicked and moves forward. • The player may not dribble with the ball over a distance of 20 cm. • A goal is awarded if the ball passes the goal line between the goal posts and under the crossbar within 30 seconds after the signal of the referee. • The player may not touch the ball again after it has been touched by the goal keeper.

FL 14.4 Infringements/Sanctions

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

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

- The referee allows the kick to proceed.
- If the ball enters the goal, the kick is retaken.
- If the ball does not enter the goal, the kick is not retaken.

The goalkeeper infringes the Laws of the Game:

- The referee allows the kick to proceed.
- 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 enters the penalty area or moves in front of or within 9.15 m (10 yds) of the penalty mark:

- The referee allows the kick to proceed.

- If the ball enters the goal, the kick is retaken.
- If the ball does not enter the goal, the kick is not retaken.
- If the ball rebounds from the goalkeeper, the crossbar or the goal post and is touched by this player, the referee stops play and restarts the match with an indirect free kick to the defending team.

A team-mate of the goalkeeper enters the penalty area or moves in front of or within 9.15 m (10 yds) of the penalty mark:

- The referee allows the kick to proceed.
- 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:

The kicker touches the ball a second time (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.

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


- A direct free kick is awarded to the opposing team, the kick to be taken from the place where the infringement occurred.

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:

- The referee stops play.
- Play is restarted with a dropped ball at the place where it touched the outside agent.

 RoboCup Changes and Comments	
RC-14.4: Infringements/ Sanctions	For RoboCup, replace “ <i>enters the penalty area or moves in front of or within 9.15m (10yds) of the penalty mark</i> ” with “ enters the side of the field where the penalty kick takes place ”. All clauses referring to situations, where the player taking the penalty is touching the ball a second time, do currently not apply.

FIFA LAW 15 – The Throw-In

A throw-in is a method of restarting play.

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

A throw-in is awarded

- when the whole of the ball passes over the touch line, either on the ground or in the air,
- from the point where it crossed the touch line,
- to the opponents of the player who last touched the ball.


FL 15.1 Procedure (The Throw-In)

At the moment of delivering the ball, the thrower

- faces the field of play,
- has part of each foot either on the touch line or on the ground outside the touch line,
- uses both hands,
- delivers the ball from behind and over his head.

The thrower may not touch the ball again until it has touched another player.

The ball is in play immediately after it enters the field of play.

	RoboCup Changes and Comments
RC-15.1: Procedure	<p>In RoboCup, the following procedure is used for throw-in:</p> <ul style="list-style-type: none"> • The referee gives a "stop" signal. • All players have to stop their movement. • The ball is placed on the touch line by the referee or one of the assistant referees. • The referee gives a "throw-in" signal. • Players of the throw-in awarded team can stay anywhere. • All players of the defending team can stay anywhere on the field except in a circle with a radius of 2m around the ball until it is in play. • The referee gives a "start" signal. • A player of the team who was awarded the throw-in kicks the ball. • The ball is in play when it is kicked and moves, or 10 seconds after the referee has given the signal. <p>It is forbidden to reposition robots by hand or remote control unless the referee instructs the team leader to do so. Referee may show a yellow card to the robot that doesn't leave from the ball or follow the referee instructions more than twice consecutively. After that, referee may instruct the teams to move the robots to the right position only if the robots don't follow the position restrictions of the procedure.</p> <p>The referee must restart the game within 10 seconds after game stops.</p>

FL 15.2 Infringements/Sanctions**Throw-in taken by a player other than the goalkeeper**

If, after the ball is in play, the thrower touches the ball a second time (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.

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, the kick to be taken from the place where the infringement occurred.
- A penalty kick is awarded if the infringement occurred inside the thrower's penalty area.

Throw-in taken by the goalkeeper

If, after the ball is in play, the goalkeeper touches the ball a second time (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.

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, the kick to be taken from the place where the infringement occurred.
- An indirect free kick is awarded to the opposing team if the infringement occurred inside the goalkeeper's penalty area, the kick to be taken from the place where the infringement occurred.

If an opponent unfairly distracts or impedes the thrower

- he is cautioned for unsporting behaviour and shown the yellow card.

For any other infringement of this Law

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

	RoboCup Changes and Comments
RC-15.2: Infringements/ Sanctions	In RoboCup, all clauses referring to situations, where the player taking the throw-in is touching the ball a second time, do currently not apply.

FIFA LAW 16 – The Goal Kick

A goal kick is a method of restarting play.


A goal may be scored directly from a goal kick, but only against the opposing team.

A goal kick is awarded when

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

FL 16.1 Procedure (for Goal Kick)

- 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.
- The kicker does not play the ball a second time until it has touched another player.
- The ball is in play when it is kicked directly beyond the penalty area.

	RoboCup Changes and Comments
RC-16.1: Procedure	<p>In RoboCup, the following procedure is used for a goal kick:</p> <ul style="list-style-type: none"> • The referee gives a "stop" signal. • All players have to stop their movement. • The ball is placed at the nearest restart marker to the position where the ball passed the goal line by the referee or one of the assistant referees. • The referee gives a "goal kick" signal. • Players of the goal kick awarded team can stay anywhere. • All players of the opponent team can stay anywhere on the field except in a circle with a radius of 2m around the ball until it is in play. • The referee gives a "start" signal. • A player of the team who was awarded the goal kick kicks the ball. • The ball is in play when it is kicked and moves, or 10 seconds after the referee has given the signal. <p>It is forbidden to reposition robots by hand or remote control unless the referee instructs the team leader to do so. Referee may show a yellow card to the robot that doesn't leave from the ball or follow the referee instructions more than twice consecutively. After that, referee may instruct the teams to move the robots to the right position only if the robots don't follow the position restrictions of the procedure.</p> <p>The referee must restart the game within 10 seconds after game stops.</p>

FL 16.2 Infringements/Sanctions

If the ball is not kicked directly into play beyond the penalty area

- 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 a second time (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.

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, the kick to be taken from the place where the infringement occurred.
- 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 a second time (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.

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, the kick to be taken from the place where the infringement occurred.
- An indirect free kick is awarded to the opposing team if the infringement occurred inside the goalkeeper’s penalty area, the kick to be taken from the place where the infringement occurred.

For any other infringement of this Law:

- The kick is retaken

 RoboCup Changes and Comments	
RC-16.2: Infringements/ Sanctions	In RoboCup, all clauses referring to situations, where the player taking the goal kick is touching the ball a second time, do currently not apply.


FIFA LAW 17 - The Corner Kick

A corner kick is a method of restarting play.

A goal may be scored directly from a corner kick, but only against the opposing team.


A corner kick is awarded when

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

	RoboCup Changes and Comments
RC-17: Throw-In	A goal can be scored directly from a corner kick in RoboCup.

FL 17.1 Procedure (for Corner Kick)

- The ball is placed inside the corner arc at the nearest corner flagpost.
- The corner flagpost is not moved.
- Opponents remain at least 9.15m (10yds) from the ball until it is in play.
- The ball is kicked by a player of the attacking team.
- The ball is in play when it is kicked and moves.
- The kicker does not play the ball a second time until it has touched another player.

	RoboCup Changes and Comments
RC-17.1: Procedure	<p>In RoboCup, the following procedure is used for a corner kick:</p> <ul style="list-style-type: none"> • The referee gives a "stop" signal. • All players have to stop their movement. • The ball is placed inside the corner arc at the nearest corner to the position where the ball passed the goal line by the referee or one of the assistant referees. • The referee gives a "corner kick" signal. • Players of the corner kick awarded team can stay anywhere. • All players of the opponent team can stay anywhere on the field except in a circle with a radius of 2m around the ball until it is in play. • The referee gives a "start" signal. • A player of the team who was awarded the corner kick kicks the ball. • The ball is in play when it is kicked and moves, or 10 seconds after the referee has given the signal. <p>It is forbidden to reposition robots by hand or remote control unless the referee instructs the team leader to do so. Referee may show a yellow card to the robot that doesn't leave from the ball or follow the referee instructions more than twice consecutively. After that, referee may instruct the teams to move the robots to the right position only if the robots don't follow the position restrictions of the procedure.</p> <p>The referee must restart the game within 10 seconds after game stops.</p>

FL 17.2 Infractions/Sanctions

Corner kick taken by a player other than the goalkeeper

If, after the ball is in play, the kicker touches the ball a second time (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.

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, the kick to be taken from the place where the infringement occurred.
- 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 a second time (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.


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, the kick to be taken from the place where the infringement occurred.

- An indirect free kick is awarded to the opposing team if the infringement occurred inside the goalkeeper's penalty area, the kick to be taken from the place where the infringement occurred.

For any other infringement:

- The kick is retaken

 RoboCup Changes and Comments	
RC-17.2: Infringements/ Sanctions	In RoboCup, all clauses referring to situations, where the player taking the corner kick is touching the ball a second time, do currently not apply.

Chapter

Competition Rules

Competition Rules include:

- Competition Rule 1 - Team Qualification
- Competition Rule 2 - Referee Recruitment and Assignment
- Competition Rule 3 - Tournament Regulations
- Competition Rule 4 - Summary of Object Colouring
- Competition Rule 5 - Referee Box

COMPETITION RULE 1 - Team Qualification

CR 1.0 Admissibility of Team Qualification Procedures

The organising committee of a tournament may limit the number of teams, that are allowed to participate in the tournament, for any of the following reasons:

- Scientific reasons, for example, when allowing more teams is likely to hurt scientific exchange and discussion or the overall scientific standard of the tournament.
- Space limitations are imposed by the site of the tournament.
- Time limitations are imposed by the overall tournament schedule.
- Any other kind of organisational constraint limits the number of teams that can be accommodated for.

In order to limit the number of participating teams, the organising committee of a tournament may request teams to successfully complete a qualification procedure. The team qualification procedure shall be such that scientific progress and exchange is fostered.

CR 1.1 Team Qualification for RoboCup-2006

For RoboCup-2006, the team qualification procedure requires teams to submit the following material:

- Scientific Papers (one or more)
- Team Description Paper

Teams are encouraged to provide web-accessible player capability videos on their team web pages.

CR 1.2 Scientific Papers

Because RoboCup is primarily a scientific (not an entertainment) event, teams are strongly encouraged to submit technical papers to journals, major conferences and workshops. In particular, if a RoboCup tournament is associated or held in conjunction with a conference or a workshop, teams are strongly encouraged to submit papers to this event. The usual scientific evaluation criteria will be applied to scientific papers. Teams contributing technical papers to the scientific community will be given preference over teams that do not.

CR 1.3 Team Description Paper

Every team must submit a team description paper. Details on content, format, and length will be provided by the league organising committee.

The RoboCup-F2000 team description paper should contain in detail the specific approach chosen by the team to build and program a team of robotic soccer players, even if the methods used are not innovative. Team description papers should also describe the scientific problems a teams intends to tackle, the goals it strives to achieve, and the methods it tries to use within its RoboCup effort. A good team description paper allows the reader to find out about:

- the specific areas of expertise of a team (e.g. AI Planning, Vision, reinforcement learning, adaptive neural control, development of specialised hardware like sensors or processors for RoboCup, construction of innovative mechanical bases, etc.).
- the problems the team wants to tackle within RoboCup.
- the actual approach in assembling and programming the team for the tournament.

Teams without a team description paper **WILL BE EXCLUDED** from participation in the tournament.

CR 1.4 Player Capability Video

No player capability video is currently required. However, teams are encouraged to provide web-accessible videos on their team web pages.

CR 1.5 Due Date, Submission, and Review of Team Qualification Material

All team qualification material must be submitted to the chair of the organising committee for the middle size robot league by March 1st, 2006.

The league organising committee will review the material submitted as part of the qualification procedure and select teams for the tournament.

CR 1.6 Agreement on Open Source Development

For the benefit of scientific exchange, teams should make available technology and software developed for RoboCup as much as possible after a tournament has been played.

COMPETITION RULE 2 - Referee Recruitment and Assignment

CR 2.1 Selection of Referees

Every team participating in a tournament must name at least two team members who serve as referees for matches.

The named persons must have good knowledge of the rules as applied in the tournament. The persons should be selected among the more senior members of a team, and preferably have prior experience with games in the RoboCup middle size league.

CR 2.2 Referee Assignment

The assignment of referees and assistants to matches is the task of the league organising committee.

One referee and at least one assistant will be assigned for judgement of a match. The league organising committee may choose to assign more assistants. The recommended number is one main referee, one assistant referee and two goal assistants.

Assistants can be assigned specific tasks, like handling the stop watch, ensuring the absence of manual interference by team members, and such. It is recommended that the assistant referee takes care of timing, taking notes on cards shown, and filling out the referee game sheet. The duties of the goal assistants is to check the occurrence of goals and survey the timing rules regarding robots in the goal area.

If either a referee or an assistant assigned to a match cannot fulfil his duty for some reason, he has to inform the organising committee as soon as possible, give the reason for his inability to fulfil his duty, and request a replacement to be named.

CR 2.3 Referees during Match

The referee and assistant referees should wear black clothing/shoes and avoid reserved colours for the ball, the goals, and player markings in their clothing.

The referee and his assistants will be close to but off the field during play. The referee should take a position at some distance to team areas. The referee may order team members to maintain positions at an appropriate distance.

The referee and the assistants may enter the field in particular situations, e.g. to re-position the ball when stuck.

The referee and his assistants should avoid to interfere with robots as much as possible, unless a robot is threatening to cause serious damage to people, other robots, or other equipment.

The referee may order team members onto the field in order to move or remove a robot. Orders by the referee have to be executed promptly.

The referee may allow members of a team to enter the field, in particular during game breaks. No team members are allowed to enter the field or to interfere otherwise with the game process unless permitted or ordered by the referee.

CR 2.4 Infringements/Sanctions

A team failing to meet its refereeing duties, either by not naming appropriate persons to the organising committee or by the assigned referee not fulfilling his duties, is subject to penalties decided upon by the organising committee of a tournament.

Penalties may include fines, to be paid immediately before the team's next match, or exclusion from the ongoing or future tournaments.

COMPETITION RULE 3 - Tournament Regulations

CR 3.0 Preliminary Remarks

In order to provide a good opportunity to gain match experience, the tournament plan shall be designed such that all teams can play as many games as possible.

CR 3.1 Parts of the Competition

The RoboCup2006 competition consist of the following parts:

- Team Registration, Setup, and Technical Inspection
- Technical Evaluation Rounds to assign Scientific and Engineering Awards and define groups for tournament
- Preliminary Rounds (Round-Robin)
- Playoffs

Every team that is admitted to the tournament must participate in all parts of the competition. Teams that do not qualify for the playoffs after the preliminary rounds will have to serve as referees and for various other duties. Teams failing to serve the duties they have been assigned to may be excluded from future tournaments.

CR 3.2 Team Registration, Setup, and Technical Inspection

Every team has to set up and register on site at least 24 hours before the first game of the tournament is scheduled.

The Middle Size League Committee **strongly recommends** arriving no later than 48 hours before scheduled games start.

It is the sole responsibility of the teams to plan transport of equipment and travel of team members such that both arrive on time. Teams should carefully take into account any potential visa and/or customs problems that may arise.

Teams which did not personally register on site at least 24 hours prior to the first scheduled game may be excluded from the tournament.

Teams excluded from the tournament because of showing up late are not eligible to a refund of registration fees or any other kind of expenses. Neither The RoboCup Federation, nor the local organisers, nor anyone else involved in organising a RoboCup tournament can be held liable for any cost, or damage suffered, by teams excluded from the tournament.

Team shall set up their robots and equipment and make any adjustments to local conditions well before the first game starts.

During setup, teams should use the field only when necessary, and only for shortest possible times. The League Organising Committee may impose restrictions on the use of fields during setup and install special procedures for obtaining access to the field.

The Middle Size League Technical Committee will organise a technical inspection of robots during the setup phase. Currently, the following procedure will be followed:

1. Size and shape constraints will not be checked during technical inspection, unless some team leader explicitly requests a check.
2. All robots will be photographed or filmed during technical inspection.
3. Once technical inspection is over, size constraints are checked only if someone assumes some physical change to a robot. Objections may be raised only up to 10 minutes before the game starts, and only by a team leader.
4. The opponent team must permit inspection of robots for 10 minutes, from 20 minutes to 10 minutes before game start.
5. No objections will be taken later on.

Note: Details of technical inspection are subject to changes by the League Technical Committee at any time, depending on the situation or requests by a team leader meeting on site.

CR 3.3 Technical Challenge

In order to promote the scientific goals of RoboCup and an according team attitude, the Middle Size League Committee will give recognition to specific scientific and engineering achievements tested by challenge competition, as described in F-2000 Challenges.

Number and character of awards will be determined in accordance with the Executive Committee of The RoboCup Federation.

The results of technical challenges will be taken into consideration to form the groups for the game competition.

Technical challenge tasks will be selected from F-2000 Challenges and announced at a later date.

CR 3.4 Preliminary Rounds

For the preliminary rounds, teams will be assigned to groups.

The number of groups will be determined by the League Organising Committee, which takes into account the number of qualified teams as well as site and schedule constraints of the tournament.

Assignment of teams to groups will be done by considering placements in Scientific and Engineering Challenges competition and, as second criterion, by performing a draw. Details of the draw procedure will be announced during a team leader meeting prior to the tournament. Team leaders must be present during the draw procedure.

Each group will play a single round of round-robin matches, i.e. each team will play once against every other team in its group.

As a guideline, every team should be prepared to play as many as eight (8) games within two days.

During the preliminary rounds, a match ending in a draw will **NOT** be decided by a penalty shoot-out.

The winner of a match will be awarded three (3) points, the loser will be awarded no points. If a match ends in a draw, each team will be awarded one point.

All points awarded to a team are added up.

Teams are ranked within their group by the points they gained during the preliminary round. If two or more teams have the same number of points, a decision is based upon the following criteria, in the order given:

1. Goal difference.
2. Absolute number of goals achieved.
3. Result of direct match-up.
4. Result of technical challenge between tied teams.

The best eight teams of *all* groups qualify for the playoffs.

We assume the number of groups m to be less than eight. Then the first $8/m$ (rounded down to the next lower integer) teams in each group are qualified for the playoffs.

If eight is not a multiple of the number of groups m , then wildcard games may be played to determine the teams for remaining spots in the playoffs. Details will be announced prior to the tournament.

CR 3.5 Playoffs

The playoffs consist of quarter finals, half finals, and finals matches. Every playoff round is decided by a single match (best-of-one).

If playoff matches end in a draw after regular match time, they must be decided by playing a penalty shoot-out.

If playoff matches are still drawn after a penalty shoot-out, they will be decided by playing a technical challenge round.

A plan of playoff matches will be made available by the organising committee before start of the tournament.

Penalty Shoot-Out

Each team is awarded five penalty shots. All five shots will be taken in sequence. If a decision is already reached (e.g. the first team made one out of five shots, and the second team made already two), the remaining shots can be dropped by decision of the referee(s).

COMPETITION RULE 4 - Summary of Object Colourings

Here is the list of colours for objects on the field (surface, wall, goals, and ball):

Object	Colour
Field surface	GREEN
Field safety boundary	GREEN or BLACK
Lines on the field	WHITE
Ball	ORANGE
One of the goals	BLUE
The other goal	YELLOW
Flagposts	BLUE and YELLOW
Robot bodies	BLACK
Markers of robots for team A	LIGHT BLUE
Markers of robots for team B	MAGENTA/PURPLE

Colors of the objects are defined by RAL colors for a moment as shown in

- <http://www.er.ams.eng.osaka-u.ac.jp/user/yasutake/RoboCup/ralcolors.jpg>
- <http://www.er.ams.eng.osaka-u.ac.jp/user/yasutake/RoboCup/ralcolors2.jpg>

All you need to know about RAL you'll find under <http://www.ral.de/farben/en/index.html> Color cards you will find in any well equipped paint shop.

COMPETITION RULE 5 - Referee Box

The official referee box is available at

- <http://sourceforge.net/projects/msl-refbox>

It is mandatory for all teams to use this referee box.

Chapter

F-2000 Challenges

Challenges 2 and 6 have been selected by the TC for RoboCup 2006. All teams are expected to participate in the challenge competition. Teams not participating in the tournament are welcome to participate in the challenge competition. The winner of the challenge competition will be awarded a prize for technical achievements.

All other challenges are currently regarded as proposals. All teams are invited to contribute their ideas in order to add new challenges or further improve existing challenges.

Challenge 1 - Ball Control and Planning

Six to eight black obstacles (length/width 40 cm, height 60 cm) are put at arbitrary positions on the field. The ball is put on the middle of the penalty area line, and a robot inside the same goal. The robot should dribble the ball into the opposite goal within 90 seconds, while it avoids all obstacles. One point is awarded to the robot if the ball has passed the centre line, another point when a goal is scored. Penalty points are given each time the robot or the ball touches an obstacle. The challenge is repeated three times with various setups. An extra point is awarded to the team with the fastest robot. In order to be eligible for this extra point the robot may not have touched any of the obstacles. In total a team can be awarded up to seven points for this challenge.

Challenge 2 - Cooperative behaviour

Teams should demonstrate cooperative behaviour between at least two robots. The selection of the activity to be performed is free, but it should last at most 90 seconds. A jury will evaluate the quality of cooperation and cooperative behaviour and will assign up to six points to each team.

Challenge 3 - Cooperative Mixed-Team Play

Teams should demonstrate cooperative mixed-team play between at least two robots from different teams. The selection of the activity to be performed is free, but it should last at most 90 seconds. A jury will evaluate the quality of cooperation and cooperative behaviour and will assign up to six points to each team.

Challenge 4 - Play with an arbitrary FIFA ball

The aim of this challenge is to encourage teams to improve their vision routines. This challenge is carried out with three different standard FIFA balls. A robot is placed on the field and the ball is placed in front of the robot for 5 seconds. Afterwards the ball is placed at an arbitrary position on the field. The robot has now 60 seconds to find the ball and to dribble it into a predefined goal. One point is awarded to the robot for correctly identifying the ball, i.e. the robot has found and touched the ball for the first time. A second point is awarded if the robot has scored a goal. In total this challenge is repeated three times with varying balls but always with the same robot. In total a team can be awarded up to six points for this challenge.

Challenge 5 - Play with arbitrary goals

A robot is placed in a random position within its own half of the field and a regular RoboCup ball is placed in a random position in the other half. The robot should kick the ball in the opposite goal (the one in the other half of the field with respect to its initial position). No assumptions should be made on the colors of the two goals. The organizer will cover the yellow and blue goals with a different color pattern (except for the red). The challenge is repeated three times with different initial positions of the robot and of the ball. Each attempt has a time limit of 60 seconds. One point is awarded to each score and an additional point is given to robots that score three times in less than 30 seconds each. In total a team can be awarded up to four points for this challenge.

Challenge 6 - Show scientific or engineering achievements

Teams are free to show one significant achievement each, and all the other team leaders, together with the TC members will judge them. Achievements in the present list are encouraged.

Challenge 7 - Passing

At the beginning, the ball is on the own penalty kick point. A player (#1) is on the center point. Another player (#2) is in the opposite half field. A still goalie (a black box, 50 cm wide) is in the middle of the opponent goal. Player #1 has to get the ball, pass it to player #2 which should score the goal. 1 point if the ball passes midline, 1 point if it is dribbled by player #1 over midline, 3 points if it hits player #2, 3 points if player #2 tries to score in the opponent goal (either by kicking or bringing the ball there, always following the rules), 2 points if the goal is scored. Time is also taken and used to rate the teams in case of same number of points.

Appendix

Tables

A 1 Table for Computing Space Occupied by Robots Using the Rope-Based Circumference Measuring Method

Rope = Length of Rope, CD = Circle Diameter, Area = Circle Area

NR = theoretical number of robots with team area limitation $10.000cm^2$

Rope	CD	Area	Robots	Rope	CD	Area	Robots	Rope	CD	Area	Robots
90	29	645	15	127	40	1.284	7	164	52	2.140	4
91	29	659	15	128	41	1.304	7	165	53	2.166	4
92	29	674	14	129	41	1.324	7	166	53	2.193	4
93	30	688	14	130	41	1.345	7	167	53	2.219	4
94	30	703	14	131	42	1.366	7	168	53	2.246	4
95	30	718	13	132	42	1.387	7	169	54	2.273	4
96	31	733	13	133	42	1.408	7	170	54	2.300	4
97	31	749	13	134	43	1.429	6	171	54	2.327	4
98	31	764	13	135	43	1.450	6	172	55	2.354	4
99	32	780	12	136	43	1.472	6	173	55	2.382	4
100	32	796	12	137	44	1.494	6	174	55	2.409	4
101	32	812	12	138	44	1.515	6	175	56	2.437	4
102	32	828	12	139	44	1.538	6	176	56	2.465	4
103	33	844	11	140	45	1.560	6	177	56	2.493	4
104	33	861	11	141	45	1.582	6	178	57	2.521	3
105	33	877	11	142	45	1.605	6	179	57	2.550	3
106	34	894	11	143	46	1.627	6	180	57	2.578	3
107	34	911	10	144	46	1.650	6	181	58	2.607	3
108	34	928	10	145	46	1.673	5	182	58	2.636	3
109	35	945	10	146	46	1.696	5	183	58	2.665	3
110	35	963	10	147	47	1.720	5	184	59	2.694	3
111	35	980	10	148	47	1.743	5	185	59	2.724	3
112	36	998	10	149	47	1.767	5	186	59	2.753	3
113	36	1.016	9	150	48	1.790	5	187	60	2.783	3
114	36	1.034	9	151	48	1.814	5	188	60	2.813	3
115	37	1.052	9	152	48	1.839	5	189	60	2.843	3
116	37	1.071	9	153	49	1.863	5	190	60	2.873	3
117	37	1.089	9	154	49	1.887	5	191	61	2.903	3
118	38	1.108	9	155	49	1.912	5	192	61	2.934	3
119	38	1.127	8	156	50	1.937	5	193	61	2.964	3
120	38	1.146	8	157	50	1.962	5	194	62	2.995	3
121	39	1.165	8	158	50	1.987	5	195	62	3.026	3
122	39	1.184	8	159	51	2.012	4	196	62	3.057	3
123	39	1.204	8	160	51	2.037	4	197	63	3.088	3
124	39	1.224	8	161	51	2.063	4	198	63	3.120	3
125	40	1.243	8	162	52	2.088	4	199	63	3.151	3
126	40	1.263	7	163	52	2.114	4	200	64	3.183	3

Please note, that this table is provided just for convenience and to allow quick measurement and checking. It does not define permissible robot sizes or areas. These are defined in Law FL-4.

A 2 Table for Computing Space Occupied by Robots Using the Minimal Enclosing Box Measuring Method

L = Length of Box, W = Width of Box, BC = Box Circumference, BA = Box Area
 NR = theoretical number of robots with team area limitation $10.000cm^2$

L	W	BC	BA	NR	L	W	BC	BA	NR
30	30	120	900	11	32	32	128	1.024	9
30	31	122	930	10	32	33	130	1.056	9
30	32	124	960	10	32	34	132	1.088	9
30	33	126	990	10	32	35	134	1.120	8
30	34	128	1.020	9	32	36	136	1.152	8
30	35	130	1.050	9	32	37	138	1.184	8
30	36	132	1.080	9	32	38	140	1.216	8
30	37	134	1.110	9	32	39	142	1.248	8
30	38	136	1.140	8	32	40	144	1.280	7
30	39	138	1.170	8	32	41	146	1.312	7
30	40	140	1.200	8	32	42	148	1.344	7
30	41	142	1.230	8	32	43	150	1.376	7
30	42	144	1.260	7	32	44	152	1.408	7
30	43	146	1.290	7	32	45	154	1.440	6
30	44	148	1.320	7	32	46	156	1.472	6
30	45	150	1.350	7	32	47	158	1.504	6
30	46	152	1.380	7	32	48	160	1.536	6
30	47	154	1.410	7	32	49	162	1.568	6
30	48	156	1.440	6	32	50	164	1.600	6
30	49	158	1.470	6					
30	50	160	1.500	6					
31	31	124	961	10	33	33	132	1.089	9
31	32	126	992	10	33	34	134	1.122	8
31	33	128	1.023	9	33	35	136	1.155	8
31	34	130	1.054	9	33	36	138	1.188	8
31	35	132	1.085	9	33	37	140	1.221	8
31	36	134	1.116	8	33	38	142	1.254	7
31	37	136	1.147	8	33	39	144	1.287	7
31	38	138	1.178	8	33	40	146	1.320	7
31	39	140	1.209	8	33	41	148	1.353	7
31	40	142	1.240	8	33	42	150	1.386	7
31	41	144	1.271	7	33	43	152	1.419	7
31	42	146	1.302	7	33	44	154	1.452	6
31	43	148	1.333	7	33	45	156	1.485	6
31	44	150	1.364	7	33	46	158	1.518	6
31	45	152	1.395	7	33	47	160	1.551	6
31	46	154	1.426	7	33	48	162	1.584	6
31	47	156	1.457	6	33	49	164	1.617	6
31	48	158	1.488	6	33	50	166	1.650	6
31	49	160	1.519	6					
31	50	162	1.550	6					

L	W	BC	BA	NR	L	W	BC	BA	NR
34	34	136	1.156	8	37	37	148	1.369	7
34	35	138	1.190	8	37	38	150	1.406	7
34	36	140	1.224	8	37	39	152	1.443	6
34	37	142	1.258	7	37	40	154	1.480	6
34	38	144	1.292	7	37	41	156	1.517	6
34	39	146	1.326	7	37	42	158	1.554	6
34	40	148	1.360	7	37	43	160	1.591	6
34	41	150	1.394	7	37	44	162	1.628	6
34	42	152	1.428	7	37	45	164	1.665	6
34	43	154	1.462	6	37	46	166	1.702	5
34	44	156	1.496	6	37	47	168	1.739	5
34	45	158	1.530	6	37	48	170	1.776	5
34	46	160	1.564	6	37	49	172	1.813	5
34	47	162	1.598	6	37	50	174	1.850	5
34	48	164	1.632	6					
34	49	166	1.666	6					
34	50	168	1.700	5					
35	35	140	1.225	8	38	38	152	1.444	6
35	36	142	1.260	7	38	39	154	1.482	6
35	37	144	1.295	7	38	40	156	1.520	6
35	38	146	1.330	7	38	41	158	1.558	6
35	39	148	1.365	7	38	42	160	1.596	6
35	40	150	1.400	7	38	43	162	1.634	6
35	41	152	1.435	6	38	44	164	1.672	5
35	42	154	1.470	6	38	45	166	1.710	5
35	43	156	1.505	6	38	46	168	1.748	5
35	44	158	1.540	6	38	47	170	1.786	5
35	45	160	1.575	6	38	48	172	1.824	5
35	46	162	1.610	6	38	49	174	1.862	5
35	47	164	1.645	6	38	50	176	1.900	5
35	48	166	1.680	5					
35	49	168	1.715	5					
35	50	170	1.750	5					
36	36	144	1.296	7	39	39	156	1.521	6
36	37	146	1.332	7	39	40	158	1.560	6
36	38	148	1.368	7	39	41	160	1.599	6
36	39	150	1.404	7	39	42	162	1.638	6
36	40	152	1.440	6	39	43	164	1.677	5
36	41	154	1.476	6	39	44	166	1.716	5
36	42	156	1.512	6	39	45	168	1.755	5
36	43	158	1.548	6	39	46	170	1.794	5
36	44	160	1.584	6	39	47	172	1.833	5
36	45	162	1.620	6	39	48	174	1.872	5
36	46	164	1.656	6	39	49	176	1.911	5
36	47	166	1.692	5	39	50	178	1.950	5
36	48	168	1.728	5					
36	49	170	1.764	5					
36	50	172	1.800	5					

L	W	BC	BA	NR	L	W	BC	BA	NR
40	40	160	1.600	6	45	45	180	2.025	4
40	41	162	1.640	6	45	46	182	2.070	4
40	42	164	1.680	5	45	47	184	2.115	4
40	43	166	1.720	5	45	48	186	2.160	4
40	44	168	1.760	5	45	49	188	2.205	4
40	45	170	1.800	5	45	50	190	2.250	4
40	46	172	1.840	5					
40	47	174	1.880	5					
40	48	176	1.920	5					
40	49	178	1.960	5					
40	50	180	2.000	5					
41	41	164	1.681	5	46	46	184	2.116	4
41	42	166	1.722	5	46	47	186	2.162	4
41	43	168	1.763	5	46	48	188	2.208	4
41	44	170	1.804	5	46	49	190	2.254	4
41	45	172	1.845	5	46	50	192	2.300	4
41	46	174	1.886	5					
41	47	176	1.927	5					
41	48	178	1.968	5					
41	49	180	2.009	4					
41	50	182	2.050	4					
42	42	168	1.764	5	47	47	188	2.209	4
42	43	170	1.806	5	47	48	190	2.256	4
42	44	172	1.848	5	47	49	192	2.303	4
42	45	174	1.890	5	47	50	194	2.350	4
42	46	176	1.932	5					
42	47	178	1.974	5					
42	48	180	2.016	4					
42	49	182	2.058	4					
42	50	184	2.100	4					
43	43	172	1.849	5	48	48	192	2.304	4
43	44	174	1.892	5	48	49	194	2.352	4
43	45	176	1.935	5	48	50	196	2.400	4
43	46	178	1.978	5					
43	47	180	2.021	4					
43	48	182	2.064	4					
43	49	184	2.107	4					
43	50	186	2.150	4					
44	44	176	1.936	5	49	49	196	2.401	4
44	45	178	1.980	5	49	50	198	2.450	4
44	46	180	2.024	4					
44	47	182	2.068	4					
44	48	184	2.112	4					
44	49	186	2.156	4					
44	50	188	2.200	4	50	50	200	2.500	4