



Eurobot^{Open} 2023 Rules

30th edition of the robotic contest - Eurobot
OFFICIAL version



NOTE: all images in this document are provided as a guide to illustrate the various paragraphs. In no case they can serve as a reference. Only the dimensions, colors and materials indicated in the appendix shall be taken into consideration.

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A. NOTICE

WARNING!

General remarks are annotated in the document. Please, pay special attention to these points.

This year the rules have been split up in several documents. Most parts remain the same for the Eurobot^{Open} and Eurobot^{Open} Junior contests, but to avoid confusion, each contest has its own rules as a single document.

Thus the particular cases specific to one of the competitions appears only in the document concerning it.

You will find the Eurobot^{Open} and the Eurobot^{Open} Junior rules and other information on the Eurobot^{Open} website (<http://www.eurobot.org/>)

Please note that the version of this release is noted down at the end of this page. For any inquiry, only an official version should be considered.

Changes or clarifications of the rules may be made during the year. We therefore strongly encourage all participants to check our website regularly (<http://www.eurobot.org/>) as well as your NOC's own website for news. You can also follow discussions, ask questions or get further assistance on our faq (<https://www.eurobot.org/faq/>).

Possible changes of the technical specifications will be announced on the Eurobot website, (<http://www.eurobot.org/>) or on the website of the National Organization Committee (NOC) in your country.

The forum responses from a referee are official responses taken into account for match refereeing and homologation stages.

In case of doubt regarding any point of the rules or the approval of robots, the referee committee may also be contacted at referee@planete-sciences.org.

Have a good reading!

B. CONTEST PRESENTATION

Eurobot^{Open} and Eurobot^{Open} Junior are two events addressed to young people interested in robotics. Teams are usually composed of students involved in an Eurobot^{Open} school project, a group of friends, or independent robotics clubs. They share the same goal: to offer young people an active learning process, to put into practice their knowledge and soft skills during a fun and friendly event. The technical challenge of Eurobot^{Open} is to build an autonomous robot alongside with an optional secondary autonomous robot.

The rules for both events (Eurobot^{Open} and Eurobot^{Open} Junior) are based on the same concept. As organisers, we intend to provide a common platform for the Eurobot^{Open} event. This platform is dedicated to autonomous robots for Eurobot^{Open} while for Eurobot^{Open} Junior, the robots are remote controlled. In this way, a Eurobot^{Open} organiser can easily set up a Eurobot^{Open} Junior contest and vice versa.

**You're currently reading version
Eurobot^{Open} OFFICIAL of 2023rules.
(this version concerns fully autonomous robots)**

The age limit for participating in the Eurobot^{Open} finals is 30 years. However, each team may have a supervisor whose age limit exceeds 30. It is important to note that teams that do not respect the age limit, will not be allowed to participate in the Eurobot^{Open} finals.

A team is a group of 2 young people at minimum who have built one or two robots for the event. A person can only represent one team. However, we encourage teams to share their expertise and knowledge.

An organization (club, school, etc.) can supervise and register several teams, if allowed by the registration requirements set by your National Organizing Committee. The acceptance of these requirements is compulsory to validate your registration and your entry.

The project can be supervised by someone over the age limit (teacher, parent, group leader, etc.), but all elements of the robot(s) must be designed by the participants. In this context, robots manufactured from a commercially purchased chassis or rolling base will not be accepted.

In the event that a robot was imagined, built or modified by the tutor alone, organisers can disqualify or reject the participation of the team in the competition. He can in exchange advise the students and guide them.

Eurobot^{Open} and Eurobot^{Open} Junior European finals gather teams selected after national qualifications. European finals take place in Europe, but all countries can participate. Countries where more than three teams are registered have to organize a national qualification to select teams that will attend the European finals.

Common parameters can change from one year to another. Accordingly, please read the rules carefully even if the chapters may seem familiar to you (playing area dimensions, robots dimensions, starting area dimensions, etc.).

Robotics contests are public events. Therefore, we ask the teams to respect our rules of decency and safety (electrical, sound level, manners, etc.). These rules apply to the participants, their supporters and all the equipment they bring.

C. THEME PRESENTATION

Happy birthday Eurobot contest! Grandma Monique wants to celebrate the event with a ton of cakes and she has asked you to help her to prepare them according to her legendary recipe and be sure that everyone has one of these fantastic cakes.

Sponge cake, cream, icing and the famous cherry, are all the ingredients necessary to work for Grandma Monique. Take your best wooden spoon!

The missions will be:

- **Making cakes,**
- **Putting cherry on the cake,**
- **Dropping the remaining cherries in the basket,**
- **Putting the wheels in the dish,** at the end of the service,
- **Deguisse to make the party,**
- **Estimating your performance.**

Warning! All actions are independent from one another and no specific sequence is imposed whatsoever. No single action is compulsory. Give careful thoughts to your strategy. It is strongly recommended to design simple and reliable systems with a limited number of actions.



Figure 1: Overview of the playing area

D. PLAYING AREA AND ACTIONS

D.1. IMPORTANT INFORMATION

The organisers are committed to build the playing area with as much accuracy as possible. Nevertheless, they reserve the right to do minor modifications and adjustments.

No complaints regarding dimensional deviations will be taken into account.

Teams are warned that the surface condition may differ from one playing area to another and may also degrade over time.

D.2. PLAYING AREA

The playing area is a horizontal rectangular plan of 3000 mm by 2000 mm with borders of 70 mm height on each side. Depending on the building process, it may consist of one or more pieces (eg 3 pieces of 1000 mm per 2000 mm).

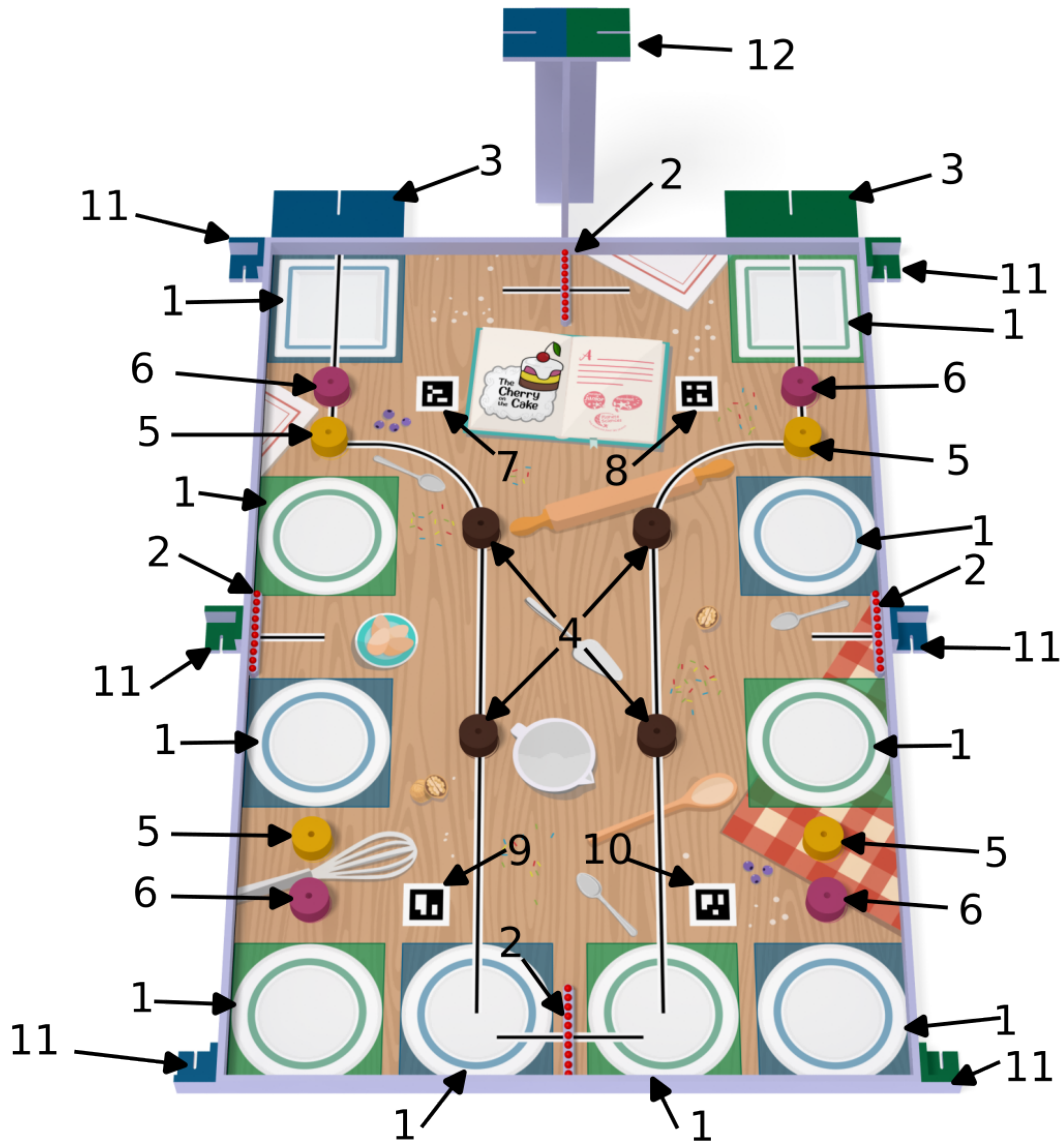


Figure 2: Detailed view of the playing area

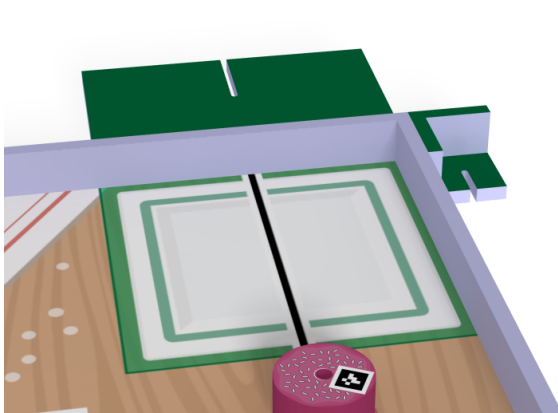
- | | |
|------------------------|-----------------------------|
| 1. Dropping areas | 7. ArUco marker number 20 |
| 2. Cherry dispensers | 8. ArUco marker number 21 |
| 3. Basket support | 9. ArUco marker number 22 |
| 4. 3 sponge cakes pile | 10. ArUco marker number 23 |
| 5. 3 cream pile | 11. Fixed beacon supports |
| 6. 3 icing pile | 12. Central tracking device |

Full specifications of the playing area and game elements (dimensions, positions at the beginning of the match, colors and other references) are listed in the appendix. In the remainder of this document, horizontal and vertical directions are stated relative to the playing area. Notions of “left”, “right”, “front” and “back” are stated with respect to the spectator’s point of view.

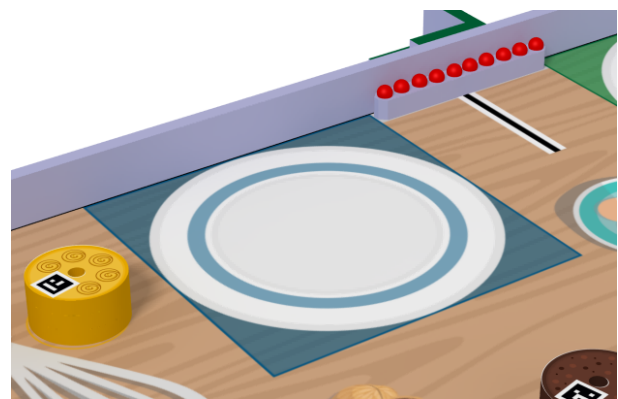
D.3. STARTING AREAS

D.3.a. DESCRIPTION

Each team has 5 dropping area, they are squared surfaces of 45 cm side delimited by a line on the table of the team’s color (the line is included in this zone). Those area are both the starting areas for their robots (it’s not mandatory to start all the robots from the same zone), the dropping area for the cakes, and the final area for the robots. (Check the distribution of the dropping areas in the general plan of the table)



(a) One of green dropping area



(b) One of blue dropping area

D.3.b. CONSTRAINTS

At the end of the setup time, the vertical projection of the robots must not exceed the limits of their starting area.

Make sure your robots can fully enter their starting area. The starting area does include the colored lines.

During the 3 minutes of preparation time, a robot can to change its starting zone among all the zones of the team. After the 3 minutes, the robot have to start from the zone in which one he is.

D.4. DESCRIPTION AND LAYOUT OF THE PLAYING ELEMENTS

Cake layer: The cake layers are solid discs, with an external diameter of 120 mm, a thickness of 20 mm and a maximum mass of 100 g. They are covered by vinyl on both sides, vinyl which contains an aruco tag. They are 36 in number, and are initially located on predefined locations (grouped by 3 of identical color) placed by the markings on the playing area.

ArUco 4x4 tags are printed on the faces of cake layers in the following way:

- A tag number **47** on the face of the **icing** colored in pink.
- A tag number **13** on the face of the **cream** colored in yellow.
- A tag number **36** on the face of the **sponge cake** colored in brown.

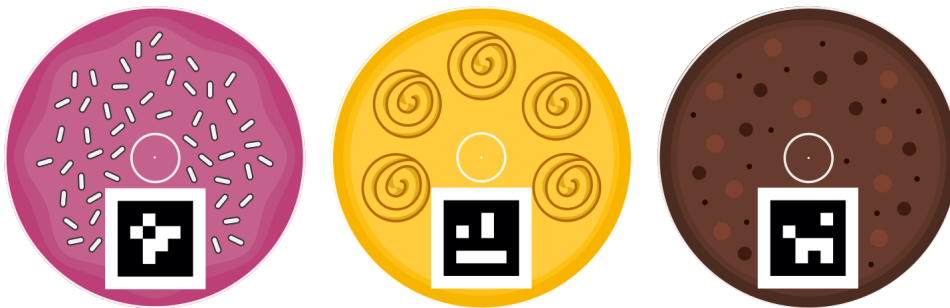


Figure 4: The cake's 3 layers

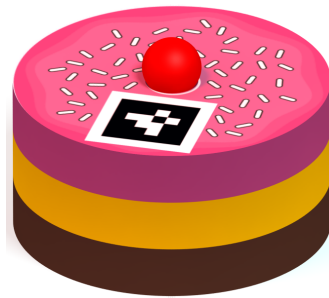


Figure 5: A cake with 3 layers and a cherry

The plates and platters: They are dropping areas of each team arranged along the edges of the playing area. The dropping area in the back corner are exclusively for the team usage, and are named "platters". The other dropping area are named "plates". (Check the distribution of the dropping areas in the general plan of the table).

The cherries: The cherries are red foam balls compatible with Nerf RivalTM. They are 60 in total on the table (40 on supports, and 20 preloaded on robots).

Cherry support: The cherry support are drilled planks filled with 10 cherries. There are 4 scattered around the table.

Basket support: The horizontal surface of the basket support is leveled with the top of the playing area border, located at the back of the table, on the same side of the team.

Basket: Made by the team, the basket is the item in which teams deposit the cherries after picking them up. It must be fixed to the basket support during the preparation phase of the game.

D.5. MAKING CAKES

Robots have to build cakes with the different layers prepared by Grandma Monique and share them with all the guests. Watch out as your opponent can steal your cakes and serve them in their own plates! Who will have the most?

D.5.a. DESCRIPTION AND LAYOUT OF THE PLAYING ELEMENTS

For this action, only the cake layers are used with the dropping areas.

D.5.b. ACTIONS AND CONSTRAINTS

Actions:

- The robots must pick up the layers of cake, sort them, and assemble them by stacking the layers in a precise order. Once the cakes are done, robots will have to place them in the dropping areas provided for this purpose.

Constraints:

- For a cake to be valid, it must be composed of at least 1 layer, and at most 3 layers.
- A layer is considered part of a cake if it is in horizontal contact with the play area for the first layer, or if it rests mainly and by horizontal contact on a lower layer. A layer will count only for 1 cake.
- A cake can be valid with any type of layers.
- The legendary recipe is composed of the 3 following layers, in order, from top to bottom:
 - Icing
 - Cream
 - Sponge cakeRespecting this order grants bonus points on the cake.
- To be considered valid, a cake must have all or part of vertical projection of one of its element in a team's dropping area.
- A dropping area cannot accommodate more than 3 cakes, any additional cake will not be counted. In this case, the counting of points will be done to the advantage of the team.
- Only the cakes dropped in the dropping area at the bottom of the table (in front of the basket supports) will be for the use of the team exclusively.
- If a cake is still under a robot's control at the end of the match, it will not be counted.

D.5.c. POINTS

- **1 point** per layer in the cake
- **4 extra points** if the cake respects the legendary recipe

D.6. PUTTING THE CHERRY ON THE CAKE

The cherry-er the better for your cakes! It is up to you to put a cherry on top of every cake.

D.6.a. DESCRIPTION AND LAYOUT OF THE PLAYING ELEMENTS

The cakes and cherries are used for this action.

D.6.b. ACTIONS AND CONSTRAINTS

Actions:

- Collect the cherries to place them on the cakes

Constraints:

- For a cherry to be considered valid on a cake, it must be present on the top layer of a valid cake.
- The limit is 1 cherry per cake.
- Teams will be able to pre-load up to 10 cherries into their robots during preparation time. Among these cherries, the non pre-loaded ones will be taken out of the playing area for the all game. They must be easily recoverable at the end of the match.
- The rest of the cherries are placed on the cherry dispensers at the start of the match.

D.6.c. POINTS

- **3 points** for each cherry placed on a cake;

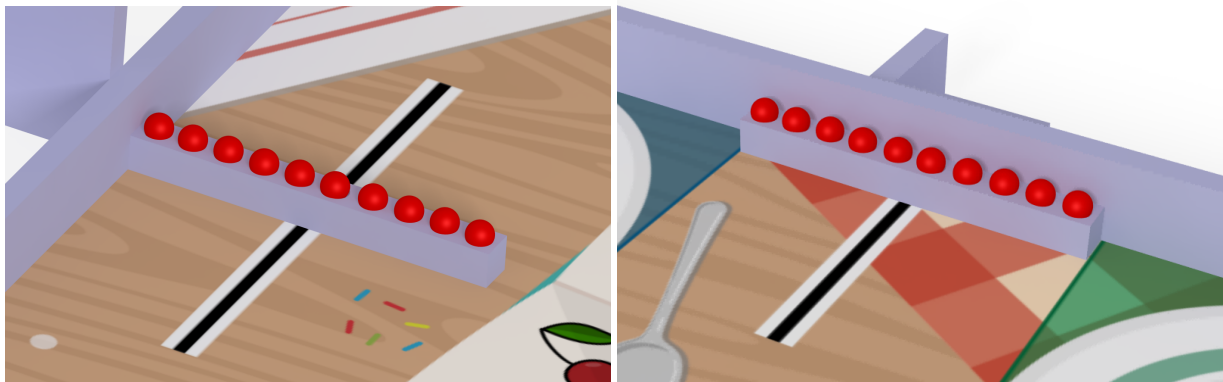


Figure 6: Cherry dispensers

D.7. DROPPING CHERRIES IN THE BASKET

Grandma Monique would like that all the ingredients are not lying around: you have to drop the cherries in the basket. Your robots are helped with an intelligent basket that counts the remaining cherries for inventory.

D.7.a. DESCRIPTION AND LAYOUT OF THE PLAYING ELEMENTS

The cherries and the basket are used for this action.

D.7.b. ACTIONS AND CONSTRAINTS

Actions:

- The team must drop the cherries in the basket of its colour.
- The basket, made by the team, must indicate the number of cherries it contains.

Constraints:

- A cherry is valid in the basket only if it is present in it at the end of the match.
- Cherries are not subject to the relative height restriction of game elements, so shooting is allowed.
- The cherries must remain visible and easily retrievable by the referees.
- The basket must indicate the number of cherries it contains via a visible and easily readable display, and must be expressed in decimal system. The counting must be done in direct reading of the value, the reading modes by calculation are not allowed. For the display, there are two exclusive options:
 - Pre-match evaluation on a static display: the team writes the number of cherries it intends to count during the match.
 - Evaluation during a match on a dynamic display device, which must continue to show the estimated number of cherries after the end of the match.
- Access of the cherries to the interior of the basket must be done above 300 mm in height from the level of the playing area.
- The vertical projection of the basket is not allowed to cross the limits of the basket stand at any time of the match.
- The basket has the following dimensional constraints:
 - Maximum depth: 222 mm.
 - Maximum width: 450 mm.
 - Maximum height: 430 mm.
- The weight of the basket must not exceed 3 kg.
- The horizontal plane of the support has a 10 mm wide groove running from the center of the support to the center of the back side. The groove must be used to fix the basket to the support by using threaded rod of 8 mm diameter and wing nut.
- Apart from the fixing screw and nut, no system or element is allowed to protrude under the support. The screw size is not counted in the height measurement of the basket.
- The action must not be dangerous for the public, the people around the table, the playground or the robots.
- The basket cannot be activated by an external element (team crew, remote control, ...).

D.7.c. POINTS

- **5 points** if the team places a basket during the preparation time;
- **1 point** per cherry in the basket
- **5 extra points** if the count is correct and not null

D.8. PUTTING THE WHEELS IN THE PLATE

Once their work is done, the robots will wait for the guests in their plates to party with them. As nobody wants a tire mark on their cakes: between a area full of cakes or a robot, it's time to choose!

D.8.a. DESCRIPTION AND LAYOUT OF THE PLAYING ELEMENTS

The deposing area zones are used for this action.

D.8.b. ACTIONS AND CONSTRAINTS

Actions:

- At the end of the match, the robot must be stopped in their own dropping area.

Constraints:

- To be considered valid a robot vertical projection must be at least partially inside the limits of the dropping area of the team.
- Any other element in the team's dropping area will not be take into account.
- A team with multiple robots can only validate this action if both robots are in the same dropping area.

D.8.c. POINTS

- **15 points** if all team's robot are in its own dropping area;

D.9. DISGUISE TO MAKE THE PARTY

D.9.a. DESCRIPTION AND LAYOUT OF THE PLAYING ELEMENTS

Only the robots are implicated for this action.

D.9.b. ACTIONS AND CONSTRAINTS

Actions:

- After its job done, the robot must disguise to celebrate the party.

Constraints:

- The disguise must change the colour or the appearance of the robot.
- If a team have two robot, only one robot disguised is necessary to validated this action.
- The disguisement have to be contained inside the robots from the beginning to the end of the match.
- The disguise must do at least 50% of perimeter of the robot, in the limit of the deployed perimeter, and with a maximum height of 35cm.
- The disguise must be at least 15cm height after deployment.

- The action must be visible to the public.
- This action must be performed before the end of the match, and after that the disguised robot must stop and turn off all their actuators.

D.9.c. POINTS

- **5 points** if the funny action is performed;

D.10. ESTIMATE THE PERFORMANCE

D.10.a. DESCRIPTION AND LAYOUT OF THE PLAYING ELEMENTS

The device for displaying the score estimation during the match must be made by the team.

D.10.b. ACTIONS AND CONSTRAINTS

- The team must evaluate the number of points scored in the match by its robot(s). For this, there are two exclusive options:
 - Pre-match evaluation on a static display: the team writes the score it intends to make during the match.
 - Evaluation during a match on a dynamic display device, which must continue to show the estimated score after the end of the match.
- The display must be on the robots or the basket.
- The display area and its reading orientation must be easily visible and identifiable by the referees.
- The estimated score is an integer and must be expressed in decimal system.
- It is allowed for a team with two robots to design a display for each robot. In this case, the score assessment will be the sum of the values of the two displays; the type of reading and the order must be explained to the referees at the beginning of the match.
- Under no circumstances should the score change once the match has ended, otherwise the bonus will be lost!

D.10.c. POINTS

The assessment is based on all the previous actions.

The estimation bonus is calculated as follows: **Bonus = 20 points - Delta**

- The score is the one scored by the team during the match on standard actions.
- The delta is the difference between the score made by the team during the match and the score estimated by the team. This one is always positive (Absolute value).
- The bonus is an integer value (rounded up).
- The bonus is added to the points of the team.
- A negative bonus is reduced to 0.
- The bonus for not "forfeit" is not include in the performance estimation.
- The penalties are not include in the performance estimation.

E. PROJECT PRESENTATION

Both Eurobot^{Open} and Eurobot^{Open} Junior encourage participants to practice science in a funny and original way. Our main objective is to assist and value your projects conceived during the year. To achieve this, the teams must conceive a poster, and, organizers may require the teams to create a technical documentation of their robots.

We expect to see attractive, innovative robots that respect this edition's technical constraints and rules. Being creative and original will add value to your work as much as the performance of your robot(s) during the matches. By doing this presentation, you will increase the communication value of your project and the visual effect of your robots, for both the public coming to the events as well as for your own satisfaction. Having created something aesthetically and functionally complete, will strengthen your work attitude during and after the competition.

TECHNICAL POSTER

Each team is required to provide a technical poster of their robot. This poster should present information related to the design of the robot (drawings, technical references, design specifications, etc.). It should be at least size A1 (594x841 mm) and ideally it should be printed. This poster is intended to encourage exchange and communication between teams.

Special vulgarization efforts should be made to make the content of the poster accessible to the general public. Ideally, the poster should include pictures and charts to explain the concept.

The poster must also include:

- the name of the team.
- the names of team members.
- the country of the team.
- the country flag of the team.

This poster will be posted on the booth of each team during the competition. For the international Finals, an English version is requested. The chosen resolution must guarantee the legibility of all texts. The resulting PDF file must not exceed 25 MB. The PDF version of the poster may be sent to the organization prior to the meeting via your National Organizing Committee.

In general, the organization encourages teams to communicate around their projects on the Internet, social media, via forums, etc.

F. THE ROBOTS

F.1. FOREWORDS

Each team is allowed to register a maximum of two robots, called respectively "main robot" and "secondary robot". Each one have identical dimensional constraints, but it must be possible to distinguish them from each other from the public. The set of both robots have additional dimensional constraints.

For Eurobot^{Open}, both robots are autonomous.

The construction of a secondary robot is optional. The aim is to allow teams with a large number of members to work on a second project. It is recommended for beginning teams to concentrate on building a single functional machine. Having one robot that works well is better than having two that do not move.

A secondary robot can compete only with the main robot with which it was designed and approved. However it can compete alone if the main robot cannot participate. It cannot be re-approved with another main robot.

The main and secondary robots must be made up of elements that are fixed to each other (so robots cannot leave parts or elements on the playing area), with the exception of the playing elements.

Deliberately vibrating the table, attach themselves to it or any other irregular action exposes the team to a refusal of approval.

Each team must design a unique and original set of robots, specific to their team.

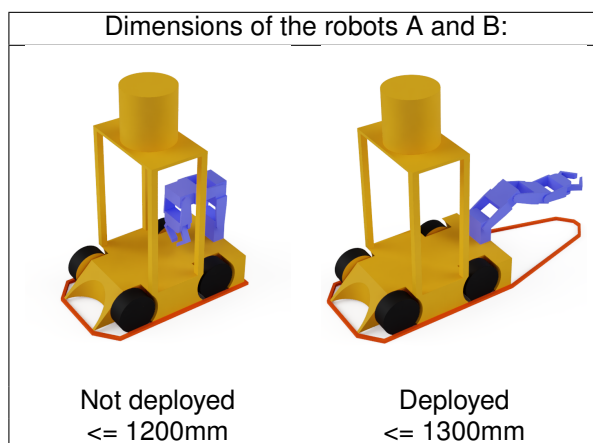
Be imaginative! For example, as an innovation but also to offer the public and the media an attractive show, your robot can use sounds, display expressions, etc.!

F.2. DIMENSIONS

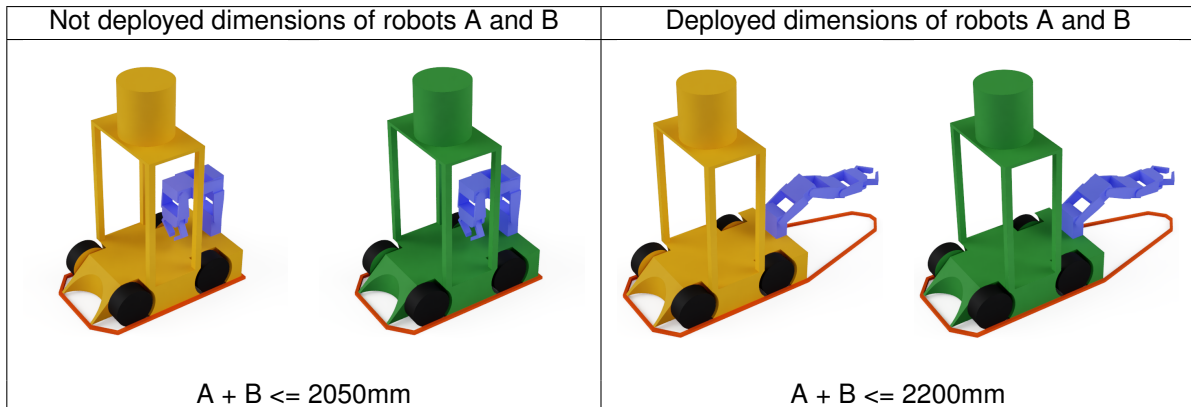
Warning: the dimensions of Eurobot^{Open} robots are identical to those of Eurobot^{Open} Junior. Eurobot^{Open} Junior participants can more easily access the Eurobot^{Open} meetings. The Eurobot^{Open} Junior robot will only need modifications to make it autonomous.

Dimensions of the robots :

The perimeter of a robot is the perimeter of the convex shell of its vertical projection on the ground. It is measured by surrounding it as shown in the illustrations below:



The perimeter of a robot must not exceed 1200 mm at the departure time. The perimeter of the fully deployed robot shall not exceed 1300 mm during the match. It is allowed to change the convex hull shape during the game, as long as the perimeter of this one always respects the maximum perimeter constraint.



The sum of the perimeters of the two robots at the start of the match must not exceed 2050 mm. The sum of the deployed perimeters of the two robots must not exceed 2200 mm. Be careful, the sum of the deployed perimeters is equal to the sum of the maximum of the deployment perimeter of each of the two robots during the entire duration of the match.

If a physical connection (mechanical, electrical, magnetic,...) exists between two robots of the same team, then the group formed by the two robots is in fact considered, for the perimeter constraints, as a single robot, until the group is dissociated. Note that a simple contact is not considered a physical connection.

At any time during the match the height of each robot and manipulated object must not exceed 350 mm. However, it can be tolerated that the emergency stop button exceeds this limit height to reach 375 mm.

This height excludes the beacon support mast, any sensors and electronic circuits integrated under the beacon holder mast.

F.3. SECURITY CONSTRAINTS

F.3.a. GENERAL ASPECTS

All systems (robots, beacons and accessories) must comply with the European standards.

This is mandatory for the countries outside the EU that are organizing national meetings or send independent teams for the European Finals. Among other things, these security standards must respect safety rules and must not endanger participants, organizers nor public. They must not have protruding or pointed parts that could be dangerous or cause damage

The use of liquid, corrosive, fuel, pyrotechnic, radioactive, living beings or zombies is prohibited.

In general, any system deemed by the referees' committee as dangerous will not be approved, and must be replaced, in order to be accepted in the competition.

F.3.b. ENERGY SOURCES

The only sources of stored energy authorized in robots and auxiliary systems are electrical chemical batteries, commercial batteries, springs and elastics, compressed air, gravitational energy. All other energy sources are prohibited.

If you have any doubt about unconventional energy sources, ask the referees' committee as soon as possible, providing the corresponding datasheets.

All robots must comply with standard "low voltage" regulations. As a result, **the on-board voltages must not exceed 48 V DC and 48 V peak to peak AC .**

Potential differences greater than 48 V may exist, but only within closed commercial devices (eg lasers, LCD backlights, etc.) and only if these devices have not been modified and comply with national and European regulations.

Batteries:

If the team chooses a battery power supply, we remind that only unmodified batteries can be used.

Teams must be able to play three games in a row. Note that this includes the time required to set up, during which the robot will be powered and awaiting the start.

Therefore, we strongly recommend that teams bring several sets of batteries and provide easy access to them in the robot for their replacement. Teams are reminded that it is essential to have a set of spare batteries, fully charged and available at all times.

Note on the use of Lithium-based batteries:

Lithium batteries are known for their lack of stability and can easily ignite when certain precautions are not taken.

This type of battery is therefore authorized under the following conditions:

- Suitable battery charger, which must be submitted for approval.
- Batteries kept in certified and unmodified fireproof bags.
- A system for detecting underloads is highly recommended.
- Exception in the case of the following batteries, authorized without the conditions listed above:
 - Lithium batteries for LEGO Mindstorm / laptop / mobile phone / power tools, not dismantled and used for the intended purpose of the manufacturer.
 - Lithium-Iron batteries (LiFePo4)

Emergency stop button :

All systems including a source of stored electrical energy must be equipped with a red emergency stop button of at least 20 mm in diameter. It must be placed on the top of the system, in a visible position on a free surface and in a non-risking area to be immediately accessible by the referees at any time during the match.

The button may exceed the system's height by 25 mm. The emergency stop button must be operated by a simple downward movement (for example, by hitting it with the fist).

(Only exceptions to this rule, the beacons embedded on the beacon mast of the opposing robots are exempt from the emergency stop button).

Pressing this button must stop all system immediately. For robots, the non-cutting of control and avoidance systems is tolerated.

In order to avoid any risk of fire, attention should be paid to the diameters of the wires, depending on the intensity of the currents flowing through them. It is also strongly advised to protect the electrical installation with a fuse, wired close to the batteries.

F.3.c. LASERS

Only laser systems and classes defined according to the IEC60825 international standards are accepted. Teams using lasers must provide the manufacturer's document mentioning **the class of the device** (this information is normally always available on the system itself).

On the basis of this classification, class lasers:

- 1 and 1M are accepted without restriction
- 2 are tolerated only in case the laser beam do not exceed the play area, and if it is off when the robot does not touch the play area.
- 2M, 3R, 3B and 4 are strictly forbidden.

WARNING: Disassembling or modifying devices using laser sources often results in a change of class. Laser devices must not be altered and only be used in the state of their commercialization (laser device = source + optics + electronics).

F.3.d. HIGH POWER LIGHT SOURCES

When using a high intensity light source, the light intensity must not be dangerous to the human eye in case of direct contact. Note that some types of LEDs have warnings. Be responsible, as your machines are evolving in front of a general audience!

In the case of slightest doubt, the organization reserves the right to request the manufacturer's specifications to verify the non-dangerous nature of the lighting system used. If it turns out that the system is potentially dangerous, it may result in revocation of lasers class 2M and more.

F.3.e. COMPRESSED AIR SYSTEMS

Compressed air systems should not exceed 4 bars, except in pre-assembled commercial products, and only if :

1. these devices have not been modified.
2. They are compliant with european safety regulations.
3. they are safe.

The use of pressurised gas cartridges such as CO2 cartridges is prohibited

F.4. COMMUNICATION SIGNALS

To avoid interference between teams, it is recommended to encode the communication signals. We strongly recommend teams using infrared devices, to take into account the strong ambient light used during the encounters. In addition, this luminosity may vary in time and according to the emplacement of the playground in the hall.

We also remind teams that the organizing staff uses high-frequency radio devices and under no circumstances can they be held responsible for the malfunctions encountered by the robots.

CAUTION: Beyond the edges of the playing area, there may be elements that may interfere with color detection or communications signals such as:

- decor, lights and objects of the playing area
- people (referees, teams, etc.)
- electronic systems (microphones, cameras, etc.)

It is strictly forbidden to ask people to go away or move away objects/decors around the playing area !.

Wifi networks:

At multiple contest locations, the number of active Wifi devices can disturb the robots implementing this technology for communication. To answer this issue, it's recommended (but not mandatory) to use the 5 GHz frequency rather than the 2.4 GHz one.

F.5. OTHER DESIGN CONSTRAINTS

All systems (robots, beacons and accessories) must be presents on the table and are not allowed to communicate with systems outside the table during the matches.

Visibility : A rectangular, entire and non-deformable space of 100 x 70 mm per robot must be left free on one of the side faces. The teams will receive stickers printed by the organization (team number, sponsors etc), which they have to place on these open spaces.

It is also highly recommended (but not mandatory) to close empty spaces inside the robots to facilitate their detection by other robots.

Starting cord of autonomous robots: Robots must be equipped with a starting device easily accessible. This device has to be triggered by pulling the end of a cord at least 500 mm long. This cord must not stay attached to the robot after departure.

No other starting system (remote control, manual rocker switch, etc.) will be approved.

The start of one robot can launch the other robot.

Avoidance system : All teams are required to equip their robot(s) with a system for detecting opposing team's robots. This system is intended to prevent collisions between robots, during a match. This point will be systematically checked during homologation.

Warning: As most of the events are filmed, please adapt your avoidance systems so that it is not disturbed by autofocus cameras and filming.

Embedded/ on-board beacon support system : In order to facilitate robot identification in the field, robots must integrate an embedded beacon support system to identify the beacon of the opposing team. This support system must respect the following points:

- have a convex hull envelope over the entire height between the top of the robot and the beacon support, with a minimal size of a 70 mm diameter circle and with a maximum size of a 100 mm square;
- be solid and opaque (a material able to intercept the light at least in the infrared spectrum; and opaque for the visible spectrum too, except in case of a justification needed);
- have its upper surface flat, horizontal and positioned at a height of 430 mm above the playing area to allow the beacon of the opposing team to be placed in good conditions;
- the top of surface of the platform will be fully covered of VelcroTM (hook side);
- the vertical projection of the on-board beacon support must be located as centrally as possible and within a circle of 20 cm diameter around the center of the robot;
- the embedded beacon support can only accommodate sensor and telecommunication systems. The beacon support must be as hollow as possible. For teams using rotating devices, make sure that the portion of cylinder removed has a height of less than 2 cm (except for the minimum size of the envelope convex), and that it is not possible to see through the mat through this opening.
- the on-board beacon support must be stable, motionless regarding the robot structure and must be able to support a minimum weight of 400 g (the opposing team's beacon and the aruco tag), without flexing or compressing.

However, a team may choose not to equip their robot with an embedded beacon support system. In this case, if the opposing team requires a beacon support, and the use of it (either to detect the mast or to place a beacon), the team or the robot concerned may be revoked for that particular game.

G. BEACON TRACKING SYSTEM

G.1. GENERAL POINTS

Teams can develop a complete beacon localisation system; in this extent there are specific zones on the playing area where these beacons can be fixed.

At the opponent's request and only if justified, the robots could be equipped with a flagpole to fix an opponent's beacon above (see subsection F.5.).

All beacons (fixed beacons, embedded beacons and central tracking device) must remain in place on their supports throughout the duration of the match. All robot safety instructions equally apply to beacons.

Fixed beacons, center marker, beacons, embedded beacons and their respective supports are described below.

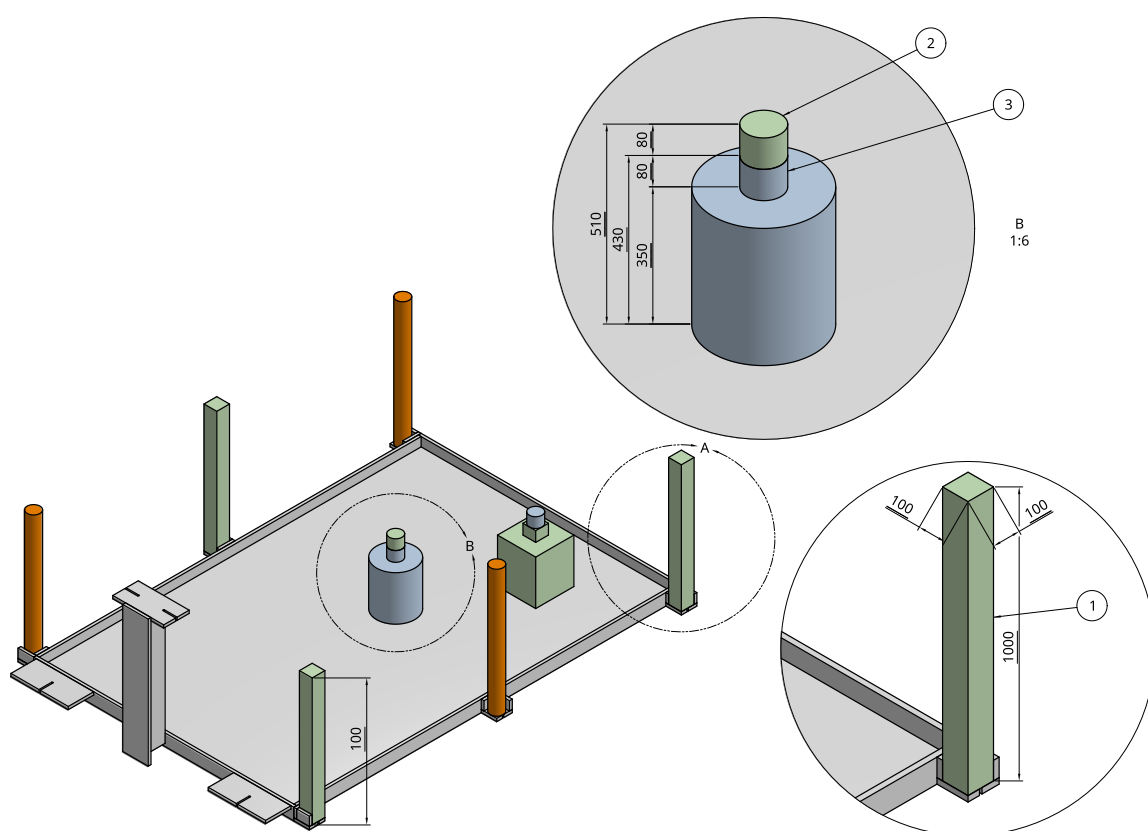


Figure 11 - Example of beacons positioning

Caption:

1. fixed beacons (maximum dimensions $W \times W \times H$: 100 x 100 x 1000 mm)
2. embedded beacon (maximum dimensions $L \times W \times H$: 100 x 100 x 80 mm)
3. mast of the support (cf. subsection F.5.)

G.2. EMBEDDED/ ON-BOARD BEACONS

A beacon can be placed on each of the adverse robots, in order to locate it. It must be placed on a dedicated mast, at an height of 430 mm above the playing area. The maximum size for an on-board location beacon is a square based parallelepiped of 100 mm side and 80 mm height.

The upper side of the on-board beacon must be flat and covered with VelcroTM on the hook side and the under side of the beacons must be covered with velvet VelcroTM.

It is recommended that the color of the beacons be mainly white or very clear, so as to favor their detection on a dark background.

In the name of fair play, the elements used for this beacon must have real utility. Any "useless" or weighted beacon will be refused by the organization.

An embedded beacon must not exceed 300 g

G.3. FIXED BEACONS

Each team can place up to three fixed beacons on fixed supports. These fixed supports are allocated to the team upon demand and will be placed around the playing area.

Action-cams not useful for the course of the game are prohibited in fixed beacons.

G.3.a. DIMENSIONS

The fixed beacons shall be integrally contained in a square rectangular parallelepiped of 100 mm side and 1000 mm height.

A fixed beacon must not exceed 1.5 kg.

G.3.b. FIXATION

Given the potential height of the fixed beacons, they must have a solid fixing system.

The fixed beacon supports are located at the level of the playing area.

The horizontal plane of the fixed beacon support has a 10 mm wide groove. This groove must be used to secure the fixed beacons using an 8 mm diameter threaded rod and a wing nut.

The screw size is not counted into the dimensional constraints of the fixed beacons.

The absence of this fixing system will forbid the approval of the fixed beacons.

G.4. CENTRAL TRACKING DEVICE

In order to help identify the robots during the matches, a common platform located on the central symmetrical axis of the ground will be placed 1 m above the surface of the playing area (see plan). This platform can be used to place a robot tracking device with a top view.

The central tracking device should be placed on the area that corresponds to the color of the team. It must not exceed beyond a horizontal plane of 600 mm above the platform's upper surface. It must also not surpass a horizontal plane of 60mm below the platform's lower surface. On the sides, an offset of 60 mm is allowed: forward, at the edge not shared with the opponent and at the back. This offset allows: placing sensors above the ground, connecting the parts situated above and underneath the platform and setting up a slid fixing for the central tracking device. Its weight must be less than 2 kg.

It is forbidden to overpass on the opponent's area.

Please note that the central tracking device can be subject to vibrations due to the movements of robots on the playing area.

In appendix, the drawing of a mast supporting the platform are represented. However, only the dimensions and the position of the platform are contractual, the mast itself may be different from one meeting to another. Its design is left free to the organizer of the meeting.

Fixation :

The thickness of the fixing platform for the central tracking device is 22 mm.

The fixing device can surround the fastening platform from above, from below and from all three sides of the support so that it can be assembled and positioned quickly and without the risk of falling.

The mounting platform has a 10 mm wide groove from the center of the beacon support to the middle of the side. This groove must be used to secure the central tracking device using an 8 mm diameter threaded rod and a wing nut.

The absence of this fastening system will prevent the approval of the tracking system.

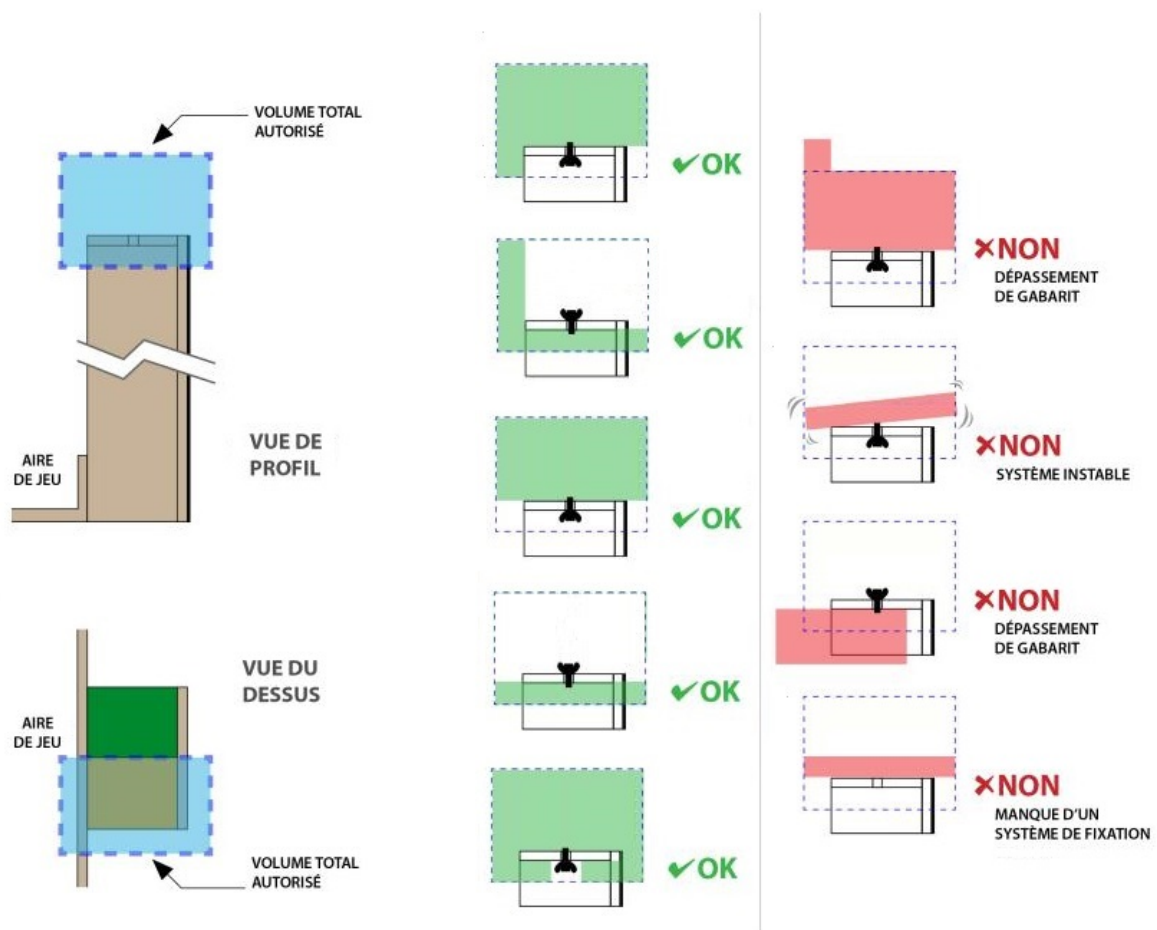


Figure 13 - How to install a central tracking device

G.5. CONNECTIONS

The fixed beacons and the central platform can be connected by a wired link. This connection must under no circumstances disturb the match. The installation of the whole system must be carried out before the match, during the preparation time. It should not disturb the opposing team's preparation.

During the preparation time, a temporary wired link may be pulled in between the robot and one or several beacons. This case scenario is accepted only if it doesn't cause any inconvenience for the opposing team.

G.6. ROBOT IDENTIFICATION

During each match, the robots will be assigned a marker (provided by the organizer) placed at the top of the beacon holder, or at the top of the on-board beacon (if present)(Figure 7b). This marker has two purposes:

- allow the public to identify the team to which a robot belongs;
- allow a vision system on the central mast to identify and locate each robot.

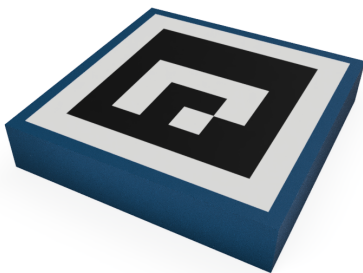
The marker is a square 10cm wide, 2cm thick ($\pm 2\text{mm}$) and with a mass less than or equal to 100g. Its upper side is covered with a vinyl with a 7cm ArUco 4x4 tag (centered). A 1cm wide white outline is drawn around the ArUco tag to facilitate its detection. A 0.5cm wide contour in the same colour as the team is drawn at the edge of the upper surface. The team's color also occupies the edge of the marker.(Figure 7a)

- Team blue robots will receive ArUco 4x4 tags between 1 and 5.
- Team green robots will receive ArUco 4x4 tags between 6 and 10.
- All robots will receive distinct markers. It will not be possible to choose them, nor to choose on which robot they will be placed.
- ArUco 4x4 tags from 11 to 50 are reserved for the playing area, but not all of them are necessarily used.

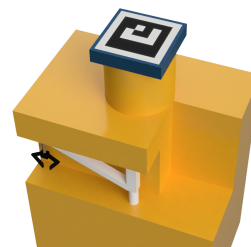
WARNING : to avoid visual disturbances, the teams are not allowed to use ArUco 4x4 tags from 0 to 50.

- ArUco 4x4 tags between 51 and 70 are reserved for team blue .
- ArUco 4x4 tags between 71 and 90 are reserved for team green .

However, other tag numbers over 90 and other dimensions than 4x4 are allowed.



(a) Robot identification marker (Tag n°1).



(b) Marker on the on-board beacon support.

H. MATCHES

Only two persons per team are permitted to go backstage and on stage to play the matches. During the homologation, if the teams justified the needs, the referees can allow the access to a third member of the team for the preparation.

To ensure that the contest runs smoothly, at least one member of the teams must be present on their booth with the robot(s) and ready to go 30 minutes before the start of each series and until that the game is played.

In case of a problem, it is tolerated by the organization to ask for a delay to go to the match but this delay can never exceed the end of the current series.

H.1. PREPARATION TIME

At the start of a match, the elements of the playing area and the playing area itself are installed as indicated in the diagrams in the appendix.

Upon arrival on the playing area, each team has a maximum of three minutes to proceed with the placement of the robots, the beacons and other equipment. At the end of the preparation time, the robots are allowed to move until the start of the match.

A robot which is not ready at the end of this period exposes the team to a forfeit for the match.

Besides, the other team's robots will still play their own game on the playing area. The team will have to score points to be declared the winner.

When both teams have finished setting up, or when the preparation time is over, the referee asks the participants if they are ready. From this moment, teams are no longer allowed to touch their robots. It will be tolerated that the emergency stop button is pressed by the teams after the preparation time in order to preserve the batteries and actuators while waiting for the beginning of the match. No dispute can be made on the disposition of the elements of play after the beginning of the match.

H.2. THE MATCH

At the signal of the referee, each robot is switched on and it has 100 seconds to do these actions.

No one except the referee can touch the robots and the playing elements unless expressly indicated by the referees.

No elements taken out of the playing area can be put back on the table before the end of the match and the validation of the scores.

H.3. END OF MATCH

At the end of the 100 seconds, the robots must stop and turn off all their actuators. It is allowed to keep on any dynamic displays.

No one except the referee can touch the robots and the playing elements unless expressly indicated by the referees. The referees count the points; they give the result of the match, including the points to the teams. If they both agree, they validate the match sheet, can take back their robot(s) and join their booth. If the teams do not agree, they refer calmly to the referees. The robots remain in place until the dispute is resolved. Refereeing decisions are final.

In the event of a situation that is difficult to judge, the referees reserve the right to decide whether or not to replay the match.

The referees are allowed to pronounce the end of a game in advance, before the end of the regular time if both teams agree (if the robots are blocked for example).

H.4. COUNTING POINTS

Points summary

H.4.a. MAKING CAKE

- **1 point** per layer in the cake
- **4 extra points** if the cake respects the legendary recipe

H.4.b. PUT A CHERRY ON THE CAKE

- **3 points** for each cherry placed on a cake;

H.4.c. DROP CHERRIES IN THE BASKET

- **5 points** if the team places a basket during the preparation time;
- **1 point** per cherry in the basket
- **5 extra points** if the count is correct and not null

H.4.d. RETURN TO A ZONE

- **15 points** if all team's robot are in its own dropping area;

H.4.e. FUNNY ACTION

- **5 points** if the funny action is performed;

Warning! An element controlled by a robot, does not yield points. An element is considered to be controlled by a robot, if by moving the robot along its natural axis of movement the element is moved.

H.4.f. ESTIMATION POINT

The assessment is based on all the previous actions.

The estimation bonus is calculated as follows: **Bonus = 20 points - Delta**

- The score is the one scored by the team during the match on standard actions.
- The delta is the difference between the score made by the team during the match and the score estimated by the team. This one is always positive (Absolute value).
- The bonus is an integer value (rounded up).
- The bonus is added to the points of the team.
- A negative bonus is reduced to 0.
- The bonus for not "forfeit" is not include in the performance estimation.
- The penalties are not include in the performance estimation.

H.4.g. THE PENALTIES

Several actions during the match may result in penalties.

The following actions will result in a **warning** or a **point loss** on the final score if a warning has already been issued for the team (the warning rule is only valid during the series):

- loss of part or element of a robot on the playground: **loss of 20 points**.
- degradation of the table or a game element: **loss of 30 points**.
- non-functional avoidance system: **loss of 30 points**.
- false start: **loss of 50 points**.
- robot keeps moving when time runs out: **loss of 50 points**.
- excessive preparation time: **loss of 50 points**.
- robot change its start zone after 3 minute of preparation : **loss of 50 points**.
- unfair behavior: **loss of 50 to 100 points**.
- on arbitration decisions: **loss of 50 to 100 points**.
- on decisions of the organization: **loss of 50 to 100 points**.

The following actions will result in a **team forfeit**:

- no robot exit from its starting area.
- repeated excessive preparation time.
- dimensional limitations not respected.
- repeated false start.
- intentionally shoot at people in the vicinity.
- voluntary fixate, vibrate the table.
- intervention of a team member on the table, game elements or robots, after the preparation time (with the exception of the emergency stop button).
- intervention of a team member on the table, the game elements or the robots, during the match.
- the team is unable to play the game before the end of the series.
- following arbitration decisions.
- following decisions of the organization committee.

The following actions will result in **disqualification of the team from the competition**:

- voluntary deactivation of robot avoidance systems.
- design robots that are noticeably similar to robots from other teams (for example: rolling bases or identical actuators). If during the year you see a team building a robot similar to yours, report it to the organization as soon as possible.
- intentional degradation of robot belonging to other teams.
- following decisions of the organization committee.

Several penalties can be applied.

The score of a forfeited team or a negative score will be reduced to 0.

Only the referees are authorized to intervene on the table or the robots after the preparation time and during the match. In case of concern, ask the referee to intervene to avoid the forfeit.

In that cas, the appreciation of the penalties is upon the discretion of the referees. They cannot be disputed after the match.

Video refereeing is prohibited.

A general definition of anti-game: "If the goal is to harm without building, then it's anti-game". The assessment of the anti-game remains at the referee's judgement.

H.4.h. BONUS POINTS

1 bonus point is awarded to all teams that are not "forfeit". This bonus point is not included in the performance estimation.

I. THE CONTESTS

I.1. GENERAL INFORMATION

The Eurobot^{Open} meetings can be organized on three levels:

- regional: when they exist (e.g. in France, Eurobot^{Open} Junior), qualify a number of teams for the national meeting,
- national: it allows to qualify the teams for the European meeting,
- European: this last stage brings together, in the same friendly spirit, teams from different countries in Europe and elsewhere.

Each meeting has several successive steps:

- The static and dynamic approvals of all the robots;
- A qualification phase, with at least 3 series;
- An optional play-off phase;
- A final phase.

I.2. APPROVAL

I.2.a. STATIC APPROVAL

Before the start of the matches, robots are subject to the supervision of a referee who checks their compliance with the rules. Robots must be able to easily show all their mechanisms.

The ancillary systems (accessories, beacons, central tracking device, etc.) will also be subject to static control (size, mass, presence of mandatory elements, etc.).

I.2.b. DYNAMIC APPROVAL

The robots must, within 100 seconds, validate at least one action. The robots are put in a game situation but without the presence of an opposing team. Certain specific features provided for in the regulation can also be checked (timer, avoidance of opponents, etc.).

If the assembly consisting of the main robot and the secondary robot fulfills these conditions, it is declared approved. If one of the two robots is not approved, the other robot can play the match alone.

I.2.c. SIGNIFICANT TECHNICAL MODIFICATIONS AFTER THE APPROVAL

It is essential to inform the referees of any significant modifications (functional, structural, dimensional ...) brought to the robot(s) or any other element after approval. The referees will then check the modifications made and re-approve the robot if they deem it necessary. In the event of a breach, the team may be declared disqualified from the contest.

I.3. QUALIFICATION PHASE

During the qualification phase, the registered teams will have the possibility to play at least three games (often more, depending on the local organizers).

A ranking is established according to the accumulated points in order to select the qualified teams for the next phase.

The tied teams are tied by comparing their scores without taking into account their bonus points. Organizers may also use additional matches.

At the end of the qualifying phase, the first teams (according to the matches) are qualified for the next phase.

Number of participating teams	Minimum team selected
$B \leq 16$	4
$16 < N \leq 50$	8
$50 < N$	16

I.4. THE PLAY-OFF PHASE

An additional play-off phase may set up in the event that a meeting hosts two contests, the first of which qualifies for the second. For example:

- a regional meeting (A) and its national meeting (B)
- or a national meeting (A) and the European meeting (B)

The organizer may carry out the qualifying phase of both matches (A) and (B) either in parallel fashion or in a mixed fashion. In this case, a play-off phase may be organised in order to allow teams from the match (A) to qualify for the match (B), exempting them from having to catch up on all the matches from the qualifying phase of (B) in favour of this play-off phase.

The teams participating in this play-off phase are:

- the teams of the match (A), in a number corresponding to its qualification quota, and chosen in the order of ranking at the end of the qualification phase of (A) or through the award of a jury prize.
- the teams of the match (B), in a number equivalent to the participants in this phase from (A), chosen from among the last teams normally qualified for the final phase of the match (B).

Example for a national meeting qualifying three teams for its European final with two teams qualified in the ranking and one per jury prize and whose European final phase has 16 teams. The teams participating in the play-off phase are:

- **the first two teams of the national meeting at the end of the final phase of the national meeting, as well as the team that received the jury prize;**
- **and the teams ranked 16th, 15th and 14th in the qualifying phase of the European meeting.**

In this play-off phase, one match will be played for each participating team. The participating teams from the match (A) qualified through the ranking will play, in order of their ranking, with the teams from the match (B) with the lowest ranking. And the team(s) of (A) qualified for this play-off phase through a jury prize will play against the top-ranked teams of (B) in a random order.

Each team that wins its play-off match will be included in the main draw of the final phase of the match (B). At the end of the play-off phase, the tree of the final phase of the match (B) presented in Figure 8 may be revised to more accurately represent the level of each team.

1.5. THE FINAL PHASE

At the end of the previous phase, the qualified teams form the table of the matches of the final phase. Depending to the meeting, only the teams composed of members less than 30 years of age will be able to enter the final stages.

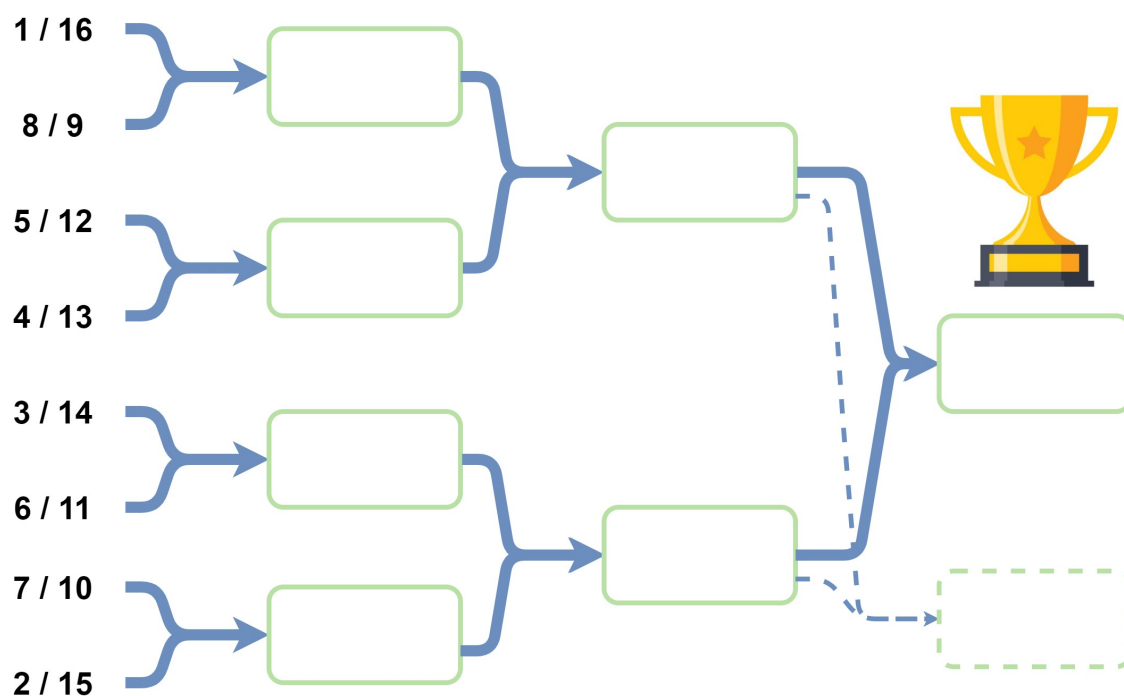


Figure 8: Tree of the final phase

The matches of the final phase are with knockout, unless otherwise organized on some meetings. In the event of double forfeit, double defeat or tie, the match is replayed immediately; if this second match is still a case of double forfeit, double defeat or equality, the winner is determined according to the points acquired at the end of the qualifying phase.

The final is played in two winning games. Be careful to provide batteries accordingly for autonomous robots.

1.6. QUALIFICATION FOR THE NATIONAL MEETING

When there are regional meetings, the number of teams qualified per regional meeting is proportional to the total number of teams registered at the national level.

The best teams in the ranking established at the end of the qualifying phase of each regional meeting, as well as at least one team chosen by the organizers from the special prizes (e.g. creativity, fair play, presentation, etc.).

1.7. QUALIFICATION FOR THE EUROPEAN MEETING

Each country participating in Eurobot^{Open} organizes a national meeting to determine the qualified teams for the international meeting.

The 3 finalist teams will qualify to take part in the European meeting.

For questions and comments, feel free to visit the Planète Sciences Forum.

<http://www.planete-sciences.org/forums/>

News and more information about Eurobot^{Open} and Eurobot^{Open} Junior are available on our website

www.eurobot.org

(It also contains links to your local organization)

The whole organization team of Eurobot^{Open} and Eurobot^{Open} Junior wishes you a lot of fun and success in the coming months, and looks forward to seeing you soon around our playing areas!

Robotic Regards,

The Eurobot^{Open} Eurobot^{Open} Junior organization committee.

J. APPENDIX

J.1. GENERAL DRAWINGS

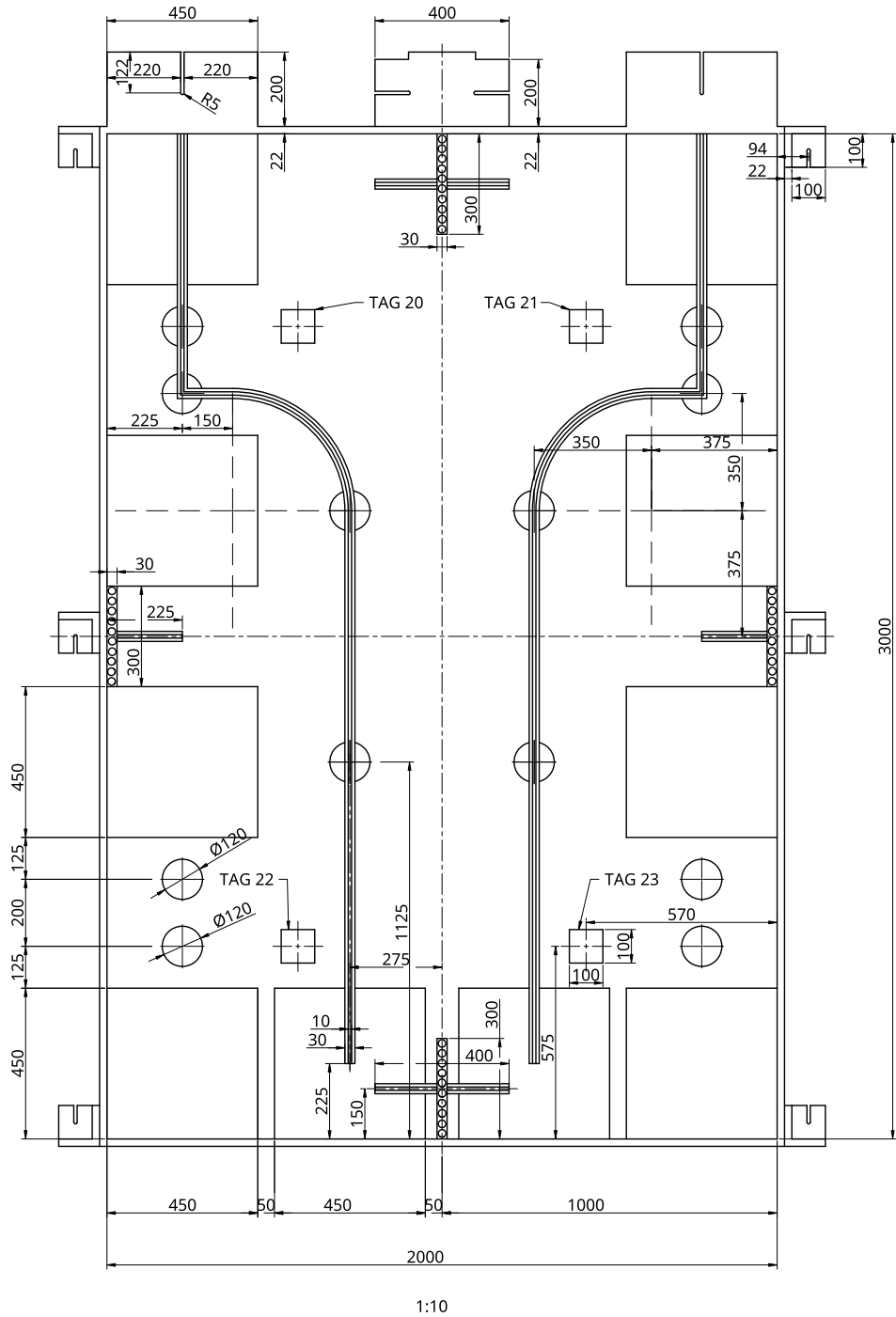


Figure 9: Top view of the playing area, symmetrical along both axes

J.1.a. CAKE STAGE

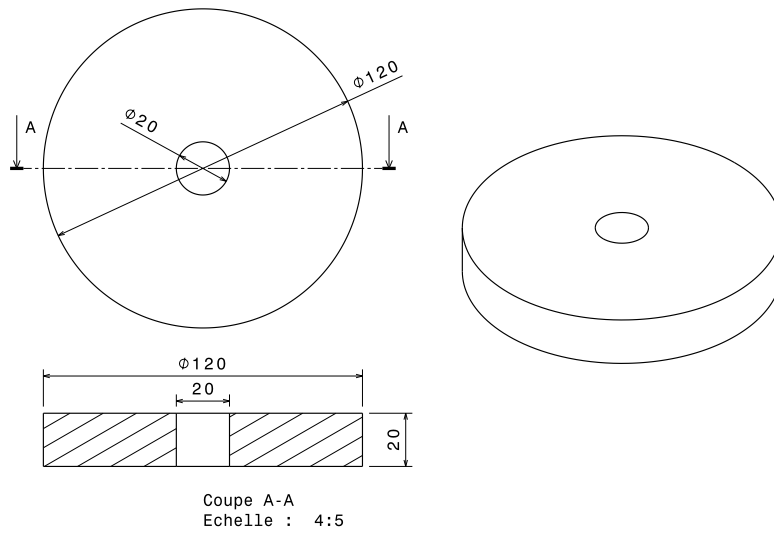


Figure 10: Cake layer

J.1.b. CHERRY SUPPORT

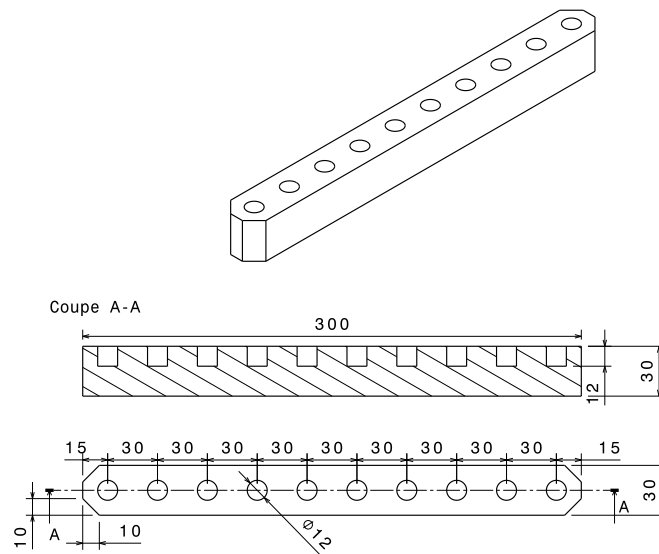


Figure 11: Cherry support

J.1.c. BASKET SUPPORT

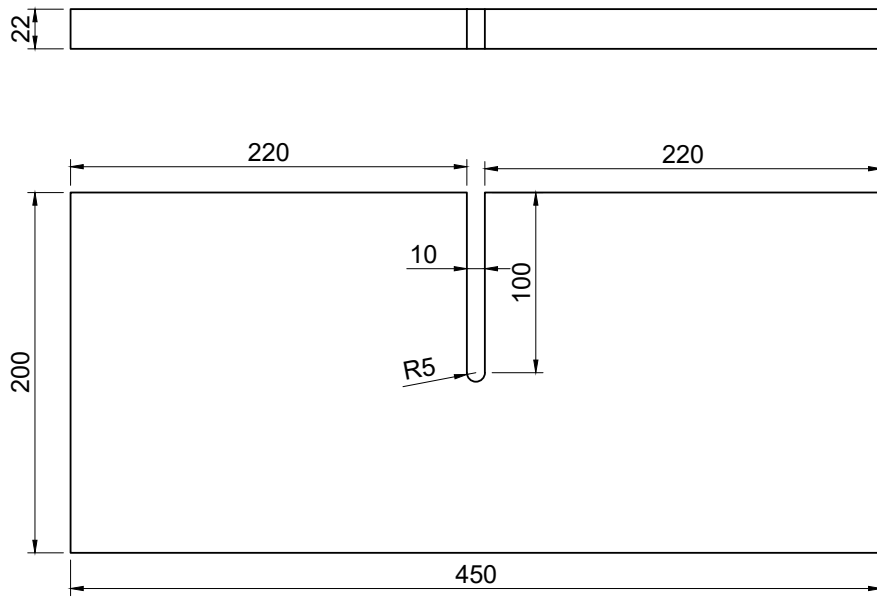


Figure 12: Basket support

J.1.d. BEACONS SUPPORTS

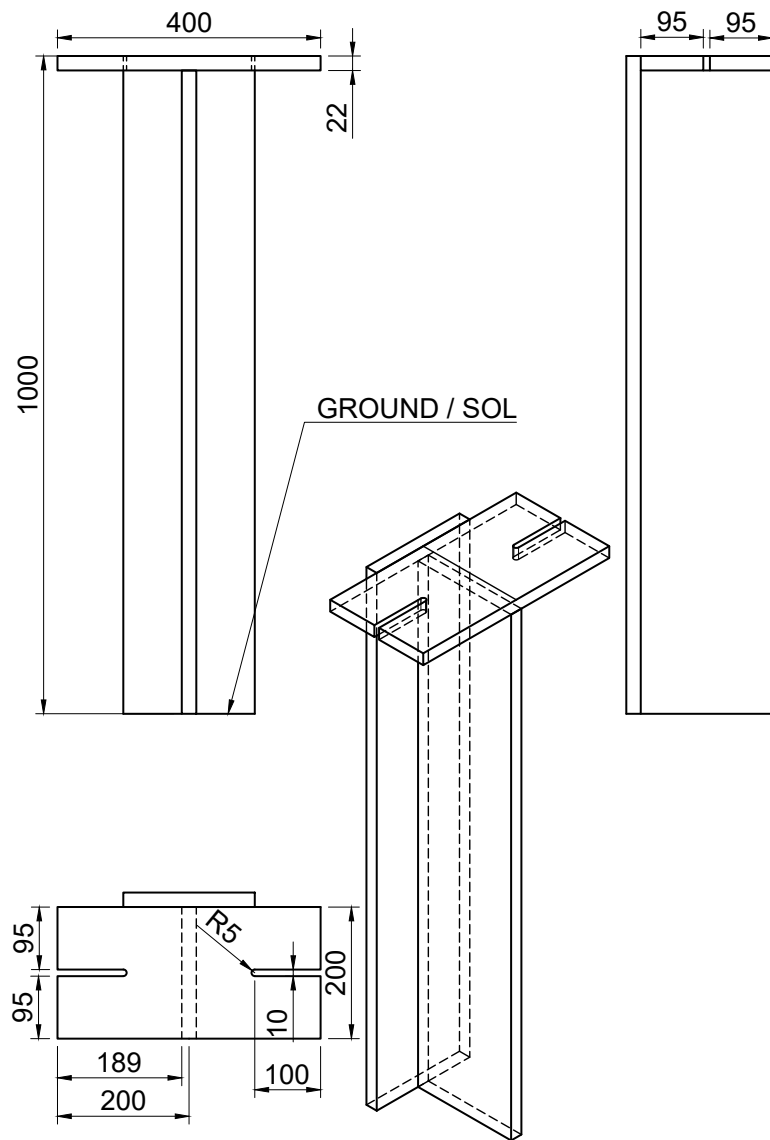


Figure 13: Central tracking device platform

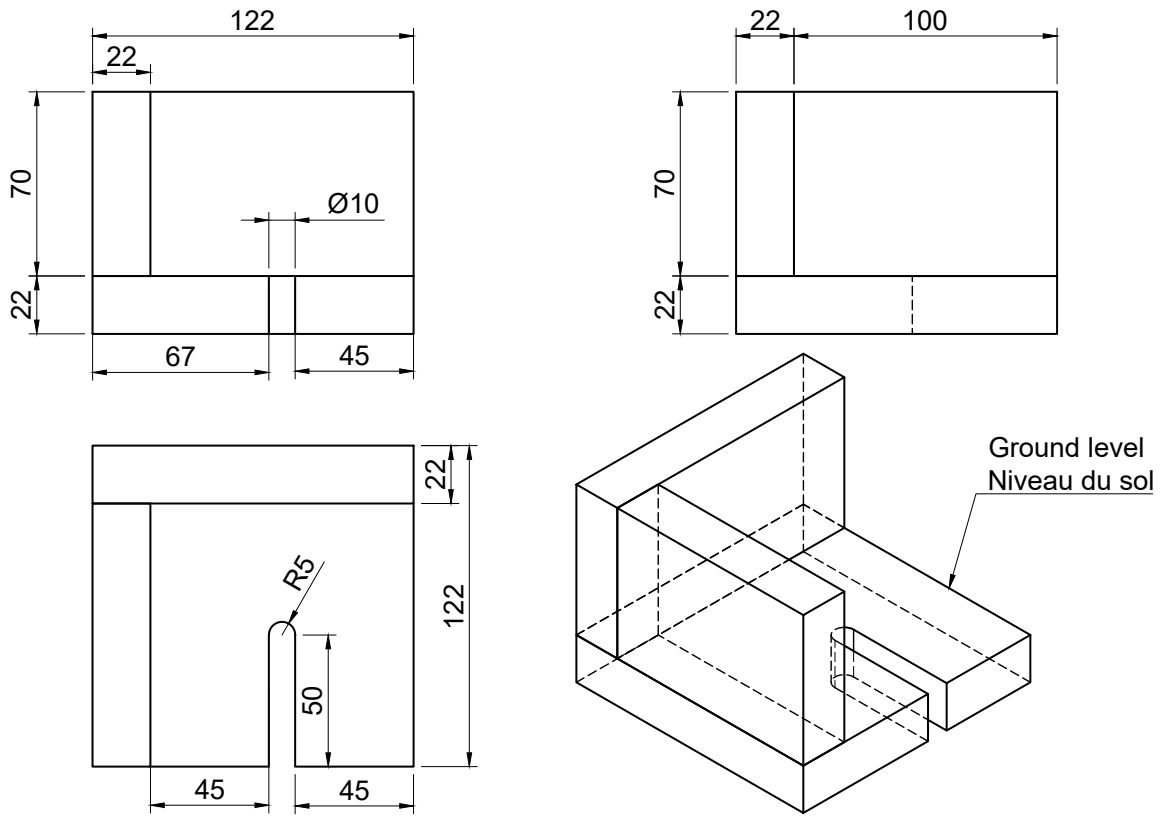


Figure 14: Left fixed beacon support

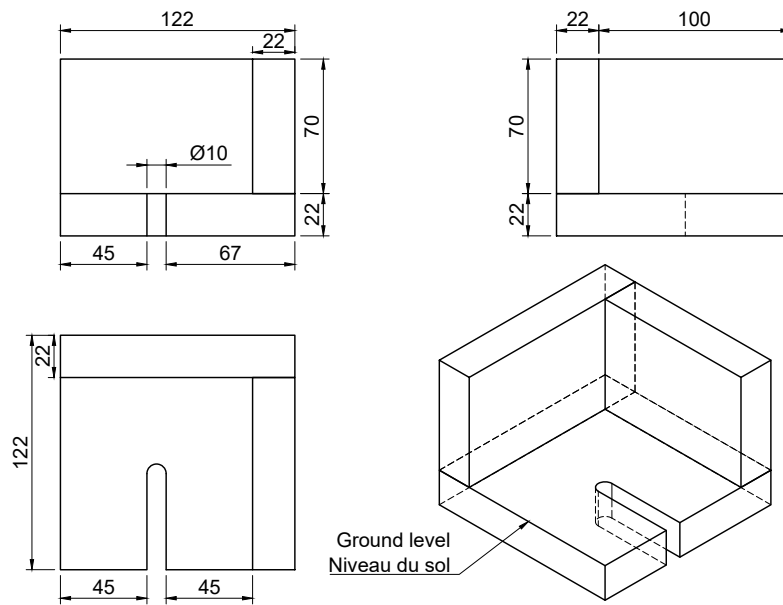


Figure 15: Right fixed beacon support

J.2. MATERIAL REFERENCES

Elements	Material or reference	Comments
Cake layer	Polyurethane foam board - Printed monomeric gripping vinyl	The cake layers can be composed of multiple layer of glued foam board
Game floor	Printed monomeric gripping vinyl	Ordering information will be provided by Planète Sciences
Showroom	Wood cover by printed monomeric gripping vinyl	
Beacon support	Wood cover by printed monomeric gripping vinyl	
Cherry	Red foam balls compatible with Nerf Rival TM	22.5mm in diameter on average
Distributors	Painted wood	
Robot identification marker	Polystyrene - Plastic - Vinyl - Velcro TM	

J.3. MANUFACTURING TOLERANCES

All dimensions are in millimeters (or mm). Manufacturing tolerances shall comply with the following rules, unless otherwise specified directly on the drawings.

Dimensions	General Tolerances
≤ 20	± 1.50
> 20 and ≤ 70	± 2.50
> 70 and ≤ 150	± 4.00
> 150	± 5.00

No objections regarding differences in dimensions will be taken into account.

The material's density can change from one country to another. It is highly recommended that the teams try different types of materials since the weight may differ significantly.

J.4. COLOUR REFERENCES

	Colors	References	CMYK
Team blue	Traffic Blue	RAL 5017 Mat	100% , 60% , 0% , 10%
Team green	Mint green	RAL 6029 Mat	100% , 5% , 90% , 30%
Cake layer 1	Telemagenta	RAL 4010 Mat	15% , 100% , 15% , 10%
Cake layer 2	Traffic yellow	RAL 1023 Mat	0% , 25% , 100% , 0%
Cake layer 3	Mahogany brown	RAL 8016 Mat	40% , 80% , 70% , 70%
Borders and non-colored elements	Pebble grey	RAL 7032 Mat	15% , 10% , 25% , 20%

RAL hues can vary from a printed soil mat to another.