

# Moon Village!

*Moon destination!*



**Note:** All the pictures in this document are provided for information. They cannot be used as references. Dimensions, colors and materials listed in the appendix are the only to be considered.





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## A. Contest presentation

Eurobot<sup>open</sup> and Eurobot<sup>open</sup> Junior are two events open to young robotics teams of amateurs. These teams can be composed of students involved in Eurobot<sup>open</sup> in the frame of a school project, group of friends, or independent clubs. Eurobot<sup>open</sup> and Eurobot<sup>open</sup> Junior share the same goal: to allow young people to be involved in an active-learning process and put into practice their knowledge and know-how by participating in a fun and friendly event.

### About Eurobot<sup>open</sup>



The age limit for participating in the Eurobot<sup>open</sup> final is 30 years old. Each team may have a supervisor to whom the age limit does not apply. Teams that do not respect this age limit will not be allowed to participate in the Eurobot<sup>open</sup> final. The technical challenge is to build an autonomous robot as well as an optional secondary autonomous robot.

### About Eurobot<sup>open</sup> Junior

The age limit for participating in the Eurobot<sup>open</sup> Junior final is **18 years old**. Each team may have a supervisor to whom the age limit does not apply. The technical challenge is to build a **remote controlled robot** as well as an optional autonomous robot.



**Be careful**, according to your country's educational system, this age limit may be slightly different. Check the registration requirements stated by your National Organizing Committee.

A team is a group of young people who have built one robot (and optionally a secondary robot) for the event.

One person can be part of only one team, **even if several teams can belong to the same organization**. However, we encourage teams to share their expertise. The project can be supervised by someone over the age limit (teacher, parent, group leader, etc.), but the robot **must be designed and built completely by the team's members**, not the supervisor.

One 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.

Eurobot<sup>open</sup> and Eurobot<sup>open</sup> Junior are intended to be held in a friendly, sporting and fair-play spirit. As for every sport events, refereeing decisions are pronounced with no possible recourse, except if an agreement between each participant is met.

Eurobot<sup>open</sup> and Eurobot<sup>open</sup> Junior European finals gather teams which are selected on national finals. These final events take place in Europe, but remain open to all other countries. Countries where more than three teams are registered must organize a national qualification<sup>1</sup>, in order to select teams among registered teams that will attend the international final.

<sup>1</sup> National Robotic Cup for Eurobot<sup>open</sup> or National Robotic Challenge for Eurobot<sup>open</sup> Junior



As usual, some parameters can vary from one year to the next. Accordingly, please read the rules carefully even if the chapters may seem familiar to you (playing field dimensions, robots dimensions, starting area dimensions etc.).

The rules for both events (Eurobot<sup>Open</sup> and Eurobot<sup>Open</sup> Junior) are similar. The aim of this approach is to provide an almost common platform for the Eurobot<sup>Open</sup> event, dedicated to autonomous robots, and for Eurobot<sup>Open</sup> Junior event, dedicated to wire-guided robots. Thus, a Eurobot<sup>Open</sup> organizer also has the ability to organize a Eurobot<sup>Open</sup> Junior contest, and vice versa. Think about it when you will organize an official or friendly event.

**WARNING!** : This document presents the Eurobot<sup>Open</sup> and the Eurobot<sup>Open</sup> Junior 2017 rules. To distinguish between them, you will find information dealing with Eurobot<sup>Open</sup> in **blue** and Eurobot<sup>Open</sup> Junior in **yellow**. Information common to both rules is in **black**.



## B. Theme presentation

Humanity has long been fascinated by the Moon. Our natural satellite, even if it's difficult to reach as situated averaging 238 897 miles away from the earth, has an important influence on our planet and way of life. Without the Moon, we would have almost no tides.

To date, 12 men had the chance to walk on the Moon. The first and most famous one was Neil Armstrong followed by Buzz Aldrin on June, 21<sup>st</sup> 1969. The last Apollo mission dates back to 1972, 44 years ago!

Since then many projects have been studied, like the construction of a permanent Moon base in 2008.

It would allow for a better scientific exploration of the Moon but could also be used as a launch station to reach Mars, further planets and asteroids in our solar system. The low gravity of the Moon, 6 times less important than the one of the Earth, facilitates to process of a rocket launch.

A lunar base would also open up the possibility of titanium ore extraction, a rare mineral on Earth.

In March 2016, ESA (European Space Agency) has revealed its Moon Village project which will take place in 20 years. The goal is to build a permanent plant on the Moon surface with resources gathered in situ. An international collaboration program will bring together the knowledge and competencies over multiple disciplines of all the countries involved. The Moon Village project would be the first step towards men's facility in space.

It is within this context that your robots will set out to conquer the Moon!

Your mission, should you accept it, will consist of:

- Collecting titanium ores extracted from the lunar soil and collecting lunar modules sent back from Earth by rockets.
- Building a Moon base with the help of the lunar modules sent from Earth and the ones already presents on the Moon.
- Funny action: launching a spacecraft in order to prepare flights leaving for planet Mars.

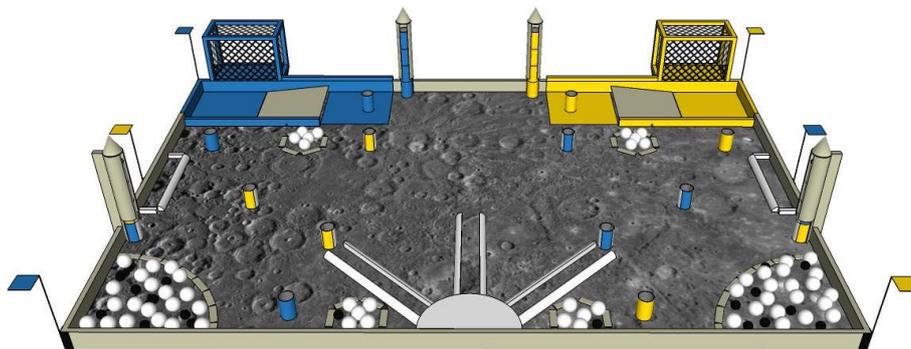


Figure 1 : Overview of the playing area with game elements

### Watch out:

All actions are independent from one another and no specific sequence is imposed whatsoever.

No single action is compulsory. Give careful thought to your strategy.

## C. Playing area and actions

### 1. Important information:

Organizers commit themselves to build the playing area with as much accuracy as possible. Nevertheless, they reserve the right to some modifications if they think it is necessary.



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

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.

Teams are advised that the quality of the painting on surfaces can vary from one table to another, and can deteriorate as time goes by.

If any problem regarding the rules occurs, the specifications of the playing area and its elements could be changed during the year. We therefore strongly encourage the participants to check our website regularly (<http://www.eurobot.org/>) as well as your NOC's own website for news. You can also follow the discussions and get further information in the forum (<http://www.planete-sciences.org/forums/>).

The answers in the forum are provided by an official referee and are taken into account during match plays and approvals rounds.

### 2. Playing area

The playing area is a 3000x2000 mm rigid rectangular flat surface, which can be made in two parts of 1500x2000 mm or more. References are provided in the appendix.



**Warning: this year, the Eurobot<sup>open</sup> Junior playing area is not 10% tilted towards the public, but it is horizontal like the Eurobot<sup>open</sup> playing area.**

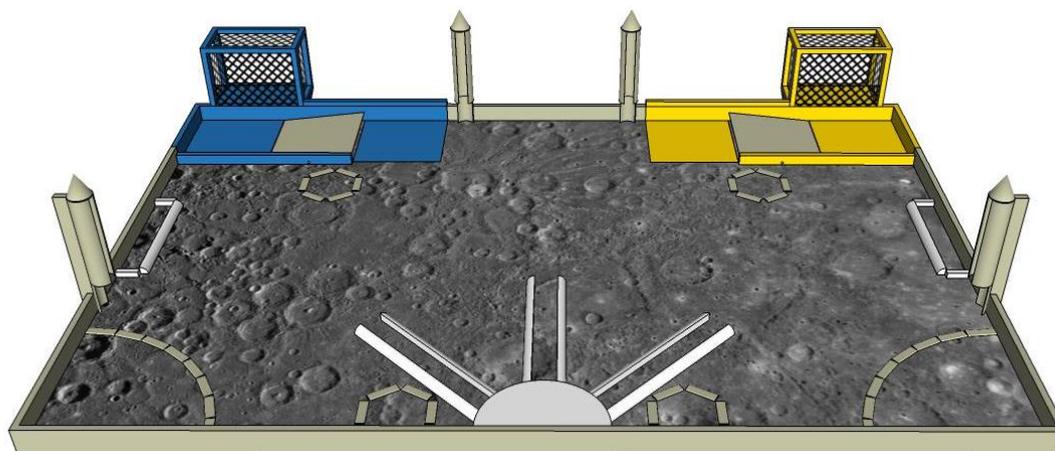


Figure 2 : Overview of the playing area without any elements



**Full specifications of the playing area and game elements (dimensions, positions at the beginning of the match, colours and other references) are listed in the appendix.**

In the rest 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.

### 3. Starting areas

#### a. Description

Once on the Moon, the robots get out of their spaceship.

Each team has a starting area divided in two distinct areas by a spaceship door represented by a seesaw:

- Area #1: located in the back corner of playing field
- Area #2: located on the back of the playing field and on the opposite of the seesaw with respect to area #1.

The only position of the seesaw is the complete low position from the area #1 of the starting area.

The starting areas are in the colour of the team. Borders are also in the colour of the team, and are included on the starting area.

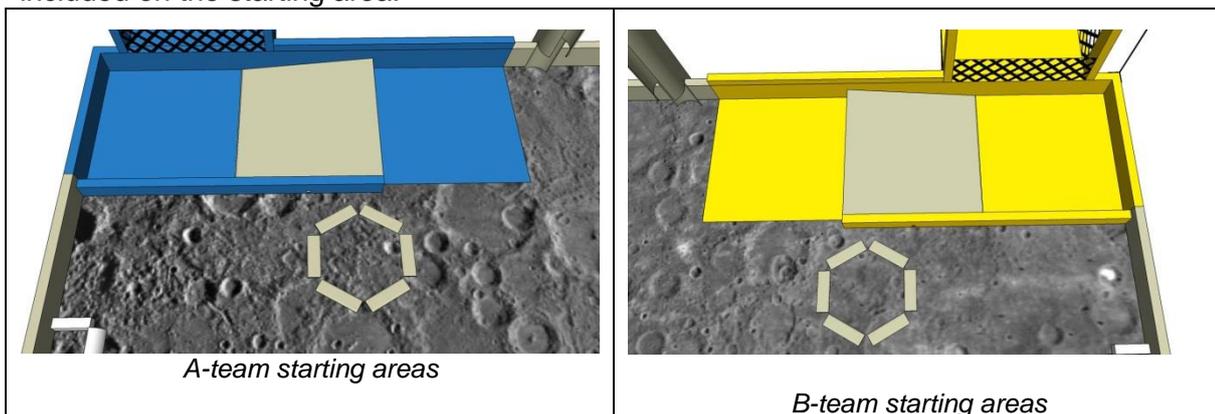


Figure 3 : overview of starting areas

#### b. Constraints

Before the start of a match, the projected shape of the robots vertically on the playing area must fit entirely within the limits of the starting areas. Please make sure that your robots can stand side-by-side in the starting area.

The seesaw and the basket are not included in the starting area.

A robot can stand alone in a starting area or share the area with a second robot.

If a robot is initially placed in area #2, the game elements that should normally be located in this area are removed from the playing area. These elements can also be removed before the match on a decision by the team.

The robots are not allowed to enter the starting areas of the other team.

#### 4. Collect titanium ores and lunar modules

To build a moon base, the robots need a few elements to complete their work: mining titanium ores extracted from the soil and lunar modules sent from Earth.

##### a. Description of the game elements and layout

- **Ores:** they are titanium ores represented by white balls.

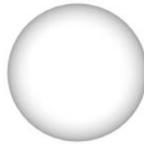


Figure 4 : Overview of a titanium ore

- **Moon rocks:** they are mixed with the titanium ores and are represented by black balls.



Figure 5 : Overview of a moon rock

- **Craters:** they are zones delimited by border segment, either of hexagonal shape or a quarter of a circle. They contain titanium ores and moon rocks.
  - o Each crater near the starting areas contains five titanium ores.
  - o Along the front border of the playing area, each crater contains five titanium ores and one Moon rock.
  - o Each crater in front corners contains 20 titanium ores and eight moon rocks.

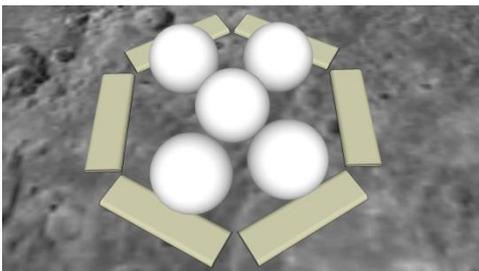


Figure 6 : Overview of a small crater

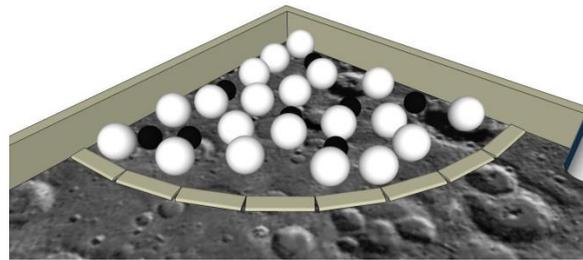


Figure 7 : Overview of a big crater

**Rockets:** The four (4) rockets are:

- Located like that:
  - Two (2) rockets located on the back of the playing area
  - Two (2) other rockets located on each side of the playing area, just near the great craters.
- Composed of half opened tubes surmounted by a top fairing. The rockets contain the lunar modules.

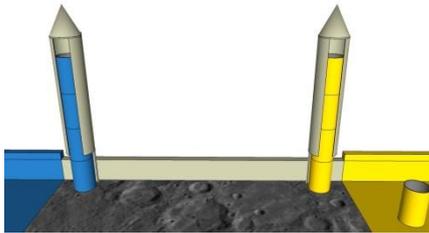


Figure 8 : Overview of "full" rockets

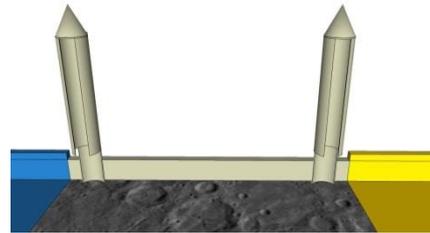


Figure 9 : Overview of "empty" rockets

- **Lunar modules:** they are represented by tubes and are distinguished in several categories :
  - Eight (8) monochrome lunar modules, uniformly painted with the colour of the teams.
  - Ten (10) multicoloured lunar modules, with yellow and blue bands separated by white colour. The positions and orientation of the lunar modules at start of the game are well-defined and detailed in appendix.

Lunar modules located in multiple places:

- In rockets :
  - Each rockets contain four (4) lunar modules
  - Each back rockets contain monochrome lunar modules
  - Each lateral rockets contains multicoloured lunar modules
- One (1) lunar module of the team colour is placed in the starting area #2 that is if no robot is placed in this area at the start of the game and if the team wishes to keep the module in there.
- On the moon surface, there are two (2) blue lunar modules, two (2) yellow lunar modules and six (6) multicoloured lunar modules.



Figure 10 Overview of a monochrome lunar module

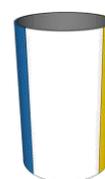


Figure 11 : Overview of a multicoloured lunar module

- **The shuttle:** it is composed of :
  - One cargo bay represented by a "basket"
  - The starting area representing the airlock of the shuttle of the team.

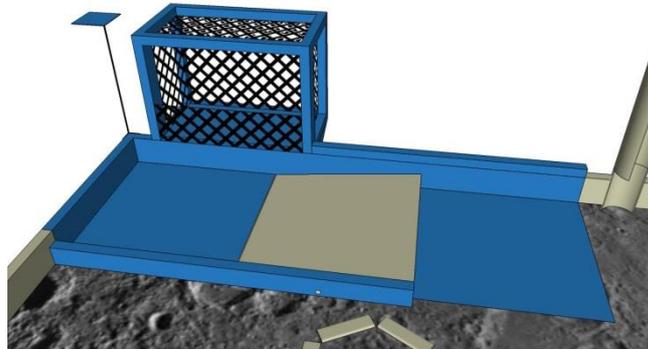


Figure 12 : Overview of a shuttle of the team

### b. Actions and constraints

#### Actions:

- Bring a maximum of useful resources (lunar modules and/or titanium ores) in the shuttle of the team.

#### Constraints:

- The starting area of each team cannot have more than ten titanium ores or moon rocks at most.
  - Moon rocks are counted before titanium ores.
  - All excess titanium ores and all excess moon rocks will not be counted
- No count limit applies to titanium ores or moon rocks in the shuttle cargo bay.
- The robots are not allowed to go in the shuttle of the other team. The robot cannot drop game elements in the shuttle of the other team, and cannot remove game elements from the shuttle of the other team.

### 5. Building the Moon base.

The robots shall assemble a moon base with the help of the lunar module to provide shelter to the first human residents. The lunar modules are more useful in the Moon base than in their storage area.

#### a. Description of the game elements and layout

- **Lunar modules:** tubes, as described here above (part C.4.a).
- **Slots for lunar module:** they represent the slots where moon base shall be assembled. They are delimited either by quarters of circle or by the playing area borders.

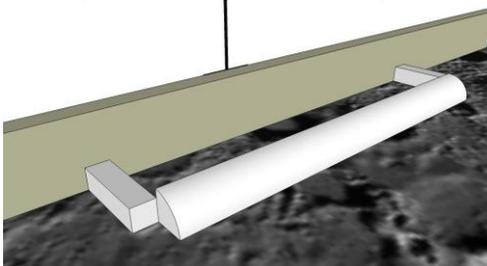


Figure 13 : Overview of a lateral slot for the lunar modules

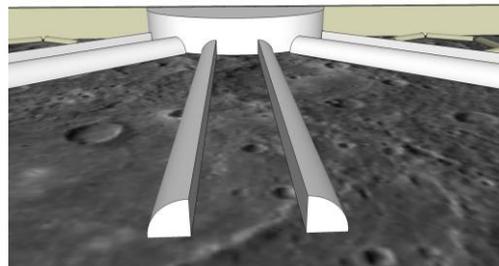


Figure 14 : Overview of the central slot for the lunar modules



### b. Actions and constraints

#### **Actions:**

Robots shall place lunar modules in their slots. Once a lunar module is in place, the robot shall check that the colour of its team is on the visible part of the lunar module (on top).

#### **Constraints:**

To be valid, a lunar module shall:

- Show its team colour on its visible part.
- Have its revolution axis horizontal.
- Be located in a lunar module slot and be in contact with the lunar soil.
  - A lunar module counts if at least its half-length is inside the place.

Teams are not allowed to remove a lunar module already present in a slot, but a lunar module can be spun in place or flipped to change its apparent colour (the colour on the top).

### **6. Launch a spacecraft (funny action)**

The robots now successfully have built the Moon base! Their last mission is to launch a spacecraft towards Mars!

#### a. Description of game elements and layout

- **Spacecraft:** element provided by participants. It is preloaded on the main and/or secondary robot.

#### b. Actions and constraints.

#### **Action:**

The robot shall launch a spacecraft vertically upwards with the 5 seconds launch window after the regulatory game time of 90 seconds (seconds 90 to 95).

#### **Constraints:**

- Spacecraft weight shall not exceed 50g.
- During the match, the spacecraft shall not exceed the regulatory height of 350mm applies to the robot.
- The spacecraft perform a complete separation from the launch robot. The spacecraft shall reach at least 450mm altitude above lunar soil and shall not exceed an altitude of 2m above lunar soil.
- Only one spacecraft launch (funny action) will be counted per team.

#### **Notes:**

- To boost creativity and increase the value of the show, the spacecraft can be equipped (within the limits of the constraints presented above) with a parachute; wings, or any other upgrade reminding of a spacecraft or a capsule.
- Reminder: as for every game element or robot action performed, the spacecraft launch (funny action) shall not expose the public to any danger. Make sure responsible propulsion system and spacecraft are used!



## **D. Project presentation**

Both Eurobot<sup>open</sup> and Eurobot<sup>open</sup> Junior encourage you to practice science through entertainment. One of the fundamental objectives is to assist and value your work and projects of this year. To achieve this, we require you to make a Technical survey and a Poster.

It is demanded to create attractive robots and, if possible according to the rules theme. To be creative and original will add value to your effort as much as the performance of your robot(s) is (are) during the matches. That will increase the value of your project communication and visual effect of your robots, for both the public coming to the events and for your own satisfaction of having created something aesthetically and functionally completed.

### **1. Eurobot<sup>Open</sup> technical poster**

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

Special vulgarization effort should be made to render the contents of the poster accessible to a novice audience. The poster should ideally include pictures and charts to explain the concepts.

The poster must also include:

- The name of the team,
- The names of team members,
- The country of the team

The poster will be on display near the pit of the team during the event. An English version of the poster must be supplied. As an option, additional posters in other languages can be displayed as well. The poster must be supplied to the Eurobot<sup>open</sup> association in PDF format.

The chosen resolution of the PDF must guarantee that all texts on the poster will remain readable. If possible, the file size of the PDF should remain below 25 MB. The PDF version of the poster may be sent to Eurobotopen beforehand via your National Organizing Committee. It may also be provided on CD-ROM or USB key during the contest when presenting your robots for the approval.

Overall we strongly encourage the teams to discuss their projects by posting information on the internet or for example in the Eurobotopen forums.

### **2. Eurobot<sup>Open</sup> Junior**

As for previous years, the presentation of your team's project (through project management on the long-term, tasks distribution ...) as well of your robots (technical systems implemented, chosen strategies ...) is an integral part of the event. Teams should present their projects in a way that is easily understandable and visible for the public and the other participants.

#### **a. Constraints**

This presentation should be done on a poster with a size of at least DIN A1 (594x841 mm). It is also possible to add further presentation supports (like video). Be creative!

We suggest the teams to create a blog explaining the steps in the development of the robot.





The blog will be created automatically when the team completes registration on the Poolzor web page. The procedure will be explained in details on the Poolzor blog step. Writing in a blog is not compulsory to validate your registration, but we strongly encourage the teams to make it to favour the collaboration and sharing around their projects.

#### **b. Evaluation**

The project should be presented to the referees and/or “guardian angels” during the approval of the robots in order to show the whole work. This presentation will be taken into account for the approval process. During the event, a jury will examine all the posters and discuss with each team, in order to choose the team that will be receiving the “award for best presentation”.



## E. The robots

### 1. Foreword

Each team is allowed to register a maximum of two robots which are referred to as the “main robot” and the “secondary robot”. The secondary robot has different dimensional constraints.

For Eurobot<sup>Open</sup> Junior, the main robot is wire-guided and the secondary robot is autonomous.

For Eurobot<sup>Open</sup> both robots are autonomous.

The construction of a secondary robot is optional. For beginner teams that are new to Eurobot it is recommended to focus on building a single functional robot. In general it is better to have one working robot instead of two robots that are barely finished. Having a secondary robot allows larger teams with more members to split their work into two projects.

The secondary robot can participate only with the main robot it has been created for and approved with. However it can participate alone if the main robot cannot participate. It cannot be re-approved with another robot.

A robot must not damage the opponent, the playing area or its elements.

During the contest, only two members per team are allowed in the backstage area and on stage. The path to the stage may contain steps or stairs. It is therefore suggested that your equipment be easily transported.

Both the main and the secondary robots must each consist of interconnected parts. Hence they are not allowed to leave or lose any parts on the playing area with the exception of game elements.

The use of objects, graphics or colours resembling the table or its game elements is against the idea of fair-play and must not be used on the robot(s). This point will be checked during the approval.

The robots are not allowed to attach to the playing area (for example by suction).

The robot(s) shall never prevent the opponent’s robot(s) from scoring points, in particular blocking the access to game elements. If a robot is motionless after for example finishing a task it should clear the area. However, blocking the access to already scored points is allowed.

A game element can be moved:

- In order to score some points with it.
- When the game element is moved during the achievement of an action, for example if a common element is on the way of the robot. The number of element moved must be lower as possible.

The use of blowers to move the playing on the table is not allowed.

Deliberately making the table vibrate or other similar actions will not be approved. If you are in doubt please contact the referees.

Use your imagination and be creative! Your robot can show emotions, play sounds or music to provide the audience and media with an attractive show.

## 2. Dimensions

The dimensions of the main and the secondary robot in Eurobot<sup>Open</sup> are identical to the ones in Eurobot<sup>Open</sup> Junior. Thus, a robot built for Eurobot<sup>Open</sup> Junior can potentially compete in Eurobot<sup>Open</sup>. The Eurobot<sup>Open</sup> Junior robot would only need to be modified in order to be autonomous.

### Dimensions of the main and the secondary robot:

The perimeter is measured according to the figure below:

Dimensions of the main robot:	Dimensions of the secondary robot:
 <p>Start configuration ≤ 1200 mm</p> <p>Totally Deployed ≤ 1500 mm</p>	 <p>Start configuration ≤ 700 mm</p> <p>Totally Deployed ≤ 900 mm</p>

The perimeter of the main robot must not exceed 1200 mm at the beginning of a match. This is called the “starting configuration”. During the match the robot may deploy to a maximum perimeter of 1500 mm which is called the deployed configuration.

The secondary robot’s perimeter is independent from the main robot’s perimeter. At start it must not exceed 700 mm but can extend up to 900 mm in the deployed state during a match.

In any case the height of the main robot and the secondary robot must never exceed 350 mm. The emergency button is allowed to exceed this limit but must stay below 375 mm in height.



**For Eurobot<sup>Open</sup>** this height excludes the beacon support, sensors and electronic circuits that can be placed below the beacon support.

No components of the robot and game elements manipulated at any moment by the robot should exceed 350 mm in height, in order not to disturb the beacons.



**At the beginning of a match the vertical projection on the playing area of both robots in the start configuration shall fit inside the starting area and may not exceed its limits.**

## 3. Energy sources

In general, all forms of energy sources stored in the robot are allowed (batteries, springs, compressed air, gravitational energy...). Energy sources using chemical reactions like combustion or pyrotechnic processes are prohibited for safety reasons. Any corrosive products or other liquids that prone to leaks are not allowed for the same reason. It is also prohibited to use living beings inside the robot.

If you have any doubts about an unusual energy source, please ask the referees in time and sharing with them the corresponding datasheets.

To prevent any risk of fire, special attention should be paid to the choice of electric wires, depending on the intensity of current passing through them. It is also recommended to protect the wiring and components with fuses placed as close to the battery leads as possible.



### For Eurobot<sup>Open</sup> Junior:

**Beware!** Power supply systems must be easily transportable. Teams may have to walk up/walk down stairs to access the stage where the matches take place.

Only electric energy can be transmitted to the robot by the cable. The maximal voltage allowed is 13.8V (measured between two wires of the cable and of the robot). The organizers do not provide this energy source during the event. Teams will have access to the standard 230V, 50Hz. In case of battery use, batteries should be water resistant. The leads must be insulated.

### **Batteries**

If the team makes the choice to use batteries as an energy source, we remind that only airtight batteries can be used.

Both robots must be able to play at least three matches consecutively. Please note that this also includes the time during the preparation phase before the match itself.

During the preparation phase the robots have to remain in stand-by until the start signal is given. For details on the procedures of a match please take a look at chapter “**G. Match procedure**”.

Therefore, it is strongly recommended to have several sets of batteries with the possibility to **change them easily** without too much effort. It is also very advisable to keep a set of batteries fully charged at any time.

### **Special note for batteries based on Lithium:**

These types of batteries are permitted only under strict conditions:

- A charger suitable for the batteries in use must be presented during the approval.
- The batteries must remain inside certified and unaltered safety bags at any time. (This also includes the time when they are not in use or being recharged)
- A system to detect and prevent undervoltage is strongly advised.
- Those restrictions do not apply if the batteries are inside commercial products such as laptops, mobile phones or LEGO NXT and only if they are not altered or modified in any way.

## 4. **Design constraints and mandatory equipment**

### a. **Common part**

#### 1. **Visibility**

Two rectangular areas of 100x70 mm shall be free on at least two visible faces no matter which ones of the robot. Teams will receive stickers printed by the organization (team numbers, event sponsors, etc.) to be placed on these two free rectangular areas.

The teams are strongly encouraged to make the mechanism inside the robot visible from the outside of the robot. The goal of this advice is to allow the audience and other participants to see how elements are moved and carried in the robot. It is in the spirit of education and knowledge transfer to understand how the robots work.

#### 2. **Starting cord of autonomous robots**

The robots have to be equipped with a starting device which shall be accessible on the robot. This device has to be triggered by pulling a cord of length 500 mm or above. This cord will not remain



attached to the robot after the start. Any other devices like a remote control, manual activation by a switch, or the release of the emergency button will not be approved.

If two robots are used, starting the robots with only one cord on one of them is allowed.

### 3. Emergency stop button of autonomous robots

The autonomous robots must be equipped with an emergency red stop button that is at least 20 mm in diameter. **It must be placed on top of the robot in a location that can be accessed safely by the referees at any time.**

The button in the released state may exceed the height limit of 350 mm by an additional 25mm.

A simple downward movement, for example by the hit of a fist, must trigger the emergency stop.

Pushing this button shall stop all actuators of the robot immediately.

### 4. Automatic shutdown (optional for Eurobot<sup>Open</sup> Junior)

Both robots must be equipped with a timer that stops the robot and its actuators after the 95 seconds of a match.

### 5. Obstacle avoidance system (optional for Eurobot<sup>Open</sup> Junior)

Teams shall equip their robots with a device to detect opponent robots.

The objective of such a system is to prevent collisions between robots during a match.

This point will be strictly verified during the approval. Referees will pay close attention to unfair teams which deactivate their avoiding system after the approval. The deactivation on purpose of avoiding systems might lead to the disqualification of the entire team.

**Warning:** Most events are filmed or photographed. Some cameras use autofocus systems with infrared light that could have a negative effect on the sensors of your robot. Please make sure your system is robust against these perturbations.

## b. Eurobot<sup>Open</sup>

### Beacon support

It is strongly recommended to equip your robots with a beacon support. Its purpose is to allow the opponent to put a beacon on top of each of your robots to be able to detect it.

This support can be made removable to be mounted only if needed. In that case the teams must be able to set it up quickly prior to a match.

The beacon support is optional. A team can also choose not to equip their robots with it. In a match with an opponent relying on putting a beacon, your robot will not be allowed to participate. It will be considered a forfeit for your team.

The beacon support should at all times comply with the following specifications:

- It needs to have an 80x80 mm square surface, located at 430 mm above playground level. This is where the opponent's beacon will be placed.
- The surface of this platform has to be entirely covered with the hook side (the rough one) of hook-and-loop tape





- The surface of the platform needs to be as close to the center of the robot as can be
- The mast under the platform must lay within the vertical projection of the platform
- Only sensors and electronic circuits can be embedded in the mast of the platform
- The mast shall offer firm stability and shall be able to accommodate beacons of mass 400 g or above

2017 specific feature:

When a robot pass throw the seesaw and the crater edges, the beacon support is temporarily allowed to lightly be higher than the 430mm high fixed.



### c. Eurobot<sup>Open</sup> Junior

#### 1. Main robot control system

Each team must design a control panel for its main robot that may only be operated by a single pilot. The control panel is an in-box system allowing the control of all the electrical devices of the robot. It is the only allowed communication device with the robot. As a consequence, any other remote control device is strictly forbidden.

#### 2. The cable

The electric cable linking the robot to its control panel is not provided; it must be designed and created by each team, according to its own needs.

The electric cable linking the socket and the power supply should be at least 2 meters long.

For reasons of sufficient mobility on the playing area it should be at least 5 meters long. It will be supported by the co-pilot with a pole provided by the organizers.

In order not to lie around on the playground, the electric cable must have to go out through the top of the robot.

During the match, the co-pilot should neither interfere in the piloting nor with the settings of the robot (like the voltage for example). In this way, only the pilot can trigger the secondary robot starting.

Furthermore, the cable must not be used to guide the robot or to put it upright again after it fell down. Such actions will result in a penalty.

#### 3. Secondary robot control system

Teams can use any kind of control system for their secondary robot (analogue, microprocessor-based, microcontroller-based, embedded computer, programmed...).

These systems must be entirely embedded in the secondary robot.

The control system must allow the robot to play a match in the role of both colours. Ideally, this technical point should be configured just before the match starts.



## 5. Safety

### a. General

All systems (i.e. robots and beacons) should comply with current national and European safety regulations. They must endanger neither the participants nor the audience during matches nor the pits or the backstage.

The robots must not have any protruding or sharp parts that can cause injuries or damage to the playing area, the game elements or other robots.

The use of liquids, corrosives, pyrotechnics and living components is strictly prohibited.

All robots must comply with the legal standards for “low voltage”. Therefore, **the internal voltage of the robots and beacons must not exceed 48 V.**

Voltages higher than 48 V are only allowed inside sealed commercial devices which comply with national and European regulations (such as lasers or LCD display back lighting). Those devices must be left unmodified and unaltered.

As a general rule, any device or system considered as potentially dangerous by the referees will be rejected. It must be removed from the robot prior to the competition, or will result in the disqualification of the team.

### b. Lasers

Only considerations based on the laser class definition “EN 60825-1:2007, Edition 2 -Safety of laser products– Part 1: Equipment classification and requirements” will be taken into account. Teams using a laser have to provide either the classification notice of the equipment or the laser component datasheet. Not being able to provide such a document will prevent the robot from being approved.

Based on this classification, lasers of classes:

- 1 and 1M are allowed without any restrictions
- 2 are tolerated if the projected spot is never projected outside the game area
- 2M, 3R, 3B and 4 are strictly prohibited

**Caution:** A laser device consists of the laser source, its electronics and the optics. Disassembling or modifying any of those components often leads to a change of classification. Only commercial products with unaltered components can be approved for Eurobot<sup>Open</sup>.

### c. Powerful lights

In case of use of a powerful light, light intensity shall not be dangerous for the human eye in case of direct exposure. Be aware that some LEDs are provided with a safety notice. Be responsible! Your machines runs in front of a public uninformed about these dangers.

In case of doubt the organizer has the right to ask for manufacturer specification to verify that the lighting system is not dangerous.

If the system is considered dangerous, it can be rejected similarly to laser systems of classes 2M or above.

### d. Compressed air system

The pressure in systems using compressed air may not exceed 400kPa (4 bar).

## F. Beacon systems (specific to Eurobot<sup>Open</sup>)

### 1. General points

Teams can use beacons around the playing area and on the opponent robot(s) to design a system for localization. The table provides three support platforms for each team to place beacons on. These beacon supports are located on fixed positions as illustrated in the figure below.

All beacons, i.e. those around the table and on the opponent robot(s) must have hook-and-loop tape on the bottom side. It has to be the soft ("loops") side of the Velcro.

Beacons need to remain on their supports for the entire match.

All points regarding the safety of robots also apply to the beacons.

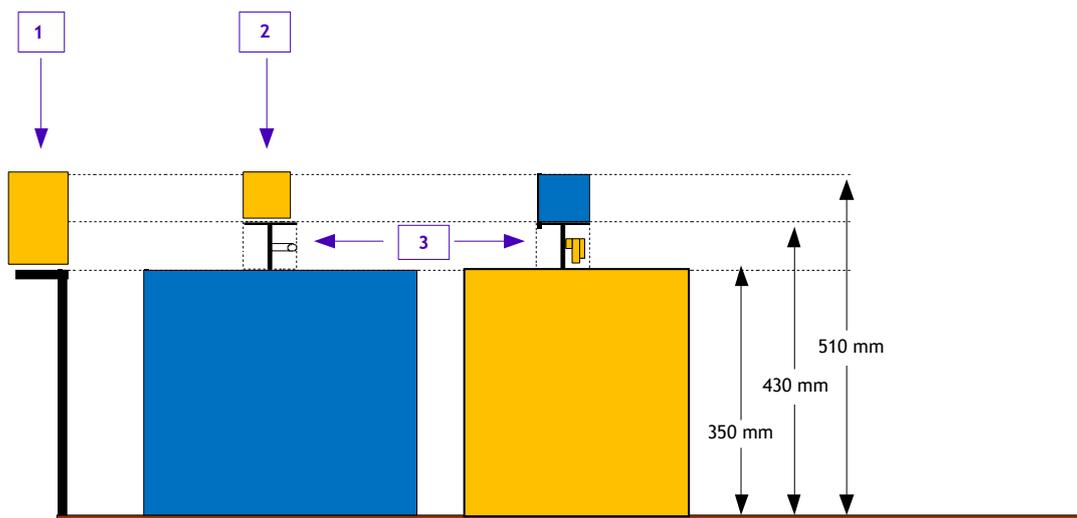


Figure 15 : Drawing of beacons positions on the robots supports and playing area supports

Legend:

- Item #1: Stationary beacon (maximum size: L x W x H: 80 x 80 x 160 mm)
- Item #2: Opponent beacon (maximum size: L x W x H: 80 x 80 x 80 mm)
- Item #3: Mast to support the platform. Sensors and electronics may be placed around the mast as long as they stay within the vertical projection of the platform

### 2. Opponent beacon

A beacon can be placed on top of each opponent robot. It can be used to localize the robot for the obstacle avoidance system.

This beacon must not exceed the size of an 80x80x80 mm cube. In the spirit of fair play the beacons may only contain components that are being put to use.

Additionally, opponent beacons also need to have hook-and-loop tape on the topside. It has to be the rough hook side of the hook-and-loop tape. During the matches a colour tag indicating the colour of the team will be placed on top of it.

The mass of a beacon shall not exceed 400g.

The top face of the beacon embedded in the robot must be covered with the rough hook side of hook-and-loop tape in order to support the colour tag placed by the organizers before a match.

### 3. Stationary beacon

Each team can place up to three beacons on three of the six stationary platforms around the playing area. Those locations are defined by the colour of the team in the match as illustrated in the figure below. The dimensions of the beacons must not exceed a cuboid with a base of 80 x 80 mm and 160 mm height.

The stationary beacons are allowed to be connected to one other by a cable. Such a cable must not interfere with the match in any way.

The setup of the whole stationary beacons system must fit within the 3 minutes time frame of match preparation and must not interfere with the opponent team in the process.

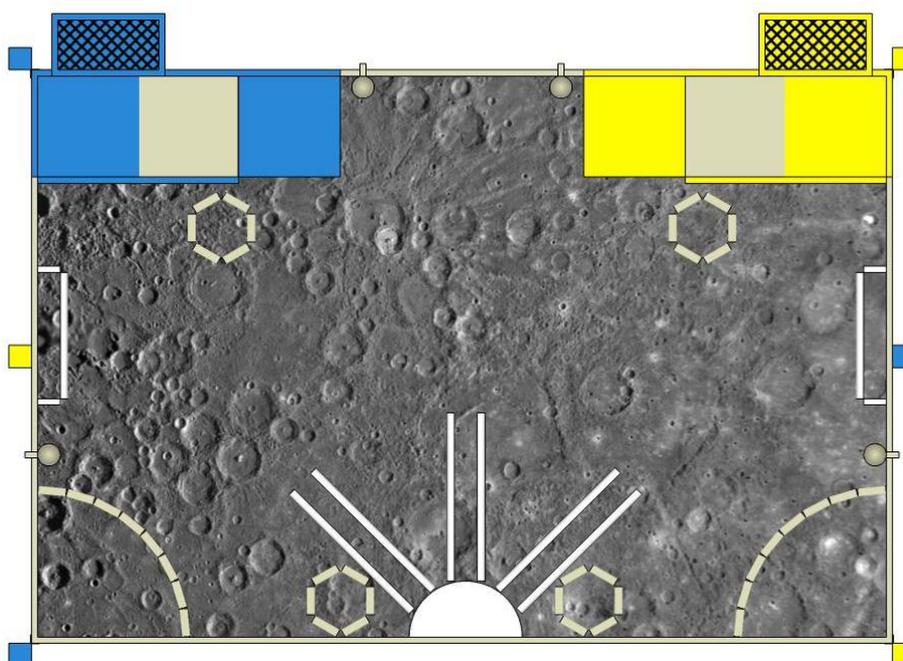


Figure 16 : Positions of the beacons on the playing area

### 4. Communication signals

It is recommended to encode all communications in order to limit the impact of interferences between the signals of the various teams.

The organizers use high-frequency radio devices and cannot be held responsible for any interference caused to the robots.

Special attention should be paid to the strong ambient light during the event, especially when using infrared or other optical devices. Furthermore, the ambient light may vary from one playing area to another or even during a match on a given playing area.

**Caution:** beyond the edge of the playing area, there may be third party items outside of the playing area that can disturb colour detection and communications signals such as:

- Decorative items of the playing area (reflections, etc.)





- People (referees, teams, etc.)
- Electronics systems (wireless microphones, cameras, etc.)

Under no circumstances will a request to remove decorative elements or people standing around the playing area be accepted

#### 5. Identification tag

Tags are assigned to the robots before every match. These tags have a negligible mass and are placed on top of the opponent beacon placed on top of the embedded beacon of your robot (or directly on the beacon support if no beacon is present).

The tags share the colour of the team and help the audience identify which team a given robot belongs to.



## G. Match procedure

The matches have a duration of 90 seconds + 5 seconds for the funny action.

Only two members of each team are allowed to access the stage and the backstage area.

### 1. The preparation phase

At first the game elements are put in place according to the illustrations found in appendix.

When requested to go to the playing table, the teams have 3 minutes to set up their robots and beacons.

Failing to meet this deadline may result in the team's disqualification (forfeit) from that match. In that case the opponent will play the match alone.

If both teams complete the setup within the 3 minutes time frame, the referees ask if the teams are ready for the match. From this moment on it is forbidden to touch their robots or beacons (except the starting cord)! No objection regarding the game elements or their locations will be accepted from this moment on.

If both teams are ready before the end of the 3 minutes preparation time frame, the match will start earlier.

### 2. The match

The referees will give the signal to start the robots after a "five-four-three-two-one-go" countdown. It is forbidden to touch the robots, the beacons, the playing area and its game elements unless explicitly allowed by a referee. This also includes pressing the emergency button! Failing to comply with that rule may result in a team's disqualification from that particular match (forfeit).

Any element leaving the playing area will not be allowed to go back to the playing area before the end of validation of the score after the match.

After 90 seconds of game the robots must have stopped moving and have all their actuators switched off except the ones required for the funny action.

After the end of a match, **no one except the referees** is allowed to touch the robots or the game elements. The referees count the points on a so-called match sheet and explain them to the teams. (Please take a look at the next section on how to count points.) If both teams agree with the result, they sign the match sheet, take their robots and leave the stage.

If one team does not agree with the result of the match it may present its arguments **calmly**, while the robots stay in place. Please remember that only two members per team are allowed on stage. The decision of the referees is final.

In case of judging difficult situations, the referees can decide to replay the match or not.

If for example all robots are blocked, the referees may announce an early match ends with both teams' agreement.

A team is forfeited of the match:

- When none of the robots of a team has completely left the starting area during the match
- When the emergency button has been pushed during the time of the match
- For other refereeing decisions.



### 3. The scoring

After the match ends, the referees will score match for each team following this scoring scale:

#### a. Collect resources

2 points for each coloured or multicolour lunar module in the starting area

2 points for each valid titanium ore in the starting area

3 points for each titanium ore in the shuttle cargo bay

Moon rocks don't score any point

#### b. Moon Base construction

10 points for each valid lunar module

#### c. Go to mars (funny action)

20 points if at least one spacecraft launch to Mars is successful.

#### d. Penalties

A penalty leads to **a loss of 20 points**.

A negative score will be counted as 0 point.

A game element held by the robot does not score any point. A game element is considered to be held by a robot if, by moving the robot along its main direction of motion, the game element is moved by the robot.

#### **Reminder:**



Penalties are intended to compensate for damages or disadvantages as a result of an incident during the match. A situation of penalty is considered as a non-compliance with the rules and should remain the exceptional case. A penalty may result in a forfeit for the team. The referees will also pay attention to the history of penalties given during the qualification phases (regional, national and also European).

#### e. Bonus points:

15 bonus points are given to every team that is not forfeited, i.e. teams that have won or lost the match.



## H. The contests

### 1. Forewords

The Eurobot<sup>Open</sup>/Eurobot<sup>Open</sup> Junior events are organized on three levels:

- **Regional:** where they exist (e.g. in France for Eurobot<sup>Open</sup> Junior), qualifications of teams for the national final,
- **National:** qualifications of teams for the European final,  
*Be aware that the number of team that can qualify has changed since last year!*
- **European:** the last uniting of teams qualified from European and world countries lived in a spirit of sportsmanship a friendship!

### 2. Approval

#### a. Pre-approval:

For a robot to participate in a match, it needs to be approved by a referee.

During the **pre-approval phase**, a referee checks that the robots are made in compliance with the rules.

Therefor the robots should be able to demonstrate all action it is capable of.

#### b. Approval:

The robots must demonstrate their ability to score at least one point under match conditions, i.e. in 90 seconds without the presence of an opponent team. The avoidance system and other equipment will also be tested during this phase.

If the main and optional secondary robots pass the tests, they are declared as approved. If only one out of two robots pass the approval, only the approved robot can participate in the matches.

#### c. Significant technical modifications after the approval:

If significant changes are made to a robot, e.g. in its function, structure or dimensions, a referee needs to be informed. The referee will need to approve the robot again and rerun some tests considered necessary.

### 3. Qualification phases

Each team should have the possibility of playing at least three matches during the qualification phase. The local organizers can also decide to play more matches which are normally organized in rounds.

In order to select the teams for the finals, a ranking based on the total points accumulated during the qualification phase is used.

If two or more teams have the same number of points, the teams will be ranked again by comparing their scores without considering the bonus points. If teams are still even, the referees may decide to organize extra matches. In that case, pairs of teams competing for the same ranking will be drawn at random and the winner of the resulting knockout matches will move on to the final rounds. In case of an odd number of teams, an opponent for the last team is drawn at random.

Points scored by the randomly chosen team will enter the ranking. In case the number of teams is odd, another match with teams chosen at random will be played along the same principle.

#### 4. The finals

After the qualification phase, the first 8 or 16 teams (depending on the number of approved teams) will participate in the finals.

Depending on the rules of the local contests, only the teams composed of people under 30 years old might be allowed participate to the finals.

The selection flowchart for the finals is illustrated below:

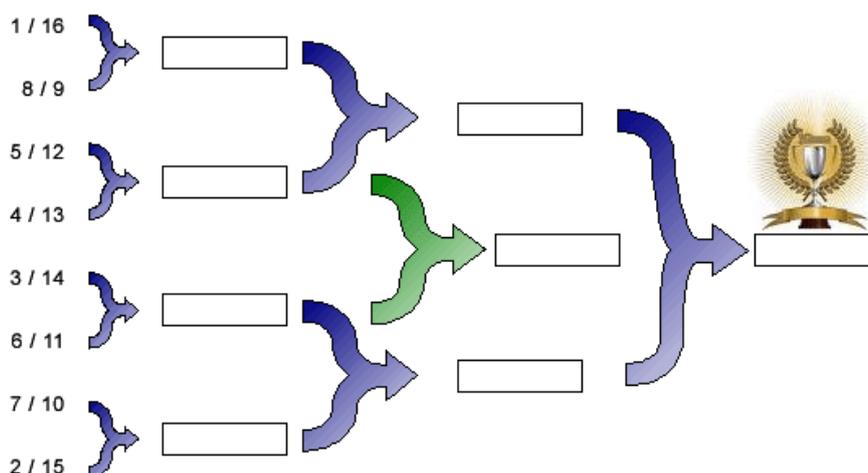


Figure 27: Selection flowchart of the finals

In this phase the matches are played as knockout matches, i.e. only the winning team moves on to the next round.

If a winner cannot be determined (double forfeit or draw) the match is replayed immediately. In case the situation is still unresolved, the points scored during the qualification phases will be taken into account to determine the winner.

The final match for the first place is played as “best of three”. The team that first wins two matches wins the match. Make sure your batteries can cope with three consecutive matches.

#### 5. Qualification for the national finals

Where the regional competitions exist (e.g. in EurobotOpen Junior in France) the number of teams that can qualify for the national competition is proportional to the total number of teams on national level.

The results of the qualification rounds are used to select the teams for the national finals.

Final rounds can still be played to define the regional champion. This champion is not necessarily qualified for the national competition!

At least one team receives a special award (for example for creativity, fair play, best presentation, etc.) and is also qualified for the national competition.



## 6. Qualification for the European final

Each country participating in Eurobot<sup>Open</sup> and/or Eurobot<sup>Open</sup> Junior organizes a national competition to determine the qualified teams for the international contest. The top teams in the final rounds (and not the qualification rounds) as well as the team who receives a special award will qualify for the European finals.

For Eurobot<sup>Open</sup>, the first two teams and a special award will qualify to go to the European final. In the case where no team receives a special award, the three first teams will qualify for the European final.

For Eurobot<sup>Open</sup> Junior, the number of qualified teams per country is proportional to the total of international registered teams.



For questions and comments feel free to visit the forum on <http://www.planete-sciences.org/forums/>. A volunteer from the refereeing committee will answer your questions there.

News and more information about EurobotOpen and EurobotOpen Junior are available at our website [www.eurobot.org](http://www.eurobot.org). It also contains links to your local organizations

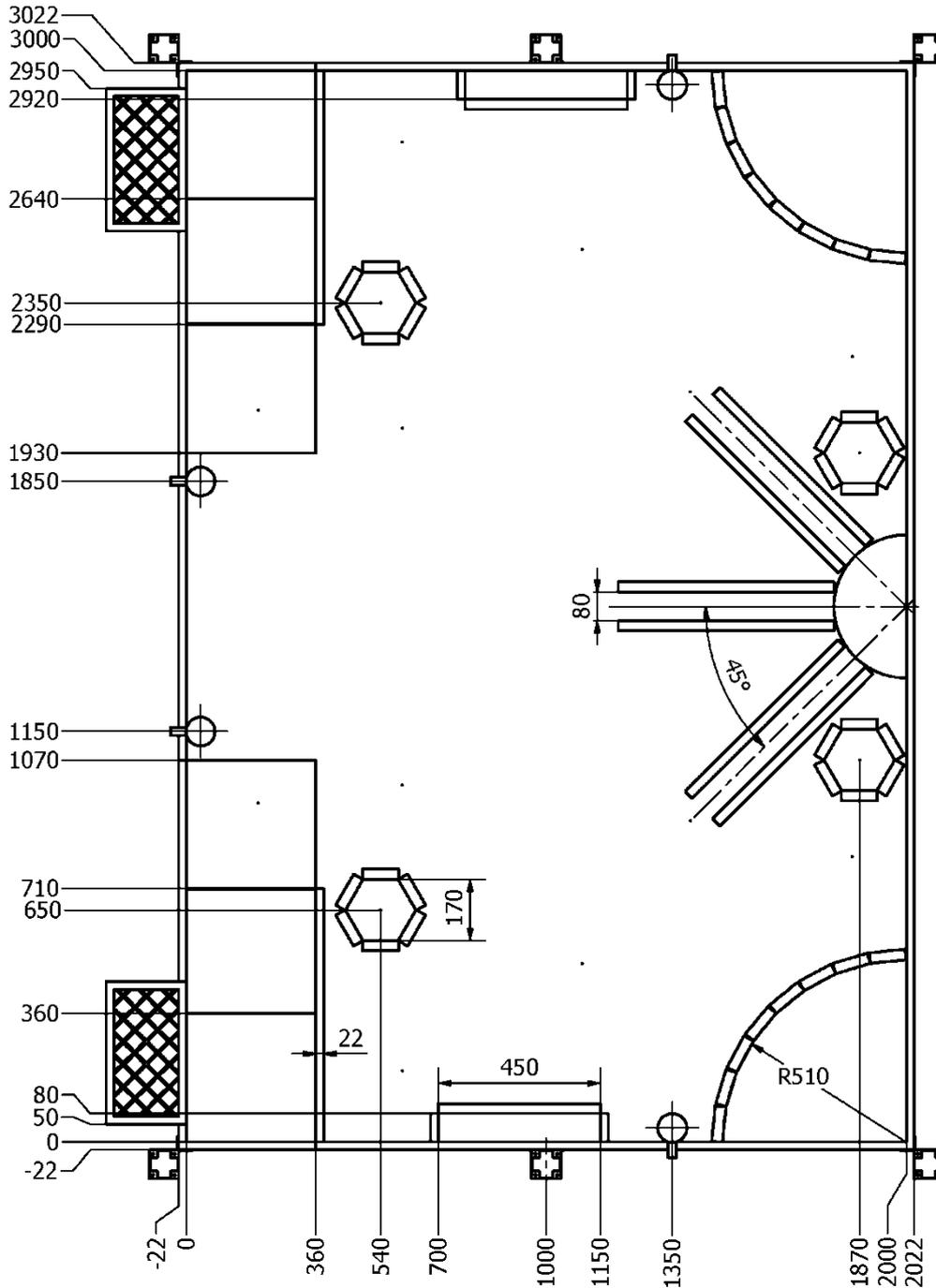
The whole organization team of Eurobot<sup>Open</sup> and Eurobot<sup>Open</sup> Junior wishes you a lot of fun and success for the coming months, and looks forward to seeing you soon around a playing field!

Robotic Regards,

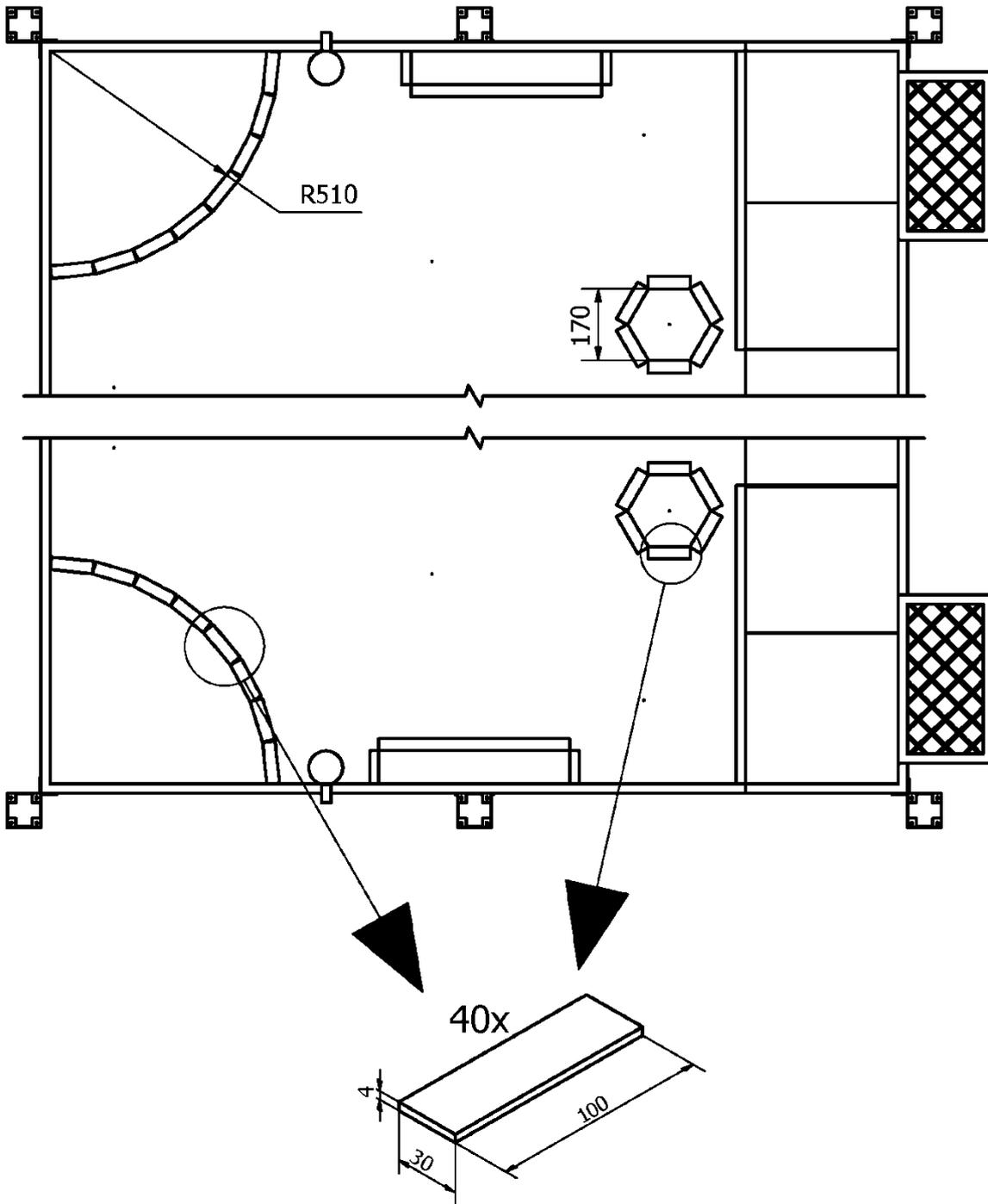
The Eurobot<sup>Open</sup> and Eurobot<sup>Open</sup> Junior organization committee.

## I. Appendix

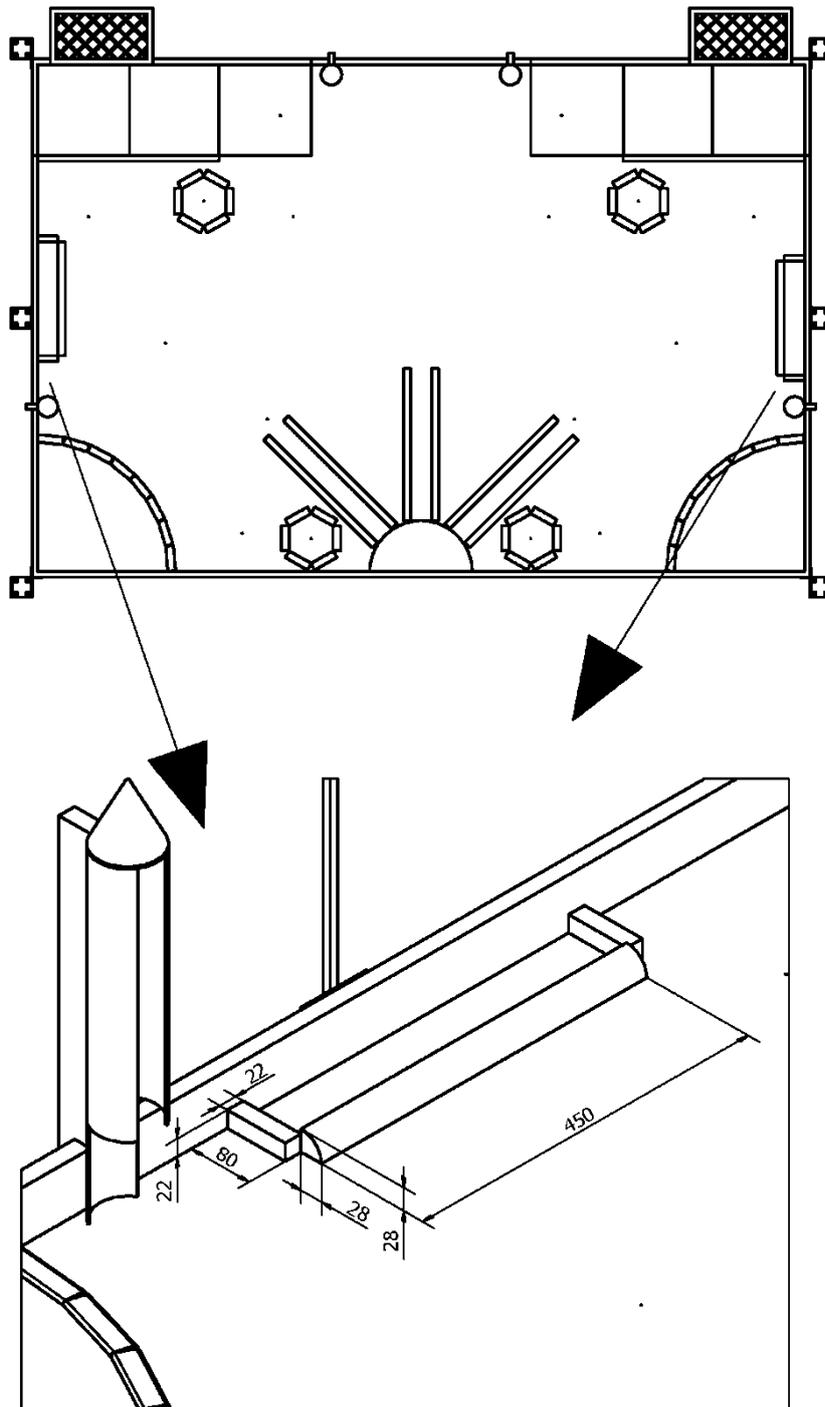
### 1. General drawing

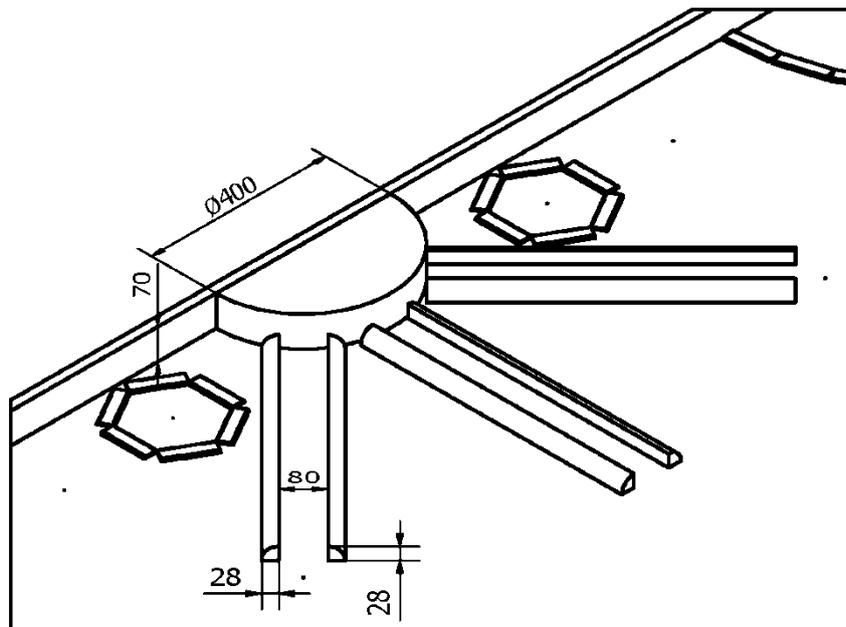
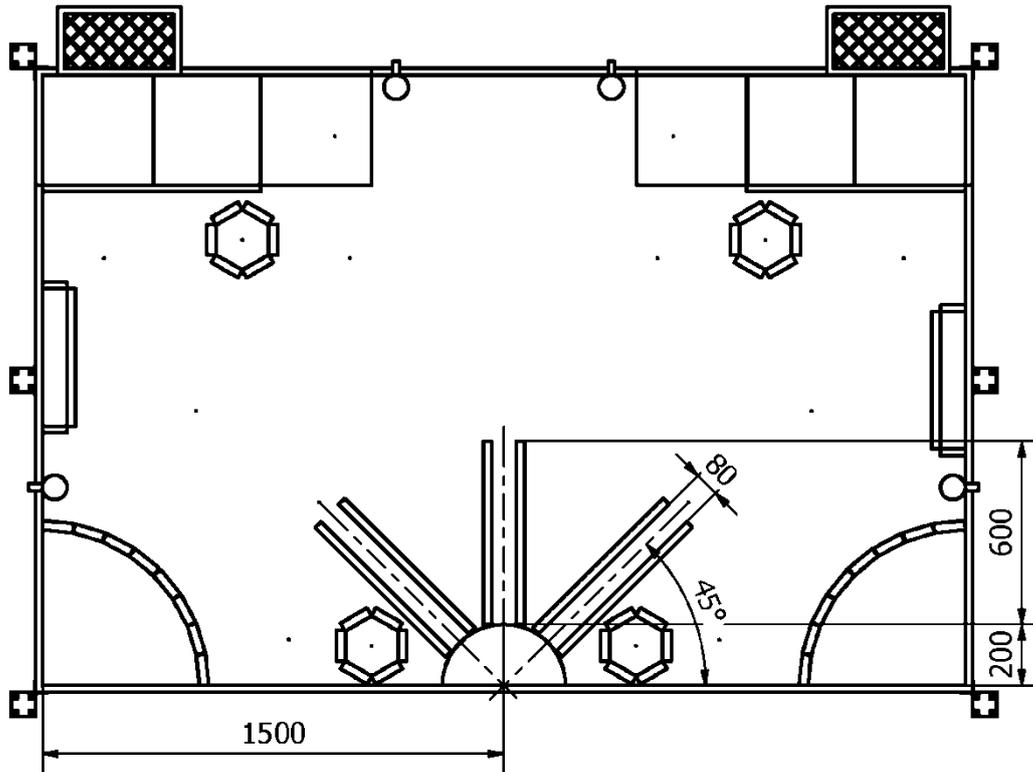


2. Craters



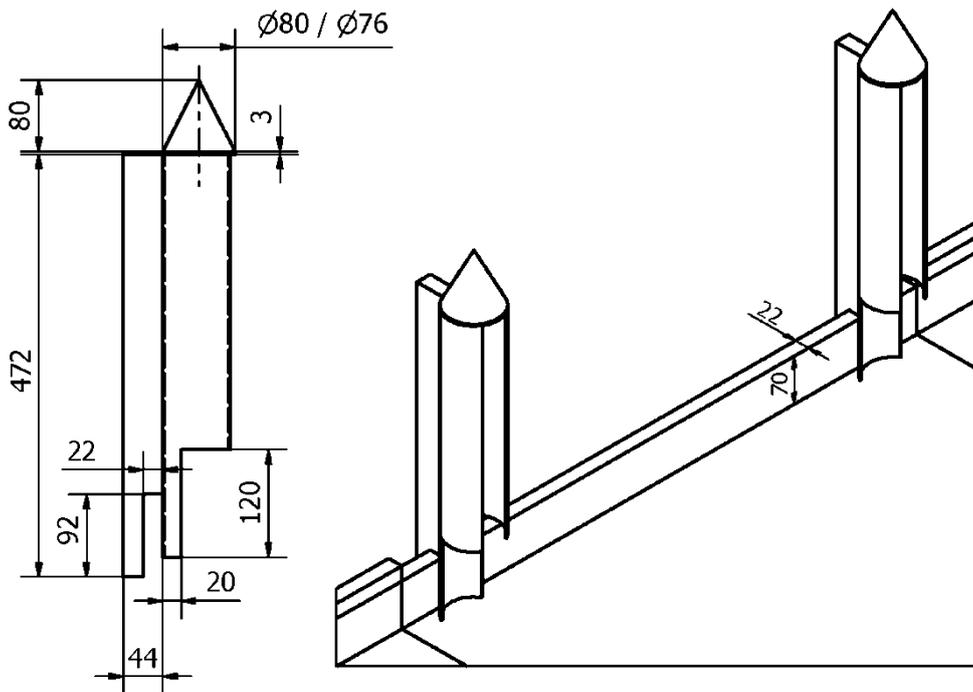
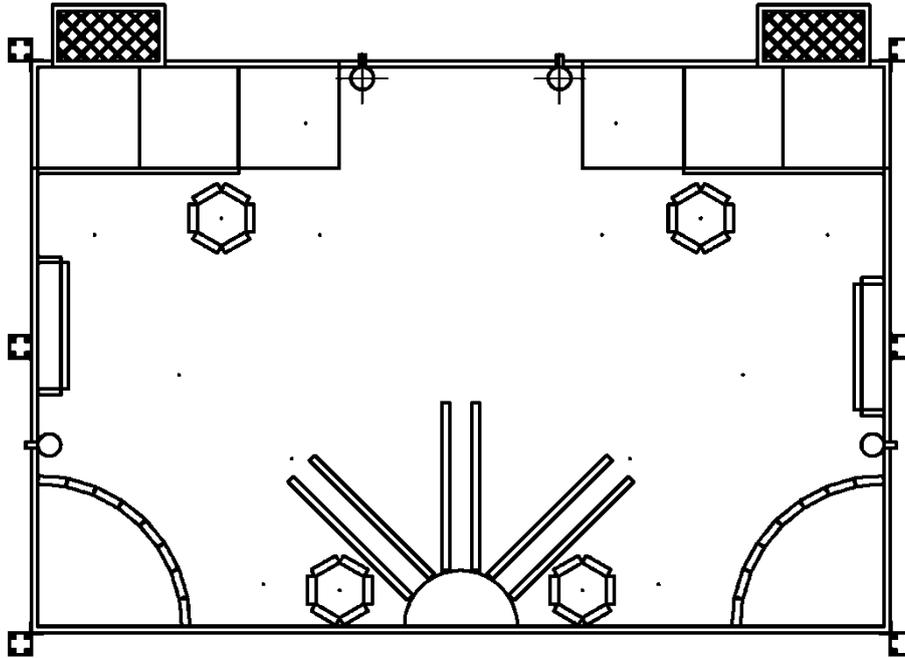
3. Moon base



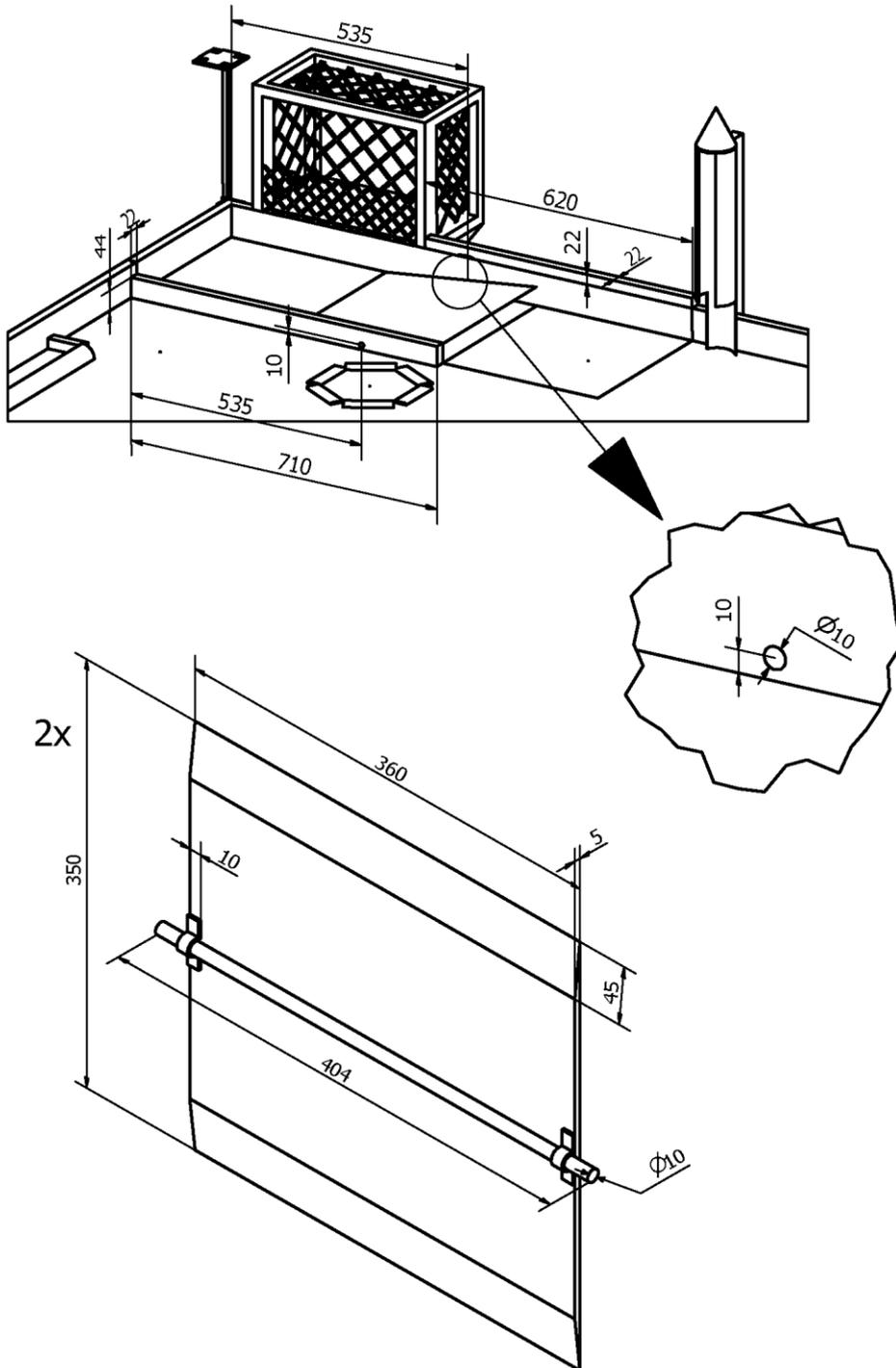




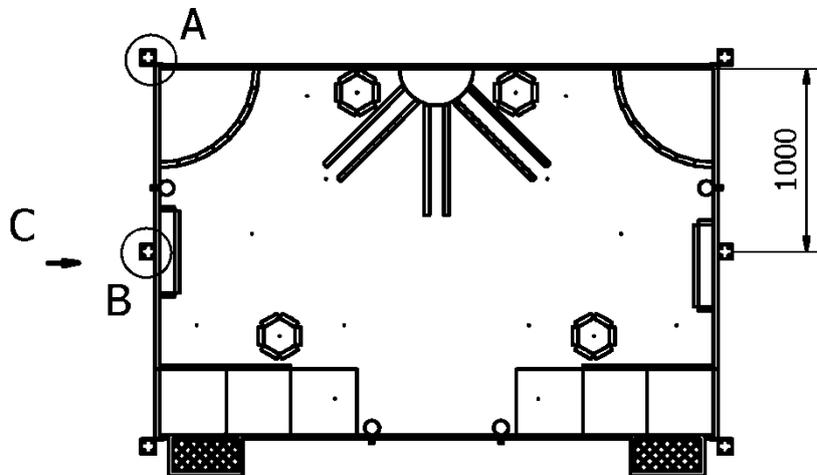
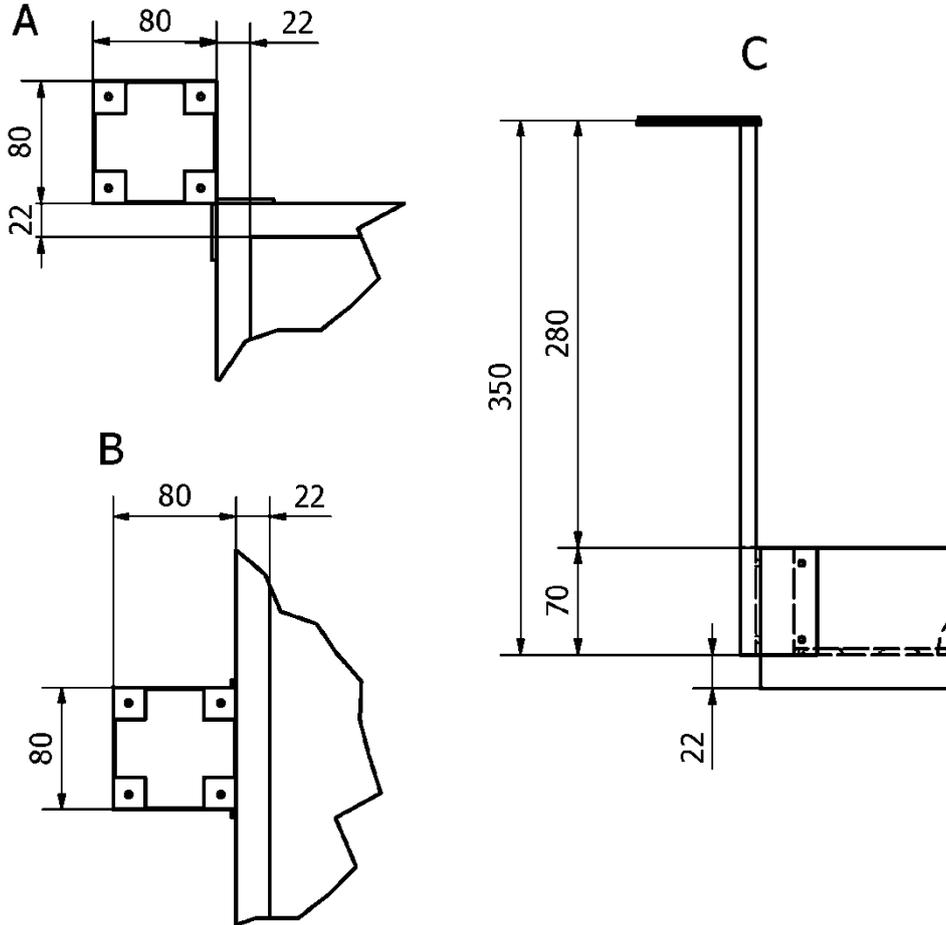
5. Rockets



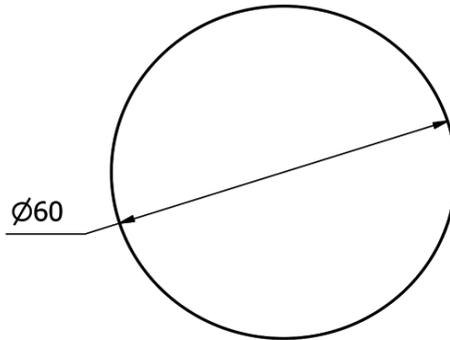
6. Shuttle airlock



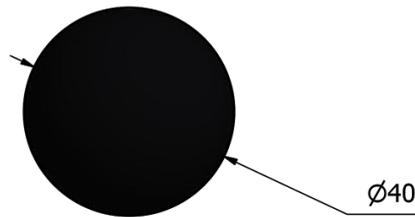
7. Beacon supports (specific to Eurobot<sup>Open</sup>)



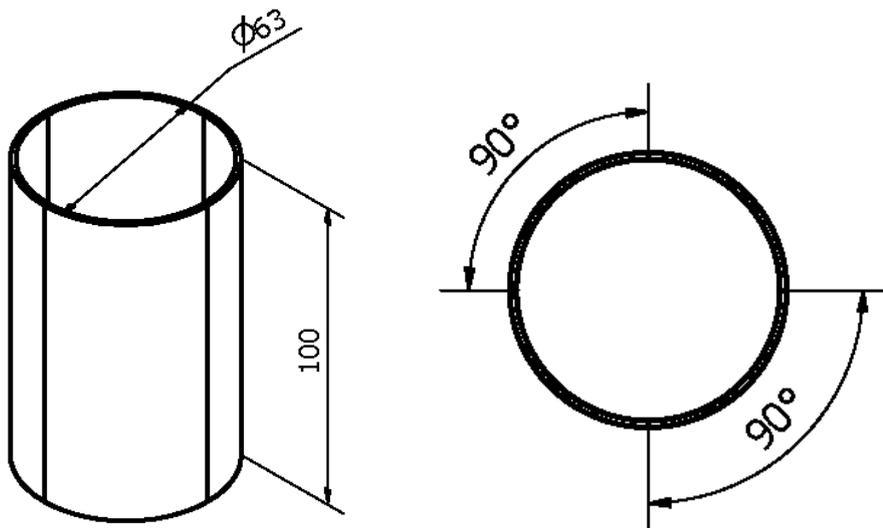
8. Titanium ore



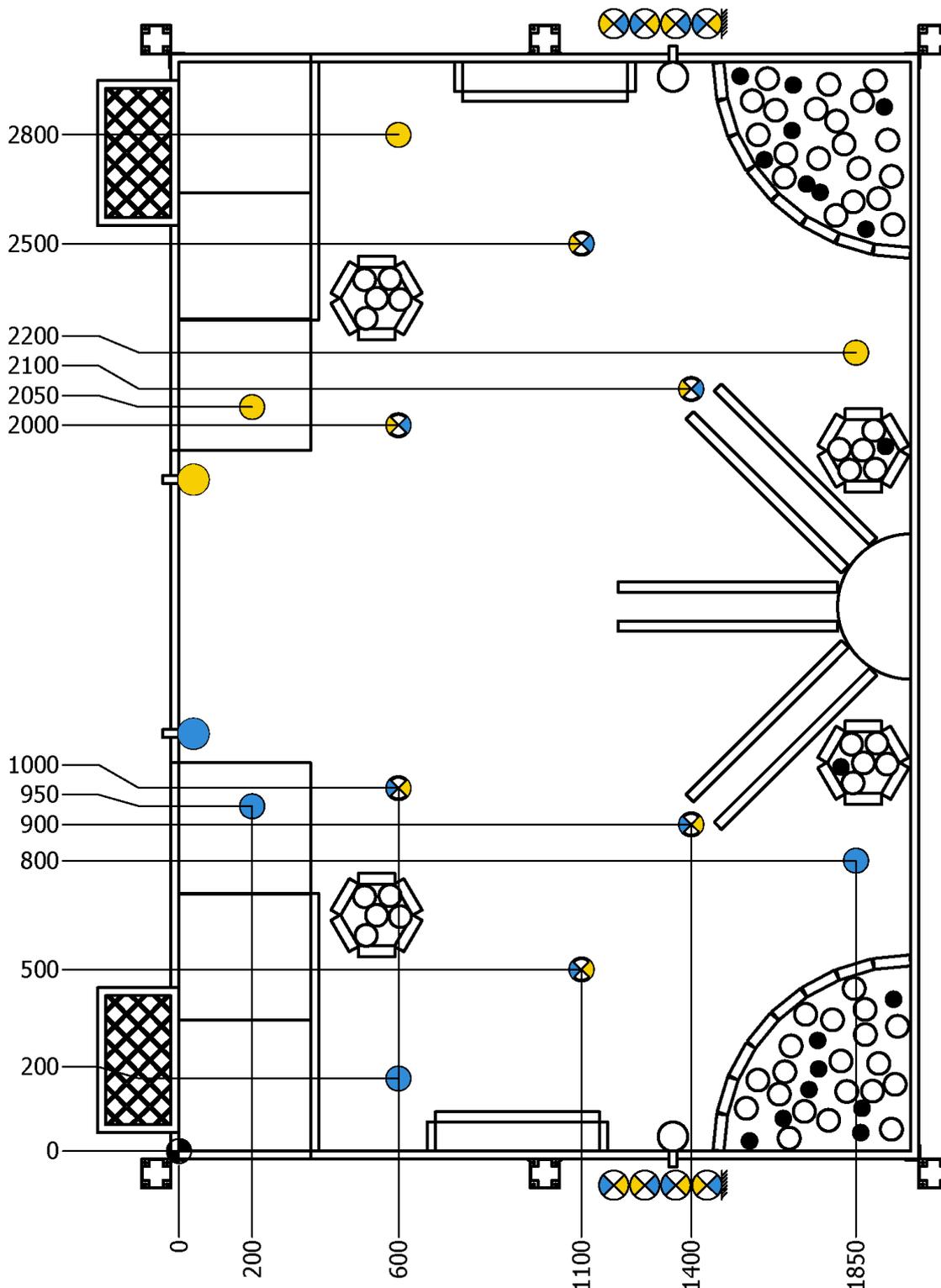
9. Moon rock



10. Multicolour lunar module



11. Location of the game elements at the beginning of the match



## 12. Material references

Material reference table for the game elements presents on the playing table:

Element	Material	Remark
Lunar Module	Rigid PVC	63mm O.D.
Titanium ore	Polystyrene	60mm diameter
Crater edges	Wood	30mm large and 4mm thickness
Seesaw	No specify	Support a 35kg weight
Lunar soil mat and shuttle airlock mat	Printed monomeric gripping vinyl	
Moon rocks	Polystyrene	40mm diameter
Cargo bay	Net	mesh size must be smaller than 40 mm
Rocket body	Rigid PVC	80mm O.D. / 76mm I.D.

**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 team tries different types of wood since the weight may differ significantly.

## 13. Painting references

	Colour	Reference
Team A	Sky blue	RAL 5015 Mate
Team B	Traffic yellow	RAL 1023 Mate
Titanium ores	White	No painting
Moon rocks	Dark black	RAL 9005 Mate
Moon base slots, base half sphere and neutral colour of the lunar module	Traffic white	RAL 9016 Mate
Crater edges, shuttle airlocks and rockets	Pebble grey	RAL 7032 Mate

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