Громадська організація
АСОЦІАЦІЯ РОБОТОТЕХНІКИ
Асоціація робототехніки в Україні

Competition rules of autonomous robots

ROBORACE 2012-2013

English version of the rules

Ternopil 2012

The version is based on the rules of «ROBORACE» - the file can be freely distributed by the Association of Robotics of Ukraine (www.roboart.org.ua). Taken as a basis version of the original file of the rules has the following parameters:

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Content

1.General Terms

1.1. Goal of the competition

- Stimulation of creative, intellectual and mental development of youth, satisfaction of demands in evolutionary self realization;
- Development and popularization of robotics, information technologies, application programming in Ukraine and throughout the world.

1.2. Participants

In the competition there can take part teams consisting of no more than 3 members, including the captain (the trainer can be also the member of the team). There are NO age, national, territory or other restrictions concerning the participation in the championship!

When passing the Registration Commision the team captain has to declare his team members no later than 2 hours before the beginning of the official start of this class of robots.

The team has a right to present one or several robots, which has to be stated during the registration.

The use of alcohol, narcotic and other psychotropic substances or being under their influence for the participants and organizators is prohibited.

1.3. Technical challenge

The technical challenge of the competition is to build an autonomous robot. This includes the solution of such problems:

1. In the shortest period of time the autonomous robot must pass the set number of laps from the starting position to the finish, avoiding other robots and without going outside the track.

2. The number of laps is set by the host party and is to be reported to the participants no later than two weeks before the tour, otherwise:

10 laps – preliminary races;

20 laps – final race.

3. The robot is allowed to take part in the race only after the positive passing of certification procedure, which has to be proven by an appropriate certificate.

4. The robots start in two columns.

5. The robots take place in the race in turn, determined by the results of the qualifying rounds; in the case of final race – by the results of preliminary races.

7. The robot can move on any circle of the track, regardless of start position.

8. It is allowed to outrun obstacles (side walls, other robots) from any side.

9. It is forbidden to cause mechanical damage to other robots intentionally.

10. During race the robot is autonomous – it can not receive data from external information sources (as an acceptation, another robot(s) participating in the same race).

11. Team and only team may withdraw his robot anywhere from the track, show it to referees on the subject of Identity, the robot can be returned to the track only after direct contact with the pit stop of the team. After returning the robot from the pit stop the robot continues to move from the start line. Repairs, adjustments and other actions with the robot during the race can be performed by the team only on the pit stop.

12. The robot must respond only to commands of referees.

2.Playing area and actions

Important information:

Although the organizers try to make the playing area as close to the standard, the road surface must be flat, minor deviation from the original size are possible. Any production process involves certain tolerances (in this case the size). No reclamations about size deviations will be taken into account. If any changes are made to the drawing field and game elements, they will be published in the additional document on the website of ROBORACE (http://www.roborace.te.ua).

Please, keep in mind, that the coatings of colored surfaces of different playing fields can vary; it also may get worse during the competition. Rules, drawings and definitions of field and game elements can be changed in case of problems. We encourage teams to regularly check both the site ROBORACE http://www.roborace.te.ua/, and the website of the Association of robotics of Ukraine http://www.roboart.org.ua/ to check for such updates. Teams should also monitor the discussions on http://www.facebook.com/pages/RoboRace/162719923762655 and the published information there.

2.1. Playing Field

The playing field is the rectangular area of 50m2, implemented on a white surface with the longitudinal black lines, and it is limited by the sides (Figure 1).

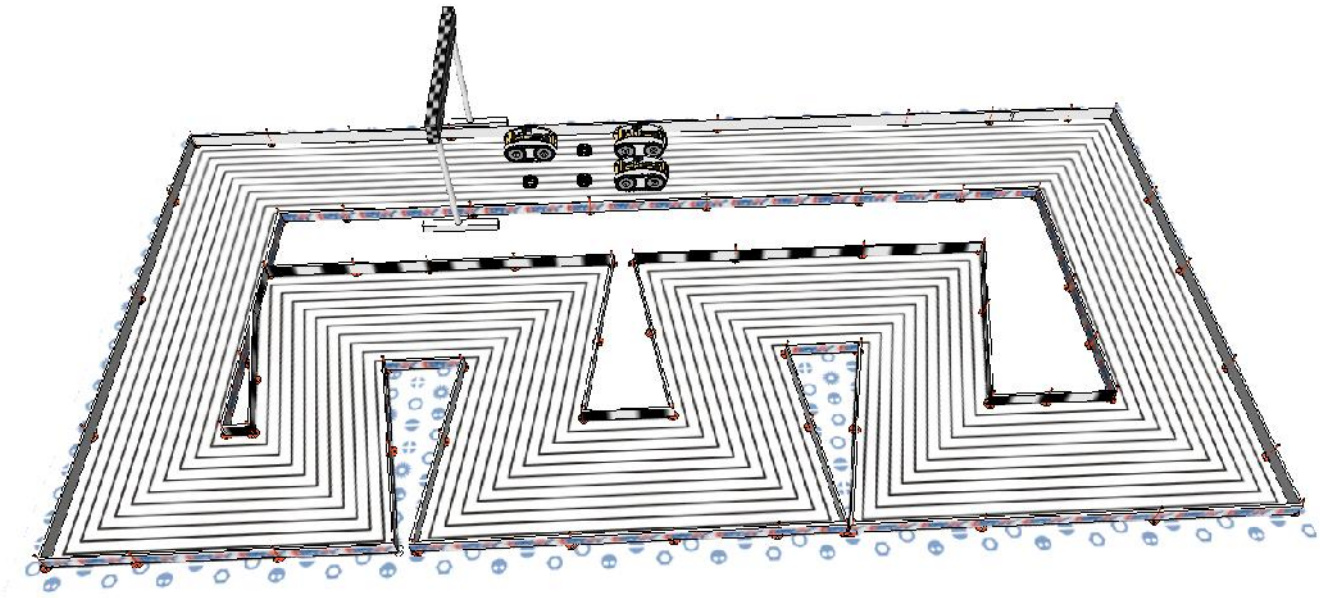


Figure1. – An example of the playing field (track).

One side of the track, namely internal, which is clearly visible from the outside the track, is covered either by vertical black and white stripes, or advertising, in order to provide robot orientation by the coefficient of reflection from the side. The ratio of the reflection coefficient should be no less than 1:2. (Figure 2).

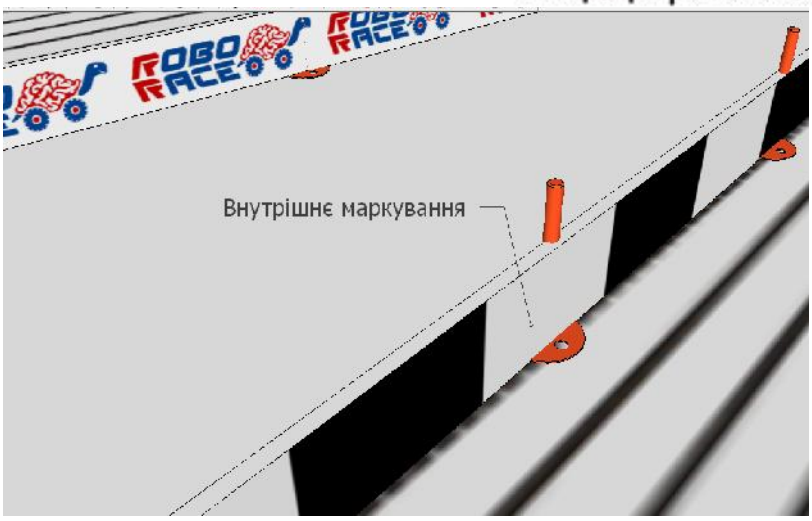


Figure 2. – An example of internal side marking of the playing field.

The hosting party declares the type of marking not later than two weeks before the stage.

The track must be smooth. Before competition the chief referee conducts the certification of the track surface using corresponding device. The hosting party is obliged to correct any defects if detected.

The requirements for sizes and lines:

- the width of the track should be not less than 1 meter;

- the sides of the track are situated at the edges and should be white, the height 100…135mm (Figure 3);

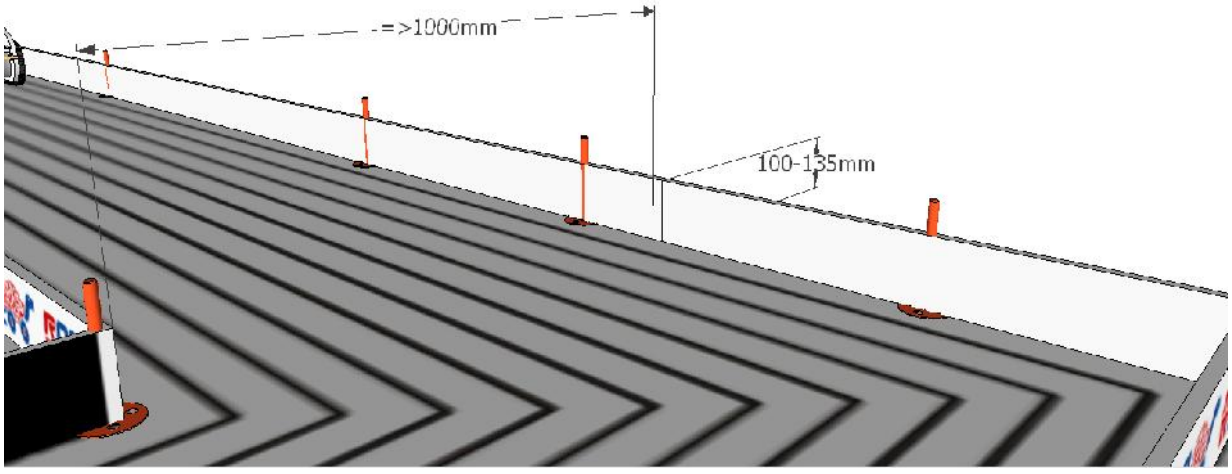


Figure 3. – The track width and track side height.

- the longitudinal black lines make not less than 8 closed circles, the width of the line is 15…20 mm;

- the width of the white surface between the lines and the track sides should be not less than 80 mm (Figure 4);

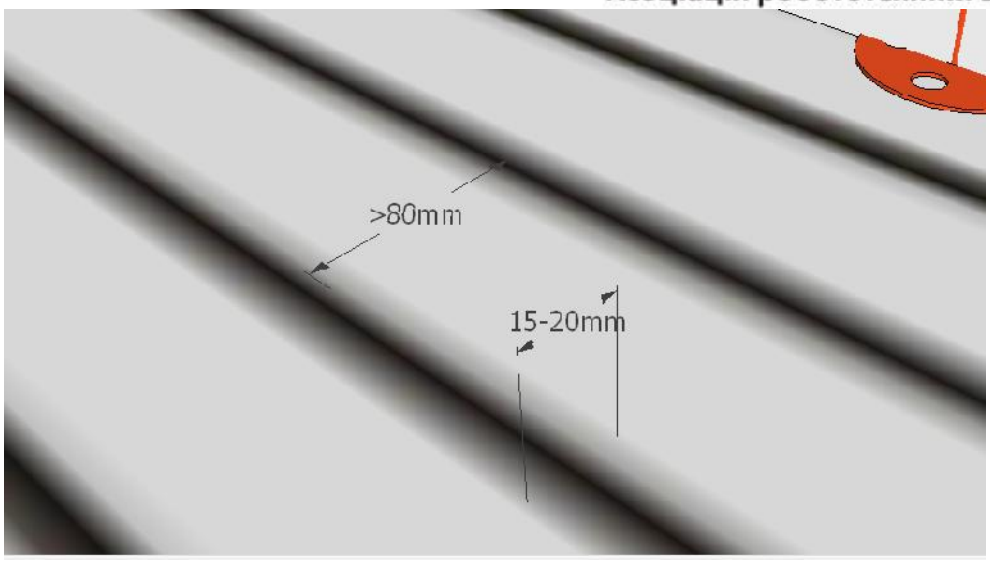


Figure 4. – The width of the lines and the distances between them.

- the length of the external circle of the track should be not less than 15 m;

2.2. Starting area

Starting areas are situated 500 mm before the finish arch.

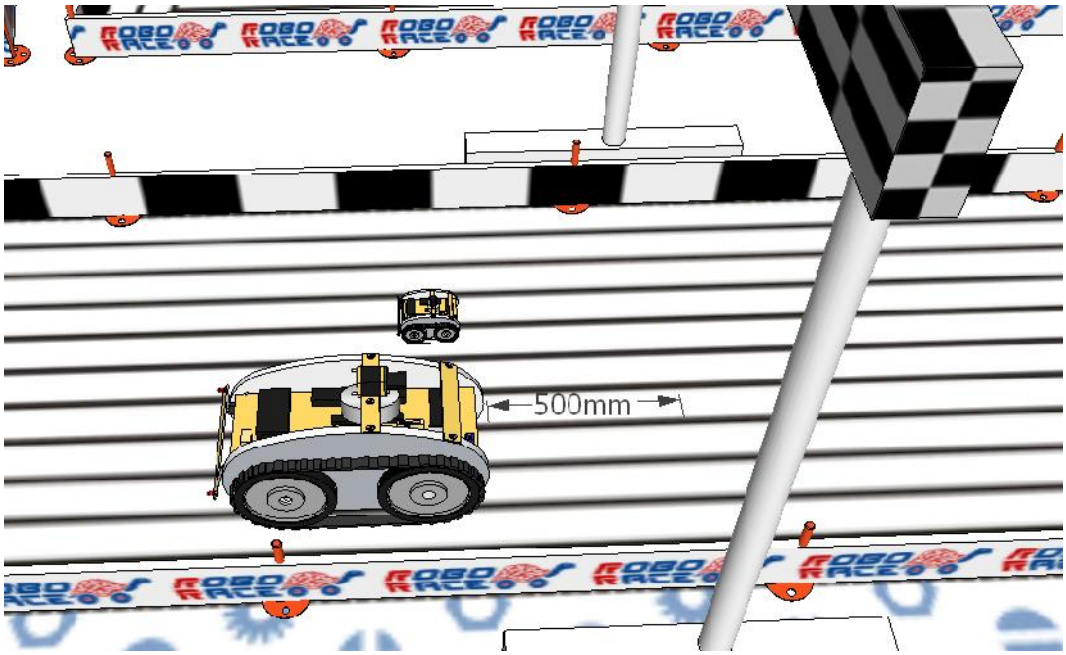


Figure 5. – The scheme of placement of robots at the start in the race.

3. Robots

3.1. General notes

• The work will not be allowed to compete if they use system that deliberately designed to create vibration board or performing other illegal actions. If you have any doubt regarding the item - please consult with referees.

- Each team may present one or more autonomous robots of various sizes, which do not contradict the restrictions to the size and weight, specified in the regulations.
- It is not required to create additional robot. It is recommended for team-beginners to work just on one robot.
- Intentionally damaging robot(s) of the opponent, playing area or any other elements of the playing area are prohibited.
- The robots must be made from the well-joined parts (the parts of the robots should not remain on the playing area during the race).
- If the robots intentionally use systems creating vibration of the playing field or perform other forbidden actions, they will be not allowed to take part in the competition. If you have any doubts regarding this item, please, appeal to referees.

3.2. Dimentions

Robot dimentions.

Autonomous robot model must have mechanical possibilities to overcome the needed distance with possible changes of the trajechtory of movement. It also has to meet the following requirements:

1. Maximum width – 250 mm, length – 500 mm.

2. The weight should not exceed 3 kg.

The restrictions to the perimeter of the robots are shown at the figure 6:

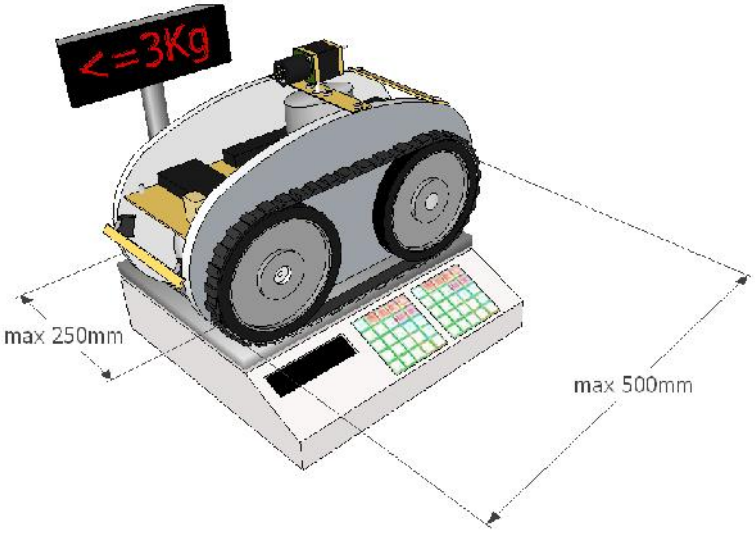


Figure 6. – The maximum dimensions and weight of the robot.

5. The robot must have rear position lights - red LED with the diameter of 5 mm and scattering angle not less than 60 degrees, directed backward and situated no more than 1 cm from the lateral sides of the rectangle circumscribing the robot (Fig. 8)

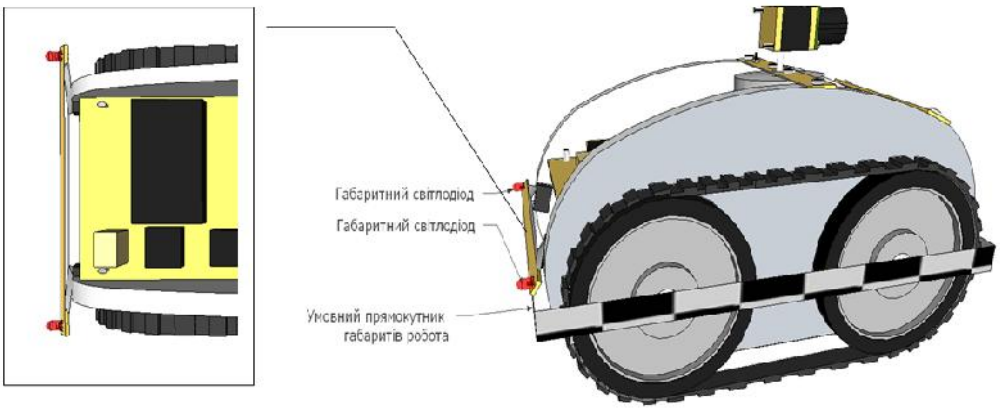


Fig.8. – The example of position LED locating.

3.3. Energy Sources

• All forms of energy sources stored in the robot are allowed (batteries, springs, compressed air, gravitational energy...), with the exception of energy sources using chemical reactions like combustion or pyrotechnic processes, which are prohibited for safety reasons. Furthermore, either use of corrosive products prohibited and splash of liquids are prohibited.

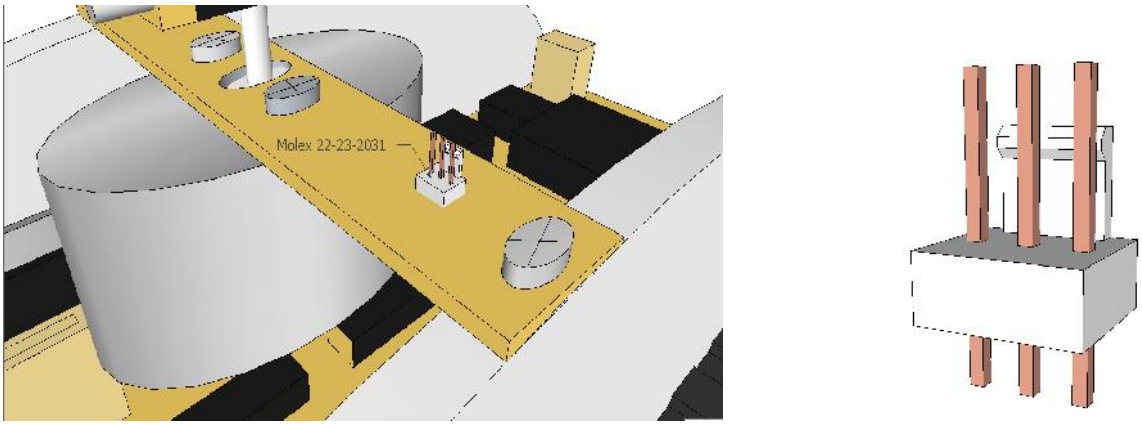
- If you have any doubt about an unusual energy source, ask the refereeing committee ahead of time
- To avoid fire risks, it is requested to pay special attention to the choice of conductors, depending on the intensity of current passing through them. It's also recommended to protect the wiring with a fuse, wired to the nearest battery

Robots must be able to play three consecutive games. Note that this includes the time required for the stand by, during which the robot is powered and waiting to start. Therefore, we strongly recommend that teams bring several sets of batteries, provide easy access to them in the robot for their replacement, and keep permanently a set of batteries fully charged.

3.4. Other Robot Constraints

3.4.1. Starting Device

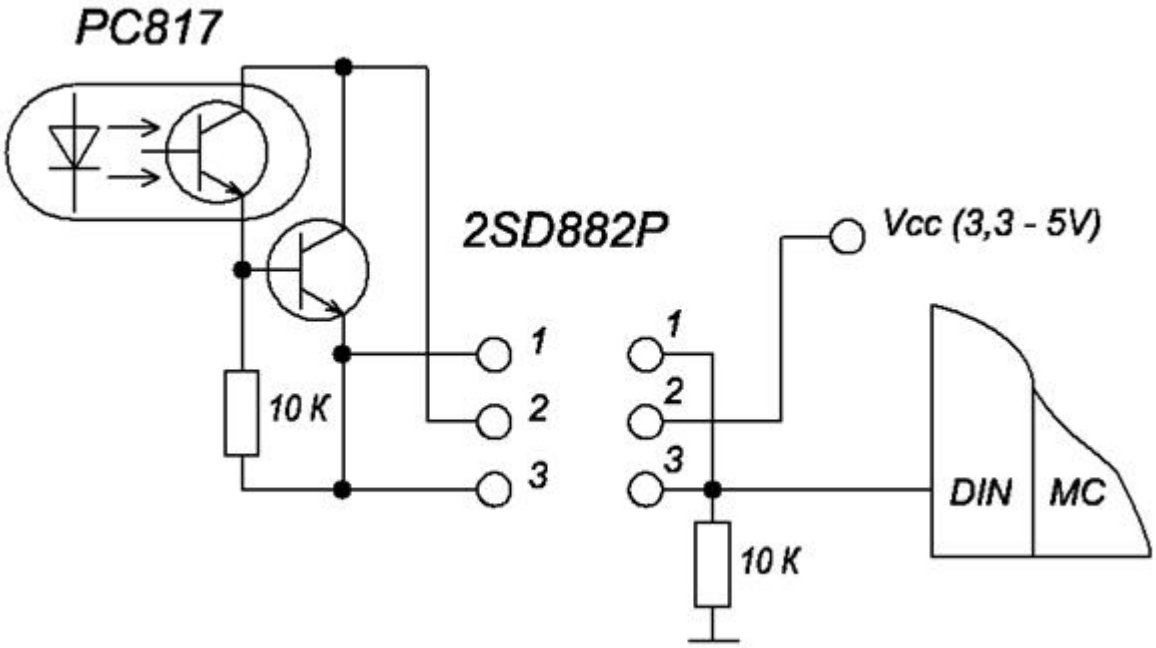
The robot(s) must be aquipped with an easy accessible starting device. Therefore the connector Molex 22-23-2031 should be output at the top of the robot (Fig.7a) (The plug to the board - 2.54 mm open)(Fig.7б)



а) б)

Fig.7. – Connector Molex 22-23-2031(а – example of location, б – appearance).

The plug is designed for the module of “mass start” system, which is made by the scheme of optical push button (Fig.8).



а) б)

Fig.8.- The output circuit of starting device (a), recommended scheme (б).

Parameters of output circuit:

The movement of the robot is allowed: transistor is open, voltage drop <1V, the current must not exceed 0.5 A.

The movement of the robot is prohibited: transistor is closed, the transistor voltage <30V, current <0.1 mA.

Starting device is issued for each robot, which passed the qualification. The device should be attached to the connector Molex 22-23-2031 on top of the robot.

When the system of mass start fails – the start of the robots is done manually with the participation of the team members. The detailed procedure of manual start is determined by the chief referee during the stage.

3.4.2. Emegency Off button

The robots must include an emergency off button, with a diameter of at least 20 mm, painted in red (for example a safety emergency stop button). It should be placed on the top of the robot, in a conspicuous position and in a safe zone, which should be immediately accessible to the referee at any time during the match. The stop button must be actuated by a simple downwards motion (such as a hit with the fist).

Pressing the emergency button must result in the immediate shut down of all of the robot's actuators, leaving them "limp" (not actively braked nor energized).

3.4.3. Obstacle Avoidance System

Teams are required to equip their robots with an obstacle avoidance system. This system is intended to prevent collisions between robots, and resulting damages, during a match.

This will be systematically checked during certification. Teams are not allowed to deliberately disable their

avoidance system after the certification.

3.5. Safety

3.5.1. General Terms

- All the systems should comply with current national and European safety regulations. They must not endanger neither the participants nor the public during matches, as well at stands and backstage.
- The robots must not have any protruding or sharp parts that can cause injuries
- The use of liquid, corrosive, pyrotechnics and living components is strictly prohibited.
- All robots must comply with the legal standards concerning “low voltage”. Therefore, the internal voltage of the robots should not exceed 48 V. Potentials higher that 48 V may be allowed, but only inside sealed commercial devices (such as lasers or LCD display back lighting) and only if these devices have been left unmodified, and if they comply with national and European regulations.
- 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 competition, or will result in the team's disqualification.

3.5.2. Lasers

Only considerations based on laser class definition (in the "EN 60825-1:2007, Edition 2 -Safety of laser products– Part 1: Equipment classification and requirements" standard) will be taken into account. Teams using a laser will have to provide either the classification notice of the equipment, or the laser component data sheet. Not being able to provide such documents will prevent the robot to be approved.

Based on the classification, it is allowed to use lasers of Class 1, 1M.

Lasers class 2 and 2M are accepted provided that the laser beam is never projected outside the playing field.

All other classes (3R, 3B and 4) are strictly forbidden.

CAUTION: disassembling or modifying devices using laser sources often leads to a change of class. The laser devices should be used as originally marketed (laser device = Source + Electronics + Optical).

Powerful lights

When high intensity light sources are used, be aware that the light intensity can be dangerous for the human eye. Note that some commercially available high power LED devices can exceed this limit. Be responsible! Your machines are evolving in front of an audience that is not informed of the specificities of each robot!

3.5.3. Lithium-based batteries

This type of battery (for example, Li - ion / Li - Po / Li - Fe) is allowed under the following conditions:

• A suitable charger must be presented at certification

• Batteries are permanently contained in special fireproof bags (either inside the robot or on the stand, even in storage)

An underload-detecting system is also highly recommended.

These conditions apply except in the case of Lithium-based batteries used in LEGO Mindstorm/laptop/cell phone, as long as:

• They shouldn't be removed from the initial device

• They should be used only for the use intended by the manufacturer.

4.Races

There are three types of races: qualifying, preliminary, final.

Qualifying – the race is performed during the robot certification. Task: to pass one lap of the track. The obstacles can be used on the lap for checking robot obstacle avoidance system. Start and stop are performed after referee signal, that can be received by the robot through its starting device. The number of trials is unlimited and can be performed till the beginning of the last qualifying race.

Preliminary – the race is performed in general offset of preliminary tour. Task: to pass the definite number of laps, which is regulated in the 2 paragraph of Technical challenge for preliminary races. Start and stop are performed after referee signal, that can be received by the robot through its starting device. The robot is allowed to take part only at one preliminary race.

Final – the race is performed by the results of the general offset of preliminary tour. Task: to pass the definite number of laps, which is regulated in the 2 paragraph of Technical challenge for final races. Start and stop are performed after referee signal, that can be received by the robot through its starting device.

4.1. Preparation to the race

The scheme of positioning of robots at the beginning of each race is shown at the Figure 9. The robots with odd numbers are placed near the internal side of the track and the robots with even numbers – near the external side of the track.

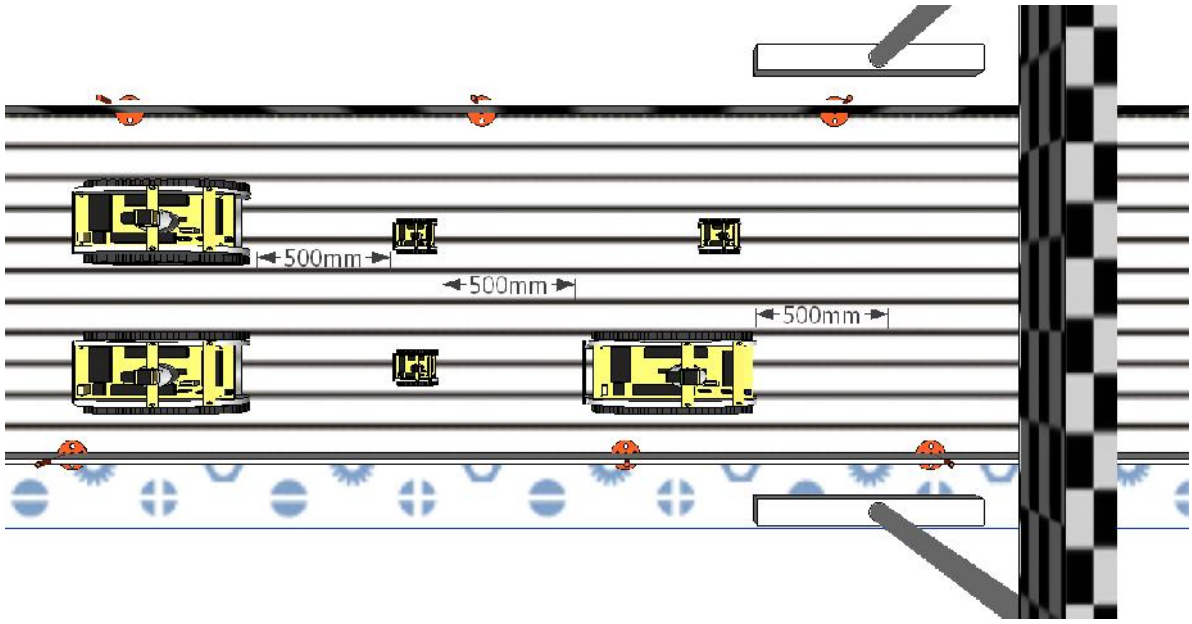


Fig.9. – The scheme of robot positioning before the beginning of race.

Before the beginning of the next race each team has 5 minutes to prepare the robot(s) to work on the playing area. The robot, which is not ready to work after the end of 5 minutes is disqualified from the race. After the

teams prepared their robots the referee for the last time asks participants about them being ready and performes countdown and start of the race.

4.2. *Process of race*

Once the referee gives the start signal, the robot is turned on. In any case, it is forbidden to push and to correct the robots, though the team and only the team can anywhere anytime remove the robot during the race for repair. Any types of repairs are allowed only at the pit-stop of the team. It means that the wheels (chassis) of the robot removed from the track during the race necessarily must touch the special zone on pit-stop (Fig. 10).

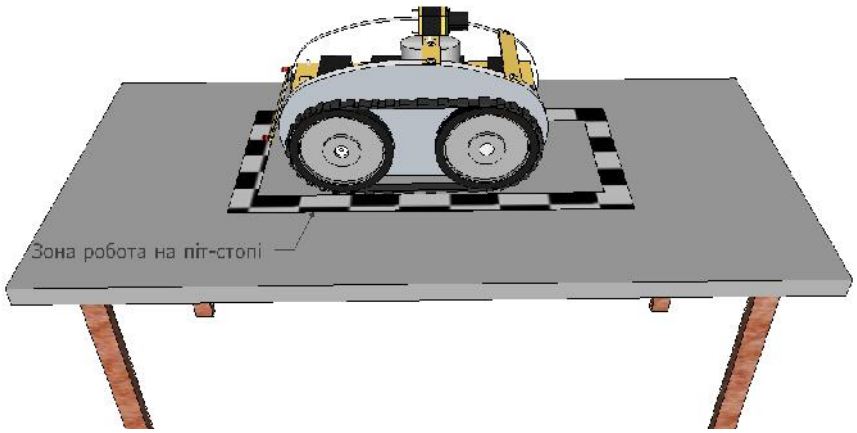


Fig. 10 – Example of the table for pit-stop of the team

After pit-stop the robot can be returned to the race in the start zone of the track.

Any manual intervention of participants on the robot of another team can lead to disqualification from the race.

During the race it is allowed to make changes in the construction within the permitted dimension.

An electronic system provides counting of passed laps and time. In the absence of the system this operation is carried out by referees. Each team has the right to duplicate counting of laps and time of the robot(s). During the whole race the video recording takes place. It is used for resolving disputes.

The chief referee has a right to stop the race: by detection of violations of the regulations, by mutual consent of the participants of the race.

After completing the task, that is full passing the definite number of laps by the robot, the referees stop the timer and record the time spent. Then the referees announce result of each robot in the race. If the teams agree with the results, they sign the protocol and only then they can remove their robots from the playing area. If the teams disagree with something, they can discuss controversies. The robots stay at their places on the track till the end of dispute. As a result the chief referee announces the final decision.

If the decision after discussion wasn't made, the chief referee has the right to deside to replay the race.

If the team has not passed the determined number of laps during the race, then it is out of the preliminary

race.

A team is declared disqualified either when none of its robots has entirely left the starting area during the race or as a result of the chief referee's decision. The chief referee makes such a decision by the results of the race, explaining the reasons of disqualification.

4.3. Scoring system

The sum of points will be counted for each team after the end of the stage as shown in the table 1,

Table 1 – Scoring scale in the race

№	Type of procedure	Points
1	Passing qualification	1
2	Participating in preliminary race	1
3	Participating in final race	1
4	Taken III place in final race	1
5	Taken II place in final race	2
6	Taken I place in final race	3

The team that scored the greatest number of points during the stage is called the winner of the stage.

The team that scored the greatest number of points after all stages of the season is called the winner of the season.

Disqualification

Disqualification situation is considered as a noncompliance with the rules: **such situation must remain exceptional!** In case of repeated penalties by a team, the referees reserve the right to declare the team disqualified from the stage.

5. Competition stages

5.1. Admission to the competition

- Pre-approval: Before the matches begin, the robots are examined by a referee who checks their compliance with the rules. The robots should be able to demonstrate all of their possible actions.
- Approval: the robots should pass the qualifying race. The robots are tested under match conditions, but without the presence of another team. Some specific features stated in the rules can also be checked (position lights, avoidance of the opponent for autonomous robots, etc.).
- If the robot meets all requirements it will be officially approved to participate in the competition and will get certificate with the referee signature.
- Significant technical changes after approval. It is mandatory to inform the referees of any significant change (functional, structural, dimensional...) made to the set of robots after its approval. The referees will then verify the changes and may redo the approval process if necessary.

5.2. Preliminary races

The team certified for the competition can take part in preliminary races. The number of cars in the race is distributed evenly depending on the overall number of robots and the number of races. The number of robots in the race can be 6, 5, 4. If it is not possible to distribute the cars evenly then there can be +-1 robot in the last race with the possibility of adding cars-obstacles.

When the robot completes the task, the referees record the time and put it into the table of general offset of preliminary races.

For determining the teams that passed to the final race, the rating on the basis of the table of general offset of preliminary races is created. The first 6 teams, that for the shortest period of time completed the task, get to the final race

After the end of preliminary races, if the time of some teams is equal then the time is compared by qualifying races. If the teams still remain in the equal position then the referees have the right to organize additional races for such teams

5.3. Final race

After the preliminary races the first 6 teams will take part in the final race. The task for the final race is regulated by paragraph 2 of Technical challenge.

For questions and comments the refereeing committee will answer you on the forum ROBORACE : http://www.facebook.com/pages/RoboRace/162719923762655

Website of ROBORACE (contains links of Organising Committees)

www.roborace.te.ua

The whole organisation team wishes you success in creating your constructions, and looks forward to seeing you around a playing field during this season!