

## REGULATIONS «ENHANCED LINE FOLLOWING»

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## 1. Introduction

The Enhanced Line Following competition is similar to the standard Line Following competition with the difference that various types of obstacles are introduced in the field.

## 2. Objective

The aim of the competition is to drive through the track as fast as possible, while precisely following the track line from the beginning to the end. The robots will have to detect and avoid the obstacles they meet during their race.

## 3. The Team - Eligibility of Participation

1. The competition accepts participation of teams and not individuals.
2. The team consists of two (2) – five (5) persons.
3. **Only one player** of category X is eligible to participate in a team of the immediate higher category. That is:
  - A player of category «4th – 6th Grade Primary» is allowed to participate in a team of category «Gymnasium»
  - A player of category «Gymnasium» is allowed to participate in a team of category «Lyceum»
  - A player of category «Lyceum» is allowed to participate in a team of category «University».
4. The opposite of the rule 3.3 above does not apply. That is, one player of category X is not allowed to participate in a team of any lower category. For example, a player that belongs in category «Lyceum» is not allowed to participate in a team of category «Gymnasium» or «4th – 6th Grade Primary»; a player in the «University» category is not allowed to participate in the category «Lyceum» or «Gymnasium» etc.
5. The coach of the team is not allowed to participate in the same competition with his/her team.
6. The team defines one of its members as a leader who will be responsible for the communication with the Organizing Committee and the judges, for the technical control process and for operating the robot during the competition.

## 4. Categories and Levels

- The competition is organized for the ARDUINO, ENGINO ERP, ENGINO PRODUINO and, LEGO EV3 platforms for the categories and levels shown below:

Category →	Primary	Gymnasium	Lyceum	University	Special
Level	4 <sup>th</sup> – 6 <sup>th</sup>				
Enhanced Line Following	√	√	√	√	√

## 5. The Field

- The field consists of white synthetic sheets with an area of 3 to 10 cm<sup>2</sup>.
- The 15mm wide line, or track, has been printed on the field with black ink or marked with a black tape.
- The track may be either closed or open. The start and finish lines may cross each other or be in different locations.
- The track may have one or more turns, or curves with up to a 90-degree angle (inclusive).
- The minimum turning radius of the line is 0.
- The line is surrounded by twenty five (25) cm of free space on both sides, except on cross-sections.
- The lines on the cross-section are perpendicular at least to the extent of twenty (20) cm.
- The field is composed of two adjacent tracks which have their ends connected to each other.
- The start and finish lines are separately marked on the field.

## 6. The Robot

1. The robot must be autonomous.
2. The maximum dimensions of the robot are (30 cm length x 30 cm width x 30 cm height) and its mass is three (3) kg.
3. For confirmation of the specifications indicated in point 5.2 above, the robot will be weighted and must easily fit in a control box.
4. The control box has dimensions (30 cm length x 30 cm width x 30 cm height) plus two (2) millimetres of tolerance.
5. *The two (2) millimetres tolerance refers to the control box only and not to the size of the robot which is specified in the clause 5.2 above. Tolerance is given so that the robot can easily fit in the control box.*
6. The robot must be placed in the control box without exerting pressure on it.
7. The robot must always cover the line, otherwise the race is considered to be failed.
8. The robot must not damage the field or endanger the spectators in any way.
9. It is forbidden to use higher voltage than 24 V in the robot.
10. The robot must have a start and stop button.
11. The body of the robot must entirely block the light beam of the time measuring system with a diameter of three (3) mm at the height of three (3) cm.
12. The robot must have a start and stop button or a remote control.

## 7. The Competition

1. Each robot runs alone in the field against the time.
2. An optical time measuring system will measure the time taken by the robot to complete the field during each attempt.
3. There will be three (3) rounds in the competition, the qualifying round, the semi-final round and the final round (best of the best).
4. In the qualifying round all teams will have to make two (2) attempts on the field.
  - The attempts will not be executed back-to-back, the first attempt for all robots will be completed followed by the second attempt.
  - All teams will make their first effort within a specific time frame that will be announced in the schedule of the event.
  - All teams will make their second attempt within a certain amount of time to be announced in the program of the event.
5. In the semi-final round the robots will have to make one (1) attempt on the field.
6. In the final round the robots will have to make one (1) attempt on the field.
7. It is the responsibility of the team leader to ensure that his/her team makes all attempts within the time framework specified.
8. The maximum duration of the field two (2) minutes. If the robot exceeds this time, it is assumed that the robot has failed in the attempt.
9. Between the attempts teams will have the ability to fix their robot and their code/algorithm.
10. Prior to each attempt, the relevant technical inspection will also be carried out, where required.
11. The robot should start moving within three (3) seconds after the referees have given the start command.
12. If the robot does not move within three (3) seconds, it is assumed that the robot has failed in the attempt.
13. The robot (or any of its part) is not allowed to drive off the limits of the field. If it does, then the robot is considered to have failed the attempt.
14. The robot must always cover the black line while competing; otherwise the attempt is considered to have failed.
15. If the robot does not complete the field then the distance it covered from the starting point until the point it stopped is recorded.
16. If the robot fails the attempt, then a DNF – DID NOT FINISH is recorded.

## **8. Declaring the Winning Team**

1. Upon completion of the qualifying round for all categories (i.e Primary, Gymnasium, Lyceum, University, Special), ranking will be realized.
  - The ranking will be based on the shortest times of the robots in the two (2) attempts.
  - In case that no robots have finished any attempt, then the ranking will be based on the longest distance covered by the robots on the field.
2. Based on the ranking of the qualifying round, the first X teams of each category will be selected.
  - The number of X teams will be decided by the Scientific Committee taking into account the total number of teams participating in the competition.
  - The X teams will be promoted to the semi-final round.
3. In the semi-final round, robots will have one (1) more attempt on the field.
4. Upon completion of the semi-final round, a new ranking will be realized.
  - The ranking will be based on the point 9.1 above, considering, however, the attempt in the semi-final round.
  - The first robot in the ranking is considered the winner and will be promoted to the final round.
  - In case of a tie in the semi-final round, all robots in the tie will be promoted to the final round.
5. In the final round, robots will have one (1) more attempt on the field.
6. Upon completion of the final round, a new ranking will be realized.
  - The ranking will be based on the point 9.1 above, considering, however, the attempt in the final round.
7. The winner is the robot ranked first in the ranking of the final round.
8. In case of a tie in the final round, then the procedure described in points 8.5 - 8.7 above is repeated for the robots that are in a tie, until a winner can be declared.

## 9. Obstacles

1. This section describes the various obstacles that may be encountered by the robot on the track during the competition. Please note that not all obstacles may be present.

### 9.1 Line break

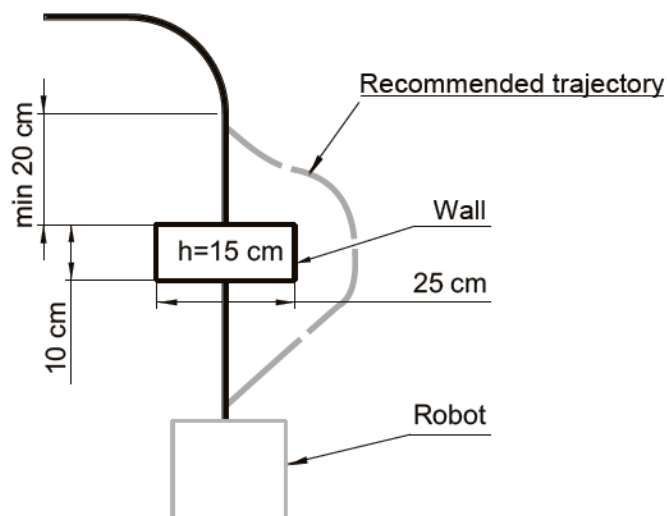
There are line breaks on track sections (see Figure 1) with a maximum length of 10 cm. Before the curve, there is at least 10 cm long and uninterrupted section of the track line. Line breaks may occur sequentially, but between two line breaks, there is at least 2 cm long track line.



**Figure 1: Line break**

### 9.2 Wall or obstacle on the line

There are cuboid shaped obstacles on the track, or walls (see Figure 2) with maximum dimensions of 25 x 15 x 10 cm. The task of the robot is to drive around the obstacle and continue with line following. It is allowed to hit the obstacle, but it is not recommended in terms of the safety of the robot. The obstacle is not white and can be made of any material. After the obstacle, there is at least 20 cm long and uninterrupted section of the track line and the robot must follow the line while being on that track.

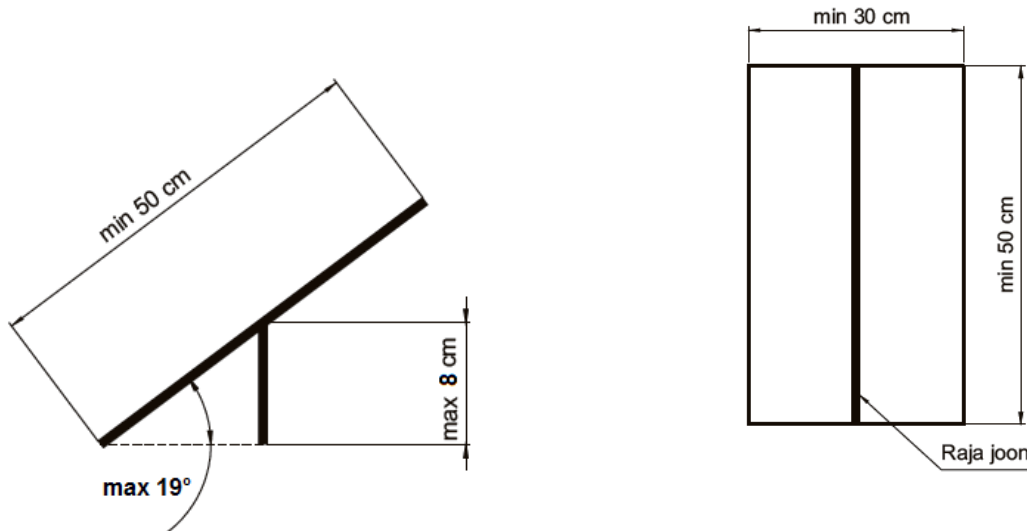


**Figure 1: Wall**



### 9.3 Swing

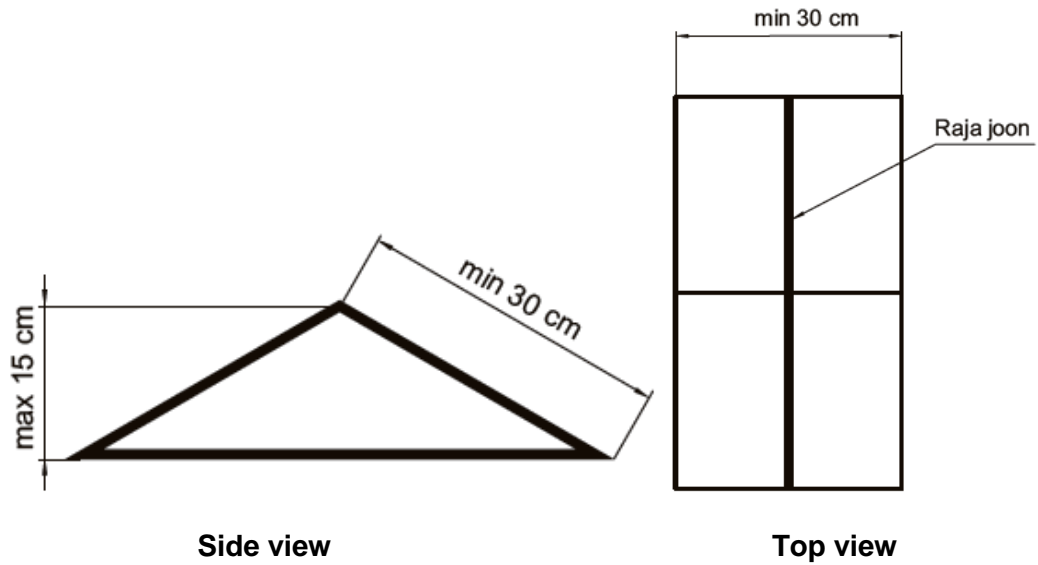
There is a swing on the field (see Figure 3). The task of the robot is to cross the swing and continue following the line. The robot is not allowed to drive around the swing. The length of the swing is at least 50 cm. The width of the swing is at least 30 cm. The fulcrum of the swing is positioned no more than 8 cm above the surface of the field. Standard track line will continue on the swing. After the swing, there is at least 20 cm of straight line.



**Figure 3: Swing**

### 9.4 Mountain

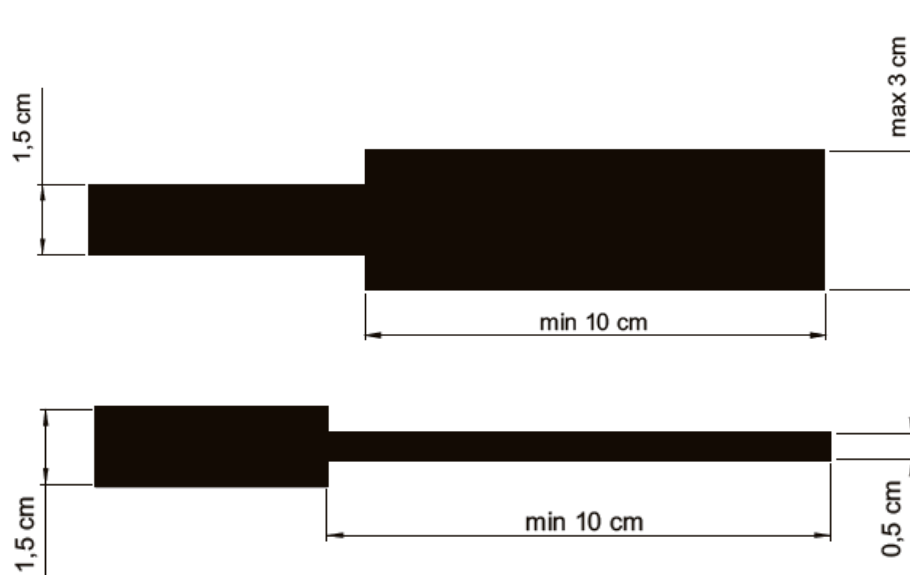
From the side view, the mountain is an isosceles triangle and from the top view, a rectangular shaped static obstacle on the track (see Figure 4). Its height is a maximum of 15 cm and the arm of the triangle is at least 30 cm. The width of the mountain is at least 30 cm. The task of the robot is to drive/jump over the mountain and continue following the line. The robot is not allowed to drive around the mountain. Standard track line will continue on the mountain. After the mountain, there is at least 20 cm of straight line.



**Figure 4: Mountain**

#### 9.4.1 Expansion/constriction of the line

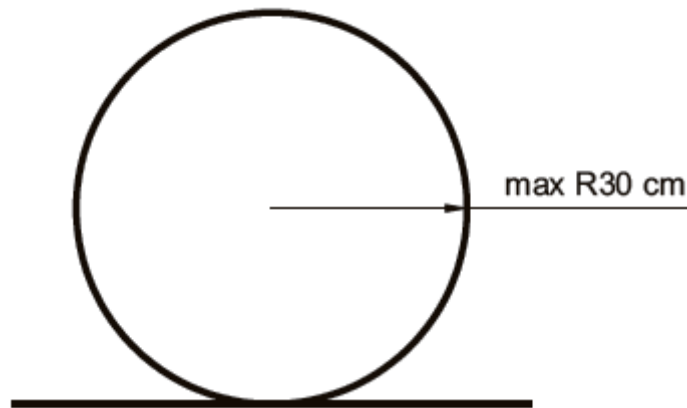
There are places on the sections of the track, where regular 15 mm line expands or constricts at a right angle. The width of the line may vary in the range of 5–30 mm. Expansion or constriction occurs on the track section with a length of 10–50 cm, where there are no other obstacles or curves at the same time. The length of the expanded or constricted line is at least 10 cm.



**Figure 5: Expansion/constriction of the line**

### 9.4.2 Track knot or loop

The loop is a circle with a radius of up to 30 cm, which has been horizontally placed onto the track line. The contestant must fully drive through the loop and once it gets out of the loop, it must continue with line following. The loop may be passed a maximum of three times, otherwise the robot loses the attempt.



**Figure 6: Loop**

## **10. Terms and Conditions of Participation**

1. Participation in ROBOTEX CYPRUS assumes and requires acceptance of all terms and conditions for participation by competitors, the coaches and the organizations they represent.
2. In case of any difference in the competition rules between the English and the Greek versions, the English version is considered as correct.
3. The robot must be registered before the competition. The registration process includes technical inspection of the robot, marking the robot with a number sticker, and the order in which it will compete which is generated by an algorithm in the information system supporting the ROBOTEX CYPRUS organization.
4. In this challenge, there are five (5) referees, each of them inspecting the performance of the robots participating at any given moment. The judges will hold a small flag that they will raise up and wave it every time the robot they control is completing one lap. An additional head referee may also be present to supervise the whole process.
5. All questions and issues that may arise during the competitions must be reported to the judges.
6. The final decision about objections will be taken by the judges in cooperation with the organizers.
7. Judges' decisions on any objections are considered final and can't be challenged by participants, the coaches or the organizations they represent.
8. In the case of a deliberate alteration or change of marking of the unique number of robots, the coach and his team will be automatically expelled from the event. As a result they will not be able to take part in any other challenge they may have enrolled. The coach and his team will leave the venue immediately. The coach also loses the right to take part in the next ROBOTEX CYPRUS event and is automatically excluded from participating in ROBOTEX INTERNATIONAL in case one of his/her teams has won a ROBOTEX CYPRUS competition. The Organizing Committee reserves the right to publicly announce the coach, the team and its members.
9. It is expected that both the coaches and the members of the teams will exhibit a spirit of noble rivalry and will behave with mutual respect, decency and esteem both to themselves and to the organizers, judges and volunteers. The behaviour of all coaches and team members should promote "fair play". Therefore, the Organizing Committee reserves the right to expel anyone from the venue of the event who violates the above principles of good practice.

## **11. Robot Technical Control**

1. An initial technical control of the robot technical control will take place on the day of the competition at an area and on time specified by the organizers.
2. Technical control takes place before each phase of the competition (preliminary, qualifying, final) in which the team may participate.
3. Failure of a team to come in time for a robot's technical check leads to the team being excluded from the event.
4. The leader of the team only is responsible to take the team's robot for technical control.
5. Technical control includes the control of the robot based on the above and the section "5. The Robot". If the robot does not meet the requirements it will not be accepted to compete and will automatically be disqualified from the event.

## **12. Changes and Cancellation of Rules**

1. Any changes and/or cancellations in the rules of the competition are decided by the Cyprus Computer Society in consultation with the Organizing Committee of the CYPRUS ROBOTEX CHALLENGE. You may address comments and suggestions to the Organizers at [robotex@ccs.org.cy](mailto:robotex@ccs.org.cy) .