DIRECTORATE GENERAL OF VOCATIONAL AND TECHNICAL EDUCATION

100 CENTURY OF EDUCATION

TÜBİTAK

TİKA

INTERNATIONAL MEB ROBOT COMPETITION

17th INTERNATIONAL MEB ROBOT COMPETITION

ARCHER (TOZKOPARAN) ROBOT CATEGORY RULES

2025

Education, Technology, Production from Roots to the Future

CONTENTS

ARCHER ROBOT CATEGORY COMPETITION RULES

1. GENERAL INFORMATION ABOUT THE COMPETITION

1.1. Theme

During the Ottoman Empire, there were kemankeş (keman: bow, keş: drawer; kemankeş: bow drawer, i.e. archer) who drew the bow so strongly that sometimes the dust parts of the bow would break off, and for this reason the kemankeş was nicknamed tozkoparan. The bowstring of the bow was made of animal intestines, and the parts where the bowstring was attached to the bow were called "dust". The theme of this competition was inspired by the very good bowmen who were nicknamed tozkoparan.

This competition is carried out with robots created using mechanical, software and sensor technology. The competition will be in the form of following a certain track and shooting from a point on the track to a target and finishing the track as fast as possible. Scoring will be made according to the stages that the robots have passed on the track and the place they hit on the target board.

1.2. Objective

Autonomous dust scooter robots in this category follow the white lines on the black track, detect the coloured area and shoot arrows at the target with a scoring on it, and try to complete the track in the shortest time without any errors by reaching the finish point.

Archer (Tozkoparan) Robot Competition will be held over 4 rounds according to point ranking. At the end of the 1st round and the 2nd round, there will be no elimination. At the end of the 3rd round, elimination will be made according to the 3 round total score ranking formed by adding the points received by the robots in all rounds and the robots that will pass to the next round (Final round) will be determined. Depending on the number of robots participating in the competition, the number of rounds can be changed by the referees. At the end of each round, the total score ranking will be published. In order to advance to the 4th round, it is essential to enter the top 16 in the ranking. At the end of the 4th round, according to the point ranking to be made at the end of the 4th round, the first three ranked robots will win the competition as 1st, 2nd and 3rd respectively. Depending on the number of robots

participating in the competition, the number of robots in the 2nd and 3rd rounds can be changed by technical advisors and referees.

2. ROBOT FEATURES

2.1. Size and Weight Restrictions

There is no restriction on the weight of the robot. However, the largest dimensions of the robots (including the arrow throwing mechanism) must be such that they pass through the starting and ending gates. Regardless of the robot length, the maximum width required for the robot to pass through the door should be within 600 mm and the maximum height should be within 250 mm.

2.2. Autonomous Operation Requirements

The robots will move autonomously and shoot arrows.

2.3. Information About Arrow Shooting Mechanism

The dimensions of the arrow to be given to the competitor by the referee committee at the start of the competition are given in Figure-1 below. An arrow throwing mechanism that can throw an arrow of these dimensions to the scored target board at a certain distance and height will be made by the competitors. This arrow throwing mechanism, which they make as they wish, will be mounted on the robot and will be in a size that can pass through the starting and finishing gates.

3. COMPETITION FORMAT AND EVALUATION CRITERIA

3.1. Application Process

Competition applications are made according to the process and principles specified in the Application Guide. Robots that meet the conditions specified in the Application Guide will be able to participate in the competitions.

3.2. Pre-Screening

There will be no pre-selection in this category

3.3. Competition Stages and Evaluation

Competition Stages:

Stage 1 - Start gate

After the start gate is opened, the robot that takes action and crosses the start line is considered to have started. If the robot does not start within 10 seconds or does not start and does not cross the start line, it is deemed to have used the 1st hand intervention right and receives (-5p). If the robot does not cross the start line in the 60th second, the competition is terminated by the referee and the robot is given "100 points" as base point and "180 seconds" as time. If the robot does not work at the start gate and uses the total of 5 intervention rights there, it is disqualified from that round of the competition in the 6th intervention. In case of manual intervention, if the robot crosses the start line, it is given 1 time (-5p) for that error only at that stage, regardless of the number of interventions (provided that it does not exceed the 5th intervention as stated above). The robot that crosses the first turquoise line completes this stage and gets "20p".

Stage 2 - Erciyes Hill Region

When the robot reaches the Erciyes Hill region, the road line will turn black and there will be a 20mm white area around it. On the return, the road lines will be white again. In case the robot leaves the line in the specified direction of movement and cannot find the road again, the robot will be put back on the track with its front part to the Turquoise line in front of the point where it left; in the meantime, the time continues to run. In case of manual intervention to the robot due to leaving the white road line during the movement on the track, 1 time (-5p) is given for that error only at that stage, regardless of the number of interventions (provided that it does not exceed 5 interventions as stated above). The robot that crosses the second turquoise line receives "20p" by completing this stage.

Phase 3 - Red zone (Shooting zone)

When the robot reaches the red zone, it detects the red zone, lights the red LED and shoots. If the robot shoots before reaching the red zone as an error, even if the arrow finds the target, this shot is considered invalid and a new arrow is given and the competition is continued from the turquoise line number 2. In the meantime, the time is not stopped and the stopwatch continues to count. After the robot shoots, it turns right and leaves the red zone and the red

LED turns off. Failure to switch off the LED is considered as an error and (-5 p) is given. In case of manual intervention to the robot, 1 time (-5p) is given for that error only at that stage, regardless of the number of interventions (provided that it does not exceed 5 interventions as stated above).

Robots that leave the red zone and go out of the line before reaching the 3rd turquoise line, whether they have shot or not, are continued to compete from the turquoise line numbered 3 in front of the previous one, exclusively for this zone. The robot that completes this stage by crossing the third turquoise line gets "20p"

Stage 4 - 90° turns zone

Elimination Round: The robot will only make a 90° turn in this area. If it goes off the line, it will be intervened manually. In case of manual intervention, only 1 time (-5p) is given in total for each intervention (provided that it does not exceed 5 interventions as stated above). The robot that completes this stage by crossing the fourth turquoise line receives "20p".

Final Lap In the final round, there are 5 90° turns in this zone. In case of manual intervention, only 1 time (-5p) is given in total for each intervention provided that it does not exceed 5 interventions as mentioned above). The robot that completes this stage by crossing the fourth turquoise line receives "20p".

Phase 5-Green zone (Bridge zone)

When the robot reaches the green zone, it will climb the bridge with a height of approximately 80 ± 5mm. The green LED will light up when it enters the green zone and will go out when it leaves the zone. In case of manual intervention to the robot, no matter how many times it intervenes manually as an error score, 1 time (-5p) is given only at that stage due to that error (provided that it does not exceed 5 interventions as stated above). The robot is given "20p" if it detects the green zone and the green LED lights up continuously until it leaves the zone and passes the green zone and then follows the white line to the finish gate. The competition is completed and the stopwatch will automatically stop the time.

Evaluation and Scoring System

An arrow will be shot autonomously by each robot. The shot is scored according to the position of the arrow tip on the target face. If the tip of the arrow touches two colours or any

dividing line in two separate scoring zones, the arrow is scored as the higher of the two contacted zones. In addition, a score of "0" is awarded if the arrow travels off the target or hits an empty Velcro area on the target board. The point value of the colours on the target surface is as follows:

Point Values of Colours:

Point Value	Colour
100	Yellow
80	Red
60	Blue
40	Black
20	White

- In the event that the arrow falls out of the mechanism in any way after the start of the competition or the arrow is shot outside the shooting area, this will be considered as an error (-5 Points) and the arrow can be put back into the mechanism by allowing manual intervention.
- If the LED is not illuminated in the zones or if the LED is illuminated in a different colour, it will be considered as an error (-5p). For example: If the Red LED is not illuminated in the Red zone and the Green LED is illuminated, the situations caused by the Red LED not illuminating or the Green LED illuminating (-5p) will be evaluated as an error.
- The time will be kept with the stopwatch on the track. The stopwatch will start counting when the referee presses the start button to start the competition and the start gate opens automatically, when the robot reaches the finish gate, the stopwatch will finish counting with the detection of the sensor and the competition will end.
- Each robot must finish the competition within 180 seconds. If the robot fails to finish the competition within this period, the stopwatch automatically stops counting and the competition is terminated. The competitor is included in the ranking according to the points he / she has received from the stages he / she has passed until that moment.
- Robots must move on the track in the specified direction of movement. From the start of the competition by the referee, 100 points are given to the robots as base points. The

5 stages that the robot has passed within the time until it moves and reaches the finish gate will be evaluated with a total of 100 points (5X20 P). The score obtained as a result of arrow shooting will be added to this score. Since the highest score on the target board is 100 points, the highest total score will be 300 points. Robots that do not come to the competition area and are disqualified will be given "0 points" and 180 seconds as time.

- In case the robot makes a mistake on the track in any way, the competitor is given the right to intervene manually by the referee a total of 5 times until the end of the competition. After the 5th manual intervention, when the robot makes the 6th manual intervention or for any other reason, the competition is terminated. The robots in this situation participate in the ranking according to the score they have received and the maximum finishing time of 180 seconds is accepted as the time they have finished. For each stage; regardless of the number of manual interventions to be made, error points are given only once (-5p) for that error at that stage.
- In case the robot makes a mistake in any way on the competition track, in case of manual intervention and other non-hand intervention (such as LED not lighting, lighting in a different colour, shooting an arrow in the wrong place, not shooting an arrow in the red zone), (-5p) is given as an error point. Only 1 time (-5p) is awarded for the same error in a stage.
- In cases such as the robot not performing any of the 5 stages in the specified direction of movement in any way, reaching the finish point in a short way, the robot not working in the start area, the arrow falling out of the mechanism and the arrow being shot outside the shooting area, the referee is allowed to intervene manually by the referee and the competition is continued from the turquoise line before the stage where the error is made.
- At the end of the first three rounds, the total time and total score of the 3 rounds will be taken into account. The robot that does not participate in any round will be given "0 points" (although the starting score is 100) and "180 sec. time" for that round.
- Entering the track with shoes will be considered as manual intervention and (-5p) penalty points will be applied.

- In case of equality of points, the robot that finishes the track in a shorter time, and if there is equality again, the robot with less error points has priority over the other. In cases where the equality is not broken, the light robot has priority.
- At the end of the 1st and 2nd rounds, there will be no elimination. At the end of the 3rd round, according to the 3 round total score ranking formed by adding the points received by the robots in all rounds, elimination will be made and the robots that will pass to the next round will be determined. Depending on the number of robots participating in the competition, the number of rounds can be changed by the referees.
- At the end of each round, the point standings for that round will be published.
- In order to get to the final round, it is essential to enter the top 16 in the ranking. According to the point ranking to be made at the end of the final round, the first three ranked robots will win the competition as 1st, 2nd and 3rd respectively. Depending on the number of robots participating in the competition, the number of robots that will go to the final round can be changed by the referees.

3.4. Description of Tasks

- According to the ranking determined as a result of the draw, each robot coming to the competition area is weighed and its weight is recorded and this weight is taken into account in case of equality in the results.
- Measurements are taken in the box with a maximum width of 600 mm and a maximum height of 250 mm required for the robot to pass through the door, without taking into account the robot length.
- Which track the Archer robot will compete on is determined by lot at the referee table. As a result of the draw, it is determined which robot will compete on which track (Track 1 or Track 2).
- The robot arriving at the referee's desk is sent to the competition area after the necessary controls (weight and size measurement, etc.) by giving an arrow for shooting.
- The competitor places the arrow on the mechanism on the robot and puts it in the starting area. The competition is started by the referee by giving the start.

- The stopwatch will start counting when the referee presses the start button to start the competition and the start gate opens automatically, and will stop counting when the finish sensor detects the robot when the robot reaches the finish area.
- After entering the track from the starting point, the robot will reach the shooting zone by passing the "Erciyes Hill" without lighting any LEDs.
- When the robot enters the red zone, the Red LED will light and the robot will shoot at the target. When the robot leaves the red zone, the Red LED will turn off.
- 2 identical tracks (A-rink) will be used for the 1st round, 2nd round and 3rd round qualifying competitions.
- In the final round, the identical tracks used in the first three rounds will be converted into B-tracks.
- As a result of the draw, it is determined which robot will compete on which track (Track 1 or Track 2).
- In all rounds, robots will compete individually and ranking will be made according to the score they receive.
- In the elimination round, the robot will reach the exit gate by fulfilling the tasks of "Erciyes Hill", Red area and arrow shooting, 90-degree turn, bridge (green area) climbing, respectively after the exit (Figure 1a).
- In the final round, the robot will reach the exit gate by completing 5 90° turns after the shot (Figure 1b).

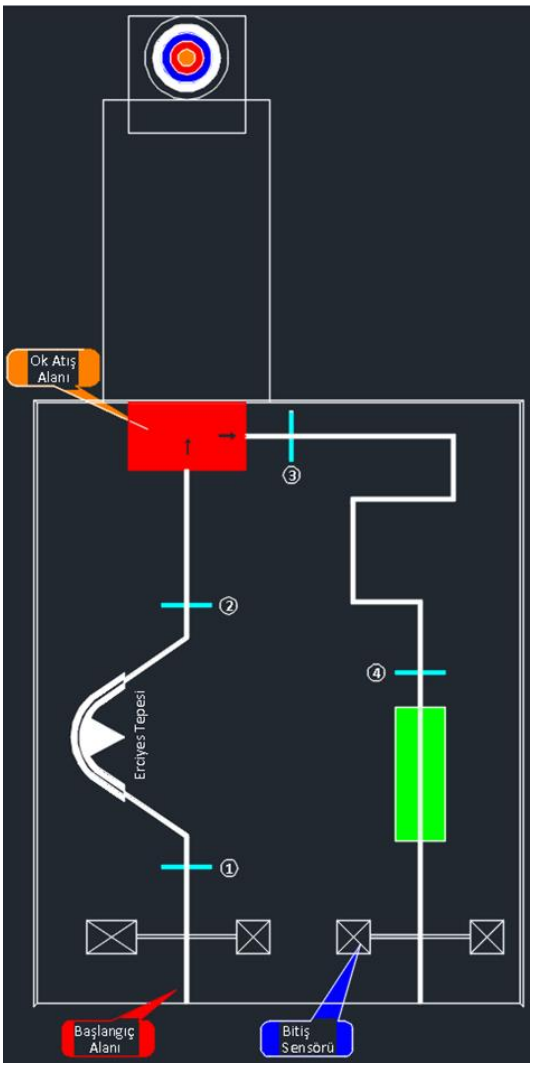


***Figure 1a** - Qualifying Track (Track-A)*

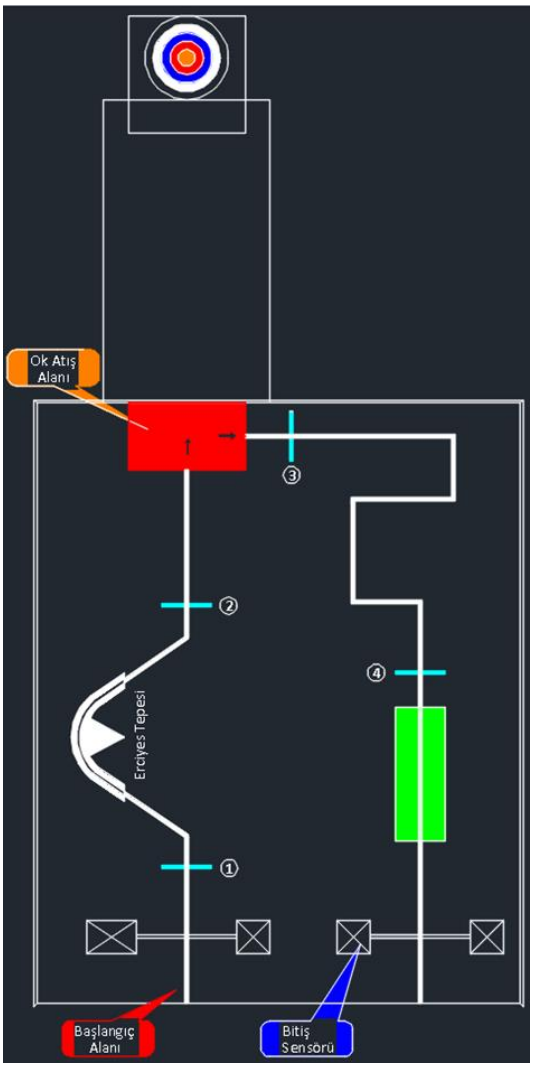


***Figure 1b** - Final Track (Track-B)*

- Only 1 person from each team will be able to intervene in the robot on the competition track.
- Competitors will not enter the track with shoes. The competitor's shoes are removed and the competition is continued from the turquoise line before the stage where the robot made a mistake.
- It is essential to finish the rounds on the same day. While the rounds are in progress, competitors whose turn has not arrived should not leave the competition area. If the rounds are postponed to the next day under compelling circumstances, the referees will announce this via text message, mobile app notification, website announcement or announcement. It is sufficient that the announcement is made by at least one method.

- After the end of the round is announced by the referees; if the competitor requests to compete for a round that he/she could not participate, this will not be taken into account and the robot will receive "0 points" and "180 seconds" from that competition.
- Referees send sms to call the robots. In order to avoid any victimisation regarding this issue, the phone numbers of the two competitors and the mentor teacher must be recorded at the time of registration.
- When the parents' phones are recorded, the message will go to the parents, the competitor will not be informed about this message.
- Robots compete in order. The order in which the robots will compete is determined by lot and announced. Regardless of the order of the competitor, if the round is not over, it is taken into the competition with the decision of the referee. The order in which the robots will compete in groups of 10 is announced by in-field announcement. Until this announcement is made, the competitors must not leave the hall regardless of their ranking. Robots that do not come to the track despite the calls will not be allowed to compete if the round is over. It is the responsibility of the competitor and the mentor teacher to follow the announcements made in the competition area.
- If the competitor is competing in a second category at the same time, he/she is waited until the end of the round at most, and if the round is over, he/she is deemed not to have participated in the round and given "0 points" and "180 seconds".
- No break, maintenance or repair time is given for the robot called to the competition at the time of the competition.
- If there are too many applications for the competition, if it is requested to finish early or if the competitions cannot be completed within the specified time for any reason (health, epidemic, heat, etc.), one more track can be added to the existing two tracks or the number of laps can be reduced.
- No permanent mark or marking may be left or damaged on the road on the competition track.
- Vehicles can use any energy source that will not harm the track and spectators.

- Matte red foil and matte green foil will be used for the coloured areas on the competition track.
- There may be changes in the dimensions of the tracks during the construction phase without disturbing the general structure.
- During the competitions, the objections made due to the illuminated marquee, camera and lighting around the track will be deemed invalid.
- Robots that have attachments other than the start button on the robot that may cause adjustment or that are judged to be adjusted by the referees are disqualified at any stage. Referees are the sole authority on whether or not adjustments have been made.
- The Competition Organising Executive Committee has the right to change the rules when it deems necessary.

3.5. Disqualifications

- The robot cannot leave permanent marks on the track or damage the track. If the judges decide that the robot has damaged the track, the robot will be removed from the track and the competitor will be disqualified. The referee committee is authorised to decide on the cleanliness, layout or suitability of the maze for the competition.
- Robots that are too big to pass through the start and finish gates are disqualified.
- In case of remote access to robots, robots are disqualified.
- Robots that do not come to the track despite the calls will not compete. It is the competitor's responsibility to follow the announcements and announcements.

3.6. Safety Precautions

- There will be no competitors in the arrow shooting area.
- When the floor has just been cleaned, the competitor must wait for the floor to dry before entering the track.
- Technical advisor and referee warnings must be taken into consideration.

4. COMPETITION AREA AND EQUIPMENT USED

4.1. Information About Arrow

The arrow consists of 4 parts. Figure-2 These parts consisted of a wooden body, a PLA tip printed on a 3D printer, polyethylene foam and female Velcro tape. The arrow body is made of wood in the form of a round slat with a diameter of 9 mm and a length of 180 mm. The tip is 28 mm in diameter, 14.75 mm long, conical shaped, printed from PLA material on a 3D printer. Polyethylene foam with a diameter of 28-20.5 mm and a thickness of 12 mm was glued to the tip of the arrow to provide flexibility. A 36 mm diameter female Velcro tape (the target board will be the male part) was glued on the polythene foam. For better adhesion of the arrow tip to the target surface, the ends of the Velcro tape were attached to the holes drilled on the conical shaped PLA material with string. The weight of the arrow is 8 ± 0.5 gr and the arrow will be given to the competitor by the referee committee before the competition starts and placed in the arrow shooting mechanism of the robot. One arrow will be shot autonomously by each robot. When the arrow sticks to the target, the highest score it touches will be scored. If the arrow does not stick to the target, the shooting score will be determined by the camera.

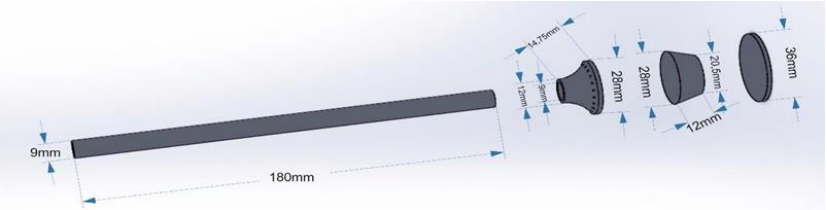


Figure-2 *Arrow Dimensions*

4.2. Information About Target Board

The target board will be made of 700x700 mm chipboard and 12 mm thick polyethylene foam will be adhered on the chipboard to provide flexibility on the surface. The foam surface will be covered with Velcro tape (male part). The target board will be at a height of 400 mm from the ground for better arrow shooting and for the spectators to watch. For this purpose, a stand will be made on the target board. The target surface to be scored on the target board is a surface with a diameter of 600 mm and 5 different coloured circles drawn inside each other. These colours are yellow, red, blue, black and white from the centre outwards.

The size of the target face is measured using the diameter of 5 circles, each enclosing a scoring zone. The tolerance of each diameter measurement should not exceed ±3 mm for the zones (Figure-3).

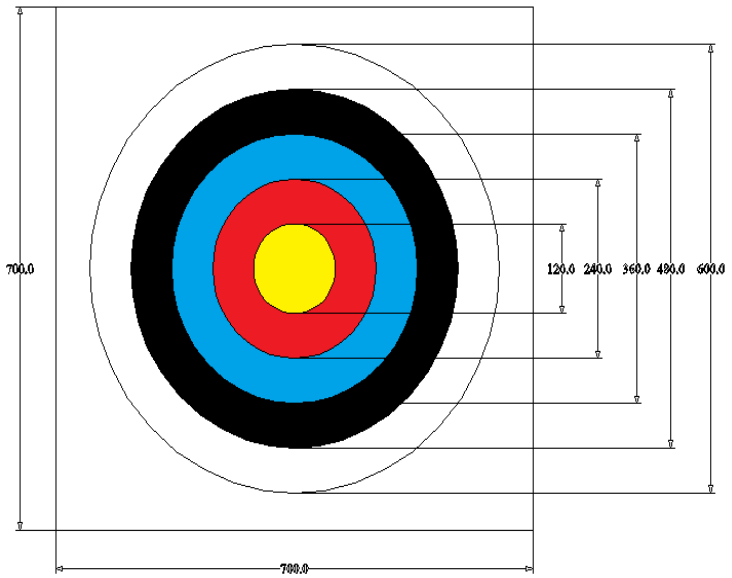


Figure-3- *Target Board and Target Face Dimensions*

4.3. Qualifying Track (Track-A)

Information about the runway:

- The dimensions of the qualifying runway, Runway-A, and the roads are given in Annex-1 (Figure-4).
- The roads on the platform are white lines on a matt black dota background. Only the road line on Erciyes Hill is black.
- The platform consists of two parts: 2900 mm x 3600 mm, 18 mm thick chipboard, 2900x3100 mm in size, made of 5 mm thick black matt dacota material and 1800 x 1000 mm, on which the 700 x 700 target board is located. For the race start area where the start gate is located and the race finish area where the sensors to end the competition are located, 2 pieces of 600 x 500 mm dacota material were also used. The joints of the parts forming the road were covered with black matt foil. The chipboard used in the first part of the platform was bordered with a thickness of 18 mm and a height of 68 mm (the height on the competition floor will be 50 mm) on three sides except for the start

and end sides. Together with the borders, the size of the first part is 2936x3618 mm. The total area covered by the platform is 5418x2936 mm.

- The road lines on the platform are made of 20±2 mm thick white matt foil.
- The entry and exit angles to Erciyes Hill on Dakota ground are 125°. After the robot enters the track from the starting area, it will move by following white lines on a black background. ***When reaching the top point, the road line will turn black and there will be a 20 mm white area around it.*** On the way back, the path lines will be white again.
- There are 4 turquoise coloured lines on the competition tracks. These lines; When the robot goes out of the line, if the competitor needs manual intervention, the robot is placed with its front side to the turquoise line it last passed. When the competitor intervenes the robot manually, the robot is placed in the competition area with its front side to the turquoise line it last left, wherever it is.
- Dimensions of the coloured zones: The dimensions of the red zone are 700 mm x 400 mm, as shown in Figure-3. The dimensions of the green coloured zone (Bridge) are: length 800 mm, width 300 mm and maximum height 80 mm.
- Two of the competition runways will be built and the runways will be prepared to be identical. In the qualifying phase; two pieces of the A runway will be prepared. These tracks will be named as Track 1 and Track 2. When the qualifying phase is finalised and the 'Final' phase is started, both of these runways will be converted into runway B. The total area of the two circuits is 7418x7872 mm, including the utilisation areas (1000 mm). There is one white coloured start gate for each track. When the start button is pressed by the referee to start the competition, the start gate will open automatically and the stopwatch will start at the same time. When the start gate is opened, the height of the upper part of the door mechanism is 250 mm from the ground, the height of the gap from the ground to the bottom of the door before opening is 15 mm, and the width of the door is 600±3 mm.
- The end sensor is located in the centre of the towers at the end door, in the form of a mutual transceiver and 15 mm above the ground.

- The target board is directly opposite the red zone where the robot will shoot an arrow. The distance of the target board to the outer edge of the track is 1600±5 mm. When the border (18 mm thick chipboard) surrounding three sides of the track is taken into account, the target board is 1618 ± 5 mm from the end of the red zone.
- The bottom point of the target board is 400 ± 3 mm above the ground.

4.4. Final Circuit (Runway-B)

- The dimensions of the final track, Runway-B, and the roads are given in Annex-2 (Figure-5).
- In the final round; unlike the qualifying round, after the robot shoots in the red zone and turns right, it has to pass through 5 90° turn paths before the bridge.

5. CONTACT US

The general rules regarding the competition applications and the Labyrinth Master Category are included in the "Application Guide". The Application Guide must be read before making an application.

Competitors should ask their questions by selecting their categories from the information menu after logging into the robot.meb.gov.tr system. Questions other than category messages will not be answered and no responsibility will be accepted.

ANNEX-1 QUALIFYING TRACK (TRACK -A)

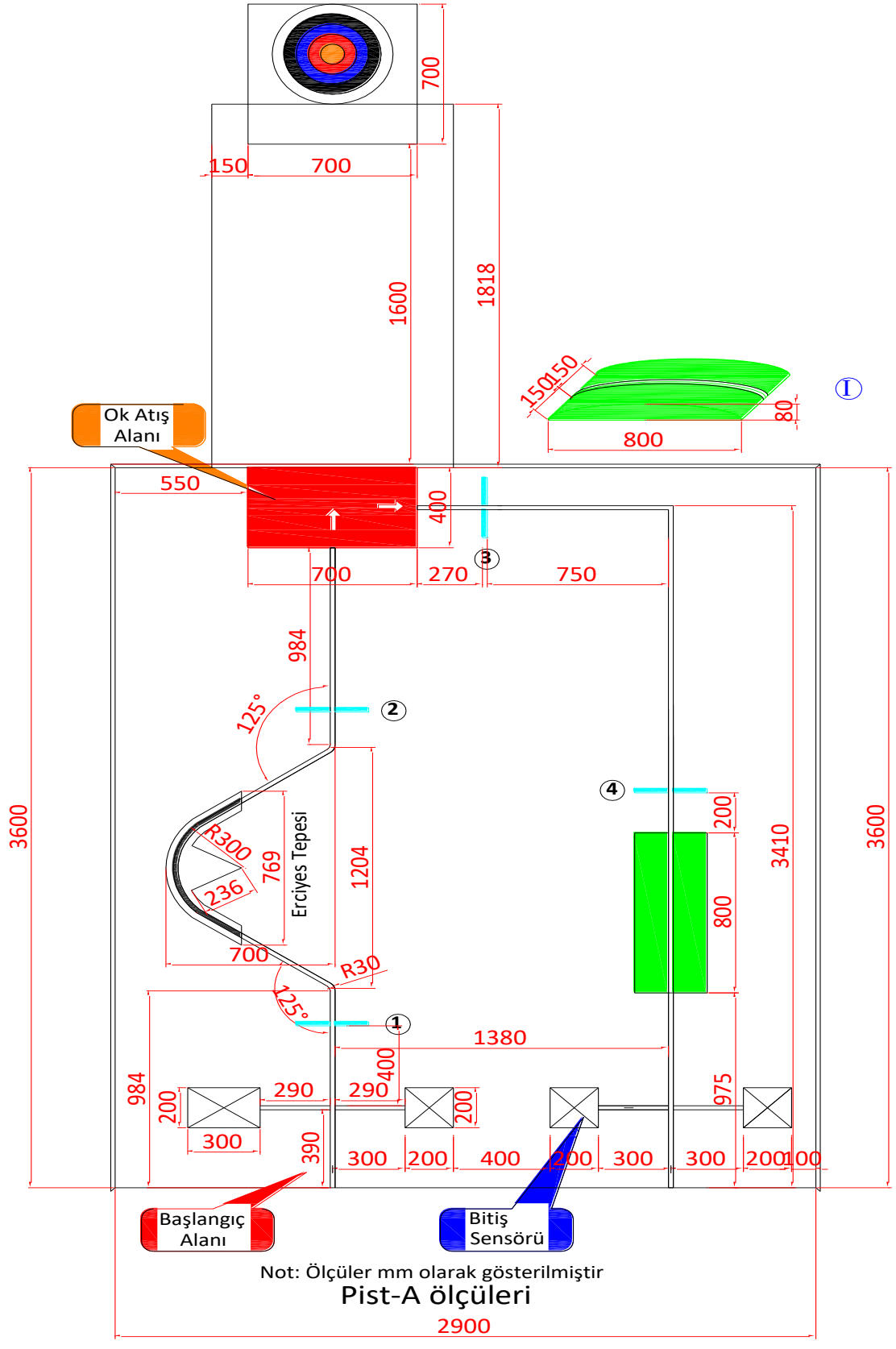
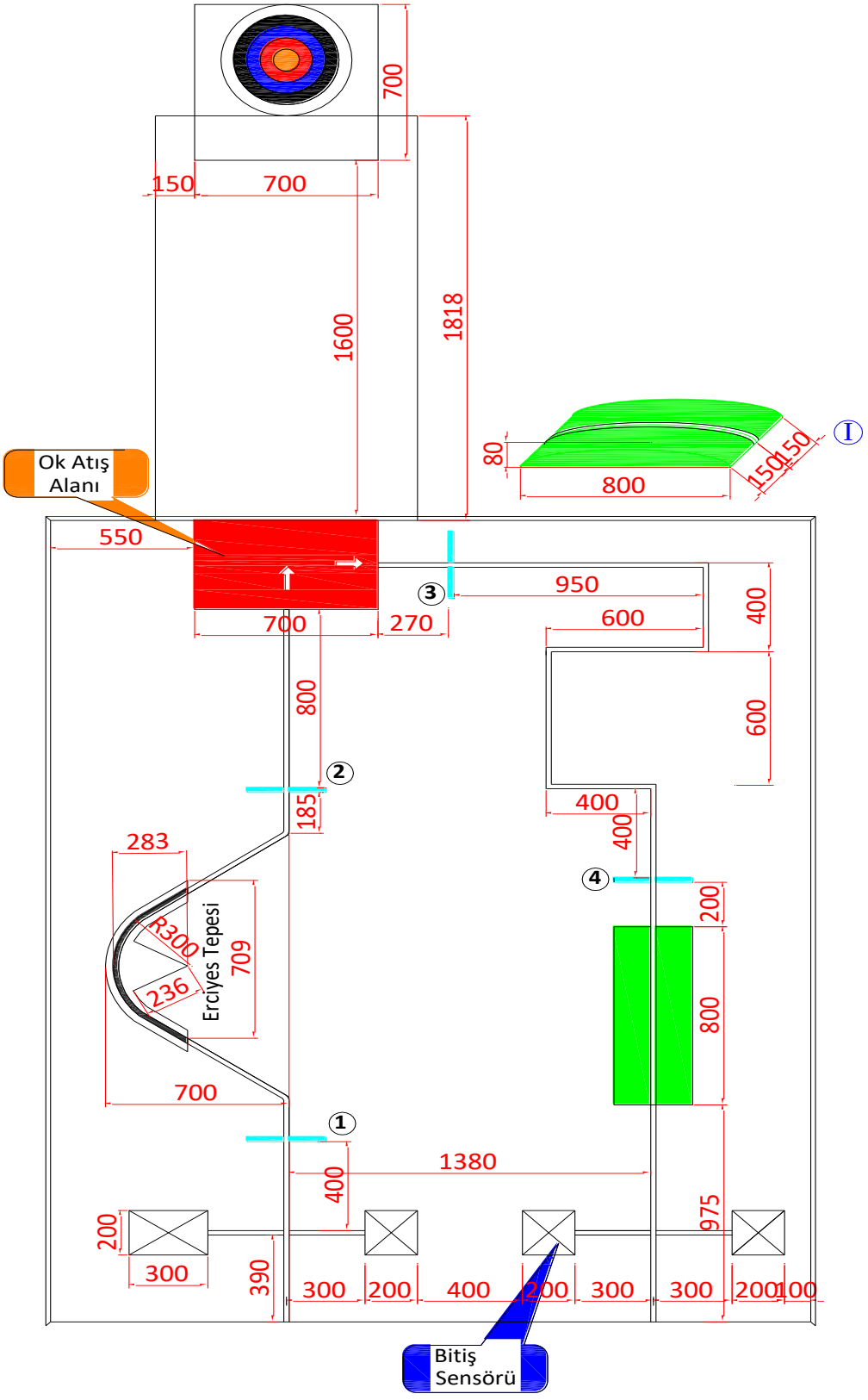


Figure 4- *Qualifying Track (Track -A)*

ANNEX-2 FINAL TRACK (TRACK -A)



Not: Ölçüler mm olarak gösterilmiştir

Pist-B ölçüleri

***Figure 5** - Final Runway (Runway -B)*