

**AUSTRALIAN-INTERNATIONAL
MODEL SOLAR CAR
CHALLENGE

2001
REGULATIONS**

**These regulations apply to the
Australian-international Model Solar Car Challenge**

OVERVIEW

This is a race for model solar cars built by school age students which compete over a 100 metre figure "8" circuit. Two cars race at a time guided by parallel guide channels attached to the track surface. Time trials are held over a 14 metre distance and the speeds are used to "seed" the cars, ie. allocate them to groups in such a way that the faster cars should not compete with each other in the earlier rounds. A "round robin" involving 3 preliminary rounds in which each car races three other designated cars, will begin the competition. At the end of these rounds, the cars with the greatest number of wins are allocated into groups which compete in a "knockout" competition in which the winners continue to the next round, the losers are eliminated and race no further. This process of elimination continues until a winner is decided by being the only undefeated car. Final rounds may consist of a number of "heats" in which each car may win one heat. However, the winner will be the car which wins most heats.

1. INTRODUCTION

1.1 Event name

The event shall be known as the "Australian-International Model Solar Car Challenge" (AIMSCC) and is conducted annually

1.2 Committee

The Executive Committee of the Australian-International Model Solar Car Challenge is a voluntary Committee consisting of State Co-ordinators and other invited interested persons and referred to herein as the Committee. The roles of the Committee include establishing the regulations for the year and organising the event.

1.3 Aim

The aim of the event is to encourage student teamwork and enterprise as students work with one another and with support and guidance from teachers and parents while researching science and engineering principles relating to solar energy and photovoltaics in constructing, testing and racing model solar cars.

1.4 Spirit of Intent

So that the competition remains financially accessible to as many schools as possible the organizers wish to limit the photovoltaic cells used to lower cost, commercially available mono-crystalline, poly-crystalline or amorphous silicon cells.

The AIMSCC is an enterprise program providing opportunities for school student teams to design, construct and race model solar cars on a track laid out by the organizers. These regulations govern some aspects of the car design while allowing considerable scope for teams to exercise their ingenuity

1.5 Competitors

The competition is open to invited schools or other organizations for school aged students to secondary level, approved by the Committee. The race organizers wish to make it clear that the spirit and intention of the competition is that the design and construction of cars will be by students. Teachers of course will need to assist and guide the students, but students should conduct the principle design, manufacturing and related activities. This approach will be tested during race day where the students will be required to make decisions under pressure and then undertake suitable modifications by themselves.

1.6 Statement of involvement

Cars entered in any given year should be substantially the work of students in the year of entry. Forms confirming that the work is that of students and not teachers or parents will need to be signed by the students and coordinators and submitted to the race organizers prior to the start of the event.

1.7 Correspondence

All correspondence should be addressed to:

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AIMSCC Executive Officer

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2. INTERPRETATION OF THE REGULATIONS

2.1 AIMSCC make decisions

The AIMSCC event officials are empowered to make a decision on any case not covered or clarified by these regulations. In the case of dissent from an AIMSCC official's ruling, the dissenting team may be excluded from the competition.

2.2 Use of AIMSCC regulations

While state model solar car challenge coordinators are encouraged to conduct their State events so as to observe the regulations pertaining to the AIMSCC event, the regulations for each State event are determined by each State Coordinator. It is, however, the responsibility of each team invited to participate in the AIMSCC event to adhere to the AIMSCC regulations, regardless of the regulations of any State or Overseas event in which they may have participated.

2.3 Unfair practices

If during the event or at scrutineering AIMSCC officials discover that an entrant or crew has deliberately violated these regulations to gain unfair advantage over other entries, or has departed from the spirit of the event, that team will be excluded from the competition.

3 ENTRIES

3.1 Number of Australian teams

The AIMSCC Executive Committee shall request each State Coordinator to invite up to four teams who have proved themselves to be among the top entrants in their state event by criteria to be determined by each state coordinator. Additional entries may be invited at the discretion of the Committee.

3.2 Number of overseas teams

The AIMSCC Executive Committee shall request coordinators of events in other countries to invite one or more teams who have proved themselves to be among the top entrants in their event. Where a country does not have a national/regional event, the AIMSCC Executive Committee may invite one or more teams to represent that country, provided their entry conforms to these regulations.

3.3 Number in team

Each team will be expected to comprise at least two students (essential for starting and catching the car).

3.4 Team representation

Each entrant must represent his or her school or other organization accepted by the Committee. If two cars are entered from the same school, the seeding process will be implemented in such a way that they will not compete in the same group during the round robin competition. However, if successful, they will compete against each other before or during the quarter finals, ensuring that no school can win more than one of the major prizes.

3.5 Statement of work

All students must sign a form indicating that the design and construction was essentially their own work.

3.6 Posters required

All entries will be required to present a laminated or contact coated A2 Poster (size 420mm x 594mm) documenting the design and development of their car to the organizers prior to scrutineering. This record should document experiments and or calculations, which were used in the design of the Model Solar Car.

This poster will become the property of the organizers and may be used for promotion of the event, but will ultimately be returned by the State Coordinator.

3.7 Optional decorated egg competition.

To enhance the fun side of the event an optional hard-boiled or blown egg may be decorated and presented as a driver for judging. NB This will not be the driver for the race but may be used for display or photographic purposes.

3.8 Entry registration

Entrants must confirm their participation with the AIMSCC Executive Officer at least 21 days before the National event. If the State event is held less than 21 days prior to the national event, the State Coordinator must make appropriate arrangements with the executive officer Mr. Mark Needham. Potential overseas entrants should notify the executive officer of their intention to compete by October 1st. The invitations will be sent to the Coordinators before their event.

4. TRACK

4.1 Size and Shape

The outdoor track used in this event will be in a 'figure 8' configuration with a low bridge at the crossover point as shown in Attachment B. The corners will feature curves with an approximate minimum radius of five metres. The track length is approximately 86 metres with cars completing one full lap plus an extra 14 metres to reach the finish line.

4.2 Slope

The uphill and downhill sections of the track at the crossover point will have a minimum clearance between tracks of 300mm. The slopes will range between 1:16 to approximately 1:8.

4.3 Construction

The track will have a smooth surface with two parallel guide tracks of PVC channel (see Diagram 2) such as 'UM20' or 'basket track' or similar, screwed to a plywood base. As the track is assembled in sections, there may be minor misalignments. The Committee will endeavor to ensure misalignments both horizontally and vertically will be less than 2 mm. If in the Committee's opinion, a car is inhibited in any race as a result of a serious track imperfection, that race shall be rerun as soon as possible.

NB. Thin metal (~1mm thick material) channel sections may be used to align the ends of adjacent plastic guide ways if in the Committee's opinion, there is a significant alignment problem. This could lead to a total width of up to 19mm, which should be allowed for if external steering guides are used.

4.4 Starting Position

Cars will start near the top of the downhill section of the track. Cars will be started by resting against the start gate which will be rotated away from the cars by a person appointed by the Committee.

4.5 Finish Position

The winning car will be determined by an electronic timing device initiated by a light/infrared beam approximately 50mm above the track. It should be noted that in rare cases, the design of the winning car may introduce small errors in the recorded times of each car. In the event of an equipment failure, stopwatches operated by persons appointed by the Committee will be used. The race-day coordinator will adjudicate on any dispute as to the finishing position of any car and there can be no appeal against that decision.

5. SCRUTINEERING

5.1 Race Ready

All competing teams shall be required to register upon arrival at the venue by a time to be announced when the invitations are issued. Cars must be in a condition ready to start when presented for scrutineering. Scrutineers have the right to examine each car at any time to ensure it conforms to these regulations.

5.2 Failure

Any car failing to pass scrutineering by the end of time allowed will not be permitted to start the event.

6. SERVICING

6.1 Service area

An official service area will be set aside for student team members to carry out repairs or modifications. Students capable of representing their State at the national level will be expected to be capable of operating independently of teacher or parent support and hence only students are to conduct car adjustment and maintenance on race day.

6.2 Modifications

Students may modify cars during practice or between rounds, but the scrutineers may reassess cars at any time. However, cars as presented at scrutineering immediately prior to the commencement of the knockout rounds of racing must be used for all knockout races. A modification to these cars between elimination rounds specifically excludes the changing of solar panels, car bodies, chassis and driver/passenger compartments irrespective of light conditions. Repairs to these major components are allowed. Changing driving wheels, gears, motors, steering mechanisms and panel voltage will be permitted between races.

6.3 Service crews

For the duration of each race, up to three students from each team will be allowed in the scrutineering or track areas. The organizing Committee will provide adult supervision.

Advice and/or physical assistance from adults is not permitted. It is recognised that during racing the student team members are under great psychological pressure, especially during the finals races, and may be confused as to the appropriate modification/repair to continue racing. The Committee will provide an independent person to facilitate the student team members to use their own knowledge as to the appropriate course of action.

6.4 Restricted areas

No person other than those nominated shall be allowed in the restricted area without permission of an AIMSCC official and must be accompanied by that official at all times whilst inside that area.

7. COMPETITION

7.1 Time trial

Following scrutineering, each car will be timed over a given distance on the designated track, for the purpose of seeding each car, to determine the groupings of teams who will compete in the 'round robin' section of the event. The time trial will start at the starting gate and end at the finish line of the figure 8 track, a distance of approximately 14 metres.

7.2 Structure of the races.

The event shall be conducted with pairs of cars competing against each other over tracks of equal length (100 m) in a series of 'round robin' and/or elimination races to be announced in the official schedule of events.

7.3 Timing

Each car will be timed over the course. Times will be posted on the result board.

7.4 Start

Cars will be presented at the start line within two minutes following the call for cars on the public address system. In the case of best of three or best of five heat races, cars will alternate between tracks. The cars will be placed on the track in a ready to run state.

7.5 Stability

If the car comes off the tracks it shall be deemed unstable and will not be re-started in that race unless the officials are satisfied that the problem was caused by the deficiency of the track. There shall be no handling of cars during the race other than by officials or by people nominated by officials.

7.6 Poor light / adverse weather conditions

If light conditions do not enable the cars to complete the course, the car that travels the furthest, or, if two cars travel the same distance, the car, which reaches that point first, will be judged the winner.

When both cars have come to a halt short of the finish line the race will be deemed to have finished if neither car has moved for a maximum of 30 seconds.

If a car stops for any reason, the car may be restarted under the marshall's discretion from any point on the track behind the stopping position, but the car must not be pushed to restart.

7.7 Practice and testing

Practice on the track will be allowed at any feasible time that marshals are in attendance.

7.8 Results

Final results will be decided after the provisional first four place winners have been rescrutineered and passed by the officials.

7.9 Prizes

Prizes will be presented to First, Second, Third and Fourth place getters. The presentation of prizes will be held as soon as possible after the completion of the event. Additional prizes for best poster, best team uniform etc. will be presented to teams deemed worthy. The categories of such prizes will be announced at the time when invitations are issued.

8. CAR SPECIFICATION

8.1 Definitions

For the purposes of these regulations the following definitions will apply.

8.1.1 Solar Panel

That complete unit on which the active photovoltaic cells are mounted. The solar panel may form part of the car body, but must not form a part of the chassis, cabin or side panels. The solar panel may carry the ON/OFF switch, but mounting other switches or devices, eg for changing output voltages, on the solar panel is not permitted.

8.1.2 Chassis

That part of the car which can be identified as providing structural support for the body, solar panel, wheels, motor/s, cabin and side panels.

8.1.3 Body

Any part of the car which provides an aerodynamic form or encloses a space and is attached to, or part of the chassis. The body may include the two side panels, chassis and cabin. NB. the cabin must be sealed when racing. see 8.19.

8.1.4 Side Panels

Either a designated part of the body or separate pieces attached to the chassis, conforming to the size requirements of these regulations.

8.1.5 Vertical panel

A cross sectional area across the width of the car, measuring a minimum of 100mm by 220mm through which air cannot pass. This may be the inside of an aerodynamic body or driver cabin. Provision must be made for the scrutineers to verify this.

8.1.6 ON/OFF switch

A commercially available switch which will electrically disconnect the solar panel from the motor. Alligator clips or plug and socket connections, while allowed as part of the electrical circuit, may not be identified as the 'on/off' switch.

8.2 No commercially built cars

Cars may not use any part of the chassis or body of any commercially available model car. This only refers to the structural frame, not to the drive train components such as gears, shafts, wheels or tyres or to suspension components. All external body covering is at the discretion of the entrants.

8.3 Size Limit

The maximum size of the car presented for scrutineering shall be no more than 650 mm long. The maximum height shall be no more than 180 mm high. The width must not exceed 320mm. (Wheels included).

8.4 Source of Power

The car is to be powered by photovoltaic cells as approved by the AIMSCC Executive. Approved photovoltaic cells will be commercially available mono-crystalline, poly-crystalline or amorphous silicon cells.

8.5 ON/OFF switch

Each car must be fitted with an 'ON/OFF' switch to minimise car set-up time whilst at the starting gate. The 'ON' position must be clearly marked.

8.6 Power Limit

The maximum power delivered by the photovoltaic cells will be 12 watts measured by the scrutineers using a light box (see attachment C) delivering approximately one Sun equivalent. For curved panels the panel output will be determined by placing the panel generally parallel to the top of the light box. It is expected that commercially available 10 watt solar panels will normally be used. The 12 Watt limit is included to allow for manufacturing tolerances.

If teams use individual cells to construct a panel, and the output as measured by the scrutineers exceeds 12 watts, the panel must be modified to limit output to conform to the 12W maximum. The team may modify the solar panel during the scrutineering process to reduce the output to comply with this regulation.

8.7 No energy storage systems

No energy storage system, either electrical, mechanical or chemical, which assists in the performance of the car will be permitted. Capacitors of less than 1 farad are allowed as part of the electrical system but the scrutineer/starter reserves the right to discharge them immediately prior to the start of the race

8.8 Panel Weight.

The panel weight will be as per the table based on the measured power outputs using the light box as defined in attachment C. The ballast weight is calculated using the formula :-

Total panel weight (grams) = (Panel power (watts) – 4) X 220

e.g.

POWER	WEIGHT
6W	440g
7W	660g
8W	880g
9W	1100g
10W	1320g
11W	1540g
12W	1760g

The Committee will provide scales to determine panel weights, measured accurate to +/- 5 gm. eg. a car with a panel output measured at 8.3watts, will weigh between 1070 and 1080 gm.

Each panel may include a single on/off switch and connecting wires, but all other mechanical, electrical or electronic devices must be separate from the panel and supported by the chassis.

8.9 Ballast

Additional weight required to be carried as ballast, may be secured in any part of the car, but must be easily removed for scrutineering.

8.10 Solar Panel Removable

The panel must be easily removed from the car for weighing and the car must be capable of free and stable movement along a flat surface with the solar panel removed.

8.11 Solar Panel Size

To allow innovation in design, the panel may be of any size. The distance from the track surface to the lowest part of the solar panel will not be less than 75mm.

8.12 Motors

There is no restriction to the type and size of motor (or motors) that may be fitted to the car. However the motor manufacturer and/or part number must be made available to the scrutineer for assessment of energy storage systems.

8.13 Wheels

There is no limit as to the diameter of wheels. So as not to damage the track knife edge wheels are not allowed. Each wheel must be at least 1mm wide or have a radius of 0.6mm on the running surface. Use of an active (moving) steering system will be viewed favourably when choosing quality engineering design awards.

8.14 Chassis

The car must have a rigid chassis independent of the solar panel so that the car is capable of free and stable movement along a flat surface with the solar panel removed. The car must have all components, such as the driver and passenger cabin, attached.

8.15 Side Panels

The car must have side panels at least 300mm long by 75mm high and 1mm in thickness. They will be mounted on each side of the car. The maximum curvature or slope of the side panel will be 25mm vertically and 75mm horizontally. The purpose of these panels is to allow easy determination from a distance of the name and/or number of each car.

8.16 Vertical Panel

Each car must contain either a solid flat panel made of a rigid material such as balsa, cardboard, plastic or foam being least 100 mm high x 220 mm wide x 1.0 mm thick or a demonstrable crosssectional area consistent with the definitions. This panel must be mounted vertically across the width of the car, at $90^\circ(\pm 5^\circ)$ to the direction of motion.

8.17 Steering

Each car must incorporate a means of steering along the guide channel of the track. Section 4.3 specifies any Track variations that may be encountered. The steering mechanism may be either a vertical peg (as per slot car principal: Refer to Diagram 2) or guide rollers designed to run inside or outside the channel. Refer diagram 1.

The front guide mechanism (combination of pegs and/or rollers) will be no longer than 75mm measured in the direction of travel. Any rear guide mechanisms will be located so that there will be at least 120mm between any device which may come in contact with the track guide channel. The location of guide mechanisms in relation to the body and wheels is at the discretion of the designer.

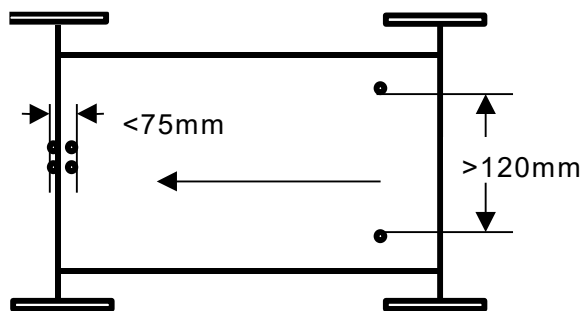


Diagram 1

If the cars' main drive is part of the steering mechanism then the 120mm distance will apply to other guiding mechanisms

The peg(s) or device(s) should be capable of adjustment to heights between 5 mm and 12 mm above the track base.

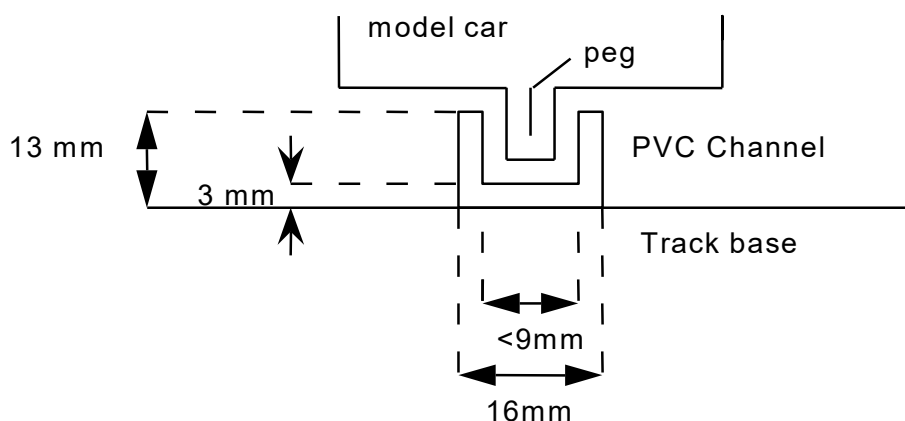


Diagram 2

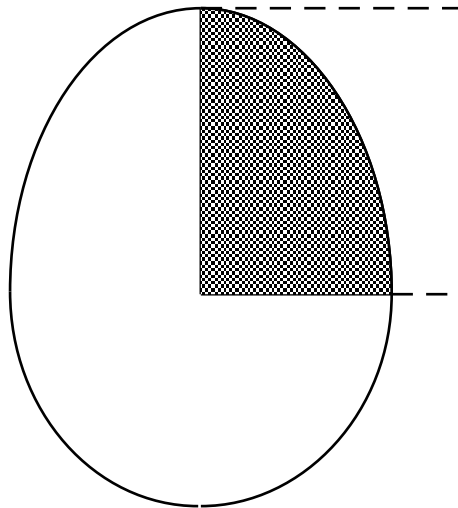
8.18 Driver

To ensure that the cars guarantee driver safety, a driver of the car will be a large egg (61g) supplied by the Committee. The egg must not be covered in a film or painted so as to increase its strength. In any race, a cracked, broken or dislodged egg will mean that the driver is injured, so the car concedes that race to its opponent. If an egg is damaged in one heat of a best of three or best of five final, a replacement egg will be provided for the remaining races.

8.19 Driver and Passenger Cabin

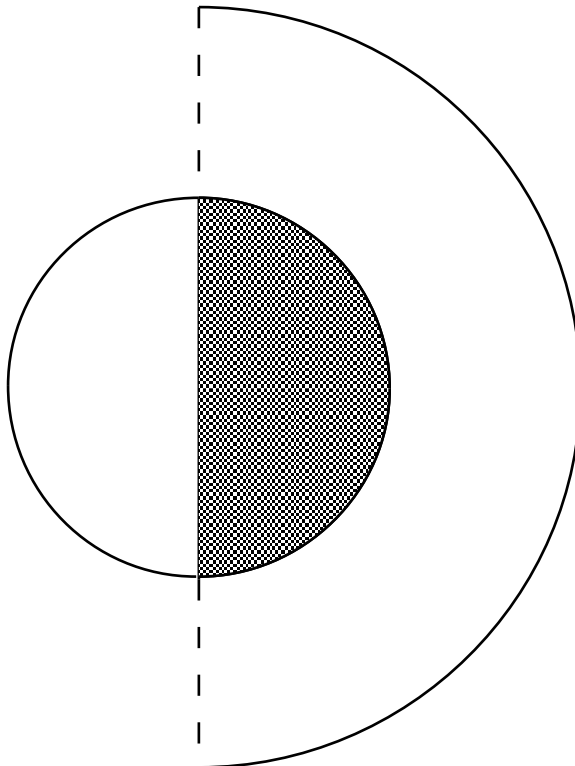
Each car must have a fully enclosed cabin at the front of the car in which the egg sits vertically (see attachment A). Adequate space and a seat must be provided inside the cabin for a second egg as a 'passenger'. The cabin must be fully sealable so that if the egg breaks nothing is spilt onto the track (such sealing may be adhesive tape). The cabin must also include a transparent (not translucent) windscreen at least 25 mm deep (in the vertical direction). This will allow at least the top half of each egg (if the passenger were carried) to be visible from straight ahead and through a 90° arc on either side when viewed horizontally.

Attachment A: Views of egg indicating necessary visibility



The windscreen must allow this part of the egg to be visible when viewed horizontally from straight ahead or any position to 90° from the centre line.

SIDE VIEW

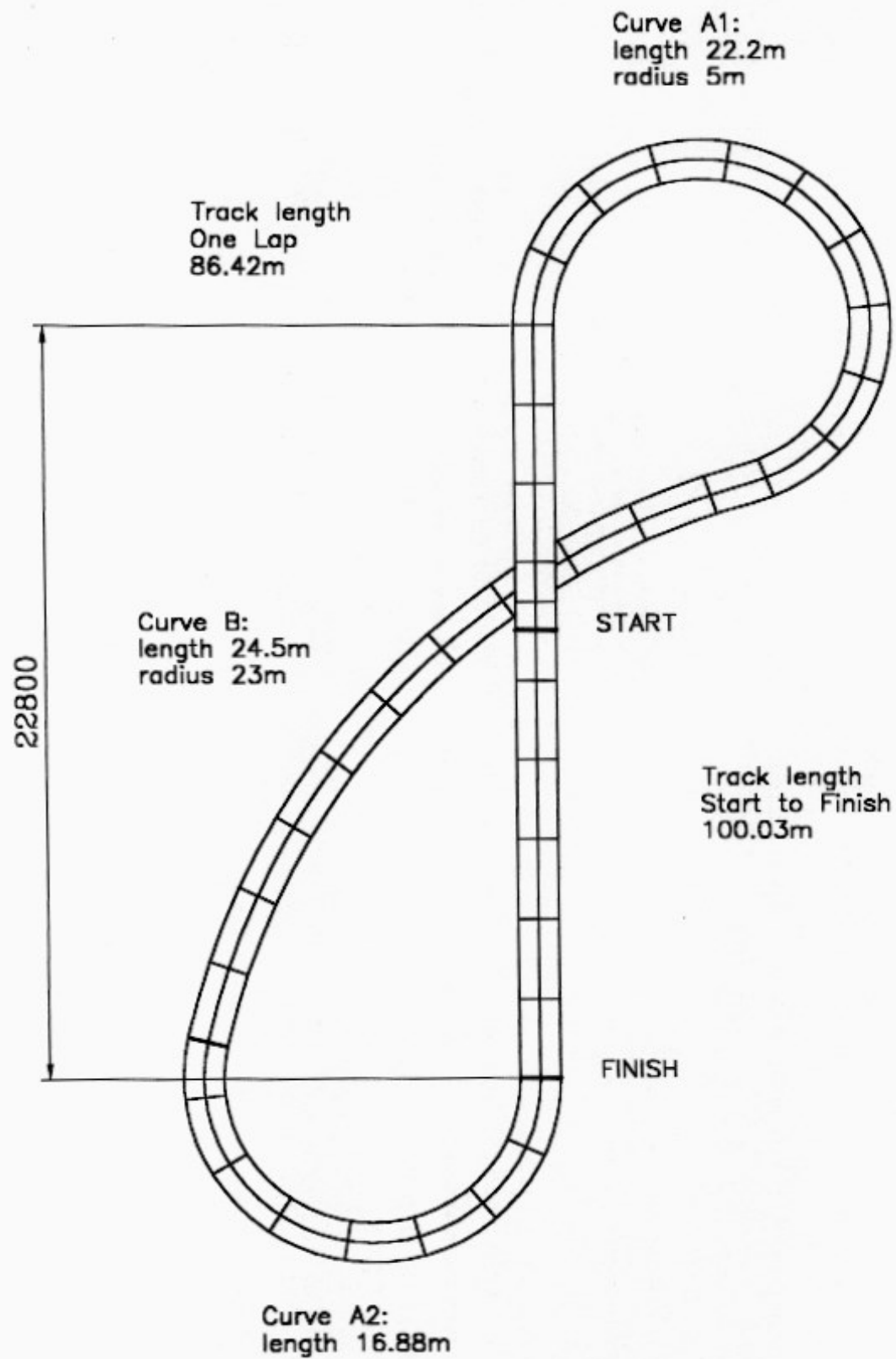


The top half of the egg must be visible through the windscreen from any point on this arc.

PLAN VIEW FROM ON TOP.

Attachment B

Outdoor Dual Lane Track Specifications



FULL TRACK TOP VIEW

Scale: 1:200