

**AUSTRALIAN-INTERNATIONAL
MODEL SOLAR CAR
CHALLENGE**

REGULATIONS

2000

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

A. INTRODUCTION

A1. TITLE

The event shall be known as the "Australian-International Model Solar Car Challenge" (AIMSCC).

A2. NATURE OF EVENT

- (1) The AIMSCC is an enterprise program providing opportunities for school student teams to design, construct and race model solar vehicles on a track laid out by the organizers. These regulations govern some aspects of the vehicle design; nevertheless there is considerable scope for teams to exercise their ingenuity to optimise the performance of their vehicle.
- (2) The competition is open to invited schools or other organizations for school aged students approved by the committee (see B1) to secondary level. The race organizers wish to make it clear that the spirit and intention of the competition is that the design and construction of vehicles will be by students. Teachers of course will need to assist and guide the students, but the principle 'hands on' activities should be conducted by students. Only students (see F) are to conduct vehicle adjustment and maintenance on race day.
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.
- (3) Vehicles entered in any given year should be substantially the work of students in the year of entry.

A3. AIMS

- (1) To engage school students in researching science principles relating to solar energy and photovoltaics; in constructing and testing model solar vehicles; and in demonstrating their achievements to the general public.
- (2) To encourage student teamwork and enterprise as students work with one another and with support and guidance from teachers and parents.
- (3) To share with the wider community the potential for science and technology, through people prepared to exercise their ingenuity, to open up new possibilities for the future, as modelled by this event.

A4. DATES AND LOCATIONS

The **2000** AIMSCC event shall be held in **Sydney** on 25th to 26th November.

A5. CORRESPONDENCE

All correspondence should be addressed to:

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AIMSCC Executive Officer

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A6. INTERPRETATION OF THE REGULATIONS

- (1) The AIMSCC event officials are empowered to make a decision on any case not covered or clarified by these regulations.
- (2) In the case of dissent from an AIMSCC official's ruling, the dissenting team may be excluded from the competition (see J).
- (3) 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 event in which they may have participated.

B. ENTRIES

B1. ELIGIBILITY

- (1) 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. It will be assumed that each team will average no more than 4 students and one teacher/chaperone.
- (2) The AIMSCC Executive Committee reserves the right to invite one or more teams not qualifying as per (1) above as "wildcard" entries. Should such an invitation be issued, the relevant state coordinator(s) will be informed.
- (3) 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.
- (4) 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 poster will become the property of the organizers and will be used for promotion of the event. This record should document experiments and or calculations, which were used in the design of the Model Solar Vehicle.

- (5) To enhance the fun side of the event an optional hard-boiled or blown egg may be decorated and presented as a driver and presented for judging. NB This will not be the driver for the race [see C3. (3)] but may be used for display and photographic purposes.
- (6) Each entrant must represent his or her school or other organization accepted by the committee.

B2. ENTRY REGISTRATION

Entrants must confirm their participation with the AIMSCC Executive Officer (see A5) within the time specified in the invitation (within 7 days of the completion of their state event); Potential overseas entrants should notify Mark Needham of their intention to compete by October 1st. The invitations will be sent to the coordinators before their event.

C VEHICLE ELIGIBILITY AND SPECIFICATION

C1. POWER

- (1) **Source of Power**
The vehicle is to be powered by direct global radiation only. The collection of this power shall be by photovoltaic cells as approved by the AIMSCC Executive Committee and described in C1 (3-7) below.
- (2) **PV Cell Type.**
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.
- (3) **PV Panel Weight.**
PV cells must be mounted on a flat or curved panel, which is removable from the vehicle for the purpose of weighing. Each panel may include a single on/off switch but all other electrical or electronic devices must be separate from the panel and supported by the chassis. Panels with a cell area of 864 cm², which include Appsys and Solarex panels listed below, will have a minimum allowed weight of 1200 grams. Where a panel weighs less than the minimum, additional ballast must be carried within a container on the chassis of the car. The weight must be able to be removed for weighing. The combined weight of the panel plus ballast must be 1200 grams, (plus penalties or minus allowances detailed in C1 (5-7)).

A penalty of 125 grams of additional ballast will be imposed for each 5% (or part thereof) by which the cell area exceeds the 864 cm². The maximum panel area allowed will be 1,036 cm² (20% greater than the optimum 864 cm²). The panel weight may include the on/off switch, wires and plugs (if any) but no capacitors, circuit boards or other electronic components

Vehicles, which lose any of their ballast during racing, will be disqualified.

APPSYS

SOLAREX (Model MSX10L)

SOLAREX (Model MSX10LAM)

SOLAREX (Model MSX10)

Regulations C1 (6,7) only apply to cells other than those listed above.

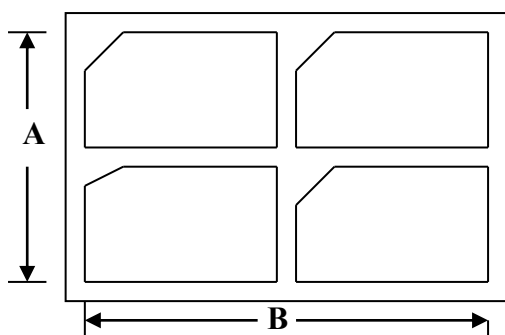
C1 POWER Cont.

(4) PV Cell Cost and Disclosure

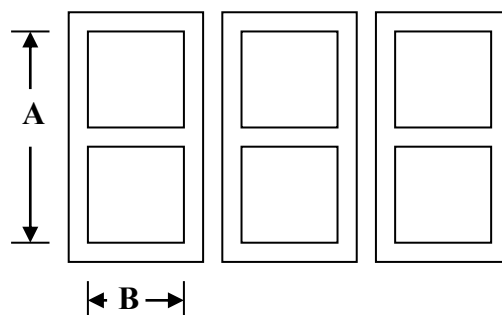
PV cells used must have a total published Tax-free price of less than \$320 Australian. Schools choosing cells other than those listed above, must provide a copy of an invoice or receipt of sale for the cells, the brand name and serial number of the cells and the name and address of their supplier. All information collected in this regard will be made public. The penalty for not complying with this rule will be to carry 400 grams of additional ballast and automatic forfeiture at the quarterfinal level in the competition.

(5) Construction of PV Panels.

The panel may have one or more modules, provided all modules are demonstrably separate and have the same area and shape. The total effective area of a single module, or the total of a number of smaller modules being counted, should be no greater than 864 cm^2 . (See the rules for weight to be carried, C3) For calculation of total area, the module or modules will be treated as rectangular, and hence circular cells, joins within a module, and cells with triangles etc. cut from the crystalline material will be counted as simple rectangles. The smallest rectangle which fully encloses the active area of PV cells shall be regarded as the module area for the purpose of this rule. In calculating the area of a module in this way, the outer edge will be ignored. Where more than one module is used to make up the panel area, the total area will be found by multiplying the area of one rectangle by the number of modules. Teams using more than one module for their panel must supply the mathematics of the area calculation to the scrutineers, who will check dimensions and calculations.



Area of single large module $A \times B$



Area of several small modules $A \times B \times \text{number}$

(6) Undersized PV panels.

Where the effective area of cells is less than 778 cm^2 (ie. 10% undersized), the panel weight may be reduced by 200 grams (to a minimum of 1000 grams).

(7) Exception for Amorphous Panels.

If flexible amorphous silicon cells are used the panels can be curved to keep the outer edges within the 864 cm^2 area.

C2. ENERGY STORAGE SYSTEMS

(1) Electrical

Fuel cells, battery power packs or any other electrical energy storage systems are not permitted in any form on the vehicle. 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. This discharging must be able to be done at the starting gate without holding up the start.

(2) Mechanical

Mechanical storage systems are allowed provided that it can be proved to the scrutineer's satisfaction, that they do not contribute to the motive power of the vehicle.

C3. VEHICLE SPECIFICATIONS

(1) Size Limit

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

(2) Steering

Each vehicle must incorporate a means of steering along the PVC channel of the track. Section (D) specifies any Track variations which may be encountered.

The steering mechanism may be either:

- (a) A vertical peg (as per slot car principal). Refer to Diagram 1.

OR

- (b) Any number of guide pegs or devices designed to run inside or outside the channel.

The peg(s) or device(s) do not have to be circular but, if elongated, must not jam in the channel during cornering. The peg(s) or device(s) should be capable of adjustment to heights between 5 mm and 12 mm above the track base.

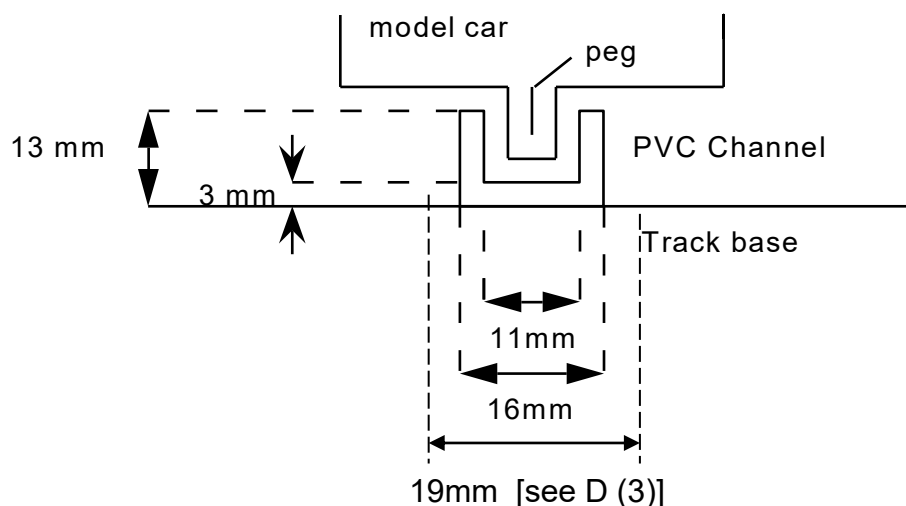


Diagram 1. [Refer to D (3)]

C3. VEHICLE SPECIFICATIONS Cont.

(3) Eggs Driver and Passenger

As a major requirement of any vehicle is to be able to travel the required route keeping the occupants safe under all circumstances, the driver will be a fresh (uncooked) large sized (>61 grams) egg. This will be provided by the organizers and must be returned at the end of the race to the judges without being damaged. The egg must be able to be installed or removed in a time of no more than 1 minute. Only one egg needs to be carried but space must be allocated in which a 'passenger' can be placed, without interference with the 'driver'.

(4) Driver and Passenger Compartment

Each vehicle must have a fully enclosed space (or spaces) at the front, which will be the cabin in which the eggs sit vertically (see attachment A). Adequate space must be made available inside the cockpit (or in a second location) for a second egg as a 'passenger'. The shape and location is at the designers' discretion. The cabin/s must be fully sealable so that if the egg breaks none of the yolk or white is spilt onto the track (such sealing may use appropriate adhesive tape). The cabin/s must also include a transparent (not translucent) windscreen at least 25 mm deep (in the vertical direction), which allows at least the top half of each egg to be visible from straight ahead and through a 90° arc on either side when viewed horizontally. Penalty for not complying with this rule will be that the panel will need to carry an extra 200 grams of ballast.

(5) The Driver Compartment.

The driver compartment must be attached to the vehicle chassis not the solar panel.

(6) Unadulterated Egg

The egg must NOT be covered in a film or painted so as to increase its strength.

(7) Replacement Egg

If an egg is damaged in one heat of a best of 3 or best of 5 final, a replacement egg will be provided for the remaining races.

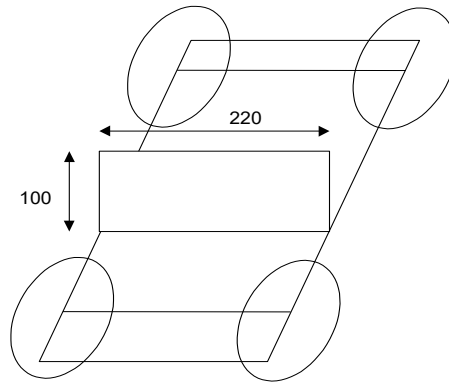
(8) Intact Vehicle

The vehicle must be constructed with a chassis and enclosed driver and passenger space so that the solar panel may be removed and disconnected for the purpose of being weighed and the vehicle chassis complete with driver and passenger cabin/s remain intact and mobile.

(9) Vertical Panel

To encourage a more innovative approach to styling, each vehicle must contain a solid flat panel made of a rigid material such as balsa, cardboard or plastic being least 100 mm high x 220 mm wide x 1.0 mm thick. This panel must be mounted vertically across the width of the car, at 90° (+/-5°) to the direction of motion.

See Diag. next page.



(10) Side Panels

The chassis must include a panel on each side of the vehicle. The panel must be capable of supporting a sticker measuring up to 100 mm long x 50 mm high over the entire area. The stickers will be provided by the organizers and may incorporate sponsors logos, the school and vehicle names and race number. **The panels may be curved but the Judges and Recorders need to be able to read the sticker numbers from the side of the track.**

(11) Motors

There is no restriction to the type and size of motor (or motors) that may be fitted to the vehicle. However the motor type and/or part number must be made available to the scrutineer for assessment of compliance to paragraph C2 (1). Where there may be some uncertainty about the motor, the scrutineer may demand the removal of the motor from the vehicle for checking at any time before, during or after the competition.

C4. USE OF COMMERCIALY BUILT VEHICLES

Vehicles may not use any part of the chassis or body of any commercially available model vehicle. 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.

D. THE TRACK

(1) Size and Shape

The outdoor AIMSCC track 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 5 metres. The track length is approximately 86 m with cars completing one full lap plus extra 14 metres to reach the finish line.

(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.

D. THE TRACK Cont.

(3) Construction

The track will have a smooth surface with two parallel guide tracks of PVC channel (see Diagram 1) such as UM20 or similar screwed to a plywood base. As the track is assembled in sections, there may be minor misalignments. The AIMSCC Executive Committee will endeavour to ensure misalignments both horizontally and vertically will be less than 2 mm.

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) Starting Ramp

Vehicles will start near the top of the downhill section of the track. The starting line on the ramp will be approximately 200mm vertically above the level of the track at the bottom of the downhill section.

E. SCRUTINEERING

(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. Vehicles must be in a condition ready to start when presented for scrutineering. Scrutinizers have the right to examine each vehicle at any time to ensure it conforms to these regulations.

(2) Failure

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

F. SERVICING

(1). Service area

An official service area will be set aside for student team members to carry out repairs or modifications.

(2). Modifications

Students may modify vehicles during practice or between rounds, but the scrutinizers may reassess vehicles at any time. However, vehicles 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 vehicles between elimination rounds specifically excludes the changing of solar panels, vehicle bodies, chassis and driver/passenger compartments irrespective of light conditions. Repairs to these major components are allowed. Changing driving wheels, gears and steering mechanisms and panel voltage will be permitted.

(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

F. SERVICING Cont.

- (4). Restricted areas
No person other than those nominated in F (3) 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.

G. THE COMPETITION

- (1). Time trial
Following scrutineering, each vehicle will be timed over a given distance on the designated track, for the purpose of seeding each vehicle, 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.
- (2). Structure of the event
The event shall be conducted with pairs of vehicles 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.
- (3). Timing
Each vehicle will be timed over the course. Times will be posted on the result board. This can be used as information to fine tune vehicles between rounds.
- (4). The start
Vehicles will be presented at the start line within two minutes following the call for vehicles on the public address system. A lane will be randomly allocated to each competitor. In the case of best of three or best of five heat races, vehicles will alternate between tracks. The vehicles will be placed on the track in a ready to run state. The vehicles will be placed behind a starting gate with their leading edge in contact with the gate. When the gate is raised, the cars will proceed down the track.
- (5). Stability
If the vehicle 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 vehicles during the race other than by officials or by people nominated by officials eg. the two students delegated by their teams to start and catch the vehicle.
- (6). Poor light / adverse weather conditions
If light conditions do not enable the cars to complete the course, the vehicle that travels the furthest, or, if 2 vehicles travel the same distance, the vehicle, which reaches that point first, will be, judged the winner.
When both vehicles have come to a halt short of the finish line the race will be deemed to have finished if neither vehicle has moved for 30 seconds.

H. PRACTICE AND TESTING

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

I. RESULTS

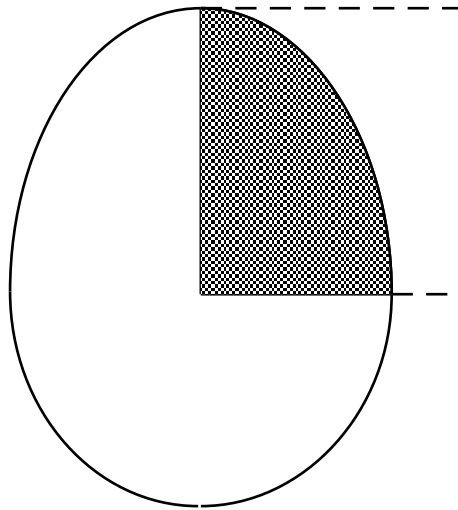
Final results will be decided after the provisional first four place winners have been rescrutineered and passed by the officials. The presentation of prizes will be held immediately after the event.

Prizes will be presented to First, Second, Third and Fourth place getters.

J. UNFAIR PRACTICES

Exclusion will occur if, during the event or at scrutineering, AIMSCC officials discover that an entrant or crew has deliberately violated these regulations (especially those listed in Section C above) to gain unfair advantage over other entries, or has departed from the spirit of the event.

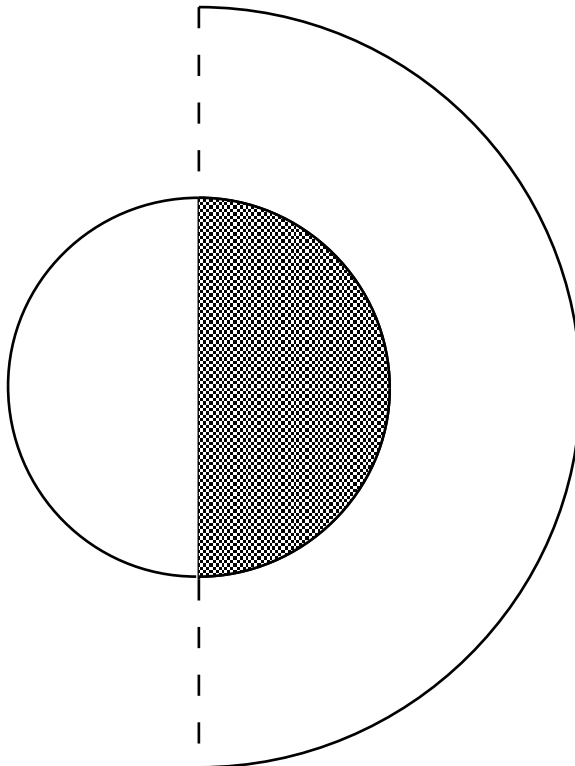
Attachment A: Views of egg indicating necessary visibility



>25mm

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

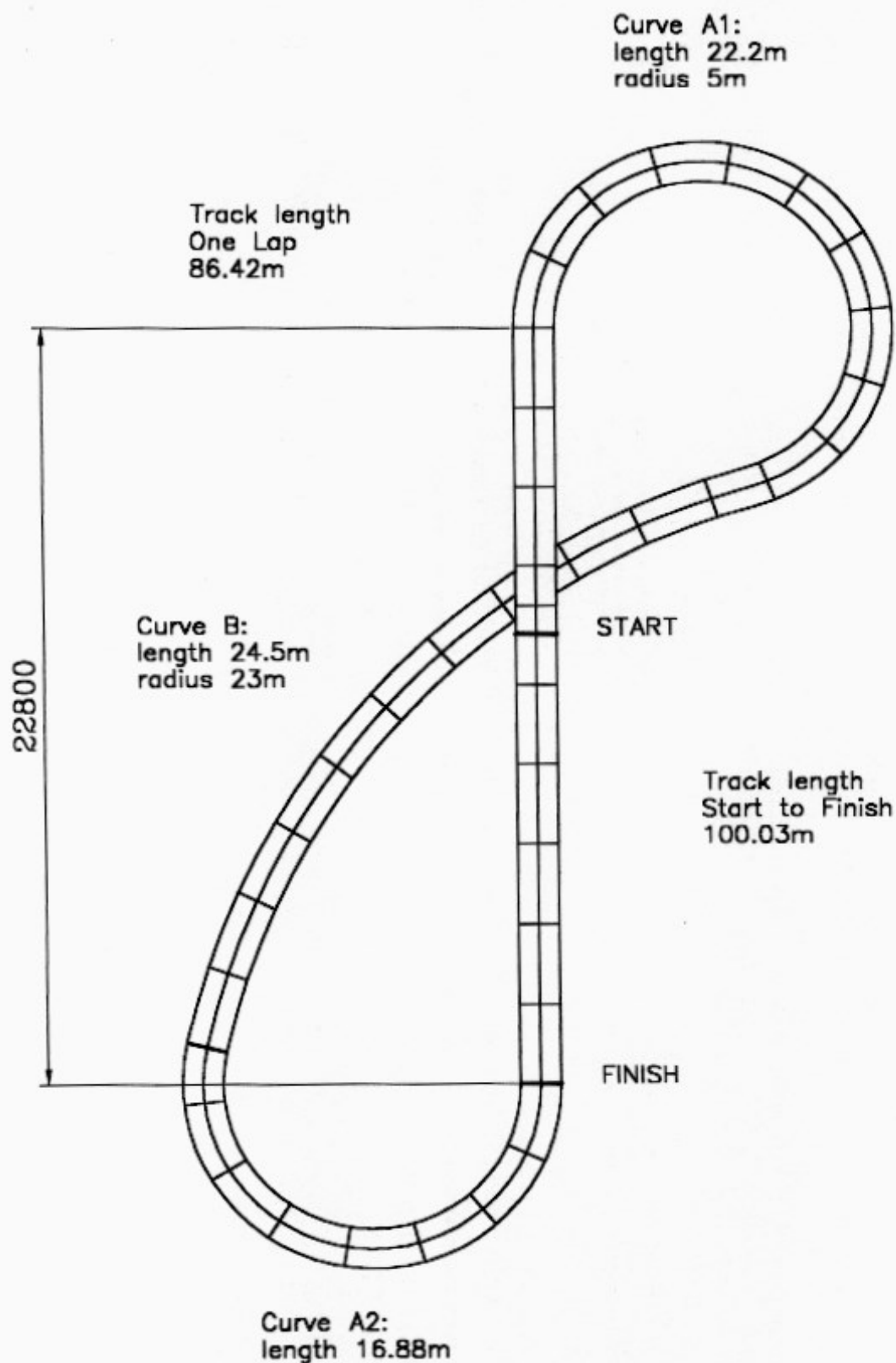


The top half of the egg must be visible through the windscreen from any point on this arc.

PLAN VIEW FROM ON TOP.

Attachment B

Outdoor Dual Lane Track Specifications



FULL TRACK TOP VIEW

Scale: 1:200