AUSTRALIAN-INTERNATIONAL

MODEL SOLAR CAR

CHALLENGE

2007
REGULATIONS

Section 8

Car Specification

Section 8 (this document) covers the car specifications
Sections 1 to 7 (a separate document) cover the administration of the event
N.B. All eight sections must be read as a single document.
Details of the design for a suitable light box are also available.

Section 8. Car Specification

CONTENTS.

8. CAR SPECIFICATION

8.1 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, tyres, or to suspension and steering components. Unless specifically specified elsewhere in this document, other external body covering is at the discretion of the entrants.

8.2 Size Limit
When the car is racing in a straight line, the overall length of the car shall be no more than 650mm, the height of the car shall be no more than 180mm and the width of the car, wheels, axles and suspension included, shall be no more than 320mm.

8.3 Source of Power
The car is to be powered only by photovoltaic cells as approved by the AIMSCC Executive. Approved photovoltaic cells will be commercially available silicon cells (mono-crystalline, poly-crystalline or amorphous). Amorphous cells currently available are not recommended however, because of their low power to weight ratio. High output cells such as Gallium Arsenide cells, as determined by the high voltage output of such cells (>0.8V per cell), will not be allowed.

8.4 Power Limit
The maximum power delivered by the photovoltaic cells will be measured by the scrutineers using a light box delivering approximately one Sun equivalent.

The solar panels must be presented for light box testing with a maximum of 25 volts open circuit and 2.0 amps short circuit. Otherwise they will be assigned the value:

Power = (open circuit voltage) x (short circuit amps) x 0.8 watts.

As the power output of a silicon solar cell is greatly affected by temperature, the scrutineers will scan all panels with a non-contact thermometer immediately after power testing. The maximum panel temperature recorded will then be used to standardise the power output to the power expected at a temperature of 25^{o}C using the following formula.

$$P_{standardised} = P_{measured} + P_{measured} \times 0.004 \times (T - 25)$$

Where P = power in Watts and T is maximum panel temperature in ^{o}C

N.B. Any ballast required will be calculated using this standardised power rating.

Panels must register a total power of less than 12 watts. If an array built up from individual modules exceeds 12 watts, cells will have to be completely removed from the array until the panel generates a power of less than 12 watts. If a team wishes to modify a panel to produce a lower power for any reason then cells must be completely removed from the array. Simply bypassing or masking off cells will not be permitted under any circumstances.

Due to advances in solar cells, some standard commercial panels may exceed their nominal ratings. The scrutineers reserve the right to allow the use of any commercial panel with a nominal rating 12 watts or less provided the power rating obtained above does not exceed 14 watts. Evidence of the manufacturers nominal rating must be provided to the scrutineers.

8.5 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 0.2 farad and inductors less than 1mH are allowed as part of the electrical system.

8.6 Solar Array and Support Structure
The solar cells connected together to provide the power which drives the car will be referred to as the array. That complete unit on which the photovoltaic cells (the array) are mounted is the array support structure. This structure must be fully removable and may form part of the car body, but must not form a part of the chassis, cabin or side panels as defined in 8.17, 8.22, and 8.19. The array support structure may carry the ON/OFF switch, and may allow for varying the voltage by means of a mechanical switch controlled by the team prior to the race start, but all other mechanical, electrical or electronic devices must be separate from the array support structure and supported by the chassis. The panel must be robust enough to enable handling by the scrutineers and officials. The organizers will accept no responsibility for any damage to the solar cells or the solar array due to normal scrutineering procedures. NB. Bare silicon cells are highly prone to breakage and are therefore discouraged.

Curved, stepped or multi-planed arrays should be able to be re-configured to within 20mm of a single plane for the purposes of power measurement. If this is not possible, the scrutineers reserve the right to calculate a maximum power value based on extrapolating measurements taken from one section of the array to the whole area.

8.7 Solar Array and Support Structure Removal
The array and its support structure must be easily removed from the car for weighing and the car must still be capable of free and stable movement along a flat surface with it removed.

8.8 Solar array wiring.
All wiring on the solar array must be visible to the scrutineers, so that wiring problems can be easily identified and problems resolved. All panels must be presented for scrutineering with a single pair of connections marked +ve and –ve and able to directly attach to the alligator clips on the power measuring equipment. Teams using panels of their own construction or modified commercial panels must provide a wiring diagram showing all cells, switches, plugs, sockets, etc., to assist in the scrutineering process**.** Where the panel has multiple outputs, teams must supply suitable open wiring, complete with diagrams, to provide scrutineers with the connections as described above.

Where different power readings are obtained using different switch settings, the highest value obtained shall be used. If the panel has multiple connections, the power will be measured on each connection and the values obtained added

8.9 Solar panel cover.
All teams should provide a suitable cover which will completely shade the active area of their solar array for use at the starting position. The use of the cover is to assist the officials detect and eliminate any hidden illegal storage devices. If teams do not provide a suitable cover, the organizers will provide a cover of their choosing. The organizers will not be responsible for any problems created by the use of this cover.

8.10 Array and array support structure weight.
The panel weight will be as per table C. This table and equation has been derived on the basis of extensive simulation data to make for a more even competition.

POWER	WEIGHT
6W	600g
7W	775g
8W	950g
9W	1125gg
10W	1300g
11W	1475g
12W	1650g

Table C Panel power vs Ballast Weight.

(Table C is based on the standardised power outputs using the light box described in a separate document.)

The combined solar array and ballast weight is calculated using the formula:-

W (Panel weight) = 175(Standardised Panel Power [watts] - 6) + 600 Grams

Note. Any panel generating less than 6 watts will still need to have the minimum weight of 600gm. The Committee will provide scales to determine array and support structure weights, measured accurate to +/- 5 gm. e.g. a panel with an output measured at 8.3watts, will weigh between 997.5 and 1007.5 gm.

8.11 Ballast
Any additional weight required is to be carried as ballast when racing. To assist, teams should attempt to have approximately the correct amount of ballast when presenting for scrutineering. Ballast will not be provided by the scrutineers. Suitable ballast includes such things as lead sheeting, sand and fine gravel, nails, etc. Ballast must be suitably contained to prevent possible spillage onto the track.

8.12 ON/OFF switch
Each car must be fitted with an 'ON/OFF' switch to minimize car set-up time whilst at the starting gate. The switch must have the ON and OFF positions clearly marked and the switch must be in a location easily visible by the official starter when the car is on the start line (i.e. left hand side or on the top). If the switch is on top of the panel, it must not protrude more than 20mm above the panel surface so as not to alter the light box reading. It must be a commercially available switch which will electrically disconnect the solar array from the motor. Alligator clips or plug and socket connections, while allowed as part of the electrical circuit, may not be used as the ON/OFF switch.

8.13 Car wiring
Where possible all electrical wiring and electronic modules in the car must be reasonably visible. Teams will be required to explain any wiring going into sealed body areas. A simple block wiring diagram will be required.

8.14 Motors
There is no restriction to the type, size, or number of 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.

8.15 Wheels
There is no limit as to the number, location, or 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.

8.16 Steering
Each car must incorporate a means of steering along the guide channel of the track (as per Diagram 1).

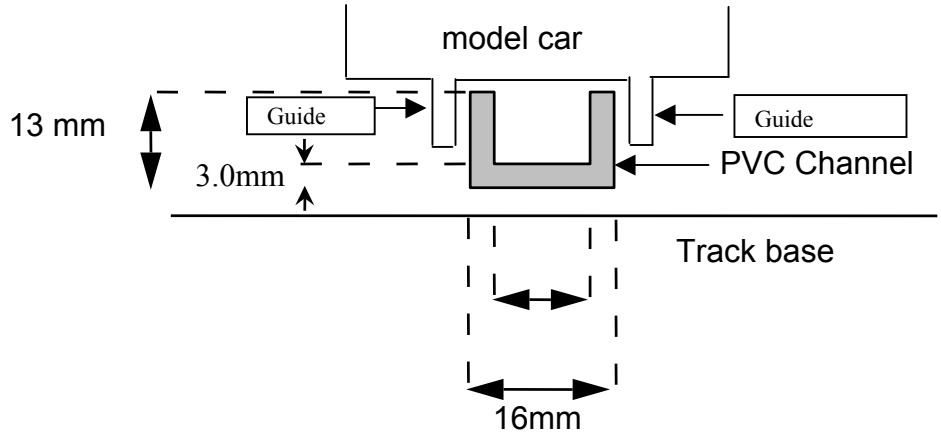


Diagram 1. - Two guides outside the channel.

Section 4.3 specifies any track variations that may be encountered. The steering mechanism must be via guides designed to run outside the channel. The guides need not be simple pins as shown above but rollers or wheels may be used. Use of an active (moving) steering system will be viewed favourably when choosing quality engineering design awards.

8.17 Chassis
The car must have a rigid chassis independent of the solar array and its support. The car must have all components, such as the driver's cabin, wheels, guides, motors, side panels and cargo area, etc, attached to the chassis. The driver's cabin, side panels, cargo area and any other bodywork may form part of the chassis.

8.18 Cargo area
The car must have an enclosed cargo space, with a floor and sides, attached to or as part of the chassis. The space must be located behind the driver's cabin. The solar array structure may form the top of the enclosure. The space must be sufficient to fit two standard 1 litre fresh milk cartons beneath the solar array when the array is in place on the car. The cartons will be full and unopened, and may not be altered or modified in any way. At least one of the cartons must be positioned transverse to the direction of travel. A standard fresh milk carton will be assumed to be approximately 235mm by 72mm by 72mm and it may be assumed that the sides of the cartons are flat and no provision needs to be made for normal bulging. With the solar array structure removed, the cargo space floor must be capable of supporting the two full cartons in any position and orientation, and the car must be capable of free and stable movement on a flat surface with those cartons in place.

N.B. The cartons are not required to be carried when racing.

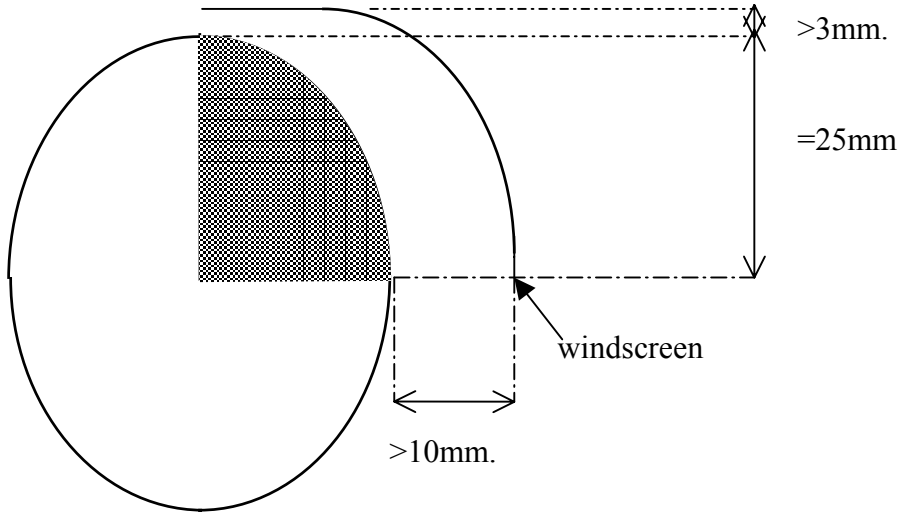
8.19 Side Panels
The car must have two side panels capable of retaining their shape at all times for attaching numbers and sponsors logos. These must be easily seen by spectators while the car is racing. They will be located one on each side of the car. Each side panel must be capable of supporting a sticker 120mm long and 75mm high. The maximum curvature allowed will be 20mm vertically and 15mm horizontally.

8.20 School and Car Name
Each entry must have its school name (possibly abbreviated) and car name shown on the car in letters at least 10mm high and visible when racing. These can be attached to any part of the body, other than that area designated as the side panels described above.

8.21 Driver
To ensure that the cars guarantee driver safety, the driver of the car will be a large (60g) fresh egg 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 will concede 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. The use of any form of adhesive (blue tack, sticky tape, etc.) on the egg is prohibited

8.22 Drivers Cabin
Each car must have a fully enclosed cabin at the front of the car in which the egg sits vertically (see diagram 2). The cabin must be sealed when racing 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 conforming to details in diagram 2. Two frame members up to 4mm wide may be incorporated into the windscreen. To allow the driver to operate the controls there must be at least 10mm clear space between the driver and the windscreen over the 180^{o} arc of visibility specified and 3mm head room (see diagram 2). NB this means that nothing but air be between the egg and screen over this area.

Diagram 2



SIDE VIEW

The windscreen must have the clearances shown above and around the egg and allow the hatched area to be visible when viewed horizontally from straight ahead to any position 90^{o} either side of the centre line.