

**AUSTRALIAN-INTERNATIONAL**

**MODEL SOLAR CAR**

**CHALLENGE**

**2009**

**REGULATIONS**

**Sections 1 to 7**

**Administration of the Event**

7 January 2009

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

## **MISSION STATEMENT.**

*To promote and develop interest and expertise in using solar and renewable energies by school students throughout the world by using active learning processes in addressing real challenges. By so doing, it is hoped that the citizens, scientists and engineers of the future will be more likely to participate in developing a more environmentally aware approach to energy usage, both by more efficient use of old technologies and appropriate introduction of renewables.*

## **OVERVIEW**

*This is a race for model solar cars built by school age students which compete on a figure of 8 circuit. Two cars race at a time guided by parallel guide channels attached to the track surface. Time trials are held to "seed" the cars, that is, to allocate them to groups in such a way that the faster cars should not compete against each other in the earlier rounds. Pairs of cars then compete in an elimination competition in which the winners continue to the next round, the losers are eliminated. This process of elimination continues until a winner is decided by being the only undefeated car. Early rounds are run as best of three heats and finals are run as best of five heats.*

# Administration of the Event.

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# 1. INTRODUCTION

## 1.1 Event name

The event shall be known as the Australian-International Model Solar Car Challenge (AIMSCC) and is conducted annually. This, along with boat races, will form a part of the Australia-International Model Solar Challenge (AIMSC).

## 1.2 Committee

The Executive Committee of the Australian-International Model Solar Challenge is a voluntary committee consisting of State Coordinators 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 Australian event to which nominated teams from Australia and other countries will be invited. The Committee will also promote the event throughout Australia and world-wide to the best of their ability and within the available resources.

## 1.3 Aim

The aim of the event is to encourage student teamwork, enterprise and learning using an action based learning model as students work together to research science and engineering principles relating to solar energy, photovoltaic cells and optimisation of energy efficiency, by designing, constructing, testing and racing model solar cars.

## 1.4 Spirit of Intent

The Challenge is designed for students to learn. Teachers, parents or other adult advisers are encouraged to teach the students the appropriate scientific and technical principles, but the design and manufacture must be predominantly that of the students. Some components may need to be made for the car using equipment unavailable to the students, but they must understand the working of their car and must be able to make all necessary adjustments or repairs on the weekend of the race. So that the competition remains financially accessible to as many schools as possible the Committee has framed these regulations so the cost and power to weight ratio of the photovoltaic panel is similar for all entries.

## 1.5 Allocation of Points.

To promote student learning, a trophy will be awarded to the team which scores the highest number of points based on car performance, their posters (discussed in 3.6) and an interview by a judging panel appointed by the AIMSC committee made up of representatives of 3 states. The interviews will evaluate the level of the whole team's understanding of their design, their car's manufacture and testing. The poster and interview also require the students to exhibit understanding of the relevance of solar energy to reducing greenhouse gas emissions. The interview will be conducted on the Saturday of the event in conjunction with scrutineering. Points will be awarded to the car performance, poster and interviews on the following basis:

Car performance	5 points per knockout round won - maximum points 20
Poster	maximum points 20
Interview (involving all team members)	maximum points 30

## 1.6 Competitors

The competition is open to invited Australian schools or other organizations for school aged students to secondary level, approved by the Committee, based on their performance in state or regional competitions. Invitations will also be issued to teams nominated by the organisers of affiliated competitions held in other countries who have national or regional events. Invitations may also be issued to individual teams where there is no national competition. All teams entering this event will need to meet the regulations listed below.

## **1.7 Correspondence**

International correspondence should be addressed to:

Mr. Paul Wellington  
Chairman AIMSC  
Department of Mechanical and Aerospace Engineering  
Monash University  
Wellington Road  
Clayton Victoria 3800  
Australia  
Tel. 613 9902 0172 Fax. 613 9905 Mob. 613 419 871 033  
Email Paul.Wellington@eng.monash.edu.au

Australian correspondence should be addressed to:

Mr Mark Needham  
Secretary AIMSC  
22 Harding Street  
Glengowrie SA 5044  
Tel 08 8295 5986 Fax (08) 8295 8584 Mobile 041 610 4490  
Email markneed@bigpond.com

Entry information for the 2009 National competition should be addressed to:

Mr. Steve Perry  
2009 Event Coordinator  
21 Montgomery Avenue  
Mt. Waverley Vic 3149  
Tel. 03 9802 8709 Fax 03 9894 1347  
Email msvnationals@gmail.com

## **2. INTERPRETATION OF THE REGULATIONS**

### **2.1 AIMSCC to make all 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 and international model solar car challenge coordinators are encouraged to conduct their local events so as to observe the regulations pertaining to the AIMSCC event, the regulations for each local event are determined by the local 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 National Coordinator appointed for the event shall request each State Coordinator to invite four teams who have proved 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 may 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 Team members**

Each team must contain at least one student unique to that team, and no team will be permitted to enter more than one car. There is no limit, within reason, to the number of students in any one team, but each entrant must represent his or her school or other organization accepted by the Committee.

### **3.4 Original work**

All teams must be able to provide evidence to the scrutineers that the car is the original work of the team members in both design and construction, performed in the current year, and not simply a restyling of a previous existing car. This will include both the chassis and the body of the car. Solar panels, motors, drive systems, wheels, suspension, guide systems and other similar components will not be included and may be reused.

If any school has more than one car entered, the cars must be significantly different in both chassis and body to indicate to the scrutineers that the cars are the work of different teams.

### **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 – may be 2 A3 posters taped together) 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. Some discussion of the benefits or use of solar power for minimizing greenhouse gas emissions will be encouraged. Graphs and design drawings will be marked favourably.

The poster will be assessed as follows:

<b>Item</b>	<b>Marks</b>
Headings readable from 5 metres	1
Writing readable from 2 metres	1
Summary of test results	5
Construction details	5
Presentation – photos, diagrams, drawings,	4
Greenhouse relevance	3
References, acknowledgements	1
Total	20

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 Interviews.**

An interviewing panel will interview all team members about the design and construction and testing of their car or its component parts. Each team will be allocated a time slot for their interview so as to minimize time wasted by queuing. Each student should be able to contribute to the answers. Questions could relate to a number of the following:

Wheel and bearing selection and rolling resistance
Effect of weight and tyres on rolling resistance
Design of steering mechanism
Design of chassis
Design of cockpit
Effect of cloud on solar intensity
Effect of solar intensity on panel performance
Explain how solar cells work
Explain how gear ratios and panel wiring can be changed to suit the weather conditions (if not using electronics)
Explain the function of any electronic controls on their car
Discuss your team’s organization and decision making

**3.8 Entry registration**

Australian entrants must confirm their participation with the State Event Coordinator, Mr Steve Perry, within 3 days of their State or Territory event. Potential overseas entrants should notify the AIMSC Chairman of their intention to compete by October 1<sup>st</sup>. The invitations will be sent to the State and Territory coordinators before their events.

**4. TRACK**

**4.1 Size and Shape**

The track used in this event will be in a ‘figure 8’ configuration with a low bridge at the crossover point. The corners will feature curves with an approximate minimum radius of 5 metres. The track can be considered to be flat in that there is no banking on the corners. The track length is approximately 85 metres.

**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 rails of PVC channel such as ‘UM20’ or ‘basket track’ or similar, screwed to a plywood base. As the track is assembled in sections, minor misalignments will be minimized by inserting joiners between adjacent channel ends. The Committee will endeavour to ensure minimal misalignments, both horizontally and vertically. 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. Entrants must realize that as the track is made in sections of light weight materials, there may be some undulation in the track. This will be minimized by the committee, but should be considered in the car design process.

#### **4.4 Starting Position**

All races 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. (See 7.4 Starting Procedure.)

#### **4.5 Finish Position**

All races will finish at a point on the straight flat section of the track approximately 9 metres beyond the starting position.

#### **4.6 Race Format**

Unless varied at the Committee's discretion:-

Time trials, round robin races and initial elimination races will be held from the starting position and cover a single full lap of the track plus the distance to the finishing position, a total distance of approximately 94 metres.

Finals, and possibly some elimination races, will be held from the starting position and cover two full laps of the track plus the distance to the finishing position, a total distance of approximately 180 metres.

### **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 race when presented for scrutineering. Teams must not be accompanied by adults through scrutineering. If, however, a dispute arises, the team will be invited to call upon their supervisor to help resolve the dispute. 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 may not be permitted to start the event. The scrutineers will make allowances for circumstances beyond the control of the students such as damage in transit. The scrutineers may allow any car which does not comply with these regulations to compete but may impose a weight penalty of 200gm minimum for each incidence of non-compliance. Any car failing to satisfy the scrutineers at any time during the competition may be excluded from further participation.

#### **5.3 Panel power output.**

Solar panels will have their output power measured by the scrutineers using a light box with a controlled output. Details of a suitable light box are available as a separate document. Panels must be presented in their ready to race form. For curved panels the panel output will be determined by placing the panel generally parallel to the top of the light box. For further details of determining panel performance, see Section 8. Car Specifications.

Each team must bring for testing the one panel that they intend to use for all time trials and races, and that panel alone will be measured by the scrutineers. The team must then use this panel, unmodified, for all time trials and races. See also 6.3 regarding damaged panels. The scrutineers reserve the right to retest any panel at any time.

#### **5.4 Check weighing.**

During scrutineering, the weight of the solar array, any ballast, and the total weight of the car will be recorded. Immediately prior to each race, all cars will be re-weighed by the scrutineers. If the car weight varies from the recorded weight by more than +/-10gm the team will be required to explain the reason for the variation. If the scrutineers are not satisfied with the explanation then the car will be required to be restored to the original condition or else the car may be excluded from further competition.

### **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.

The service area will be monitored by committee members and others appointed by the committee on the day. Any team observed having work of any sort carried out by non-team members will receive two warnings before the team will be excluded from further participation in the competition. This may not prevent team members seeking advice from non team members but direct intervention is strictly prohibited. The committee, or their appointee, may, at their discretion, allow non team members to assist team members, provided such permission is obtained before any such work is undertaken.

#### **6.2 Modifications**

Students may modify cars during practice and between races, but the scrutineers may reassess cars at any time. However, cars as passed at scrutineering immediately prior to the commencement of the seeding round robin must be used for all subsequent races. Allowable modifications to the cars between races specifically exclude the changing of the solar panel, the car body, the chassis and the driver's compartments irrespective of light conditions. Repairs to these major components are allowed. Modifications to solar panels are specifically prohibited and any repairs to solar panels must be reassessed by the scrutineers. Changing driving wheels, gears, motors, steering mechanisms and panel voltage will be permitted between races.

#### **6.3 Faulty and damaged solar panels**

After scrutineering, teams will only be allowed to change or modify the car's solar panel if the original panel is damaged or becomes faulty. Any and all panel changes must be first approved by the scrutineers, and repaired or replacement panels will be required to undergo the same examination, testing and ballasting routine as the original panel.

#### **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.

#### **6.5 Hazardous substances**

Note. Due to health and safety requirements, the use of bulk solvents, other than water, and liquefied gases of any sort, for any purpose whatsoever, is **STRICTLY PROHIBITED** at all times and in all areas of the competition. This will not include small quantities of commonly available solvents and spray cans for the purposes of cleaning or lubricating bearings, etc.

Any team found in possession of these prohibited substances will have them confiscated and the team may be excluded from further competition and escorted from the competition area.

This means cooling solar panels with anything other than water ice will not be allowed at any time.

## **7. COMPETITION**

### **7.1 Time trial**

Following scrutineering each car will be timed over a single lap of the course for the purpose of seeding the car for the main races. These preliminary races will be arranged in such a manner that teams from different states will face each other. Time and weather permitting, these preliminary races will be conducted as groups of round robins.

### **7.2 Structure of the races.**

The event shall be conducted with pairs of cars competing against each other over equal courses of approximately 94 metres in length in a series of round robin and/or elimination races to be announced in the official schedule of events. Where results are to be determined by multiple heats, they will be scheduled so that all cars in the round will have completed their first heat prior to the start of the second set of heats, allowing some minutes to elapse between the first, second and third heats. Weather permitting, the quarter finals, semi-finals and finals will be held over 2 laps of the course, the total race distance will therefore become approximately 180 metres. Where more than one car is entered from the same school, the seeding process will be implemented in such a way that they will not race each other during the first elimination round. However, if successful, they will be required to race against each other before or during the quarter finals to ensure that one school does not take more than one of the major places.

### **7.3 Timing**

Each car will be timed over the course. The winning car will be determined by an electronic timing device initiated by a light/infra-red beam. The beam and detectors will be aligned either horizontally, approximately 50 mm above the track, or vertically within 10mm either side of the guide channel. 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.

### **7.4 Starting procedure**

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. If the final race is needed (in best of 3 or 5 heat races) to determine the winner, the final race lanes shall be determined by a coin toss. The cars will be placed on the track in a ready to run state. When requested by the starter, a member of each team will place their car on the assigned track, on top of the hill and clear of the starting gate. Each car must have a solar panel cover in place. The starter will direct the team member to switch the car on. The starter or any other approved marshal may require the team to demonstrate that the car will not drive with the panel covered. When satisfied, the starter will ask for the cars to be moved along the track to rest against the starting gate. The starter will then ask for the solar panel covers to be removed and the starting gate will be rotated away from the cars to start the race.

### **7.5 Stopping procedure.**

Any stopping procedure may be used, at the discretion of the race organisers. Whatever procedure is used must not affect the other car in any way. Any device or apparatus used to catch or stop the car must not intrude into the path of the other car in any way, shape or form, or cause the car to intrude into the path of the other car. If the officials consider that the other car has been affected to its detriment, then the offending car will forfeit that round. One suggested method is for entrants to fashion a soft plastic foam block to the shape of the front of their car which will not be so wide as to intrude onto the rival cars' lane. This block should be held by a team member on the track so as to cushion the impact of the car hitting it. This team member is advised to stop the car adjacent to the straight beyond the right hand curve past the finish line.

### **7.6 Stability**

If the car comes off the track 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 a deficiency of the track. There shall be no handling of cars during the race other than by officials or by people nominated by officials. If both cars come off, the race will be awarded to the car which travelled the furthest before coming off. If one car comes off and obstructs the other lane, the other car shall be awarded the race if it reaches that point and-collides with the car which first dislodged.

### **7.7 Poor light / adverse weather conditions**

At the discretion of the Committee, races may still be run in virtually any 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. Note, due to the geometry of the track, the car that appears to be in front may not actually have travelled the furthest distance. 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, or is likely to move, for a maximum of 30 seconds. If a car stops for any reason, that car may be restarted under the marshal's discretion from any point on the track behind the stopping position, but the car must not be pushed to restart.

### **7.8 Protests**

In the event that a team believes that their car has been negatively affected by the actions of an official, another team, another vehicle or by a significant problem with the track, a protest may be lodged with the Clerk of Course immediately that race is completed. The team captain, with the support of the team coordinator, will need to make a clear statement as to what they believe the negative effect was and how they believe it was caused. The Clerk of Course will discuss the protest with other race officials as they deem necessary and will deliver a decision within 5 minutes of the protest being lodged. Due to time pressures to reach a conclusion for the event, there will be no further challenge to this decision.

### **7.9 Practice and testing**

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

### **7.10 Results**

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

### **7.11 Prizes**

Prizes will be presented to First, Second, Third and Fourth place getters. The major trophy will be awarded to the winning team. The second trophy will be awarded to the team which wins the total points aggregate. The presentation of prizes will be held as soon as possible after the

completion of the event. Additional prizes for best poster, team uniform etc. will be presented to teams deemed worthy. Such prizes will be announced at the time when invitations are issued.