



# **AUSTRALIAN-INTERNATIONAL MODEL SOLAR BOAT CHALLENGE**

## **2010 REGULATIONS**

### **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 boats built by school age students which compete in a pool steered along parallel overhead lines approximately 300 mm above the pool surface. Time trials are held to "seed" the boat, that is, to allocate them to groups in such a way that the winning boats should not compete against each other in the earlier rounds. Pairs of boats 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 boat.*

*There will be 2 divisions catering for junior students (primary school age) and senior (secondary school) age.*

## CONTENTS.

1.	INTRODUCTION	3
1.1	Event name	3
1.2	Committee	3
1.3	Aim	3
1.4	Spirit of Intent	3
1.5	Allocation of points	3
1.6	Competitors	3
1.7	Correspondence	4
2	ENTRIES	4
2.1	Number of Australian teams	4
2.2	Number of overseas teams	4
2.3	Team members	4
2.4	Original work	4
2.5	Statement of work	4
2.6	Posters required	4
2.7	Boat and School Name	4
2.8	Entry registration	5
3	POOL	5
4	RACE PROCEDURE	5
4.1	Round Robin and Knockout Races	5
4.2	Scrutineering	5
4.3	Starting	5
4.3.1	Using a starting gate	5
4.3.2	Without using a starting gate	5
4.4	Judging the results	5
4.5	Mishaps	6
5	REGULATIONS COMMON TO THE TWO DIVISIONS	6
5.1	Boat length	6
5.2	Boat width	6
5.3	Steering	6
5.4	Photovoltaic (solar) cells	6
5.5	Switch	6
5.6	Hulls	7
5.7	Storage devices	7
6	THE DIFFERENT DIVISIONS	7
6.1	The junior division	7
6.2	The advanced division	7

# 1. INTRODUCTION

## 1.1 *Event name*

The event shall be known as the Australian-International Model Solar Boat Challenge (AIMSBC) and is conducted annually. This, along with car races, will form a part of the Australia-International Model Solar Challenge (AIMSC). Each state may structure events as they wish, but these regulations will be used for the national finals.

## 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 event to which nominated teams from Australia and other countries will be invited. The Committee will also promote the event as widely as possible 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 boats.

## 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 boats using equipment unavailable to the students, but they must understand the working of their boat 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 to use low cost photovoltaic panels of limited size.

## 1.5 *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.

## 1.6 *Correspondence*

International correspondence should be addressed to:

Mr. Paul Wellington  
Chairman AIMSC  
Tel. 613 9885 7828 Mob. 613 419 871 033  
Email [paulwellington@modelsolar-vic.net](mailto:paulwellington@modelsolar-vic.net)

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](mailto:markneed@bigpond.com)

Visit [www.modelsolaraustralia.org](http://www.modelsolaraustralia.org) for updates.

## 2. ENTRIES

### 2.1 Number of Australian teams

The AIMSCC National Coordinator appointed for the event shall request each State Coordinator to invite four teams in each of the 2 divisions, Junior and Senior, 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. The committee reserves the right to limit the total number of entries from any 1 school if there are too many entries for a satisfactory competition.

### 2.2 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.

### 2.3 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 boat. 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.

### 2.4 Original work

All teams must be able to provide evidence to the scrutineers that the boat 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 boat. Solar panels, motors, propellers, guide systems and other similar components may be reused from earlier boats. If any school has more than one boat entered, the boats must be significantly different to indicate to the scrutineers that the boats are the work of different teams.

### 2.5 Statement of work

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

### 2.6 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 boat to the organizers prior to scrutineering. This record should document experiments and or calculations, which were used in the design of the Model Solar Boat. 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:

Item	Marks
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.

### 2.7 Boat and School Name

Each boat should have the school and boat name visible to the starter, judges and spectators.

## **2.8 Entry registration**

Australian entrants must confirm their participation with their local event coordinator within 3 days of their State or Territory event. Potential overseas entrants should notify the AIMSC Chairman of their intention to compete by October 25th. The invitations will be sent to the State and Territory coordinators before their events.

## **3. THE POOL.**

The pool is a rectangular pool at least 70mm deep and between 6 and 10 metres long and over 1.6 m wide. It will have fine wires, strings or fishing lines fixed to supports at either end of the pool so that the tight lines are 300 +/- 25mm above the water level and over 350mm apart.

There may be either 2 or 3 lines suspended above the pool, allowing 1, 2 or 3 boats to start in each race. Boats will be designated to specific lanes.

## **4. RACE PROCEDURE**

### **4.1 Round Robin and Knockout Races.**

The events for each division will commence with a "round robin" in which each boat will have a number of races in the morning which will be used to seed the boats for a subsequent knockout competition. In the afternoon, boats will race with either 2 or 3 boats to a pool (depending on total numbers of entries) with only the winner continuing to the next round. Boats may be run in either a North – South or a South – North direction at the discretion of the race coordinator. All races in any round will be run in the same direction. In finals where the winner is determined on a best of 3 race principle, the boats will race in alternate lanes. Racing in the opposite direction may be used if necessary to resolve a dead heat.

### **4.2 Scrutineering**

All boats will be scrutineered when they arrive to ensure that they meet the regulations of their division. If the scrutineers require, boats which fail to meet the Junior Boat Regulations may need to either be modified or to race in the Advanced Division. Boats which fail to meet key regulations (such as cell type or area, may need to carry a ballast penalty of up to 200gms, although flagrant and excessive breeches may result in disqualification.

### **4.3 Starting.**

Starting will be carried out either by use of a starting gate or by team members releasing their boat as instructed by the starter.

**4.3.1** A starting gate made of 10mm square steel mesh provides a simple means of ensuring all boats are aligned at the start. The gate pivots forward and down, allowing the boats to start to race. If boats have very pointed bows, they may need to release the boat manually from behind the gate. Boats are recommended to have bows with at least a 25mm radius.

**4.3.2** If a starting gate is not used, the start will occur when competitors release the rear guide of their boat on "Release" after the starter states "ready, set, Release". This process will be slower than the starting gate as the boats need to be visually aligned by the starter prior to giving the starting orders. Boats which are pushed or released early may be penalized if the starter so judges and requires the race to be repeated. If incorrect starting procedures are repeated, the boat may be disqualified.

### **4.4. Judging the results**

A judge will be appointed by the committee to sit level with the end of the pool to observe and record which boats win and come second and third in each race. The race will finish only when the boat strikes the end wall of the pool. If the judge is unable to select between boats, the race may be rerun with boats starting in different lanes.

### 4.5 Mishaps

Some boats fail to finish the race, either by submerging, having insufficient power or their guides coming off the guide lines. If a boat interferes with another boat in a 3 boat race, the judge and starter will confer to determine whether to rerun the race with all starters competing or only 2 with the boat causing the interference being disqualified from that race. If there are multiple heats, the boat causing the interference will only lose that 1 heat.

## 5. REGULATIONS COMMON TO THE TWO DIVISIONS

There will be an event for primary school students (the Junior Division) and secondary school students (Advanced Division). Boats will only race others in their division.

### 5.1 Boat length.

The maximum boat length ie including any front and rear projections, shall be 550 mm to ensure that the boat fits behind the starting line. (see Fig.1)

### 5.2 Boat width

The boat width (including the cells) must be no greater than 300mm at the widest point.

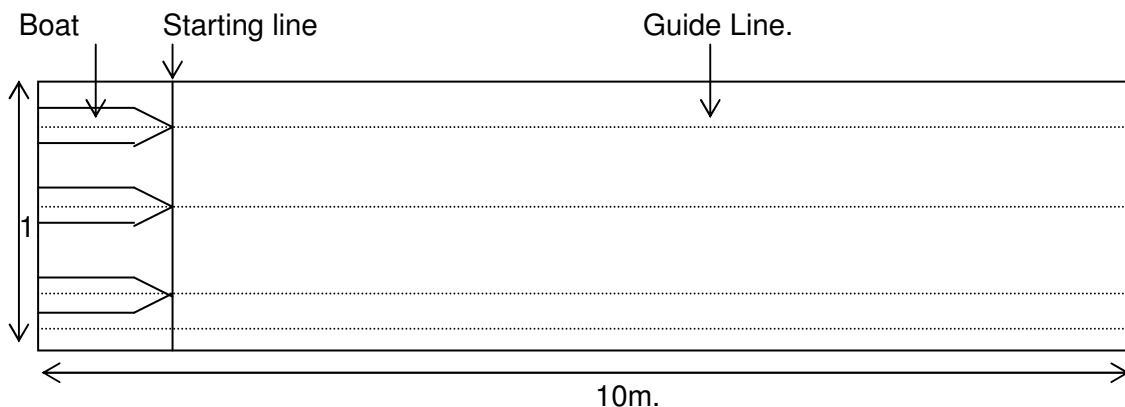
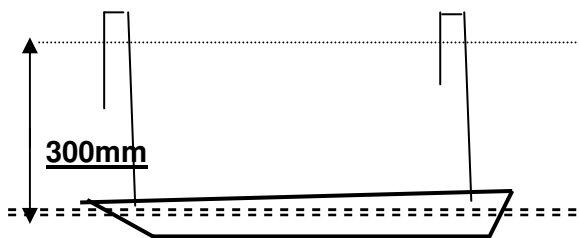


Figure 1. Layout of pool showing 3 boats lined up at the starting line.

### 5.3 Steering

To enable boats to steer a straight line, they should be fitted with rods with open loops through which the guide line will run. This line will be located as near as possible to 300mm above the water. Other designs than the one shown may be used.



### 5.4 Photovoltaic (Solar) Cells

Boats may use any available commercial silicon solar cells of no greater than 350cm<sup>2</sup> active area. (ie. The area covered by the photovoltaic cells only, not including encapsulation around the edge or between cells). Space grade and other Gallium Arsenide cells which have double the power output are not allowed.

Panels must be securely attached, so that they cannot fall into the water.

### 5.5 Switch

A switch must be installed between the solar panel and the motor.

### **5.6 Hulls**

No commercially available boat hulls or kits may be used. Entrants are to design and construct their own boats in the year of the race. Hulls unaltered from previous state or national competitions must not be submitted. Boats re-entered with very substantial modifications must have alterations documented to the satisfaction of the race coordinator.

Multiple boats entered by one school/group cannot be of an identical hull design – eg each entry from a school would not be allowed to use a hull vacuum formed using the same mould. Advanced students using vacuum formed or other moulded hulls must have designed and substantially made the moulds themselves.

### **5.7 Storage Devices**

No batteries or other energy storage devices are allowed.

## **6. THE DIFFERENT DIVISIONS**

The Junior Division is intended to be cheaper and require more simple techniques than the Advanced Division.

### **6.1 Junior Division**

This division is open to any student attending primary school or of primary school age for their state.

Only one motor of maximum value of \$50 is to be used. Only hulls made from drink bottles or cans, polystyrene foam, cardboard or balsa wood (appropriately waterproofed) may be used.

Moulded hulls, eg. vacuum formed plastic and fiberglass hulls are not allowed in this division. Propulsion is restricted to one propeller either under-water or model aeroplane style. There is no restriction on paddle wheels, oars, etc. Maximum cost for the whole boat should be \$50 not counting the solar panels and motor. Boats built by primary students which do not obey these restrictions may be required to compete in the advanced division.

### **6.2. The Advanced Division**

This division is open to primary or secondary age students (up to and including year 12). Any number and type of motor/s may be used. Any materials including vacuum formed, fiber reinforced composite hulls (eg fiberglass) may be used. Electronics and capacitors may be used, but capacitors over 15,000 $\mu$ F will be discharged at the start line. There is no restriction on the propulsion method including underwater screws or above water propellers, paddle wheels etc. The only restrictions are boat size and solar cell area limitations as indicated in section 5.