Australian - International Model Solar Challenge

AIMSC

2018 Regulations for:

Model Solar Boat

Sections 1 to 10

The event will be held at the University of New South Wales towards the end of November 2018.

Additional information will be published on web site www.modelsolarchallenge.com.au

MISSION STATEMENT

To promote, develop and encourage an interest in using solar and renewable energies in school aged students throughout the world and to give these students the opportunity to gain some experience and expertise in this by using active learning in addressing real life challenges. By doing this, 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 the way energy is used, both by a more efficient use of old technologies and the appropriate introduction of renewable energies and technology.

THE COMMITTEE

The Organising Committee of the Australian - International Model Solar Challenge Event is a voluntary body consisting primarily of members of the Australian-International Model Solar Challenge and members from the local state associations and may include sponsors representatives, teachers, students and other invited interested persons, is hereafter referred to herein as the Organising Committee.

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1 INTRODUCTION

1.1 Event Name

The Event shall be known as the Australian - International Model Solar Challenge - Boats (“AIMSCB”) and is run annually. This, along with other events for student designed cars, will form the Australian - International Model Solar Challenge (“AIMSC”).

1.2 Overview

This is a race for model solar boat built by students in studying at primary or secondary levels up to and including Year 12 level. The Organising Committee of the event believe that the skills necessary to build a competitive boat are appropriate for younger students and give a learning experience which can lead on in later years to designing entries for the advanced division. A "round robin," in which boats race against other designated boats, will begin the competition. This round robin is conducted in a single pool between 2 (two) or 3 (three) competitors. The format of the racing is a first past the post style where the winner is the first boat to reach the finish line.

Based on the results of the “round robin”, boats are allocated into groups which then compete in an elimination competition, the winners of each round continue to the next and the losers are eliminated. This process of elimination continues until a winner is decided by being the only undefeated boat.

1.3 Spirit of Intent

The objective of the Challenge is to develop a craft that will most effectively travel along a guide line suspended above the water’s surface and race against other like crafts, travelling from one end to the other of a pool, approximately six (6) to ten (10) metres long, in the shortest possible time.

The Challenge is designed to provide students currently studying up to and including Year 12 secondary level, with an opportunity to learn, so it is very important that the design and building of the boat be completely that of the students. The aim is to encourage exploration of solar energy through design and construction of working models powered by the sun shining on solar cells.

Teachers, mentors, parents and/or other adult advisors are encouraged to teach the students the correct scientific and technical principles; however they are not allowed to undertake any of the physical work on the boat themselves. In the past, there have been occasions where adults have done the work instead of the students, which can significantly advantage the team involved; this is inappropriate, unfair and is not allowed. As the main object of the experience is for the students to learn how to do it themselves, inappropriate adult help only interferes with this goal and the Organising Committee take this problem very seriously, see **§2.2**.

So that the competition remains financially accessible to as many organisations as possible the Organising Committee has framed these regulations to use low cost photovoltaic panels of limited size and limited power output.

1.4 Competitors

The competition is open to applicants from schools and other organizations for school aged students in Australia and invited parties from overseas.

1.5 Eligibility and Divisions

The competition is run in two divisions.

1.5.1 Entry level

Open to primary school aged students.

1.5.2 Advanced Division

Open to primary or secondary students up to and including year 12 level.

1.6 Statement of Involvement

Boats entered in any given year must be the work of students in that year. Hulls will be photographed and marked at each year's event so that they cannot be re-entered in subsequent years.

1.7 Correspondence

Email: secretary@modelsolarchallenge.com.au

2 INTERPRETATION OF THE REGULATIONS

2.1 Students Must Do the Work

To maximize the learning experience, students are to design and construct the boats themselves, adults should not undertake any physical work on the boat, though some adult help to improve student skills is acceptable. High level technical work on 1.5.1 entry level boats (routing, welding, moulding, spray painting, 3D printing, etc.) is discouraged, as students will not normally have access to these skills. It is recognised that some components will need to be either purchased or made using equipment unavailable to students, however those competing in the advanced division should be able to show understanding of the processes which were or could have been used for making these components.

All students must understand the working of their boat and be able, without outside assistance, to operate and make all necessary adjustments or repairs over the duration of the event. Special circumstances should be reported to the Adjudication Sub-Committee who will consider the circumstances and may if deemed appropriate sanction or provide assistance.

2.2 Unfair Practices

In the past there have been instances of inappropriate adult input, which can significantly advantage the team involved. The Organising Committee views this problem very seriously. Any adults seen to be acting inappropriately will be given one warning before penalties will be applied to the team involved. Flagrant and repeated breaches will attract penalties commencing at the requirement to carry 100gm of ballast, progressing ultimately to disqualification.

Where the officials find that the boats from a single organisation are insufficiently different from each other, students may be asked either at scrutineering or a subsequent interview to explain how they chose that design or construction method.

2.3 AIMSCB Rulings

The Officials are empowered to make decisions on any case not covered or clear in these regulations. Dissent from their rulings may be referred to the Event organisers who will adjudicate. Dissent from their ruling may lead to disqualification from the event.

3 ENTRIES

3.1 Number of Teams

No more than 4 teams from Australian regional level events will be invited to the this event. International competitors may also be restricted to a maximum of 4 teams from any region at the discretion of the Organising Committee. In extenuating circumstances additional invitations may be extended by the Organising Committee.

3.2 Statement of Work

All entrants will be required to sign a form indicating that the construction of their boat was done with minimal help from teachers, mentors or parents and is predominantly their own work. This work will be proven by the submission of a poster (**§3.3**)

All teams must be able to provide the scrutineers with evidence that the boat is the original work of the team members in both design and construction, performed in the current year (2018) and not simply a restyling of any boat from a previous year. However, teams are permitted to reuse: solar arrays, motors, drive systems, guide systems and other similar components.

3.3 Posters

Students should document their work as in any quality design and build project. Prior to scrutineering, all teams are expected to present to the AIMSCB organisers a laminated or contact coated A2-sized Poster, documenting the design and development of their boat (this is standard: all engineering projects require documentation and research is often presented as a poster). This record should document experiments and/or calculations and the design decisions made. Some discussion of the benefits or use of solar power for minimizing greenhouse gas emissions is encouraged. Graphs, photos and design drawings will be marked favourably.

Posters should clearly state the organization and boat names and list the team members names. Teams may be interviewed to determine their level of understanding and the way in which they reached their design and construction process.

Once submitted this poster becomes the property of the AIMSC organisation. The organisers may elect to keep the best posters for exhibition at the event and at other places where the event is publicized. All other posters should be collected by one of the associated team member at the end of the competition as any poster left behind and not required by the AIMSC organisers will be discarded at the completion of the event.

Posters will be assessed using the following rubric

Item	Points
Headings readable from 5 metres	1
Writing legible from 2 metres	1
Summary of test results	5
Construction details	5
Presentation = photos, diagrams drawings etc	4
Greenhouse relevance	3
What has been learnt	5
References, acknowledgements	1
Total	25

The posters considered the best, those that achieve the highest total number of points, will be subsequently displayed and a prize awarded for the best poster at the event.

4 REGISTRATION

Australian entrants will be issued with an invittion to participate at the AIMSBC finals by their regional event coordinator and must confirm their iuntention to participate with that Coordinator within one week of receiving the invitation . Potential overseas entrants must notify the AIMSC Organisers of their interest in competing by September 1st 2018. Each entrant must also register on the official AIMSC website by November 1st.

5 PRIZES

Prizes for the following will be awarded to teams which achieve the following.

- First place
- Second place
- Third place
- Best first entry from a new school
- Best display of recycled materials – not last years boat!
- Most innovative design
- Best poster
- Best team uniform
- Best student made captain and crew (entry level only)

All team members of boats that run in the event receive a certificate of participation. However, teams which have inadequate posters (score of less than 13 out of a maximum of 25) or cannot demonstrate to the AIMSC organisers that the boat was their own work may forfeit their place to another team.

6 THE POOL

A single pool will be used for all races.

6.1 Size and Shape

The pool is rectangular in shape, approximately 1.6m wide and between six (6) and ten (10) metres long with a side wall of approximately 300mm. The height of the side walls permit for a minimum water depth of 70mm over the entire pool surface area.

6.2 Construction

Several layers of polyethylene plastic sheeting is laid over a support frame. The pool is divided into "lanes" equally spaced across the pool using fine wires, strings or fishing lines fixed to supports at both ends of the pool. These supports are stabilised so that the lines can be tensioned ensuring that they are 300mm ±25mm above the water surface level in the pool. There may be either 2 (two) or 3 (three) lines suspended above the pool, allowing 2 (two) or 3 (three) boats to participate in each race.

6.3 Starting Position

Boats will be assigned a lane on the day for each race in which they compete. Each boat will be placed in their assigned lane and placed on the starting line by a team member. Starting the race is either by the use of a starting gate or the manual release of the boat by the team member.

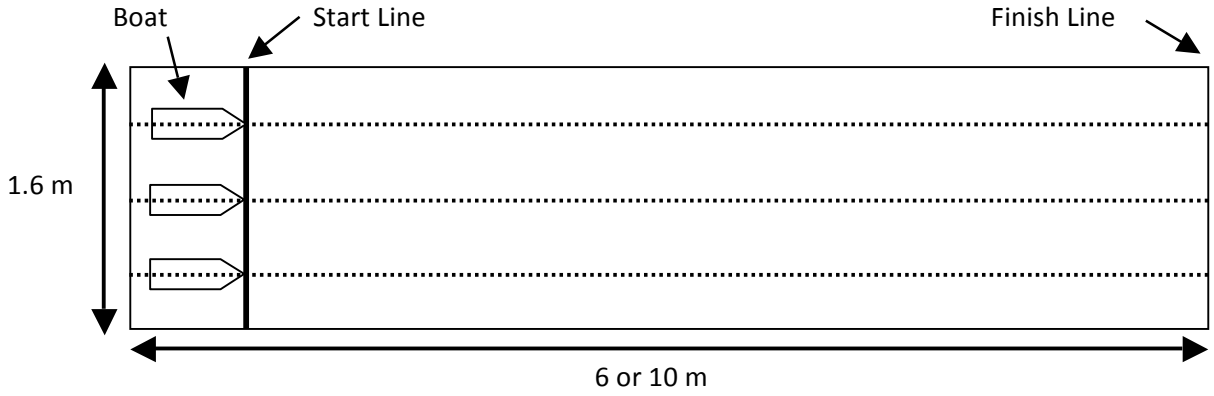


Figure 1: Layout of a pool configured for 3 (three) lanes with boats lined up at the start line

6.4 Finish Position

The winning boat will be the one which reaches the finish line first, as judged by the AIMSC official at the finishing line. The order of finishing as judged by this AIMSC official is final.

7 SCRUTINEERING

All boats will be scrutineered before racing to ensure that they meet the regulations of their chosen division. If the scrutineers require, boats which fail to meet the Entry Level Boat Regulations, will need to either be modified to conform to the regulations or race in the Advanced Division. Any boats which fail to meet key regulations such as cell type or area, will be required to carry a ballast penalty of up to 400gm, although flagrant and excessive breeches that are expected to result in an unfair advantage will result in disqualification.

7.1 Individual Design

See 2.2.

7.2 Commercial Components

No commercially available boat hulls or kits may be used. All entrants are to design and construct their boats in the year of the event, 2018.
It is expected that the only commercial component assemblies that would be used for the construction of a boat would be the Silicon solar array, an on/off switch, wiring/electronics (advanced division only), the motor(s) and the propulsion parts, i.e. shafts, bearing, propeller, impellor, paddle wheel, fan, etc…
The re-use of any of these allowed commercial components from a previous year's team entry for a new boat design is permitted.
Each boat entered in the AIMSCB must have a dedicated panel (panels should not be shared between boats).

8 SERVICING

8.1 Service Area

An official "service area" is available for team members to conduct boat adjustment and maintenance. It is expected that only team members, independently of teacher, mentor or parent support, are performing repair or adjustments to their boat.

8.2 Hazardous Substances

Please Note. Due to mandatory 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 means cooling solar panels with anything other than water ice will not be allowed at any time.

9 COMPETITION

9.1 Structure of the Races.

The races for each division will commence with a "round robin" competition. Each boat will have at least 3 races to provide results which will be used to seed the boats for the later "knockout" competition. In the "knockout" competition boats will race with either 2 (two) or 3 (three) 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 the finals where the winner is determined in a best of 3 (three) race format, the boats will race in alternating lanes. Racing in the opposite direction may be used if necessary to resolve a dead heat.

9.2 Starting Procedure

See 6.3

9.2.1 Starting Gate

A starting gate made of 10mm square steel mesh provides a simple means of ensuring all boats are aligned on the starting line. The gate pivots forward and down into the pool, allowing the boats to start to race with the minimum of interference. If boats have very pointed bows, they may need to release the boat manually from behind the gate to ensure that they are not disadvantaged by the gate operation. Boats are recommended to

have bows with at least a 25mm radius to avoid any complications on the starting gate.

9.2.2 Manual Release

The start will occur when competitors release the rear guide of their boat upon issuance of the “Release” command. The AIMSCB official starter will voice the starting order, “Ready”, “Set” and “Release”, to start the race. This process will be slower than the use of a starting gate as the boats need to be aligned on the start line by the starter prior to giving the starting orders. Boats which are pushed or released early may be penalized if the AIMSCB officials so judges and requires the race to be repeated. If incorrect starting procedures are repeated, the offending boat may be disqualified.

9.3 Judging the Results

An AIMSCB finishing line judge will be appointed by the Organising 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.
The order of finishing as recorded the AIMSCB finishing line judge is final and is not open dispute. This includes any third party contesting the result due to information from “Photo Finish” and/or “Effect of Parallax” claims.
If the AIMSCB finishing line judge decides that they are unable to select between boats to assign the order of finishing, the race will be rerun with all boats starting in different lanes to the original race.

9.4 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 (three) boat race, the AIMSCB officials will confer to determine whether to rerun the race with all starters competing or only 2 (two) competitors, 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 (one) heat.

9.5 Practice and Testing

Practice in the pool will be allowed at any feasible time that at least one of the AIMSCB official is in attendance.

10 BOAT SPECIFICATIONS

To be eligible to compete boats must conform to all applicable specifications. The following details the specifications which are common to both the Entry Level and Advanced divisions. The additional specifications which apply to each division only are detailed separately in **§10.1** and **§10.2**.

10.1 Specifications Common to Both Entry level and Advanced Boats

10.1.1 Maximum Length

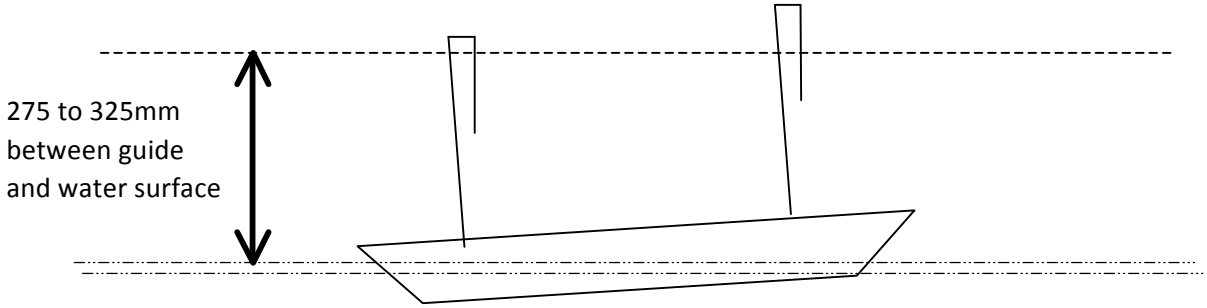
The maximum boat length including any front and rear projections, shall be 550mm to ensure that the boat fits behind the starting line (a previously show in Figure.1).

10.1.2 Maximum Width

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

10.1.3 Maximum Guide Height

To enable boats to steer a straight line, they should be fitted with rods with open loops through which the above pool guide line will run. This line will be located as near as possible to 300mm ±25mm above the water. Other designs than the one shown below may be used; viz 2 skewers held together by a rubber band.



igure 2:
guide wire height and guide rod position

10.1.4 Solar Panels

Boats may be powered only by commercial silicon cells with a maximum active area of 350 square cm. The solar panels must be securely attached to the boat, so that they cannot fall into the water.

10.1.5 Other Energy Sources

No batteries or energy storage devices are allowed. However capacitors are allowed as part of an electronics system in the advanced division.

10.1.6 On/Off Switch

A functioning on/off switch should be installed between the solar panel and the motor.

10.1.7 Propulsion

There is no restriction on the use of underwater propellers, air propellers, paddle wheels, oars etc. for the selection of the boats propulsion system.

10.1.8 Identification

Teams will be provided with a "flag" with the boat's number and name. This flag is to be affixed to the rear guide wire

10.2 Entry Level

10.2.1 Motor

Only one hobby type motor commercially available within Australia with a maximum recommended retail price ofAUD $ 10.00 is permitted. Motors from scrapped equipment such as VCR's etc. are not permitted as we cannot verify their performance. Boats using such motors will be required to compete in the advanced division.

10.2.2 Hulls

Only hulls made from recycled packaging (such as plastic drink bottles or cans etc.), polystyrene foam, cardboard or balsa wood (appropriately waterproofed) may be used. Moulded hulls, e.g. vacuum formed plastic and fiberglass hulls are not allowed in this division.

10.2.3 Propulsion

Boats using in water propellers must use direct drive between motor and propeller. Gearboxes or other methods of changing the propeller speed relative to the motors rotor speed are not permitted in this division

10.2.4 Captain and Crew

A “captain” and 1 (one) “crew member” must be carried on the boat during racing and must be in position when the boat reaches the end of the pool. The figures must be at least 35mm high and 10mm wide and can be made of Lego™, other plastics, waterproofed cardboard, timber, pipe cleaners etc.
The captain and crew must be vertical and be protected from the sun by the solar panel or some other shielding above their heads. They must be able to “see” where the boat is going and at least 20mm of their height must be above the deck, i.e. visible from the side.

10.2.5 Non Conformance

Boats built by primary students which do not meet these restrictions will be permitted to compete by either carrying an additional weight penalty or by electing to compete in the advanced division. The boat must also meet the regulations of the advanced division if that option is chosen.

10.3 Advanced Division

10.2.6 Motor

Any type or number of motors may be used.

10.2.7 Hulls

Any materials including vacuum formed plastic, fiberglass or carbon fibre hulls can be used. Boats from the same organisation must have hulls that are deemed non-identical by the AIMSCB Committee (see **§2.2**).

10.2.8 Propulsion

Any type or any number of propellers, impellors or other propulsion units may be used. Gearboxes or any type of speed varying system may be used between motor and the chosen propulsion component(s).

10.2.9 Electronics

Electronics and capacitors may be used, but the total capacitance on board the boat must not exceed 15,000 µF.

10.2.10 Cargo

All boats must carry a cargo of one empty, undistorted 375ml drink can (66mm diameter and 130mm long), which must be in place when the boat reaches the end of the pool.

10.2.11 Non Conformance

Boats which do not meet these restrictions will be permitted to compete by either carrying an additional weight penalty or if it is decided by the scrutineers that the infraction gives the boat a significant advantage and that carrying extra weight isn’t enough to “level the playing field”, the boat will be excluded from the AIMSCB event.