

**AMT MotoCorp**

Presents

**Indo Asian  
Solar Challenge'19**



Inspiring Green Technology

**RULEBOOK**

## Table of contents

<b>1. About the event .....</b>	<b>04</b>
✓ About the AMT MotoCorp	
✓ About IASC	
<b>2. Purpose.....</b>	<b>05</b>
<b>3. Administrative .....</b>	<b>05</b>
<b>4. Entries .....</b>	<b>06</b>
✓ Registration	
✓ Team initial registration	
✓ Entree fee	
<b>5. Technical Requirements.....</b>	<b>08</b>
✓ Technical Inspection	
✓ Vehicle dimensions	
✓ Chassis	
✓ Material selection	
✓ Bodyworks	
✓ Firewall	
✓ Jack point	
✓ Pushbar/ pullbar	
✓ Bumper	
✓ Node to node triangulation	
✓ Forward and side vision	
✓ Cooling and hydration	
✓ Seat and seat belt	
✓ Locknut	
✓ Fire extinguisher	
<b>6. Steering system, braking and suspension .....</b>	<b>12</b>
<b>7. Electrical system .....</b>	<b>13</b>
✓ Solar panel	
✓ Battery	
<b>8. Drive train .....</b>	<b>15</b>
<b>9. Part B.....</b>	<b>16</b>
<b>10.Virtual Round.....</b>	<b>17</b>
<b>11.Engineering Design Round.....</b>	<b>20</b>
<b>12.Cost reports &amp; B-Plan Presentation.....</b>	<b>22</b>
<b>13.Final round Dynamic Event.....</b>	<b>23</b>

- ✓ Technical Inspection
- ✓ Brake and Acceleration test
- ✓ Weight test
- ✓ Auto cross
- ✓ Innovation test
- ✓ Solar performance test
- ✓ Endurance B-“ The road race “

**14.Command flag.....30**

**15.Penalties .....30**

**16.Driver Requirements.....33**

**17.Contact us.....36**



## About the Event:

---

### About the AMT MotoCorp

We , the Ashman's are a team which has been instrumental in promoting motor sports events and ushering a new era of engineers, where they will know, what practicality in technical world stands for. The AMT MotoCorp will act as a launch-pad to accord the seamless endurance of engineers and their prolific inputs. We will craft a world, where knowledge and wisdom in engineering domain will lead to imagination and innovation.

Much to the emergence of engineers in India in the last decades, the indispensability of this troupe has somewhat been whacked. Primarily, our competency will include giving birth to an atmosphere, where engineers do not feel their job as a livelihood, but a way to live life. A bridging gap is what, we will mend between the ideas and prospects of an engineer, who has no dearth of enthusiasm and zeal the Ashman pledge to work for the engineers, and to give the much needed impetus, which can make them operate without being asymptotic about the obstacles.

### About the IASC

**Indo Asian Solar Challenge (IASC)** is an Asia's biggest solar vehicle race which was organized from past 5 years.

The purpose of the Indo Asian Solar Challenge is to stimulate research into, and development of, sustainable transport, meaning that the Indo Asian Solar Challenge is primarily a design competition. The regulatory philosophy is to provide the parameters upon which to base the design, rather than specify exactly how each is to be achieved. Science and technology evolve and to encourage the most innovative ideas, so too do the event requirements. Participation in the 2019 Indo Asian Solar Challenge calls for the design and construction of a Solar Electric Vehicle within the given design parameters, and driving the Solar Electric Vehicle across the continent of Asia in accordance with these regulations.

The name “**Indo Asian Solar Challenge**” and the solar related logo are registered trademarks maintained by the **AMT MotoCorp**. This work is copyright Indo Asian Solar Challenge. The Indo Asian Solar Challenge assert its moral right to be identified as the copyright owner of intellectual property contained in this documents whether in physical or electric form.

## **PART A. PURPOSE**

### **Article 1. Fundamental Vision**

The Indo Asian Solar Challenge (INDO-ASC), hosted by the AMT MotoCorp in collaboration with other industries, seeks to promote and celebrate educational excellence and engineering creativity. Fuelled by the spirit of friendly competition and teamwork, the INDO-ASC champions the creative integration of technical and scientific expertise across a range of exciting disciplines.

### **Article 2. Missions**

The support and encouragement of bright young minds to succeed in the fields of engineering, the sciences, mathematics, business, in multi-disciplined experiential learning, and in subsequent careers. The creation of public awareness and enthusiasm, both for education excellence and engineering creativity itself, and for the technologies and practices that emerge from that excellence.

### **Article 3. Scope**

These regulations apply to the 2019 Indo Asian Solar Challenge®, and comprise participants' eligibility, pre-event preparation, scrutinizing, testing, on-road components and any associated activities published by the Organizers as being part of the Event. The Event will be conducted under the regulations described in this document (which supersede regulations for any previous Indo Asian Solar Challenge) and any Further Regulations or Bulletins that may be issued.

## **PART B: ADMINISTRATIVE:**

### **Article 1: Indo Asian Solar Challenge Organizers**

The AMT MotoCorp shall be the official organizers of the Indo Asian Solar Challenge, and shall be responsible for all management oversight and application of the regulations for the Event.

### **Article 2: Control Room**

During the Event, a Headquarters will be established at a site appropriate to each function and will assume the management functions for the Event.

### **Article 3: Officials**

A team of Officials to conduct the Event including all event components will be selected by Indo Asian Solar Challenge Organizers. Officials having specific duties shall be announced to the teams through the briefings. Team Handler: Several Officials will be assigned the role of “Team Handler” who have the responsibility to help in technical and also any kind of rules and regulation related to the event.

#### **Article 4: Official Announcement**

All the official announcements and the information regarding the competition will be displayed on the official website of Indo Asian Solar Challenge. Our official website is <http://iasc.amtmotocorp.com/> and the official Facebook page of Indo Asian Solar Challenge is <https://www.facebook.com/Indoasiansolarchallenge>. After completion of registration, important information will be sent through the emails to the respective team mail Id. The rules will be same throughout the event and any amendments done will immediately be informed to all the participating teams. The Organizers reserve the right to revise these Regulations at any time.

#### **Article 5: Right to Impound**

During the event any registered team can be called for technical inspection and examination at any point of time and stage and can be questioned for any technical element related to the vehicle during the event to any team member.

#### **Article 6: Vehicle Shipping**

The teams must ensure that their shipping agency or freight forwarder or commercial carrier complies with all the rules laid down by the government for inter-state transportation. The vehicle shipping may be a complex and lengthy process. It is the responsibility of teams to ship the vehicle on proper time so that it reaches the event-site before start of event. Teams must keep proper care of vehicle during transport to avoid any damage to the vehicle. A proper care must be taken while selecting the mode of shipping (train/truck etc.). Vehicle and team member must be reached at the site of event, before the inauguration of the event.

### **PART C: ENTRIES**

#### **C.1.Registration**

Team Captain has to register the team online on <http://iasc.amtmotocorp.com/> by providing Team Name, Team Leader Name, College Name, Email Id, Contact

Number, College Address, City, State, and Country. After Online Registration, Team Captain will receive a response mail immediately confirming team registration from [indoasiansolarchallenge@gmail.com](mailto:indoasiansolarchallenge@gmail.com)

## C.2. Team Initial Registration

- **Team Name:** Every team should have an Inspirational and meaningful name.
  - **Team Logo:** Every team should have an attractive team logo (Not downloaded from internet or copied). And teams are required to upload the profile pic of official mail id.
  - **Team Captain:** Every Team requires a team captain and Vice-captain.
  - **Discipline:** Every team member must be undergraduate / diploma student or pass out student can participate after the approval from their respective college/ University.
  - **Driver:** Every team must have minimum two drivers; driver must be minimum 18 years old. The driver should have a valid driving license and officials can verify that any time during event.
  - **Medical Insurance:** Both the Driver should have a valid medical Insurance.
- Faculty Advisor: Every team requires two faculty advisors (One from Mechanical department and one from Electronics or Electrical department) appointed by the college/University who will provide guidance as needed throughout the solar car design, building, and testing process.

**Status:** *Each team is supposed to have a Faculty Advisors appointed by the college/university. At least one of the Faculty Advisors is required to accompany the team to the competition and will be considered by competition officials to be the official college/university representative.*

**Responsibilities:** *Faculty Advisors may advise their teams on general engineering and engineering project management theory and act as guide to them for INDO ASIAN SOLAR CHALLENGE-2019 this project. The Faculty advisors are allowed to attend virtual round, static & dynamic events along with their team at event site but will not be allowed to provide answers or justifications for any question on behalf of team. He/she can also not perform in the dynamic event on behalf of the team members.*

**Limitations:** *Faculty Advisors should not design any part of the vehicle nor directly participate in the development of any documentation or presentation. Additionally,*

*Faculty Advisors may not fabricate nor assemble any components, nor assist directly in the preparation, maintenance, testing or operation of the vehicle. In Brief Faculty Advisors may not design, build or repair any part of the vehicle. But they can support their team for proper upkeep of vehicle in case of any breakdown. Also it is recommended that all documentation of team should be verified by the Faculty Advisor.*

**Team Member:** Every team require minimum 12 members and maximum 25 members.

**NOTE:** Multiple teams can participate from same college/ university in Indo Asian Solar Challenge, but every team should have different Team name and all the data given in the section Team Requirements.

### **C.3. Entry Fee**

The Indo Asian Solar Challenge is not a commercial operation. The cost of staging an event over 5 days and 130 km are significant and the Organizers, whilst cognisant of the cost of participation, recognizes that the basic costs of the operation must be borne by the Entrant.

The team have to pay the registration fee **INR 25,500/-**

*The account Detail will be send by mail after the registration.*

## **PART B: TECHNICAL REQUIREMENT**

### **A.1 Technical Inspection**

The following requirements and restrictions will be enforced through technical inspection. Noncompliance must be corrected and the car re-inspected before the car is allowed to operate under power.

#### **Modifications and Repairs**

Once the vehicle has been presented for judging in the Cost or Design Events, or submitted for Technical Inspection, and until the vehicle is approved to compete in the dynamic events, i.e. all the inspection stickers are awarded, the only modifications permitted to the vehicle are those directed by the Inspector(s) and noted on the Inspection Form.

Once the vehicle is approved to compete in the dynamic events, the ONLY modifications permitted to the vehicle are those listed below.

- ✚ Adjustment of belts, chains.
- ✚ Adjustment of brake bias
- ✚ Adjustment of the driver restraint system, head restraint, seat and pedal assembly drivers
- ✚ Adjustment of mirrors
- ✚ Adjustment of the suspension where no part substitution is required, (except that springs, sway bars and shims may be changed)
- ✚ Adjustment of tire pressure
- ✚ Replacement of worn tires or brake pads. Replacement tires and brake pads must be identical in material/composition/size to those presented and approved at Technical Inspection.
- ✚ The changing of wheels and tires for “wet” or “damp” conditions as allowed before the race.
- ✚ Recharging of battery.

## **A.2. Vehicle Dimensions:**

### **A.2.1. Vehicle Requirement**

- ✚ Vehicle must have minimum 3 wheel or more wheels not in straight line.
- ✚ The points of contact between the tires and the road must be symmetrical about the longitudinal centerline of the vehicle.
- ✚ The steering system must be able to control (simultaneously) at least two wheels.
- ✚ Maximum vehicle dimensions should not exceed 190 cm by width and 360 cm by length. It will be measured at the widest point with the wheels pointing forward at static ride height.
- ✚ The smaller track width (front or rear) must be at least 75% of the Wheelbase of the vehicle.
- ✚ The three wheeler vehicles must have the tadpole configuration. Delta configuration is not allowed.

## **A.3. Chassis:**

### **A.3.1. Cross Sections**

- ✚ Teams are instructed to use only **seamless pipe** only.
- ✚ Circular cross sections are mandatory.
- ✚ Tube cross-section requirement.

- ⇒ Minimum outer dia- 1 inch.
- ⇒ Maximum outer dia – 2 inch
- ⇒ Minimum wall thickness- 1 mm.

### **A.3.2 Material Selection**

- ✚ Teams can be used any type of material – steal/aluminum/carbon fiber.
- ✚ Teams need to carry material composition certificate and strength test certificate during the event place and also original bill.

### **A.3.3 Bodyworks**

- ✚ For bodyworks teams can prefer glass fiber, carbon prefer, GI sheet or any other material which is water resistant and fire resistant and also submitted the body works technique in detail.

### **A.3.4 Firewall**

- ✚ A firewall must separate the driver compartment from all components of the electrical and electronics and high voltage system.
- ✚ The firewall must be a non-permeable surface made from a rigid, fire resistant material.
- ✚ Material for firewall must have fire resistance and electrical resistance properly.
- ✚ No nylon tie or strap of any kind should be used to fix the floor.

### **A.3.5 Jack Point**

- ✚ There must be two jack points on the vehicle, one at the rear other at the front. Both the jack points must be colored in Orange.
- ✚ The jack point must be oriented horizontally and perpendicular to the centerline of the car.

### **A.3.6. Push/Pull bar**

- ✚ The detachable push rod is mandatory for all the teams, push rod have capability to push and pull the vehicle.
- ✚ There should be a single rod for both the usage.

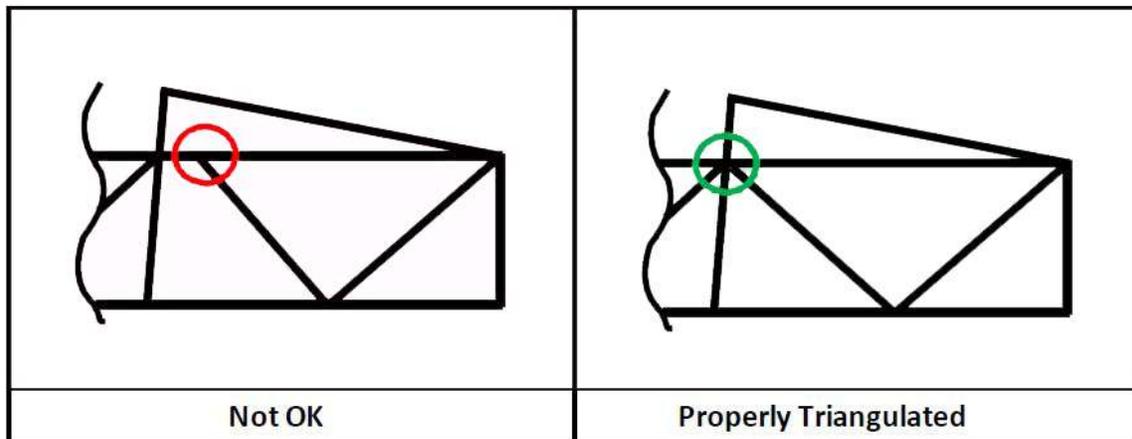
### **A.3.7. Bumper**

- ✚ There should be impact bumper on front and rear of the vehicle. It should be rigid and strong. Without bumper teams will not clear the TI.

- ✚ The bumper should cover the outer point of the tire.

### A.3.8. Node to Node triangulation

An arrangement of frame members projected onto a plane, where a co-planar load applied in any direction, at any node, results in only tensile or compressive forces in the frame members. This is also what is meant by “properly triangulated”.



### A.3.9. Forward and Side Vision

Each driver, when seated in the normal driving position with safety-belt and helmet on, must be able to identify 75 mm high letters at every point of forward travel that is:

- ✚ 4 m from the driver’s eyes, and
- ✚ Between 100° left and 100° right of the direction of travel.

### A.3.10. Cooling and hydration

- ✚ Each solar car occupant must be provided with ventilation or cooling sufficient to ensure that they will not overheat. The team must describe the system and have it approved by their certifying engineer.
- ✚ Each team must prepare a cooling system for motor and battery.

### A.3.11. Seat and seat belt

- ✚ The distance from the hip point to the top of the head restraint must be at least 800 mm.
- ✚ It is mandatory to use off road bucket seat.
- ✚ Seat should be rigidly mounted and fastening should be attained by lock nut.

- ✚ Seat belt must be minimum 3 point seat belt used in car, it has the capability of self-locking.
- ✚ Use OEM seat belt is recommended.

### A.3.12. Lock Nut (Nylon Nut)

- ✚ Use of Lock Nuts is compulsory in Wheels, Motor mounting, Suspension system, and Steering system in the vehicle. Shown below is a snap of lock nut.

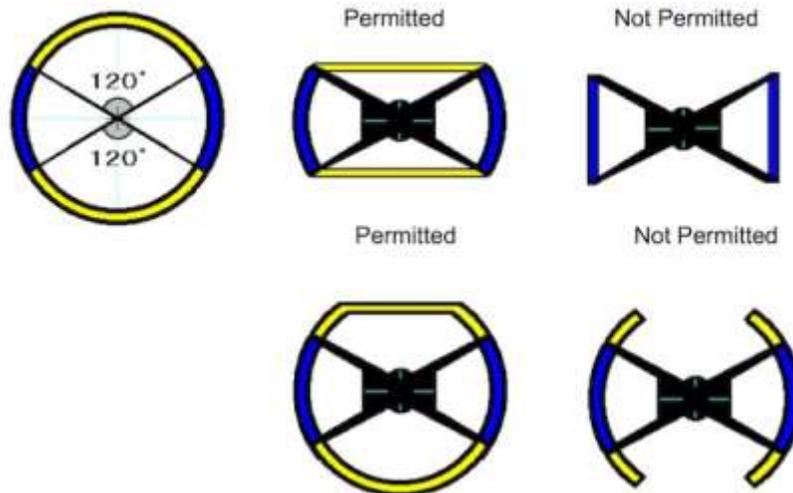
### A.3.13. Fire extinguisher

- ✚ Teams should install a fire extinguisher of minimum 1kg.

## A. 4. Steering system, Braking and Suspension

### 4.1. Steering

- ✚ The steering wheel must be mechanically connected to the wheel, i.e. “steer-by-wire” or electrically actuated steering is prohibited.
- ✚ Rack and pinion type steering system is mandatory.



- ✚ Allowable free play is restricted to 5 degree.
- ✚ Solar car must be able to make a U-turn in either direction within a 10m lane.

### 4.2. Brake

A car must be equipped with brakes on all the wheel, operated by single control and must be **hydraulic braking system**.

- ✚ It must have two independent hydraulic circuits such that in the case of a leak or failure at any point, effective braking power is maintained on at least two (2) wheels.
- ✚ Each hydraulic circuit must have its own fluid reserve, either by the use of separate reservoirs or by the use of a dammed.
- ✚ "Brake-by-wire" systems are prohibited.
- ✚ The brake system must be capable of locking all wheels simultaneously during the brake test.
- ✚ Pedal should only be operated from driver's foot and no usage of hand operated levers for braking mechanism is allowed.
- ✚ The pedal over travel should be restricted by positive locking mechanisms.
- ✚ Brake Over-Travel Switch is mandatory to use.
- ✚ The car must be equipped with two red colored brake lights.
- ✚ Each brake light must be clearly visible from the rear in very bright sunlight.

### 4.3. Suspension

- ✚ Use of Suspension system is mandatory on all wheels.
- ✚ The car must be equipped with a fully operational suspension system with shock absorbers. That can work on an off road terrain also.
- ✚ The judges reserve the right to disqualify cars which do not represent a serious attempt of an operational suspension system or which demonstrate handling inappropriate for a qualifying circuit.
- ✚ All suspension mounting point must be visible at Technical Inspection, either by direct view or by removing any covers.
- ✚ Wishbone/ A-Arm must be of the Seamless tube.
- ✚ For fastening lock nut or else safety wire should be used.
- ✚ At least 2-3 thread should be visible after fastening.

## A. 5. Electrical System

### A.5.1. Solar Panel

- ✚ Teams are free to use any kind of solar power system in their vehicle; team are also allowed to develop (fabricate) their own solar panel or solar cell.
- ✚ If teams are planning to develop solar panel or cells on their own, then they need to submit the whole design report of solar panel or cells manufacturing.
- ✚ No solar panel should exceed the body of the vehicle, solar panels must be securely attached with the bodywork using fasteners, over hanging solar panels are not allowed.

- ✚ Solar system must follow the dimensional restriction of vehicle.
- ✚ Solar Panels must be capable of charging the batteries using definite charge controllers used for this purpose.
  
- ✚ Teams should make sure that fluctuating Direct Current should not reach Battery Pack directly. There should be usage of any charge controllers through which fluctuating direct current from solar panel is converted into DC current and supplied to the Batteries

## 5.2. Battery Specification

- ✚ Teams can use either Li ion battery or Lead acid battery.
- ✚ Voltage output of battery pack should not exceed by 60 volts.
- ✚ Teams can also use a separate battery of max 12V, for the following function, and the mentioned function must be installed in the vehicle:
  1. Innovations.
  2. Horn.
  3. Battery level indicator.
  4. Brake light.
  5. Side indicators.
- ✚ **Battery pack (power pack)**
  1. The cover material of Battery Pack must be fire and electric proof and properly insulated
  2. Flexible rubber or plastic sheets are not allowed to be used as covers.
  3. Also, the battery cover should be made up of rigid plastic/glass fibre/ sheet metal, with an insulating coating.
  4. It should be mounted rigidly, nylon ties, strings or wire of any kind is not allowed for mounting.
  5. The casing of the battery should be fixed/ welded/ fastened (using lock nuts) with the chassis.
  6. If power storage pack is capable of spilling dangerous liquids when damaged, there must be a spill-proof barrier between that storage pack and solar car occupants.
  7. The cover should be de-attachable type, if required then it can be easily removed from batteries.
  8. There should be forced convection system installed, such that air from atmosphere is forced into battery for cooling purpose

9. Teams can use cooling fans or hoses for this purpose
10. Use of battery management system with battery pack is compulsory.
11. Original GST bills for battery pack should be present during technical inspection.

## **A.5.3 DRIVE TRAIN**

### **A.5.3.1. Motor Specification**

- ✚ Teams can use DC motor with OEM plate.
- ✚ Maximum motor power should not exceed 2250 watts (at peak).
- ✚ No constrain on torque and RPM.
- ✚ Maximum operating voltage to Motor and controller should not exceed 60 volts.

### **A.5.3.2. Transmission**

- ✚ It is mandatory for teams to use rear wheel drive.
- ✚ Any transmission and drive train may be used.

### **A.5.3.3. Throttle pedal**

- ✚ Only foot operated paddle is allowed.
- ✚ There should be a positive lock provided with the throttle paddle.

### **A.5.3.4. Electrical accelerator**

- ✚ The accelerator pedal must be a right-foot-operated foot pedal. The foot pedal must return to its original, rearward position when released. The foot pedal must have positive and negative stops at both ends of its travel respectively, preventing its sensors from being damaged or overstressed.

### **A.5.3.5. Kill switch**

- ✚ There should be three kill switches in the vehicle. One on the dashboard and other on roll hoop, either side of the driver.
- ✚ Only push and rotate type of Kill Switch is allowed.
- ✚ They should be placed such that one can be easily accessed by the driver and other outside the vehicle.
- ✚ For Professional Class it should be on either side of the vehicle, easily accessible.
- ✚ Kill switch should be clearly visible from a long distance with a bright red color.

#### A.5.3.6. Horn

- ✚ An audible warning device must be permanently fitted to the Solar Vehicle.
- ✚ It must be capable of giving sufficient audible warning of the presence of the Solar Vehicle and have a constant amplitude and frequency.

## PART B: EVENTS & JUDGING CRITERIA

<b>Rounds</b>	<b>Score</b>
Virtual Round	200
Weight Test	50
Design Round	100
Innovation	100
B-Plan & Cost Report	100
Team Knowledge test	50
Acceleration test	150
Auto cross	200
Solar performance test	200
Final Endurance Race	350
<b>Total Score</b>	<b>1500</b>

## **B.1. VIRTUAL ROUND**

### **B.1.1. Overview**

- ✚ Virtual round is a pre-final round, in which all the teams have to give a 15 minutes' presentation illustrating their vehicle design and other vehicle specifications in front of judges.
- ✚ In virtual round, teams have to testify that they have necessary knowledge and research work done to make this vehicle.
- ✚ Organizers will give you confirmation after the registration that either you have to give presentation online or offline.
- ✚ Only 5 members have to present their design during the Virtual Round.

### **B.1.2. Report submission**

All the design reports shall be submitted as a PDF and Excel file with each technical report appearing within. File names shall be formatted as: Organization name\_IASC2018DR. Example: a report from the college LPU may appear as “LPU\_IASC2018DR.pdf” with the first letter of each new word capitalized and common abbreviations accepted.

*Teams have to submit hard copy of all the reports mentioned below to the judges before starting the presentation:*

1. Overall design report
2. CAD File
3. FMEA
4. DVP
5. Gantt Chart
6. Cost Report
7. Technical Specification sheet
8. Report on electric and solar

#### **B.1.2.1. Overall design report**

##### **Mechanical Technical Report:**

This report should consist data of following departments and their calculations.

**Design**

**Steering**

**Braking**

**Suspension**

*It is mandatory to show the calculations of the steering, braking and suspension.*

The mechanical tech report must present the as-built design; addressing:

Design issues involved in impact, roll over and suspension scenarios Address vehicle stability, including center of gravity and relative weights on each wheel.

### **Electrical System Technical Report:**

An electrical system technical report must be submitted during the virtual round as part of the Vehicle Design Report. The tech report must document the electrical design approach. The tech report must include: A functional system diagram; and, rough schematic; showing all essential power circuits and electrical equipment of the solar car in schematic form. The drawing should include power generation devices (array, regen, etc.), power storage (batteries, etc.), switching and isolation mechanisms, battery protection systems, motor, motor controller, and any auxiliary circuits.

#### **B.1.2.2. Cad file**

This includes a document with all the views of the chassis, assembled vehicle and vehicle with Bodywork and the CAD file of whole designed vehicle.

*Irrelevant documents should not be considered.*

#### **B.1.2.3. FMEA (Failure Modes Effect Analysis)**

It is a structured approach to:

Identifying the ways in which a product or process can fail

Estimating risk associated with specific causes

Prioritizing the actions that should be taken to reduce risk

Evaluating design validation plan (design FMEA) or current control plan (process FMEA)

#### **B.1.2.4. DVP (Design Validation Plan)**

The design validation plan is the assurance that a product, service, or system meets the needs of the customer and other identified stakeholders. It often involves acceptance and suitability with external customers. All the virtual and real time tests and analysis are to be included in the design validation plan.

#### **B.1.2.5. Gantt chart**

Gantt chart includes all the process during manufacturing of vehicle from starting date to final date. This chart is basically the management of the project and distribution of different tasks in the team members with completion deadlines.

### **B.1.2.6. Cost Report**

Teams have to show their estimated cost of vehicle. Each and every components cost should be mentioned in the report. Teams have to give the comparison cost report of the actual manufacturing (using second hand component) cost and the virtual manufacturing cost.

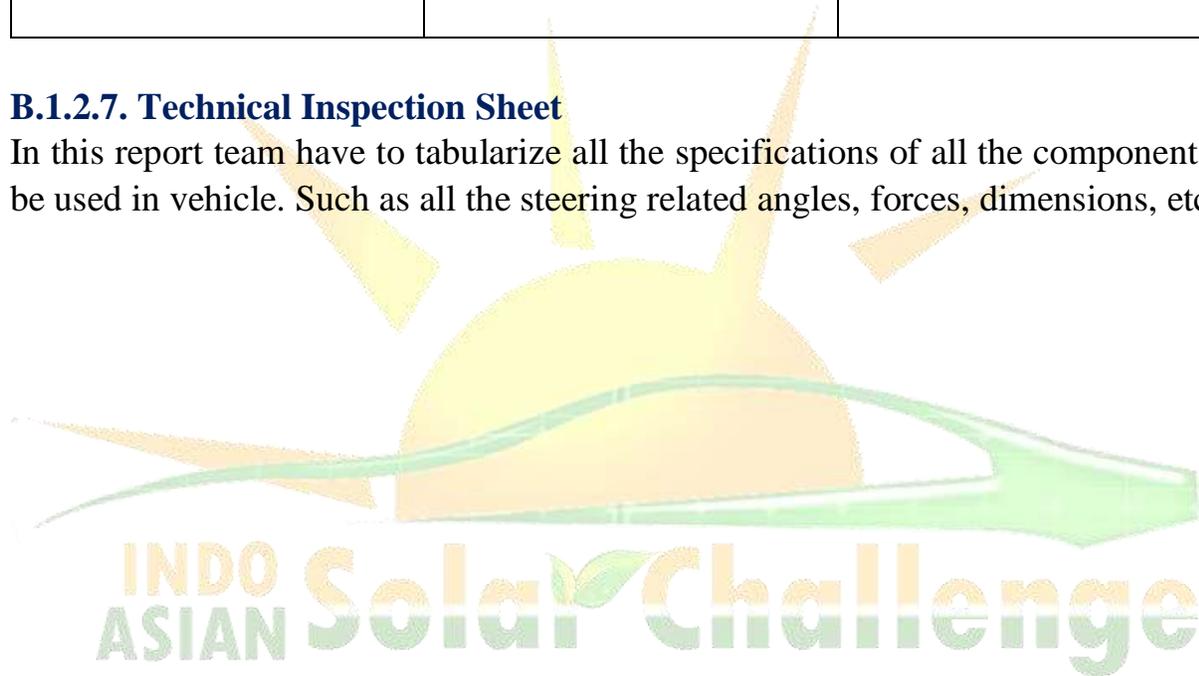
*Note: Team have to give minimum 2 dealer name for each and every component they are going to use in their vehicle.*

For Example

<b>Component name</b>	<b>Dealer 1 Contact &amp; Address</b>	<b>Dealer 2 Contact &amp; Address</b>

### **B.1.2.7. Technical Inspection Sheet**

In this report team have to tabularize all the specifications of all the components to be used in vehicle. Such as all the steering related angles, forces, dimensions, etc.



# Final Round

## Static Event

### **B.2 ENGINEERING DESIGN EVENT**

#### **Objective and Overview**

The objective of the engineering design event is to evaluate the engineering effort that went into the design of the vehicle and how the engineering meets the intent of the market. Students will be judged on the creation of design specifications and the ability to meet those specifications, computer aided drafting, analysis, testing and development, manufacturability, serviceability, system integration and how the vehicle works together as a whole. Each of these parts of the engineering product development cycle will be judged within the following subsystems: Steering, Brakes, Drive-train/Power-train, Suspension (if used), Chassis and Ergonomics.

The vehicle that illustrates the best use of engineering to meet the design goals and the best understanding of the design by the team members will win the design event. Final Design reports submitted will be cross checked and any deviation from the data given in report will lead to point deduction.

#### **B.2.1. Scoring Formula**

Final design report submission (compulsory but no marks)

On site design evaluation (100 marks)

#### **B.2.2. Final Design Report - Required Submission**

The design evaluation judging will start with submission, before the event, of a Design Report. Soft copy of the design report must be submitted before 10th Feb. 2019 at official mail of Indo Asian Solar Challenge i.e. [indoasiansolarchallenge@gmail.com](mailto:indoasiansolarchallenge@gmail.com) . Hard copy of final design report must be submitted on day-1 of the event. The Design Report will be reviewed by the design judges who will ultimately judge the team and vehicle at on-site Design Evaluation.

#### **B.2.3. Following Reports have to be submitted only.**

Overall Design Report

Design Validation Plan (DVP)

- ✚ The Design Report must not exceed fifteen (15) pages including table of contents and cover page. All pages must be either 8 1/2” x 11” or A4.

- ✚ The Design Report should contain a brief description of the vehicle with a review of your team’s design objectives, vehicle concepts, and a discussion of any important design features. Note or describe the and back-up data should be brought to the competition and be available, on request, for review by the judges.
- ✚ If the data in final design report has a deviation more than 20 % than that of reports submitted during virtual round, marks will be deducted.

**Comment:** *Note that while the Design Report is not explicitly scored, it may be considered to be the “resume of your car”, preparing your on-site Design Evaluation judges to view your design effort in its most positive light. Failure to convincingly point out your design success in the Design Report will almost certainly lead to failure of your design judges to be impressed by your success.*

- ✚ The Design Report must be submitted electronically in Adobe Acrobat Format (PDF). The document must be a single file. File name must be in the format “team ID\_final\_design\_report”. E.g. team ID IASC011 will have file name as “IASC011\_final\_design\_report”

**WARNING:** *Failure to exactly follow the above submission requirements may result in exclusion from the Design Event. If your file is not submitted in the required format or is not properly named, then it cannot be made available to the design judges and your team will be excluded from the Design events.*

#### ✚ **Penalty for Late Submission or Non-submission**

Late submission or failure to submit the Design Report will be penalized at negative ten (-10) points per day. **If your Design Report is received more than five (5) days late it will be classified as “Not Submitted” and your team will not participate in the Design Event and will receive zero (0) points for design.**

### **B.2.3. On-Site Design Evaluation**

In onsite design evaluation, Teams will be evaluated on the basis of their design and questionnaire. The designer/s of top scorer team will be given “THE BEST DESIGN AWARD”.

- ✚ The design judges will evaluate the engineering effort based upon the team’s Design Report, responses to questions, and an inspection of the car.

- ✚ The design judges will inspect the car to determine if the design concepts are adequate and appropriate for the application (relative to the objectives set forth in the rules).
- ✚ It is the responsibility of the judges to deduct points if the team cannot adequately explain the engineering and construction of the car.

#### **B.2.4. Support Material**

Teams may bring with them to Design Evaluation any photographs, drawings, plans, charts, example components, or other materials that they believe are needed to support the presentation of the vehicle and the discussion of their development process. Use of laptop or notebook computers, posters, and binders is allowed, but projectors may not be used.

### **B.3. Cost Report & B-Plan Presentation (100 marks)**

#### ***Cost Reports***

- ✚ Teams have to give a brief overview of design features or fabrication processes that are innovative or are expected to result in significant cost savings. Teams may also use the overview to explain items or processes that might appear to be discrepancies within the report. The overview section is limited to a maximum of four (4) pages. In short teams have to explain the ways in which they have reduced the total cost of fabricating this vehicle.
- ✚ Also, teams have to submit copies of receipts, invoices, price tags, catalogue pages, on-line prices, or other documentation, to substantiate the costs of the parts and materials of any item costing more than PRs. 200. Cost documentation must be at full retail Indian prices. The report is expected to be comprehensive, well documented, truthful and accurate.
- ✚ If details of parts are found missing in the report, severe penalties will be applied in terms of adding the cost of missing part into projected cost by multiple times.

[Final Cost = Cost Projected in Cost Report + (2 x Cost of missing Equipment)]

#### ***B-Plan Presentation***

##### **Presentation – Objective**

The aim of the Marketing Presentation is to provide an opportunity for the engineering students to prepare a strategic business model of establishing a firm which can produce their own design at a certain rate (say 1,000 vehicles per year) and market it.

- ✚ For the purpose of the presentation, teams are to assume that the judges are to be a mixed group of corporate executives who may have experience in marketing, production and finance as well as engineering.

### **Presentation – Format**

Teams are advised to prepare the model by working out on the following points in the presentation: 1. Unique Selling Proposition (USP)

2. Market/Customer Survey (to analyses the product demand)
3. Different concepts & variants
4. Plant layout for mass production
5. Cost of product in mass production
6. Break-Even Analysis (in terms of time & quantity)
7. Return on Investment (in terms of time & money)
8. Marketing strategies (sales & after sales)

Three team members may make the presentation to the judges. The presentation itself is limited to a maximum of ten (10) minutes.

- ✚ Following the presentation there will be an approximately five (5) minute question period.
- ✚ Only the judges are permitted to ask questions. Any team member on the presentation floor/stage may answer the questions even if that member did not speak during the presentation itself.

### **B.4. Final Round- Dynamic Event**

The Dynamic events venue will be announcing during the virtual round of event. Teams have to reach there with their vehicles and team members. At least half of the team members should be present at dynamic events.

### **Article1: TECHNICAL INSPECTION**

#### **4.1. Technical Inspection overview**

Technical inspection will consist of three (3) separate parts as follows:

- Rulebook Inspection
- Safety Inspection
- Electrical Inspection

- ✦ *All vehicles must pass technical inspection before they are permitted to operate under power or to participate in Dynamic Events.*
- ✦ The inspection will determine if the vehicle satisfies the requirements and restrictions of the Indo Asian Solar Challenge rules.
- ✦ If vehicles are not ready for technical inspection when they arrive at the inspection site, they will be sent away in pit to perform required changes.
- ✦ Teams will be given maximum three chances to clear the Technical inspection.
- ✦ Any vehicle may be re-inspected at any time during the competition and correction of any non-compliance will be required.
- ✦ **Drivers Present:** All drivers must be present at technical inspection with their valid license. Without driver, Technical inspection will not be started.

**DRIVING OFF-SITE IS ABSOLUTELY PROHIBITED. TEAMS FOUND TO HAVE DRIVEN THEIR VEHICLE AT AN OFFSITE LOCATION MAY BE EXPELLED FROM THE COMPETITION.**

#### **4.1.1. Rulebook Inspection**

In this inspection the technical inspector/s will check whether rulebook is followed in manufacturing the vehicle or not. Any deviation from rulebook will lead to point deduction.

#### **4.1.2. Safety Inspection**

This inspection will include an examination of vehicle and driver safety.

##### **Helmet:**

An ISI or ISO certified helmet should have worn by the driver while driving the vehicle. Test of driver exit time to ensure that driver can come out of vehicle easily in any emergency. **Kill switches** and other safety requirements will be tested.

Proper functioning of **brake light & horn** will be checked. Driver must come to Technical Inspection by wearing the driver suit. **Seat and Seat belt:** The vehicle should have a fixed driver seat with seat belt. Use of 3- point seat belts is mandatory. Use of OEM seat belts is recommended. Normal shoulder straps, side release buckle straps, belts with metal cam lock buckles etc. cannot be considered as seat belts.

**Shoes and Hand Gloves:** It is compulsory for the driver to wear a hand glove and proper shoes as per his/her comfort (prefer sport shoes).

### 4.1.3. Electrical Inspection

- ✦ Electrical & electronics used in the vehicle will be inspected. All the wirings should be safe and high current circuits must be isolated from driver.
- ✦ Batteries must be mounted with sound engineering practice and not come loose during any part of event. Battery terminals must be insulated by using rubber (bicycle tube etc.). Failing this, the technical inspectors may debar the team from the dynamic events.
- ✦ **Battery pack should be mounted/connected in such a way, that it can be removed/disconnected during endurance round A. Use of mechanical fixings such as nut bolts to hold the batteries are recommended.**
- ✦ Battery terminals should be tight and should not generate a spark during the race.
- ✦ Solar power circuits will be checked.
- ✦ The vehicle must not have chances of electrical shock. Loose connections and UN insulated electrical parts should not be there.
- ✦ An appropriate MCB must be placed in series with the positive terminal of battery pack, Teams can use the same for cockpit kill switch also.

### 4.1.4. Self-Certification Check Sheet- Pre-Inspection Required

- ✦ Before bringing their vehicle to technical inspection each team must (1) pre-inspect the vehicle for compliance with the rules, (2) complete the official Self Certification Check Sheet (Download from [iasc.amtmotocorp.com](http://iasc.amtmotocorp.com) & also mailed at team's e-mail) , (3) have the completed check sheet signed by the faculty advisor and team captain.

**NOTE:** Teams presenting Self Certification Check Sheets that are (1) incomplete, (2) inaccurate (i.e. do not correspond to the actual condition of the vehicle) (3) are found to have the items not in accordance with the rules, or (4) do not represent a serious effort at pre-inspection will be denied inspection at that time and sent back to the end of the inspection line.

### 4.1.5. “AS-Approved Condition

- ✦ Once a vehicle has passed technical inspection its configuration may not be modified. All accessory components such as roofs, solar plates, bumpers, etc. are considered part of the configuration and must remain on the vehicle at all times.

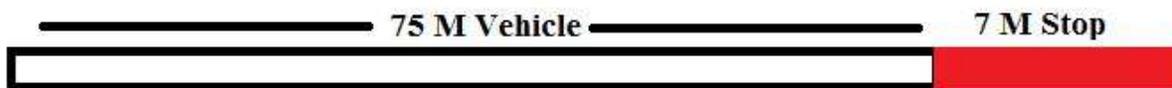
- ✚ Approved vehicles must remain in “as-approved” condition throughout the competition. Any repairs of a part that is not identical as the broken part must be approved prior to the repair by judges or organizers.
- ✚ Non-identical parts not approved will be subject to an appropriate performance penalty.
- ✚ Minor adjustments permitted by the rules and normal vehicle maintenance are not considered modifications.

*After clearing the Technical Inspection round (T.I. round), a T.I. OK sticker will be awarded to your vehicle which will make it eligible for the next round i.e. Brake Test round*

## **B.5. Brake & Acceleration Test (150 points)**

### **Overview**

- ✚ Brake test is a mandatory process, without passing this test vehicle will not be allowed to proceed further. Each vehicle will be given 3 attempts to pass the brake test.
- ✚ The vehicle has to accelerate at its maximum along a 75m track and then apply brake and stop the vehicle within the distance of 7 meters at a minimum speed



25Kmph.

- ✚ The time taken by the vehicle for covering 75 m length will be considered to determine the acceleration of vehicle.
- ✚ If the vehicle did not stop within the distance of 7 metres the brake & acceleration test will not be cleared and team has to attempt again.
- ✚ If the team has cleared the brake test they may take one more attempt to improve their acceleration time.
- ✚ Vehicle yawning/drifted more than 30 degrees will not be considered as “Brake Ok”.

### B.5.1. Scoring Formula

$$\text{Acceleration Score} = 150 \times (t_{\text{longest}} - t_{\text{Yours}}) / (t_{\text{longest}} - t_{\text{shortest}})$$

#### Where

$T_{\text{shortest}}$  = fastest time by any vehicle

$t_{\text{yours}}$  = time for the vehicle to be scored

$t_{\text{longest}}$  = the lesser of: a) slowest time by any vehicle; b)  $2.5t_{\text{shortest}}$

### B.6. Weight Test (50 Point)

#### Overview

After brake test, weight test will be conducted. We will weight your vehicle in this round and lowest weight vehicle will get the “**Light weight award**”.

#### B.6.1. Scoring

$$\text{Lightweight score} = 50 \times (w_H - w_Y) / (w_H - w_L)$$

$w_H$  = Weight of heaviest vehicle.

$w_Y$  = Weight if your vehicle.

$w_L$  = Weight of lightest vehicle.

### B.7. Autocross (200 point)

#### Overview

- ✚ Auto cross is an endurance test. Here we will check the endurance of the vehicle in all manners. Vehicle's maneuverability, handling ease, ergonomics, manufacturing strength, safety will be checked out. It will have combined with an integrated testing mechanism that will also check the acceleration, braking, steering, cornering, overtaking capabilities of the vehicle without hindering other vehicles movement.
- ✚ Each team gets two attempts with same or different drivers. Best out of two attempt score will be taken into consideration. Timings will be checked out using electronic system or stop watches.
- ✚ Track Details will be given at the time of event.

#### B.7.1. Scoring

$$\text{Autocross score} = 200 \text{ points} \times (T_I - T_y) / (T_I - T_s)$$

#### Where:

$T_s$  = Minimum time taken by any vehicle

T<sub>y</sub>= time for the vehicle to be scored  
T<sub>l</sub>= maximum time taken by any vehicle

### **Penalties-Cones down Or Out-**

*Two seconds / cone, including any after the finish line.  
20 seconds penalty if any part of vehicle leaves the track*

## **B.8. INNOVATION TEST (100 Point)**

After autocross event, judges will visit into the pit area where all the innovations done in the vehicle will be tested. Points will be awarded on the basis of concept, on solar innovations. The innovation must be related to solar. The innovation must be properly fitted in the vehicle.

## **B.9. SOLAR PERFORMANCE TEST: (200 point)**

### **Overview**

The intension of this round is to check the engineering skills of team about solar power, and judge whether the solar power generated by the team is sufficient enough to power the vehicle.

### **Procedure**

- ✚ Team is required to remove the battery terminals (both +Ve and –Ve) from the motor controller and connect the Motor controller directly to Solar charge controller
- ✚ There should be no Super capacitor circuit or any other device which stores the charge involved in between Solar Charge Controller and Motor controller.
- ✚ Team has to cover a straight track of length 50 m with the above condition provided.

### **B.9.1. Scoring Formula**

**Running directly on solar= 200 points x (T<sub>longest</sub> – T<sub>yours</sub>)/ ( T<sub>longest</sub> - T<sub>shortest</sub>)**

#### **Where**

T<sub>shortest</sub> = Minimum time by any vehicle

T<sub>yours</sub> = Time for the vehicle to be scored

T<sub>longest</sub> = Maximum time taken by any vehicle

#### **Penalties:**

- If the vehicle hit the cone for 2 seconds will be added to time per hit.
- If the cone totally displaces or fell down, 10 seconds will be added each time

## B.10. ENDURANCE-B --“THE ROAD RACE” (350 POINTS)

### Overview

- Vehicle has to cover a distance of approx. 130+ km in a maximum time limit of 3.5 hours.
- The vehicle reaching the 130Km finish point fastest will be the winner of this round and rest teams will be given points relative to the winner team.
- For runner up of this round must be cover also 130 km distance otherwise runner up will be not awarded.
- Teams can change their driver as many times on the check point.
- The vehicles not completing the whole race will be evaluated on the distance they are covering from the start point.
- If none of the teams are able to complete at least 130 Km in given time, there will be no winner in the Endurance B round. But the points will be awarded.

### Scoring Formula

VEHICLE CATEGORY	ENDURANCE-B SCORE
Group-I: Vehicle completing the race	$350 \text{ points} \times (TL - T_y) / (TL - TS)$
Group-II: Vehicle not completing the race	Lowest score from Group-I $\times (D_{\text{yours}} / D_{\text{course}})$
Group-III: No vehicle completes the race	$175 \text{ points} \times (D_{\text{yours}} / D_{\text{course}})$

### where:

TS= smallest time taken by any vehicle

Ty= time for the vehicle to be scored

TL= maximum time taken by any vehicle;

Dyours = Distance covered by the vehicle to be scored.

Dcourse= Distance from start line to finish line.

## B.11. Command FLAGS

Flag colour		Meaning
Green / whistle		Start / Everything is good.
Red		Stop immediately and report to judges.
Checker Flag		Finishing line.
Yellow Flag(steady)		Something happened ahead slow down the car.
Yellow flag (waving)		Something happened ahead prepare for a halt.
Blue Flag		Stop by penalty box.
Black flag		Warning by judge/ penalty added (should drive properly).

**Penalty will be applicable on the team for not following the flags as follows**

Flags	Penalty percentage
Red flag	100%
Blue flag	50%
Yellow flag	10%

## C. Penalties

Any team failing to comply with these Regulations during the scoring or judging or during the event, the Qualifier, or the team will be penalized. Penalties range from official warnings to disqualification from the Event. It is the responsibility of the Chief Judge, with input from the other Inspectors and the Observers, to determine whether an infraction occurred, the severity of the incident, and the appropriate penalty. All time penalties will be submitted by the Chief judge to the control room. Disqualification of a team from the Event requires concurrence of the Event organizer.

**Pushing:** A 2-minute penalty for every 15 seconds a team pushes may be assessed each time a team pushes or pulls their solar car in order to advance along the track Route. (Except in an emergency).

**Unauthorized Drivers:** Any solar car that is on the track with an unauthorized driver will be required to return to the starting point of the infraction and drive with an authorized driver in order to receive credit for driving beyond that point.

**Non-Solar Charging of Batteries:** After the start of the Race until the official finish, teams will be disqualified from the Event for charging their solar car's storage batteries from any source other than those allowed by officials, without specific written instruction from Race Officials.

**Replacement of Batteries:** Decisions to exchange all or part of a battery must be communicated formally to the team's Observer or an Inspector. The penalty will be decided during the race.

### **Over weight penalty**

**Any breakage on vehicle in any event the penalty will be decided by concern round judges & vehicle have to attend the TI again.**

**Any change in vehicle after TI are not allowed.**

**Welding is prohibited after the TI.**

**Electrical connection must not be distributed after the TI.**

---

### **Penalties Section:**

#### **Video submission round Penalties:**

- ✚ Teams will be penalized a point of 100 points if teams are unable to submit the video as the dynamic round will be on HIGHWAY ROAD and organizer will ensure the safety upon the video submitted.

#### **T.I Penalties:**

- ✚ For all the missing safety equipment's such as Helmet, Driver suit, Neck rest, Balaclava, Gloves, Fire extinguisher, Leather Shoes etc min 40 points will be penalized.
- ✚ A penalty of min 40 points will be imposed if teams are unable to meet the rules for dimension and ground clearance of the vehicle.
- ✚ Disqualification of team will be lead if the brakes are not in working condition when manual check is done.
- ✚ A steering free play more than 5 degree will cause a penalty of 10 points.

- ✚ If there is any issue with kill switch and MCB then there will be a penalty of 20 points
- ✚ Teams will face a disqualification if they are unable to prove the motor specification correctly.
- ✚ Rest of the penalties from the T.I sheet will be decided by the Technical Inspection judge during the conduct of the event.

### **Braking penalties:**

- ✚ A penalty of 60 points will be imposed for an extra attempt.
- ✚ If the vehicle is unable to stop within the braking distance but wheels are perfectly locked then a penalty of 20 points will be imposed adding the extra attempt penalty.

### **Weight Test:**

- ✚ If the weight exceeds maximum given weight then a penalty of 80 points will be imposed.

### **Auto cross:**

- ✚ If any tyre of the vehicle touches the line then a penalty of 2 sec will be imposed
- ✚ 5 sec penalty if the tyre comes out of the line or the whole vehicle comes out.

### **Endurance “B” or Road Endurance:**

- ✚ Road endurance penalties will be updated during the event as per situations during the event.

### **Misbehavior penalties:**

- ✚ Refusal to follow the instructions of the organizer may lead to disqualification of the team.
- ✚ Misbehavior with either volunteers or coordinators also may lead to disqualification of the team.

## Part C: Driver Requirement

- ✚ Every team must have minimum two drivers.
- ✚ A valid government issued driving license is must for all drivers.
- ✚ Representing driver of the teams must be a regular graduate/post-graduate student of engineering college/university of the participating team.
- ✚ **Medical Insurance:** Individual medical insurance coverage for both driver is must. Valid hard copy of insurance paper must be submitted at the time of technical inspection.
- ✚ The minimum permissible age for driver in the competition is 18 years.

### C.1. Driver's Equipment

#### C.1.1. Drivers Safety Gear:

- ✚ The following driver safety equipment specified below is the minimum safety requirement and must be worn by driver during all dynamic condition of the vehicle.
- ✚ Using authentic driver's equipment with valid safety ratings as prescribed in rulebook will be prime responsibility of the team.
- ✚ Date/Year of Manufacturing of equipment must be on all critical safety equipment.

#### C.1.2. Driver's Suit

- ✚ A fire resistant one piece suit, made from a minimum of 1 layer that covers the body from the neck Down to the ankles and the wrists. The suit must be certified to either one of the following standards and be labelled such as SFI 3.2A/1 (or higher) / FIA Standard 1986/ FIA Standard 8856-2000.

*Note: -Damaged suits (with minor cuts or holes) or over stitched suits are not permitted to be used. Before purchasing the driver suit teams must check the suit's safety rating along with the manufacturing dates.*

#### C.1.3. Underclothing

- ✚ It is mandatory for all drivers to wear fire resistant underclothing of SFI 3.2A/5 / FIA standard 1986 or higher under their approved driving suit. This fire resistant underclothing (SFI/ FIA rated) should be made from an acceptable fire resistant material as listed in 2.9 and that should cover the driver's body completely from neck down to ankles and also the wrists.

**Note:** - Drivers must have inner wears of required rating, Teams must check the rating and manufacturing details of the innerwear before purchasing.

#### **C.1.4. Helmet:**

A well- fitting closed face helmet that meets one of the following certifications and is labelled as such

Snell K2000, K2005, K2010, M2000, M2005, M2010, SA2005, SA2010, SAH2010, SA2015,

SFI 31.2A, SFI31.1/2005, SFI 31.2/2005, 31.2/2010, 31.2/2015, 41.2/2005, 41.2/2010, 41.2/2015 FIA 8860-2004, FIA 8860-2010, FIA 8859-2015

✚ Open faced helmets are not a permissible. All helmets to be used in the competition must be presented during Technical Inspection where approved helmets will be a stickered. The organizer reserves the right to impound all non-approved helmets until the end of the competition.

**Note:** - Motocross helmets are not allowed, Teams must check the specified rating along with manufacturing details of the helmet before purchasing. -Beware of Chinese helmets.

#### **C.1.5. Balaclava:**

A balaclava which covers the driver's head, hair, and neck, made from an acceptable fire resistant material (SFI 3.2A/5 / FIA standard 1986 or higher) as or a full helmet skirt of acceptable fire resistant material. The balaclava requirement applies to drivers of either gender, with any hair length.

#### **C.1.6. Neck Support:**

The neck support must be a full circle (360°) and SFI rated. Horseshoe collars are not allowed. Simpson, RCI, G-Force, Deist or Leaf Racing Products supply neck collars that meet this requirement.

*Note:* - 360 degree continuous perimeter neck support along with required rating is allowed, Neck support with slots is not allowed.

#### **C 1.7 Gloves:**

Fire resistant gloves made from made from acceptable fire resistant material (SFI/ FIA rated) Gloves of all leather construction or fire resistant gloves constructed using leather palms with no insulating fire resisting material underneath are not acceptable.

*Note: - Damaged or torn out gloves are not allowed.*

### **C 1.8 Shoes:**

Fire resistant shoes made from acceptable fire resistant material shoes must be certified to the standard and labelled as such: SFI 3.3/ FIA 8856-2000.

*Note: - Sports shoes/Canvas shoes/Leather shoes/Industrial safety shoes are not allowed at any point of the event.*

### **C 1.9 Shocks:**

Fire resistant socks made from acceptable fire resistant material, which covers the bare skin between the driver's suit and the boots or shoes. For the purpose of this section the approved fire resistant materials are: Carbon X, Indura, Nomex, Polybenzimidazole (commonly known as PBI) and Proban.

### **C 2.10 Fire Resistance material:**

For the purpose of this section some, but not all, of the approved fire resistant materials are: Carbon X, Indura, Nomex, Polybenzimidazole (commonly known as PBI) and Proban.

T-shirts, socks or other undergarments made from nylon or any other synthetic material which will melt when exposed to high heat are prohibited.

*Note: Expired driving equipment's are not allowed, Team must ensure expiry date of their driving equipment's is beyond the date of event. Individual safety equipment should be available for each Driver in a team.*

*Every team have to carry all the driver suit parts.*

## **Contact Us**

**Indo Asian Solar Challenge**

**AMT MotoCorp**

Near Prism Cement, 183k, Hinauti  
Post Sijahata Rampur Baghelan  
Satna, Madhya Pradesh  
485111

**Email Id:** [indoasiansolarchallenge@gmail.com](mailto:indoasiansolarchallenge@gmail.com)

**Website:** [iasc.amtmotocorp.com](http://iasc.amtmotocorp.com)

**Contact number:** +91-9977322244, +91-9653153989, and +91-9584404666

**Facebook Page:** <https://www.facebook.com/Indoasiansolarchallenge>

**Instagram Id:** amt.motocorp

