

# **SOLAR ELECTRIC VEHICLE CHAMPIONSHIP 2024**

## **RULEBOOK**



**CHALLENGE UNLEASHED**

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# **SECTION A - GENERAL GUIDELINES**

## **1 Overview:**

### **1.1 Introduction:**

Solar Electric Vehicle Championship is an intercollegiate design competition aimed at inspiring engineering students to create environmentally responsible future mobility solutions for India. The participants are given the task of conceptualizing, designing and fabricating a single-seat vehicle with three or four wheels. To give teams maximum design flexibility and the freedom to express their creativity and imaginations there are very few restrictions mentioned in the rulebook. Teams must use engineering principles to create vehicles that meet the needs of real-world users.

### **1.2 Objective:**

The competition's goal is to promote "Emerging Future Mobility" as a culture. The vehicle must be aerodynamic, highly engineered, safe, and ergonomically suited for this purpose. The primary objective of this competition is to foster engineering applicants' excitement and passion for alternative energy sources. This event promotes the development of a clean and green society. Teams can consider themselves as employees of a fictitious company that aims at producing and selling Electric Vehicles. As a result, the design must be commercially viable as a market product and appealing to consumers in terms of aesthetic appearance, performance, reliability, and ease of use.

## 1.3 Event Summary:

The event focuses on designing, building, and validating the vehicle created by student teams in accordance with the rulebook. The vehicle's design, performance, safety, durability and commercial viability will be evaluated. All of the participating teams compete against one another, with the teams' overall ranking determined by the total of their scores from all of the events. Also, the individual and best performances for each category are awarded. The SEVC event will have the following categories:

### **Category 1: Battery Electric Vehicle (BEV)**

### **Category 2: Solar Electric Vehicle (SEV)**

In addition to vehicle manufacturing, the team will also work on many industry-level reports. Participation in SEVC will enhance the technical skills of the student's paving the way for their professional success. Also, students will improve themselves in many areas like team coordination, managerial skills, business development, financial management and entrepreneurship.

## 2 Rules and Organizing Authority:

### 2.1 Rules Authority:

Teams competing in SEVC 2024 must follow the rules and regulations laid down by the organizing committee. SEVC reserves all the rights to change any rule of the event for the benefit of teams. Violating any of the mentioned rules by any of the participating team members may result in severe penalties, disqualification of the team from the competition at any stage or withdrawal of awards. Queries concerning the meaning or intent of these rules will be resolved by organizing committee during competition.



## 2.2 Rules Validity:

The rules will be the same throughout the competition. However, any amendments made according to the circumstances will be updated to all the participating teams. No excuses will be accepted from the teams for breaking any of the rules.

## 2.3 Rules Compliance:

By participating in a SEVC 2024 competition, team members, faculty advisor, and other college/university personnel agree to abide and be bound by the rules, as well as any rule interpretations or regulations released or announced by the SEVC 2024 Organizing Committee. All team members, faculty advisors and other university/college representatives are required to cooperate with, and follow all instructions from, competition organizers, officials and judges.

## 2.4 Understanding the Rules:

The rules of the competition must be read, interpreted, and understood by the teams themselves. Teams should contact the organizing committee at [sevcevent@gmail.com](mailto:sevcevent@gmail.com) for clarifications on the rules. Teams must keep records of all such email communications on hand for judges to refer during the event.

## 2.5 Loopholes:

A set of rules can't be so comprehensive that it covers all possible questions about the vehicle's design parameters or the conduct of the competition. Please keep in mind that safety remains paramount during SEVC 2024, so any perceived loopholes should be resolved in the direction of increased safety/concept of the competition.

## **2.6 Participating in the Competition:**

Teams, individual members, faculty advisors, and other representatives of a registered college who are present on-site at a competition are considered to be "Participating in the Competition" from the time they arrive at the event site until they depart after the competition or earlier by withdrawing will have to be bound by the present season's event rules.

## **2.7 Violations on Intent & Misinterpretation:**

The violations of the intent of a rule will be considered a violation of the rule itself. Questions about the intent or meaning of a rule may be addressed to the organizing Committee. If the team wants to use some particular parts/methods/procedures which are not included in the rulebook directly or indirectly, teams must get a clarification from organizing Committee. Special permissions (through email only) may be granted at the committee's discretion in some cases. Teams are not permitted to employ such parts/methods/procedures, etc., without the permission of the committee, and such use would be considered a rule violation.

## **2.8 Official Communication:**

All teams must pay attention to the official announcements made by the SEVC Organizing committee. All official announcements will be posted on the website [SEVC](http://www.sevc.in) and/or at the official individual team WhatsApp Group. SEVC Organizing committee may directly communicate to teams/captains/faculty advisor to provide any additional information.

Following are the official email IDs for the communication with competition organizers:

1. Teams are requested to contact the following official mail for technical queries, rules clarifications, event procedures, etc. as well as general queries regarding team registrations, fees submission, etc.

[sevcevent@gmail.com](mailto:sevcevent@gmail.com)

Communication with any individual event organizers through email, phone calls or social media will not be considered as official communication and will not hold any validity for competition purposes.

## **2.9 Right to Impound:**

SEVC Organizing Committee reserves the right to impound any on-site registered vehicle at any time during the competition for inspection and examination by the organizers, officials and technical inspectors.

## **2.10 General Authority:**

SEVC Organizing Committee reserves the right to revise the schedule of the competition and/or interpret or modify the competition rules at any time and in any manner that is in their sole judgment, required for the efficient and smooth operation of the event.

Also, if the organizers decide that it is necessary to re-conduct a specific round or event due to any disputes, confusion, failure to maintain strictness, or any other reason, the organizers have complete authority to do so at their sole discretion without being questioned.

## **3 Team Participation requirements:**

### **3.1 Eligibility Limits:**

Eligibility is limited to undergraduate engineering students.

### **3.2 Student status:**

Students pursuing an undergraduate program in any engineering discipline at any registered College/University can form a team to participate in SEVC.

### **3.3 Team Size:**

A group of minimum of 5 to maximum 35 student members can register as a team in SEVC 2024. Teams can have maximum of 35 members and it is recommended to have atleast 5 girl participants. The team may contain students from any engineering discipline. (Teams are recommended to choose members from various engineering disciplines like Mechanical, Electrical, Electronics, Instrumentation, etc., as building an electric vehicle requires the support of several departments.)

### **3.4 Liability Waiver:**

All on-site participants, including students and faculty advisor, are required to sign a liability waiver upon registering on-site.

### **3.5 Faculty Advisor:**

Each team is supposed to have a minimum of one “Faculty Advisor” appointed by the College/university. The team must be accompanied by the faculty advisor, who will be considered the Official College/University Representative.

Faculty Advisor may advise their teams on general engineering and engineering project management theory and act as guide of team. Faculty advisor is allowed to attend static and dynamic events at the event site with their team, but they are not permitted to answer or justify any questions on behalf of the team.

Faculty advisor should not be involved in the design of any part of the vehicle or the development of any documentation or presentations. Furthermore, Faculty Advisor is not permitted to fabricate or assemble any components, nor to participate directly in the vehicle's preparation, maintenance, or operation. However, they can assist their team in maintaining the vehicle in the event in case of any breakdown.

## **4 Registration Procedure:**

### **4.1 Team Registration:**

Teams must do their initial registration on the official SEVC website. The procedure to do the registration will be shared by document.

### **4.2 Form filling:**

It is mandatory to have an official team mail id to register for the event. Personal student or faculty mail id will not be considered valid in web portal for Team Registration. After registration, teams will receive a confirmation mail from our registration committee.

### **4.3 Change in Team Details & Vehicle Category:**

Changes in team details and vehicle category can be performed with the permission of the organizing committee. Any changes in the team details and vehicle category will be allowed till 30 days before the start of the final event.

### **4.4 Entries per college/university:**

There is no limit on the number of teams that can participate from one college/University. But the team's name, logo, Captain, Vice-Captain and Faculty advisor should be exclusively separate for each team.

# SECTION B - VEHICLE REQUIREMENTS

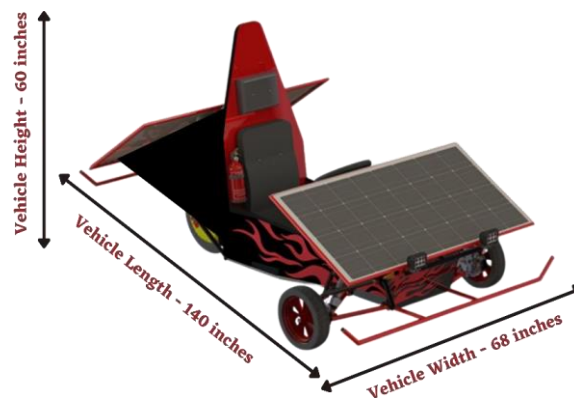
## 5 Vehicle Design Constraints

### 5.1 Vehicle Configuration:

- Teams can design 3-wheel or 4-wheel vehicles based on their design needs.
- The vehicle must be capable of carrying one (1) person of 190cm height & weighing 110 kg.
- Teams must have two wheels in front of the vehicle if they are building a three-wheel vehicle ([Tadpole / 2F1R configuration](#)).
- Teams can design open/close cockpit. SEVC encourages the teams to design close cockpit vehicle and have considerations for the close cockpit vehicles.
- Tandem configuration is **not allowed**.

### 5.2 Vehicle Dimension:

Vehicle width and height must not exceed **68 inches (1727.2mm)** and **60 inches (1524mm)** covering all its rigid or movable projected parts. Length of the vehicle is restricted to **140 inches (3556mm)**. Team must maintain the percentile length of 36 inches from the lower torso point to the frontmost part of the pedals (Accelerator or Brake Pedal). (mentioned in the image in 5.10)



\*The above-mentioned image is for reference only\*

## 5.3 Vehicle Weight:

The vehicle's weight should not exceed 250kg. (Teams are encouraged to follow lightweight components and materials in the vehicle).

With driver it must not exceed 350 kg.

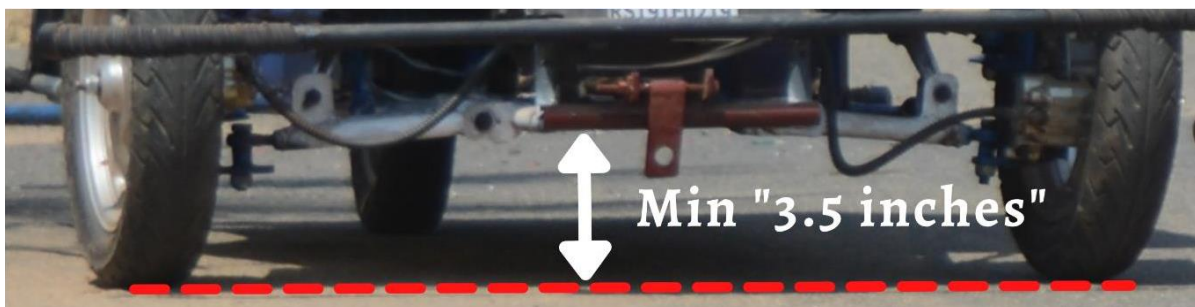
## 5.4 Wheel Track:

The Vehicle's smaller track (front or rear) must not be less than 75% of the Wheel Base. It is recommended to get the Wheelbase to track width ratio near to golden ratio=1.75.



## 5.5 Ground Clearance:

The ground clearance with the driver onboard must be a **minimum of 88.9 mm (3.5 inches)** of static ground clearance measured from the lowest point (except wheel assembly) of the vehicle, under the complete vehicle in **fully laden condition**.





## **5.6 Frame Material:**

- Teams are allowed to use only seamless tube for primary frame members, it should be a circular cross-section of outer diameter in the range of 1 to 2 inches. For secondary members, teams can use a minimum of  $\frac{3}{4}$  inches outer diameter but must be easily weldable with primary members.
- The thickness of the tube should be a minimum of 1mm. In the case of steel alloys, the carbon percentage should be a minimum of 0.1%.
- Titanium or magnesium on which welding has been utilized may not be used for any part of the Primary Structure. This includes the attachment of brackets to the tubing or the attachment of the tubing to other components.
- Also, the teams should have at least one open end tube in the frame (this end must be capped.)
- Teams can use any grade of steel, Aluminum, Glass fiber, or Carbon fiber for chassis. If teams are using any material other than these materials, they have to get permission and approval from the SEVC organizing committee.
- The frame should be rigid, protective and ergonomically designed. Any type of holes, cracks dents, etc., in frame members are forbidden.
- Teams must bring 1m length of their primary frame member to the event spot.

## **5.7 Material Testing Report:**

- Material testing report must contains composition of the material, yield strength and ultimate tensile strength for all materials used in vehicle frame.
- Certificate provided by the material dealers will not be accepted.
- Teams have to take the material testing report in the authorized testing laboratory or institute's own facility.



### **5.8 Vehicle Enclosure: (For Close Cockpit)**

- Vehicle must have fully enclosed body structure (like Enclosed Mini Car).
- The driver must be covered by the enclosure from all sides.
- Any flexible material with high durability and rigidity can be used for this.
- Doors have to be provided for the easy egress of the driver.
- It is not mandatory to go for the door on both sides of the vehicle.
- Teams are also recommended to use sheet metal provided with proper stiffness and rigidity for the enclosure.
- In case of sheet metal minimum of 0.5mm thick sheets must be used. Other than sheet metals a minimum of 1.5mm thick sheets have to be used for enclosures.
- Entire door must be made by primary or secondary member. Minimum three door stopper must be provided to ensure the door not to enter inside the cockpit range.
- Only the viewing area in the front and the side viewing area in door must be transparent. Other than these two areas, all the enclosures must not be transparent.

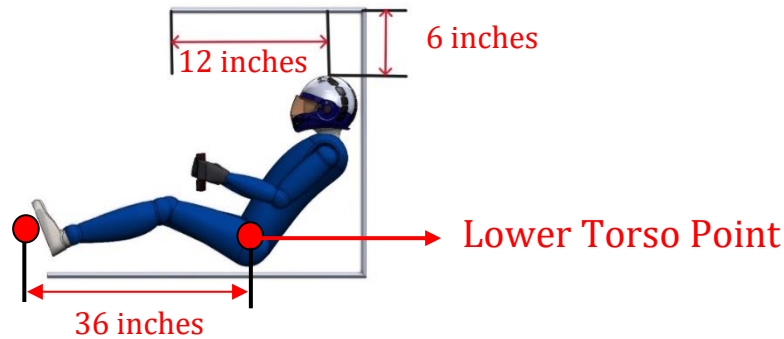
### **5.9 Rear Roll Hoop (RRH): (For Open & Close Cockpit)**

- The main roll hoop should be a **continuous member**. No weld joints allowed in the Roll Hoop.
- Teams must provide a roll hoop behind the driver. Separating the driver compartment from the rear of the vehicle
- Team must have a front roll hoop such that the driver hands must not contact the ground in any rollover scenario.
- A mandatory gap of driver helmet top point to Roll hoop top point should be **at least 6 inches**.

### **5.10 Roll Hoop Overhead Member (RHO): (For Close Cockpit)**

- Roll hoop overhead member protects the driver during the case of roll over.
- The extended length of the RHO must be 12 inches measured from the center of driver's head in their actual seating position.

- From the extreme top of the driver's helmet to the bottom point of the RHO member must maintain minimum of 6 inches.
- Separate Lateral Cross Member must be provided to connect the right and left side of the RHO, to ensure the rigidity of the RHO during side roll.

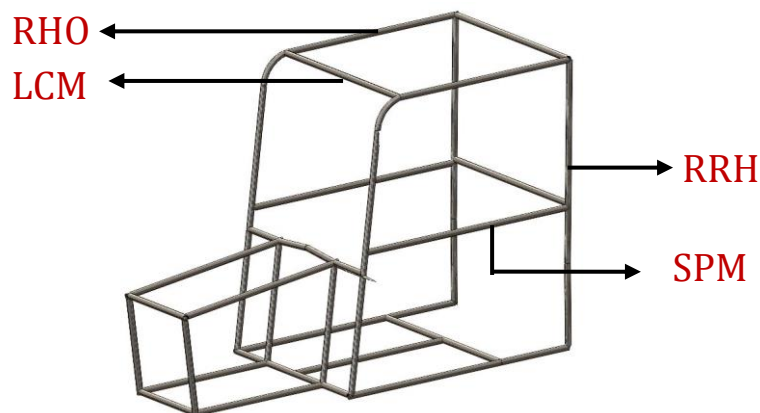


## 5.11 Side Protection Member (SPM): (For Open & Close Cockpit)

- Side Protection Member must offer the complete protection to the driver during the side impact by other vehicles.
- SPM height must be maintained with a minimum of 12 inches from driver's lower torso point in a seating condition.
- The door of the vehicle must have the SPM.

## 5.12 Lateral Connection Member (LCM): (For Close Cockpit)

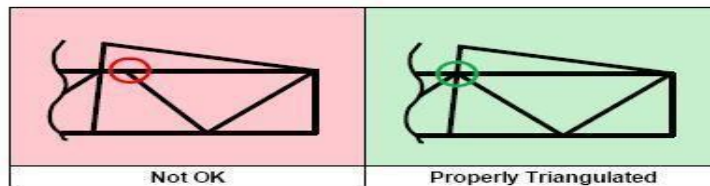
- Lateral Connection Member must connect both the right and left side of the member in the vehicle.
- Team can use secondary tubing for LCM.



**\*\*The above provided images is just for representation. Teams are advised to create the chassis according to the rules provided\*\***

### 5.13 Node-to-node triangulation:

An arrangement of frame members projected onto a plane, where a coplanar 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". **Frames should be properly triangulated at all nodes. A node can contain a maximum of four primary members.** It is mandatory to follow the proper triangulation. Team may be subjected to disqualification if they fail to adhere this rule.



### 5.14 Centre of gravity:

It is recommended to keep the center of gravity of the vehicle in the center of the structure most preferably right beneath the driver's seat. A sticker showing the expected position of the center of gravity must be pasted in the outer body cover of the vehicle on both sides.

### 5.15 Jack Point:

- The vehicle must have a jacking point capable of supporting the vehicle's weight and engaging the organizers to quickly jack.
- There must be two jack points for the vehicle, one at the rear and the other at the front. Both jack points must be orange in color.
- The jack point must be oriented horizontally and perpendicular to the center-line of the car.
- A minimum 3mm thickness plate with 06 inches (152.4mm) long x 3 inches (76.2mm) wide, or it must be minimum of their primary frame member with 12 inches(304.88mm), if circular member is used.
- Jack point must be weld only on the chassis member, not on the bumper. At any case deformation in jack points are strictly prohibited.

## 5.16 Hitch point:

- Every vehicle must have a hitch point at both the front and the rear end. Hitch point will be used to attach pushrod.
- Every team will have to fabricate a detachable push rod that should have the capability to push and pull the vehicle.
- Hitch point should ONLY be mounted onto the frame and NOT on the bumper. It should be welded and projected from the appropriate chassis member.
- The rear hitch point must be positioned in center exactly at a height of **14inches** mm from the ground. (Note: Teams may not be able to participate in some of the dynamic rounds like Load haul, if they are not properly fixed the height of rear hitch point)

## 5.17 Pushrod:

The detachable push rod is mandatory for all the team. Pushrod should have the capability to push as well as pull the vehicle. Teams must use their push rod to move their vehicle throughout the event. Teams are not allowed to drive their vehicle inside the college premises without an instruction from the committee members.



## 5.18 Impact Bumper:

- There should be an impact bumper on the front and rear of the vehicle. It should be rigid and strong. **Without a bumper, team cannot participate in the dynamic event.**
- The Bumper should be point to point of the tires and not exceed the dimensional restrictions of the vehicle. Short bumpers are not allowed.

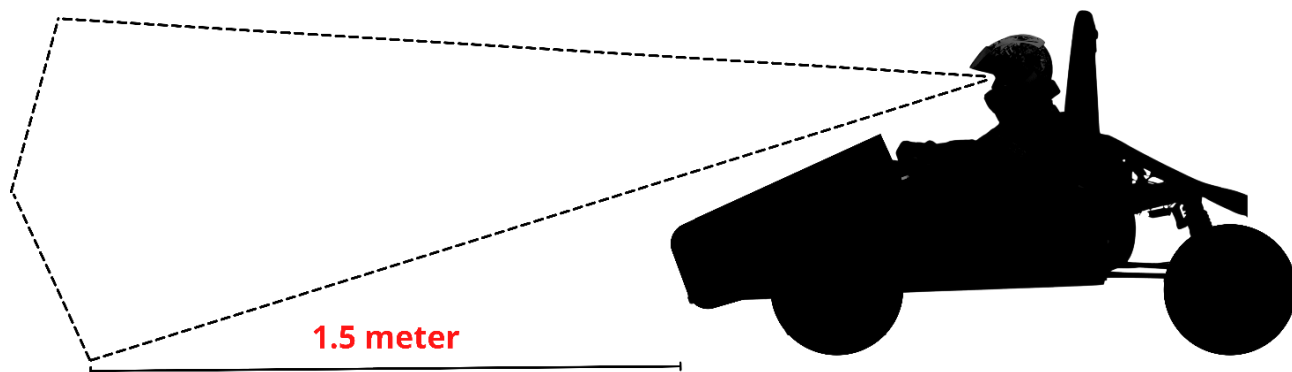
- The bumper should also be able to bear front impact load, as well as vertical load up to 100kg.
- It is mandatory to paste reflective stickers onto the end of bumpers in order to ensure visibility during Rush in Dusk.
- Side bumper is mandatory for all the team, such that the extension length of the side bumper will cover the vehicle width.

## 5.19 Rider Compartment Floor:

All vehicles must have a floor closeout made of one or more panels, which separates the driver from the pavement. If multiple panels are used, gaps between panels **should not exceed 3 mm (1/8 inch)**. The compartment must extend from the foot area to the firewall and also prevent track dust, debris, or any other foreign material from entering the vehicle. The panels must be made of a solid, non-flexible, non-brittle material. Panels must be minimum of 1mm thickness.

## 5.20 Driver Visibility:

- The driver, when seated in the normal driving position with both seat belt and helmet, must have a clear forward vision as shown in the above figure. An object 1.5m from the front most of the vehicle must be visible from the driver's position.
- The driver must have adequate visibility to the front and sides of the car. With the driver seated in a normal driving position, he/she must have a minimum field of vision of two hundred degrees (200°) (a minimum one hundred degrees (100°) to either side of the driver). The driver's view should not be restricted by steering wheel positioning.
- Rear vision system may be electronic, mirrors or both.



## 5.21 Ergonomics:

- There must be a **minimum clearance of 3 inches** from any motion parts inside the driver cockpit (i.e., steering wheel) and **at least 2 inches clearance of any static parts** (i.e., Frame, Dashboard) to the driver.
- The vehicle should be designed such that the driver can easily get in and out. A driver should be able to access all the parts in the cockpit (Fire-extinguisher, Switches).

S. No	Clearance Description	Annexure	Clearance (In Inches)
1	Ground Clearance	Refer 5.5	Minimum 3.5
2	Driver helmet top point to roll hoop top point	Refer 5.7	Minimum 6
3	Driver to any motion part	Refer 5.15 & 5.17.2	Minimum 3
4	Driver to any static part	Refer 5.15	Minimum 2
5	Brake pedal to side frame member	Refer 5.19.2	Minimum 3
6	Components to firewall	Refer 6.1	Minimum 2
7	Motor controller to Motor	Refer 7.3	Minimum 4

## 5.22 Steering:

### 5.21.1 Steering system:

- The entire steering system must be mechanically connected to the wheels. Steer-by-wire and electrically actuated steering system is prohibited. Rack and Pinion steering system is advisable for the vehicle.
- A rear-wheel steering system is prohibited.
- Any extra boost-up effort through hydraulic or electrical boosters is not allowed. Steering must be designed according to the vehicle geometry.

### 5.22.2 Steering Wheel:

- Steering wheel must be designed such that its shapes match the circular or oval shape.
- Steering wheel shape having **H-type is prohibited**.
- All the steering systems must be fastened using lock nuts and the free play of the steering must be within 7 degrees.
- Steering wheel must have **minimum dimensions of 10-inch diameter**.
- There must be a **clearance of 3 inches to the driver** and the steering wheel.
- The steering wheel must be positioned between the shoulder line and the abdomen of the driver.



### **5.22.3 Steering stopper:**

- Steering system must have Positive steering stops.
- Steering stoppers must be mounted on the chassis or the rack to avoid Steer-Lock.
- Steering stopper mounted on the uprights or load bearing points is strictly prohibited.
- Position of steering stopper have to be mounted such that it will not affect the steerability of the vehicle.
- The stopper must be rigid and must not deform in the case of steering.

### **5.22.4 Steering system closure:**

- The Rubber Boot must be given to cover universal joints and the rack in the steering system.
- All steering or suspension links exposed in the cockpit shall be shielded with a sturdy, robust, metal cover.
- The shielding must prevent the driver's legs and feet from coming in contact, becoming entangled, or being struck during operation or failure.



## **5.23 Suspension:**

### **5.22.1 Suspension system:**

- Use of suspension system is mandatory for all wheels along with proper actuation and weight transfer.
- The suspension used must have a minimum of 4 inches of travel. That is 2 inches of each bounce and rebound.



- In loading conditions, the vehicle's bottom should not contact the surface or any other portions of the vehicle. It will be tested when the driver is on board.

## 5.23.2 Suspension Sub-parts:

- Wishbones or A-arms must be made up of Seamless tubes. It is advisable to use either Primary or Secondary members of the roll cage for A-arms.
- Teams must ensure that the minimum bending stiffness of the frame(A-arm or wishbone) material have to match with the 70% of the primary member bending stiffness.
- Not more than 4 threads from the Heim's joint shall extend from the A-arm end.
- It is preferable to use an Anti-Roll bar mechanism.

## 5.23.3 Wheels and Tires dimension:

- The wheel diameter should be a **minimum of 10 inches** and **the tire minimum width must be 90mm**.
- The tire and wheel assembly must be properly tightened such that there is no wobbling of the wheel is allowed.
- **Wheels must be locked either with a Lock Nut or with the Cotter Pin.**

## 5.24 Brake:

### 5.23.1 Brake system:

- The Vehicle must be equipped with Hydraulic Braking System with brakes on all the wheels and must be operated by a single control. The pedal must directly actuate the master cylinder through a **rigid link**.
- It must have Two Independent Hydraulic circuits and each circuit must have its fluid reserve.

- The Master cylinder must be fixed through a rigid member, such that **no visible deformation** of the member while applying to the brake.
- The braking system must be capable of locking all the wheels simultaneously.
- **“Brake-by-wire” system is strictly prohibited. Team will be disqualified from the event if they provided “Brake-by-wire” system.**
- During the brake test, the vehicle should come to stop in a straight line; brakes must be applied on all the brake wheels simultaneously.
- Brake Pedal should be properly mounted according to the pedal ratio.

## 5.24.2 Brake Pedal:

- Brake pedal must be of rigid member and is fabricated by metals only.
- Braking must be done only by Foot Pedal.
- Wobbling in pedal assembly is strictly prohibited.
- Brake pedal shall be positioned to avoid entrapment of the driver's foot when in any position.
- Mechanical extension such as thick pads or block may not be attached to the pedal or the driver's feet.
- Brake pedal must return to the idle position when there is no load given by the driver.



- Minimum of 3 inches clearance must be provided for the brake pedal to the chassis member.

### 5.24.3 Brake Oil:

- Teams are advised to use DOT3, DOT4 and DOT5 as brake fluid.
- Leakage of Brake oil at any point in the brake system is strictly prohibited.
- No Teflon tape is used to tighten the screw of the brake liner to the master cylinder or caliper.
- Use metal tags for tying flexible liners.



### 5.24.4 Brake Liner:

- All brake lines must be firmly attached to the vehicle and not projected below the frame or suspension components (during the steering movement).
- All brake lines shall be routed and oriented such that they are not pinched or engaged with sharp edges by steering or suspension parts.
- All brake lines shall have a full range of motion within the steering and suspension system.
- The brake lines must never be loaded or become engaged with the vehicle's tires and wheels.
- All brake lines shall be designed for the pressures expected in the braking system, and be chemically compatible with the brake fluid in use.

### 5.24.5 Brake Over-Travel Switch:

- Brake over travel switch must be installed on the vehicle as a part of the safety system in case of brake failure.
- Activation of BOT switch must result in the cut-off of the tractive power supply only. The SLI power supply must still be active in this scenario.

- The Switch must be rigidly mounted in such a way there is no visible deformation of mounting happens.
- The mounting must be welded directly to the chassis member.
- The small hinge (parallel to the brake pedal pad) must be weld to the rear side of the brake pedal to push the BOT switch.
- No extension pipes or bolt is welded on the brake pedal for BOT actuation.
- Brake over-travel switch must be a single point, single throw. Only pushtype of brake over travel switch must be used.
- The switch must not restore power to these components after repeated activation, and it must be built such that the driver cannot reset it.



## 5.24.6 Brake Light:

- All vehicles are required to have a functional brake light to signal to other drivers the vehicle is stopping or slowing down. [Brake light strictly to be red in color.](#)
- All brake lights shall be configured to be fully illuminated when the brakes are applied.
- The brake light can be activated by means of any actuators properly mounted.
- The position of the brake lights must be a minimum of 350mm from the ground.
- Brake light must be visible on the backside of the vehicle even in bright sunlight.

- Brake light should not be mounted on the Bumper.
- OEM brake lights must be used (Led Strips are not allowed).



## 5.25 Fasteners:

- Motor, suspension, steering, braking and transmission should be fastened only by locknut.
- Only nuts with lock pin and nylon locknut are allowed.
- Bolt must be equivalent to [Metric grade 8.8](#).
- At least [3 threads](#) of every bolt should be visible outside.
- Use of cotter pins and castle nut for fastening of rotary parts such as wheels.
- Teams must not drill their chassis members for mounting any parts.
- Cotter pin and castle nut are also allowed provided 3 threads of every bolt should be visible outside.
- Teams can use rivets in firewall and for mounting their body panels. Teams must have their body panel detachable for the purpose of VAP check.
- Detachable body panels must be rigidly mounted after the VAP check is over.

## 5.26 Side/Rear View Mirror:

All teams must use a side mirror that reflects the rear view of the vehicle. Mirrors should be properly fixed and able to see a clear vision.

## 6 General Safety requirements:

### 6.1 Firewall:

- The firewall is the part of the vehicle that separates the drive-train and Energy storage compartment from the driver compartment.
- It must also isolate the driver from high voltage electrical components. No such components must be placed in the driver cockpit in front of the firewall.
- Electrical energy storage, power drive and high voltage components like battery, motor, motor controller, etc. must be placed behind the firewall. (Minimum 2inch distance away from the firewall).
- Direct mounting of any components on the firewall is strictly prohibited as it violates the safety of the occupant.
- The firewall must cover the entire driver's seating area (must cover the Rear roll hoop) and isolate the driver from any smoke or heat generated by the vehicle's rear end.
- The firewall must be made of rigid, non-flammable, electrically insulating, non-perforated material of a minimum 1 mm thickness. It can be bolted or riveted to the chassis.
- **No slots or visible gaps should be there in the firewall** except for the electrical wire routing and seat belt shoulder harness.
- For the slots or visible gaps provided for the seat belt shoulder harness, the protective cover must be made of sheet metal and must be mounted to the rear side of the fire wall provided such that it covers the slot or visible gaps.
- This protective cover can be mounted on the firewall.
- Team has to use sheet metals such as Aluminum, Mild Steel with a minimum of 1mm thickness. If team choose any other material mentioned above, team must get approval from the organizing committee before proceeding for production.

## **6.2 Bodyworks:**

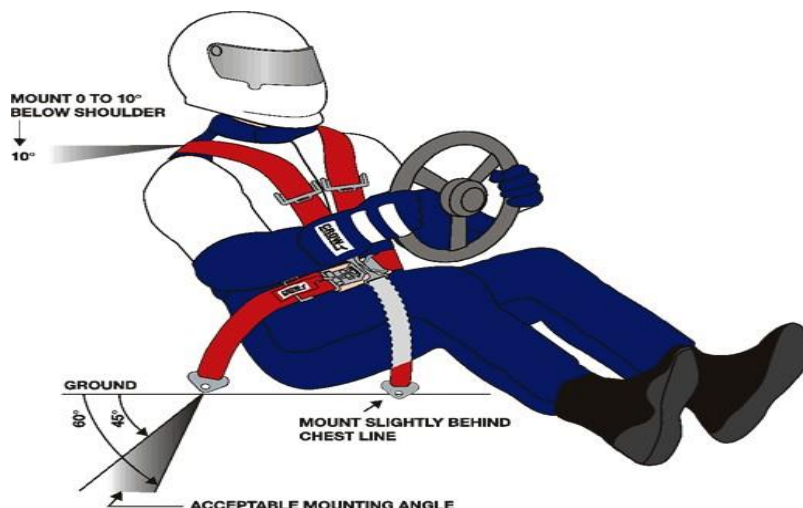
- Bodyworks used for the vehicle must cover the entire length of the vehicle. There should not be any sharp edges or projections that are extending beyond the vehicle frame boundaries.
- Teams can use materials like polycarbonate, carbon fiber, GFRP sheet.
- It must also cover the Electrical part over the rear side of the vehicle such that no water or debris entered to the electrical system.
- It must have ventilation or slots for air cooling of heat-radiating components like battery, motor, controllers, etc.
- Bodyworks must be attached to the frame only by means of fasteners and must be detachable and easy to assemble (Hinged to one end of frame) so that areas like battery, transmission, steering, suspension and other components could be easily visible and reached at the time of Vehicle Acceptance Protocol Check or maintenance.
- The bodywork should neither hit any part of the vehicle in motion like (wheels, actuation of steering and suspension) nor hit any part of the frame or ground. It should be mounted rigid and must not flutter during motion.

## **6.3 Driver's seat:**

- Split type seats are prohibited. Seat must support the driver's back up to the shoulder line.
- The seat should be sufficiently padded so that the driver is not uncomfortable while driving.
- Minimum four mounting to be provided for the seat belt for rigid mounting.
- Seat mounting must be directly welded into the primary member. Direct mounting of the seat to the firewall or floor closeout is strictly not allowed.
- Seat must be mounted rigidly and fastening should be attained by locknuts.

## 6.4 Seat Belt:

- Teams must use a minimum **5-point harness seat belt** meeting the requirements of either SFI or FIA specification. Teams can use different types of metal-to-metal contact type latches, such as the Latch-and-link and the Cam-lock type.
- All the 5-points of the seatbelt must be mounted directly on the primary member and the mounting must be welded in the primary member.
- 3-point harness seat belts are not allowed.
- Seat belt must be in good condition, no wear and tear allowed.
- A driver should not be able to move after wearing the seatbelt.
- The shoulder harness must be the “over-the-shoulder type”. Only separate shoulder straps are permitted (i.e., “Y”-type shoulder straps are not allowed). The “H”-type configuration is allowed.
- The lateral spacing of the shoulder belts shall be in between 7.0 inches to 9.0 inches. when measured center-to-center.
- The shoulder belts must run directly from their mountings to the driver’s shoulders, without any redirection. Excess shoulder belt webbing shall be neatly contained and rolled.
- Tension of Seat belts must not deform the seats.

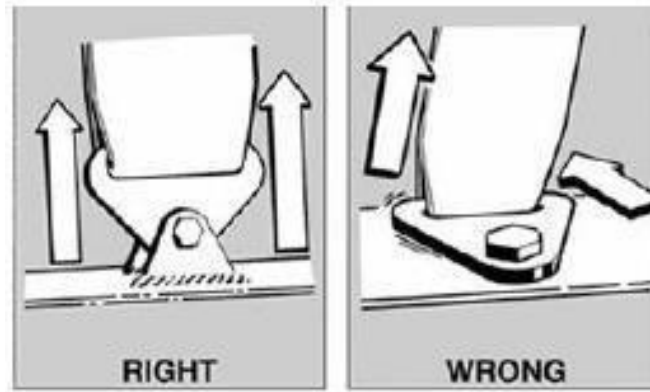






## 6.4.1 Seat belt mounting positions:

- The lap belt halves must run directly from the buckle, over the driver's hips and to their mounting points. The lap belt halves must be mounted to frame tabs using the bracket supplied with the safety harness. Lap belts may not be mounted by wrapping around tubes.
- In a side view, the lap belt must be at an angle of between 45 deg and 65 deg to the horizontal. The lap belt end tab must be mounted vertically as per the figure below.
- The shoulder harness belt mount (Anchor plate) must be mounted below 0 deg to 10 deg of the driver shoulder.
- The anti-submarine belt serves to positively locate the buckle and prevent the driver from riding under the lap belts.
- The anti-submarine belt of a 5-point harness should be mounted in line with or angled slightly forward up to twenty degrees (20°) of, the driver's chest-groin line.
- The Anchor plate must be rigidly mounted and tightly locked to the hinge such that there must be only one degree of freedom for its movement.



## 6.5 Fire extinguisher:

- In the case of a fire on the car, in the pit area, or on the track, all vehicles must be equipped with a fully charged and operable fire extinguisher. All team members shall be familiar with the use and operation of fire extinguishers.
- Each team must have a minimum of two fire extinguishers, each weighing **at least 1 Kg**. When the vehicle is driving out of the pit, one fire extinguisher must always be fitted on the vehicle, and another must be carried by a team member.
- The fire extinguisher shall be fixed to the mount via hose clamps. The hose clamp adjusters must not snag a driver's clothes during vehicle entry/egress.
- The fire extinguisher must be firmly attached to its mount such that no shake or sagginess is found.
- The fire extinguisher must be mounted inside the driver's cockpit.
- Fire extinguishers installed in the vehicle should be within the reach of the driver after being harnessed by seat belts. Fire extinguisher refill date should not be more than one year prior to the current date of the final event. The sufficient pressure (Green zone) should be maintained in the pressure dial gauge.



## 7 Electrical System:

### 7.1 Transmission:

- Rear-wheel drive is only allowed in the event.
- All the parts involved in the transmission system must be rigidly mounted.
- All the rotating parts must be covered with a scatter shield and it must be made up of metals only.
- Accelerator pedal must be **Right foot operated**.
- A separate mounting must be provided for the accelerator pedal and that mounting must be directly welded to the chassis.
- Teams using flange-type motors should have a proper reduction gear in the transmission system.

### 7.2 Motor:

- Traction Motor shall be any electric motor (flange type or hub type) based on their requirement.
- Rated power of the motor should not exceed 3000 W and the peak power should not exceed 7000 W.
- Operating voltage should not be greater than 60V DC.

- The speed of the motor should not exceed 4000 rpm.
- Teams must make sure that the overall vehicle speed does not exceed 60 Kmph.
- If the speed violation is found in any dynamic round, heavy penalties or disqualification of team will be done by the committee members.
- Reverse operation of the motor is mandatory and proper forward & reverse switch must be provided.
- Motors must be operated through their corresponding motor controller only.
- The mountings must be rigid, tightened with lock nuts and the outer frame (yoke) must be waterproof.
- Only one motor must be used for traction. (In case of dual motors, teams must contact technical committee for clarifications and approval)
- Proper cooling system should be installed in order to reduce the overheating of the motor. To avoid short-circuiting while employing a liquid cooling system, the motor must be securely insulated from the coolant.
- Teams must utilize appropriate temperature-detecting devices for the motors, with the value displayed on the dashboard for the driver.
- The motor and controller should be connected using suitable connectors. Cutting and joining of wires are strictly prohibited.
- In the case of flange motors, teams can use any type of transmission, provided the speed is under the maximum limit.
- In case of hub motors, motor wires should be rigidly mounted & Free-hanging of motor wires is not allowed.
- It should be installed behind the firewall and away from the driver compartment.

- Proper motor specification sheet along with the bill must be submitted at the VAP check.
- Minimum of 2-inch clearance must be provided to the firewall.

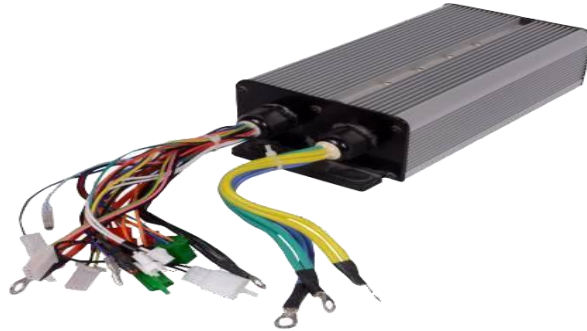
**Warning!** Connect motor wires tightly with connectors, Loose connections are not allowed.



## 7.3 Motor Controller:

- The maximum input voltage capability of the motor controller is 60V but the output must strictly be equal to the operating voltage of the motor.
- The current rating of the motor controller should be greater than the rated current of the motor.
- Teams are recommended to use all the features available in the controller to the maximum level.
- There must be a proper casing of the controller circuit with a proper heat sink inside. Open or bare controllers are strictly prohibited.
- Proper Cooling System shall be provided for control of the temperature rise of Controller.
- The motor controller must be rigidly mounted onto the vehicle at a distance minimum of 4 inches away from the motor.

- Connection of motor controller to the battery should be done using connectors.
- If teams are using programmable controllers, the power limit should not exceed 3000 W.
- Team using programmable controllers must show their parameter settings at any time of the event.
- Controller power rating shall be  $\pm 500$  W from the rated power of the motor.
- Proper controller specification sheet along with the bill must be submitted at the VAP check.



**Warning!** Never Ever By-pass or Short the Controllers with jumpers.

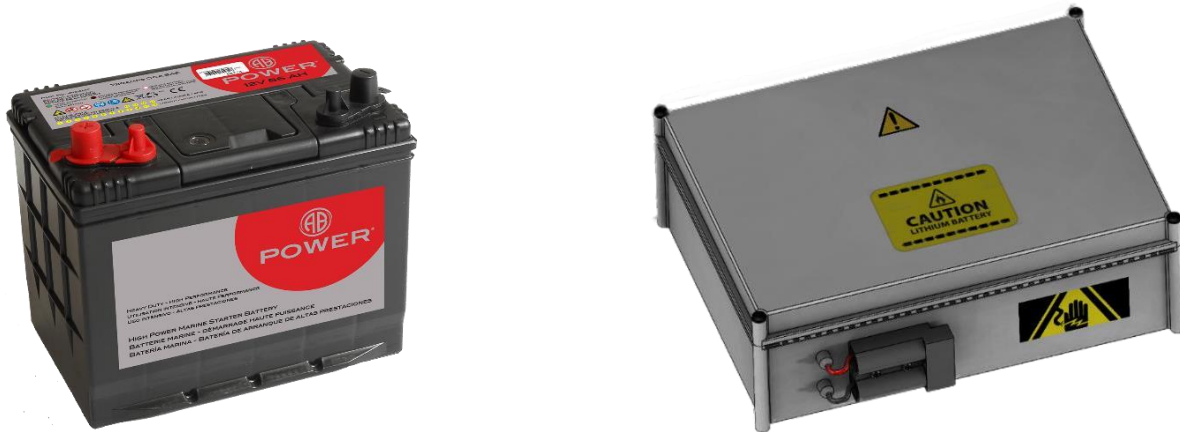
## 7.4 Accumulators/Batteries:

- Teams can use either lead-acid or lithium-type batteries for the tractive as well as the SLI purposes.
- The maximum voltage of the tractive battery pack must be 60V with a capacity of not more than 5.4 kWh.
- For powering the auxiliary components, an additional SLI battery can be used whose ratings should not be more than 12V and 10Ah.
- Usage of isolated DC-DC converters is only allowed.
- The power lines for both the battery packs should be separate and well protected.



- For lithium-type batteries, BMS is mandatory.
- Use sealed gel-type battery packs in the case of lead-acid batteries. **Liquid electrolyte batteries are strictly prohibited.**
- Similar to the motor, the temperature of the battery packs must be monitored and displayed in the dashboard.
- Teams are allowed to use any type of Lithium Chemistry based on their interest. But the BMS should be compatible with the particular type that is used by the teams.
- Battery packs must be rigidly mounted and connections must also be tight and firm.
- Battery packs must not be placed beneath the driver seat or driver compartment at any cost. Battery packs must be placed behind the firewall only.
- The mounting of the battery pack must be welded to the chassis member. No movement of battery is allowed after mounting.
- Minimum of 2-inch clearance must be provided from the firewall.
- Teams using more than one battery pack must use Master-Slave configuration BMS. In such case, each battery pack must be provided separate casing.
- Teams are strictly not allowed to connect multiple battery packs in series or parallel without the availability of Master-Slave BMS.
- In case of using more than one battery pack each and every cell should be properly patched with the appropriate ratings of Nickel-induced fuse strips.
- Battery should be connected to the motor controller using proper terminal connectors and it should be easily visible and accessible for verification.
- **The SLI battery must be grounded to the chassis (GLV) whereas the tractive battery must not be grounded anywhere on the chassis.**

**Warning!** Use only connectors to connect the battery terminal. Teams must not use bare conductors for providing any connections on the terminal.



## 7.5 Battery Cover:

- Battery packs must be placed in a suitable electrically insulated and fireproof battery box or cover.
- Danger sign sticker must be pasted over the battery box with proper visibility.
- The battery box must be rigidly mounted **behind the firewall and away from the driver compartment.**
- The design of the vehicle should also adhere to enclose the battery box and hold it rigidly such that it will not move even in adverse situations.
- If teams are using more than one battery pack, separate battery box must be used for each battery pack.
- While placing the battery pack at the rear, proper body covering must be incorporated to ensure the battery packs are completely sheltered.

**Warning!** Battery box should be only of insulating material and provide proper insulations.





## 7.6 Charger & Charging Socket:

- Teams are insisted to use suitable chargers to charge both their tractive and SLI batteries.
- The charger ratings should be 220V 50 Hz as the input and the output should be greater than 60V and 12 V for tractive and SLI chargers respectively.
- Moreover, the output current of the chargers is not limited as it is up to the team's choice.
- Self-designed chargers are allowed in the event which will be inspected by the technical personnel and then allowed for usage.
- Separate charging sockets must be used in the vehicle for both tractive as well as SLI batteries to connect these chargers. The current ratings of the sockets should be chosen based on the current involved in the circuit.
- Only cap-type charging connectors of suitable IP ratings must be used as mentioned in the figure.



## 7.7 Kill switch:

- Kill switch or emergency stop switch must be used in the tractive line and should stop the flow of current from the battery to the motor when activated.
- Every vehicle should have a **minimum of two kill switches**, one at the reach of the driver and the other kill switch must be easily accessible to the audience/participants in the track.
- Kill switch must be “push to off” and “rotate to release” type.
- Kill switch must be chosen in a manner capable enough to withstand the voltage and current involved in the tractive system.
- Kill switch must be rigidly mounted **only on the mounting hinge welded on the chassis.**

**Warning!** Negative Wire Should not be connected. only positive (Live) wires must be connected.



## 7.8 Fuse and circuit breaker:

- Use of appropriate fuse is mandatory for each electrical component in the vehicle.
- Fuse rating and specifications should be visible on the fuse boxes.
- **Use of automotive blade-type fuses is mandatory for the low voltage circuit components.**
- The power to the motor must be drawn from the battery through an isolated relay(Solid State Relay – SSR is recommended).
- Separate fuse of suitable rating must be used on the tractive live line for safety.
- Teams shall use DC MCB of suitable rating in the tractive system.

- Warning: DC MCB should be capable enough to withstand the peak current of the tractive motor.



## 7.9 Wiring & Connectors:

- Wires used in the vehicle should be of suitable gauge resistance capable enough to withstand the voltage and current in the electrical system.
- Wiring done for tractive and SLI circuits should be separate. Proper gauge and color variation must be given to each of the wires.
- When joining two wires, **twisted pair joints are strictly prohibited**. Instead, connectors of suitable ratings must be used.
- For connecting to terminals, wire lugs must be used. This connection should be done by using a proper crimping tool so that wires are held rigidly onto the lug.
- All wiring joints must be strong and rigid and the wiring conduit must be laid within the flexible hoses. Separate hoses shall be provided to envelope the tractive and SLI battery circuit wiring if necessary.
- Also, the flexible hoses should be tied to the body of the vehicle so that loose connections do not exist and no hanging of the wiring conduit takes place.
- Teams must perform proper calculations for the selection of wire gauge which will be cross-verified during the VAP.
- Teams are recommended to have **the live wire in red color**.

- Wiring should be given with separate colors for identification purpose. Also, teams are recommended to provide identification tags for each of the wiring lines so that trouble shooting of faults will be easy.



### 7.10 Dashboard:

- The vehicle must have a dashboard. (It is Mandatory)
- Dashboard must bear all the controls of the vehicle and must be at the reach of the driver.
- Speed, temperature values of the tractive components, voltage and current of battery (charging and discharging), voltage and current of the motor must be displayed clearly for the driver in the dashboard.
- Suitable switches must be available for lamps, forward and reverse operation, indicators, horn, etc. at the suitable ratings.
- Vehicle ON/OFF can be done by key or switch based on the team's desire.
- All components and their respective connections must be rigid and the rear side of the dashboard must be covered. Wiring of the dashboard should be reliably connected and contained inside by providing a proper enclosure.
- Material used to design the dashboard should be preferably electrically insulated and the dashboard should not have any sharp edges.

## 7.11 Turn Indicator:

- Separate indicators should be established for the left and right sides. Same side indicators may flash simultaneously or alternatively.
- Lever-type switches, toggle switches, push-button switches, and rotary-type switches can be used to operate indicators.
- The lights should be positioned symmetrically and at a height of **0.5 m above the ground**.
- Turn indicators should be circuited and mounted such that they may also serve as a danger light.
- During the event, if the vehicle breaks down or is unable to proceed, the danger lights must be turned on immediately to warn any vehicles approaching.

## 7.12 Horn:

Permanent audible warning system should be installed on the vehicle. The loudness of horns should not exceed 120 dB sound.

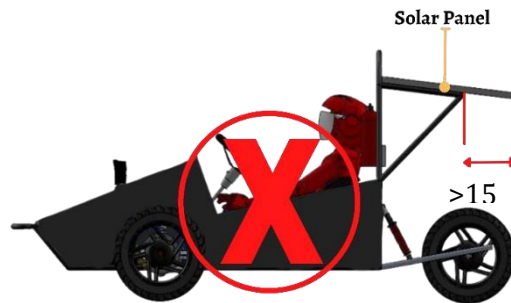
## 7.13 Vehicle Lighting:

- Headlight is mandatory to light the pathway of the vehicle and it should be placed in the front at a suitable height providing maximum illumination.
- Lights must be provided for reverse operation.
- Teams can also use lights to illuminate the driver's cockpit area if they desire.
- Usage of decorative lighting is also allowed (Any Color). It should not affect the headlight lighting and brake light lighting.



## 7.14 Solar Panel: (Only for SEV Category):

- Solar panels are chosen accordingly to your required Motor Voltage Ratings.
- Solar panels should be rigidly mounted with a frame. **Wire tags and ropes are strictly prohibited for mounting.**
- Solar Panel must not exceed the overall width and the length of the vehicle as mentioned in the rulebook (refer rule 5.2). The mountings of the solar panel must be rigid. An additional mounting member must be provided if the projection exceeds 15cm from the end support.
- Solar Panels should be connected only using solar panel connectors.
- The vehicle's stability must be assured even at a 45-degree (in case of a rooftop solar panel).



## 7.15 Solar Charge Controller: (Only for SEV Category):

- Only PWM (Pulse Width Modulation) type and MPPT (Maximum Power Point Tracking) type charge controllers are allowed to use.
- It is mandatory to use a solar charge controller while connecting solar panel to the battery.
- Solar Charge Controller Ratings should match with your Solar Panel Ratings.
- Charge Controller should be rigidly mounted on a hard surface. Wire tags and ropes are strictly prohibited for mounting.

- If needed Proper Cooling arrangements can be provided.
- Teams are encouraged to build their own solar charge controllers which will be allowed for usage in the event after the inspection of the judges.

**WARNING!** To prevent the device from being short-circuited, more insulation should be given while using liquid cooling.



## 7.16 Autonomous Driving:

- Teams are insisted to build the autonomous driving system in your vehicle during the designing process, as our society needs the most in future.
- Teams are instructed to use at least Level 2 of Driving Automation in their vehicle i.e., Partial Automation.
- Teams are also advised to go more than Level 2 of Automated Driving, but they have to get permission with the technical committee before installing such automation in their vehicle.

### Expected Features:

- Have to provide lateral & longitudinal vehicle motion control support to the driver.
- Have to support the driver in maintaining the position of the vehicle within its lane of travel during long run.
- Have to provide adaptive cruise control to the driver.
- Have to disengage immediately upon driver request.
- Have to perform parking by its own by controlled lateral and longitudinal motions under the supervision of driver.



# **SECTION C - DRIVER'S REQUIREMENT**

## **8.1 Driver's Documents:**

### **8.1.1 Driver Restrictions:**

Representing driver of the teams must be a member of the participating team.

### **8.1.2 Driver's License:**

A minimum of two team members who will drive the vehicle at any time during the competition must hold a valid government-issued 4W driver's license. Learning license is not accepted. (Both drivers must provide a copy of the license when demanded by the technical team at the time of Vehicle Acceptance Protocol).

### **8.1.3 Medical Insurance:**

Individual medical and accident insurance coverage is required for at least 2 team members designated for driving the vehicle during competition and is the sole responsibility of the participants. No medical insurance will be provided by SEVC Organizing Committee. (Driver without valid Medical Insurance will not be allowed to participate in the Dynamic Events)

## **8.2 Driver Equipment:**

**Note:** Driver equipment's SFI rating tags will be verified by the judges during the Vehicle Acceptance Protocol (VAP). Without markings these items won't be considered as valid and will be deemed as unfit.

1. Driver equipment to be used in the competition by team must be presented during Vehicle acceptances protocol where approved driver equipment will be stickered.



### **8.2.1 Helmet:**

A well-fitting, closed face helmet that meets one of the following certifications ISI rated, SFI rated, FIA rated or Snell rated. Open faced helmets are not approved.

### **8.2.2 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.



### **8.2.3 Neck Support:**

All drivers must wear a neck support/collar. The neck support must be a full circle (360-degree) continuous perimeter neck support and SFI rated (SFI 3.3).

**Note:** - Horseshoe collars and Neck support with slots are not allowed.



### **8.2.4 Driver's Suit:**

A fire-resistant suit (one piece), made from a minimum of 1-layer up to multiple layer that covers the body from the neck to the ankles and the wrists. The suit must have a factory label showing that it is SFI rated, FIA rated.



### **8.2.5 Underclothing:**

If the driver is wearing a single layer suit, then the underclothing is mandatory, i.e. (a t-shirt of cotton and long pants down to ankles). In case the driver is wearing a two or three-layer suit then the underclothing is not mandatory.



## 8.2.6 Gloves:

Fire-resistant gloves 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.



## 8.2.7 Shoes:

Fire-resistant shoes made from acceptable fire-resistant material, shoes must be certified to the standard and labelled as such (SFI 3.3 or higher, FIA 8856-2000)

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



### **8.2.8 Socks:**

Fire-resistant socks are made from acceptable fire-resistant material or cotton socks that cover the exposed skin between the driver's suit and the boots/shoes.



### **8.2.9 Fire Resistant Material:**

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

### **8.2.10 First-Aid Box:**

Each Team must have their own first-aid box consisting of normal medicines and bandages for sudden and minor wounds on the body.

**Note:** Expired driving equipment are not allowed, Team must ensure that the expiry date of their driving equipment's is beyond the date of the event.

### **NOTE!**

In the upcoming stages of the event, SEVC will provide the following documents:

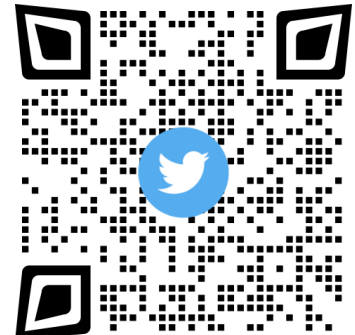
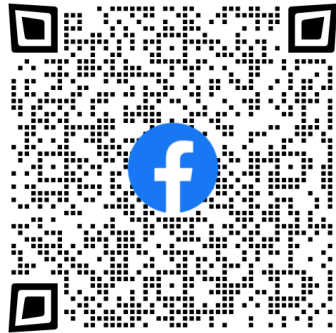
1. Report formats
2. Virtual Presentation Guidelines
3. Workshop Brochure
4. Dynamic Event Guidelines.
5. Internship and placement brochure



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