

SAEINDIA



2019 Collegiate Design Series

Baja SAEINDIA[®] Rules

Applicable for Main Baja & e-Baja events being conducted in 2019.



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Read the Rules, thoroughly!

Please be sure to refer the Baja SAE India Website (<http://www.bajasaeindiaforum.com>) for all updates.



2019 Baja SAE India Rules

PART A: ADMINISTRATIVE REGULATIONS

ARTICLE 1: BAJA SAE OVERVIEW

The Baja SAE competition originated at the University of South Carolina in 1976, under the direction of Dr. John F. Stevens. Since that time, the Baja SAE Series has grown to become a premier engineering design series for university teams.

A1.1 Baja SAE Program Objective

Baja SAE is an intercollegiate engineering design competition for undergraduate and graduate engineering students. The object of the competition is to simulate real-world engineering design projects and their related challenges. Each team is competing to have its design accepted for manufacture by a fictitious firm. The students must function as a team to design, engineer, build, test, promote and compete with a vehicle within the limits of the rules. They must also generate financial support for their project and manage their educational priorities.

A1.2 Design Subject

Each team's goal is to design and build a single-seat, all-terrain, sporting vehicle whose structure contains the driver. The vehicle is to be a prototype for a reliable, maintainable, ergonomic, and economic production vehicle which serves a recreational user market, sized at approximately 4000 units per year. The vehicle should aspire to market-leading performance in terms of speed, handling, ride, and ruggedness over rough terrain and off-road conditions. Performance will be measured by success in the dynamic events which are described in the Baja SAE Rules, and are subject to event-site weather and course conditions.

A1.3 Good Engineering Practices

Vehicles entered into Baja SAE competitions are expected to be designed and fabricated in accordance with good engineering practices.

ARTICLE 2: BAJA SAE SERIES

A2.1 The Baja SAE Series will consist of seven competitions. Three competitions are held in North America under the sponsorship of SAE. (Refer details on SAE INTERNATIONAL website)

Baja SAE competitions held in Africa, Asia and South America are associated with SAE, but organized and sponsored by their local hosts:

Baja SAE Brazil – Sponsored and hosted by SAE BRASIL

Baja SAE Korea – Sponsored and hosted by Yeungnam University

Baja SAE South Africa – Sponsored by Sasol and hosted by the Gerotek Test Facilities

Baja SAE India 1 & 2 – Sponsored by Mahindra & Mahindra Ltd. and SAEINDIA and hosted by NATRiP, in Indore Pithampur during January 2019 and in Punjab during March 2019.



Note: Pl refer BAJA SAEINDIA Forum for details regarding event dates & schedule.

A2.2 All Baja SAE competitions have open registration policies and accept teams of university students from any country.

A2.2.1 Teams are required to visit www.saeindia.org/student-activities or www.bajasaeindia.org or www.bajasaeindiaforum.com for the rules pertaining Baja SAE India® Rules and for the dynamic events.

A2.3 Official Announcements and Competition Information

Teams are required to read the articles posted on the Baja SAE India homepage (www.bajasaeindiaforum.com) published by Baja SAE India Organizing Committee. Teams must also be familiar with all official announcements concerning the competitions and rule interpretations released by the Baja SAE India Organizing Committee.

A2.4 Official Languages

The official language of the Baja SAE Series is English. Document submissions, presentations and discussions in English are acceptable at all competitions in the series.

Team members, judges, and officials at non-U.S. competition events may use their respective national languages for document submissions, presentations and discussions if all the parties involved agree to the use of that language.

- U.S. and Canadian Events - English
- Baja SAE Brazil – English and Portuguese
- Baja SAE Korea – English and Korean
- Baja SAE South Africa – English and Spanish
- Baja SAE Mexico - English and Spanish
- Baja SAE India – English and Hindi

A2.5 Event specific:

The dynamic and endurance events at different competitions are different. The teams should check the BAJA SAEINDIA Forum and consider any unique requirements that might affect the design and fabrication of their vehicle.

ARTICLE 3: BAJA SAE INDIA RULES AND ORGANIZER AUTHORITY

A3.1 Rules Authority

The Baja SAE India Rules are the responsibility of Baja SAE India Organizing Committee and are issued under the authority of Baja SAE India Organizing Committee. Official announcements from Baja SAE India Organizing Committee shall be considered part of and have the same validity as these rules.



Ambiguities or questions concerning the meaning or intent of these rules will be resolved by Baja SAE India Organizing Committee during competition onsite.

A3.2 Rules Validity

The Baja SAE India Rules posted on the Baja SAE India website and dated for the calendar year of the competition are the rules in effect for the competition. Rule sets dated for other years are invalid.

A3.3 Rules Compliance

By entering a Baja SAE India competition, the team members, faculty advisors and other personnel of the entering university agree to comply with, and be bound by, the rules and all rules interpretations or procedures issued or announced by Baja SAE India Organizing Committee. All team members, faculty advisors and other university representatives are required to cooperate with, and follow all instructions from competition organizers, officials and judges.

A3.4 Understanding the Rules

Teams are responsible for reading and understanding the rules in their entirety for the competition in which they are participating. The section and paragraph headings in these rules are provided to facilitate reading: they do not fully explain all the paragraph contents.

A3.4.1 Loopholes

It is virtually impossible for a set of rules to 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 Baja SAE India, so any perceived loopholes should be resolved in the direction of increased safety/ concept of the competition.

A3.5 Participating in the Competition

Teams, team members as individuals, faculty advisors and other representatives of a registered university 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 the site at the conclusion of the competition or earlier by withdrawing.

A3.6 Violations of Intent

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 Baja SAE India Organizing Committee or Technical Inspectors.

A3.7 Right to Impound

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

A3.8 General Authority

Baja SAE India Organizing Committee reserves the right to revise the schedule of any 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 operation of the event.



A3.9 Penalties

Organizers have the right to modify the penalties listed in the various dynamic event descriptions (part D) to better reflect the design of their event courses, the course lengths or any special conditions unique to the site. The standard dynamic event penalties in these rules are default values that will be applied unless there is a change by the organizer.

A3.10 SAE Technical Standards Access

A list of accessible SAE Technical Standards can be found in Appendix S. For getting access to those standards shortlisted teams in virtual event may send the specific request to Knowledge Centre of ARAI Pune / SAE INDIA Western Section Pune at mail id: executive-ws@saeindia.org

ARTICLE 4: INDIVIDUAL PARTICIPATION REQUIREMENTS

A4.1 Eligibility Limits

Eligibility is limited to undergraduate students to ensure this is an engineering competition rather than a race. Individual members of teams participating in this competition must satisfy the following requirements:

A4.2 Student Status

Team members must be enrolled as degree seeking undergraduate student in a college or university. Team members who have already graduated prior to the competition (Jan. 2019) are NOT eligible to participate.

A4.3 Society Membership

Team members must be members of SAE INDIA (with a +1 type of membership) or an SAE International or affiliate society i.e. ATA or IMechE or VDI. Proof of membership, such as a valid membership card, is required while registration & also necessary during the event. Students who are members of one of the societies listed above are not required to join any other societies in order to participate in SAE INDIA competition. Those interested may join SAEINDIA at: www.sae.org/students and SAEINDIA at: www.saeindia.org .

A4.4 Age

Team members must be at least eighteen (18) years of age at the time of the competition.

A4.5 Driver's License

Team members who will drive a competition vehicle at any time during a competition must hold a valid, government issued driver's license. This will be required onsite for proof.

A4.6 Liability Waiver

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

A4.7 Insurance

Individual medical and accident insurance coverage is required and is the sole responsibility of the participant.



A4.8 Individual Registration Requirements –

A4.8.1 All participating team members and faculty advisors must be sure that they are individually linked to their respective college / university on the SAEINDIA website through their team’s profile page for each event they are participating in.

A4.8.2 A team can have a maximum of 25 and a minimum of 5 eligible members. The team having less than 5 and more than 25 members should not register, and if registered will not be allowed to participate. **All the team members present on-site should compulsorily wear shoes during the entire course of event.**

NOTE: Teams are advised to take proper care while forming the team before initial registration for Virtual Baja and refrain from further modification at a later date. No changes in team composition (i.e. Addition of new members or deletion of any pre-registered members) is permitted after registration. Exceptional cases such as death, natural calamity etc. shall be dealt with separately. In such cases a letter on the Institution’s/College’s letter head with declaration from the Institution Head / Principal is mandatory. Backing-out or withdrawal of any member from the team, due to any reason other than “exceptional” as mentioned above, is NOT permitted. Penalties for the same will have to be borne by the team.

A4.8.3 If you are not an SAEINDIA member, go to www.saeindia.org and select the “Join SAE/Membership Renewal” link under “Quick links”, and then select the “Join SAE” link in the top right column. Students will need to select the “Student Membership” link and then follow the series of questions that are asked.

Faculty members who wish to become SAE members should choose the “Professional Membership” link. Please note all student participants must be SAE members to participate in the events; Faculty members who wish to become SAE members should choose the “Professional Membership” link. The faculty advisor is expected to be a member of SAEINDIA or SAE International or any other SAE affiliate society i.e ATA, or IMechE or VDI.

A4.8.4 Once you have associated yourself to your respective university team(s), all affiliated students and faculty must complete all Requested information (i.e. Emergency contact information) on the team registration page, all students must affiliate prior to the virtual round of competition. (NEW)

A4.8.5 International team registration(NEW)
Teams interested to participate in Baja SAEINDIA, shall visit www.bajasaeindiaforum.com and write to saeindia_indore@saeindia.org , along with team member details and SAE membership ID.

ARTICLE 5: FACULTY ADVISOR

A5.1 Faculty Advisor Status

Each team is expected to have a minimum one and maximum two “Faculty Advisors” appointed by the College/university. The faculty advisor will be considered as the Official University Representative, accompanying the team. The presence during the competition is **mandatory** for all the event days and for the Virtual Event as well.



A5.2 Responsibilities

Faculty Advisors are expected to advise their teams on general engineering and engineering project management theory. He/She shall:-

- Advise, review, and monitor the progress of the team for overall design, development, manufacturing and testing of Baja buggy.
- Ensure safety of the vehicle and in-house manufacturing within college premises.
- Support & assist to Baja SAEINDIA organization committee to conduct the event peacefully and in case of any disputes, resolve the issues that may arise during the competition.

A5.3 Limitations

Faculty advisors must not design any part of the vehicle or any system of vehicle nor directly participate in the development of any documentation or presentation.

Faculty Advisors or college staff should neither fabricate nor assemble any components nor assist in the preparation, maintenance, testing or any operation of the vehicle.

Faculty Advisors are not allowed to participate during technical inspection, cost audit or design presentations. The team captain or other designated members of the team must do all the presenting work. However Faculty Advisors may silently observe the process and work for improvement in future participation years.

In brief – Faculty Advisors do not get involved directly or indirectly in design, build or repair any part of the vehicle & ensures it is done by participating student team only.

ARTICLE 6: ELIGIBILITY – VEHICLES

A6.1 Student Created

The vehicle and associated documentation must be conceived, designed and fabricated by the team members without direct/ indirect involvement from professional engineers, faculty or professionals in the off-road and racing communities. Proof of manufacturing location will be essentially required to be furnished by the teams on-site upon being so asked for by the officials.

A6.2 Professional Fabrication Limits

1. Only those teams, whose management gives an undertaking to allow them to use the workshop facilities, would be allowed to participate without exception. Also teams need to submit a list of facilities / equipment in operating condition with the college facilities which will be used to fabricate & assemble the vehicle as per design presented in Virtual Baja SAE India event.
2. During the actual manufacturing and fabrication process, the video clips that cover students working in college facility need to be taken and written in a CD, to be furnished anytime throughout the course of project. The video clip is required to cover each of the manufacturing processes carried out in college.
3. Extensive use of readymade subassemblies may invoke penalties. Vehicles, which have been professionally fabricated, may be penalized up to 400 points or even disqualified from the



competition. The decision of the organizers committee in this regard will be final. The registration fee would NOT be refund in such case.

A6.3 Kit Vehicles – Prohibited

Vehicles fabricated from a kit or published designs are ineligible to compete.

A6.4 Prefabricated Subassemblies

These rules do not exclude the use of prefabricated or modified sub-assemblies. Extensive use of readymade subassemblies may invoke penalties. List of pre-fabricated parts allowed are – shock absorbers, spring, brake drum, brake disc, brake calipers and brake holding assembly, master cylinder, steering gear box, steering column, steering wheel, wheel rims & tires, seat frame, tie rod ends.

Engine, fuel tank and exhaust system - complete assembly supplied from B&S to be used. All other parts need to be fabricated in house and not allowed to outsource from professional manufactures/ designers.

Any outsourcing must be reflected in cost report with supporting receipts from your out sourcing vendor.

ARTICLE 7: REGISTRATION

A7.1 Registrations for Baja SAE India event held in India must be completed online. Online registration must be done by either (a) An SAE member or (b) the official faculty advisor connected with the university and recorded as such in the SAE record system. Active SAEINDIA collegiate club (minimum one year old) is required to register the team. Also collegiate club should have the bank account & bank details need to be available before competition. (NEW)

A7.2 Entries per university-Registration for Baja SAE India competition allows a maximum of 1 (ONE) vehicle per college / university location.

A7.3 Registration Limit

There is no limit to overall number of registrations for Baja SAE India event. However, one team per college/university will only be allowed for one m-baja & one e-baja event separately. The institutions having multiple college(s) at different locations, may register as different team.

A7.3.1 Failure to Meet Deadlines - NEW POLICY!

All teams registered for Baja SAE India competition are required to submit the following documents prior to the competition.

- (a) Roll Cage design & detailed drawing to be submitted for approval by Technical Evaluation team before starting of fabrication.
- (b) TIS – Technical Inspection Sheet to be filled based on the actual status of the vehicle & to be submitted to technical evaluation mentor on given date.
- (c) Cost Documents (Refer Section D4).
- (d) Design Documents (Refer Section D3).



During the event judges need to evaluate the team with respect to all above submissions with given time deadlines. Failure to submit the reports is Violation of rules and the penalties will be applicable, as decided by the Organizing Committee.

Failure to submit any of above listed documents within the deadline will constitute an automatic withdrawal of your team. Your team will be notified after the deadline day and your team's registration will be cancelled with no refund.

A7.4 Registration Dates

Teams must register for Baja SAE India competition they intend to enter by the specified date on the action deadline webpage –www.bajasaeindia.org. Registration dates are available online.

A7.5 Registration Fees

The registration fee for Baja SAE India must be paid by “Bank Challan Form” at the time of registration. Registration fees may not be paid by any other means. Registration fees are NOT refundable or transferable. Registration fees is classified in two stages 1) Before Virtual & 2) After Virtual. The dates will be declared on BAJA official web site.

Mentoring: A special team for mentoring and advising students for technical inspection is put in place. Any team desirous of mentoring for technical inspection are free to hire advisory sessions from the technical inspection team before the event by paying a nominal non-refundable fees. For this, the participating team has to register along with the second phase of registration after the Virtual BAJA. The BAJA organizing committee will announce the dates for registration.

Note: Follow <http://bajasaeindiaforum.com/> for further updates regarding mentorship registration.

A7.6 Withdrawals

Registered teams that find that they will not be able to attend the competition are requested to officially withdraw by notifying the following not later than 15 days before the event starts.

Baja SAE India event withdrawals: saeindia_indore@saeindia.org.

A7.7 International Participation – Vehicle Shipping/Indian Customs

Baja SAE India Organizing Committee strongly recommend international teams ship their vehicles early in order to allow enough time to compensate for any delays that may occur in clearing Indian Customs. Please check with the Indian Customs Service concerning the regulations governing the temporary importation of vehicles. You may want to consider using the services of freight forwarder, who is familiar with the international shipping of racing vehicles.

Vehicle Shipping

Vehicle shipments by commercial carrier must comply with the laws and regulations of nations from which, and to which, the vehicle is being sent. Teams are advised to consult with their shipping company or freight forwarder to be sure their shipment fully complies with all relevant customs, import/export and aviation shipping requirements.

Shipments must be sent with the participating university listed as the receiving party. The competition organizers, SAE Staff, nor the competition sites can be listed as the receiving party for your vehicle.



Vehicle shipping procedure for the Baja SAE India competition is published on the Baja SAE India website and is incorporated into these Rules by reference.

Baja SAE India Organizing Committee members are not permitted to provide advice on Indian Custom matters.

ARTICLE 8: RULES QUESTIONS

A8.1 Questions

By submitting a question to Baja SAE India, you and your team agree that both your question and the Committee's answer can be reproduced and distributed by SAE, in both complete and edited versions, in any medium or format anywhere in the world.

A8.2 Question Types

Baja SAE India Organizing Committee will answer questions that are not already answered in the rules or FAQs or that require new or novel rule interpretations. The committee will not respond to questions that are already answered in the rules. For example, if a rule specifies a minimum dimension for a part the committee will not answer questions asking if a smaller dimension can be used.

A8.3 Question Submission

An Electronic question submission system has been developed for Indian competition, the current submissions instructions are published on <http://bajaeindiaforum.com/>

A8.3.1 Question Documentation

Teams submitting questions are required to bring copies of the questions and answers with them to technical inspection.

A8.4 Response Time

Please allow a minimum of two (2) weeks for a response. Organizing Committee will respond as quickly as possible, however responses to questions presenting new issues, or of unusual complexity, may take more than two weeks.

NOTE: Please keep in mind that final operating approval of a Baja SAE India vehicle can only be given on site at the competition.

A8.5 Event Related Questions

Questions pertaining to the operation and schedules of Baja SAE India competition should be published on <http://bajaeindiaforum.com/>

ARTICLE 9: PROTESTS

It is recognized that hundreds of hours of work have gone into fielding a vehicle. In the heat of competition, emotions peak and disputes can arise. Baja SAE India Organizing Committee will make every effort to fully review all questions and resolve problems quickly and efficiently.

A9.1 Preliminary Review – Required

If a team has a question about scoring, judging, policies or any official action it must be brought to the Convener/Joint Convener (this may be designated) of the Baja SAE India for an informal preliminary



review before a protest can be filed.

A9.2 Cause for Protest

A team may protest any rule interpretation, score or official action (unless specifically excluded from protest) which they feel has caused some actual, non-trivial harm to their team, or has had a substantive effect on their score. Teams may not protest rule interpretations or actions that have not caused them any substantive damage.

A9.3 Protest Format and Forfeit

All protest must be filed in writing and presented to the convener/joint convener of the Baja SAE India by the team captain or a designated student team member. In order to have a protest considered, a team must post a twenty-five (25) point protest bond which will be forfeited if the protest is rejected.

A9.4 Protest Period

Protests concerning any aspect of the competition must be filed within one half hour (30 minutes) of the end of the event to which the protest relates.

A9.5 Hearing

The time of protest will be noted by the convener/joint convener who will in turn decide the protest with the event head.

A9.6 Decision

The decision regarding any protest is final

PART B: TECHNICAL REQUIRMENTS

ARTICLE 1: GENERAL DESIGN REQUIREMENTS

B.1.1 - General Requirements

The vehicle may only use one Briggs & Stratton engine of a model specified below. The vehicle must be capable of carrying one (1) person 190 cm (75 in.) tall weighing 113 kg (250 lbs.).

B.1.2 - Ergonomic Design

All drivers shall meet the roll cage minimum clearances, and fit into a comfortable driving position, while wearing the entire required driver's equipment. All drivers shall be able to comfortably reach all of the vehicle's controls.

Teams shall be prepared to demonstrate the compliance to this requirement in the design event.

B.1.3 - Good Engineering Practices

Vehicles entered into Baja SAEINDIA® competitions are expected to be designed and fabricated in accordance with good engineering and construction practices.

B.1.4 - All-Terrain Capability

B.1.4.1 - Terrain Type

The vehicle must be capable of safe operation over rough land terrain including obstructions such as rocks, sand, logs, steep inclines, mud, and shallow water in any or all combinations and in any type of weather including rain.



B.1.4.2 - Clearance and Traction

The vehicle must have adequate ground clearance and traction for the terrain type at the competition.

B.1.5 - Vehicle Configuration

The vehicle must have four (4) or more wheels not in a straight line.

B.1.6 - Limitations

Width: 162 cm (64 in) at the widest point with the wheels pointing forward at static ride height.

Length: Unrestricted.

Weight: Unrestricted.

Note: Teams should keep in mind that Baja SAEINDIA® courses are designed for vehicles with the maximum dimensions of 162 cm (64 in.) width by 274 cm (108 in.) length.

ARTICLE 2: ENGINE

B2.1 – Required Engine

Since the year 2012, the Briggs & Stratton India has generously provided engines to the Baja SAE India teams with subsidized charges. In addition, teams are required to pay for the shipping & handling charges. You must order your engine by 1st Aug, 2018 along with necessary payment to B&S. No exceptions each engine will come with a maintenance kit.

A maintenance kit includes the following parts (NEW)

- 5 - Air Filters
- 5 - Air Filter Pre-Filters
- 5 - Fuel Filters
- 5 - Spark Plugs

B2.2 - Engine Orders

Students are advised to purchase engine from Briggs & Stratton authorized engine supplier for Baja SAEINDIA 2019.

M/s Power Equipment's
G8 Sansarchand Road
Ambar Tower
Jaipur
Rajasthan
Ph- 0141-4015633
Email- pe.operations@yahoo.com

B.2.3 - International Orders

Teams from countries outside India will need to write to B&S directly and the engine can be procured from any worldwide location of B&S. Correct part number has to be ensured. For any assistance required, SAEINDIA could be contacted at saeindia_indore@saeindia.org.



Briggs & Stratton India will not ship engines outside Indian borders.

Neither Briggs & Stratton nor SAEINDIA assume any responsibility for the delivery of engines

B.2.4 - Additional Engines

Teams may purchase additional Briggs & Stratton engines directly through the official authorized supplier (Power equipment). There is no special discount on purchase price for additional engines.

B.2.5 - Hybrid Electric Systems

Hybrid-electric drivetrain systems are explicitly prohibited.

B.2.6 - Energy Storage Devices

B.2.6.1 - Hydraulic

Hydraulic accumulators are the only type of stored energy device that may be incorporated into the vehicle for propulsion purposes. Hydraulic power systems must be properly shielded and documentation of the shielding made available for review.

B.2.6.2 - Kinetic

Kinetic energy storage devices, such as flywheels, are explicitly prohibited.

B.2.6.3 - Electric

Batteries or other electric energy storage device for vehicle propulsion are explicitly prohibited. Hybrid electric vehicle propulsion systems are explicitly prohibited.

B.2.6.4 - Compressed Gas

Compressed gas systems for vehicle propulsion are explicitly prohibited.

B.2.7 - Engine Requirements and Restrictions

To provide a uniform basis for the performance events, all vehicles must use the same engine: a stock four cycles, air cooled, Briggs & Stratton OHV Intake Model. The following Briggs & Stratton engines are the only acceptable engines for the 2019 Baja SAE India competition: **No Exceptions**

The required engine must remain completely stock in all ways.

Note: Blueprinting (reworking an engine to a manufacturer's exact specifications) is considered to be a modification and is explicitly prohibited.

Baja Acceptable Engines

19L232-0054-G1 (Vanguard Series)

We are allowing the following engine model codes for this year's event along with the 19-series engine model, in which the first use of engine should be at least 2017 Baja event. (I.e. Engines used for 2017 Baja as new engines are acceptable).

20S232 0036 - F1

20S432 0536 - E9

20S332 0536 - E9

20S332 0536 - B1

The new Model 19 engine is not equipped with an engine mounted fuel tank. A Briggs and



Stratton fuel tank and cap are required to be procured separately from the engine. The fuel tank shall be mounted separately from the engine. Fuel pumps are prohibited.

Teams can use approved fuel tanks and caps or order parts below:

Fuel Tank - 799863

Fuel Cap - B4325GS

B.2.7.1 - Replacement Parts

Only Original Equipment Briggs & Stratton replacement parts may be used. Consumable parts may be ordered on the Briggs & Stratton Web site: <http://www.briggsandstratton.com> or procured from a Briggs & Stratton dealer.

B.2.7.2 - Piston Rings

Only standard size, original Briggs & Stratton piston rings may be used.

B.2.7.3 - Intake Ports

No cleaning or removing of aluminum flashing from intake or exhaust ports may be done.

B.2.7.4 - Valves

Any valve clearance setting between tappet and valve stem may be set. Valves may be lapped to ensure proper sealing. Intake valve seat angle must remain at 45 deg. Exhaust valve seat angle must remain at 45 deg.

B.2.7.5 - Shafts and Rods

The camshaft, crankshaft, connecting rod, and flywheel must not be altered or modified.

B.2.7.6 - Spark Plugs

The only permitted spark plug is RC12YC. No other spark plugs are permitted.

B.2.7.7 - Armature

Any armature air gap setting is allowed. The armature mounting holes shall not be slotted or elongated to increase or retard ignition timing.

B.2.7.8 - Flywheel Rotation

The flywheel shall not be rotated in order to advance or retard timing.

B.2.7.9 - Engine Governor

Each engine is equipped with a speed governor. Each governor will be set at the competition to 3,800 RPM or lower maximum speed. Briggs and Stratton may perform random inspections of the governor on any vehicle and these may be conducted at any time. Any attempt to defeat the engine governor so as to increase the engine speed is grounds for immediate disqualification.

GOVERNOR SETTING NOT TO EXCEED 3800 RPM.

The governor operation must remain free of obstructions at all times. Governor area must be shielded from debris. The stock configuration of fuel tank mounted to the engine is acceptable for debris management. However, if the fuel tank is to be remote mounted, a debris shield covering the exposed governor area is required. Briggs & Stratton part number 697326 Control Cover may be used or some

other part with equivalent features.

The governor spring must be placed in hole #5 for 19 Series Engine

The governor spring must be placed in hole #6 for 20 Series Engine

Part number for Governor Spring is 264080.

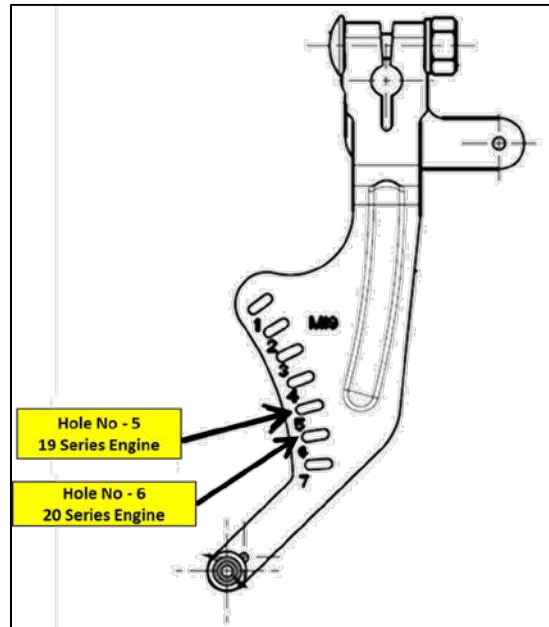


Figure B-1

B.2.7.10 - Idle Speed

Any idle speed adjustment is allowed, Briggs & Stratton recommends 1,750 RPM \pm 100 RPM.

B.2.7.11 - Air Cleaner

The air intake cleaner may be relocated, but Briggs & Stratton parts must be used to relocate the air filter. Parts 592251 (remote kit), 695329 (choke shaft), and 699960 (base) are permitted. No previous part versions are allowed. The supplied intake air hose may be shortened to a minimum of 152 mm (6.0 in.). No other type of hose will be allowed. A team may also add additional pre-filters to the top of the air intake. These parts must be included on the cost report. Any changes made to the air filter will have to pass inspection by Briggs & Stratton.

A fresh air cleaner element & paper filter is required during On-site Technical Inspection - Engine at Baja SAE India 2019.

Note: Relocation of air filter or cleaner housing may decrease engine performance.

B.2.7.12 - Carburetor

B.2.7.12.1 - Jetting

Modifying the carburetor jet or re-jetting of the carburetor is prohibited.

B.2.7.12.2 - Float

The carburetor float is not adjustable and may not be modified.

B.2.7.12.3 - Venturi

Modification of the carburetor venturi is prohibited.

B.2.7.13 - Exhaust System

B.2.7.13.1 - Muffler Relocation

If the vehicle design requires an exhaust system reconfiguration to keep it from impinging on part of the vehicle, the re-routing must be done using tubing having an ID of 32 mm (1.25 in.). Any remote mounted exhaust system must use the original muffler and must be securely mounted so that it does not vibrate loose during the competition.

B.2.7.13.2 - Muffler Support

Supports for the exhaust pipe and muffler are required. Supports must be attached exclusively to the engine.

B.2.7.13.3 - Exhaust Pipe Port

Exhaust pipe may not protrude inside of the exhaust port, so as to alter port configuration.

B.2.7.13.4 - Exhaust Pipe Length

Any exhaust pipe length is allowed, however pipe length may not be adjustable.

B.2.7.13.5 - Exhaust Pipe Continuity

No extra holes or tubes are allowed in the exhaust pipe. One inlet and one outlet are required.

B.2.7.13.6 - Exhaust Durability

The exhaust pipe and muffler must be durable, resilient, completely intact and functional throughout the competition. Any vehicle found to have a loose or leaking exhaust system will be removed from competition until the issue can be corrected.

B.2.7.13.7 - Exhaust System Complete

The complete exhaust system shall be located such that its extremities lie at least 100 mm within the perimeter of the vehicle. (The perimeter of the vehicle stands for the envelope formed by the planes of the roll cage members). (Refer figure B2.1)

Note (Updated): Engines shall not be placed in a way such that exhaust is facing towards the firewall. In case of exhaust facing the firewall, the teams should ensure the clearance between exhaust and firewall is minimum 100mm after rerouting of exhaust & which will be validated by Briggs & Stratton at the main event. The team may be subjected to modify the routing if it's not meeting the requirements of Briggs & Stratton.

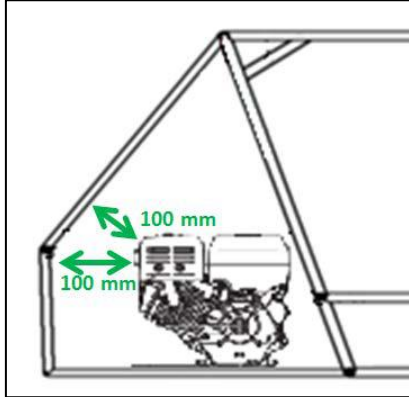


Figure B-2.1

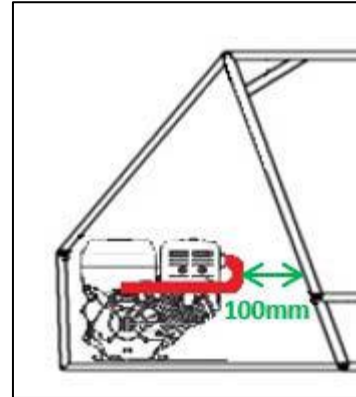


Figure B-2.2

Note (Updated): Figure B-2.2 showing Engine placed & exhaust facing towards driver with red colored pipe used for rerouting. Green arrow indicates the clearance required between the outer periphery of the exhaust rerouting pipe and RRH which should be > 100mm.

B.2.7.14 - Starter Rope Extension

The starter rope may be extended to accommodate the driver starting the engine while seated.

B.2.7.15 - Alternator

The engine may be fitted with an approved alternator to generate electrical power. The only alternators which are permitted are those which Briggs & Stratton specifies for the engine model. Available alternators are sized in 3, 10, and 20 Ampere versions.

B2.8 - GO GREEN AWARD

Regarding GO GREEN Award, concept model & system need to be separately worked out for fitment on vehicle to demonstrate the performance & presentation during the event. Details for GO GREEN Award will be separately put on the official Baja SAE India website.

ARTICLE 3: ROLL CAGE

B.3.1 - Objective

The purpose of the roll cage is to maintain a minimum space surrounding the driver. The cage must be designed and fabricated to prevent any failure of the cage's integrity during normal operation or during a collision or roll over.

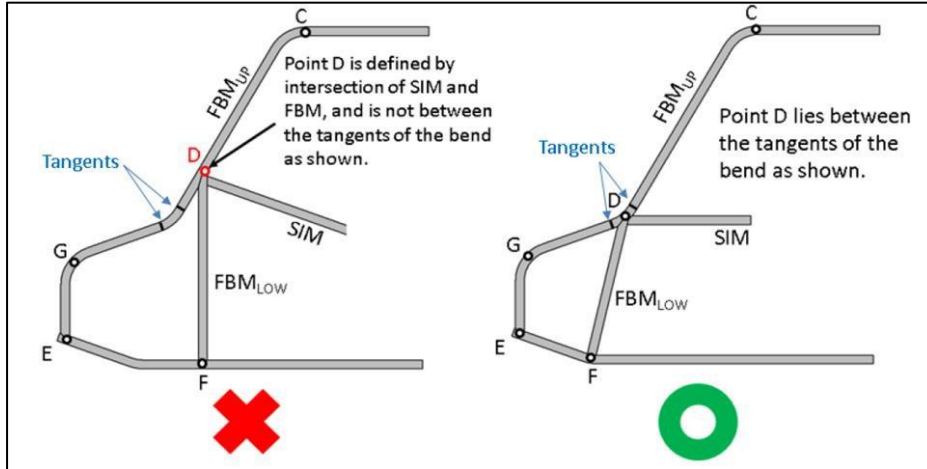


Figure B-3: Roll Cage, Bend and Member Termination

B.3.2 - Roll Cage Structure

The following section outlines the requirements of the physical members and joining methods of the roll cage.

B.3.2.1 - Member Requirements

Roll cage members must be made of steel tube, and may be straight or bent. Straight members may not extend longer than 1016 mm (40 in.) between Named Points. Bent members may not have a bend greater than 30 deg. that does not occur at a Named Point; and may not extend longer than 838 mm (33 in.) between Named Points. Small bend radii (<152 mm or 6 in.) that terminate at Named Points are expected, and are not considered to make a member bent, regardless of angle. A bend that terminates at a Named Point implies the point lies between the tangents of the bend, as shown in Figure B-3. Required dimensions between roll cage members are defined by measurements between member centerlines, except where noted.

B.3.2.2 - Primary Members

The roll cage must be a space frame of tubular steel. The required members of the roll cage are illustrated in Figure B-4. Primary members must conform to B.3.2.16 - Roll Cage Materials.

Primary members are:

RRH	Rear Roll Hoop
RHO	Roll Hoop Overhead Members
FBM	Front Bracing Members
ALC	Aft Lateral Cross Member
BLC	Overhead Lateral Cross Member
CLC	Upper Lateral Cross Member
DLC	SIM Lateral Cross Member
FLC	Front Lateral Cross Member
LFS	Lower Frame Side Members

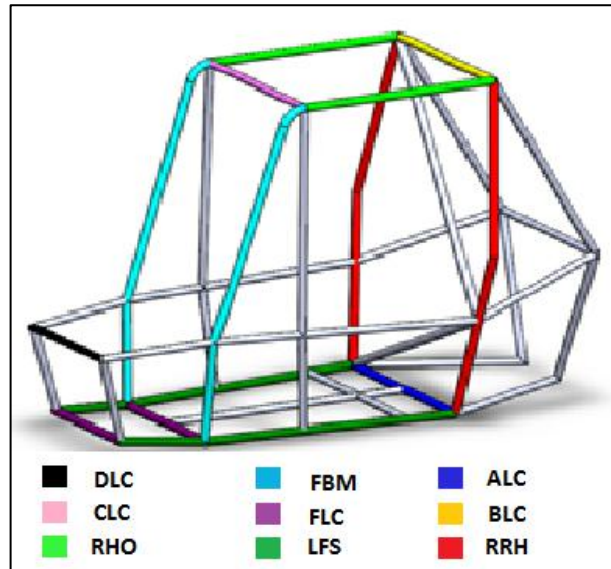


Figure B-4: Roll Cage, Primary Members

B.3.2.3 - Secondary Members

The required secondary members of the roll cage are illustrated in Figure B-5

LDB	Lateral Diagonal Bracing
SIM	Side Impact Members
FAB	Fore/Aft Bracing Members
USM	Under Seat Member
RLC	Rear Lateral Cross Member

- Any tube that is used to mount the safety belts or fuel tank

Secondary members must be steel tubes having a minimum wall thickness of 0.89 mm (0.035 in) and a minimum outside diameter of 25.4 mm (1.0 in):

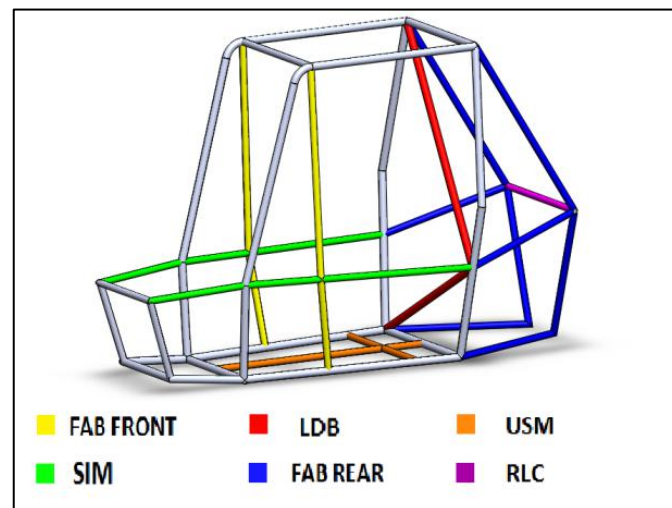


Figure B-5: Roll Cage, Secondary Members

Note: Ends of the ALC member should be extended and left open for measurement purpose of the pipe cross section.

Any one member in the engine compartment area should also be left open for the same purpose.

Note: Colour coding is given only for the better understanding of the design & not to be related with primary & secondary members.

B.3.2.4 Additional Support Members

For bent or straight Roll Cage Members that exceed the maximum allowable length, additional support members may be added. For straight members, a single secondary member should connect from the mid-point (+/- 127 mm or 5 in.) to a Named Point. For bent members, a single secondary member should connect from between the tangents of the bend to a Named Point. At no time may a bent member have a bend greater than 30°.

Named Roll Cage Points: A, B, C, D, F, S, (E and/or G for 'Nose' cars) and P, Q, and R as applicable for FAB systems. All named points are implied to have a Left and Right hand side, denoted by subscript L or R (e.g. AL and AR) as shown in Figure B-6 and Figure B-7.

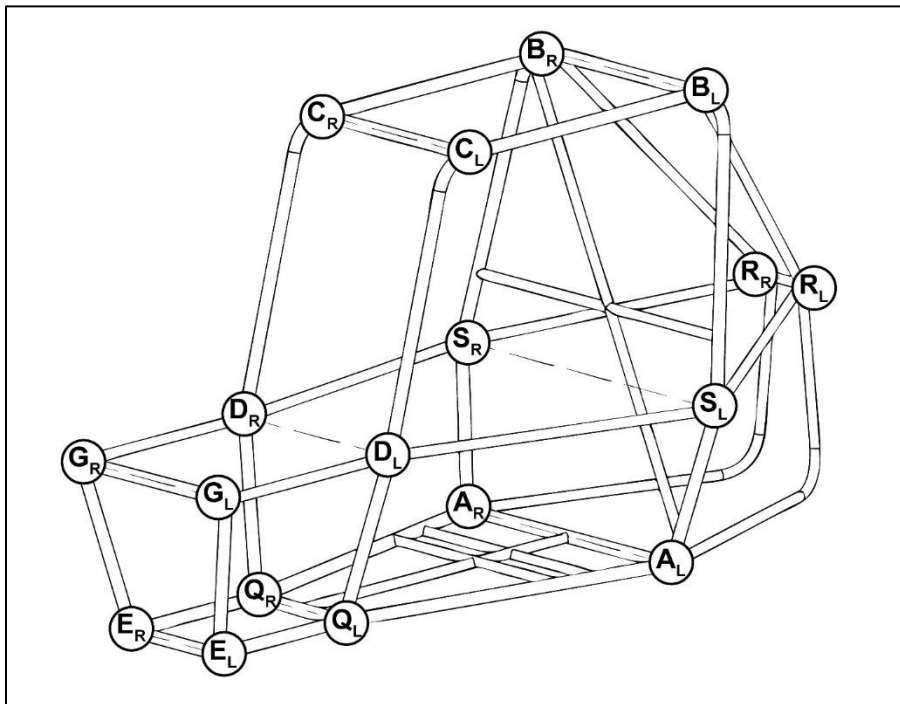


Figure B-6: Roll Cage, Named Roll Cage Points, Rear Braced Frame.

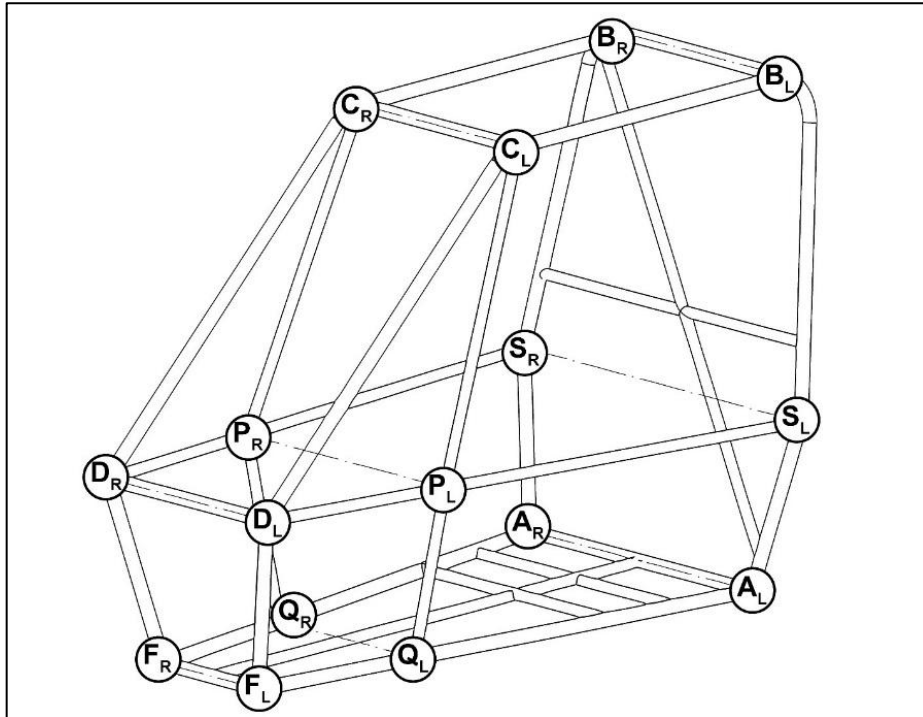


Figure B-7: Roll Cage, Named Roll Cage Points, Front Braced Frame

B.3.2.5 LC – Lateral Cross Member

Lateral cross members cannot be less than 203.5 mm (8 in.) long. LC's cannot have a bend; however, they can be a part of a larger, bent tube system, provided the minimum length is met between bend tangents. The cross members which connect the left and right points A, B, C, D, F and E/G for 'Nose' cars (in which case DLC may be omitted) and must be made of primary materials and shall meet minimum required lengths. LC's are denoted by the points they connect (e.g. ALC, FLC, etc.). The LC at Point R (RLC) for Rear FAB systems may be secondary material and must meet the minimum length described above.

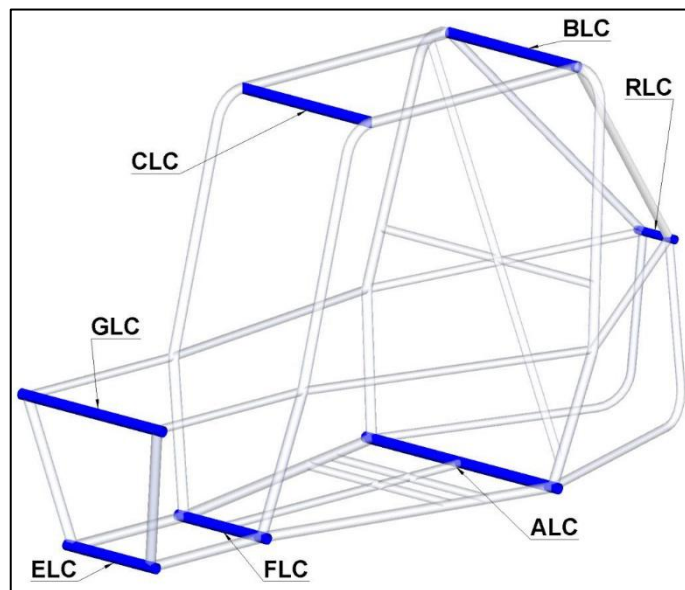


Figure B-8: Roll Cage, LC

Note (Updated): however, ALC member minimum length requirement should be of 457mm (18in) & does not fall under above clause of (8in) requirement.

B.3.2.6 - RRH (Rear Roll Hoop)

The RRH is a planar structure behind the driver's back, and defines the boundary between the front-half (fore) and rear-half (aft) of the roll cage. The driver and seat must be entirely forward of this panel. The RRH is substantially vertical, but may incline by up to 20 deg. from vertical. The minimum width of the RRH, measured at a point 686 mm (27 in.) above the inside seat bottom, is 736 mm (29 in.). In addition to this, minimum width of the RRH measured 14 in above the inside seat bottom should be minimum 32 inch. The vertical members of the RRH may be straight or bent, and are defined as beginning and ending where they intersect the top and bottom horizontal planes (points AR and AL, and BR and BL in Figure B-9). The vertical members must be continuous tubes (i.e. not multiple segments joined by welding). The vertical members must be joined by ALC and BLC members at the bottom and top. ALC and BLC members must be continuous tubes or adhere to B.3.2.14 - Butt Joints. ALC, BLC, RRH members, LDB and the shoulder belt tube must all be coplanar.

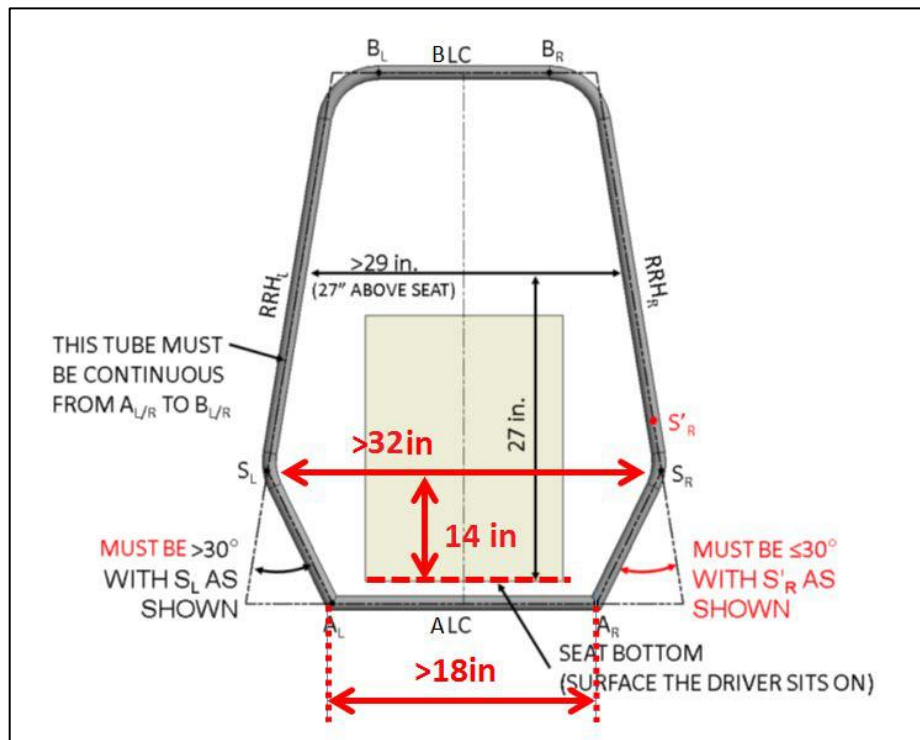


Figure B-9: Roll Cage, RRH

B.3.2.7 LDB Lateral Diagonal Bracing

The RRH must be diagonally braced. The diagonal brace(s) must extend from one RRH vertical member to the other. The top and bottom intersections of the LDB members and the RRH vertical members must be no more than 127 mm (5 in.) from points A and B. The angle between the LDB members and the RRH vertical members must be greater than or equal to 20 deg. Lateral bracing may consist of more than one member.

A single straight LDB is exempt from the maximum length in B.3.2.1 - Member Requirements.

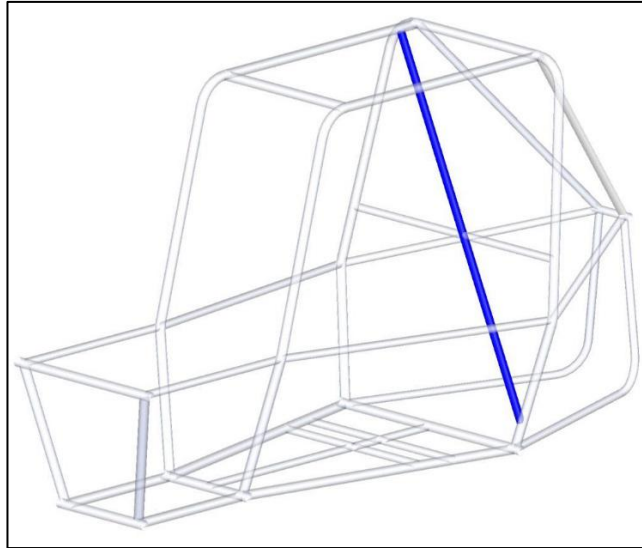


Figure B-10: Roll Cage, LDB

Note Updated: If more than one members are used for LDB (as shown in Figure B-11), both members must meet at the same point.

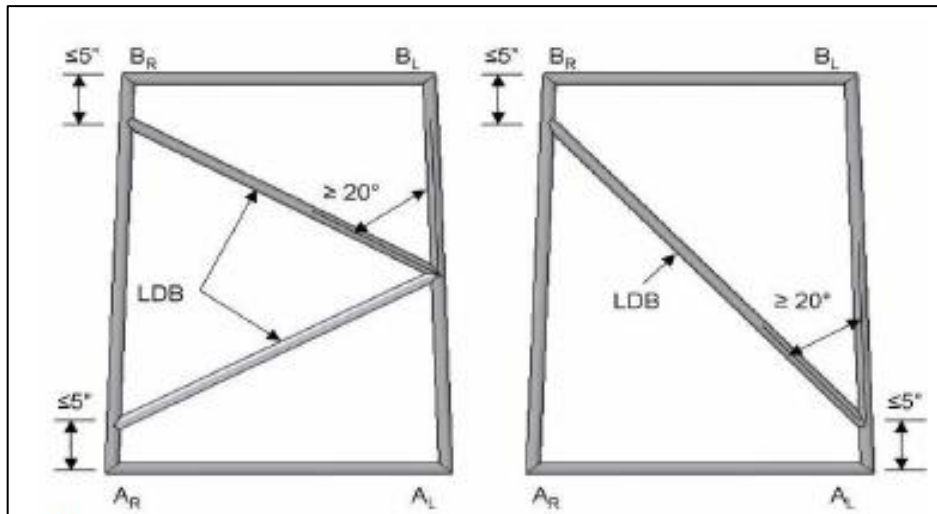


Figure B-11: Roll cage, LDB

B.3.2.8 RHO Roll Hoop Overhead Members

The aft (rearward) ends of the RHO members intersect the RRH and define Points BR and BL (joined by BLC). The forward ends of the RHO members (intersection with the CLC) define points CR and CL (Figure B-12). CLC, BLC and RHO members must all be coplanar and bends at the aft (rearward) ends of the RHO members are not permitted.

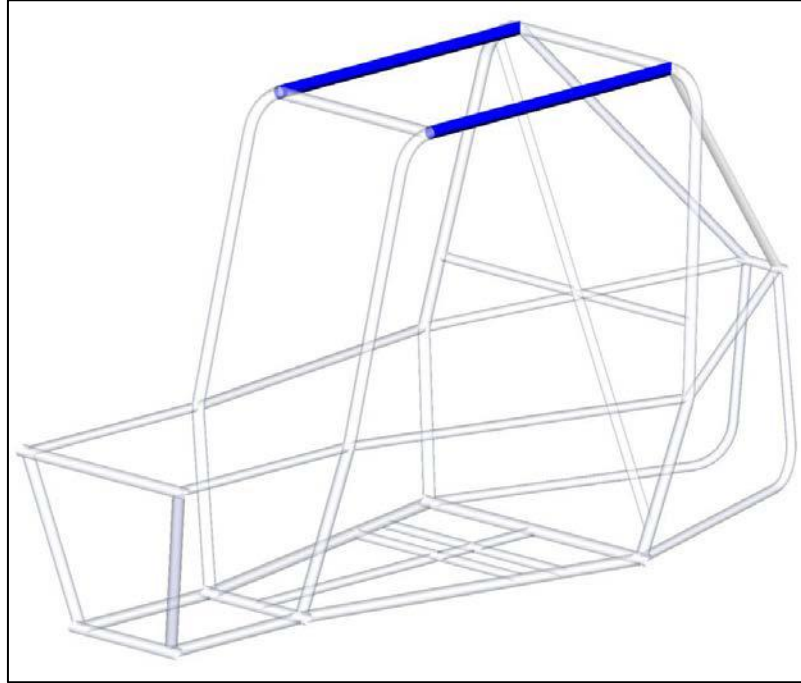


Figure B-12: Roll Cage, RHO

Points CR and CL must be between at least 305 mm (12 in.) forward of a point, in the vehicle's side view, defined by the intersection of the RHO members and a vertical line rising from the aft end of the seat bottom. This point on the seat is defined by the seat bottom intersection with a 101 mm (4 in.) radius circle which touches the seat bottom and the seat back. The top edge of the template is exactly horizontal with respect to gravity.

Points CR and CL and Points BR and BL must also be no lower than the top edge of the template, 1041.4 mm (41 in) above the seat and shall satisfy the Lateral Space requirements in Rule B.3.3.1 - Lateral Space.

Note: The top, longitudinal edge of the template shall be oriented exactly horizontal with respect to gravity.

The two RHO members must be braced using a diagonal member conforming to Rule 3.2.1 Secondary member as highlighted in blue in Figure B - 13. The end points of the diagonal members welded must lie in the same plane as the RHO members and must be less than 3 inch away from points CR/CL and BR/BL respectively measured in the direction of vehicle's longitudinal axis.

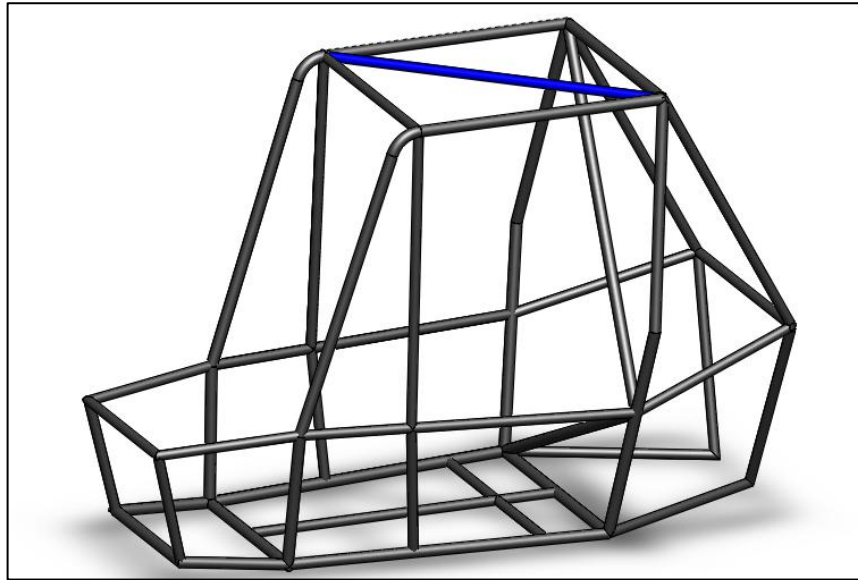


Figure B- 13

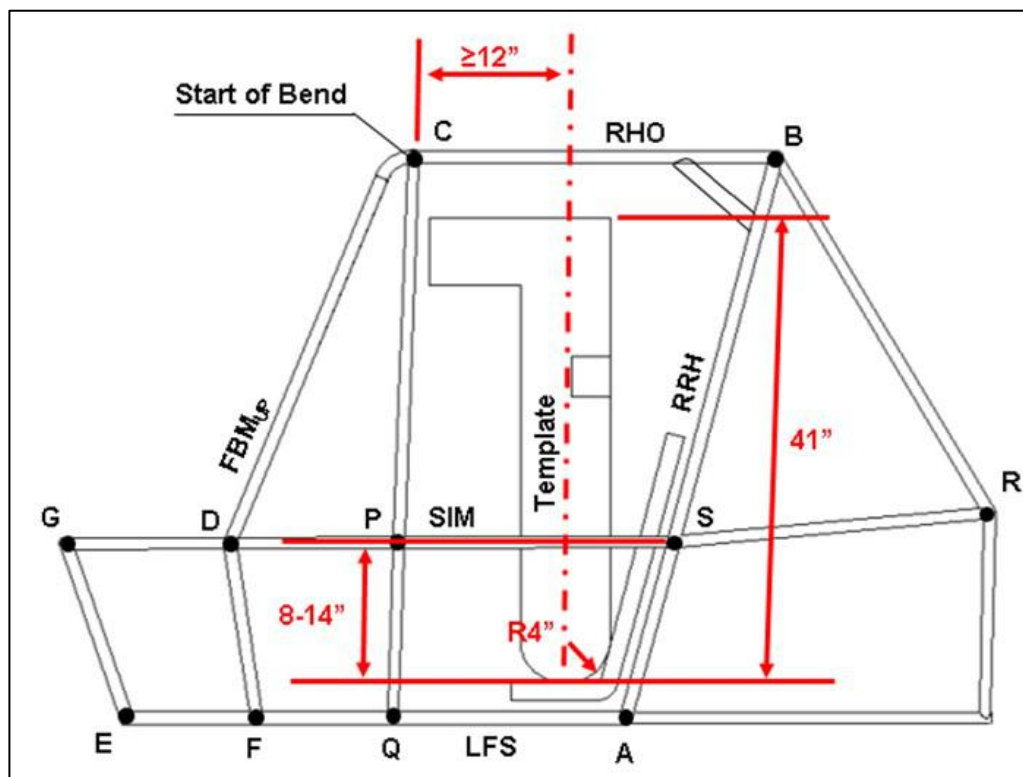


Figure B-14: Roll Cage, Template Installation

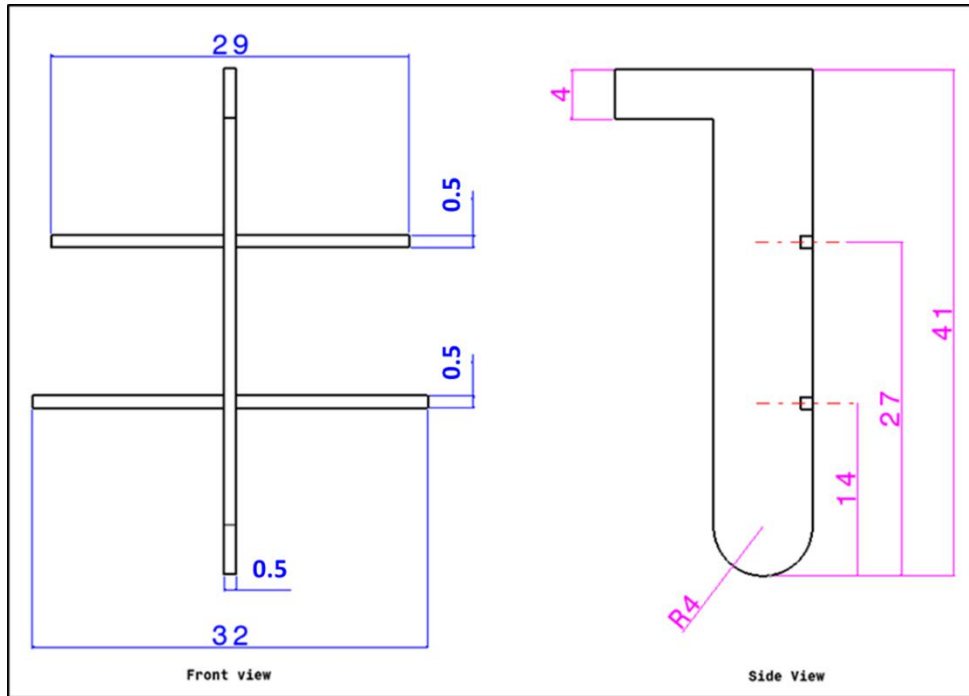


Figure B-15: Roll Cage Template Drawing (All Dimensions are in inches)

B.3.2.8.1 - Gussets for RHO and RRH

If a gusset is used to brace the RHO and RRH to achieve the Lateral Clearance in Rule B.3.3.1 - Lateral Space the added tubes must be a primary member (B.3.2.16 - Roll Cage Materials); completely welded around the circumference of both ends of the gusset tube.

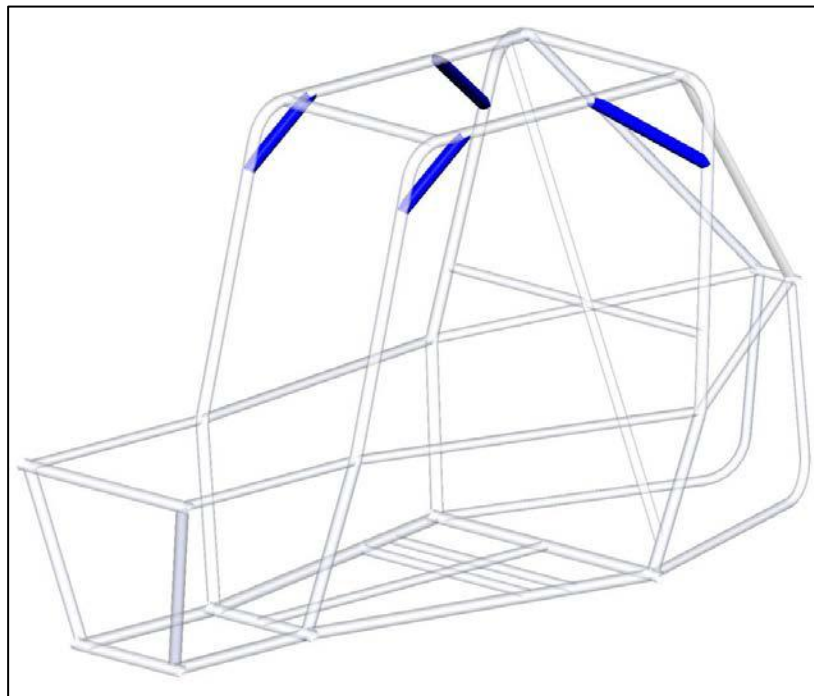


Figure B-16: Roll Cage, Gussets

B.3.2.9 - LFS – Lower Frame Side Members

The two Lower Frame Side members define the lower right and left edges of the roll cage. These members are joined to the bottom of the RRH at Point A and extend generally forward, at least as far as a point forward of every driver’s heels, when seated in normal driving position. The forward ends of the LFS members are joined by a lateral cross member, FLC (Figure B-8). The intersection of the LFS members and the FLC define the points FR and FL. In ‘Nose’ designs, as shown in Figure B-17, the LFS extends forward to Point E, and is joined by a lateral cross member FLC and ELC (Figure B-8).

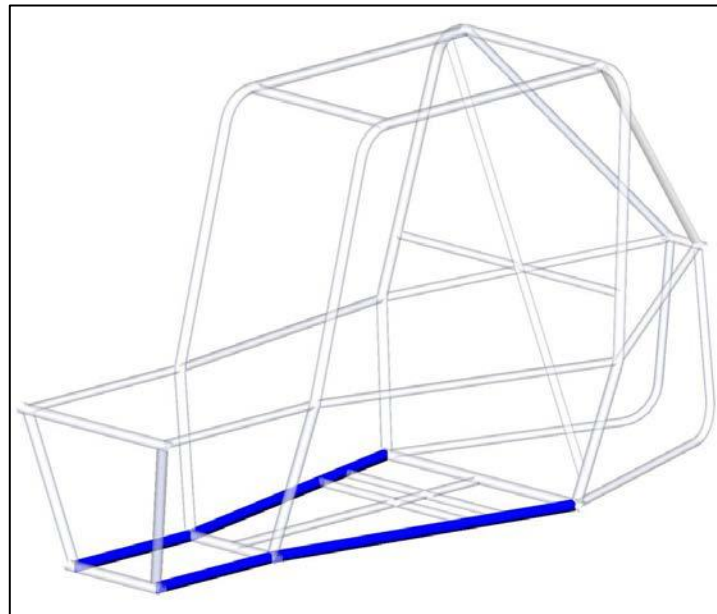


Figure B-17: Roll Cage, LFS

B.3.2.10 SIM – Side Impact Members

The two Side Impact Members (SIM) define a horizontal mid-plane within the roll cage. These members are joined to the RRH, defining Point S, and extend generally forward, at least as far as a point forward of every driver’s toes, when seated in normal driving position. The forward ends of the SIM members are joined by a lateral cross member, DLC. The intersection of the SIM and DLC define the points DR and DL. The SIM members must be between 203 mm (8 in.) and 356 mm (14 in.) above the inside seat bottom (Figure B-14) at all positions between points S and D. In ‘Nose’ designs, as shown in Figure B-18, the SIM extends forward to Point G, and is joined by a lateral cross member GLC (Figure B-8). In this case, DLC may be omitted if GLC provides adequate protection for the driver’s toes as noted below.

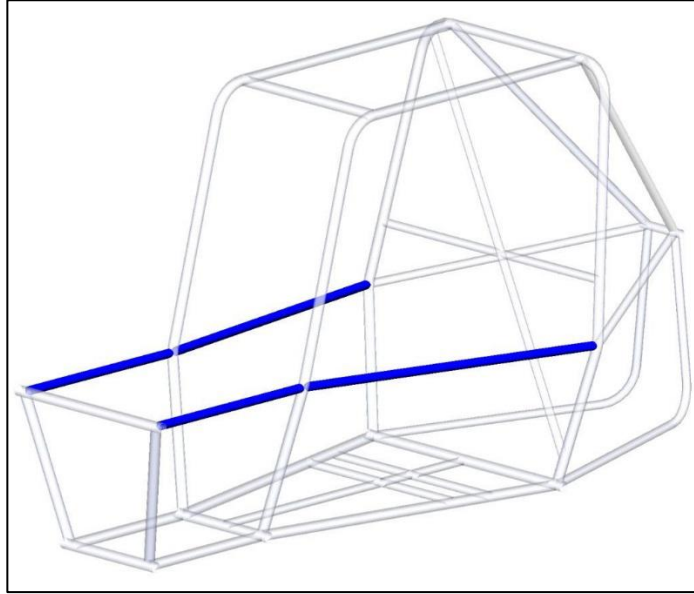


Figure B-18: Roll Cage, SIM

Note: Every driver's feet must be entirely behind the plane defined by points FR, L and DR, L. If DLC is below the driver's toes, then an additional primary material Lateral Cross Member must run between the FBM members above the driver's toes.

In 'Nose' designs, if GLC is below the driver's toes then an additional primary material Lateral Cross Member must be run between FBM members above the driver's toes.

B.3.2.11 USM – Under Seat Member

The USM must be positioned in such a way to prevent the driver from passing through the plane of the LFS in the event of seat failure. Two options are given for the USM member:

- 1) The two LFS members must be joined by the Under Seat Members. The USM must pass directly below the driver where the template in Figure B-14 intersects the seat bottom.
- 2) The ALC and FLC members must be joined longitudinally by the Under Seat Member. The USM must and pass directly below the driver where the template in Figure B-14 intersects the seat bottom.

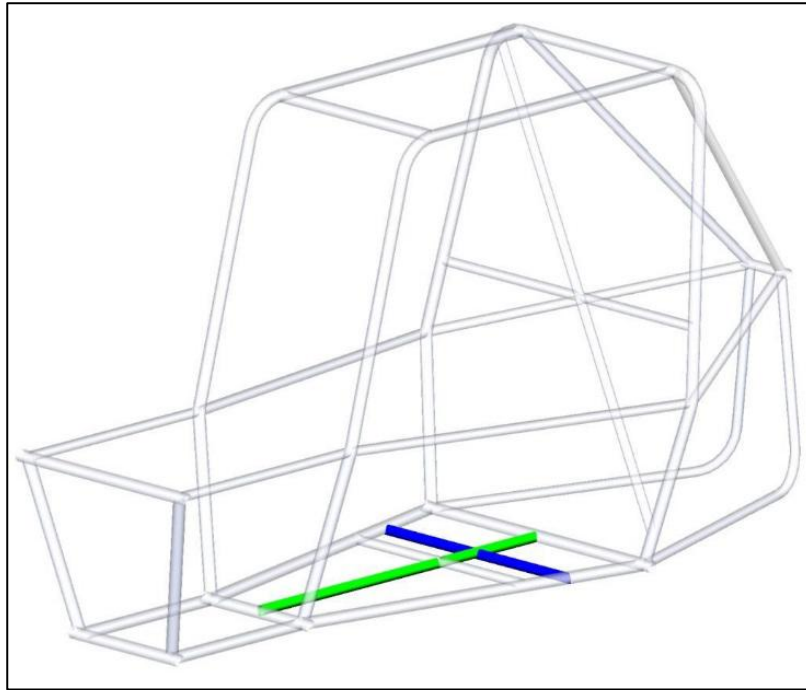


Figure B-19: Roll Cage, USM

B.3.2.12 FBM – Front Bracing Members

Front Bracing Members must join the RHO, the SIM and the LFS (Figure B-20) at Points C, D and F. The upper Front Bracing Members (FBM_{UP}) must join points C on the RHO to point D on the SIM. The lower Front Bracing Members (FBM_{LOW}) must join point D to point F. The FBM must be continuous tubes. The angle between the FBM_{UP} and the vertical must be less than or equal to 45 deg. If Front FAB, per Rule B.3.2.13.1 - Front Bracing, is used there is no angle requirement between FBM and vertical.

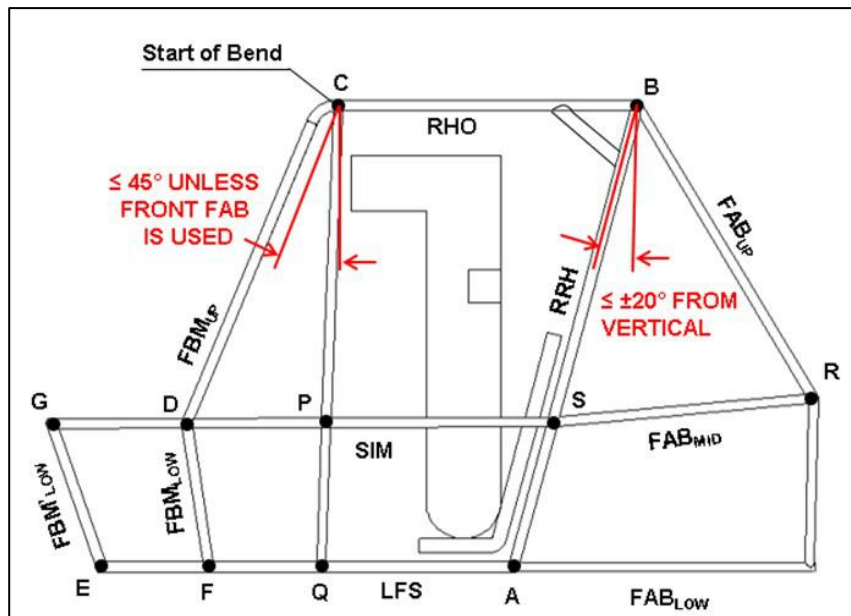


Figure B-20: Roll Cage, FBM

B.3.2.12.1 - Gussets for RHO and FBM

If the RHO and FBM on one side of the vehicle are not comprised jointly of one tube, bent at point C, then a gusset is required at point C to support the joint between the RHO and the FBM. The total weld length of the gusset must be two times the tubing circumference (of the primary material). Thus, if a tube is used to brace the FBM and RHO, it must be a primary tube.

B.3.2.13 - FAB – Fore - Aft Bracing

The RRH must be restrained from rotation and bending in the side view by a system of triangulated bracing. Bracing must either be front bracing or rear bracing:

- Rear Bracing - directly restrain both points B from longitudinal displacement in the event of failure of the joints at points C; or
- Front Bracing - restrain both points C from longitudinal and vertical displacement, thus supporting points B through the RHO members. A better design will result if both front and rear bracing are incorporated.

Members used in the FAB systems must not exceed 1016 mm (40 in.) in unsupported length. Triangulation angles (projected to the side view) must be at least 20 deg. between members.

B.3.2.13.1 - Front Bracing

Front systems of FAB must connect the FBM_{UP} members to the SIM members (on the same sides). The intersection with the FBM_{UP} members must be within 127 mm (5 in.) measured as a straight line distance from centerline to centerline of point C. The intersection with the SIM members (defined at Point P) must be vertically supported by further members connecting the SIM members to the LFS members (defined at Point Q).

B.3.2.13.2 - Rear Bracing

Rear systems of FAB must create a structural triangle, in the side view, on each side of the vehicle. Each triangle must be aft of the RRH, include the RRH vertical side as a member, and have one vertex at Point B and one vertex at either Point S or Point A. The tubes forming this structural triangle must be continuous members; but bends of less than 30 deg. are allowable. The third (aft) vertex of each rear bracing triangle, Point R (Figure B-21), must additionally be structurally connected to whichever Point, S or A, is not part of the structural triangle. This additional connection is considered part of the FAB system, and is subject to B.3.2.1 - Member Requirements, but may be formed using multiple joined members, and this assembly of tubes, from endpoint to endpoint, may encompass a bend of greater than 30 deg.

Attachment of rear system FAB must be within 127 mm (5 in.) of Point B, and must be within 51 mm (2 in.) of points S and A, on each side of the vehicle. Distances are measured as a straight line distance from centerline to centerline. The aft vertices, at Point R, of the FAB structural triangles must be joined by an LC.

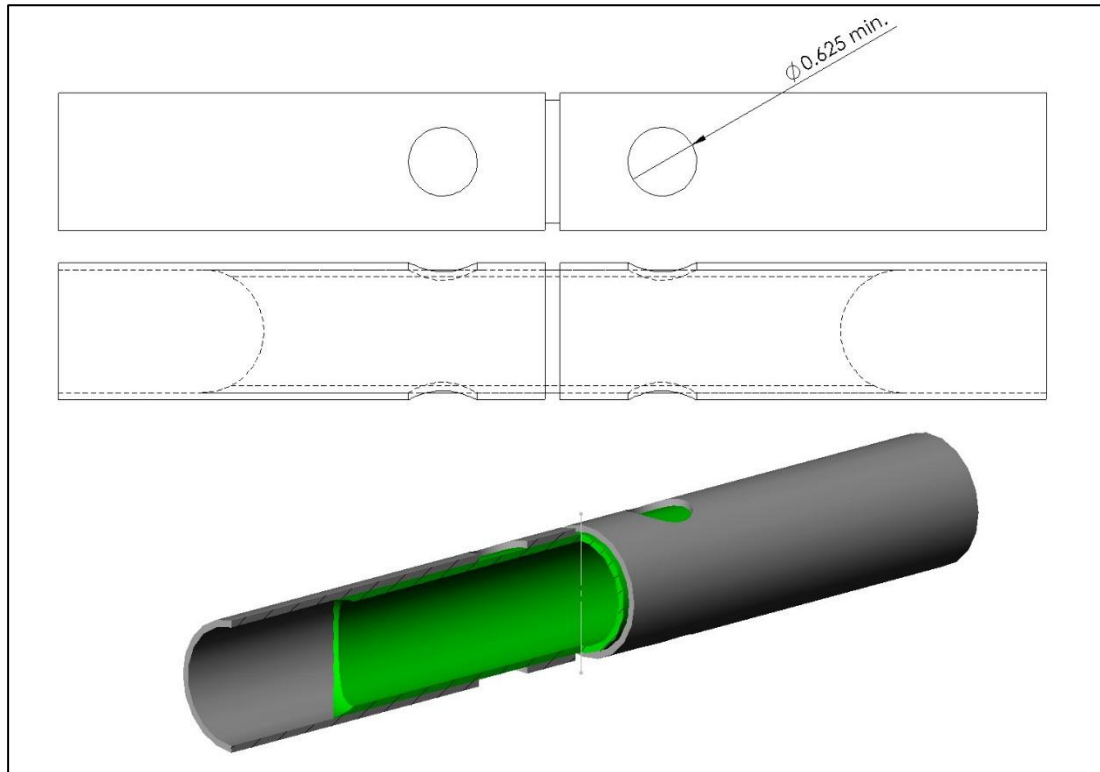


Figure B-22: Roll Cage, Butt Joint Tube Sleeve

B.3.2.14.3 - Welding

The general arrangement of an acceptable sleeved joint is shown in Figure B-22. A butt weld and four (4) rosette welds are required. Two (2) rosette welds are required each tube piece. Rosette welds are to be made in holes of a minimum diameter of 16 mm (0.625 in.).

A minimum of 102 mm (4.0 in.) of linear weld is required to secure the sleeve inside the joint, including the butt joint and the rosette welds.

B.3.2.15 - Welding Process Check

Each person who makes any welded joint on any of the vehicle's roll cage elements must personally make two welding samples (defined below), using the same materials and processes as used in the roll cage element welds. All welding samples must be submitted at Technical Inspection. Vehicles for which complete sets of welding samples are not submitted, or for which any of the welding samples are judged inadequate, will not be allowed to compete in dynamic or endurance events.

Welding samples must be made from the same tube material, diameter, and thickness as the welds made by each person on the roll cage elements. For information on best practices for weld samples, see www.bajasae.net/go/downloads.

All weld samples shall be labeled by permanent means such as engraving, etching, or stamping with all of the following information:

- College Name or College Initials
- Welder Name or Welder Initials

- Date of construction of weld sample

Sample 1 – Destructive Testing:

A 90-degree joint, the leg length is unrestricted (Figure B-23). This joint must be destructively tested causing the joint to fail in the base material (as opposed to the weld metal). The testing method is free either tensile or bending failure may be induced; however, the peak stress must be located at the weld. In the case of bending failure, take care that the largest bending moment is located at the weld.

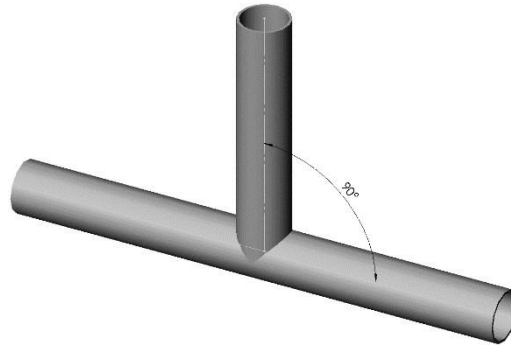


Figure B-23: Roll Cage, Welding Sample 1

Sample 2 – Destructive Inspection

Two tubes joined at a 30 degree angle with a length of at least 150 mm (5.9 in.) from the center of the joint (Figure B-24). The sample must be sectioned along the length of tube to reveal adequate and uniform weld penetration (Figure B-24).

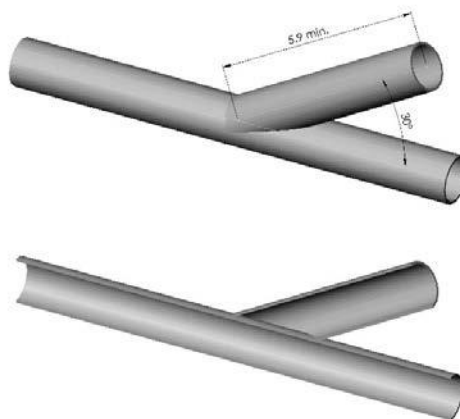


Figure B-24: Roll Cage, Welding Sample 2

B.3.2.16 - Roll Cage Materials

The material used for the Primary Roll Cage Members and bracing must meet one of the following requirements:



- Circular steel tubing with an outside diameter of 25 mm (1.0 in) and a wall thickness of 3 mm (0.120 in.) and a carbon content of at least 0.18%.
- A steel shape with bending stiffness and bending strength exceeding that of circular steel tubing with an outside diameter of 25 mm (1.0 in.) and a wall thickness of 3 mm (0.120 in.). The wall thickness must be at least 1.57 mm (0.062 in.) and the carbon content must be at least 0.18%, regardless of material or section size. The bending stiffness and bending strength must be calculated about a neutral axis that gives the minimum values.

Bending stiffness, k_b , is given by:

$$k_b = EI$$

Where:

E - Modulus of elasticity (205 GPa for all steels)

I - Second moment of area for the structural cross section

Bending strength, S_b , is given by:

$$S_b = \frac{S_y I}{c}$$

Where:

S_y - Yield strength (365 MPa for 1018 steel)

c - Distance from neutral axis to extreme fiber

Documentation of the equivalency must include:

- 1) Typed calculations to be presented at Technical Inspection which proves sufficient bending stiffness and bending strength. All calculations must be in SI units, to three significant figures to the nominal tube sizes as specified by the invoice. Teams shall show figures for 1018 steel and the substitute material.
- 2) Invoices of the roll cage materials.
- 3) Material tests or certifications, which specify the carbon content and yield strength.

B.3.2.17 - Roll Cage Specification Sheet

Each vehicle must present a completed and signed Baja SAEINDIA® Roll Cage Specification Sheet at Technical Inspection.

B.3.3 - Driver Clearance

B.3.3.1 - Lateral Space

Minimum space is based on clearances between the driver and a straight edge applied to any two points

on the outside edge of the roll cage structure. The driver's helmet shall have 152 mm (6 in.) clearance, while the driver's shoulders, torso, hips, thighs, knees, Lower legs, arms, elbows, and hands shall have 76 mm (3 in.) clearance. Clearances are relative to any and all drivers selected at technical inspection, seated in a normal driving position, and wearing all required equipment.

For any member to be a part of the roll cage, that member must be listed in B.3.2.2 - Primary Members, otherwise it is assumed to have no contribution (Suspension components, additional gussets, and cross members are examples of members which do not conform to B.3.2.2). If there are any triangulating members joining the RHO to the vertical members of the Rear Roll Hoop, and these triangulating members conform to B.3.2.16 - Roll Cage Materials, then the virtual side surfaces may be extended by an outboard crease over the triangulating members.



Figure B - 25

B.3.3.2 - Vertical Space

The driver's helmet shall have 152 mm (6 in.) minimum clearance from any two points among those members that make up to top of the roll cage. These members are: the RHO members (exclusive of any covering or padding); the RRH upper, LC; and the LC between points C (left and right). In an elevation (side) view, no part of the driver's body, shoes, and clothing may extend beyond the envelope of the roll cage.

B.3.4 - Sharp Edges

The entire vehicle, including the roll cage shall have no exposed sharp edges which might endanger the driver, track workers, or people working around the vehicle while the vehicle is in any attitude (static, dynamic, inverted, etc.).

B.3.5 - Bolted Roll Cages

Bolted Roll cages joints are acceptable only if the following requirements are met (Figure B-26):

- 1) Flanges or tabs must be twice (2x) the thickness of the frame tube, and made of the same material. They must be properly welded to each tubing part to be joined. The face of the flange must be perpendicular to the axis of the frame tube.
- 2) The radius of the flange must be at least 25 mm (1.0 in.) larger than the outer radius of the frame tube.

- 3) The gap between faces of the flanges (before being tightened) must be no greater than 0.07 mm (0.003 in).
- 4) The flanges must be attached with at least 3 bolts with a minimum diameter of 8 mm (0.313 in.), equally spaced on the flanges. The minimum edge distance between the bolt holes and the edge of the flanges must be twice the bolt diameter.
- 5) Pin Joints are not permitted

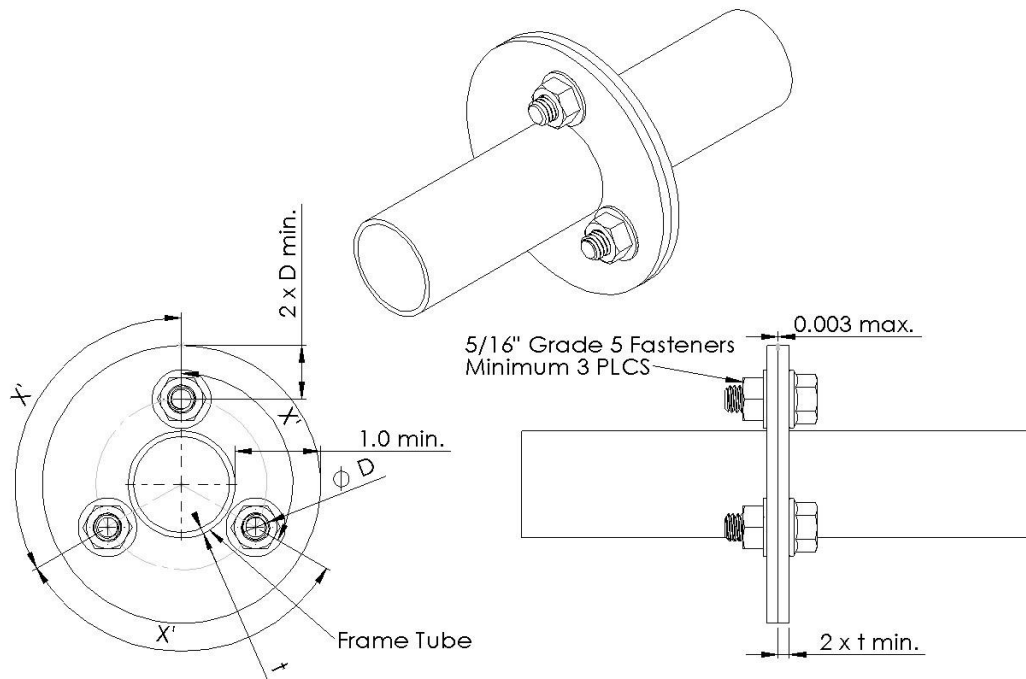


Figure B-26: Roll Cage, Required Joint for Removable Members

B.3.6 - Drilled Frame Members

B.3.6.1.1 - Sleeved Joints

Frame members which need to be drilled for the purpose of mounting fasteners or routing accessories must be reinforced with a weld-in sleeve. Sleeves must be designed to fit tightly on the inside of the hole or joint being reinforced. Sleeves must extend beyond the tube on both sides and be fully welded to the tube. An unacceptable joint is denoted by a red "X". An acceptable joint is denoted by a green "O" in Figure B-27.

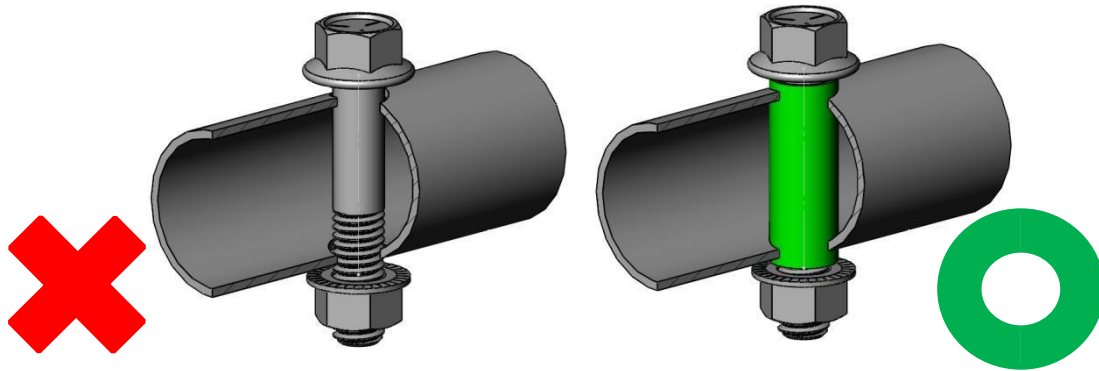


Figure B-27: Roll Cage, Required tube sleeve for drilled holes

B.3.7 - Frame Documentation Package

B.3.7.1 - Required Documents

Required documents for the Frame Documentation Package include: Roll Cage Specification Sheet & frame material documentation (invoices, certifications, calculations, etc.). Frame diagram/drawings are not required.

B.3.7.2 - Document Submittal

- 1) Download the form and template from www.bajasaeindiaforum.com download section (Note: All files that are uploaded must be in a PDF format)
- 2) Upload the Frame Documentation Package (max size 5 MB)
 - a. Roll Cage Specification Sheet
 - b. Frame Material Documentation
 - c. Invoice of roll cage material
 - d. Material Test of Certification
 - e. Any Required Calculation per rule B.3.2.16 - Roll Cage Materials
 - f. A diagram highlighting what parts of the frame were outsourced or professionally fabricated

B.3.7.3 - Process

Documents will be reviewed by the National Technical Inspectors on a first come first serve basis. Typical review period will be 30 days after submittal. After review, feedback will be given to teams. If the submission is rejected by the National Technical Evaluation judges, the team must correct the error noted in the rejection and continue to resubmit the Frame Documentation Package, until they are marked Accepted. It is the responsibility of teams to submit complete documents by the appropriate deadlines. If teams have additional questions, they will need to use other resources to find the answers or wait until competition.

Note: If a team's initial Frame Check Document is received more than five (3) days late it will be classified as "Not Submitted" and your team will be removed (withdrawn) from the event. Documents do not need to receive a Pass Judgement in order to satisfy this requirement.

ARTICLE 4: DRIVER RESTRAINT

B.4.1 - Function

The driver restraint system shall function to safely and securely hold the driver within the envelope of the vehicle's roll cage. The driver restraint system shall also quickly and completely disengage when required to allow the driver a minimum egress time. The driver restraint system consists of a safety harness, arm restraints, and the vehicle's seat. The driver restraint system shall be fully functional and properly worn whenever the driver is seated in the vehicle.

B.4.2 - Driver Harness

The driver harness shall consist of a 5-point (or more) system comprised of two shoulder belts (left and right), two lap belts (left and right), and one or more anti-submarine belts all joining at a single, central buckle (disconnect point). The anti-submarine belt serves to positively locate the buckle and prevent the driver from riding under the lap belts.

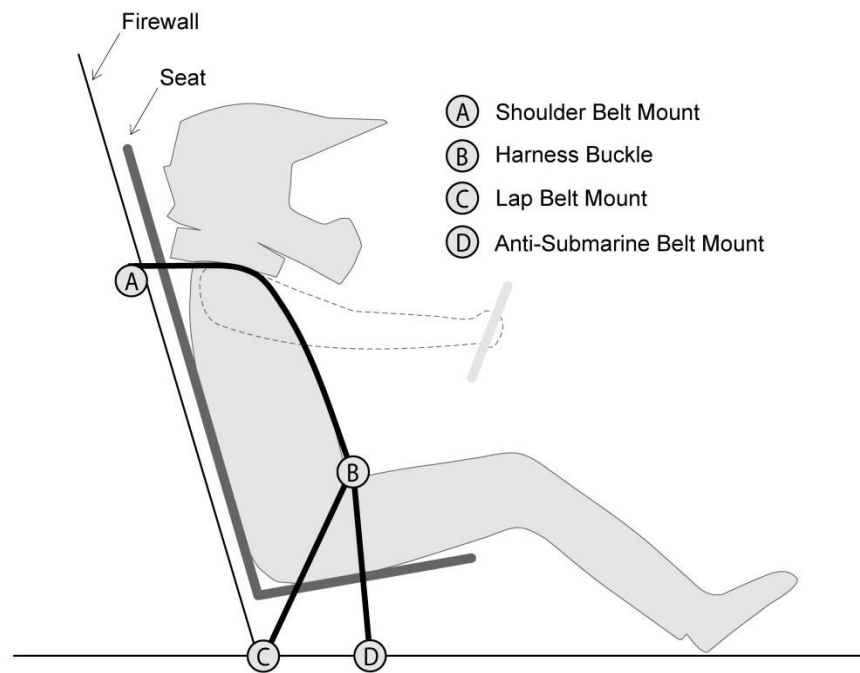


Figure B-28: Driver Harness Schematic

B.4.2.1 - Certification

All driver restraint systems shall meet either SFI Specification 16.5/16.1, or FIA specification 8853/98. The material of shoulder and lap belts shall be of Nylon or Dacron polyester and in new or like-new condition, 76 mm (3.0 in.) in width, and free from injurious defects. Anti-submarine belts shall meet the same conditions, but have a minimum width of 51 mm (2.0 in.).

B.4.2.2 - Expiration

In December of 2016, SFI updated the design and format of driver harness expiration tags. Manufacturers are permitted to use old tags until their supply runs out. Baja SAEINDIA® permits the use of driver

harnesses with the old and the new tag design, provided:

For old style tags: On **April** 1st of the competition year, harnesses shall be no more than three (3) years old.

For new style tags: Harnesses with expiration tags bearing a “Valid Until” date that is on or after the last day of the current competition.



Figure B-29: Driver Harness, SFI Tag, Old Style (Left), New Style (Right)

B.4.2.3 - Release Mechanism

All belts in the driver harness must join to a single, central, metal-to-metal, lever-type, quick-release buckle. Cam-Lock, and other enclosed buckles susceptible to jamming from small debris (such as sand particles) are explicitly prohibited. The release mechanism (buckle) shall be protected against accidental unfastening from a direct pull, rollover or slide along the side.

B.4.2.4 - Shoulder Belts

The shoulder harness shall be of the over-the-shoulder type. Only separate shoulder straps are permitted. “Y”-type shoulder straps are explicitly prohibited.

B.4.2.4.1 - Positioning, Vertical

The shoulder belt mounting point (A) (see Figure B-30) shall be positioned no higher than vertically level with each driver’s shoulders, and no lower than 102 mm (4.0 in.) vertically below each driver’s shoulders.

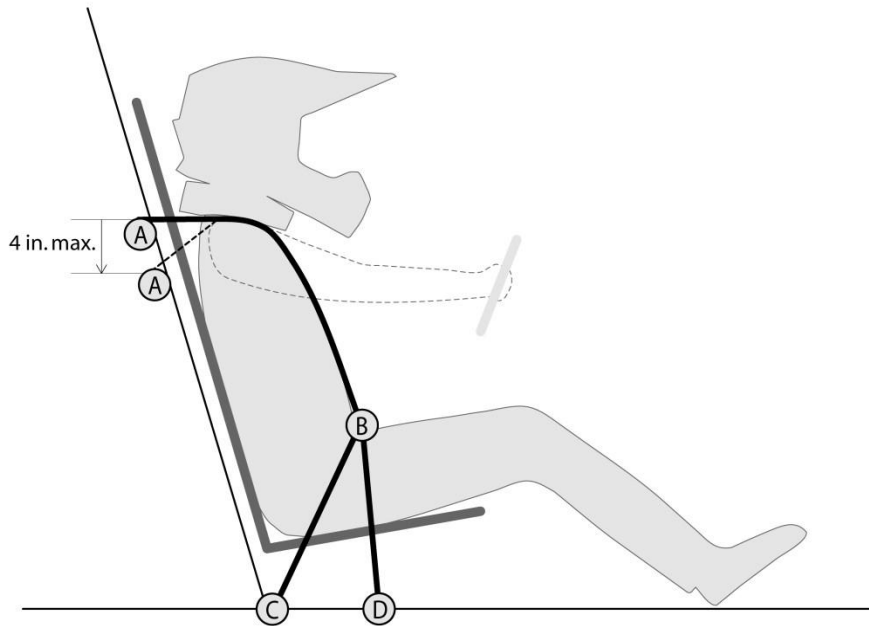


Figure B-30: Driver Harness, Shoulder Harness Vertical Position

B.4.2.4.2 - Positioning, Lateral

The lateral spacing of the shoulder belts shall be between 178 mm (7.0 in.) and 229 mm (9.0 in.) when measured center-to-center. See Figure B-31. Lateral position of the shoulder belts along their mounting tube must be restrained by a structure other than the firewall.

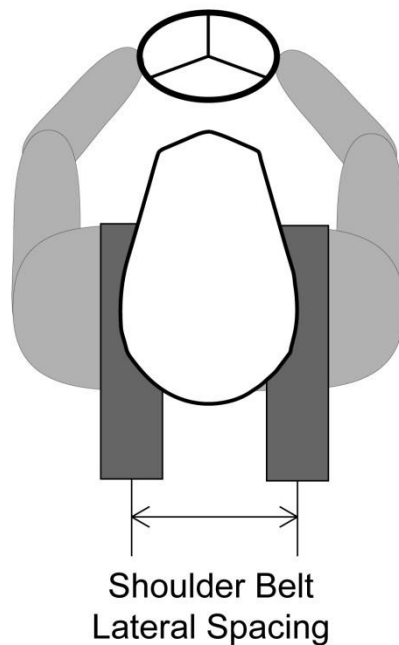


Figure B-31: Driver Harness, Shoulder Harness Lateral Position

B.4.2.4.3

The shoulder belts shall be looped and secured around a straight, horizontal tube welded within the plane of the RRH. The tube that the shoulder belts are looped around shall meet the requirements of a secondary member, B.3.2.3 - Secondary Members. Provisions for lateral position restraint shall be provided. Firewall material is not acceptable for lateral position restraint. See Figure B-32 for details.



Figure B-32: Driver Harness, Shoulder Harness Lateral Restraint

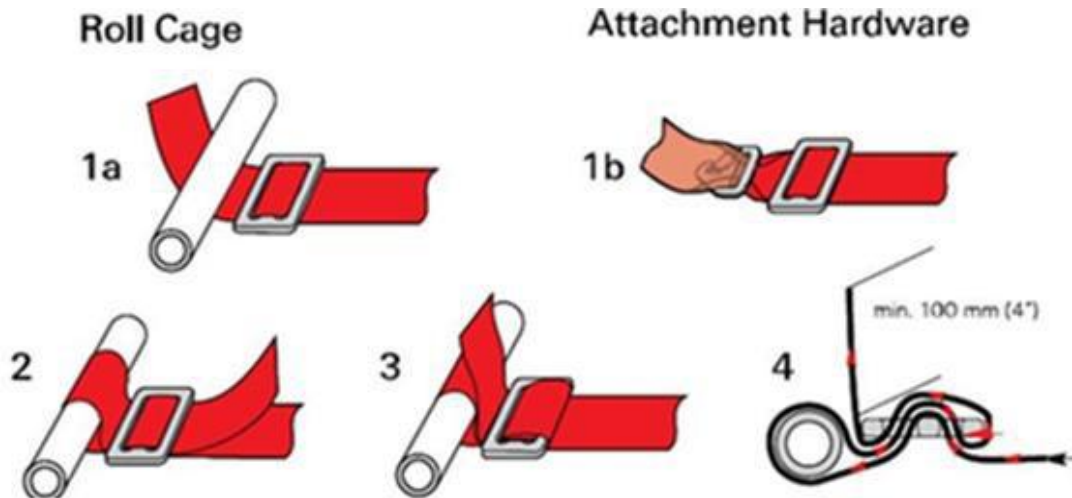


Figure B-33: Driver Harness, Diagram of Proper Wrapping of Webbing

B.4.2.4.4 - Redirection

The shoulder belts must run directly from their mountings to the driver's shoulders, without redirection by any part of the vehicle or its equipment, including seats.

Webbing shall not be twisted or rotated at any point along the path of the shoulder belt.

B.4.2.4.5 Adjustment

The shoulder belts shall be in proper adjustment for the driver at all times. When the driver harness is worn, each buckle or adjuster in the system shall have excess adjustment capacity to fit all drivers.

B.4.2.4.6 - Protection

The shoulder belts shall be protected from potential damage from aft of the RRH. The firewall must protect the shoulder belts. The firewall may be pocketed or extended to facilitate this requirement, as long as no open gaps result. Excess shoulder belt webbing shall be neatly contained and kept within the roll envelope of the vehicle.

B.4.2.5 - Lap Belts

The lap belt halves must run directly from the buckle, over the driver's hips and to their mounting points without redirection by any part of the vehicle or its equipment (including the seat). 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.

B.4.2.5.1 - Positioning

The lap belt (point B to point C) in Figure B-34 shall be positioned such that it passes over the driver's pelvic area below the Anterior Superior Iliac Spines (the hip bones). The lap belt shall not be worn over the driver's intestines or abdomen.

In a side view, the lap belt must be at a minor angle (angle "L" or angle BCD) of between 45 deg and 65 deg to the horizontal. This requirement means that the centerline of the lap belt at the seat bottom will be approximately 76 mm (3.0 in.) forward of the bottom of the seat back.

Note: Quick disconnect fasteners for body panels are recommended, and facilitate a faster technical inspection process.

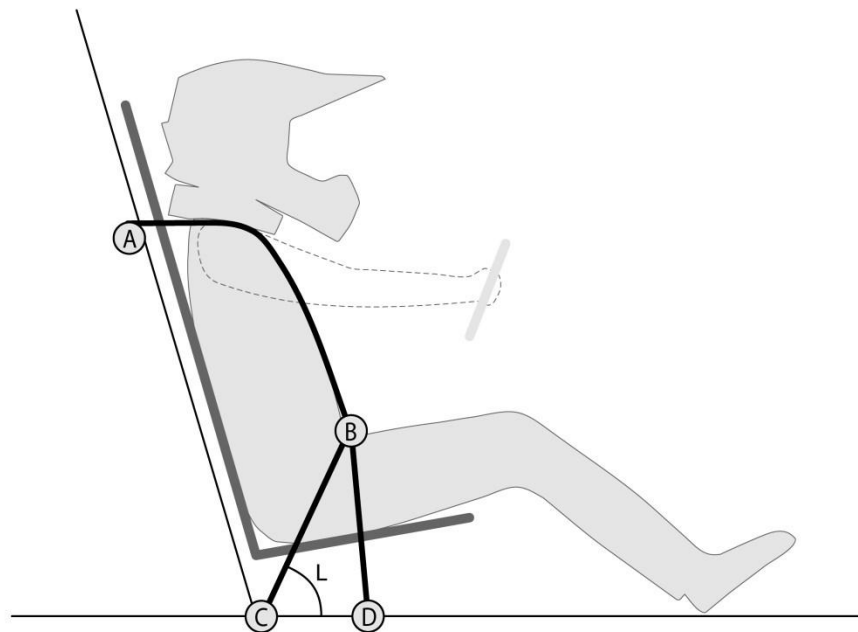


Figure B-34 Driver Harness, Lap Belt Angle

B.4.2.5.2

The lap belts shall be securely attached to the vehicle frame with metal tabs joined by a threaded fastener. Lap belts wrapped around tubes or secured with eye-bolts are explicitly prohibited. Webbing shall be wrapped per Figure B-33: Driver Harness, Diagram of Proper Wrapping of Webbing.

Threaded fasteners in the driver restraint system shall meet the requirements of Article 12 - Fasteners.

Threaded fasteners in the driver restraint system shall match the nominal diameter of the mounting holes in the lap belt mounting bracket. For example, if a lap belt mounting tab is drilled for a 13 mm (0.5 in.) hole, the fastener and the frame lap belt tab shall be 13 mm (0.5 in.) in diameter.

The frame tabs which accept the metal lap belt tabs shall meet the following requirements:

- a. The frame lap belt tabs shall be no less than 2.3 mm (0.090 in.) thick and configured for double shear mounting. Frame lap belt tabs configured in bending are explicitly prohibited. See Figure B-35.
- b. The frame lap belt tabs shall be attached to the frame with no less than 38 mm (1.5 in.) of weld length per tab.
- c. The frame lap belt tabs shall have no less than 6.4 mm (0.25 in.) of edge distance. (edge distance is the measurement from the edge of the bolt hole to the outside edge of the tab.)
- d. The frame lap belt tabs and lap belt shall be installed such that the lap belt tabs pivot freely.
- e. The frame lap belt tabs and their mounting shall be stiff and not readily deformed.
- f. No lightening holes or other cutouts are permitted on the frame lap belt tabs

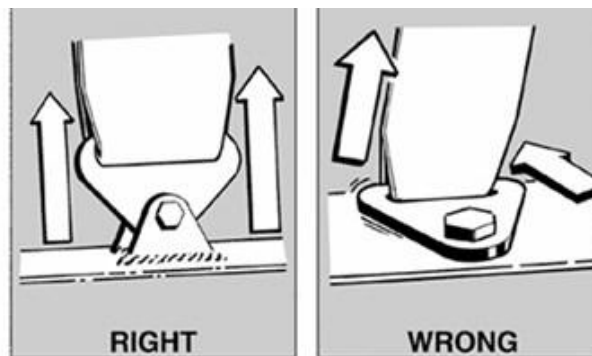


Figure B-35: Driver Harness, Lap Belt Tab Orientation

B.4.2.5.3 - Redirection

The lap belts shall be routed directly from the mounting points over the driver's hips and to the release mechanism (buckle) without redirection by any part of the vehicle or its equipment (including the seat).

Webbing shall not be twisted or rotated at any point along the path of the lap belt.

B.4.2.5.4 - Adjustment

The lap belts shall be in proper adjustment for the driver at all times. When the driver harness is worn, each buckle or adjuster in the system shall have excess adjustment capacity.

B.4.2.5.5 Protection

The lap belts shall be protected from potential damage by the vehicle's body panels. Excess lap belt webbing shall be neatly contained and kept within the roll envelope of the vehicle.

B.4.2.6 - Anti-Submarine Belts

B.4.2.6.1 - Number of Points

The anti-submarine belt (Line BD in Figure B-36) shall be at least a single-point mount (a 5-point driver harness configuration). Driver harnesses of the 6-point and 7-point types are permitted. A 6-point system utilizes two anti-submarine belt mounting points. A 7-point system utilizes three anti-submarine belt mounting points.

B.4.2.6.2 - Positioning

Anti-submarine belts shall be mounted to the vehicle frame at a point aft of the chest line as denoted by a positive angle "S" in Figure B-36. The anti-submarine belt mounting point shall be forward of the lap belt mounting points. The chest line passes through point B and is parallel to the driver's sternum. The antisubmarine belt angle (angle S) is suggested to be 20 deg. The anti-submarine belt shall be mounted either to a frame tab or wrapped around a frame member meeting at least secondary member requirements.

6-point and 7-point harnesses shall be installed per the manufacturer's instructions. Teams shall be prepared to provide documentation of mounting instructions to NTI at the time of technical inspection.

Note: Quick disconnect fasteners for body panels are recommended, and facilitate a faster technical inspection process.

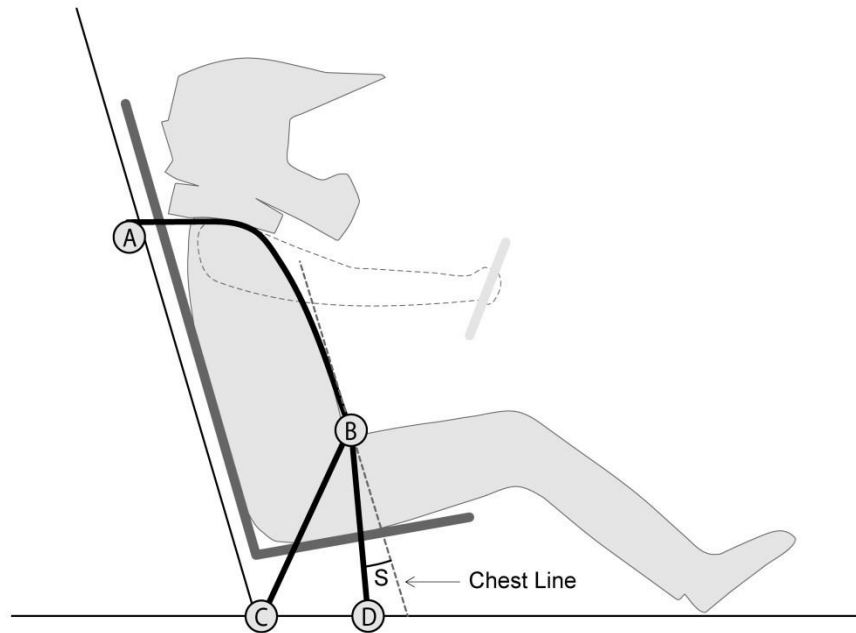


Figure B-36: Driver Harness, Anti-Submarine Belt Angle

B.4.2.6.3

The anti-submarine belts shall be securely attached to the vehicle frame with metal tabs joined by a threaded fastener. Anti-submarine belts may also be wrapped around tubes provided the tubing meets the requirements of secondary members (B.3.2.3 - Secondary Members) and the webbing is protected per B.4.2.6.6 - Protection. Anti-submarine belts secured with eye-bolts are explicitly prohibited. Webbing shall be wrapped per Figure B-33: Driver Harness, Diagram of Proper Wrapping of Webbing.

Threaded fasteners in the driver restraint system shall meet the requirements of Article 12 - Fasteners. Threaded fasteners in the driver restraint system shall match the nominal diameter of the mounting holes in the lap belt mounting bracket. For example, if an anti-submarine belt mounting tab is drilled for a 13 mm (0.5 in.) hole, the fastener and the frame tabs tab shall be 13 mm (0.5 in.) in diameter.

The frame tabs which accept the metal anti-submarine belt tabs shall meet the following requirements:

- a. The frame anti-submarine belt tabs shall be no less than 2.3 mm (0.090 in.) thick and configured for double-shear mounting. Frame anti-submarine belt tabs configured in bending are explicitly prohibited.
- b. The frame anti-submarine belt tabs shall be attached to the frame with no less than 38 mm (1.5 in.) of weld length per tab.
- c. The frame anti-submarine belt tabs shall have no less than 6.4 mm (0.25 in.) of edge distance. (edge distance is the measurement from the edge of the bolt hole to the outside edge of the tab).
- d. The frame anti-submarine belt tabs and lap belt shall be installed such that the lap belt tabs pivot freely.
- e. The frame anti-submarine belt tabs and their mounting shall be stiff and not readily deformed.
- f. No lightening holes or other cutouts are permitted on the frame anti-submarine belt tabs

If the anti-submarine belt is wrapped around a frame member, the following requirements shall be met:

- a. The anti-submarine belt mounting tube shall have features designed to limit lateral movement to 25.4 mm (1.0 in.) or less.
- b. The anti-submarine belt mounting tube shall meet the frame requirements of secondary member. The mounting tube may be constructed of a single tube with bends, or may be constructed with no more than three tubes and two mitered joints (excluding connections to the LFS). The antisubmarine belt mounting tube shall join both of the vehicle's LFS members and be oriented parallel to the LC's. The mounting tube may not be cantilevered off of another tube creating an undue bending moment.

B.4.2.6.4 - Redirection

Redirection of the anti-submarine belt by a rigid frame, seat member, or seat edge is allowed. Redirected belt webbing must not contain a bend of more than 30 deg (Figure B-37). The redirecting member or edge must be designed to prevent chaffing or abrasion of the belt webbing.

Webbing shall not be twisted at any point along the path of the anti-submarine belt.

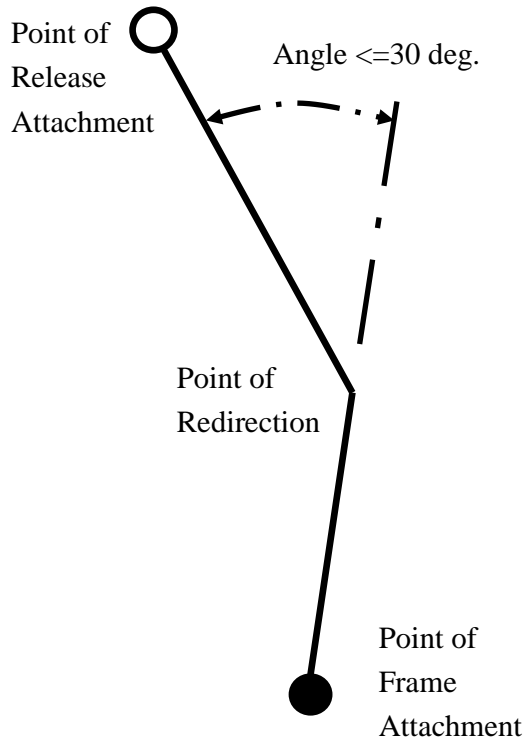


Figure B-37: Driver Harness, Anti-Submarine Belt Redirection

B.4.2.6.5 - Adjustment

The anti-submarine belts shall be in proper adjustment for the driver at all times. When the driver harness is worn, each buckle or adjuster in the system shall have excess adjustment capacity.

B.4.2.6.6 - Protection

All anti-submarine belts shall be protected by the vehicle skid plate. Excess anti-submarine belt webbing shall be neatly contained and kept within the roll envelope of the vehicle.

B.4.3 - Arm Restraints

In the event of a rollover, the driver’s arms must be kept within the limits of the roll cage space (B.3.3.1 - Lateral Space) by use of arm restraints. Arm restraints must be securely fastened to the driver restraint system. Only commercially available arm restraints meeting SFI 3.3 are allowed. The arm restraints must independently connect to the safety belts.

B.4.3.1 - Certification

The restraints must be in overall good condition and show no signs of wear, no cuts chaffing or wear. The restraints must bear the appropriate labels.



Figure B-38: Driver Harness, Arm Restraints

Note: Manufactures are required to ensure they have labeled the belts with a date of manufacture. The date tag may be separate from the SFI tag.

B.4.3.2 - Expiration

In December of 2016, SFI updated the design and format of driver harness expiration tags. Manufacturers are permitted to use old tags until their supply runs out. Baja SAEINDIA® permits the use of arm restraints with the old and the new tag design, provided:

For old style tags: On **April 1st** of the competition year, harnesses shall be no more than three (3) years old.

For new style tags: Harnesses with expiration tags bearing a “Valid Until” date that is on or after the last day of the current competition.

See Figure B-28 for more information.

B.4.3.3 - Positioning

Arm restraints must be installed such that the driver can release the harness and exit the vehicle unassisted, regardless of the vehicle’s position. The arm restraint must be worn by the driver on the forearm just below the elbow. The driver must be able to reach the cockpit kill switch and steering wheel, but not allow their arms to exit the cockpit.

B.4.3.4 - Attachment

Arm restraints shall be attached to the buckle of the driver harness when assembled.

B.4.4 - Head Restraint

A head restraint must be provided to limit rearward motion of the driver’s head from a normal driving position. The head restraint must be mechanically fastened to the vehicle, preferably to the vehicle frame. Hook-and-loop and adhesive methods are prohibited. Head restraints may also be mechanically fastened or integral to the driver’s seat.

Caution: HANS devices and Leatt braces are not allowed due to the improper fitment of these devices with respect to nominal Baja SAEINDIA® seat design and seating position.

B.4.5 - Seats

The seat shall work in concert with the driver harness to secure the driver within the envelope of the roll cage. Seats shall be of conventional design. See details below. All seats shall be designed for the upright seating position. Suspension seats are prohibited. The upright seating position is defined by the angle of the driver's back to a horizontal line. The seat back angle (Figure B-39) for an upright seating position is greater than 65 deg. As a reference, a completely upright driver will have a back angle of 90 deg.

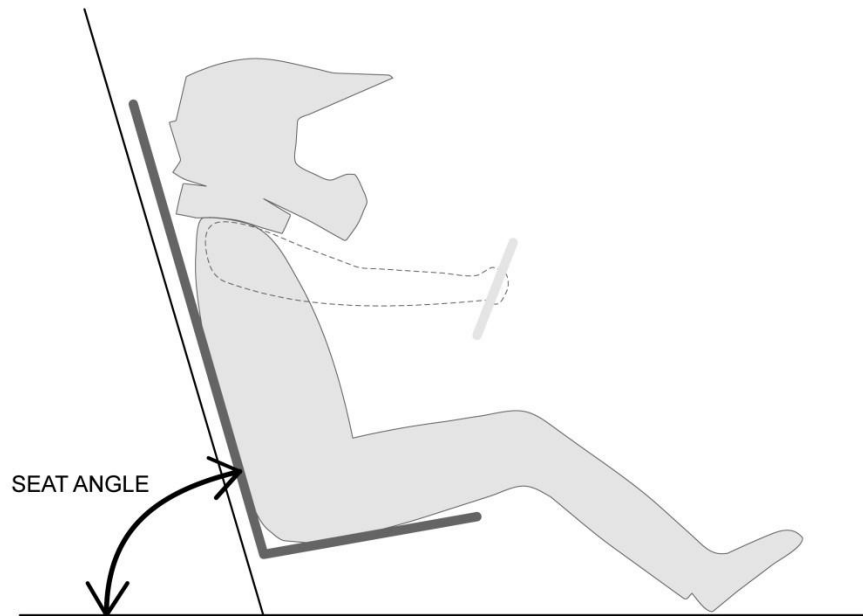


Figure B-39: Seat Angle

B.4.5.1 - Seat Construction

B.4.5.1.1 - Conventional Seats

Conventional seats shall be generally rigid and be of metal or composite construction (fiberglass or carbon fiber). Seats constructed of thermoplastic are prohibited. Conventional seats may also have a removable seat cover and foam padding. Seats may be purchased from a manufacturer or constructed by teams.

B.4.5.1.2 - Suspension Seats

Suspension seats, sling seats, hammock seats, or similar designs with webbing or cordage as the primary load path are explicitly prohibited.

B.4.5.2 - Seat Design

Seats shall be designed to have at least two generally planar surfaces when the driver is seated in the vehicle. The seat back plane shall be inclined between 65 and 90 deg from horizontal as viewed from the side (see Figure B-39: Seat Angle). The seat bottom plane shall be underneath the driver and be horizontal or generally sloped such that the leading edge of the seat bottom plane is level with or higher than the intersection with the back plane. Seats may also include material oriented vertically along the sides of the seat bottom plane and the seat back plane designed to assist in laterally restraining the driver.

B.4.5.3 - Seat Mounting Points (Conventional Seats)

B.4.5.3.1 - Quantity

All seats shall have no less than six (6) total mounting points to the vehicle frame. Seats shall have no less than four (4) mounting points from the seat bottom plane and no less than two (2) mounting points from the seat back plane.

B.4.5.3.2 - Arrangement

The seat bottom plane and seat back plane mounting points shall be generally symmetrical about the longitudinal center line of the seat itself or the vehicle. Seat back plane mounting points shall be at or near the plane of the RRH. All seat mounting points shall attach to the LFS, USM, RRH or other tubes having met the requirements of secondary frame members. Each seat bottom mount shall be designed to evenly distribute vertical load.

B.4.5.3.3 - Structure

Any tabs utilized in mounting the seat shall be a minimum thickness of 2.3 mm (0.090 in) and have at least 38 mm (1.5 in.) of weld length per tab.

Mounting Tabs shall not visibly deform when a load is applied. The average distance from the tab hole to the main tab weld line shall not exceed 25.4 mm (1.0 in.). Any tube used to mount the seat with radial holes drilled in the tube shall be sleeved and reinforced per rule B.3.6 - Drilled Frame Members.

ARTICLE 5: DRIVER EQUIPMENT

B.5.1 - Helmet

All drivers must wear a properly sized motocross-style helmet with an integrated (one-piece composite shell) chin/face guard.

All drivers must wear a well-fitting Motocross style helmet with an integrated (one piece composite shell) chin/face guard and a rating of: Snell M2010,2015, SA 2005, British Standards Institution BS 6658-85 types A or A/FR. ISI rating is also acceptable. DOT rated helmets are not allowed.



MOTOCROSS STYLE

Full Face Helmets

Figure B - 40

WARNING: Some Motocross helmets have extended chin guards that will not contact the required neck collars when the head is flexed forward. This combination of helmet/collar system is prohibited. Any non-specification helmets will be confiscated until after the competition. This rule has no exceptions and it will be strictly enforced. Helmets certified to other rating systems may not be worn.

Note: Some Motocross helmets have extended chin guards that will not contact the required neck

collars when the head is flexed forward. This combination of helmet/collar system is prohibited.

Note: Any non-specification helmets will be confiscated by the NTI for the duration of the event. At the close of the endurance race, all confiscated items will be available for pick up.

Caution: Do not rely on salespeople to determine if a helmet is Snell rated. Check for the Snell sticker under the foam liner of the helmet.

B.5.2 - Eye Protection

B.5.2.1 - Type

All drivers shall wear motocross-style goggles with a full-circumference elastic band that wraps completely around the driver's helmet. "Quick Straps" or other quick-release systems are explicitly prohibited.

B.5.2.2 - Lens Protection

All goggles used by drivers must have tear-off or roll off lens protectors. These tear-offs or roll-offs are used to ensure the driver has unobstructed vision through their goggles. Teams must present their goggles and properly installed tear offs or roll-offs at tech inspection. Teams without tear offs or properly functioning roll offs are subject to being black flagged.

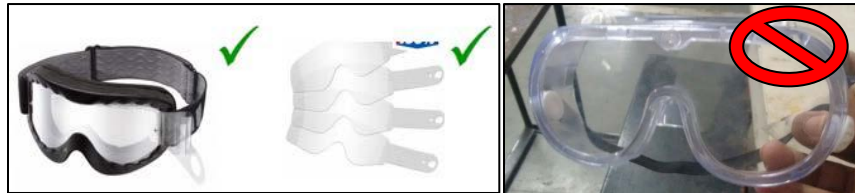


Figure B - 41

B.5.3 - Neck Support

B.5.3.1 - Certification

All drivers must wear a neck support / neck collar. The neck support must be a full circumference (360 deg.) and SFI 3.3 rated. Horseshoe collars are not allowed. Simpson, RCI, GForce, Deist or Leaf Racing Products supply neck collars that meet this requirement.

The support/collar must be in overall good condition and show no signs of wear or other injurious defects. The support/collar must bear the appropriate dated labels, and on Jan 1st of the competition year be no more than three years old.



Neck Support Permitted



Neck Support Not Permitted

Figure B-42: Driver Equipment, Neck Restraint

B.5.3.2 - Expiration

In December of 2016, SFI updated the design and format of neck support/collar expiration tags.

Manufacturers are permitted to use old tags until their supply runs out. Baja SAEINDIA® permits the use of arm restraints with the old and the new tag design, provided:

For old style tags: On **April** 1st of the competition year, harnesses shall be no more than three (3) years old.

For new style tags: Support/collar with expiration tags bearing a “Valid Until” date that is on or after the last day of the current competition.

See Figure B-29 for more information.

Note: Manufacturers are required to ensure they have labeled the support/collar with a date of manufacturing. The date tag may be separate from the SFI tag.

B.5.4 - Clothing

B.5.4.1 - Gloves

Drivers shall wear gloves to protect their hands. Durable, abrasion resistant gloves are required.

B.5.4.2 - Shoes

Drivers shall wear socks and shoes.

B.5.4.3 - Upper Garments

Drivers shall wear a fire resistant shirt. The shirt must have a factory label showing an SFI rating, FIA rating, NFPA 2112 rating, or other fire resistant rating.

B.5.4.4 - Lower Garments

Drivers shall wear long pants made of natural materials such as cotton, denim, etc. Drivers may also wear fire resistant pants having an SFI, FIA, NFPA 2112, or other fire resistant rating.

B.5.4.5 - Combustible Material

Jerseys, gloves, socks or other garments made from nylon or any other synthetic material which will melt or combust when exposed to open flame or extreme heat, are explicitly prohibited from use during competition.

ARTICLE 6: FUEL SYSTEM

B.6.1 - Function

All vehicles shall have a fuel system comprising of a fuel tank, fuel hose and fittings, and splash shields. The fuel system shall function to safely contain and control fuel and to safely convey fuel to the engine carburetor. The entire engine is considered to be part of the fuel system.

B.6.2 - Fuel

The only fuels permitted for Baja SAE® competitions are grades of automotive gasoline consisting of hydrocarbon compounds. The fuel may contain anti-oxidants, metal deactivators or corrosion inhibitors.

Note: At Baja SAEINDIA site Bharat Petroleum fuel supply is available & hence outside fuel is

restricted.

Caution: Lead alkyl compounds such as tetra-ethyl lead are explicitly prohibited.

B.6.2.1 - Specific Gravity

The specific gravity of the fuel may not exceed 0.75 for leaded gasoline or 0.80 for unleaded gasoline when measured at 15.5 deg. C (60 deg. F).

B.6.2.2 - Prohibited Additives

The addition of nitrogen bearing additives, or additives designed to liberate oxygen is explicitly prohibited.

B.6.3 - Location

The entire fuel system, including carburetor, air cleaner cover, splash shield, and engine (excluding intake air hoses) must be located within the envelope of the vehicle's roll cage. The envelope shall be tested by means of a straight edge in contact with any two points on the outside of the vehicle frame. The fuel tank mountings must be designed to resist sustained vibration and shock.

B.6.4 - Fuel Cap

A standard Briggs and Stratton gas cap with a built-in check valve, Part B4325GS is required. The retail price must be included in the cost report.

B.6.5 - Fuel Tank

One fuel tank is permitted on the vehicle. Fuel tanks shall be unmodified and free from injurious defects. Fuel tanks are restricted to Briggs and Stratton part 799863. All fuel tanks shall be remote mounted, and not affixed to the engine. Fuel tank mounting shall be fixed. Removable tanks are explicitly prohibited.

Note: 799863 is the tank supplied with the Briggs and Stratton Model 20 engine during the 2017 season.

The retail price of the fuel tank must be included in the cost report.

B.6.5.1 - Mounting

Fuel tanks shall be mounted directly to a tube or tubes meeting the requirements of at least a secondary member. Cantilever mounting of fuel tanks to the vehicle frame is explicitly prohibited.

Fuel tank mounts shall meet the following requirements:

1. The frame fuel tank mounting tabs shall be no less than 1.6 mm (0.063 in.) thick.
2. The frame fuel tank mounting tabs shall less than 50.8 mm (2.0 in) long when measured along the tab from the center of the bolt hole to the outside of the attached frame member.
3. The frame fuel tank mounting tabs shall have no less than 6.4 mm (0.25 in.) of edge distance. (edge distance is the measurement from the edge of the bolt hole to the outside edge of the tab.)
4. The frame fuel tank mounting tabs shall have a minimum cross sectional area of 19mm (.75") x 1.6mm (.063") in the region bounded by the edge of the secondary member it is attached to and the nearest edge of the fuel tank bolt hole.
5. The frame fuel tank mounting tabs shall be attached to the frame with no less than 25 mm (1 in.) of weld length per tab or 51mm (2in) for tabs combined to attach to two mounting points on the fuel tank.
6. The frame fuel tank mounting tabs and their mounting shall be stiff and not readily deformed.

7. No lightening holes or other cutouts are permitted on the frame fuel tank mounting tabs

All fasteners used to mount the fuel tank to the vehicle frame shall meet the requirements in Article 12 – Fasteners.

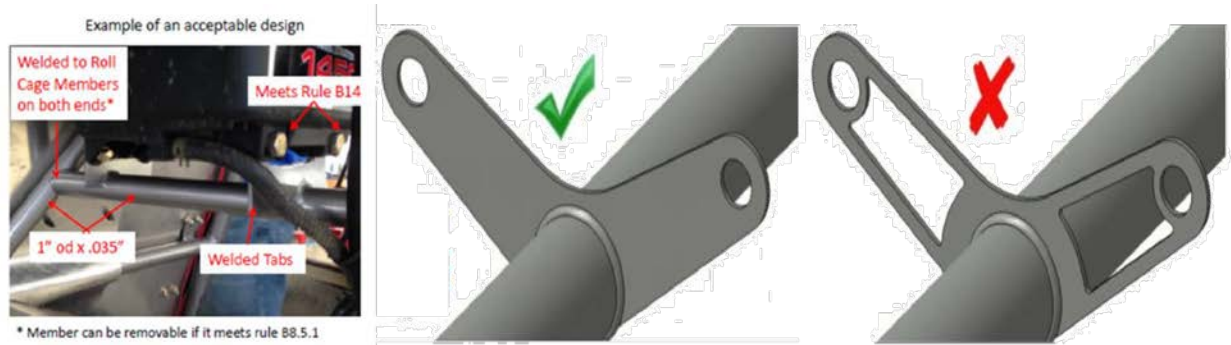


Figure B – 43, Fuel System, Example of acceptable fuel tank mounting

B.6.6 - Fuel Lines and Filters

B.6.6.1 - Location

All fuel lines shall be located away from sharp edges, hot engine components and be protected from chafing or abrasion. Grommeting is required where the lines pass through any member of the vehicle. Fuel lines are prohibited in the cockpit.

B.6.6.2 - Rating

All fuel lines shall be SAE rated fuel lines. The Briggs and Stratton fuel line is SAE J30R14 or 30R7-RP. Bulk fuel line can be ordered through Briggs and Stratton and is part number 395051R.

B.6.6.3 - Size

All fuel lines shall be no larger than the stock fuel lines supplied with the engine. Fuel lines shall be no greater than 12.7 mm (0.5 in.) outer diameter and 6.3 mm (0.25 in.) inner diameter. The nominal size or trade size for the required fuel line is “1/4 inch”.

B.6.6.4 - Fuel Filters

If a fuel filter is used, it must be a Briggs and Stratton stock filter.

B.6.6.5 - Fuel Sensors

Fuel level gauges and sensors are allowed as long as the fuel tank is not modified. Fuel level gauges and sensors are allowed such that the capacity of the fuel system is not increased.

B.6.7 - Splash Shields

Splash shields are required to prevent fuel from accidentally being poured directly on the engine or exhaust while refueling or preparing to refuel the vehicle.

The splash shield shall be either metallic material (greater than 0.5 mm or 0.02 inches thick) or fuel resistant non-metallic material (greater than 1.5 mm or 0.060 inches thick). Shields must be generally rigid, shaped such that any spilled fuel runs towards the outside of the vehicle, and does not pool on the shield. An example arrangement of splash shielding is shown in two views in Figure B-44.

Splash shields shall be mounted so they are engaged and effective at all times and are not adjustable. The splash shield must be mounted lower than the structural member supporting the fuel tank.

If the fuel line passes through the splash shield, it must either pass through a grommeted hole in the shield, or utilize a metallic barbed bulkhead union (recommended). With either method, the hole must be sealed to prevent spilled fuel from leaking to the engine.

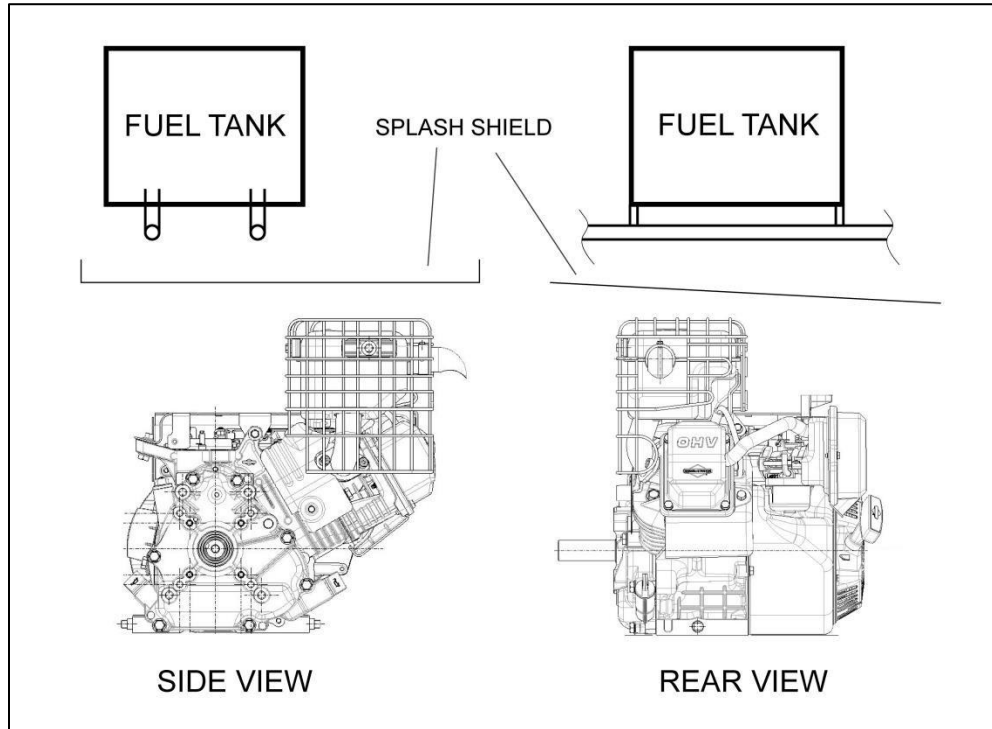


Figure B-44: Fuel System, Splash Guard Installation Example (for remote mounting of fuel tank)

Note: For 20-Series B&S engines with fuel tank fixed on engine (default mounts), the vehicle must have a drip pan & splash shield as per following mentioned requirements (Rule B.6.7.1 to B.6.7.4).

B.6.7.1 – Drip Pan Mounting

Drip pans must be mounted using sound engineering practices. A drip pan mounting comprised only of fastening to the fuel tank filler neck is insufficient, and is not allowed. Drip pans must be graded or inclined such that all spilled fuel drains from the drip pan, fuel must not pool anywhere in the pan.

B.6.7.2 – Drip Pan Drain

Fuel must drain from the drip pan through a drain line composed of pipe or tubing that carries fuel to the bottom of the vehicle and releases under the vehicle. Tubing shall be rated for fuel use, and shall have appropriate fuel rated markings. Fuel may not be released onto the belly pan, flotation, or any other part of the vehicle. The drain line shall be robust and be mechanically fastened to the drip pan with a threaded connection or a hose barb and hose clamp, or a combination of the two. Adhesive connections are specifically prohibited. All materials in the drip pan system shall be rated for fuel or fuel resistant. The nominal minimum inside diameter of the drain line is 12.7 mm (.5 in.) and minimum inside diameter of fittings is 9.5mm (.375 in.).

B.6.7.3 – Drain Line Material

Drains lines must be made of either fuel line material, or other pipe or tubing which is not weakened or dissolved by fuel. The drain line connection to the drip pan must be sealed and

robust. The cross section of the pipe shall not reduce throughout the length when compressed.

B.6.7.4 – Splash Shields

The splash shield can be prepared by two methods:

1. Integrated Splash shield with Drip Pan. The flow must be towards a common drip pipe and there should be no logging of liquid.
2. Separate splash shield that covers the complete engine & exhaust area.

The splash shields shall be mounted such that they are effective at all times, and are not adjustable by the driver or team members. Splash shields shall be of resilient mounting and protect against fuel being poured on the hot surfaces of the engine. The splash shields must have a minimum of 3 in. vertical clearance from the exhaust finger guard and must cover the entire exhaust area (when looked from top) at all times. All sharp edges must be removed.

Note: Use of m-seal is strictly prohibited for both drip pan and splash shields.

B.6.8 - Fuel Containers

All fuel must be transported in, and put into vehicle fuel tanks, from approved, unmodified containers. Approved, unmodified containers shall:

- Have a volume of 5.7 L (1.5 gal.) or less for fueling vehicles during endurance event.
- Have a volume of 18.9 L (5 gal.) or less for all other capabilities.
- Be equipped with an original cap to prevent spills when not in use.
- Be labeled with College name and car number.

Teams are required to bring all fuel to the fueling zone during the endurance event, see rule D.7.3.7 - Refueling.

B.6.9 - Fuel Tank Access Panels

Any panels or doors that must be removed or opened to provide access to the fuel tank must be easily opened or actuated by track workers wearing gloves.

ARTICLE 7: VEHICLE CONTROLS

B.7.1 - Brake System

The vehicle must have a primary hydraulic braking system that acts on all wheels and is operated by a single foot pedal. The pedal must directly actuate the master cylinder through a rigid link (i.e., cables are not allowed). The brake system must be capable of locking and sliding all wheels, both in a static condition as well as at-speed on pavement and on unpaved surfaces.

Note: Brake Pedal to be actuated with right foot only for both manual as well as CVT Transmission setup. Ensure sufficient gap is provided between the Accelerator pedal & steering column to that of Brake Pedal. Pedal Actuation shall not be hindered at any cause by the nearby components.

B.7.1.1 - Independent Circuits

The braking system must be segregated into at least two (2) independent hydraulic circuits such that in case of a leak or failure at any point in one system, effective braking power shall be



maintained on at least two wheels. Each hydraulic circuit must have its own separate fluid reservoir either through physically separate reservoirs or by the use of a full-height dam in an OEM-style reservoir.

B.7.1.2 - Brake Location

The brake(s) on the driven axle must operate through the final drive. Inboard braking through universal joints is permitted. Braking on a jackshaft through an intermediate reduction stage is prohibited.

B.7.1.3 - Cutting Brakes

Hand or feet operated “cutting brakes” are permitted provided the section B.7.1 is also satisfied. A primary brake system must be able to lock all four wheels with a single foot. If using two separate pedals to lock two (2) wheels apiece; the pedals must be close enough to use one foot to lock all four wheels.

Any and all brakes, when actuated, shall cause the brake light to illuminate.

B.7.1.4 - Brake Lines

All brake lines shall be securely mounted to the vehicle and not project below the vehicle frame or suspension components.

All brake lines shall be routed and oriented such that they are not pinched by steering or suspension parts, nor engaged with sharp edges.

All brake lines shall have full range of motion within the steering and suspension system.

At no time shall the brake lines be loaded in tension 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.

No brake line may be constructed of plain, plastic tubing.

B.7.2 - Throttle System

The vehicle’s throttle system shall be capable of fully actuating the throttle arm to full throttle (100%) on the engine and return to idle (0% throttle) when released. The throttle shall remain in the as-inspected condition for the duration of the event. Re-inspection is available by appointment with Briggs and Stratton at the event site. “Throttle-by-wire” or other electronic throttle controls are explicitly prohibited.

B.7.2.1 - Pedal

Only mechanical, pedal (foot) operated throttle controls are allowed. The throttle pedal shall actuate a throttle cable.

Foot pedals shall be positioned to avoid entrapment of the driver’s foot when in any position. Mechanical extensions such as thick pads or blocks may not be attached to the pedal or to the driver’s feet.

Note: Accelerator Pedal shall be actuated by right foot only.

B.7.2.2 - Pedal Stop

A substantial, mechanical, wide-open throttle stop must be mounted at the pedal. Body panels or other flexible materials are explicitly prohibited.

B.7.2.3 - Throttle Cable

The throttle cable must be covered (sheathed or jacketed) from the forward mounting point in the cockpit and the vehicle firewall.

Throttle cables may be of “bicycle style” construction where the cable operates only in tension.

Throttle cables may be of “aircraft style” construction where the cable is capable of push-pull (tension - compression) operation.

B.7.2.4 - Fail Safe

All throttle controls shall be designed to return to the idle-stop in the event of a failure. The throttle cable must be covered (sheathed) between its forward mounting point and the firewall to prevent debris ingress.

B.7.3 - Other Control Systems

B.7.3.1 - Compressed Gas Systems

Compressed gas systems are allowed for vehicle control systems. For example, a compressed gas system may be used to change transmission states (i.e. shift gears). Compressed gas systems are explicitly prohibited from providing increased engine power and/or vehicle propulsion. The NTI reserves the right to require additional protections or safety features on any compressed gas system.

B.7.3.1.1 - Gas Composition

Compressed gas systems shall operate only with non-flammable or non-oxidizing gases. Air, nitrogen, and carbon dioxide are examples of acceptable gases. Methane, propane, oxygen, are examples of unacceptable gases.

B.7.3.1.2 - Gas Storage

Compressed gases shall be stored in containers meeting the following requirements.

- a. Compressed gases shall be stored in cylinders (tanks) of propriety manufacture, designed and built for storage and operating pressures, certified by an accredited testing laboratory in the country of the cylinder’s origin, and be labeled or stamped appropriately.
- b. The compressed gas cylinder shall be located within the roll envelope and aft of the RRH, protected from rollover and collision damage.
- c. The compressed gas cylinder shall be protected from damage from failed rotating equipment.
- d. The compressed gas cylinder shall be securely mounted to the vehicle frame, engine, or transmission, and oriented such that the longitudinal axis of the cylinder is not in line with the driver.
- e. The compressed gas cylinder shall be insulated from excess heat such as the engine or exhaust.

B.7.3.1.3 - Gas Service Equipment

All service equipment in the compressed gas system shall meet the following requirements.

- a. Pressure Regulators shall be rated for compressed gas service and be mounted directly to the compressed gas cylinder.

- b. Any and all fittings or connectors in the compressed gas system shall be rated for the pressures and temperatures experienced downstream of the pressure regulator.
- c. Any and all hoses, tubing, or other conveyances in the compressed gas system shall be rated for the pressures and temperatures experienced downstream of the regulator.
- d. Any and all gauges, indicators, or other instrumentation in the compressed gas system shall be rated for the pressures and temperatures experienced downstream of the regulator.

B.7.3.1.4 - Compressed Gas Mechanisms

All compressed gas mechanisms, including cylinders, slides, actuators, or motors shall be rated for the pressures and temperatures experienced downstream of the regulator.

ARTICLE 8: COCKPIT

B.8.1 - Design Objective

The cockpit shall be designed to protect the driver and permit easy egress in an emergency.

B.8.2 - Cockpit Egress

Any and all drivers must be able to egress (exit) on either side of the vehicle within five (5) seconds. Drivers tested for egress time shall begin with all safety gear and be fully seated and secured in the vehicle with their hands on the connected steering wheel.

Egress time is timed from the instant either hand of the driver is removed from the steering wheel to the instant the driver is clear of the vehicle with both feet on the ground.

The TEJ will select one or more drivers to perform the cockpit egress test.

Drivers unable to demonstrate successful egress will have their driver status revoked.

Each team is required to have a minimum of two designated drivers.

B.8.3 - Firewall

All vehicles shall have a firewall separating the cockpit from the engine and fuel tank compartments. The firewall shall be constructed of metal, at least 0.50 mm (0.02 in.) thick. The firewall shall be mounted in the plane of the RRH and cover the area between the ALC and BLC.

Multiple metal panels may be used to form the firewall, provided there are no gaps between the joints. Select cutouts are allowed for control or engine intake pass-through, provided the cutouts have proper Grommeting and sealing.

Note Updated: Use metal fasteners only. Plastic screws/snap fit plugs/Zip ties are not acceptable.

B.8.4 - Front or Mid-Engine Vehicles

If the mounting points of the engine are completely forward of the RRH, then a firewall is not required to cover the area between within the plane of the RRH and between the LC's of the RRH. If the mounting points of the engine are completely forward of the RRH, the following

requirements must be met:

- a. The fuel tank shall be enclosed in a sealed container that prevents fuel from leaking in the event of a fuel tank failure.
- b. Splash shields must prevent fuel from being poured anywhere in the cockpit area during fueling.
- c. The engine shall be completely enclosed and the enclosure shall protect the driver in the event of an engine failure. The engine enclosure shall be metal and meet the requirements of Article 9 - Powertrain Guards.
- d. Engine enclosures must prevent fuel from spilling into the cockpit should the vehicle be involved in a collision or roll-over.
- e. All engine compartment venting shall be directed away from the cockpit.
- f. The driver must be able to egress from both sides of the vehicle.
- g. The engine exhaust shall not exit in the direction of the driver and shall be shielded from contact by track workers and competition officials.
- h. A panel, 300 mm x 300 mm (12 in. x 12 in.), shall be affixed to the vehicle in the plane of the
RRH, on the right side of the driver's head, and above the shoulder level of the tallest driver. This panel shall be used to affix the Technical Inspection sticker, and shall be easily viewed by track workers and competition officials.

B.8.5 - Body Panels

The cockpit must be protected with body panels that completely cover the area between the LFS and the SIM. No gaps can exist that are larger than 6.35 mm (0.25 in) and will be checked with a 6.35 mm (0.25 in) dowel rod). These panels must be made of puncture resistant material, including: plastic, fiberglass, metal, or similar material. They must be designed to prevent debris and foreign object intrusion into the driver compartment. The panels must be mounted securely to the frame using sound engineering practices (cable ties or hook-and-loop fastening is not acceptable).

Note: Quick disconnect or easily accessible fasteners for body panels are recommended, and facilitate a faster technical inspection process.

B.8.6 - Skid Plate

The cockpit must be fitted with a skid plate (belly pan) over the entire length of the cockpit, so that the driver cannot contact the ground and is protected from debris while seated normally. Skid plate material must be metal, fiberglass, plastic, or similar material. They must be designed to prevent debris and foreign object intrusion into the driver compartment. Expanded metal, fabric, or perforated panels are not allowed.

Note: belly pan should withstand the load of the driver at all conditions.

B.8.7 - Shielding for Legs and Feet

B.8.7.1 - Linkages

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 struck by during operation or a failure.

Note: Quick disconnect or easily accessible fasteners for cockpit steering & suspension covers are recommended, and facilitate a faster technical inspection process.

B.8.7.2 - Universal Joints

Universal joints in the steering system near the driver's feet must be shielded or sealed such that the driver may not become entangled in the joint.

Caution: Loose shoelaces can and have become entangled in universal joints and will hinder driver egress from the cockpit.

B.8.8 - Fire Extinguisher

All vehicles shall be equipped with a charged and functional fire extinguisher in the event of a fire on the vehicle, in the paddocks, or on the track. All team members shall be familiar with the use and operation of fire extinguishers.

B.8.8.1 - Rating and Required Features

All fire extinguishers for use on the vehicle shall have a minimum UL rating of 5BC. All fire extinguishers for use on the vehicle shall be equipped with a manufacturer installed dial pressure gauge. The dial pressure gauge shall be readily visible and indicate the unit has been properly charged. Each fire extinguisher shall be labeled with College name and vehicle number.

B.8.8.2 - Quantity

Each team shall have two or more fire extinguishers meeting the requirements above. One fire extinguisher shall be installed on the vehicle, and the remaining extinguishers shall serve as spares.

Note: Both the fire extinguishers (Spare & one fixed in vehicle) must have same size.

B.8.8.3 - Required Bracket

The only permitted fire extinguisher mounting brackets are the:

- Drake FIREX-MNT-DOR
- Drake FIREX-MNT-S-DOR
- [http://www.drakeautomotivegroup.com/Store/Product/FIREX-MNT-](http://www.drakeautomotivegroup.com/Store/Product/FIREX-MNT-DOR.aspx?wid=141)

[DOR.aspx?wid=141](http://www.drakeautomotivegroup.com/Store/Product/FIREX-MNT-DOR.aspx?wid=141)

Note: It is recommended teams keep a spare mount available.

B.8.8.4 - Mounting

The fire extinguisher mounting bracket shall be mounted in the plane of the vehicle's RRH. The fire extinguisher mounting bracket shall be affixed to the RRH via steel tabs with a minimum thickness of 3 mm (0.125 in.) thick.

Mounting hardware shall be flat socket head cap screws with a countersink angle and head

diameter matching the required Drake bracket. Hardware used to secure the bracket to the vehicle frame shall meet all requirements of Article 12, Fasteners.

The fire extinguisher shall be affixed to the mount via hose clamps. The hose clamp adjusters shall be installed as not to interfere with the operation of the pull-knob on the Drake bracket. The hose clamp adjusters and protruding material shall be installed as not to snag on the clothing of a driver during vehicle egress.

B.8.8.5 - Location and Clearance

The fire extinguisher shall be positioned on the right side of the driver, within the cockpit such that the fire extinguisher is below the driver’s head, and the top half of the fire extinguisher is above the SIM. The fire extinguisher shall be easily accessible by track workers.

The pull knob of the required bracket shall be easily actuated. To facilitate this, a minimum radial clearance around the pull knob of 64 mm (2.5 in.) is required. It is understood the area aft of the pull knob will be less than 64 mm (2.5 in.) due to the design of the bracket. See figure B – 45(A) for further clarification.

Note: Radial clearance is the unoccupied space between the edge of the pull knob and the nearest obstruction. The measurement is not made to the center of the pull knob.

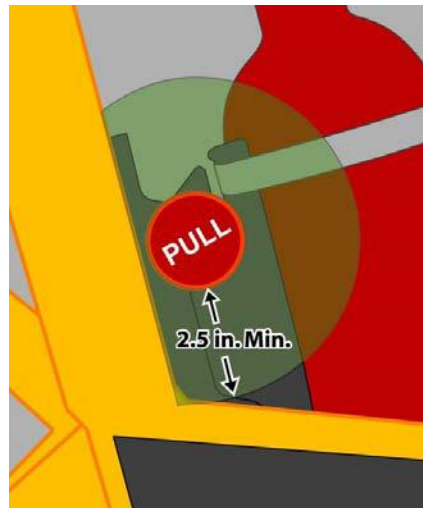


Figure B-45 (A): Fire Extinguisher, Diagram of Clearance around Pull Knob (green)



Figure B-45 (B): Fire Extinguisher Mounting, Do’s & Don’t’s

ARTICLE 9: POWERTRAIN GUARDS

B.9.1 - Powertrain Guards

All rotating powertrain components (CVTs, Gears, Sprockets, Belts and Chains) shall be shielded to prevent injury to the driver, track workers, or bystanders. Guards shall protect against hazardous release of energy should rotating components fail. Guards shall also protect against fingers, loose clothing, or other items from being entangled in the rotating components (pinch points). Universal joints, CV joints, hubs, rotors, wheels and bare sections of shafts are exempt from the requirements of B.9.1 and B.9.2.

B.9.2 - Hazardous Release of Energy

Powertrain guards and shields protecting against hazardous release of energy shall extend around the periphery of the rotating components (chains, gears, sprockets, belts, and CVT's) and have a width wider than the rotating part the guard is protecting.

Note: This means the entire periphery of the primary CVT pulley, not just the belt width.

All powertrain guards shall be constructed of one or both of the following required materials:

- Steel, at least 1.5 mm (0.06 in.) thick, meeting or exceeding the strength of AISI 1010 steel.
- Aluminum, at least 3.0 mm (0.12 in.) thick, meeting or exceeding the strength of 6061-T6 aluminum.

Holes and/or vents in the portion of the powertrain guard surrounding the rotating components are acceptable provided that in the event of a powertrain failure, no parts can escape. No direct path shall exist tangent to any rotating components.

Powertrain guards shall be mounted and secured with sound engineering practices in order to resist vibration and shock.

B.9.3 - Pinch Points and Entanglement

Rotating parts in the powertrain system rotating faster than the final drive shall be guarded on all sides, in addition to the guard around the periphery. Guarding for pinch points shall prevent small, searching fingers from getting entrained in any rotating part. Flexible, non-rigid, fabric coverings such as "Frogskin", Ceconite, and neoprene are unacceptable for use as finger guards. Powertrain covers fastened with adhesive, ratcheting tie-downs, and other temporary methods are explicitly prohibited. All powertrain covers shall have resilient and durable mountings with easily accessed and actuated fastening devices.

A complete cover around the engine and drivetrain is an acceptable shield for pinch points, but does not relieve the requirement for release of hazardous energy.

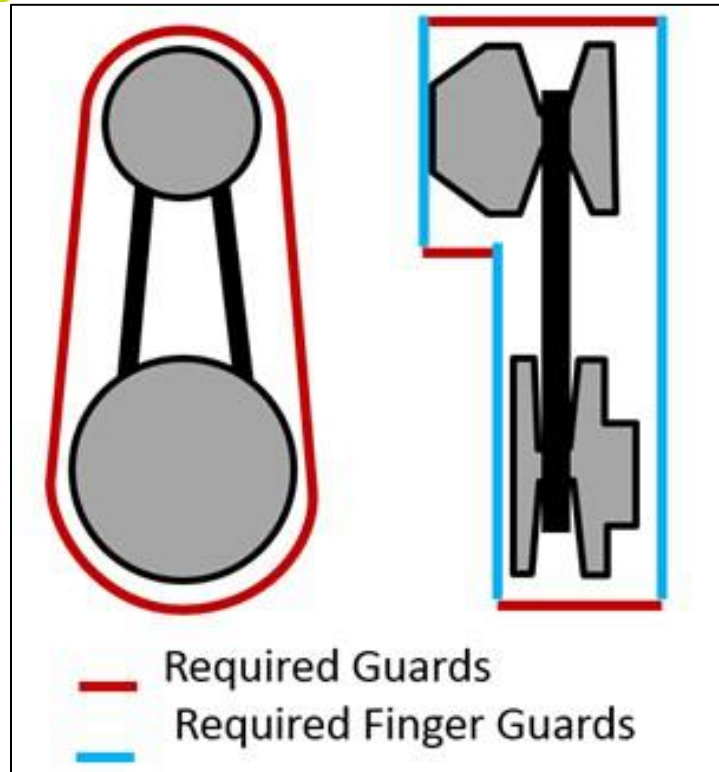


Figure B-46: Powertrain Guard Extents

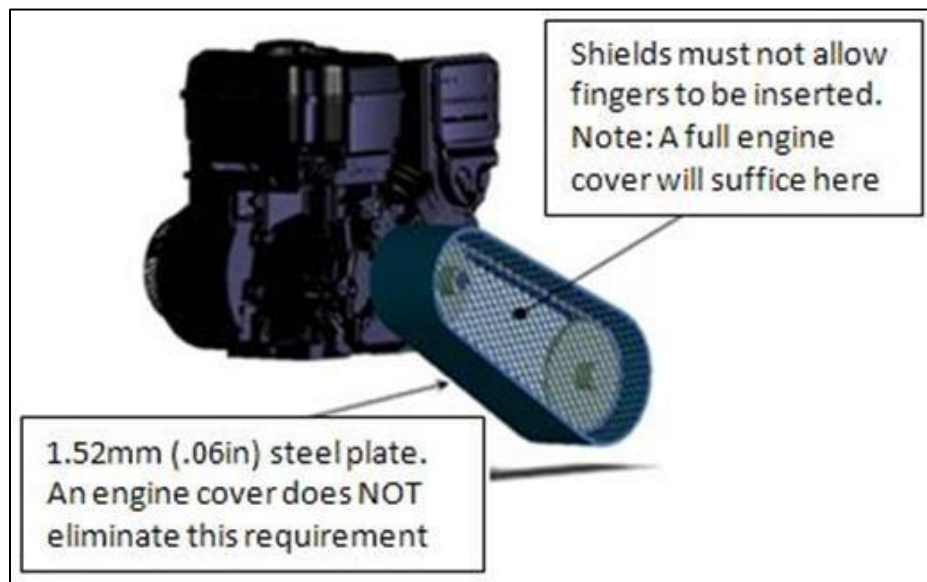


Figure B-47: Powertrain Guard Example

Note: All guards, whether Chain-drive or CVT, must maintain a clearance of at least 25mm from any nearby rollcage member or suspension component.

B.9.4 - Stock, OEM Guards

Factory stock guards (OEM) shall meet the requirements in this article. Any OEM, factory stock guards that are not modified are exempt from the requirements in rule B.9.1 - Powertrain

Guards and B.9.2 - Hazardous Release of Energy. OEM covers must still meet the requirements of B.9.3 - Pinch Points and Entanglement in way of the vent.

ARTICLE 10: ELECTRICAL SYSTEM

A minimum electrical system comprising of at least two engine kill switches, a brake light, brake switch, battery, and associated wiring is required. The vehicle electrical system shall be designed and constructed in accordance with good engineering and electrical practices. Brake lights, reverse lights and alarms shall operate regardless of kill switch setting. Brake lights, reverse lights and alarms shall be powered and functional at all times.

B.10.1 – POWER SOURCES

B.10.1.1 - Batteries

B.10.1.1.1 - Mounting

All batteries shall be mounted with sound engineering practices and not come loose during normal operation, a collision or rollover. Battery terminals shall be insulated and protected against an electrical short.

B.10.1.1.2 - Sealed Batteries

All batteries must be factory sealed and maintenance free. Batteries shall be incapable of being opened or serviced and not leak in the event of a collision or rollover.

B.10.1.1.3 - Non-Rechargeable Batteries

Batteries not recharged by an engine alternator shall only power safety appliances (brake light, reverse light, reverse alarm). Batteries not recharged by an engine alternator shall not power any control or actuation function in the drivetrain, steering, or suspension systems. Any battery used for safety appliances (brake light, reverse light, reverse alarm) shall have sufficient electrical capacity to last the entire length of the endurance event.

B.10.1.1.4 - Rechargeable Batteries

Only batteries which are recharged by an engine alternator may be used to power control or actuation functions in the drivetrain, steering, or suspension systems.

B.10.1.2 - Engine Alternator

Only approved engine alternators may be used. See rule B.2.7.15 - Alternator for further information.

B.10.1.3 - Solar Panels

Solar panels are permitted to recharge on-board batteries.

B.10.2 - Wiring and Connectors

All vehicle wiring and connectors shall be cleanly and neatly installed. Wiring shall be routed away from sources of excessive heat, abrasion, chafing, and possible short circuit. Wiring shall be installed and routed such that it does not become a hazard to cockpit egress.

B.10.3 - Engine Kill Switches

B.10.3.1 - Quantity

Each vehicle shall be equipped with a minimum of two (2) engine kill switches.

B.10.3.2 - Required Switch

The vehicle shall be equipped with one or more of the following required switches:

- Polaris Part 4013381
- Ski-Doo Part 01-171 (<http://www.mfgsupply.com/01-171.html>)
- WPS 27-0152 (<http://www.parkeryamaha.com/skidoostopswitch.aspx>)
- WPS 27-0154(<http://www.parkeryamaha.com/skidoostopswitch.aspx>)

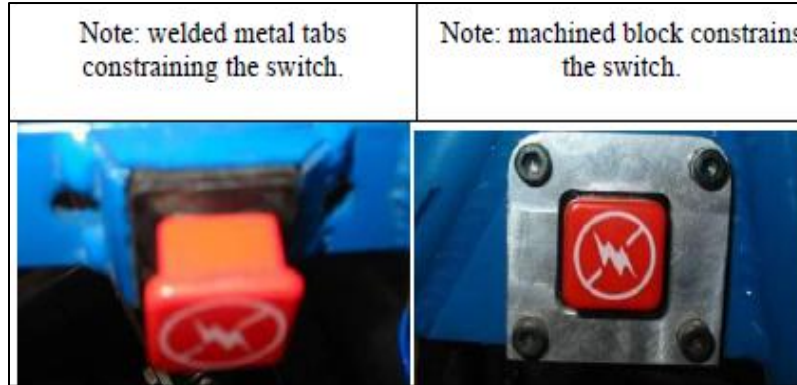


Figure B – 48, Allowed Kill switch type



Figure B – 49, Prohibited Kill switch type

Note: Older versions of the approved switches are allowed.

B.10.3.3 - Location

B.10.3.3.1 - Cockpit Switch

One of the required kill switches shall be located in the cockpit within easy reach of a driver that is properly seated and secured in the vehicle. Cockpit kill switches may not be located on removable steering wheels.

B.10.3.3.2 - External Switch

One of the required kill switches shall be located within easy access to track workers on the right side of the vehicle, aft of the plane of the RRH, and forward of the right FAB_{UP}. The external kill switch shall be generally perpendicular to the firewall (± 15 deg), below frame point B_R, and no further than 180 mm (7.0 inches), dimension “Z” in Figure B-50, below frame point B_R, and shall be mounted on a tab connected directly to the RRH. The external kill switch shall not be recessed more than 51 mm (2.0 inches) from the outside edge of the RRH tube.

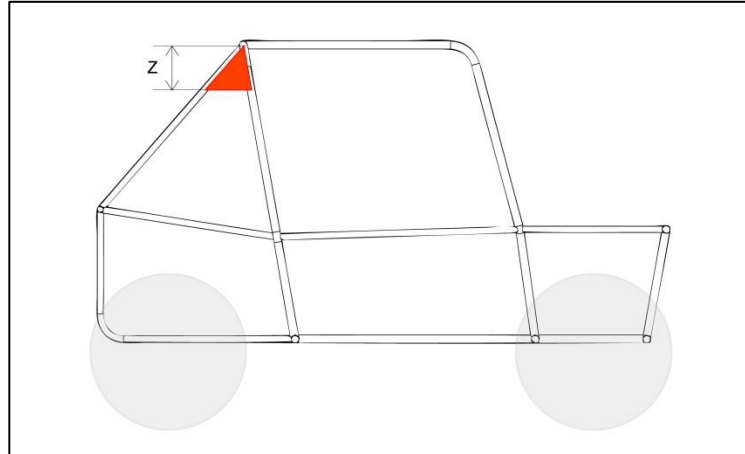


Figure B-50: Engine Kill Switch Mounting Position

B.10.3.4 - Mounting

All engine kill switches shall be rigidly mounted to the vehicle frame with unobstructed access to the switch. All engine kill switches shall be free and clear of sharp edges or other hazardous conditions to track workers or the driver. All switches shall be mechanically fastened to the frame. Adhesives are explicitly prohibited. Any and all fasteners used to mount an engine kill switch shall meet the requirements of Article 12 - Fasteners.

Exception: Rivets are acceptable fasteners for fastening kill switches to the mounting tab.

B.10.4 - Signaling

B.10.4.1 - 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 colour.

B.10.4.1.1 - Required Brake Light

Only the following brake lights are permitted along with Indian OEM Brake lights. Brake lights not listed and apart from OEM are explicitly prohibited. Modification of the brake light from the OEM design is explicitly prohibited. All brake lights shall be configured to be fully illuminated when the brakes are applied, and completely extinguished with the brakes are released.

- Polaris Part # 2411450
- Polaris Part # 2411099
- Polaris Part # 2411092-432
- Haul-Master – Part # 93263
- Command Electronics Part # 003-6018R
- Command Electronics Part # 003-6016

B.10.4.1.2 - Location and Orientation

The vehicle brake light shall have a resilient and durable mount and be positioned at a minimum of 1000 mm (39.4 in.) above the ground. The vehicle brake light shall be oriented to be visible to

trailing vehicles and shine parallel to the ground or at a slightly downward angle. Brake lights angled (aimed) above a horizontal plane are not permitted.

B.10.4.1.3 - Brake Light Switch

The brake light shall be activated only by a hydraulic pressure switch installed in the brake hydraulic lines. Each independent hydraulic brake circuit must be equipped with a hydraulic pressure switch. Cutting brakes are required to activate the brake light by way of a hydraulic pressure switch.

Note (Updated): Push style or momentary switches are not allowed. Only automobile OEM Hydraulic Brake pressure switches are allowed. Brake pressure switches of 2 wheelers are strictly prohibited.

B.10.4.2 - Reverse Light

Vehicles with a reverse gear shall be equipped with a reverse light. The reverse light shall illuminate when the vehicle is shifted to reverse gear and is extinguished when the vehicle is shifted out of reverse gear.

B.10.4.2.1 - Specification

Reverse lights shall be marked with an SAE "R" on the lens of the reverse light and be of LED design, equal to or exceeding the SAE standard J759.

B.10.4.2.2 - Location and Orientation

The reverse light shall have a resilient and durable mount and be positioned at a minimum of 700 mm (27.6 in.) above the ground. The reverse light shall be oriented to be visible to trailing vehicles and shine generally parallel to the ground.

B.10.4.3 - Reverse Alarm

Vehicles with a reverse gear shall be equipped with an audible reverse alarm. The reverse alarm shall sound when the vehicle is shifted to reverse gear and silenced when the vehicle is shifted out of reverse gear.

B.10.4.3.1 - Specification

Required reverse alarms shall be rated to meet the SAE standard J1741 or J994.

B.10.4.3.2 - Location

Required reverse alarms shall be mounted to the vehicle frame aft of the plane of the RRH.

B.10.5 - Instrumentation

Vehicles may be equipped with instrumentation to provide operational or performance information to the driver. All vehicle instrumentation must be included in the cost report.

B.10.6 - Data Acquisition

Vehicles may be equipped with data acquisition (data logging) systems. Data acquisition systems providing live feedback to the driver or telemetry data to the team must be included in the cost report. Data acquisition systems not providing live data to the driver and/or telemetry data to the team may be excluded from the cost report.

B.10.7 - Communication Systems

Teams are permitted to use radio-frequency (RF) communications systems. Any team using RF systems shall comply with Indian, state, and local regulations based on the location of the event. At no point may a team's RF systems cause harmful interference to the voice or data systems in service of competition officials or emergency responders.

B.10.7.1 - Voice

Vehicles are permitted to use RF voice communications systems. RF Voice communication systems and equipment may be **excluded** from the cost report.

B.10.7.2 - Data

Vehicles are permitted to use RF data communications systems. All RF data communications systems and associated equipment shall be **included** from the cost report

ARTICLE 11: TOW POINTS

B.11.1 - General Requirements

Each vehicle must have towing hitch points at the front and rear, along its longitudinal centerline. These hitch points are used both for dynamic events and for vehicle recovery. Tow points must be attached to the vehicle frame and must allow for transmission of both longitudinal and lateral towing loads. Towing loads will be imparted to the tow point by way of hook or clevis. Tow points shall have sufficient strength to serve as a vertical lift point for the vehicle.

B.11.2 - Front Tow Point

Front tow points shall be constructed of tubular steel, not to exceed 31.75 mm (1.25 in.) and not less than 25.4 mm (1.0 in.) in diameter. Tubing thickness shall not be less than 0.89 mm (0.035 in.).

Front tow points shall be mounted no higher than the vehicle's SIM and not below the vehicle's LFS.

The front tow point shall be able to freely pass a gauge measuring 50.8 mm tall, 50.8 mm deep, and 203.2 mm wide (2.0 in. x 2.0 in. x 8.0 in.) behind the front tow point tube. See Figure B-51 for further information.

Note: Front numbers may not interfere with the tow point.

Note (Updated): Front or Rear Bumper can't be considered as hitch point. If tubes are being used, they must be made of primary members. In addition, there must be lateral constraints for the hook or clevis to be properly in place which is optimum for the effective transmission of vehicle loads while lifting. Note that a bumper must be a FIXED one and not removable part and should be present from GO-NO-GO till end of the event.



Figure B - 51

Examples of acceptable Front Hitches:



Figure B - 52

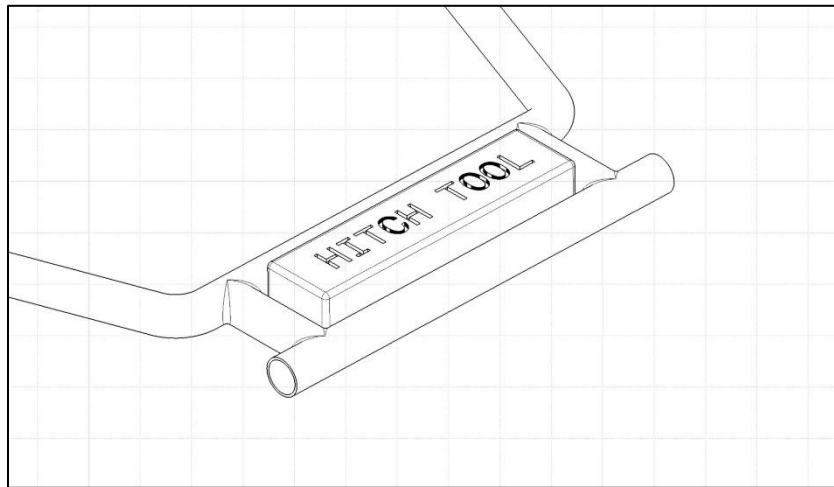


Figure B-53: Tow Point, Inspection Tool Fitment

B.11.3 - Rear Tow Point

Rear tow points shall be constructed from steel and meet the following requirements. See Figure B-55 for further information.

Dimension	Symbol	Minimum	Maximum
Tab Thickness	None	8 mm (0.31 in)	9.5mm (0.375 in.)
Hole Diameter	D	25.4 mm (1.0 in.)	31.75 mm (1.25 in.)
Hole-to-Tube Offset	X	19.0 mm (0.75 in.)	25.4 mm (1.0 in.)
Edge Distance	R	15.9 mm (0.625 in.)	25.4 mm (1.0 in.)
Width at Frame Connection	Y	76.2 mm (3.0 in.)	Unrestricted

Material	None	Steel 1018	
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Figure B-54: Tow Point, Table of Tow Point Dimensions

Note: Material for Tow-Hitch plate is strictly restricted to steel. Use of Aluminum is prohibited.

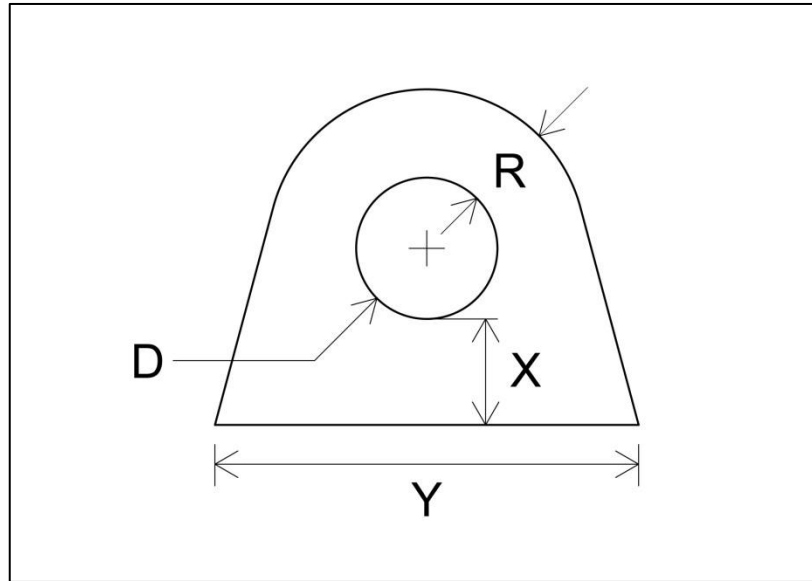


Figure B-55: Tow Point, Rear Tab Dimensions

Note: The bracket shall be design in such a way that it withstands sled pull event load.

ARTICLE 12: FASTENERS

B.12.1 - Scope

Fasteners in the following vehicle systems shall meet the requirements of this article.

- Driver Harness
- Fuel System
- Fire Extinguisher
- Engine Kill Switches

B.12.2 - Captive Fasteners

Fasteners shall be made captive by the use of the following:

- Nylon Locknuts
- Cotter Pins
- Safety Wire (for blind hole applications)

Lock washers and/or thread sealants do not satisfy the requirements of this rule.

B.12.3 - Thread Projection

To provide for proper thread engagement in the lock nut, threaded fasteners shall have at least

two (2) threads projecting past the end of the nut.

B.12.4 - Grade

Threaded fasteners shall meet or exceed one or more of the following strength grades:

- SAE Grade 5
- Metric Grade 8.8
- AN/MS specifications

Figure B-56 below depicts bolt markings meeting or exceeding requirements above.

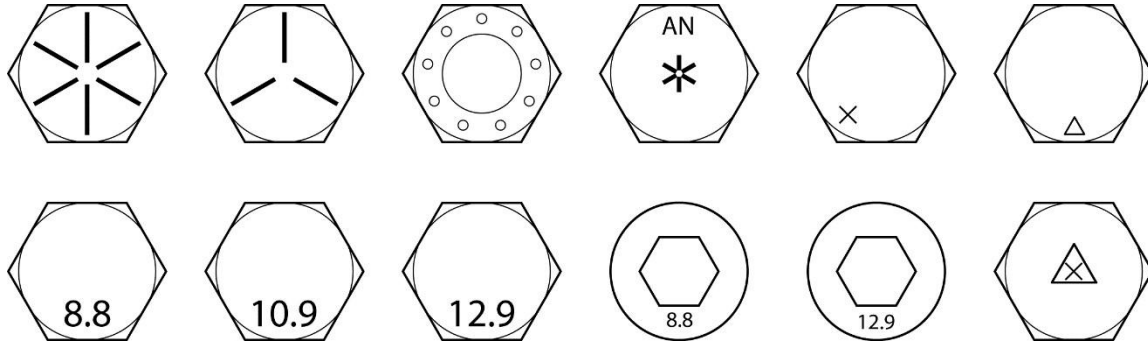


Figure B-56: Fasteners, acceptable markings

B.12.5 - Proof of Grade

For fasteners without markings as described above, proper documentation shall be supplied which requires a purchase receipt and manufacturer's specification (including markings) indicating the fastener strength exceeds or is equivalent to the requirements of B.12.4 - Grade.

Note: Teams using fasteners with readily visible grade markings will reduce their time in technical inspection.

B.12.6 - Unmarked or Custom Fasteners

Any threaded fastener (threaded rod, eye bolts, titanium bolts, etc.) that is unmarked, or does not have any markings as listed, must be documented by one or both of the following:

- A purchase receipt and manufacturer's documentation indicating the fastener meets or exceeds Grade 5 standards for that size.
- Equivalency calculations with a purchase receipt or test data showing that the fastener exceeds the strength for a Grade 5 fastener of the same size.

B.12.7 - Modified Fasteners

Fasteners which have been modified in any way other than: drilling for safety wire or shortening of the shank (threads) shall be proven to the TEJ to meet the requirements of this article.

ARTICLE 13: VEHICLE IDENTIFICATION AND MARKINGS

B.13.1 - Vehicle Number Assignment

Numbers are automatically assigned as part of the final list of selected teams after Virtual Baja. Assigned numbers may be found on the Baja SAE India website www.bajasaeindiaforum.com after the declaration of results.

B.13.2 - Transponders

For all Baja SAEINDIA® competitions, a transponder system is used for timing and scoring. All Baja SAEINDIA® vehicles are required to have a transponder. Vehicles must carry a functional, properly mounted and fully charged transponder of the specified type. Vehicles without the specified transponder will not be allowed to compete in any event for which a transponder is used for timing.

B.13.2.1 - Required Transponder

All vehicles must be equipped with at least one MYLAPS rechargeable transponder. The only acceptable transponder types are:

- Classic MX
- Flex MX
- X2 MX

Subscriptions for Flex MX or X2 MX transponders must be up-to-date and all Flex MX and X2 MX transponders must have been activated prior to Transponder Check at Technical Inspection. The timing system is capable of recording two transponder identifications per vehicle; therefore, a second transponder may be mounted as a backup if desired.

Visit <http://www.mylaps.com> for more information.

B.13.2.2 - Purchase

All teams are responsible for purchasing their transponder(s) directly through MyLaps.

<http://www.mylaps.com>

B.13.2.3 - Mounting

All vehicle transponders shall be mounted in the proper location, correctly oriented, and using sufficient fastening methods.

B.13.2.3.1 - Orientation

The transponder shall be installed vertical to the frame in the orientation shown in figure. The transponder shall also be oriented so the transponder number can read “right-side up.”



Figure B-57: Transponder Orientation

B.13.2.3.2 - Location

The transponder shall be mounted on the right side of the vehicle, forward of the seat, and preferably within the lower horizontal plane of the front suspension. The transponder shall be no more than 61 cm (24 in) above ground level.

The transponder shall have an open, unobstructed path between the antenna on the bottom of the transponder and the ground.

Caution: Metal and carbon fiber may interrupt the transponder signal.

Note: The transponder signal will normally transmit through fiberglass and plastic.

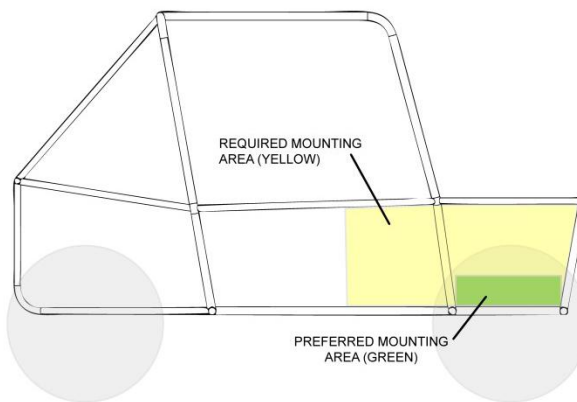


Figure B-58: Transponder, Mounting Location

B.13.2.3.3 - Fastening

Each transponder is supplied with a mounting bracket. Teams are advised to weld a small plate to their frame to attach the transponder mounting bracket.

Note: Attaching the bracket with an M4 pan OR flat head bolts with lock nuts OR wire is strongly suggested.

B.13.2.3.4 - Interference

RF systems transmitting voice and/or data can cause harmful interference with the signal



transmitted by the transponder. Care should be taken when designing, fabricating, or maintaining RF systems near the transponder.

Note: The transponder equipment operates at a frequency of 3.59 MHz

B.13.3 - Vehicle Numbers

Vehicle numbers are used by the organizers and officials to positively identify team vehicles. Teams must design numbers to be visible in all race conditions or keep them clean and conspicuous.

Caution: Numbers that are not easily read may be black flagged and might not be scored during the endurance event.

B.13.3.1 - Required Numbers

Three primary numbers in block-style numerals are required to be securely affixed to the car. The vehicle's number shall be readily visible from the left side, right side, and the front of the vehicle and strongly contrast with the number's background color.

B.13.3.2 - Location

B.13.3.2.1 - Side Numbers

Side numbers, mounted to the left and the right sides of the vehicle, shall be mounted above the SIM and aft of the plane of the RRH.

B.13.3.2.2 - Front Number

The angle of the plane of the front-facing numbers, when affixed to the vehicle above the SIM, shall be less than or equal to 45 deg. from vertical.

The angle of the plane of the front numbers, when affixed to the vehicle below the SIM, shall be less than or equal to 15 deg. from vertical.

B.13.3.3 - Number Size

The primary cutout numbers must be at least 203 mm (8.0 in) high, dimension "H" in Figure B-51. The primary cutout numbers shall have a minimum line width of 25 mm (1.0 in.) (dimension "S" in Figure B-59) and a minimum character width of 102 mm (4.0 in) (dimension "W" in Figure B-59). The primary cutout numbers shall be mounted such that the projecting face is a minimum of 13 mm (0.5 in) from the background panel (dimension "D" in Figure B-59).

Note: Avoid sharp edges or points on the inner and outer edges of the cutout numbers.

B.13.3.4 - Backing Panel

Each number on the vehicle shall have a highly contrasting background to facilitate easy reading. Numbers may be outlined to provide enhanced contrast. Number backing panels must be securely fastened to the vehicle frame.

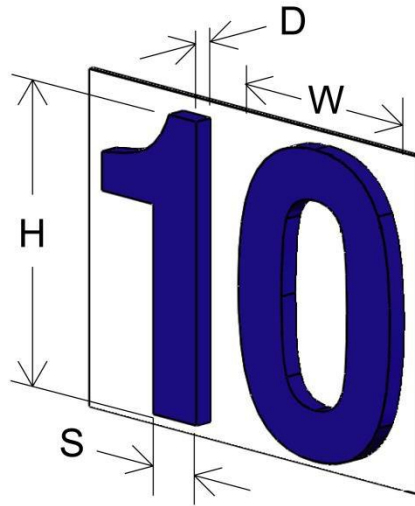


Figure B-59: Vehicle Numbers, Dimensions

B.13.4 - SAE India Logo

Two (2) SAE India logos must be displayed on the vehicle in prominent locations. These will be distributed during registration at the competition.

B.13.5 - Sponsor Identification

Teams may display advertising from their vehicle's sponsors, provided it is in good taste and does not conflict with the vehicle's number. SAE International may require all entrants to display advertising from the competition sponsors.

ARTICLE 14: ERGONOMIC REQUIREMENTS FOR DRIVER SAFETY

B14.1 Rollcage Requirements

1. Teams are advised to design the Driver cockpit giving maximum safety to driver. Reducing weight/compact rollcage can be a secondary part of it.
2. Brackets/Mountings welded in the rollcage to be filleted to avoid sharp edges which may prompt injury to team member/Driver.
3. Ensure Good visibility for the driver through FBM.
4. Triangulate in areas that require more strength.

B14.2 Sub-System Requirements

B14.2.1 – Pedal Clearances

The Accelerator, Brake and Clutch (if applicable) must meet the **minimum clearances** as illustrated below in Figure B-60 and B-61. Clearances are measured w.r.t the nearest point/Plane of rollcage inner surface.

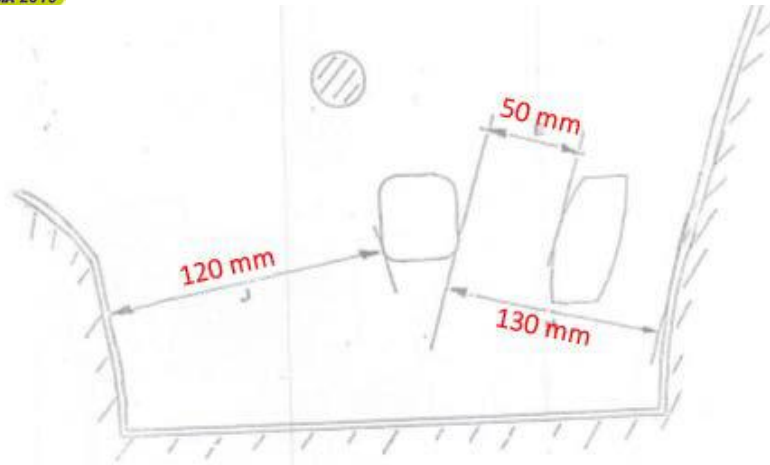


Figure B-60: Automatic Transmission (Without Clutch)

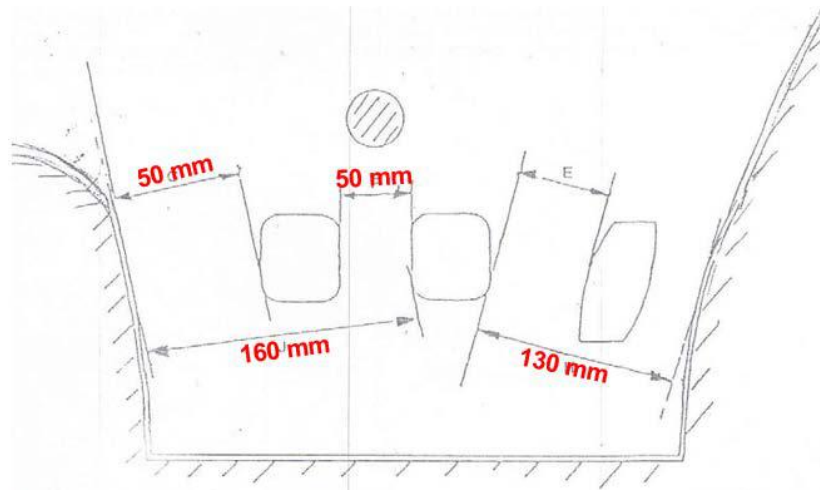


Figure B-61: Manual Transmission (With Clutch)

Note:- For further information on the clearances, refer to the automotive standards issued by ARAI on below mentioned link.

https://www.araiindia.com/Publish_AIS_Standards.asp

B14.2.2 – Steering Wheel Clearances

There must be a minimum clearance (RA) of **220mm** between the driver’s chest or upper body/torso whichever is closest to the steering wheel, as illustrated in Figure B-62.

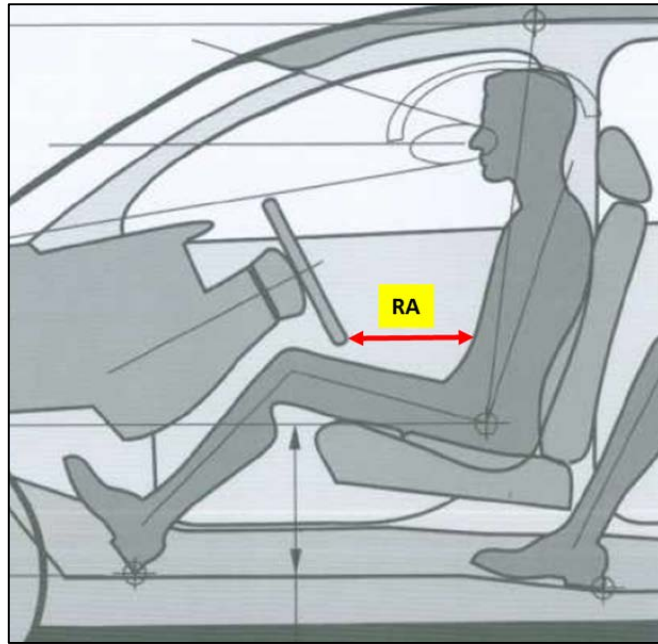


Figure B-62: Driver’s Chest Clearance

B14.3 Driver Knee Safety Requirements

This requirement deals with the safety requirements to be followed to ensure driver knees are not coming out of rollcage. The maximum height of the knees that can be allowed above the SIM member when viewed from side is **76mm (3in)** as shown in image B-63. The check will be done when the driver’s foot are kept on the pedals, hands on the steering wheel and with the comfortable pedal operating position.

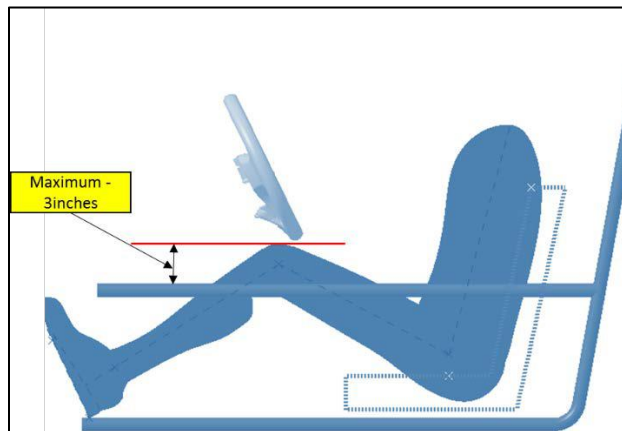


Figure B-63: Driver Knee Safety Requirement

In line with the above rule, teams are required to meet the lateral clearance requirement of the knees. This is also measured when the driver's foot are on the pedals and hands on the steering wheel. The dimension "A" mentioned in figure B-64 should be minimum of **76mm (3in)** w.r.t SIM member inner surface.

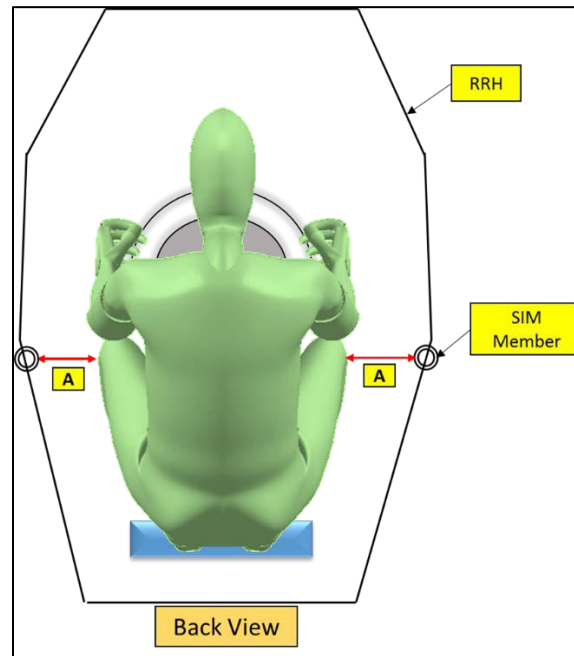


Figure B-64 Driver Knee Safety Lateral Clearance

PART C: ELECTRICAL POWERTRAINS AND SYSTEMS [E-BAJA SPECIFIC]

ARTICLE 1: ELECTRIC SYSTEM DEFINITIONS

C1.1 HIGH VOLTAGE (HV) AND LOW VOLTAGE (LV)

C1.1.1 Whenever a circuit has a potential difference where the nominal operation voltage is greater than or equal to 48V DC, it is defined as part of the High Voltage or tractive system.

C1.1.2 Low voltage is defined as any voltage below 48V DC.

C1.1.3 The maximum permitted voltage that may occur between any two electrical connections is 60 V DC.

C1.1.4 The tractive system accumulator is defined as all the battery cells that store the electrical energy to be used by the tractive system.

C1.2 GROUNDED LOW VOLTAGE AND TRACTIVE SYSTEM

C1.2.1 The tractive system of the car is defined as every part that is electrically connected to the motor(s) and tractive system accumulators.

C1.2.2 The grounded low voltage (GLV) system of the car is defined as every electrical part that is not part of the tractive system

C1.2.3 The tractive system must be completely isolated from the chassis and any other conductive parts of the car.

C1.2.4 The tractive-system is a high-voltage system by definition, see C1.1.1.

C1.2.5 The GLV system must be a low-voltage-system, see C1.1.2.

C1.2.6 All components in the tractive system must be rated for the maximum tractive system voltage.

C1.2.7 The tractive system motor(s) must be connected to the accumulator through a motor controller (Traction Controller). Bypassing the control system and connecting the tractive batteries directly to the motor(s) is prohibited.

ARTICLE 2 TRACTIVE SYSTEM - POWERTRAIN

C2.1 EKIT REQUIREMENTS

C2.1.1 The eKit Comprises of all major aggregates of electric power train such as Battery, Motor, Battery & Motor Controllers, Chargers etc.

C2.1.2 The eKIT components from any Supplier can be used in eBAJA SAEINDIA 2019, provided all the components are in compliance with the Automotive Electric Vehicle standards (Refer Part H, Article 1). Certificates confirming the same shall be submitted to the eBAJA Technical Team.

C2.1.3 Teams shall submit the ESF Part-1(Refer D2.2.4) with all the required certification and technical specification documentation of the Electrical Kit during Virtual BAJA SAEINDIA 2018. Only the components approved by the eBAJA Technical Committee shall be used by the teams in building their vehicle's powertrain.

C2.1.4 Allowed Traction Motor shall be a BLDC motor with Peak Power not more than 6 kW.

C2.1.5 Allowed Battery Specs shall not exceed 48V, 110Ah Li-ion batteries.

C2.1.6 All the eKit components shall follow International Electrotechnical Commission (IEC) 60529 IP65 i.e. no dust or water entry.

C2.2 POWER and VOLTAGE LIMITATION

C2.2.1 The maximum voltage in the tractive system must not exceed the voltage defined in C1.1.3.

C2.2.3 Violating these values will lead to disqualification for the entire event.

C2.3 ACCELERATOR PEDAL

C2.3.1 The accelerator pedal must be a right-foot-operated foot pedal.

C2.3.2 The Traction Motor controller must be actuated by a foot pedal

C2.3.3 The foot pedal must return to its original rearmost position when released. The foot pedal must have positive stops at both ends of its travel.

ARTICLE 3 TRACTIVE SYSTEM - ENERGY STORAGE

C3.1 TRACTIVE SYSTEM ACCUMULATOR – GENERAL REQUIREMENTS

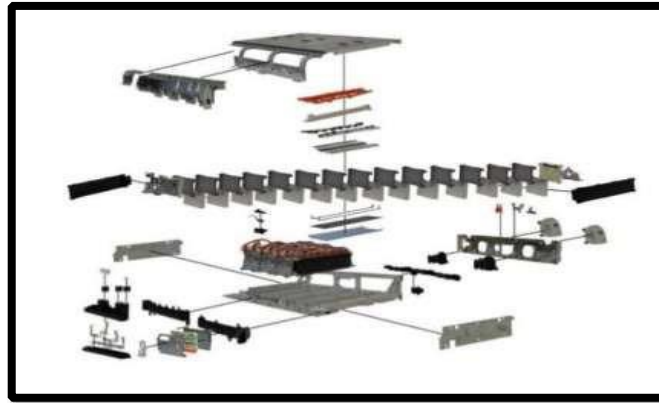


Figure 1

- C3.1.1** All Batteries shall be in compliance with the AIS 048 or other similar standards (Refer Part H , Article 1). The battery pack which stores the tractive system energy will be built into accumulator segments and must be enclosed in (an) electrically insulated accumulator container(s). Refer figure 1,2,3 mentioned below.
- C3.1.2** The accumulator container(s) should be easily accessible anytime during the entire event for inspection in case of any failures in the functioning of the kit.
- C3.1.3** The Tractive System Accumulator pack shall include at least one AIR and one Fuse which will open the circuit and disconnect the energy flow from accumulator to the remaining tractive system whenever a fault is detected.

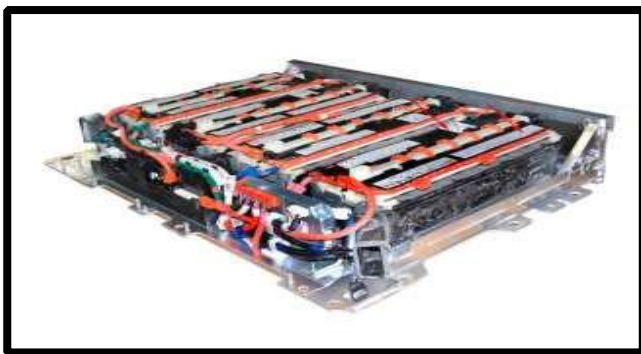


Figure 2

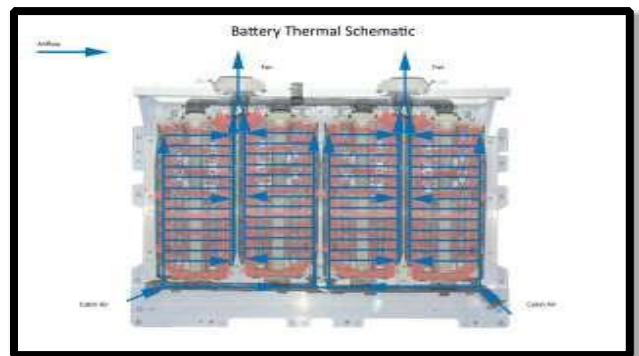


Figure 3

C3.2 TRACTIVE SYSTEM ACCUMULATOR CONTAINER - ELECTRICAL CONFIGURATION

- C3.2.1** The tractive system accumulator container must be made from an insulating material. If the container is made from an electrically conductive material, then the poles of the accumulator segment(s) and/or cells must be isolated from the inner wall of the accumulator container with an insulating material that is rated for the maximum tractive system voltage. All conductive surfaces on the outside of the container must have a low-resistance connection to the GLV system ground, see article on Grounding. Care must be taken to ensure that conductive penetrations, such as mounting hardware, are adequately protected against puncturing the insulating barrier.
- C3.2.2** The battery pack must be electrically insulated in all the directions using suitable material for the container to prevent arc flashes caused by contact with any other parts and tools. Air is not considered to be a suitable insulation material.
- C3.2.3** The Accumulator Isolation Relays (AIRs) and the main fuse must be separated with an electrically insulated and fireproof material from the rest of the accumulator. Air is not considered to be a suitable insulation material in this case.
- C3.2.4** Contacting / interconnecting the single cells by soldering in the high current path is prohibited. Soldering wires to cells for the voltage monitoring input of the BMS is allowed, since these wires are not part of the high current path.
- C3.2.5** Every wire used in an accumulator container, no matter whether it is part of the GLV or tractive system, must be rated to the maximum tractive system voltage.

C3.3 TRACTIVE SYSTEM ACCUMULATOR CONTAINER - MECHANICAL CONFIGURATION

- C3.3.1** All accumulator containers must be rugged and rigidly mounted to the chassis to restrict its motion in all direction. If fasteners are used for mounting an accumulator container, they must comply with PART C. Any Tampering/break open the Battery pack is STRICTLY PROHIBITED.



- C3.3.2** The mounting system must be designed to withstand forces from a 17g deceleration in the horizontal plane and 10g vertical deceleration.
- C3.3.3** Accumulator containers must lie within the Electrically insulated frame. Mounting the accumulator containers on the either sides of the driver's seat and in the gap between the firewall and the driver's seat is strictly prohibited. Examples of some accumulator container mounting positions which are **strictly prohibited** are provided below:



- C3.3.4** All accumulator containers must be protected from side or rear impact collisions by structure equivalent to that defined in B3.2.
- C3.3.5** The accumulator container must be built of mechanically robust material. The container material must be fire resistant.
- C3.3.6** Holes, both internal and external, in the container are only allowed for the wiring-harness, ventilation, cooling or fasteners. External holes must be thoroughly sealed. Proper cooling system should be designed to ensure the excessive heat is dissipated and temperature of the tractive system is adequately maintained.
- C3.3.7** The container must be completely closed at all times, when mounted to the car and also when dismantled from the car without the need to install extra protective covers. Openings for ventilation should be of a reasonable size, e.g. completely open side pods containing accumulators are not allowed.
- C3.3.8** A sticker with an area of at least 750mm² and a red or black lightning bolt on yellow background or red lightning bolt on white background must be applied on every accumulator container. The sticker must also contain the text "High Voltage" or something similar if the accumulator voltage is greater than or equal to 48V DC.

- C3.3.9** In case of accumulators that may vent an explosive gas must have a ventilation system or pressure relief valve to prevent the vented gas from reaching an explosive concentration.



C3.4 ACCUMULATOR ISOLATION RELAY(S) (AIR)

- C3.4.1** The accumulator isolation relays must open both poles of the accumulator. If these relays are open, no HV system must be in active state.
- C3.4.2** The isolation relays must be of a “normally open” type.
- C3.4.3** The fuse protecting the accumulator tractive system circuit must have a rating lower than the maximum switch off current of the isolation relays.
- C3.4.4** The accumulator isolation relays must not contain mercury.

C3.5 BATTERY MANAGEMENT SYSTEM (BMS)

- C3.5.1** Each cell must be monitored by a battery management system whenever the tractive system is active or the accumulator is connected to a charger
- C3.5.2** The BMS must continuously measure the cell voltage of every cell, in order to keep the cells inside the allowed minimum and maximum cell voltage levels stated in the cell data sheet. If single cells are directly connected in parallel, only one voltage measurement is needed.
- C3.5.3** Any GLV connection to the BMS must be galvanically isolated from the tractive system, including any connections to external devices such as laptops.
- C3.5.4** The temperature of all the cells should be monitored and if the temperature exceeds the permissible battery temperature specification, BMS should shut down the system.
- C3.5.5** BMS should sustain vibration and must be tightly fastened to the body of the vehicle.
- C3.5.6** BMS should follow International Electrotechnical Commission (IEC) 60529 IP65 i.e. no dust or water entry.

NOTE: It is compulsory to monitor every cell temperature and voltage.

ARTICLE 4: TRACTIVE SYSTEM – GENERAL REQUIREMENTS

C4.1 SEPARATION OF TRACTION SYSTEM AND GROUNDED LOW VOLTAGE SYSTEM

- C4.1.1** The layout of electrical devices designed by the team must be documented accurately in the in ESF Part-2(Refer D 2.2.4).
- C4.1.2** There must be no connection between the frame of the vehicle (or any other conductive surface that might be inadvertently touched by a crew member or spectator), and any part of any tractive system circuits.
- C4.1.3** Tractive system and GLV circuits must be physically segregated such that they are not run through the same conduit, except for interlock circuit connections.
- C4.1.4** GLV systems must not be included in the accumulator container except for required purposes, for example the BMS and AIR. The BMS should contain its own galvanic isolation. Any connections between the BMS and the Low Voltage wiring outside of the accumulator must be galvanically isolated. Any Low Voltage wiring within the accumulator, its galvanic isolation must be described in the ESF Part-2.
- C4.1.5** When both tractive system and GLV are present within an enclosure, they must be separated by insulating barriers made of moisture resistant, UL Standard recognized or equivalent insulating materials (e.g. Nomex based electrical insulation).
- C4.1.6** Components and cables capable of movement must be positively restrained to maintain spacing.

C4.2 POSITIONING OF TRACTIVE SYSTEM PARTS

- C4.2.1** All parts belonging to the tractive system including cables and wiring must be contained within the envelope of any part of the frame which is made from any regulated tubing defined in B3.2 and/or an additional envelope of tubing which meets the minimum specification defined in B3.2 or equivalent, such that they are protected against being damaged in case of a crash or roll-over situation.
- C4.2.2** If tractive system parts are mounted in a position where damage could occur from a rear / side impact or has clearance from ground < 350mm , then it has to be protected by a fully triangulated structure with tubes of a minimum outer diameter of 25.4mm and a minimum wall thickness of 1.25mm or equivalent – see B3.2.
- C4.2.3** In side or front view no part of the tractive-system can project below the lower surface of the frame.

C4.3 TRACTIVE SYSTEM FIREWALL

- C4.3.1** The tractive system firewall must comply with the main firewall regulations as defined in B8.3.

In addition a firewall must separate the driver compartment from all tractive system components.

C4.3.2 The firewall must be made from or coated with an electrically insulating material or there must be an electrically insulating barrier between all the tractive system components and the firewall.

C4.3.3 The firewall must be fire resistant according to UL94-V0, FAR25 or equivalent.

C4.3.4 The firewall must be resistant to puncture and scratch.

C4.3.5 C4.4 applies, if a coated material is used, which is or may become conductive.

C4.3.6 HV cables shall be color coded as orange.

C4.4 GROUNDING

C4.4.1 All electrically conductive parts of the vehicle (e.g. parts made of steel, (anodized) aluminum, any other metal parts, etc.) which are within 100mm of any tractive system or GLV component, and any driver harness mounting points, seat mounting points and driver controls must have a resistance below 300m ohms (measured with a current of 1A) to GLV system ground.

C4.4.2 All parts of the vehicle which may become electrically conductive (e.g. completely coated metal parts, carbon fibre parts, etc.) which are within 100mm of any tractive system or GLV component, must have a resistance below 5 Ohm to GLV system ground.

C4.4.3 Electrical conductivity of any part may be tested by checking any point which is likely to be conductive, for example the driver's harness attachment bolt, but where no convenient conductive point is available then an area of coating may be removed.

NOTE: Carbon fibre parts may need special measures such as using copper mesh or similar to keep the ground resistance below 5 Ohms.

C4.4.4 All HV components should have a low contact resistance (i.e. resistance between enclosure of HV components and ground) preferably below 1m Ω .

C4.5 TRACTIVE SYSTEM INSULATION, WIRING AND CONDUIT

C4.5.1 All parts, especially live wires, contacts, etc. of the tractive system need to be isolated by non-conductive material or covers to be protected from being touched.

C4.5.2 Non-conductive covers must prevent inadvertent human contact with any tractive system voltage. This must include crew members working on or inside the vehicle. Covers must be secure and adequately rigid. Body panels that must be removed to access other components, etc. are not a substitute for enclosing tractive system connections.

- C4.5.3** Tractive system components and containers must be protected from moisture in the form of rain or puddles.

Note: A rating of IP65 is recommended for the rain test.

- C4.5.4** Only insulation material that is appropriate for the expected surrounding temperatures may be used and this must have a minimum temperature rating of 90°C. Using only insulating tape or rubber-like paint for insulation is prohibited.

- C4.5.5** All wires and terminals and other conductors used in the tractive system must be sized appropriately for the continuous tractive system current and the wires must be marked with wire gauge, temperature rating and insulation voltage rating. Alternatively, a serial number or a norm printed on the wire is sufficient if this serial number or norm is clearly bound to the wire characteristics for example by a data sheet. The minimum acceptable temperature rating for tractive system cables is 90°C.

NOTE: Sizing of the conductors for the 'continuous tractive system current' can take account of the RMS or average electrical current that will be used and the anticipated duration of time at maximum electrical current.

- C4.5.6** All tractive system wiring must be done to professional standards with appropriately sized conductors and terminals and with adequate strain relief and protection from loosening due to vibration etc.
- C4.5.7** All tractive system connections must be designed so that they use intentional current paths through conductors such as copper or aluminum and should not rely on steel bolts to be the primary conductor. The connections must not include compressible material such as plastic in the stack-up.
- C4.5.8** Tractive system wiring must be shielded against damage by rotating and / or moving parts.
- C4.5.9** If external, un-insulated heat sinks are used, they must be properly grounded to the GLV System ground, see C4.4.
- C4.5.10** All electrical connections in the high current path of the tractive system that rely on screwed connections must have a rigid locking mechanism.

C4.6 TRACTIVE SYSTEM ENCLOSURES

- C4.6.1** Every housing or enclosure containing parts of the tractive system, except motor housings, must be labelled with (a) reasonably sized sticker(s) with a red or black lightning bolt on yellow background or red lightning bolt on white background. The sticker must also contain the text "High Voltage" or something similar if the voltage is more than or equal to 48V DC.

C4.7 ACTIVATING THE TRACTIVE SYSTEM

- C4.7.1** The driver must be able to (re-)activate or reset the tractive system from within the cockpit without the assistance of any other person except for situations in which the BMS have shut down the tractive system.
- C4.7.2** Only closing the shutdown circuit must not set the car to ready-to-drive mode. The car is ready to drive as soon as the motor(s) will respond to the input of the torque encoder / acceleration pedal. Therefore, additional actions are required by the driver to set the car to ready-to-drive-mode e.g. pressing a dedicated start button, after the tractive system has been activated. One of these actions must include the brake pedal being pressed as ready to-drive-mode is entered.
- C4.7.3** The Tractive system should not be activated while charging is in progress
- C4.7.4** The Tractive system should not be activated if the gear is not in neutral position
- C4.7.5** The Tractive system should not be activated if the accelerator pedal is in pressed condition

C4.8 TRACTIVE-SYSTEM-ACTIVE LIGHT (TSAL)

- C4.8.1** It must be clearly visible when the tractive system is set to active. The car is defined as active whenever the accumulator isolation relay is closed or when there is supply to the tractive system. For this the car must be equipped with a light mounted under the highest point of the main roll hoop which lights if the car's tractive system is active and which is off when the tractive system is not active, see definition above.
- C4.8.2** The TSAL must be red.
- C4.8.3** The TSAL must flash continuously with a frequency between 2Hz and 5Hz.
- C4.8.4** It must not be possible for the driver's helmet to contact the TSAL.
- C4.8.5** The TSAL must be clearly visible even in very bright sunlight.
- C4.8.6** The TSAL must be visible by a person standing up to 3m away from the TSAL. The person's minimum eye height is 1.6m.

NOTE: If any official e.g. track marshal, scrutinizer, etc. considers the TSAL to not be easily visible during track operations the team may not be allowed to compete in any dynamic event before the problem is solved.
- C4.8.8** It is prohibited to mount other lights in proximity to the TSAL.

C4.9 READY-TO-DRIVE-SOUND

- C4.9.1** The car must make a characteristic sound, once but not continuous, for at least 1 second and a maximum of 3 seconds when it is ready to drive.
- C4.9.2** The car is ready to drive as soon as the motor(s) will respond to the input of the torque encoder / accelerator pedal.
- C4.9.3** The sound level must be a minimum of 70dBA, fast weighting, in a radius of 2m around the car.
- C4.9.4** The used sound must be easily recognizable. No animal voices, song parts or sounds that can be interpreted as offensive will be accepted.

ARTICLE 5: FUSE

C5.1 FUSING

- C5.1.1** All electrical systems (both low and high voltage) must be fused greater than the current rating of the electrical system. The current rating of a fuse must not be greater than the continuous current rating of any electrical component, for example wire, bus bar, cell or other conductor that it protects. The continuous current rating of a fuse must not be greater than the continuous current rating of any electrical component, for example wire, bus bar, cell or other conductor that it protects.



- C5.1.2** All fuses and fuse holders shall be of automotive standards and must be rated for the highest voltage in the systems they protect. Fuses used for DC must be rated for DC, and must carry a DC rating equal to or greater than the system voltage.
- C5.1.3** All fuses must have an interrupt current rating which is higher than the theoretical short circuit current of the HV system that it protects.
- C5.1.4** If multiple parallel strings of batteries or capacitors are used then each string must be individually fused to protect all the components on that string. Any conductors, for example wires, bus bars, cells etc. conducting the entire pack current must be appropriately sized for the total current that the individual fuses could transmit or an additional fuse must be used to protect the conductors.

- C5.1.5** Cells with internal over-current protection may be used without external fusing or fusible-links if suitably rated.

ARTICLE 6: HIGH VOLTAGE PROCEDURES & TOOLS

C6.1 WORKING ON TRACTIVE SYSTEM ACCUMULATOR CONTAINERS

- C6.1.1** Whenever the Accumulator or tractive system is being worked on, only appropriate insulated tools should be used.
- C6.1.2** Safety glasses with side shields and safety gloves must be worn by all participating team members when (a) parts of the tractive system are exposed while it is active, or (b) work is being done on the accumulators.

C6.2 CHARGING

- C6.2.1** There will be a separated charging area on the event site. Charging tractive system accumulators is only allowed inside this area.
- C6.2.2** Accumulators may be charged inside the car.
- C6.2.3** It is also possible to charge the accumulators outside the car with a removable accumulator container.
- C6.2.4** The accumulator containers or the car itself, depending on whether the accumulators are charged externally or internally, must have a label with the following data during charging: Team name and Electrical System Officer phone number(s).
- C6.2.5** NO WORK IS ALLOWED ON ANY OF THE CAR'S SYSTEMS DURING CHARGING, IF THE ACCUMULATORS ARE CHARGED INSIDE THE CAR.
- C6.2.6** No grinding, drilling, etc. is allowed in the charging area.
- C6.2.7** At least one team member who has knowledge of the charging process must stay with the accumulator(s) / car during charging.
- C6.2.8** Moving accumulator cells and/or accumulator segment(s) around at the event site is only allowed inside a completely closed accumulator container.

C6.3 CHARGERS

- C6.3.1** Charger shall be of 48V.

- C6.3.2** Only chargers presented and sealed at Electrical Tech Inspection are allowed. All connections of the charger(s) must be isolated and covered. No open connections are allowed.
- C6.3.3** All chargers must either be accredited to a recognized standard e.g. CE or where built by the team they must be built to high standards and conform with all electrical requirements for the vehicle tractive system.
- C6.3.4** The charger must incorporate an interlock such that the connectors only become live if is correctly connected to the accumulator.
- C6.3.5** HV charging leads must be orange
- C6.3.6** When charging, the BMS must be live and must be able to turn off the charger in the event that a fault is detected.

ARTICLE 7: GROUNDED LOW VOLTAGE SYSTEM (<=48VDC)

C7.1 General Electrical System Overview

The electrical system must include at least two kill switches, a brake light, a reverse light and a reverse alarm. The battery power source for the above-mentioned items may be given from the tractive system accumulators or teams may use an additional auxiliary battery for the same.

The kill switches must deactivate the complete electrical system (except for the brake lights, reverse lights and alarms). The kill switches must NOT deactivate the brake light, reverse light and alarms. The brake light, and any reverse light and alarm, must be powered and functional at all times and shall operate regardless of the kill switch setting. Cut-out or disabling switches to the brake light and reverse light (if so equipped) are prohibited.

C7.2 Auxiliary Batteries

Batteries shall not be recharged by a Traction Motor \ alternator and may power only safety items (brake light, reverse light and alarm) and instrumentation (driver display, data acquisition), and may not power any control or actuation function in the drive-train, steering and suspension systems.

Batteries must be mounted with good engineering practice and not come loose during a roll over. The battery must be safely placed & concealed. Failing this, the technical inspectors may debar the team from the dynamic events.

- C7.2.1** Auxiliary batteries must be attached securely to be frame.
- C7.2.2** Any wet-cell battery located in the driver compartment must be enclosed in a nonconductive marine-type container or equivalent.
- C7.2.3** The hot (ungrounded) terminal must be insulated.

C7.2.4 Battery packs based on Lithium Chemistry other than LiFePO4 must have over voltage, under voltage, short circuit and over temperature cell protection and be separated from the driver with a firewall.

C7.3 Non-recharging batteries,

Instrumentation that is used to relay data back to driver or pits must be included in the cost report. If no live feedback is provided then it does not need to be included in the cost report. All instrumentation must be included in the cost report.

C7.3.1 Batteries must be able to provide power to safety items (brake light, reverse light and alarm) for the duration of each event.

C7.3.2 Vehicles will be black flagged if safety equipment is not functioning which is to be indicated by the driver to the marshal.

C7.3.3 The batteries must be factory sealed (incapable of being opened or serviced) and not leak in the event of a roll over.

C7.4 Kill Switches \ Master Switches: Each vehicle must be equipped with two (2) easily accessible kill switches turning off the tractive system, Refer B10.3. The Kill switch must not de-energize the Brake Light, Reverse Light and the Alarms.

C7.5 Instrumentation and Data Acquisition

C7.5.1 Live Data or Driver Feedback Instrumentation and Data Acquisition

Systems that provide live information about the cars operation or performance are allowed. Battery pack Voltage (Over all Voltage of HV system), Battery Pack Temperature (Over all Temperature), State of Charge (SOC) shall be displayed time to time on the driver dashboard. When key is turned ON, all the above-mentioned information shall be displayed to the driver. Any other information displayed to the driver using the Data Acquisition is up to the team's choice. Any system that provides data back to the driver or team track side must be included on the Cost Report. Additionally, any batteries used to power the system must comply with the battery rules in Section C7.2.

C7.5.2 Data Loggers and Event Recorders

Systems that provide live information about the cars current operation or performance are allowed. Additionally, any batteries used to power the system must comply with the battery rules in Section C7.2.

C7.5.3 Mixed Use Instrumentation and Data Acquisition

Any system that is used as part of live data loggers or driver feedback instrumentation system as well as a component of a control or actuation mechanism for the drivetrain, steering and suspension systems must be included on the Cost Report. Additionally, any batteries used to power the system must comply with the Recharging batteries rule in Section C7.2.

PART D: STATIC EVENTS – 300 POINTS

ARTICLE 1: SCORING

Event	mBaja	eBaja
Static Events		
Design Evaluation	150	150
Cost Report	15	15
Prototype Cost	85	85
Sales Presentation	50	50
Total	300	300
Dynamic Events		
Acceleration	75	100
Hill Climb or Sled Pull	75	100
Land Maneuverability	75	100
Suspension & Traction	75	NA
Endurance	400	400
Total	700	700

Total Score: Static + Dynamic = 1000Points

ARTICLE 2: TECHNICAL EVALUATION

D2.1 Technical Evaluation - Pass/Fail

All Baja SAE India vehicles must pass a technical inspection before they are permitted to operate under power.

D2.1.1 The evaluation will determine if the vehicle satisfies the requirements and restrictions of the Baja SAE India rules.

D2.1.2 If vehicles are not ready for technical evaluation when they arrive at the inspection site, they will be sent away.

D2.1.3 Any vehicle may be re-inspected at any time during the competition and correction of any non-compliance will be required.

D2.2 Technical Evaluation Process

Technical inspection will consist of three (3) separate stages & will issue 3 stickers after completion of those critical stages. The Format will be issued to all teams, and must be carried for technical evaluation. The timing data per attempt and No. of attempts will be monitored. The same data sheet will be finally submitted to technical committee while issuing 3rd and final sticker of 'Tech OK'.

D2.2.1 Weight measurement

The tare weight of vehicle will be measured & recorded.

D2.2.2 Engine inspection and governor setting- Governor Setting Check

Briggs & Stratton Technical Representatives will set the governors of all vehicles. Vehicles must be presented for governor setting with the engine output shaft bare, the drivetrain disconnected and the throttle cable disconnected from the engine and working kill switches. Each vehicle engine will be confirmed by Briggs and Stratton technical staff that will:

- (1) Confirm its compliance with the rules and
- (2) Set the governor to the specified rpm. (3800)

B&S team will provide “Engine OK” sticker on confirmation. Their after, teams are not supposed to make any changes in engine governor settings. If any team found with noncompliance will be disqualified.

D2.2.3 Technical Safety Scrutiny -

Each vehicle will be inspected to determine if it complies with the requirements and restrictions of the Baja SAE India rules. This inspection will include an examination of the driver’s equipment including helmet and arm restraints, a test of driver exit time and to ensure that all drivers meet the requirements of the rules. Each team must bring the following items to inspection.

- A. **Frame Material Documentation:** Receipts documenting the materials purchased, or otherwise acquired, and used to build the frame. Note that material certificate from supplier as well as certificate of **MATERIAL COMPOSITION & MECHANICAL PROPERTIES CONFIRMATORY TEST AT AUTHORIZED LABORATORY ARE MANDATORY**. Roll cage tube material suppliers test report and Local Test Reports need to be submitted.
- B. **Roll Cage Specification Sheet:** A completed copy of the Roll Cage Specification Sheet. In case of higher grade of Steel is used then the supportive calculations should prove that cross-section is adequate and bending stiffness & strength is achieved.
- C. **Technical Inspection check sheet:** At college level, **Technical Inspection check sheet** compliance is expected and the same should be submitted while technical evaluation is being done.
- D. **Drivers Present:** All drivers must be present at technical inspection with a valid license and complete safety gears.

The safety scrutiny will also check for electrical systems, kill switch, lighting, reverse lamp, Buzzer (if installed), horn, wiring and their mountings etc. Both the external and cockpit kill switches will be tested for functionality. The system should pass the test.

All hardware fasteners and their mountings should comply basic requirements.

Note: Any major rework suggested during technical inspection must be carried on in respective vehicle pits and not in any other place.

D2.2.4 Electrical Technical Inspection [e-Baja Specific]

Each vehicle will be inspected to determine if it complies with the requirements and restrictions of the eBAJA SAENDIA rules. This inspection will include an examination of the entire Electrical



Architecture and the two Electrical System Form.

Electrical System Forms (ESF):

The ESF is a two-part document which gives information about the entire electrical architecture of the vehicle.

ESF Part-1: This document gives the information on all the components used in the Tractive System along with the vendor data and the individual component certifications.

ESF Part-2: This document gives the information on the electrical architecture both high and low voltage systems with the necessary circuit diagrams where ever required in detail.

The templates for both ESF Part 1&2 shall be available for download to all the participating teams in [BAJA SAEINDIA FORUM](#)

Teams shall submit the ESF Part-1 during the Virtual BAJA SAEINDIA 2018 and ESF Part-2 few months before the main event (submission details will be communicated through (BAJA SAEINDIA FORUM)). Also teams shall bring the hard copies of ESF Part-1&2 for the technical inspection onsite.

Note: The electrical architecture of the vehicles found deviating from the submitted ESF documents both Part-1&2 shall fail to finish the electrical Technical Inspection and all such vehicles shall be disqualified from the event.

Teams shall proceed for the Mechanical Inspection only after the electrical inspection is successfully finished and the sticker is achieved. Teams who failed to clear Electrical Technical Inspection shall not be eligible to attempt for Mechanical Technical Inspection.

D2.2.4.1 Water Wading:-

The Water bed designed for the event is 150ft in length with 3in depth of water. All the vehicles will be allowed to run on the wet track specially laid for the eBAJA vehicles with water sprinkled from all the directions in the track. The functioning of the kit is measured at the end of the run.

Vehicles need to be completely covered such that no electrical component gets in contact with water being sprayed on the track. Before and After Water Wading Test the isolation resistance of the vehicle will be measured. The functioning of the kit should not be hampered after the Water Wading test for the successful completion of the test. All the eBAJA teams shall successfully pass the Water Wading test for a successful Technical Inspection.

D2.2.5 Dynamic/panic brake test

The objective of this test is to ensure the vehicle is safe for driving, while it goes up to the speed of 60 kmph. The test demands to attain the minimum speed of 45 kmph within 100 ft. distance and should be capable to stop with all four wheels locked within the distance of 15 ft.

Every team should demonstrate that all four-wheel brakes are effective for high speed braking. Each vehicle must come to rest in an approximately straight line after acceleration run specified by the inspectors. If a vehicle fails to pass any part of the inspection it must be corrected/modified and brought into compliance with the rules before it is permitted to operate.

Only two attempts are permitted for Brake test.

On successful completion of brake test the vehicle is considered for 'Technical Evaluation OK' and 3rd sticker is pasted on the vehicle.

D2.2.6 Vehicle Level Safety Requirements [E-BAJA SPECIFIC]

(A) Mounting of Batteries:

The mounting of batteries in the vehicle shall be such that batteries / battery packs are not displaced from their place and there is no spillage of electrolyte when vehicle is driven on gradient or any other type of road.

(B) Protection against direct contact with live parts of the power train

1. For protection of live parts inside the battery compartment, the protection degree IP65 shall be provided.
2. For protection of live parts in areas other than the battery compartment, the protection degree IP65 shall be satisfied.

(C) Protection against indirect contact with exposed conductive parts of the power train.

1. For protection against electrical shock which could arise from indirect contact, the exposed conductive parts, such as the conductive barrier and enclosure, shall be galvanically connected securely to the electrical chassis by connection with electrical wire or ground cable, or by welding, or by connection using bolts, etc. so that no dangerous potentials are produced.
2. The resistance between all exposed conductive parts and the electrical chassis shall be lower than 0.1 ohm when there is current flow of at least 0.2 amperes. This requirement is satisfied if the galvanic connection has been established by welding.
3. In the case of motor vehicles which are intended to be connected to the grounded external electric power supply through the conductive connection, a device to enable the galvanical connection of the electrical chassis to the earth ground shall be provided. The device should enable connection to the earth ground before exterior voltage is applied to the vehicle and retain the connection until after the exterior voltage is removed from the vehicle. Compliance to this requirement may be demonstrated either by using the connector specified by the car manufacturer, or by analysis.

(D) Isolation resistance

1. For vehicles having both AC & DC High Voltage buses, If AC high voltage buses and DC high voltage buses are galvanically isolated from each other, The isolation resistance between the high voltage bus and the electrical chassis shall have a minimum value of 100 Ω /volt of the working voltage for DC buses, and a minimum value of 500 Ω /volt of the working voltage for AC buses.

2. If AC high voltage buses and DC high voltage buses are galvanically connected isolation resistance between the high voltage bus and the electrical chassis shall have a minimum value of 500 Ω /volt of the working voltage.

(E) Safety Speed limit for Vehicle

1. The maximum speed achieved in forward direction shall not be more than 60 km/h.
2. The maximum speed achieved in reverse direction shall not be more than 20 km/h.

(F) On-board Charger & Off-board Charger Indicators Requirement

The vehicles shall have at least indication of 'charging in process' and 'charging is over in vehicle' indications along with the State of Charge are to be displayed on the Instrumentation Display of the vehicle.

D2.3 Inspection Stickers

D2.3.1 A multi-part inspection sticker will be issued in sections to each vehicle as each of the three parts of technical evaluation is completed. The inspectors will place the inspection sticker on the right side of the firewall above the driver's shoulder. The inspection sticker must remain on the vehicle throughout the competition. Vehicles without all parts of the inspection sticker may not be operated under power.

D2.3.2 Any or all parts of the inspection sticker may be removed from any vehicle that has been damaged or which is reasonably believed may not comply with the rules.

D2.4 **The college level technical inspection shall be carried out by Technical team and reports must be submitted before the deadline dates. It should be 100% completed with thorough inspection of vehicle.**

NOTE: Teams presenting Technical Inspection Sheets that are **(1)** incomplete, **(2)** inaccurate (i.e. do not correspond to the actual condition of the vehicle) **(3)** are found to have 4 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.

D2.5 "As-approved" Condition

D2.5.1 Once a vehicle has passed technical inspection its configuration may not be modified. All accessory components such as roofs, wings, bumpers, etc. are considered part of the configuration and must remain on the vehicle at all times.

D2.5.2 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.

C2.5.3 Non-identical parts not approved will be subject to an appropriate performance penalty.

C2.5.4 Minor adjustments permitted by the rules and normal vehicle maintenance and tuning are not



considered modifications.

ARTICLE 3: ENGINEERING DESIGN EVENT-150 points

D3.1 Engineering Design Event Overview and Objective

D3.1.1 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, as detailed in the Program Objective A1.1 and the Design Subject A1.2. 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: Suspension, Steering, Brakes, Drive-train/Power-train, Chassis and Ergonomics.

D3.1.2 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.

Comment: Teams are reminded that Baja SAE India is an engineering design competition and that in the Engineering Design Event; teams are evaluated on their design. Components and systems that are incorporated into the design as finished items are not evaluated as a student designed unit, but are only assessed on the team's selection and application of that unit. For example, teams that design and fabricate their own shocks are evaluated on the shock design itself as well as the shock's application within the suspension system. Teams using commercially available shocks are evaluated only on selection and application within the suspension system.

D3.1.3 The engineering design event guidelines and scoring criteria can be found at www.bajasaehindiaforum.com.

D3.1.4 The engineering design event consists of two parts: Design Evaluation and an un-scored Design Report that will be used as a part of the design evaluation.

D3.2 Design Report - Required Submission

D3.2.1 Design Report - The design evaluation judging will start with the submission, before the event, of a Design Report. The Design Report will be reviewed by the design judges who will ultimately judge the team and vehicle at on-site Design Evaluation.

D3.2.2 The Design Report must not exceed eight (8) pages, consisting of not more than four (4) pages of text, three (3) pages of drawings (see D3.3, "Vehicle Drawings") and one (1) optional page containing content to be defined by the team (photo's, graphs, etc.). All pages must be either 8 1/2" x 11" or A4.

D3.2.3 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 application of analysis and testing techniques (FEA, part/system/vehicle testing, etc.). Evidence of this analysis and back-up data should be brought to the competition and should be made available, on request, for review by the judges.

D3.2.4 The Design Report will be used by the judges to sort teams into the appropriate design groups based on the quality of their review.

Note: 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.

D3.3 Design Report - Vehicle Drawings

D3.3.1 The Design Report must include one set of three (3) view drawings showing the vehicle, from the front, top, and side.

D3.3.2 Each drawing shall appear on a separate page. The drawings can be manually or computer generated.

D3.3.3 Photos should be placed on the optional page and will not be counted as drawings.

D3.4 Design Spec Sheet - Required Submission

D3.4.1 Design Spec Sheet - A completed Baja SAE India Design Spec Sheet must be submitted.

D3.4.2 The Baja SAE India Design Spec Sheet template can be found at www.bajasaeindiaforum.com. Do not alter or re-format the template prior to submission.

D3.4.3 The design judges realize that final design refinements and vehicle development may cause the submitted figures to diverge slightly from those of the completed vehicle. For specifications that are subject to tuning, an anticipated range of values may be appropriate.

D3.4.4 The Design Report and the Design Spec Sheet, while related, are independent documents and must be submitted as two (2) separate files.

D3.5 Design Comparison Requirement (For Old Teams)

Teams with vehicles that participated in previous year Baja SAE India competitions are required to provide a comparison, using the template given at www.bajasaeindiaforum.com, of their current design with their previous year’s design.

D3.5.1 As part of the design event, the judges will evaluate the comparison documentation. If the judges find that the design changes are (A) not significant, (B) not supported by a detailed analysis, or (C) have not been sufficiently documented, then a penalty of up to one hundred and fifty (150) points may be assessed against the design score.

D3.6 Changes in Design with respect to initial design

Any changes made in the final design of the vehicle, as compared to initial design at the time of first design submission, needs to be documented with justification. This must follow the template available at www.bajasaeindiaforum.com and should be accompanied with your design

report as an addendum.

Design changes to correct failures during validation should be accompanied by a thorough analysis of why the failure occurred and the theoretical data supporting the new design, etc. The comparison report must be attached to the design report as an addendum and submitted electronically in Adobe Acrobat Format (PDF). The document must be a single file (text, drawings and optional content are all inclusive).

D3.7 CAE Report - Required Submission

D3.7.1 CAE Report - The CAE evaluation judging will start with the submission, before the event, of a CAE Report. The CAE Report will be reviewed by the CAE design judges who will ultimately judge the team and vehicle at on-site Design Evaluation.

D3.7.2 The CAE Report must not exceed ten (10) pages. All pages must be either 8 1/2" x 11" or A4.

D3.7.3 The CAE Report may include (but not limited to) the following analysis: Roll Cage (Meshing + Analysis + Justification), Static Analysis on Roll Cage, Dynamic Analysis on Roll Cage, Torsional Rigidity and Bending Stiffness Calculation on Roll Cage, Computational Fluid Dynamics Analysis (CFD), Multi-Body Dynamics Analysis (MBD), Thermal Analysis, Calculation and Analysis of Components which are fabricated by team & Fatigue Analysis.

Teams are advised to indicate input parameters, boundary conditions, simulation methods, simulation results and conclusions drawn from the simulations for all the different analysis included in the CAE Report.

Evidence of this analysis and back-up data should be brought to the competition and should be made available, on request, for review by the judges. Teams are advised to use dedicated CAE software for carrying out analysis.

D3.8 Format for Document Submission

D3.8.1 Design Report

The Design Report must be submitted electronically in Adobe Acrobat Format (PDF). The document must be a single file (text, drawings and optional content are all inclusive). The design report file must be named as follows: Vehicle #_school name (full name)_competition_DesignReport. EXAMPLE: Vehicle # 001_XYZ University_Baja SAE India 2019_DesignReport.pdf. The maximum size for the file is 5 megabytes.

D3.8.2 Design Spec Sheet

Design Spec Sheets must be submitted electronically in Microsoft Excel[®] Format (*.xlsx file). The format of the Spec Sheet MUST NOT be altered. Similar to the Design Report, the Design Spec Sheet file must be named as follows: Vehicle #_school name (full name)_competition_specs. EXAMPLE: Vehicle # 001_XYZ University_Baja SAE India 2019_specs.xlsx.

D3.8.3 Design Comparison Document (For Old Teams)

The Design Comparison Document must be submitted electronically in Adobe Acrobat Format



(PDF). The document must be a single file (text, drawings and optional content are all inclusive). The design comparison document file must be named as follows: Vehicle #_school name (full name)_competition_DesignComparison. EXAMPLE: Vehicle # 001_XYZ University_Baja SAE India 2019_Design Comparison.pdf.

D3.8.4 CAE Report

The CAE Report must be submitted electronically in Adobe Acrobat Format (PDF). The document must be a single file (text, drawings and optional content are all inclusive). The design report file must be named as follows: Vehicle #_school name (full name)_competition_CAEReport. EXAMPLE: Vehicle # 001_XYZ University_Baja SAE India 2019_CAEReport.pdf. The maximum size for the file is 5 megabytes.

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 Event.

D3.9 Document Submission Deadline

D3.9.1 The Engineering Design event documents must be submitted online on or before the submission deadline. The deadline for the design event document submission and the submission procedure will be announced on BAJA SAEINDIA Forum. Teams are advised to check the forum on a regular basis to keep themselves updated regarding submission deadlines. Design Report submission will be acknowledged either on the competition website or by email. Teams should have a printed copy of this acknowledgement available at the competition as proof of submission in the event of discrepancy.

D3.9.2 Penalty for Late Submission or Non-submission

The teams who fail to submit their Design Documents before the deadline, will not receive any points in the Design Evaluation. No request from any defaulter team will be entertained under any circumstances in the case of non-submission or delayed submission.

Note: It is the responsibility of the team to verify when the report was received by organizers; submission time will be the time the report is received by organizers.

D3.9.3 Penalty for Unsatisfactory Submissions

At the discretion of the judges, teams that submit a Design Report which, in the opinion of the judges does not represent a serious effort to comply with the requirements of Rules D3.1 and D3.2 will also not compete in the design event, but may at the design judges' discretion receive between five (5) and twenty (20) points for their efforts.

D3.9.4 Excess Size Design Reports

If a team submits a Design Report that exceeds four (4) pages of text, three (3) pages of drawing and one (1) optional page, then only the first four pages of text, three pages of drawings and first optional page will be read and evaluated by the judges.



Note: If included, cover sheets and tables of contents will count as text pages.

D3.10 Static Evaluation.

D3.10.1 The design judges will evaluate the engineering effort based upon the team's Design Report, their responses to the judges' questions, and an inspection of their car.

D3.10.2 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).

D3.10.3 The judges would give the score depending on the ability of team to explain the engineering and construction of the car.

D3.10.4 Support Material

Teams are required to bring three (3) color copies of the submitted design documents (As per C 3.8) to the Design Evaluation event on-site. Failure to bring the hard copies of the design documents at the Design Evaluation may result in disqualification from the design evaluation. Teams may also bring with them to Design Evaluation any photographs, drawings, plans, charts, posters, and binders, example components, or other materials that they believe, are needed to support the presentation of the vehicle and the discussion of the their development process. Use of laptop or notebook computers might be allowed to support any additional information which teams may like to give. Use of projectors is not permitted.

D3.11 Judging Process

D3.11.1 The actual format and process of Design Evaluation may change from year to year as determined by the organizing body. The engineering design event guidelines can be found at www.bajasaehindiaforum.com.

ARTICLE 4: COST EVENT-100 Points

D4.1 Cost Event consists of two related sections: Cost Report and Prototype Cost. The cost report provides all the background information to verify the vehicle's actual cost. The prototype cost is the actual cost and the points related thereto.

D4.2 Cost Report (Required Submission)

The Cost Report may contain a maximum of three sections:

D4.2.1 Report Section 1 - Overview (Optional)

The optional overview is intended to give each team the opportunity to point out, and briefly comment on, any 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 and is optional. This should be included as part of the Cost Documentation (.pdf) file.

D4.2.2 Report Section 2 - Costing Sheets

The core of the report is the series of costing sheets. This section must contain the one-page



summary sheet broken up into the individual subsystems. Each subsystem needs an individual sub-assembly sheet (Form A). Note that Vehicle Assembly Labor cost is for the labor it takes to assemble a subassembly to the frame. All fabricated parts on the sub-assemblies sheets (Form A) require a Form B. Note that the sub-system assembly time is the time it takes to assemble all the parts in that assembly together.

D4.2.3 Report Section 3 - Cost Documentation

This section includes copies of receipts, invoices, price tags, catalog pages, on-line prices, or other documentation, to substantiate the costs of the parts and materials of any item costing more than Rs.200. Cost documentation must be at full retail Indian prices. The use of foreign receipts, purchases from discount sites such as Craig's List, EBay or junk yards are not allowed. The report is expected to be comprehensive, well documented, truthful and accurate.

D4.2.4 Cost Component Categories

Teams must put items that are specified in the correct component categories and sub categories or the items will not be considered. See Cost Template for more details on component categories.

D4.2.5 Cost Event guidelines can be found at www.bajasaehindiaforum.com

D4.2.5 Cost Report – Submission Format

1. The Microsoft Excel format (with the extension .xls (no macros) or .xlsx), using the supplied template posted on the Baja SAE India Forum.

This document should not be modified from its current form. This includes password protecting and embedding macros. Teams will receive zero (0) points for Cost if the report is in the incorrect format or the files have been modified.

2. A PDF file with all of the cost documentation described above (C 4.2.1 to C 4.2.3). The cost report file must be named as follows: Vehicle #_school name (full name)_competition_Cost Report. For example: Vehicle # 001_XYZ University_Baja SAE India 2019_CostReport.

D4.2.6 Cost Report Submission Deadline

The Cost Report for BAJA SAE India 2019 must be submitted online. The deadline for the cost report and the submission procedure will be announced on BAJA SAE India Forum. Teams are advised to check the forum on a regular basis to keep themselves updated regarding submission deadlines. Cost Report submission will be acknowledged either on the competition website or by email. Teams should have a printed copy of this acknowledgement available at the competition as proof of submission in the event of discrepancy.

D4.2.7 Penalty for late or non-submission

The teams who fail to submit their cost reports before the deadline, will not receive any points in the Cost Event. No request from any defaulter team will be entertained under any circumstances in the case of non-submission or delayed submission.

Note: It is the responsibility of the team to verify when the report was received by organizers; submission time will be the time the report is received by organizers. Teams will be cost audited at competition.

D4.2.8 Cost Correction

The judges may increase costs and/or fabrication times if they believe that the figures submitted are below current prices for the item, source, or process involved. Prices or times that are higher than the judge expects will not be corrected. Mathematical errors will be penalized. Reports that are highly inaccurate, highly incomplete, or in which the costs cannot be substantiated, may be rejected in their entirety and scored accordingly. Teams are required to bring their car to on-site cost judging by their scheduled appointment time. Failure to report by the scheduled appointment time will result in an automatic zero for the event. If teams need to reschedule their appointment, it must be done prior to the start of the cost event evaluation.

D4.2.9 Prototype Cost - 85 points

Prototype cost is scored on the cost, as corrected by the judges, to produce the finished vehicle, brought to the competition.

Prototype cost score will be calculated as follows:

$$\text{Prototype Cost} = 85 \text{ points} \times \frac{(C_{\text{max}} - C_{\text{your}})}{(C_{\text{max}} - C_{\text{low}})}$$

Where:

C_{your}	Vehicle cost, as corrected
C_{low}	lowest vehicle cost, as corrected
C_{max}	highest vehicle cost, as corrected

D4.3 Static Evaluation

D4.3.1 The cost evaluation judges will evaluate the team's total cost, adjustments made, and effort taken to optimize the cost of the vehicle using appropriate pricing for various components of the vehicle.

D4.3.2 Cost report hard copy

Teams must bring a hard copy of their cost report to the cost judges on-site. **Teams that fail to bring a hard copy at the event, will receive zero (0) score for their cost evaluation.**

D4.3.3 Cost Adjustment Form

The purpose of the cost adjustment form is to make additions to previously submitted report. Items may be deleted, but the total adjustment for the individual component categories must be positive (cost will not be subtracted). This gives the team the chance to add items that were not previously planned. It is not an opportunity to redo the entire report. The total amount of adjustments may not exceed 10% of the total cost of the vehicle previously submitted. If the adjustment exceeds 10%, the additional amount will be added with a multiplier of 3 times (3x). If the adjustment exceeds 25%, the report will be considered incomplete and will not be graded. **Teams need to bring the hardcopy of Cost Adjustment Form during the Cost Event.**

D4.3.4 Cost Eligibility

Upon review of the data, the cost evaluation judge reserves the right to disqualify cost reports that have not been sufficiently validated (i.e. either through lack of documentation or outdated receipts), are determined to not be complete based on review, or are outside a reasonable level of cost based on the other cars in the competition (i.e. either too high or too low).

ARTICLE 5: SALES PRESENTATION EVENT – 50 Points

D5.1 Presentation - Objective

The objective of the Presentation is for the team to convince the “executives” of a hypothetical manufacturing company to purchase the team’s Baja SAE India vehicle design and put it into production at the rate of 4000 units per year.

- D5.1.1** For the presentation, teams are to assume that the judges are following 2 set of people –
Group 1 - Perspective Buyers
Group 2 - Investors (who need to be convinced that factory set up by the teams will make profit)

D5.2 Presentation - Format

- D5.2.1** Up to 4 members from a team are allowed to make the presentation to the judges.

D5.2.2 Total time for presentation

Presentation: 10 minutes
Q&A: 10 minutes

- D5.2.3** Only the judges are permitted to ask questions. Any team member on the presentation floor/stage may answer the questions.

- D5.2.4** The Sales presentation guidelines and template can be found at www.bajasaeindiaforum.com

D5.3 Static Event

- D5.3.1** Teams are required to bring their presentation in a laptop and a ‘Clean & Formatted’ pen drive. No laptops/projector facility will be available on-site. Students to ensure that they have a fully charged laptop loaded with their presentation ready as per their sales evaluation slot.

D5.3.2 Support Material

Teams may bring with them to Sales presentation any photographs, drawings, plans, charts, posters, models and binders, example components, or other materials that they believe are needed to support the presentation.

D5.4 Presentation - Scoring

- D5.4.1** The presentation event will be scored based on the following five categories:

- (1) Presentation Content including company financials and break even analysis.

- (2) Presentation organization, effectiveness & team’s response to Judges’ questions.
- (3) USP coverage – Market research, analysis, SWOT.
- (4) Marketing Strategy.
- (5) Project Schedule – Time Lines, Project Execution, Capital, Materials.

D5.4.2 The team that makes the best presentation will receive the highest score regardless of the finished quality of their actual vehicle.

D5.4.3 Sales Presentation - Scoring – Bonus

The presentation judges shall apply bonus points to the top three (3) teams of the presentation event in the event of a tie. This bonus can range from 0-5 points and is applied at the discretion of the presentation judges. The final authority on allotment of bonus points lies with the BAJA Organizing Committee.

ARTICLE 6: TIE BREAKERS

D6.1 Tie breakers

There will be no tie-breakers for static events.

PART E: DYNAMIC EVENTS – 700 POINTS

The dynamic events are intended to determine how the Baja SAE India vehicles perform under a variety of conditions. Note that the organizers may modify the dynamic events to address local conditions, weather or resources.

Organizers may or may not provide a practice track to teams. A practice track allows teams to test or tune their vehicle within the limits of the rules. If the organizer provides a practice track, the course length and features are at the organizer’s discretion.

ARTICLE 1: ACCELERATION – 75 Points

D1.1 Objective

The Acceleration Event is designed to measure each vehicle’s ability to come up to speed quickly from a standing start.

D1.2 Course

Acceleration is measured as the time to complete a 30.48 m (100 ft) or 45.72 m (150 ft) flat, straight course from a standing start. The course surface may vary from concrete / asphalt / pavement to loose dirt. The choice of course length and surface is at the organizer’s discretion.

D1.3 Procedure

Each vehicle may make two (2) attempts. Scoring will be based on the better of the two attempts. Timing will be done using an electronic system.

D1.4 Penalties

False Start or Stall at Start	First Time- Rerun at end of line
	Second Time – Run DNS



Driving off Course

Run DNF

The organizer may modify the penalties imposed for different violations to account for differences in the length or design of specific event courses.

D1.5 Scoring

The following equation will be used for the acceleration score:

$$\text{Acceleration Score} = 75 \text{ points} \times \frac{(t_{\text{longest}} - t_{\text{yours}})}{(t_{\text{longest}} - t_{\text{shortest}})}$$

where:

t_{shortest} fastest time by any vehicle

t_{yours} time for the vehicle to be scored

t_{longest} $1.5t_{\text{shortest}}$

Vehicles with acceleration times that are more than 1.5 times that of the fastest vehicle will not receive a score for this event. Teams attempting the event, but exceeding the time limit will be classified as “Excess Time”.

ARTICLE 2: HILL CLIMB or SLED PULL EVENT – 75 POINTS

The Hill Climb Event is designed to measure each vehicle’s ability to transmit excess (climbing) force to the ground. If local terrain does not support a significant Hill Climb, a Sled Pull Event may be substituted, usually involving pulling an excess load.

D2.1 Objective

This event tests the vehicle’s relative ability to climb an incline from a standing start or pull a designated object, e.g. “eliminator skid”, vehicle, or chain along a flat surface. The organizer will determine the hill height steepness and surface or object to be pulled.

D2.2 Procedure

Each vehicle may make two (2) attempts with the best time or distance counting for score. If a vehicle cannot complete the course and get a time, it will be scored on the distance that it travels before stopping. Once the vehicle stops moving forward the attempt is over and the attempt is scored for distance at that point. Vehicles may not continue the attempt after they have stopped on the course.

D2.3 Penalties

False Start - First - Rerun at end of line
Second - Run DNS

Driving off Course - Score as maximum progress at point of DOC

The organizer may modify the penalties imposed for different violations to account for differences in the length or design of specific event courses.

D2.4 Scoring

Method A: Different Distances

If none of the vehicles are able to complete the course, then:

$$\text{Hill Climb or Sled Pull Score} = 75 \text{ points} \times \frac{(d_{yours} - d_{shortest})}{(d_{longest} - d_{shortest})}$$

where:

- $d_{shortest}$ shortest distance travelled by any vehicle
- d_{yours} distance traveled by the vehicle to be scored
- $d_{longest}$ longest distance travelled by any vehicle

Method B: Fixed Distance-All Succeed

If there is (a) a set maximum distance and (b) all teams succeed in completing a full distance hill or pull, then the score will be based on the time for the full distance.

$$\text{Hill Climb or Sled Pull Score} = 75 \text{ points} \times \frac{(t_{longest} - t_{yours})}{(t_{longest} - t_{shortest})}$$

where:

- $t_{shortest}$ fastest time by any vehicle
- t_{yours} time for the vehicle to be scored
- $t_{longest}$ the lesser of: a) slowest time by any vehicle, b) 2.5 times $t_{shortest}$

Method C: Fixed Distance-Some Succeed

If there is (a) a set maximum distance and (b) at least one team climbs the hill or makes a full pull and others do not, then the vehicles going the full distance (Group I) will be scored based on time and the vehicles that fail to climb the hill or make a full pull (Group II) will be scored based on distance.

Group I - Teams that make the full distance will be scored

$$\text{Hill Climb or Sled Pull Score} = 75 \text{ points} \times \frac{t_{shortest}}{t_{yours}}$$

where:

- $t_{shortest}$ fastest time by any vehicle
- t_{yours} time for the vehicle to be scored

Group II - Teams that do not make the full distance will be scored by the following:

$$\text{Hill Climb or Sled Pull Score} = \text{lowest score from group I} \times \frac{(d_{yours})}{(d_{course})}$$

where:

- d_{yours} distance traveled by the vehicle to be scored
- d_{course} distance from start line to finish line

ARTICLE 3: MANEUVERABILITY EVENT – 75 points

D3.1 Objective

Maneuverability is designed to assess each vehicle’s handling ability over typical Baja terrain. The course may consist of a variety of challenges at the organizer’s option, possibly including tight turns, pylon maneuvers, ruts and bumps, drop-offs, sand, rocks, gullies, logs, and inclines.

D3.2 Procedure

Each vehicle may make two (2) runs with the best time including penalties, counting for score.

D3.3 Penalty Default Values

Obstacle/Pylon moved	2 seconds
Missed gate*	10 seconds
Excessive Driving Off Course +	Run DNF
False Start	First - Rerun at end of line Second - Run DNS

*Missed gate is when 2 or more wheels are outside the gate.

+ Excessive driving of course is when any one wheel of the vehicle is outside the boundary line of the course over a considerable distance. The distance is discretionary and will be determined by the course captain.

The organizer may modify the penalties imposed for different violations to account for differences in the length or design of specific event courses.

D3.4 Time Limit

Only vehicles that complete the maneuverability course within a time not exceeding 2.5 times that of the fastest vehicle will receive a score. If a vehicle is on the course for a time that exceeds 2.5 times the fastest time recorded to that point then the attempt may be declared over and the vehicle may be removed from the course and scored as “Excess Time”.

D3.5 Scoring

Maneuverability scoring is based on the vehicle’s time through the course including any penalties.

$$\text{Maneuverability Score} = 75 \text{ point} \times \frac{(t_{\text{longest}} - t_{\text{yours}})}{(t_{\text{longest}} - t_{\text{shortest}})}$$

Where,

t_{shortest}	fastest time by any vehicle
t_{yours}	time for the vehicle to be scored
t_{longest}	the lesser of: a) slowest time by any vehicle; b) 2.5 times t_{shortest}

ARTICLE 4: SUSPENSION & TRACTION EVENT – 75 points [For mBAJA ONLY]

D4.1 Objective

Suspension & Traction event is designed to assess each vehicle’s suspension design and traction ability over typical Baja terrain. The course may consist of a variety of challenges at the organizer’s option, possibly including steep climbs, pylon maneuvers, bumps, drop-offs, sand, rocks, gullies, logs etc.

D4.2 Procedure

Each vehicle may make two (2) runs with the best time including penalties, counting for score.

D4.3 Penalty Default Values

Obstacle/Pylon moved	2 seconds
Missed gate*	10 seconds
Excessive Driving Off Course +	Run DNF
False Start	First - Rerun at end of line Second - Run DNS

*Missed gate is when 2 or more wheels are outside the gate.

+ Excessive driving of course is when any one wheel of the vehicle is outside the boundary line of the course over a considerable distance. The distance is discretionary and will be determined by the course captain.

The organizer may modify the penalties imposed for different violations to account for differences in the length or design of specific event courses.

D4.4 Time Limit

Only vehicles that complete the Suspension & Traction course within a time not exceeding 2.5 times that of the fastest vehicle will receive a score. If a vehicle is on the course for a time that exceeds 2.5 times the fastest time recorded to that point then the attempt may be declared over and the vehicle may be removed from the course and scored as “Excess Time”.

D4.5 Scoring

Suspension & Traction scoring is based on the vehicle’s time through the course including any penalties.

$$\text{Suspension \& Traction Score} = 75 \text{ point} \times \frac{(t_{\text{longest}} - t_{\text{yours}})}{(t_{\text{longest}} - t_{\text{shortest}})}$$

Where,

t_{shortest}	fastest time by any vehicle
t_{yours}	time for the vehicle to be scored
t_{longest}	the lesser of: a) slowest time by any vehicle; b) 2.5 times t_{shortest}

ARTICLE 5: ENDURANCE - 400 Points

E5.1 Endurance - Objective

The endurance event assesses each vehicle's ability to operate continuously and at speed over rough terrain containing obstacles in any weather conditions.

E5.2 Endurance - General Description

Endurance may be run for either time or distance. Endurance events for time usually run for four (4) hours. Endurance events for distance continue until at least one car has gone the specified distance.

E5.2.1 Endurance will be run as either (A) a single four (4) hour race, (B) a predetermined and published distance, or as (C) elimination heats followed by a final in which the total time of one elimination heat plus the final is 4 hours. The organizer will announce the structure of the event prior to the start.

E5.2.2 Determining the winner of the endurance race:

A Team that completes the distance of the competition first, or the greatest distance in the time set for the competition will be declared the winner.

B In competitions of a given distance, the chequered flag will be given first to the leading car, then to the other finishers as they cross the finish line.

C In competitions of a timed length, the chequered flag will be given first to the leading car as it crosses the finish line at or after the expiration of the specified duration, then to the other finishers as they cross the finish line.

D If the leading car is not running at the expiration of the time limit, the chequered flag will be given to the next highest running car in the same manner.

E5.3 Endurance - Starting

E5.3.1 The starting grid for endurance will be based on each team's performance in a previous dynamic event, or set of dynamic events, to be determined by the organizer.

E5.3.2 All vehicles will be considered to have begun the race simultaneously at the time when the starter releases the first vehicle onto the course regardless of their actual position in the grid.

E5.3.3 During grid formation, vehicle engines will be started and the Technical Inspectors will perform a compliance check. During compliance check and gridding, the driver and vehicle may only have one team member accompany them. The compliance check includes, but is not limited to inspection of the following:

- Helmet Certification
- Helmet Fitment and Securement
- Safety Harness
- Driver Equipment
- Driver Wrist Band

- Fire Extinguisher
- Engine Kill Switches
- Brake System

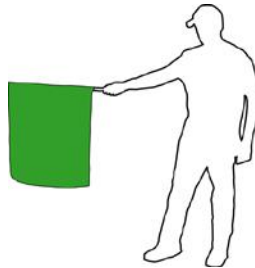
Unprepared drivers or out-of-compliance vehicles deemed unsafe or not ready to drive will be ordered out of the grid area by the Technical Inspector and sent to the paddocks to make corrections. Vehicles not ready to drive must check in at the fuel area to be admitted to the track.

E5.4 Endurance - Command Flags

Command flags are just that - flags that the competitor must immediately obey without question.

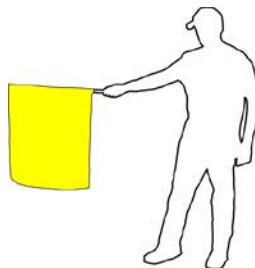
E5.4.1 Green Flag -

- 1) When displayed at a starting line or when re-entering the course: The event has started; enter the course under the direction of the starter.
- 2) When running on the course: Course is clear, proceed.



E5.4.2 Yellow Flag –

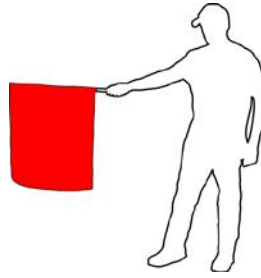
When displayed, there is a dangerous situation on the track beyond the flag station. Reduce speed and be prepared to take evasive action or stop on the track. Passing is not permitted, unless directed by the course workers.



E5.4.3 Red Flag –

When displayed, there is a dangerous situation somewhere on the track requiring a full-course stop. Come to an immediate, safe, and controlled stop on the course. Passing is not permitted. Pull to the side of the track as much as possible to keep the course open. Follow course worker

directions.

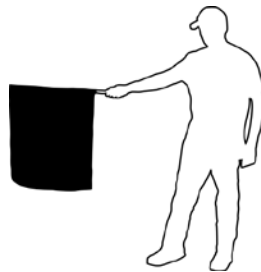


E5.4.4 Black Flag (Furled and Pointed) –

Warning, the officials are watching this vehicle's driving - obey the event rules.

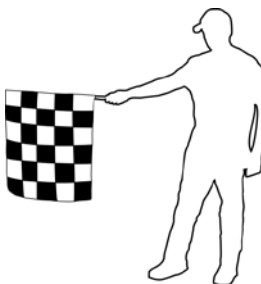
E5.4.5 Black Flag (Displayed) –

- 1) Pull into the penalty box for a discussion with the Technical Inspector or other official concerning an incident. A penalty may be assessed for the incident.
- 2) Pull into the penalty box for a mechanical inspection of the car; a dangerous condition has been observed on the vehicle.



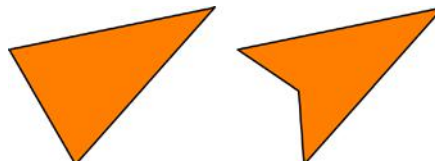
E5.4.6 Chequered Flag –

The event has been completed. Exit the course as directed by event officials.



E5.4.7 Directional Arrow –

Orange triangle with a 1.5:1 height to base ratio, with or without forked base. White or black trim is optional. The minimum base width is 6 inches.



E5.4.8 Control Zone Boundary –

This sign denotes the beginning of the control zone around an event. Beyond this sign, the vehicle and driver must be ready to run the event. The driver must have all required equipment on and the vehicle may not have any adjustments made. Beyond this sign, one team member is allowed to accompany the vehicle. Teams entering the control zone not ready to run or with more than one attendant may be sent to the back of the line.



E5.4.9 Time Control Marshal –

This sign denotes the location of the time control marshal. The time control marshal will position your vehicle to start the event. At this location a Technical Inspector may do a final compliance check on your vehicle.



E5.4.10 Start Line –

This sign denotes the location of the event starting line. At this location the driver will be given the signal from the start marshal to begin the run.



E5.4.11 Finish Line –

This sign denotes the end of the run, where a time or distance will be taken. Proceed through the finish line to record your score.



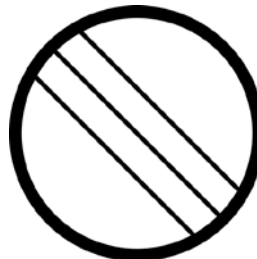
E5.4.12 Stop Line –

All vehicles are required to stop at the stop line at the end of the run. At this location, proceed only upon the instruction of the Finish Marshal.



E5.4.13 End Control Zone –

This sign denotes the end of the control zone boundary.



E5.4.14 Begin Fuel Zone –

This sign indicates the beginning of the fuel zone where fueling is permitted.



E5.4.15 End Fuel Zone –

This sign denotes the end of the fuel zone. Beyond this sign fueling is not permitted unless approved by the Fuel Zone Official.



E5.4.16 Begin Service –

This sign denotes the beginning of the service area (paddocks and/or hot pit). Beyond this sign, vehicle adjustments, service, and/or maintenance are permitted.



E5.4.16 End Service –

This sign denotes the end of the service area (paddocks and/or hot pit). Beyond this sign, vehicle adjustments, service, and/or maintenance are not permitted.



E5.5 Endurance - Stalled or Disabled Vehicles

E5.5.1 Disabled or stalled vehicles must be immediately removed from the roadway. It is the driver's responsibility to assist and cooperate with the course marshals in removing the vehicle.

E5.5.2 Vehicles may only be started with the driver seated with all belts properly fastened.

E5.5.3 The driver may not exit the vehicle to execute a restart. Course marshals, volunteers or team members may assist drivers in restarting their vehicles.

E5.5.4 Officials and course marshals may stop any vehicle, at any time, if they believe it no longer complies with the requirements and restrictions of the rules.

E5.5.5 If a vehicle is stopped by officials for a mechanical fault, the fault must be corrected/repared before it may reenter the event.

E5.6 Endurance - Repairs

The organizer will announce the rules governing repairs that are permitted to be made during

the endurance event.

E5.6.1 No repairs are permitted on the course during the endurance competition. All work must be done in team paddocks/pits.

E5.7 Endurance – Driver Change

Driver change is permitted in the endurance race. Driver change is allowed ONLY in Pits. All vehicles coming for repairs or for driver change to paddocks/pits need to be inspected by a Technical Inspector for safety before re-entering the track.

E5.8 Endurance Event - Penalty Default Values

E5.8.1 The organizer may modify the penalties imposed for different violations to account for differences in the length or design of the course. Note that all time penalties are enforced from when the vehicle is in the black flag area, i.e. the time spent being towed back to the pits does NOT count towards the penalty.

Infraction	1st Offense	2nd Offense	3rd Offense
Possession of fuel or active fuelling outside the fuel area after endurance gridding closes	10 min	20 min	DQ
Fueling on track	DQ	-	-
Speeding in pit or fuel area	10 min	20min	DQ
Team members found on track	20 min	DQ	-
Use of tools on the car in fuel area	Warning	10 min	DQ
More than three people in fuel area	Warning	10 min	DQ
Fueling with driver in car	30 min	DQ	-
Fire extinguisher not ready during fuelling	10 min	20 min	DQ
Run out of fuel on track	5 min	5 min	5min
Vehicle rollover	-	Warning	DQ
Passing under yellow flag	Warning	Discretionary	Discretionary
Failure to stop for black flag	10 min	Discretionary	Discretionary
Leaving the course and advancing	5 min	Discretionary	Discretionary
Aggressive driving	10 min	DQ	-

E5.8.2 Endurance Event Enforcement

- A. All cars must remain in the as-approved condition in order to compete; any condition that is deemed to not meet this requirement will be flagged to make necessary repairs.
- B. Any driver that is not using all of the approved and required drivers' equipment will be flagged.
- C. Certain areas of the track have been identified as difficult obstacles. If your team is assisted 2 times on the same obstacle you will be black flagged and warned that one more assist will result in removal for the rest of the event.

- D. If the vehicle rolls over (ex. end over end) anywhere on the track 3 times you will be removed from the event. Your team will be warned after the second roll over. What constitutes a roll over is up to the discretion of the Technical Head.

E5.9 Fueling Area and Fueling Zone

The Fueling Zone (FZ) consists of the Fueling Area (FA), Fuel Quarantine Area (FQ), Crew Area (CA) and Harness Check Area (HC).

Only three (3) people from any given team, including drivers, are allowed within the Fueling Zone (FZ) at any one time.

E5.9.1 Fuel Storage Requirements

Teams are not permitted to bring fuel to the event. The event organizers will supply fuel to the teams. Fueling will be done only in the designated FZ area. Any team found with fuel in the paddocks during the event will be disqualified from participation in any event and points earned thus far will be eliminated.

Teams carrying additional removable fuel tanks may store them in their paddock, without fuel. All removable fuel tanks must have a cap with a check valve installed.

E5.9.1.1 Fuel Penalties

Fuel cans in the paddock (not impounded) during the Endurance Event, if observed will be considered for serious Penalty of "Elimination of team" as well as "forfeit of all earned points from static & dynamic events".

Fueling will not be allowed until the engine is turned off, the driver is out of the vehicle, and a fire extinguisher is ready.

E5.9.2 Work in fuel Area

No work requiring a tool may be performed in the Fueling Area. Teams are allowed to make adjustments that do not require any tools. Example (seat position, shock pre load, etc.) Teams may only have approved removable fuel tanks, fire extinguishers, and funnels, if required, in the Fueling Area. Tools of any kind, backpacks, wagons, extra driver equipment, and coolers are specifically prohibited.

E5.9.3 Refueling in Fuel Area

Only three (3) people from any given team, including drivers, are allowed within the Fueling Zone (FZ) at any one time.

Before removing the fuel tank cap or, in the case of a removable fuel tank, before unlatching the cover, the vehicle must be completely stopped, the engine must be shut off, the driver must be completely out of the vehicle, and a fire extinguisher must be pointed at the fuel transfer. The driver must not be tethered to the vehicle in any way (e.g. a cable connecting a headset to a radio mounted in the car). Any team found refueling with a driver in the vehicle or without a fire extinguisher present and pointed at the fuel transfer will be assessed a penalty as per Rule E5.9.1.1.

A fire extinguisher must be present and pointed at ANY transfer of fuel, including re-filling removable tanks when a vehicle is not present.

E5.9.3.1 Removal of the Fuel Cap

When refueling during the endurance event, *the driver exiting the vehicle* must be the one to remove the fuel cap prior to fueling.

In the case of a removable fuel tank, the latch holding down the cover is considered equivalent to the fuel cap.

(Please check with Rule B11.9)

E5.9.4 Driving in the Fuel Area

All cars must operate at a walking speed while in the Fueling Area and when entering/exiting the area. Any team found speeding in the fueling area will be assessed a penalty as per rule E5.9.1.1

Cars may not be pushed into the Fueling Area (FA) without a driver being present and prepared to drive (i.e. wearing all required safety equipment).

E5.10 Endurance - Scoring

E5.10.1 The endurance event score is determined by (a) the number of laps each team completes during the endurance\ final and (b) the finish order of teams at the end of the event.

E5.10.2 “Scored laps” are the number of full laps actually completed during the endurance event final. Only full laps count, partial laps do not count for score. A vehicle must cross the counting/timing line under its own power for a lap to be counted.

E5.10.3 “Finish order” is the sequence in which vehicles cross the finish line after the lap scoring period has ended. Finish order determines the ranking of teams completing the same number of laps. For example, if the top four teams finish with the same number of laps, then they will be ranked 1st to 4th based on their finish order.

E5.10.4 “Bonus points” are additional points awarded to the first ten (10) vehicles on the leading (winning) lap, as separated by finish order as required, in part to differentiate teams finishing with the same number of scored laps. Up to 10 bonus points will be awarded in the inverse order of finish. Thus, the first vehicle to cross the finish line in the highest lap group will receive bonus points equal to the number of cars on the lead lap (max of 10); the second vehicle will receive one less bonus point etc.

Example:

Position	Lap	Bonus Points
1	48	4
2	48	3
3	48	2
4	48	1
5	47	0

E5.10.5 Endurance scoring is based on number of laps the vehicle completes in the allowed time:

$$\text{Endurance Score} = 400 \text{ points} \times \frac{(L_{\text{yours}} - L_{\text{lowest}})}{(L_{\text{highest}} - L_{\text{lowest}})} + \text{bonus points}$$

where:

L_{highest} highest number of laps completed by any vehicle

L_{yours} number of laps completed by the vehicle to be scored

L_{lowest} lowest number of laps completed by any vehicle

E5.11 Endurance Heats plus a Final - Point Distribution: When endurance is run as heats plus a final, the points for the event will be distributed between the heats and the final in proportion to the time/distance of each stage.

E5.11.1 Thus, if endurance is run as one (1) hour eliminations plus a three (3) hour final, the four hundred (400) total points will be allocated as one hundred (100) points to each elimination heat plus three hundred (300) points to the final.

E5.11.2 Ties in the endurance race will be judged by the endurance event judge and may remain a tie.

Ties for overall winner will be broken by the following criteria:

Endurance score

Total dynamic events score

Total static events score

If a tie remains after all the above tie-breakers then the tie remains for the overall winner(s).

ARTICLE 6: COMPETITION PROCEDURES AND REGULATION - GENERAL

E6.1 Meetings

All team members identified as captains or drivers and all faculty advisors MUST attend all meetings as designated. Attendance at meetings is mandatory. Failure to attend meetings can result in disqualification of members or the entire team.

E6.2 Tie-breakers

Tie-breakers for dynamic events will be the second-best run time or score for the given tied event. If both scores for tied teams in the event are equal, then the tie remains.

E6.3 Pre-inspection Operation Prohibited

Vehicles may not be started or driven prior to passing technical inspection, except as required as part of the inspection process itself.

E6.4 Engine governors are subject to check and resetting.

E6.5 Refueling

Refueling of vehicles must be performed with (1) the engine shut-off and (2) the driver out of the vehicle and (3) fire extinguisher (other than that carried in the vehicle) must be on hand and pointed toward the vehicle/fuel tank whenever a vehicle is being refueled.

Teams are not permitted to carry fuel to the event. Teams found with fuel in the event will be

eliminated and points earned will be withdrawn. (refer article 5.8.1.1.)

Refueling of vehicles must be performed with

1. Engine shut-off
2. Driver out of the vehicle
3. Fire extinguisher (other than that carried in the vehicle) must be on hand and pointed toward the vehicle/fuel tank whenever a vehicle is being refueled.

E6.6 Engine and Drive-train Inspection

Any vehicle may be inspected anytime during the competition. Any vehicle found to have: (1) altered or substituted its parts or equipment since passing technical inspection or (2) an engine in violation of the rules may receive a point deduction of 75 points each time it is found in violation.

E6.7 Engine Recall Option

The organizers may, recall the engine from any vehicle in the competition in exchange for a new Briggs and Stratton engine. Recalled engines will not be returned and will be inspected at Briggs and Stratton's facilities to confirm compliance with the rules.

E6.8 Practice Area

Practice may only take place in designated areas.

ARTICLE 7: PADDOCK RULES

E7.1 Vehicle Movement - Walking Pace Required

When a vehicle is driven anywhere except within the practice area or on event courses it must move at walking speed with a team member walking along side at a normal pace. During the performance events when the excitement is high, it is particularly important that vehicles move at a walking pace in the paddocks. The walking speed rule will be strictly enforced and point penalties will be assessed for violations.

Under no circumstances may anyone other than the driver, ride on a vehicle.

E7.2 Team Work Area

The team's work area should be clearly defined and should be kept uncluttered at all times. When a team leaves their area, it must be left clean.

E7.3 Vehicles in the Paddocks

Only the Baja SAE India vehicles themselves are allowed in the paddocks.

E7.4 Occupancy Restrictions

The organizers may limit the paddocks to team members, faculty advisors and competition officials.

E7.5 Compressed Gas Storage

Teams shall properly store compressed gas cylinders. Cylinders shall be upright and properly



secured by chain or other method, capped when not in use, and stored such that cylinder temperature is below 50 °c.

All teams' members should be wearing eye protection in the paddock when performing any activity involving fuel, grinding welding or cutting.

ARTICLE 8: DRIVING RESTRICTIONS

E8.1 During the competition, Baja SAE India vehicles may only be driven between the paddocks and an event site, during official practice or in the events themselves and only after

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

ARTICLE 9: RULES OF CONDUCT

E9.1 All Baja SAE India participants can be proud of the excellent sportsmanship and cooperation among teams that are two of the hallmarks of the series. Good conduct and compliance with the rules and the official instructions are expectations and requirements for every team member.

E9.1.1 An incident of unsportsmanlike conduct, the organizer is authorized to impose an appropriate penalty.

E9.1.2 Unsportsmanlike conduct can include arguments with officials, disobedience of official instructions and the use of abusive or threatening language to any official or other participant. Depending on the seriousness of the infraction the penalty for such actions can range from a deduction of up to fifty percent (50%) of the team points to expulsion of the entire team. Penalties of this type will only be imposed after a complete review of the incident by the organizer.

E9.2 Alcohol and Illegal Material

Alcoholic beverages, firearms, weapons of any type and illegal materials are prohibited at Baja SAE India site during the competition. The penalty for violation of this rule is the immediate expulsion of the entire team, not just the individual(s) involved. This rule applies to team members, advisors and any individuals working with the team on-site.

E9.3 Smoking - Prohibited

Smoking is prohibited in all competition areas.

E9.4 Parties

Disruptive parties either on or off-site must be prevented by the faculty advisor or team captain.

E9.5 Trash Clean-up

Clean-up of trash and debris is the responsibility of the teams. Please make an effort to keep your paddock area clean and uncluttered. At the end of the day, each team must clean their



work area.

E9.6 Site Condition

Please help the organizers keep the site clean. The sites used for Baja SAE India is generally private property and should be treated as such. Competitors are reminded that they are guests of the owners. All trash should be placed in the receptacles provided. Glass is not allowed on the grounds. Failure to clean the premises will result in an unsportsmanlike conduct penalty. Competitors are encouraged to police their areas after meals.

E9.7 Motorcycles, Bicycles, Rollerblades, etc. - Prohibited

The use of motorcycles, quads, bicycles, scooters, skateboards, rollerblades or similar person-carrying or motor driven devices by team members and spectators in any part of the competition area, including the paddocks is prohibited.

E9.8 Open toed shoes/ chappals/ kitos are not allowed in the competition areas

ARTICLE 10: SPECTATOR RULES

E10.1 General

The organizers typically do not have a direct line of communication with spectators other than on-the-spot at the competition; thus, the competitors, faculty and volunteers are expected to help inform the spectators of the safety rules and help restrict spectators to the spectator areas.

E10.2 Alcoholic Beverages

Spectators may not drink or possess alcoholic beverages at any competition location.

E10.3 Access Restrictions

Spectators must keep a specified distance back decided by the organizers, from any area where vehicles are operating under power. Motor vehicle competitions are potentially dangerous and safety rules will be strictly enforced.

E10.4 Children

A competition site is not a safe place for children and unsupervised young people. Spectators who fail to strictly control their children will be asked to leave the site.

E10.5 Removal of Spectators

The course officials and organizers have the absolute right to restrict spectator access to any parts of the site and to eject anyone who violates safety rules or ignores the instructions of officials.

E10.6 Unsafe Practices and Conduct

All participants are required to exercise safe practices and avoid unsafe activities at all times during the competition. The event organizer has the discretionary authority to impose a just penalty for any conduct deemed unsafe. All team members will be held to this rule.



ARTICLE 11: MISCELLANEOUS

E11.1 Driver Equipment

Drivers must wear all of the equipment specified in “Driver Equipment Requirements” and a properly fastened restraint system at all times when the vehicle is running in any event or on the practice track.

E11.2 Drivers not wearing the proper equipment will not be permitted to drive, and may have their competition driver’s privileges revoked.

E11.3 Water Competitions Only – Driver equipment rules for water events may be adjusted by the organizer and SAEINDIA depending on the characteristics of the site.

ARTICLE 12: SAFETY - TEAM RESPONSIBILITY (VISAS)

E12.1 Safety is the primary consideration in the design of Baja SAE India vehicles and the conduct of the competitions.

E12.2 Teams need to include safety considerations in all parts of their program.

E12.3 At all performance events, it is the responsibility of the team to ensure both the vehicle and driver meet and follow all the requirements and restrictions of the rules.

E12.4 VISA

Affiliated Student Team Members will have the ability to print out a Registration Confirmation Letter for the individual event(s) that they are attending. Once a student team member affiliates themselves to their team’s profile page under their individual edit section. They will have the opportunity to print out their personalized letter with the following information:

Student’s Name, the College’s Name, the SAEINDIA Event Name, Official Dates and Location(s).

Please be advised that SAEINDIA cannot intervene with, or call or send personal letters to, the State Departments, Embassies or Consulates of the United States or other governments on behalf of any meeting or event participant.

Indian Visa

Teams requiring visa to enter India are advised to apply at least sixty (60) days prior to the competition. Although most visa applications seem to go through without an unreasonable delay, occasionally teams have had difficulties and in several instances visas were not issued before the competition.

Do not wait - apply early for your visa.

Note - If your team has registered for a Baja SAE India competition held in India then you



may print out your online registration page as an acknowledgement of your registration.

SAEINDIA does not issue letters of invitation

Neither SAE staff nor any competition organizers are permitted to give advice on visas, customs regulations or vehicle shipping. Nor will they intervene on either matter concerning India or any other country.

PART F: NOTICE

ARTICLE 1: POSSIBLE RULE CHANGES FOR 2020

- A new frame fixture that will more closely fit the 95th percentile male.
- Frame requirement to be evaluated yearly.
- Only one team per university per competition/event.

ARTICLE 2: NOTE FOR EBAJA PREPARATIONS:

For e-baja roll cage is same with single driver only. The power train specification will be released soon. Overall desired weight for e-baja vehicle will be between 250~300Kg considering electrical motor, controller & Li battery system. These e-motor & battery can be sourced from any reliable sources. The battery management, charging system & diagnostic systems need to be designed & installed effectively by team.

The event is almost similar to main-baja and will undergo all Technical Evaluations, Static design evaluation. The cost & sales presentation will be in line with events. The various tests like panic brake test, water splash & shower test for electrical leakage test, acceleration, slate pull test, Hill climb test, Maneuverability will be part of technical & dynamic test for e-baja. The endurance test for minimum 3 hours will be conducted on rough terrain and plain road to witness the performance of Car & battery management. The marks & ranking system are same as main baja event.

PART G: DESIGN AND COST SUBMISSION PROCEDURES

ARTICLE 1: ONLINE SUBMISSIONS

New document submission process for Baja SAE India competition.
Design and Cost Report submission process

Forms -The standard forms that are required for documentation and submissions at Baja SAE India competition can be downloaded from www.bajasaeindiaforum.com

Web Based Submission - The required documents must be submitted online through www.bajasaeindiaforum.com

Account Signup for Online Submission- Teams must comply with certain requirements when registering at www.bajasaeindiaforum.com and submitting documents online.

ONLINE SUBMISSIONS



Web Based Submission -

Teams competing for Baja SAE India competition must submit the following documents online through www.bajasaeindiaforum.com

- “Design Report” (C 3.2.3)
- “Cost Report” (C4.2.1 & C4.2.2)
- “Cost Documentation” (C 4.2.3)
- “Design Spec Sheet” (C3.3)

The Design Report and the Design Spec Sheet, while related, are independent documents and must be submitted as two (2) separate files.

Documents may be uploaded to the website from the time your Baja SAE India online account has been created and accepted until the "No Submissions Accepted After" deadline (which is 10 days after the "Due Date").

Submissions may be replaced with new (updated) uploads at any time before the "Due Date" without penalty.

Teams have the option to replace uploaded documents with a new file at any time, however between the "Submission Due Date" and the "No Submissions Accepted After" date such replacements are classified as late submissions and the appropriate penalties will be applied.

Documents may not be uploaded or replaced following the "No Submissions Accepted After" deadline and late submission penalties will be applied.

Account Signup for Online Submission - Account creation for online document submission through Baja SAE India online requires the following steps:

- (1) Visit: www.bajasaeindiaforum.com
- (2) Follow the account signup instructions on the website. Select "Your Affiliation" as either "Team Captain/Team Advisor" or "Team Member (non-captain)"
- (3) Your "authentication number" for Baja SAE India online signup is the SAE confirmation number that was issued when your team registered.

Note - There may be a delay of up to three (3) business days between the time your team registers for a competition and the Baja SAE India online site recognizes the validity of your authentication number and the captain can create his account.

Once your team captain has created an account it will remain valid until your team becomes dormant or no longer registers to compete.

- (4) Responsibilities and Restrictions

Team Captain Role -

Each team must have at least one person with an account at www.bajasaeindiaforum.com and identified as the Team Captain. The Team Captain(s) have unique responsibilities on



the site including accepting other team members for site access. Until the captain accepts a member's signup request that person cannot upload or view team documents. Team captains automatically have the same roles and privileges as their team members.

Team Member Restrictions - Team members must be approved by the Team Captain or the Faculty Advisor before being able to view or upload team documents.

Note – All team members are not required to be affiliated on www.bajasaeindiaforum.com, just the person uploading documents.

Uploading Documents - All team members and the team captain have equal authority to upload and/or replace documents in the name of the team.

Document Access - Uploaded documents can only be viewed by (1) members of the submitting team, (2) authorized judges, technical inspectors and officials and (3) members of Baja SAE India OC .

Reminder - The website does not know what you intended to submit or what you thought you were doing. Anything your team uploads to the site is considered to be an official action by your team.

ARTICLE 2: APPENDIX - SAE TECHNICAL STANDARDS

The SAE Technical Standards Board (TSB) has made the following SAE Technical Standards available on line, at no cost, for use by Collegiate Design teams. Standards are important in all areas of engineering and we urge you to review these documents and to become familiar with their contents and use.

The technical documents listed below include both (1) standards that are identified in the rules and (2) standards that the TSB and the various rules committees believe are valuable references or which may be mentioned in future rule sets.

All Collegiate Design Series teams registered for competitions in North America have access to all the standards listed below - including standards not specific to your competition.

SAE Technical Standards included in the CDS Rules

Baja SAE

J586 - Stop Lamps for Use on Motor Vehicles Less Than 2032 mm in Overall Width

J759 - Lighting Identification Code

J994 - Alarm - Backup - Electric Laboratory Tests

J1741 - Discriminating Back-Up Alarm Standard

Formula Hybrid

J1318 - Gaseous Discharge Warning Lamp for Authorized Emergency, Maintenance and Service Vehicles

J1673 - High Voltage Automotive Wiring Assembly Design

Formula SAE



SAE 4130 steel is referenced but no specific standard is identified
SAE Grade 5 bolts are required but no specific standard is identified

Super-mileage

J586 - Stop Lamps for Use on Motor Vehicles Less Than 2032 mm in Overall Width
SAE Technical Standards for Supplemental Use

Standards Relevant to Baja SAE

J98 - Personal Protection for General Purpose Industrial Machines. Standard
J183 - Engine Oil Performance and Engine Service Classification - Standard
J306 - Automotive Gear Lubricant Viscosity Classification - Standard
J429 - Mechanical and Material Requirements for Externally Threaded Fasteners - Standard
J512 - Automotive Tube Fittings - Standard
J517 - Hydraulic Hose - Standard
J1166 - Sound Measurement - Off-Road Self-Propelled Work Machines Operator-Work Cycle
J1194 - Rollover Protective Structures (ROPS) for Wheeled Agricultural Tractors
J1362 - Graphical Symbols for Operator Controls and Displays on Off-Road Self-Propelled Work Machines - Standard
J1614 - Wiring Distribution Systems for Construction, Agricultural and Off-Road Work Machines
J1703 - Motor Vehicle Brake Fluid - Standard
J2030 - Heavy Duty Electrical Connector Performance Standard
J2402 - Road Vehicles - Symbols for Controls, Indicators and Tell-Tales - Standard

Standards Relevant to Formula SAE

J183 - Engine Oil Performance and Engine Service Classification - Standard
J306 - Automotive Gear Lubricant Viscosity Classification - Standard
J429 - Mechanical and Material Requirements for Externally Threaded Fasteners - Standard
J452 - General Information - Chemical Compositions, Mechanical and Physical Properties of SAE Aluminum Casting Alloys - Information Report
J512 - Automotive Tube Fittings - Standard
J517 - Hydraulic Hose - Standard
J637 - Automotive V-Belt Drives - Recommended Practice
J829 - Fuel Tank Filler Cap and Cap Retainer
J1153 - Hydraulic Cylinders for Motor Vehicle Brakes - Test Procedure
J1154 - Hydraulic Master Cylinders for Motor Vehicle Brakes - Performance Requirements - Standard
J1703 - Motor Vehicle Brake Fluid - Standard
J2045 - Performance Requirements for Fuel System Tubing Assemblies - Standard
J2053 - Brake Master Cylinder Plastic Reservoir Assembly for Road Vehicles – Standard

PART H: MISCELLANOUS TOPICS

ARTICLE 1: AIS STANDARDS

AIS 041 - This standard applies to the representation of the curve as a function of motor speed and the power at full load indicated by the vehicle/motor manufacturer for motors of electric drive trains

Determination of Net Power

1. The motor/vehicle and its entire equipment assembly must be conditioned at a temperature of 250C +/- 5 0C for a minimum of two hours before start of test.
2. The net power test shall consist of a run at full setting of the power controller.
3. Just before beginning the test, the vehicle / motor shall be run on the chassis / bench dynamometer for three minutes delivering a power equal to 80% of the rated maximum power at the speed recommended by the manufacturer.
4. Measurements shall be taken at a sufficient number of motor speeds, (at least four) to define correctly the power curve between lowest and the highest speeds recommended by the manufacturer.
5. The whole test shall be completed within 5 minutes. It may be necessary to recharge the batteries once for completion of the power curve measurement.

Determination of Maximum 30 Minute Power:

1. The motor/vehicle and its entire equipment assembly must be conditioned at a temperature of 250C +/- 5 0C for minimum four hours before the test. The electric motor / vehicle shall be run on the bench dynamometer/chassis dynamometer at a power, which is declared by manufacturer for the maximum 30 minutes power. The speed is recommended to be in a range, at which the net power is greater than 90% of the maximum power measured in clause 5.0. This speed shall be recommended by the manufacturer.
2. Speed and power shall be recorded. The power must be in a range of $\pm 5\%$ of the power value at the start of the test. The maximum 30 minutes power is the average of the power within the 30 minutes period.

AIS 048 - This standard applies to the traction (driving power) batteries used for battery operated vehicles

Electrical Safety Test Requirements

(A) Short Circuit Test (Cell Level or Battery Module or Battery Pack):

Test may be carried out on battery cell (if the electrodes are approachable) or battery module or battery

pack. At the end of the test, there shall be no :

- i) Physical damage to the casing or other mechanical parts.
- ii) Melting of components.
- iii) Fire or explosion.

It is acceptable for the battery to become dry at the end of the test.

(B) Overcharge Test (Cell Level or Battery module or Battery Pack):

The battery is to be overcharged at a constant charging current of 0.1(C10) for 10hrs. At the end of the test, there shall be no :

- i) Physical damage to the casing or other mechanical parts.
- ii) Melting of components.
- iii) Fire or explosion.

Mechanical Safety Test Requirements

(A) Vibration Test

At the beginning of the vibration test, battery module shall be charged to 100% SOC. The battery module shall be subjected to sinusoidal vibration for at an acceleration of 3 g in both the axis and a frequency of 30-150 Hz at a sweep rate of 1 octave per minute. Testing is to be carried out for 2 hours in each axis. The deterioration of battery rated capacity shall not be more than 10%. At the end of the test, there shall be no :

- i) Physical damage to the casing or other mechanical parts.
- ii) Melting of components.
- iii) Fire or explosion.

(B) Mechanical Shock Test

At the beginning of the shock test, battery module shall be charged to 100% SOC. The battery shall be subjected to the 10 shocks in each axis in half-sine wave, 30 g amplitude and 15 ms duration. The deterioration of battery rated capacity shall not be more than 10%. At the end of the test, there shall be no :

- i) Physical damage to the casing or other mechanical parts.
- ii) Melting of components.
- iii) Fire or explosion.

(C) Nail Penetration test (Cell Level or Battery module)

The battery cell module shall be penetrated with a mild steel (conductive) pointed rod, which will be electrically insulated from the test fixture. The rate of penetration shall be 8 cm/s nominal. The diameter of the rod and the depth of penetration must be 3mm in Cell level and 20mm in battery module level. At the end of the test, there shall be no:

- i) Physical damage to the casing or other mechanical parts.
- ii) Melting of components.
- iii) Fire or explosion.

ARTICLE 2: SAFETY GUIDELINES

1.1 Do's while working on HV system:

- Check accessories like strap jigs, washers, terminal connectors, etc. before discharging of battery.
- Provide rubber insulation to the terminals of battery pack/ section of batteries.
- All connections on battery should be done by wearing safety gloves and insulated tools.
- Only specified torque should be used to tighten the battery connections as over or under torque may damage the battery terminals.
- Understand the HV System and risks associated.
- Check for availability, ratings and condition of HV personal protective equipment (PPE)
- Always assume the HV components in the as "LIVE" as precautionary measure
- Always wear insulating gloves that are rated for the voltage and check for the integrity of gloves before using
- Wear rubber bottom shoes or appropriate insulating shoes while working on HV system
- Maintain the PPEs properly and service the PPEs regularly to ensure their integrity

- Check for the presence of fire extinguishers (dry powder or CO2 type, ABC type) and know the nearest exit routes for emergency exit before start work on HV system
 - Always keep first-aid kit within access to work area
 - Mark the working area with caution tapes and put up warning signs in the work area with HV warnings.
 - Place insulation mats and stand on it when working on HV components and especially working on any live components.
 - Before start of work check for any potential electrical hazards in the work area and check all grounds or for any loose objects, wires that anyone might trip over and de-clutter the area
 - In emergency, use emergency disconnect switch to bring vehicle to stand still
 - Check the equipment/ component or vehicle before start of the work and ensure no-one else is working on the system
 - Use only insulated tools and measurement equipment that are rated for the voltage and current specified
 - All the measurement equipment and tools should be protected from moisture and water. The measurement equipment and should be checked for its working condition before it is used and replaced any damaged tools.
 - Measurement equipment should be properly calibrated, serviced and properly maintained
 - Wear gloves and touch the HV component with the back of the hand first before start of work to check for electric shocks. Touching with back of the hand will make it easy to withdraw if there is a shock.
 - Read and understand the equipment's their SOP before using any equipment
 - While working on hybrid vehicle, turn the ignition keys off before starting any work on HV system.
 - De-energize the equipment/component at least twice before beginning work on the HV system
 - If possible keep one hand free while working on the HV system
 - Wait for at least 5 mins after de-energizing before start of work on HV component
 - Secure open connection, wires etc. with insulation tapes while not working
 - Before energizing the system check if anyone else is working in vicinity and warn them
 - Ensure that all HV connectors are properly secured and no leaks are present in system
 - Stop working on a HV system if hazard is perceived and contact your supervisor and respective component owner immediately for guidance and support. If needed evacuate personnel from the vicinity until safe work condition is ensured.
 - Notify any safety violation to supervisor.
 - Always observe & follow the safety instructions
 - If any visible damage is seen on HV Battery immediately contact the HV Battery team stop working and remove battery to a safe location.
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- Handle battery carefully to avoid puncturing case or electrically shorting the terminals
 - Battery packs should be protected against excessive shock and vibration
 - Store batteries in the proper storage container and away from heat source.

- All work under live electrical conditions must be carried out by qualified electrician or under management and supervision of a qualified electrician
- Persons with pacemakers are to be prohibited from working/coming in to close proximity with the electric motor even in ignition OFF condition
- Ensure that potential at HV terminals (AC&DC) is zero before attempting to access/remove HV connection.
- All the HV & LV terminals should be checked for terminal tightening torque.
- There should be standard safety marking for all high voltage areas in the vehicle
- There should be no overlapping of the HV cables over each other. During continuous operation, temperature of the cables may rise and chances of short circuit.
- HV cables Mid joints are not allowed
- LV cables mid joints are allowed with proper soldered joints with heat sink tube covered over that.
- Electrical components that are being used in vehicle should have its own thermal protection.
- Brake over riding requirements to be checked. Also the firm connections of the accelerator and brake potentiometer to be checked to avoid unintended acceleration during driving.

1.2 Don'ts while working on HV system:

- Don't work alone while working on high voltage system. Two people, both with HV safety awareness training, are required.
- Do not short circuit the battery terminals in any situation.
- Do not discharge new batteries. It must be fully charged at first.
- Do not remove safety valve on the batteries.
- Do not install terminal connector with violent force to prevent damage of terminal screws. Apply only specified torque.
- Don't wear any jewellery or have any metallic articles on person that could accidentally come in contact with high voltage component, while working on the high system
- Don't attempt repair work on high voltage components when you are tired
- Don't assume anything without checking it out for yourself
- Don't work on live components, unless it is necessary and you are trained to work with live voltage
- Don't touch any live wires or expose these wires to heat and pressure
- Don't start the work on HV system if anyone else is working on the vehicle/ component nearby. Inform them about your work. Ensure everyone's safety.
- Don't do parallel activities in the same vehicle without the knowledge of other person's tasks. Always perform one activity at a time and inform everyone working both before and after the HV commissioning
- Don't cut orange colour coded HV cables
- Don't touch or work on the HV components unless you know the system and authorized to work on that component
- Don't leave the wires loose or un-insulated until they are ready for termination or until the time to install it to a connector
- Don't smoke in the HV work area

- Don't try to extinguish uncontrolled fire in HV components or vehicles with HV components unless you are trained to do that. Ensure personnel's safety first and evacuate everyone in the vicinity if needed
- Don't overburden an extension cord with too many electrical types of equipment's
- Don't allow anyone without HV safety/ awareness training to work on a HV system or hybrid vehicle
- Don't short circuit the positive and negative terminals of the battery with the metal object.
- Don't use the service disconnect in the HV Battery as an emergency shutdown switch, use emergency switch in the vehicle for triggering proper shut down procedure during emergency
- Don't reuse dropped HV batteries or visibly damaged HV battery. Dropped batteries should be treated as a potentially hot cell.
- Don't allow Fire, sparks, open flame, soldering objects, and smoking near the HV work area or near the HV battery storage area
- Don't disassemble a battery pack or attempt to replace a blown fuse or work on the internal components of the HV battery without prior authorization from HV battery supplier.
- Don't subject the HV Battery proto samples to excessive vibration or mechanical shock or perform immersion tests in water without approval from the supplier
- Don't allow food and beverages inside the battery pack storage or testing area and don't pour water or other liquids into battery or battery compartment.
- Do not drive the vehicle through water
- Do not attempt extreme driving manoeuvres
- Do not drive the vehicle without completing fitment of all components and protective covers.

1.3 High Voltage Procedures & Tools

- Opening of or working on accumulator containers is only allowed in the charging area, see B7.2, and during Electrical Tech Inspection.
- Whenever the accumulator containers are opened the cell segments have to be separated by using the maintenance plugs, see B3.3.3.
- Whenever the Accumulator or tractive system is being worked on, only appropriate insulated tools may be used.
- Safety glasses with side shields must be worn by all participating team members when (a) parts of the tractive system are exposed while it is active, or (b) work is being done on the accumulators.





ARTICLE 3: VEHICLE TESTING

Important Note to all teams:

Team must make a note that, the baja competition vehicle (ebaja & mbaja) are not CMVR approved vehicle to ply on public road. Therefore the testing and usage on public road is strictly prohibited. This mean none of the teams will test or make a trial on public road and public places/grounds etc. The legal compliance is strictly team's responsibility and SAEINDIA is not responsible for any non-compliances.