Baja SAEINDIA® Rules

Rev 01, 30 May' 2020

Applicable for e-Baja event being conducted in 2021.
Foreword
Welcome to eBaja SAEINDIA 2021

The Baja SAEINDIA Rulebook Committee has come up with an updated Rulebook for the 2021 season. There are a significant number of changes, many which are made through insights gained from the 2020 Baja season. As you are aware, the Baja SAEINDIA Rulebook follows the pattern set by Baja SAE (USA). Additionally, many Indian teams are now participating in Baja challenges abroad and hence our Rulebook needed to be modified to reflect the changes. Hence, beginning 2021, the M-Baja Rulebook and E-Baja Rulebooks will be issued separately.

Teams are required to make a new roll cage every year. This Rule book includes special emphasis on safety aspects with regards to driver’s safety gears (as per SFI standards from approved manufacturers) and equipment, safety of all the team members and safe conduct of the entire event. All participants, Faculty advisor, Organising committee members, Judges, Visitors and vendors all are advised to follow the safety guidelines during the main event. For the benefit of teams with regards to brakes design and improving performance, we have provided design guidelines and best practices adopted by industry.

These changes aim at making the competition safer and an improved learning experience for students.

In the recent times, before eruption of COVID 19 Govt. of INDIA and world over all the automotive companies were focused on expansion plans for EV, HEV & Fuel Cell EV / HEV and Hydrogen fueled vehicle programs. Globally, the collective and concentrated efforts have moved researchers and developments in this direction, supplemented by the Govt. policies are supportive of Electric vehicle platforms. The technological disruption will become effective post COVID 19 situation and are likely to become more popular, in the years to come.

Taking a clue on the advice from the discussions with reverend Dr. A.P.J. Abdul Kalam, the then President of India, Baja SAEINDIA Organising Committee took initiative to begin eBAJA SAEINDIA event in the year 2015. The subsequent events have seen continuous growth and up gradation, in terms of specifications of Electric drive train, in line with the improvements in the automotive electric vehicles in the market place. Also, the eBAJA team has incorporated necessary changes for enhancing learning experience for the participating students. Since 2019, we have made AIS standards as part of eBAJA Rule book. The objective is to make students absorb all applicable AIS compliance, to build prototype vehicles, by introducing the tests as per AIS standards as part of eBAJA event. Also, the students have learned to optimize the product specification by designing the respective input parameters (for the entire eKit parts), for achieving the peak output performance within the competition rules. By participating in eBAJA, they acquired the expertise in commercial purchase processes, including negotiations skills. It is aimed at developing skills of decision making for deriving the best performance, preparing leaders who can independently think and comparative study, managing finances and working in a team to accomplish the results, with in the time line schedules. The challenges posed in eBAJA competition since 2015, have made the students ready for upcoming challenges in automotive Industry.

BAJA Organising Committee has now realized that eBAJA event has grown to a level, from where it can be conducted as a standalone, independent event, for providing new set of opportunities for the participating Teams and all those who are associated with eBAJA 2021.

We expect all the collegiate clubs to promote and come up with two teams to participate in BAJA SAEINDIA 2021 (one for mBAJA & one for eBAJA). Wishing all teams’ good luck for an exciting “eBAJA SAEINDIA 2021”, season ahead. Thorough and repeated reading of the rulebook is strongly recommended.
Table of Contents

PART A: ADMINISTRATIVE REGULATIONS 04
ARTICLE 1: BAJA SAE OVERVIEW 04
ARTICLE 2: BAJA SAE SERIES 04
ARTICLE 3: BAJA SAEINDIA RULES AND ORGANIZER AUTHORITY 05
ARTICLE 4: INDIVIDUAL PARTICIPATION REQUIREMENTS 07
ARTICLE 5: FACULTY ADVISOR 08
ARTICLE 6: ELIGIBILITY – VEHICLES 09
ARTICLE 7: REGISTRATION 10
ARTICLE 8: RULES QUESTIONS 12
ARTICLE 9: PROTESTS 13

PART B: TECHNICAL REQUIREMENTS 14
ARTICLE 1: GENERAL DESIGN REQUIREMENTS 14
ARTICLE 2: ELECTRIC POWERTRAIN 14
ARTICLE 3: ROLL CAGE 15
ARTICLE 4: DRIVER RESTRAINT 40
ARTICLE 5: DRIVER EQUIPMENT 52
ARTICLE 6: VEHICLE CONTROLS 55
ARTICLE 7: COCKPIT 57
ARTICLE 8: POWERTRAIN GUARDS 60
ARTICLE 9: VEHICLE ELECTRICAL SYSTEM 63
ARTICLE 10: TOW POINTS 68
ARTICLE 11: FASTENERS 71
ARTICLE 12: VEHICLE IDENTIFICATION & MARKINGS 72
ARTICLE 13: ERGONOMIC REQUIREMENTS FOR DRIVER SAFETY 78

PART C: ELECTRICAL POWERTRAIN AND SYSTEMS 81
ARTICLE 1: ELECTRIC SYSTEM DEFINITIONS 81
ARTICLE 2: TRACTIVE SYSTEM - POWERTRAIN 81
ARTICLE 3: TRACTIVE SYSTEM – ENERGY STORAGE 82
ARTICLE 4: TRACTIVE SYSTEM – GENERAL REQUIREMENTS 85
ARTICLE 5: FUSE 92
ARTICLE 6: HIGH VOLTAGE PROCEDURES & TOOLS 92
ARTICLE 7: GROUNDED LOW VOLTAGE SYSTEM 94
ARTICLE 8: ACCUMULATOR SWAPPING 95

PART D: STATIC EVENTS – 300 POINTS 97
ARTICLE 1: SCORING 97
ARTICLE 2: TECHNICAL EVALUATION 97
ARTICLE 3: ENGINEERING DESIGN EVENT- 150 Points 101
ARTICLE 4: COST EVENT -100 Points 106
ARTICLE 5: SALES PRESENTATION EVENT- 50 Points 109
ARTICLE 6: TIE BREAKERS 111
PART E: DYNAMIC EVENTS – 700 POINTS
ARTICLE 1: SCORING SUMMARY
ARTICLE 2: PRACTICE
ARTICLE 3: ACCELERATION
ARTICLE 4: WATER WADING TEST
ARTICLE 5: MANEUVERABILITY
ARTICLE 6: SPECIALITY EVENTS
ARTICLE 7: ENDURANCE
ARTICLE 8: GENERAL EVENT PROCEDURES AND REGULATIONS
ARTICLE 9: VISAS

PART F: NOTICE
POSSIBLE CHANGES FOR MAIN BAJA 2020 EVENT

PART G: DESIGN AND COST SUBMISSION PROCEDURES
ARTICLE 1: ONLINE SUBMISSIONS
ARTICLE 2: APPENDIX S- SAE TECHNICAL STANDARDS

PART H: MISCELLANOUS TOPICS
ARTICLE 1: AIS STANDARDS
ARTICLE 2: SAFETY GUIDELINES
ARTICLE 3: VEHICLE TESTING

PART I: ANNEXURE: GENERAL RECOMMENDATIONS FOR BRAKES DESIGN

-----------------------------------------------------------------------------------------------------------------------------

Read the Rules, thoroughly!

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

Revision History:

<table>
<thead>
<tr>
<th>Date</th>
<th>Revision</th>
<th>Description</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>30/05/2020</td>
<td>01</td>
<td>1st Release</td>
<td>eBaja Tech Team</td>
</tr>
</tbody>
</table>
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 eight 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 SAEINDIA 1 - Sponsored by SAEINDIA and hosted by NATRIIP at Pithampur, MP, India
Baja SAEINDIA 2 - Sponsored by SAEINDIA and hosted by Chitkara University at Chandigarh, India

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 SAEINDIA® Rules and for the dynamic events.

A2.3 Official Announcements and Competition Information
Teams are required to read the articles posted on the Baja SAEINDIA homepage (www.bajasaeindiaforum.com) published by Baja SAEINDIA Organizing Committee. Teams must also be familiar with all official announcements concerning the competitions and rule interpretations released by the Baja SAEINDIA 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 SAEINDIA – 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 SAEINDIA RULES AND ORGANIZER AUTHORITY

A3.1 Rules Authority
The Baja SAEINDIA Rules are the responsibility of Baja SAEINDIA Organizing Committee and are issued under the authority of Baja SAEINDIA Organizing Committee. Official announcements from Baja SAEINDIA 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 SAEINDIA Organizing Committee during competition, onsite.
A3.2 Rules Validity
The Baja SAEINDIA Rules posted on the Baja SAEINDIA 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 SAEINDIA 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 SAEINDIA 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.

A3.5 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 SAEINDIA, so any perceived loopholes should be resolved in the direction of increased safety/ concept of the competition.

A3.6 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.

A3.7 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 SAEINDIA Organizing Committee or Technical Inspectors.

A3.8 Right to Impound
Baja SAEINDIA 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.

A3.9 General Authority
Baja SAEINDIA Organizing Committee reserves the right to revise the schedule & venue 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.
A3.10 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.

A3.11 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 / SAEINDIA 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. 2021) are NOT eligible to participate.

A4.3 Society Membership
Team members must be members of SAEINDIA. Proof of membership, such as a valid membership card, is required while registration & also necessary during the event in order to participate in BAJA SAEINDIA competition. Interested students may join SAE International at: www.sae.org/students or 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 & Faculty advisors.

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. Teams having less than 5 and more than 25 members will not be allowed to participate.

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) are 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 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.

The faculty advisor should also be a member of SAEINDIA or SAE International. Faculty members should choose the “Professional Membership” link while registering for SAE membership.

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.bajasaeindia.in and write to saeindia_indore@saeindia.org, with a copy to bajasaeiniciomunications@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 of Faculty Advisor during the competition is mandatory for all the event days and for the Virtual Event as well.

Note: Teams will be penalized by 50 points (from overall score), if faculty advisor is not present at the time of registration and for entire duration of the event.
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.
- Accompany team at virtual & main event site and be present with vehicle during technical evaluation, brake test, static events and dynamic events.

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 allowed to remain present during technical inspection, cost audit or design presentations (static events). The team captain or other designated members of the team must do all the presentation and answer to questions asked by the judges. 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 the 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. Without exception, only those teams, whose college management gives an undertaking allowing use of their own workshop facilities, would be allowed to participate. Additionally, teams need to submit a list of operating facilities / equipment available with the college that will be used to fabricate & assemble the vehicle as per the design presented in the 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/ downloaded on a pen drive, 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 that have been professionally fabricated may be penalized up to 400 points or disqualified from the competition. The decision of the organizing committee in this regard will be final. In such case, registration fee would NOT be refunded.

A6.3 Kit Vehicles – Prohibited
Vehicles fabricated from a kit (except C 2.1) or published designs are ineligible to compete.

A6.4 Prefabricated Subassemblies
These rules do not exclude the use of prefabricated or modified sub-assemblies. However, extensive use of readymade subassemblies may invoke penalties. The 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.

All other parts need to be fabricated in-house and are not permitted to be outsourced from professional/other manufactures/ designers.
Any outsourcing must be reflected in cost report with supporting receipts from your outsourcing vendor.

A6.5 Bills & Document
For all procured items, teams must submit original GST bills. In case of electronic copy of bills the team MUST carry a printed copy signed by Faculty Advisor, HOD and Accounts Department of College, along with college stamp on it.
Note: For items whose original bills are retained by college authorities; teams must submit photocopied bills signed by Faculty Advisor, HOD and Accounts Section of College, along with college stamp on it.

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. An active SAEINDIA collegiate club (minimum one year old) is required to register the team. Also, the collegiate club should have a bank account & bank details need to be available before competition. (NEW)

A7.2 Entries per university-Registration for Baja SAEINDIA competition allows a maximum of 1 (ONE) each of eBAJA & mBAJA vehicle per college / university location / event format.

A7.3 Registration Limit
There is no limit to overall number of registrations for Baja SAE India event. However, two teams per college/university will only be allowed (one M-Baja & one E-Baja event separately). Institutions having multiple college(s) at different locations may register different teams, limited as above per location.
A7.3.1 Failure to Meet Deadlines -

All teams registered for Baja SAEINDIA 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).
(e) Other event related submissions will be informed through BAJA SAEINDIA FORUM

During the event, judges need to evaluate the team with respect to all the above submissions within given time deadlines. Failure to submit the reports is deemed violation of the rules and penalties may be applicable as decided by the Organizing Committee. OR 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 their intended Baja SAE India competition on or before the date specified on the action deadline webpage – www.bajasaeindia.org. Registration dates are available online.

A7.5 Registration Fees

The registration fee for Baja SAEINDIA must be paid through payment mode as mentioned in the latest BAJA SAEINDIA Registration Guidelines at the time of registration. Teams can refer www.bajasaeindia.org for more details. Registration fees are NOT refundable or transferable. Registration fees are 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 teams 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 fee. 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

If any team have initially registered for participation in BAJA SAEINDIA event, but later they realize that they are not able to participate in competition, they are requested to officially withdraw (by notifying to the following), not later than 15 days before the event starting dates. Such teams will not be eligible for refund of fees paid.

Write for Baja SAEINDIA event withdrawal to saeindia_indore@saeindia.org with copy to baisaesaeindiacomunications@saeindia.org.
A7.7 International Participation – Vehicle Shipping/Indian Customs

Baja SAEINDIA Organizing Committee strongly recommends that international teams should ship their vehicles early in order to allow enough time to compensate for any delays that may occur in clearing at 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 SAEINDIA competition is published on the Baja SAEINDIA website and is incorporated into these Rules by reference.

Baja SAEINDIA 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 SAEINDIA, 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 SAEINDIA 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 part of 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://bajasaeindiaforum.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 SAEINDIA vehicle can only be given on site at the competition.

A8.5 **Event Related Questions**
Questions pertaining to the operation and schedules of Baja SAEINDIA competition should be published on [http://bajasaeindiaforum.com/](http://bajasaeindiaforum.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 SAEINDIA 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 notice of the Convener/Joint Convener (this may be designated) of Baja SAEINDIA 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 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 Baja SAEINDIA 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 30 minutes of the end of the event to which the protest relates.

A9.5 **Hearing**
The time of protest will be noted by and decided upon by the designated sub-committee.

A9.6 **Decision:** The decision regarding any protest is final.
PART B: TECHNICAL REQUIREMENTS

ARTICLE 1: GENERAL DESIGN REQUIREMENTS

B.1.1 - General Requirements
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.1.5.1 - 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: ELECTRIC POWERTRAIN

B.2.1 – Definition
Refer to Part C : Electric Powertrain and Systems specific rules for e-BAJA vehicles.
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.

Note: Teams must build a new roll cage every year, teams using roll cage from previous competitions will not be allowed for main event. The roll cage MUST have a unique signature on the RRH member of roll cage, refer Figure B-3.

Roll cage signature to be in the following format, TEAM ID / SEASON YEAR / CAR NUMBER (THREE DIGIT)

For example, team XYZ with Team ID 20161, car number E87 participating in BAJA 2021 to have the roll cage signature as, 20161 / 2021 / E87

Teams may reuse tyres, suspension, CVT, Motor and driver’s seat for a maximum of three years.
The signature on roll cage is to be stamped using 6 mm (0.25 inch) sized number punch. Refer Figure B-4 for tool that can be used for stamping.
B.3.2 - Roll Cage Structure

The roll cage must be a space frame of tubular steel. The following section outlines the requirements of the physical members and joining methods of the roll cage. Roll cage and Frame Members must be fully welded, and welds must not be ground, sanded or modified so as to prevent inspection. Roll Cage Members that are bent must not exhibit any wrinkles, kinks or any detrimental deformation to the cross-section. Terminology used in the rule book relating to the roll cage structure is given below:

Frame: The entire tubular structure including all non-cantilevered tubes.
Roll Cage: Primary and Secondary Members used to protect the driver.
Member: A Primary or Secondary required element beginning and ending at Named Points.

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 or comply with Rule B.3.2.4 - Additional Support Members. 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 or comply with Rule B.3.2.4 - Additional Support Members. 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 at or between the points of tangency of the bend. Required dimensions between roll cage members are defined by measurements between member centerlines, except where noted. Junctions of Primary and Secondary members described below must be within 51 mm (2.0 in) of the Named Point, except where noted.

Mitered tubing joints of greater than 5 deg. will be treated as bends. Miters of less than 5 deg. will be treated as butt joints and subject to Rule B.3.2.14 - Butt Joints. Required members constructed of multiple members, such as the SIM and LFS, will be judged as continuous members from Named Point to Named Point, 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-6. Primary members must conform to B.3.2.16 - Roll Cage Materials.

Primary members are:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RRH</td>
<td>Rear Roll Hoop</td>
</tr>
<tr>
<td>RHO</td>
<td>Roll Hoop Overhead Members</td>
</tr>
<tr>
<td>FBM</td>
<td>Front Bracing Members</td>
</tr>
<tr>
<td>ALC</td>
<td>Aft Lateral Cross Member</td>
</tr>
<tr>
<td>BLC</td>
<td>Overhead Lateral Cross Member</td>
</tr>
<tr>
<td>CLC</td>
<td>Upper Lateral Cross Member</td>
</tr>
<tr>
<td>DLC</td>
<td>SIM Lateral Cross Member</td>
</tr>
<tr>
<td>FLC</td>
<td>Front Lateral Cross Member</td>
</tr>
<tr>
<td>LFS</td>
<td>Lower Frame Side Members</td>
</tr>
</tbody>
</table>
B.3.2.3 - Secondary Members

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) or rectangular steel tubes having a minimum wall thickness of 0.89mm (0.035 in) and a minimum outside dimension of 25.4 mm (1.0 in).

<table>
<thead>
<tr>
<th>Abbr.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LDB</td>
<td>Lateral Diagonal Bracing</td>
</tr>
<tr>
<td>SIM</td>
<td>Side Impact Members</td>
</tr>
<tr>
<td>FAB</td>
<td>Fore/Aft Bracing Members</td>
</tr>
<tr>
<td>USM</td>
<td>Under Seat Member</td>
</tr>
<tr>
<td>RLC</td>
<td>Rear Lateral Cross Member</td>
</tr>
</tbody>
</table>

Any tube that is used to mount the safety belts
Figure B-7: 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 tractive system 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-8 and Figure B-9.
Figure B-8: Roll Cage, Named Roll Cage Points, Rear Braced Frame.

Figure B-9: 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-10: Roll Cage, LC](image)

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-11). 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.
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.
B.3.2.8 RHO Roll Hoop Overhead Members

The aft (rearward) ends of the RHO members intersect the RRH within 51 mm (2.0 in.) of Points BR and BL (defined by BLC). The forward ends of the RHO members (intersection with the CLC) define points CR and CL (Figure B-14). CLC, BLC and RHO members must all be coplanar and bends at the aft (rearward) ends of the RHO members are not permitted.
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 confirming to Rule 3.2.1 Secondary member as highlighted in blue in Figure B - 15. The end points of the diagonal members welded must lie in the same plane as the RHO members and must be less than 3 inches away from points CR/CL and BR/BL respectively measured in the direction of vehicle’s longitudinal axis.
Figure B – 15: Diagonal Bracing for RHO members

Figure B-16: Roll Cage, Template Installation
B.3.2.8.1 - Gussets for Lateral Clearance

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 members must be a primary material (B.3.2.16 - Roll Cage Materials); completely welded around the circumference of both ends of the gusset.

Gusset members connecting the SIM to RRH or FBM for the purposes of achieving the Lateral Clearance in Rule B.3.3.1 - Lateral Space may be primary or secondary material (B.3.2.3 - Secondary Members) and must be closed in with Body Panels per Rule B.8.5 - Body Panels

Figure B-17: Roll Cage Template Drawing (All Dimensions are in inches)

Figure B-18: 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-10). The intersection of the LFS members and the FLC define the points FR and FL. In ‘Nose’ designs, as shown in Figure B-19, the LFS extends forward to Point E, and is joined by a lateral cross member FLC and ELC (Figure B-10).

![Figure B-19: Roll Cage, LFS](image)

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-16) at all positions between points S and D. In ‘Nose’ designs, as shown in Figure B-20, the SIM extends forward to Point G, and is joined by a lateral cross member GLC (Figure B-10). In this case, DLC may be omitted if GLC provides adequate protection for the driver’s toes as noted below.
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, every driver’s feet must be entirely behind the plane defined by points GR, L and ER, L. If GLC is below the driver’s toes, then an additional primary material Lateral Cross Member must be run between FBM or SIM 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. The USM may also serve as the mounting location for the seat and/or the anti-submarine belts per Rules B.4.5.3 - Seat Mounting Points and B.4.2.6.3 - Anti Submarine Belt Attachment.

Two options are given for the USM member:

1) Lateral USM - The two LFS members shall be joined by the Under Seat Members. The USM shall pass below the driver within the fore-aft envelope of the part of the template as noted in Figure B-17 that intersects the seat bottom.
2) Longitudinal USM - The ALC and FLC members shall be joined longitudinally by the Under Seat Member. The forward end of the USM may also terminate at an additional cross member made from primary material that joins the LFS members between Point A and Point F. The USM must pass within the fore-aft envelope of the template as noted in Figure B-17 intersects the seat bottom, and the lateral center-line of the seat.

![Figure B-21: Roll Cage, USM](image)

**B.3.2.12 FBM – Front Bracing Members**

Front Bracing Members must join the RHO, the SIM and the LFS (Figure B-22) at Points C, D and F. The upper Front Bracing Members (FBM\text{UP}) must join points C on the RHO to point D on the SIM. The lower Front Bracing Members (FBM\text{LOW}) must join point D to point F. The FBM must be continuous tubes. The angle between the FBM\text{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.
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 primary material. Plate gussets may be used if the thickness of the material meets or exceeds that of the primary material used. Figure B-18: RHO / FBM Gussets
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<sub>UP</sub> members to the SIM members (on the same sides). The intersection with the FBM<sub>UP</sub> 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 defines Point P must be vertically supported by further members connecting the SIM members to the LFS members which defines point Q. Points P&Q exist only with complete Front Bracing.

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-24), 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.
B.3.2.14 - Butt Joints

B.3.2.14.1 - Requirement
Roll cage members which are made of multiple tubes, joined by welding, must be reinforced with a welding sleeve. Many roll cage members are required to be continuous tubes and may not be made of multiple pieces. **Tubes which are joined at an angle greater than 5 deg. need not be sleeved; angles of less than 5 deg. will be considered butt joints.**

B.3.2.14.2 - Size
Sleeves must be designed to fit tightly on the inside on the joint being reinforced. External sleeves are not allowed. Sleeves must extend into each side of the sleeved joint, a length of at least two times the diameter of the tubes being reinforced and be made from steel at least as thick as the tubes being reinforced.
B.3.2.14.3 - Welding
The general arrangement of an acceptable sleeved joint is shown in Figure B-25. 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-26). 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-26: Roll Cage, Welding Sample 1](image)

**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-27). The sample must be sectioned along the length of tube to reveal adequate and uniform weld penetration (Figure B-27).
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.3.3 - 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, calves, 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.
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-29):
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-29: 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-30.

Figure B-30: Roll Cage, Required tube sleeve for drilled holes
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-31: 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.). Refer the link below for list of approved manufacturer’s for SFI Rated driver restraint assemblies, https://www.sfifoundation.com/wp-content/pdfs/manufacturers/16.1%20Manufacturers%20List.pdf
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-32: Driver Harness, SFI Tag, Old Style (Left), New Style (Right)](image)

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-33) 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.
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-34. Lateral position of the shoulder belts along their mounting tube must be restrained by a structure other than the firewall.

Figure B-34: 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-35 for details.

Figure B-35: Driver Harness, Shoulder Harness Lateral Restraint

Figure B-36: 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. The minimum length of excess shoulder harness webbing is 102 mm (4.0 in). See Figure B-36.

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-37 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-37: 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-38.

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-38: 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-39) 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-39. 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 requirement.

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 TEJ at the time of technical inspection.

Note: Quick disconnect fasteners for body panels are recommended and facilitate faster technical inspection process.
B.4.2.6.3 - Attachment
The anti-submarine belts shall be securely attached to the vehicle frame by one of the following methods:

a. Metal tabs joined by a threaded fastener.

b. Webbing wrapped around a frame member.

c. Webbing wrapped around a bolt secured by metal tabs in double shear.

Anti-submarine belts secured with eye-bolts are explicitly prohibited. Webbing shall be wrapped as per Figure B-33: Driver Harness, Diagram of Proper Wrapping of Webbing.

Any threaded fastener in the driver restraint system shall meet the requirements of Part B : 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 or a bolt, the following requirements shall be met:

a. The anti-submarine belt mounting tube shall have features designed to limit total lateral movement to 25.4 mm (1.0 in.) or less.

b. The anti-submarine belt webbing shall be protected from sharp edges such as bolt threads, tab edges, and

c. The anti-submarine belt mounting tube or tube holding tabs shall meet the frame requirements of a 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 anti-submarine 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-40). 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.
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. Refer the link below for list of approved manufacturer’s for SFI 3.3 rated driver’s accessories, https://www.sfifoundation.com/wp-content/pdfs/manufacturers/3.3%20Manufacturers%20List.pdf

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-41: 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-32 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-42) 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-42: 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. The bottom and back panel of seats must have at least 2 inches of non-removable foam (in uncompressed state, without the driver seated) on them. Conventional seats may also have a removable seat cover. 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-42: 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

NOTE: The following items must have COLLEGE NAME INITIALS marked with PERMANENT MARKERS (in contrast with the safety gears). (For example, for the college named, “Xyz Hub of Technology” mark as “X.H.T.” on items)

NOTE:
1. Without markings these items won’t be considered as valid.
2. Thinner is strictly banned inside the main event premises.

Items to be marked with college name Initials:
Driver’s Helmet (B.5.1)
Arm Restraint (B.4.3)
Driver’s Suit (both Upper and Lower Garments, for teams using split Driver’s Suit B.5.4.3 & B.5.4.4)
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.

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 TEJ 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.

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. Refer the link below for list of approved manufacturer’s for SFI 3.3 rated driver’s accessories, https://www.sfifoundation.com/wp-content/pdfs/manufacturers/3.3%20Manufacturers%20List.pdf

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.

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-32 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 durable and abrasion resistant gloves to protect their hands.

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. Refer the link below for list of approved manufacturer’s for SFI rated Driver’s Suits, https://www.sfifoundation.com/wp-content/pdfs/manufacturers/3.2A%20Manufacturers%20List.pdf

B.5.4.4 - Lower Garments
Drivers must wear fire resistant pants/suits having an SFI, FIA, NFPA 2112, or other fire-resistant rating. Refer the link below for list of approved manufacturer’s for SFI rated Driver’s Suits, https://www.sfifoundation.com/wp-content/pdfs/manufacturers/3.2A%20Manufacturers%20List.pdf

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: VEHICLE CONTROLS

B.6.1 - 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 braking system must distribute its action appropriately among axles. The action of the service braking system shall be distributed between the wheels of same axle symmetrical to the longitudinal plane of the vehicle. Brake system must achieve the prescribed 4 wheels locking within stopping distance (as a reference) specified in dynamic test, without any abnormal noise, vibration and juddering.

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. Brake pedals shall be fabricated or machined from steel or aluminum, and be designed to withstand a maximum brake pedal force of 450 lbf (2000 N).

Note: Teams are advised to go through additional inputs for brakes design put up as annexure labeled “GENERAL RECOMMENDATIONS FOR BRAKES DESIGN”
B.6.1.1 - 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 circuit brake system shall be designed to achieve minimum 50% prescribed dynamic performance requirement.

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.6.1.2 - 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.6.1.3 - Cutting Brakes
Hand or feet operated “cutting brakes” are permitted, provided the section B.6.1 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.6.1.4 - 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. IS 7079 compliance flexible Hydraulic Brake hose assembly, must be used to cater relative movements of steering and suspension system and any other.

Teams are recommended to use Bundy tube where there are no relative motions of components in the circuit routing; this is to minimize the volume expansions in tubes.

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 as per IS 8654. No brake line may be constructed of plain, plastic tubing.

B.6.1.5 - Brake Pedal:
Teams are recommended and advised to use brake pedal by right foot, this requires the pedal to be placed to the right side of the steering column. This is recommendation is made considering required foot pressure to be applied on brake pedal for effective braking.

Note: For use of brake pedal and accelerator pedal on the same side(right side),
1. There must be a minimum of 40 mm clearance between both the pedals.
2. It is recommended that the driver does not use the brake and acceleration pedal simultaneously.
B.6.2.1 – Accelerator Pedal
Foot pedals shall be positioned in such a way that entrapment of the driver’s foot is avoided.

Accelerator Pedal should be actuated by right foot only.

ARTICLE 7: COCKPIT
B.7.1 - Design Objective
The cockpit shall be designed to protect the driver and permit easy egress in an emergency.

B.7.2 - 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. Driver’s unable to demonstrate successful egress will have their driver status revoked. Each team is required to have a minimum of two designated drivers.

B.7.3 - Firewall
All vehicles shall have a firewall separating the cockpit (driver’s compartments) from the tractive system. The firewall shall be of 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 panels may be used to form the firewall, provided there are no gaps between the joints. Select cutouts are allowed for control cables, brake lines, electrical cables only, provided the cutouts have proper grommets and sealing.

Large cutouts in the firewall are explicitly prohibited. Large cutouts include those for ventilation of CVT, Battery box, Controller and other similar items. Air intakes may not penetrate the firewall and must remain within the roll cage envelope. All ventilation intakes may extend outside the roll cage envelope.

Firewall should adhere to all the rules mentioned in Tractive System.

Note: Use metal fasteners only. Plastic screws/snap fit plugs/Zip ties (for fixing of Fire wall) are not acceptable.

B.7.4 - 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).

Overhead body panels covering Plane of CLC-BLC members is strictly prohibited.

**Note:** Quick disconnect or easily accessible fasteners for body panels are recommended which facilitates faster technical inspection process.

**B.7.5 - Skid Plate**
The cockpit must be fitted with a skid plate (belly pan) over the entire length of the cockpit, so that the driver is not exposed to direct contact with the ground and he/she 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 be able to withstand the load of the driver at all conditions.

**B.7.6 - Shielding for Legs and Feet**

**B.7.6.1 - 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 which facilitates faster technical inspection process.

**B.7.6.2 - Universal Joints**
Universal joints in the steering column, near the driver’s feet must be shielded or sealed such that the driver’s clothes or feet may not become entangled.

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

**B.7.7 - 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 (in particular drivers) shall be familiar with the use and operation of fire extinguishers.

**B.7.7.1 - Rating and Required Features**
All fire extinguishers for use on the vehicle shall have a minimum UL rating of SBC. 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 to indicate that the unit has been properly charged. Each fire extinguisher shall be labeled with College name and vehicle number.
B.7.7.2 - 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 spare.

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

B.7.7.3 - Required Bracket
The only permitted fire extinguisher mounting brackets are the:

- Drake FIREX-MNT-DOR
- Drake FIREX-MNT-S-DOR


**Note: Keep a spare mount available.**

B.7.7.4 - 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 11, Fasteners.

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

B.7.7.5 - 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 – 54(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.**
ARTICLE 8: POWERTRAIN GUARDS

B.8.1 - Powertrain Guards and Finger protection
All rotating powertrain components (CVTs, Gears, Sprockets, Belts and Chains, Motor, Axles) shall be shielded to prevent injury to the driver, track workers, or bystanders. Guards shall protect against hazardous release of energy, should the rotating components fail. Finger protection 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 (Not applicable for Inboard Brakes), wheels and bare sections of shafts are exempt from the requirements of B.8.1 and B.8.2.

B.8.2 - Hazardous Release of Energy
Powertrain guards and shields protecting against hazardous release of energy shall extend around the periphery of the rotating components (CVTs, Gears, Sprockets, Belts and Chains, Motor) 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 in tangential direction to any rotating components.

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

**B.8.3 - 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 drivetrain is an acceptable shield for pinch points but does not relieve the requirement for release of hazardous energy.

**Note:** Inboard Braking rotors should meet the rules of powertrain Guard & should prevent the unintentional contact of hands with the rotor.
Note: All guards, whether Chain-drive or CVT, must maintain a clearance of at least 15mm from any nearby roll cage member or suspension component.

B.8.4 - 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.8.1 - Powertrain Guards and B.8.2 - Hazardous Release of Energy. OEM covers must still meet the requirements of B.8.3 - Pinch Points and Entanglement in way of the vent.

B.8.5 - Powertrain Breather / Vent System
Gearboxes and transmissions with a breather / vent system shall prevent loss of fluid in a rollover or by thermal expansion. This may be achieved with a vent tube, or other suitable means.

Any vent line connected to a gearbox or transmission shall be constructed from a material suitable for oil used in the gearbox or transmission. At all times, the vent line shall maintain a clearance of at least 100 mm (3.94 in.) from the exhaust, be properly secured without being pinched, and shall terminate inside a non-primary frame member. The hole shall not be a through hole and is not required to be sleeved in accordance with B.3.6.1.1 – for Sleeved Joints. If the hole is larger than 8.0 mm (5/16 in.) then a reinforcing plate (scab plate) is required around the hole.
ARTICLE 9: ELECTRICAL SYSTEM
A minimum electrical system comprising of at least two kill switches, a brake light, brake switch, (if required auxiliary) battery, and associated wiring is required. The vehicle electrical system shall be designed and constructed in accordance with best engineering and electrical practices. Brake lights shall operate regardless of kill switch setting and shall always be powered and functional all the times. The e-BAJA vehicles shall include “Ready to Drive Sound (RTDS) – 50 db level Buzzer is mandatory, TSAL as well into their Electrical System. Additional specifics of Low Voltage systems for e-BAJA vehicles are mentioned in detail in Part C Article 7.

B.9.1 –POWER SOURCES
B.9.1.1 - Batteries (Auxiliary Battery)

Any electronics parts or items on the vehicle can now simply be battery powered. Any battery used for safety appliances (brake light, reverse light, reverse alarm) shall have sufficient electrical capacity to last the entire duration of the endurance event.

B.9.1.1.1 – Mounting

All batteries shall be mounted with sound engineering practices and not become loose during normal operation, a collision or rollover. Battery terminals shall be insulated and protected against an electrical short circuit.
B.9.1.1.2 - Sealed Batteries
All batteries must be factory sealed for life (SFL type) and maintenance free. Batteries shall be incapable of being opened or serviced and not leak in the event of a collision or rollover.

B.9.2 - 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 obstruction for cockpit egress.

B.9.3 - Kill Switches
B.9.3.1 - Quantity
Each vehicle shall be equipped with a minimum of two (2) kill switches to deactivate the Tractive System.

**Note: It is mandatory for both the Kill Switches to be “PUSH TO KILL” type only.**

B.9.3.2 - 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 – 57, Allowed Kill switch type](image-url)
Note: Older versions of the approved switches are allowed, provided the purchase date is less than 3 years at the time of competition.

B.9.3.3 - Location

B.9.3.3.1 - Cockpit Switch

A minimum of one cockpit kill switch is required as defined by this rule. Additional cockpit kill switches are permitted provided the switch meets rule B.9.3.2 - Required Switch.

The cockpit kill switch shall be mounted on the Left/Right side of the driver, along the SIM or near the dash panel, within reach of a driver’s palm, while the driver is properly secured in the vehicle with all restraints (including arm restraints) on.

Note: The switch must not be placed close to the driver’s elbow and knee. The switch must be positioned ahead of the driver’s torso. Teams should ensure that kill switch mount does not hinder cockpit egress.

B.9.3.3.2 - 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_{BR}, and no further than 180 mm (7.0 inches), dimension “Z” in Figure B-59, below frame point B_{BR}, 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.
B.9.3.4 - Mounting
All kill switches shall be rigidly mounted to the vehicle frame with unobstructed access to the switch. All 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 a kill switch shall meet the requirements of Article 11 - Fasteners.

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

Note: Both the kill switches shall be located within the roll envelope and protected from rollover and collision damage.

B.9.4 - Signaling
B.9.4.1 - Brake Light
All vehicles are required to have a functional brake light to signal to other drivers that your vehicle is stopping or slowing down. Brake light is strictly required to be RED in color. Wattage of Brake light bulb should be as per AIS standard.

B.9.4.1.1 - Required Brake Light
Only the following brake lights are permitted along with Indian OEM Brake lights. Brake lights not listed below and non-OEM parts 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 when the brakes are released.

- Polaris Part # 2411450
- Polaris Part # 2411099
- Polaris Part # 2411092-432
B.9.4.1.2 - Location and Orientation
The vehicle brake light shall have a resilient and durable mount (with lock nuts if necessary) 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.9.4.1.3 - 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.9.4.2 - 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. Wattage of Reverse light bulb should be as per AIS standard.

B.9.4.2.1 - 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.

Note: LED strips for reverse light are strictly prohibited.

B.9.4.2.2 - 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.9.4.3 - 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.9.4.3.1 - Specification
Required reverse alarms shall be rated to meet the SAE standard J1741 or J994.

B.9.4.3.2 - Location
Required reverse alarms shall be mounted to the vehicle frame aft of the plane of the RRH.
B.9.5 - 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.9.5.1 – Cost of Voice Communication system (excluded)
Vehicles are permitted to use RF voice communications systems. RF Voice communication systems and equipment may be excluded from the cost report.

B.9.5.2 – Cost of Data acquisition system (included)
Vehicles are permitted to use RF data communications systems. All RF data communications systems and associated equipment shall be included in the cost report.

ARTICLE 10: TOW POINTS

B.10.1 - 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.10.2 - 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-60 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.
Examples of acceptable Front Hitches:

Figure B - 60

Figure B - 61

Figure B-62: Tow Point, Inspection Tool Fitment

B.10.3 - Rear Tow Point
Rear tow points shall be constructed from steel and meet the following requirements. See Figure B-64 for further information.
<table>
<thead>
<tr>
<th>Dimension</th>
<th>Symbol</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tab Thickness</td>
<td>None</td>
<td>8 mm (0.31 in.)</td>
<td>9.5mm (0.375 in.)</td>
</tr>
<tr>
<td>Hole Diameter</td>
<td>D</td>
<td>25.4 mm (1.0 in.)</td>
<td>31.75 mm (1.25 in.)</td>
</tr>
<tr>
<td>Hole-to-Tube Offset</td>
<td>X</td>
<td>19.0 mm (0.75 in.)</td>
<td>25.4 mm (1.0 in.)</td>
</tr>
<tr>
<td>Edge Distance</td>
<td>R</td>
<td>15.9 mm (0.625 in.)</td>
<td>25.4 mm (1.0 in.)</td>
</tr>
<tr>
<td>Width at Frame Connection</td>
<td>Y</td>
<td>76.2 mm (3.0 in.)</td>
<td>Unrestricted</td>
</tr>
<tr>
<td>Material</td>
<td>None</td>
<td>Steel 1018</td>
<td></td>
</tr>
</tbody>
</table>

**Figure B-63: 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-64: Tow Point, Rear Tab Dimensions**

*Note:* Rear Hitch Plate should be directly welded to the roll cage member. Latch type rear hitch plates are not allowed.
ARTICLE 11: FASTENERS

B.11.1 - Scope
Fasteners in the following vehicle systems shall meet the requirements of this article:

- Driver Harness
- Fire Extinguisher
- Kill Switches
- Steering, Suspension & Brake System
- Battery & Powertrain mounts

B.11.2 - Captive Fasteners
Fasteners shall be made captive by the use of the following:

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

Usage of Lock washers and/or thread lock solutions does not satisfy the requirement of this rule.

B.11.3 - Thread Projection
To provide for proper thread engagement in the lock nut, threaded fasteners shall have at least two (2) threads projecting beyond the end of the nut.

B.11.4 - Grade of Fastener’s
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, with above markings are acceptable](image-url)
B.11.5 - 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 that the fastener strength exceeds or is equivalent to the requirements of B.11.4 –
Grade of Fasteners.

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

B.11.6 - 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.11.7 - 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 12: VEHICLE IDENTIFICATION AND MARKINGS

B.12.1 - 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 SAEINDIA website
www.bajasaeindiaforum.com after the declaration of results.

B.12.2 - 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).

Note: Teams can mount two transponders on their vehicles, so that in case of failure of one
transponder data recorded by the other (functional) transponder can be used. The two
transponders should be mounted 300 mm apart.
Teams must ensure that the path between the transponder (or transponders) and the
ground is unobstructed.
It is the teams responsibility to get an active transponder subscription and charge the
transponder adequately for it to last the entire duration of the endurance event (for 4
hours).

B.12.2.1 - Required Transponder
All vehicles must be equipped with at least one MYLAPS rechargeable transponder. The only
acceptable transponder types are:
• Classic MX
• Flex MX

Figure B-66: List of approved and unapproved transponders

Subscriptions for Flex MX, X2 MX or TR2 MX transponders must be up-to-date and all Flex MX, X2 MX and TR2 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.
All teams are responsible for purchasing their transponder(s) directly through MyLaps.

http://www.mylaps.com

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

**B.12.2.3.1 – Installation Orientation of Transponder**

The transponder shall be installed to the frame in the orientation as shown in figure B-68. It shall be also oriented such a way that transponder number can be read “right-side up.”

![Figure B-68: Transponder Orientation](image)

**B.12.2.3.2 - 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 sensor cable underground, near finish line of each of the Dynamic events.

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

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

![Transponder Mounting Location](image)

Figure B-69: Transponder Mounting Location

**B.12.2.3.3 - Fastening bracket**

Each transponder is supplied with a mounting bracket. Teams are advised to weld a small plate / bracket (with an M4 pan OR flat head bolts - with lock nuts OR wire) to their frame to facilitate assembly of the transponder.

**B.12.2.3.4 - 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.12.3 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. Numbers shall not be obscured by any other portion of the vehicle.

**Caution:** If the any one of the Car Numbers are not easily readable, that car may be black flagged and might not be scored during the endurance event.

**B.12.3.1 - Required Numbers**
Primary numbers 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 (Three sides) of the vehicle. The number’s color must be strongly in contrast with background color. Use of adhesive to stick the numbers to the body panels is prohibited.

**B.12.3.2 - Required Font**

Vehicle numbers shall be displayed in either the “Highway Gothic Regular” font or “Century Gothic Bold” font. No other fonts are permitted. Examples of both fonts are given below.

**Highway Gothic: 1 2 3 4 5 6 7 8 9 0**

**Century Gothic Bold: 1 2 3 4 5 6 7 8 9 0**

*Figure B-70: “Approved vehicle number” – Font examples*

**B.12.3.3 - Location**

**B.12.3.3.1 - 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. Side numbers shall not be visually obstructed by any part of the vehicle.

**B.12.3.3.2 – Method of displaying Car 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.12.3.4 - Orientation**

Numerals shall be aligned along a common horizontal line, and the entire number panels shall be mounted in a generally horizontal orientation to facilitate fast vehicle identification. The number panels shall have 25.4 mm (1.0 in.) spacing between numerals.

**B.12.3.5 - Number Size**

The primary cutout numbers must be at least 152 mm (6.0 in) high, dimension “H” in Figure B-71. The primary cutout numbers shall have a width in proper proportion to the font size design for the given height (more than 152 mm) of each character. The primary cutout numbers shall be mounted such that the projecting face (thickness of Numbers) is higher than 13 mm (0.5 in) from the base panel on which they are mounted.
Note: Avoid sharp edges or points on the inner and outer edges of the cutout numbers.

B.12.3.6 - Backing Panel
Each number on the vehicle shall have a color which is highly contrasting with respect to the background color of base plate, to facilitate easy readability. The edges of the backing panel shall be no less than 25.4 mm (1.0 in.) from the outer edge of the numbers. Numbers may be outlined to provide enhanced contrast. Number backing panels must be securely fastened to the vehicle frame.

![Figure B-71: Vehicle Numbers, Example](image)

B.12.3.7 - Number Color
Teams are free to select colors of their own number and backing panel, provided that both the colors are of high contrast to each other, to facilitate fast vehicle identification. All the number backing panels shall be of same / one color and all numerals shall be of matching color. See Figure B-71.

B.12.4 SAEINDIA Logo
Two (2) SAEINDIA logo stickers must be displayed on the vehicle in prominent locations. Those will be distributed during registration at the competition.

B.12.5 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 India may require all entrants to display advertising from the competition sponsors, also.

Note: Teams must keep sufficient space (approximately 10 X 10 inch² space) unoccupied on
the firewall; on the left side of the driver (refer the yellow highlighted region in Figure B-72). This region will be used for putting stickers as part of Technical Evaluation (three stickers) and weighment (one sticker) process.

Figure B-72: Portion (Highlighted in Yellow) for Technical Evaluation and Weighment Stickers

ARTICLE 13: ERGONOMIC REQUIREMENTS FOR DRIVER SAFETY

B13.1 Roll cage Requirements
1. Teams are advised to design the Driver cockpit giving maximum safety to driver. Reducing weight/compact roll cage can be a secondary part of it.
2. Brackets/Mountings welded in the roll cage to be filleted to avoid sharp edges which may induce injury to team member/Driver.
3. Ensure Good visibility for the driver through FBM.
4. Creating Triangle of members is recommended in areas that require more strength.

B13.2 Sub-System Requirements
B13.2.1 - Steering Wheel Clearances
The teams must ensure minimum clearance (RA) of 220 mm between the driver’s chest or upper body/torso, whichever is closest to the steering wheel, as illustrated in Figure B-73.

Note: Teams not satisfying this criterion will be marked as ‘not cleared safety scrutiny’.
B13.2.2 Driver Knee Safety Requirements

This requirement deals with the safety requirements to be followed to ensure driver knees are not projecting out of the roll cage. The maximum height of the knees that can be allowed above the SIM member when viewed from side is **76 mm (3 in)** as shown in Figure B-74. The check will be done when the driver’s hands are placed on the steering wheel and with the feet placed on pedals, in comfortable operating position.

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 feet are on the pedals and hands on the steering wheel. The dimension “A” mentioned in figure B-75 should be minimum of 76mm (3in) w.r.t inner face of SIM member.

**Note:** Teams must ensure that their vehicle meets both the clearances mentioned under B13.2.2 (as per Figure B-74 and Figure B-75), both the limits should be met simultaneously. Teams that do fails to meet anyone or both of these criteria will be marked as ‘not cleared safety scrutiny’.
Figure B-75: Driver Knee Safety Lateral Clearance
PART C: ELECTRICAL POWERTRAIN AND SYSTEMS

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 strictly prohibited.

ARTICLE 2: TRACTIVE SYSTEM – POWERTRAIN

C2.1 E-KIT REQUIREMENTS

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

C2.1.2 Traction Motor shall be a BLDC motor with Peak Power not more than 6 kW.

C2.1.3 Battery Specifications shall not exceed 48V, 110Ah. It is recommended to deploy Li-ion battery pack.

C2.1.4 All the e-kit components shall compulsorily follow International Electro Technical Commission (IEC) 60529 IP67 standards (i.e. no dust and water entry) to achieve the required protection from failures, when the tractive system comes in contact with water.

C2.1.5 The e-kit components from any Supplier can be used in e-BAJA SAEINDIA 2021
provided all the components are in compliance with the relevant AIS - Automotive Electric Vehicle standards (Refer Part H, Article 1). Certificates confirming the same shall be submitted to the e-BAJA Technical Team through ESF Part-1(Refer D2.2.4).

Note: Only the components approved by the e-BAJA Technical Committee shall be used by the teams in building their vehicle’s powertrain.

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

C2.3.2 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 SYSTEMS - ENERGY STORAGE

C3.1 TRACTIVE SYSTEM ACCUMULATOR – GENERAL REQUIREMENTS

C3.1.1 All Batteries shall be in compliance with 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), must be enclosed in an electrically insulated accumulator container(s).

C3.1.2 The accumulator container(s) should be located behind the firewall and 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 Ttractive 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.

C3.1.4 The accumulator isolation relays should isolate the Accumulators from the HV system and must be Normally Open type. The fuse protecting the accumulator tractive system circuit must have a rating lower than the maximum switch off current of the isolation relays.

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.

**Note:** Wood/Rubber is not permitted to be used for building and mounting the Accumulator Containers.

**C3.3.2** The Accumulator container along with the mounting structure must be electrically insulated in all the directions using suitable material (UL 94-V0 Grade) 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.

**C3.3.3** The Accumulator Isolation Relays (AIRs) and the main fuse must be separated with an electrically insulated and fire proof material from the rest of the accumulator. AIR is not considered to be a suitable insulation material in this case.

**C3.3.4** Contacting / interconnecting the single cell’s by soldering in the high current path is strictly 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.

**C3.3.5** 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 opening of the Battery pack is STRICTLY PROHIBITED.*

![Figure C-1: Accumulator Container Mounting](image)

**C3.3.2** Accumulator containers must be placed behind the firewall. Mounting the accumulator containers in the cockpit area is strictly prohibited. Examples of some accumulator container mounting positions which are strictly prohibited are provided below:
C3.3.3 The mounting system must be designed to withstand forces in dynamic condition. Usage of any type of Belts/Ropes to support or hold the accumulator container is prohibited.

C3.3.4 All accumulator containers must be protected from side or rear impact collisions, by providing equivalent structure as defined in B 3.2.

C3.3.5 The accumulator container must be built from 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 dissipation of excessive heat and maintaining adequate temperature of the tractive system.

C3.3.7 A 750 mm² sticker showing the text “High Voltage” and a “red or black lightning bolt on yellow background” OR “red lightning bolt on white background” must be applied on accumulator container.

C3.4 ACCUMULATOR ISOLATION RELAY(S) (AIR)
C3.4.1 The accumulator isolation relays should be provided to isolate the Accumulators from the HV system and must be “Normally Open Type”.

C3.4.2 The fuse for protecting the accumulator tractive system circuit must have a rating lower than the maximum switch off current of the isolation relays.
C3.5 BATTERY MANAGEMENT SYSTEM (BMS)
C3.5.1 Cells 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 cell voltage levels (within the allowable minimum and maximum cell voltage) as stated in the cell data sheet. If individual 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 must be rigidly fastened to sustain vibrations in dynamic condition.
C3.5.6 BMS should follow International Electrotechnical Commission (IEC) 60529 IP67 i.e. no dust and water entry.

ARTICLE 4: TRACTIVE SYSTEM – GENERAL REQUIREMENTS
C4.1 SEPARATION OF TRACTION SYSTEM AND GROUNDED LOW VOLTAGE SYSTEM
C4.1.1 The complete layout of electric circuit 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 contained within / existent 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 galvancially isolated.
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, UL94-V0/FAR25 Standard recognized or equivalent insulating materials (e.g. Nomex based electrical insulation).
C4.1.6 Tractive system components shall be rigidly mounted with electrically insulating and fire-resistant materials. Components and cables capable of movement must be positively restrained to maintain safe 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 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 25.4 mm and a minimum wall thickness of 1.25 mm or equivalent – see B3.2.

C4.2.3 When observed from side view or front view, no part of 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 B7.3. Firewall must separate the driver compartment from all tractive system components.

C4.3.2 The firewall must be made from an electrically insulating material. In case the firewall made from an electrically conductive material, it should be completely covered by an electrically insulating material on both sides. Firewall shall act as an insulating barrier between all the tractive system components and the driver.

C4.3.3 The firewall must be resistant to puncture and scratch. The insulating material must be fire resistant, made of UL94-V0, FAR25 or equivalent grade.

C4.4 GROUNDING

C4.4.1 All electrically conductive metallic parts of the vehicle (and also any driver harness mounting points, seat mounting points and driver controls) which are within 100 mm of any tractive system or GLV component, must have a resistance below 300 mΩ (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 fiber parts, etc.) which are within 100 mm 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 which is likely to be conductive may be tested, for example the driver’s harness attachment bolt. But, where ever no convenient conductive point is available then an area of the coating may be removed.

**NOTE:** Carbon fiber 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 1 mΩ.
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 protect each of them from being touched. All the wires shall be properly routed. The battery terminals and other HV contact points shall be properly insulated with best engineering practices.

C4.5.2 All HV Cables must be in orange color (Fig. C-5). All the GLV wires shall be color coded to differentiate between the positive and negative current paths.

Figure C-3: Improper Harnessing and wrong engineering practices

Figure C-4: Example of proper harnessing and safety measures to be followed
C4.5.3 Tractive system components and containers must be protected from moisture in the form of rain or puddles.

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. Usage of insulation tape or rubber-like paint for insulation purposes 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 data sheet based on specified wire characteristics norms for serial number of wires printed on the wire is sufficient. 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 or maximum electrical current that will be pass / used for the anticipated duration of time.

C4.5.6 All tractive system wiring must be done as per professional standards with appropriately sized conductors and terminals and with adequate strain relief and protection from loosening due to vibration etc.

It is advisable not to use extension of cables. However, in case any extensions are provided, both the connected wires must be of the same gauge and rigidly connected.

C4.5.7 All tractive system connections must be designed to use intentional current paths (through conductors such as copper or aluminum). Steel bolts should not be used as 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. Packaging the wires in any kind of plastic containers is strictly prohibited.

C4.5.9 If external, un-insulated heat sinks are used, they must be properly grounded to the GLV System ground, Refer 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 All housings or enclosure containing parts of the tractive system, except motor housings, must be labeled 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.

![High Voltage Sticker](image)

Figure C-6: HV Indication Sticker

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 by closing the shutdown circuit, the car must not set to “Ready to Drive Mode”. Additional actions are required by the driver to set the car to ready-to-drive-mode. The car will be ready to accelerate as soon as the motor(s) will respond to the input of the torque encoder / acceleration pedal.

C4.7.3 Ready-to-Drive-Mode: The tractive system should be activated by pressing the dedicated start button. In order to set the vehicle in Ready-to-drive-mode brake pedal should be in pressed condition along with vehicle in Neutral mode.

Note: After the kill switch has been released, the above process shall be followed to set the vehicle into “Ready-to-drive-mode”.

C4.7.4 The Tractive system should not be activated while charging is in progress.

C4.7.5 The Tractive system should not be activated if the gear is not in neutral position.

C4.7.6 The Tractive system should not be activated if the accelerator pedal is pressed (without pressing the brake pedal), immediately after starting the vehicle.
C4.8 TRACTIVE-SYSTEM-ACTIVE LIGHT (TSAL)

C4.8.1 TSAL should be continuously flashing when Tractive system is in active state (when vehicle is in “Ready to Drive Mode”). Tractive system is defined to be active, when the accumulator isolation relay is closed, and the energy is available to the tractive system.

C4.8.2 The TSAL must be single Red flashing light (Refer images below) with the frequency of 2Hz-5Hz. It must be clearly visible in all the directions even in very bright sunlight. It should have opening from at least three sides.

*Note: Using more than one light, LED Strips/strobe lights as TSAL is strictly prohibited.*

![Figure C-7: Examples of permissible lights](image1)

![Figure C-8: Examples of Prohibited lights](image2)

C4.8.3 The TSAL shall be rigidly mounted to roll cage to protect from any kind of damage during rollover. It should be located in the center plane of vehicle on RRH Plane, 2 inches below from the center line of BLC. TSAL housing should be at minimum distance of 1.5 inches above the driver’s helmet reference plane. (Ref. Fig C-9)

![Figure C-9: TSAL Mounting Position](image3)
C4.8.4 With the reference Fig. C-10, the member BR should be at a minimum angle of 30 degrees from the RHO reference plane. Use of body panel to cover BLC to RLC member is prohibited in order to maintain visibility of TSAL.

![Diagram of member BR with RHO reference plane](image)

Figure C-10: Minimum required angle made by FAB up (BR) with RHO reference plane

C4.8.5 The TSAL must be visible to a person standing up to 3m away from the TSAL. It is prohibited to mount other lights in the proximity to the TSAL.  
NOTE: In case of any malfunction or improper visibility of the TSAL on the track, the vehicle will be black flagged until the problem is resolved.

C4.8.6 There should not be any object/sticker placed in the peripheral distance of 50 mm from the center of the TSAL.

C4.8.7 TSAL shall be rigidly mounted by using fasteners on a member supported by at least two primary members of the roll cage to protect from any kind of damage during rollover.  
NOTE: Use of cable ties, straps, adhesive tapes for TSAL mounting is prohibited.

C4.8.8 Any cut-out in the firewall for mounting TSAL, should be compliant to Firewall guidelines mentioned in section B7.3 & C4.3.

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 immediately after it is set in ready to drive mode.

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 maintained at a minimum level of 70dB, fast weighting, in a radius of 2m around the car, while the eBAJA car is in running condition (at all times).

C4.9.4 The sound (Buzzer) type used by the team must be easily recognizable. But, animal voices, song parts or sounds that can be interpreted as offensive are not permitted.
ARTICLE 5: FUSE

C5.1 FUSE SPECIFICATIONS

C5.1.1 Each of the electrical systems (both low and high voltage) must be protected by providing fuse of the rating 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.

Figure C-11: Fuses

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, e.g. Any conductors, wires, bus bars, cells etc. conducting the entire (pack current inclusive of all parallel strings) current. Fuse must be appropriately sized for the total current that the individual string 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 (if suitably rated), without external fuse or Fusible links.

ARTICLE 6: HIGH VOLTAGE PROCEDURES & TOOLS: The recommendations below are advisable to be followed while the team members are working at their own institute or during their presence at event site for eBAJA competition:

C6.1 WORKING ON TRACTIVE SYSTEM ACCUMULATOR CONTAINER

C6.1.1 Only appropriate insulated tools should be used whenever work is being carried out on the Accumulator or tractive system.

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 separate 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 phone number(s) of Electrical System Officer of the respective Team.

C6.2.5 WHEN THE ACCUMULATORS ARE BEING CHARGED INSIDE THE CAR, NO WORK IS ALLOWED ON ANY OF THE CAR'S SYSTEMS (DURING CHARGING).

C6.2.6 No grinding, drilling, etc. is allowed in the charging area.

C6.2.7 At least one team member who has knowledge about 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 allowed only if accumulator container is completely inside a closed enclosure.

C6.2.9 Charging circuit shall include a Kill Switch to de-energize the HV system when the vehicle is charging.

C6.3 CHARGERS

C6.3.1 Charger shall be of 48V.

C6.3.2 Only chargers presented and sealed at Electrical Tech. Inspection are permitted for usage at event site. 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 wherever they were built by the team they must be built to high standards and conform to 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 it is correctly connected to the accumulator.

C6.3.5 HV charging leads must be orange.

C6.3.6 During the process of charging of accumulator, the BMS must be live and must be able to turn off the charger if a fault is detected.

C6.3.7 Batteries shall not be recharged by Traction Motor or an alternator.
ARTICLE 7: GROUNDED LOW VOLTAGE SYSTEM (≤=48VDC)

C7.1 GENERAL ELECTRICAL SYSTEM OVERVIEW

C7.1.1 The electrical system must include at least two kill switches, a brake light, a reverse light, TSAL, RTDS 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.

C7.1.2 Kill Switches \ Master Switches: Each vehicle must be equipped with two (2) easily accessible kill switches turning off the tractive system, Refer Part B Article 10. The Kill switch must not de-energize the Brake Light.

C7.2 AUXILIARY BATTERIES

C7.2.1 Batteries shall not be recharged by Traction Motor or an alternator and it may be used to 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 drivetrain, 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 team may not get “Technical scrutiny” sticker.

C7.2.2 Auxiliary batteries must be attached securely to the frame. Installing auxiliary batteries in cockpit is prohibited. The Battery terminals should be covered with standard battery caps.

C7.2.4 The batteries must be factory sealed (incapable of being opened or serviced) and not leak in the event of a roll over.

C7.3 DRIVER DISPLAY

C7.3.1 Battery pack Voltage (Over all Voltage of HV system), Battery Pack Temperature (Over all Temperature), State of Charge (SOC) shall be displayed (all at a time) on the driver dashboard, when key is turned ON. Any other information displayed to the driver, by using the Data Acquisition system is up to the team’s choice. Any system that provides data back to the driver or to the team for tracking must be included in the Cost Report. Additionally, any batteries used to power the system must comply with the battery rules in Section C7.2.
ARTICLE 8: ACCUMULATOR SWAPPING (For Endurance only)

C8.1 SECONDARY ACCUMULATOR

C8.1.1 Teams may have spare battery pack which will be referred as Secondary accumulator. The secondary accumulator, if so available will be permitted (provided TI is cleared as per competition rule) to be used to swap with the primary tractive system accumulator, if the team so desires; during endurance event. Both primary and secondary accumulators are required to be presented at the time of Technical Inspection and seek approval.

C8.1.2 The secondary accumulator set up must be compliant with Part C, Article 3. It should be of the same size and having identical mounting design as per the primary tractive system accumulator, which will be replaced.

C8.1.3 The secondary accumulator must be stored in an electrically insulated container made of fire-retardant material, as per Accumulator Container guidelines (Refer Part C Article 3).

C8.2 SWAPPING MECHANISM / PROCESS

C8.2.1 Teams shall avail the option of Battery Swapping when the SOC drops less than 50% during the Endurance race only.

C8.2.2 Accumulators shall be easily accessible and removable from the vehicle for the team to qualify to be allowed for swapping during the endurance race. Same shall be demonstrated by the team during the Electrical Technical Inspection. Teams should have HV insulated tools and gloves to execute the swapping activity.

C8.2.3 Before swapping, the HV system should beenergized by activating the kill switch. The Negative terminal of the battery should be removed first and insulated with caps followed by removing the positive terminal.

C8.2.4 The accumulator setup shall be carefully removed and installed without interfering with the surrounding components at any time during the entire process.

C8.2.5 Removing the accumulator setup shall be restricted to the respective plane in which the setup is mounted. Refer to the figure C-12 mentioned below,

1. If accumulator container is placed completely below plane S-R, its removal is allowed only via horizontal path through side or rear of the vehicle below plane S-R (i.e. Path of removal should be such that no part for accumulator container is raised above plane S-R during process of battery removal.)

2. If accumulator container is placed completely or partially above SR plane, path of accumulator removal should be completely above plane S-R. Path of removal can consist of motion in vertical as well as horizontal direction but, vertical motion of accumulator more than 10 inches during removal process is prohibited.
C8.2.6 During the complete path of removal min. 2-inch clearance is mandatory against any roll cage member or component of the vehicle (excluding accumulator mounting & removal mechanism). For ease of removal and faster battery swapping process it is allowed to use mechanism and linkages, but it should be ensured that accumulator container should be rigidly connected and mechanically locked to arrest any motion during normal operation of vehicle as mentioned in C 3.3.

C8.2.7 Teams should follow the same process for reinstalling the secondary accumulator as executed while removing the setup.

C8.2.8 The Secondary accumulator shall be installed, and the positive terminal is connected first followed by the negative terminal.

C8.2.9 Teams shall have a 4-wheel hand cart for transporting the spare accumulator around the competition site.

C8.2.10 The time spent on swapping of Battery pack is considered as continuation / part of Endurance race.
PART D: STATIC EVENTS – 300 POINTS

ARTICLE 1: SCORING

<table>
<thead>
<tr>
<th>Event</th>
<th>eBAJA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Static Events</strong></td>
<td></td>
</tr>
<tr>
<td>Design Evaluation</td>
<td>150</td>
</tr>
<tr>
<td>Cost Report</td>
<td>15</td>
</tr>
<tr>
<td>Prototype Cost</td>
<td>85</td>
</tr>
<tr>
<td>Sales Presentation</td>
<td>50</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>300</td>
</tr>
<tr>
<td><strong>Dynamic Events</strong></td>
<td></td>
</tr>
<tr>
<td>Acceleration</td>
<td>75</td>
</tr>
<tr>
<td>Hill Climb or Rock Crawl</td>
<td>75</td>
</tr>
<tr>
<td>Land Maneuverability</td>
<td>75</td>
</tr>
<tr>
<td>Water Wading</td>
<td>75</td>
</tr>
<tr>
<td>Endurance</td>
<td>400</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>700</td>
</tr>
</tbody>
</table>

Total Score: Static + Dynamic = 1000 Points

ARTICLE 2: TECHNICAL EVALUATION

D2.1 Technical Evaluation - Pass/Fail
All Baja SAEINDIA 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 SAEINDIA 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 to be carried out (as directed by TEJ), in order to continue to remain in competition. Otherwise the Team will be disqualified.

D2.2 Technical Evaluation Process
Technical inspection will consist of three (3) separate stages– Electrical check, Safety Scrutiny and Panic Braking and one sticker will be issued for completing each of those critical stages (i.e., a total of three stickers to be issued for clearing all three stages of technical evaluation). The self-evaluation Format will be issued to all teams, which 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 Technical Safety Scrutiny
Each vehicle will be inspected to determine if it complies with the requirements and restrictions of the eBaja SAEINDIA rules. This inspection will comprise an examination of the driver’s safety 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 CONDUCTED 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 with basic requirements as stated in the rule book.

Note: Any major rework suggested during technical inspection must be carried out in respective vehicle pits / hot pit available at event site and not in any other place.

D2.2.3 Dynamic/panic brake test
The objective of this test is to ensure the vehicle is safe for driving, when it is driven up to the speed of 60 kmph. The test demands to attain the minimum speed of 40 kmph within 200 ft. distance and should be capable to stop with all four wheels locked (within the distance of 26 ft or 8 m).

Note: All four tyres must be marked with a radial strip of white paint (on the outer side of tyres) for wheel lock checks. Refer the region highlighted within red box in Figure D-1.
Figure D-1: Tyre Markings for Wheel Lock Check During Brake Test

A vehicle will be allowed to enter / appear for the Brake test, only if the vehicle has been granted both the Electrical Check & Safety Scrutiny check – Okay stickers, by TEJ Teams at event site.
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, during a panic braking from 40 kmph speed. If a vehicle does not attain a speed of 40 kmph, before applying brakes at a designated line, during appearing for brake test; that test will not be considered as satisfactory. The decision of the inspectors will be binding to all. If a vehicle fails to pass any part of the inspection, the vehicle must be corrected / modified and brought into compliance with the rules before it is submitted again for inspection / verification. If the tests are passed then only it will be 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. Log Sheet should be submitted to brakes technical evaluator.

**Note:**

1. **FOR IN-BOARD BRAKES:** Since teams are using inboard brakes which is mounted on shaft, the other side of the shaft is connected with UJ or CV joint creates play while brake is in action. This results in delay in brakes being applied on one of the rear wheels and further rotation in it.

2. Such case only half turn rotation (max 180 degree) will be considered. Brake effectiveness will be allowed only if rotation of all 4 wheels stop and vehicle comes to stop at a place instantly.

3. Juddering of wheels due to reactive forces on rotor and brake caliper, will be considered as ineffective braking. Generally, two-wheeler brake systems show this characteristic. Therefore, it is not recommended to use on BAJA vehicles.
D2.2.4 Electrical Technical Inspection

Each vehicle will be inspected to determine if it complies with the requirements and restrictions of the eBAJA SAEINDIA rules. This inspection will include an examination of the entire Electrical Drive train Architecture and the Electrical System Form – 1 & 2, submitted by the respective Teams.

Note: Teams having Innovation as a part of their Electrical Circuit shall ensure to keep the circuit installed in the vehicle during the Technical inspection as well as all along the event.

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 in detail, wherever required.
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 with all technical specification details for the EKit and the supporting certification documents to the eBAJA team for approval. Teams shall use only the components approved by the eBAJA team to build their vehicle. Schedule for submission of both ESF Part 1 & 2, 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.

For a successful clearance of Technical Inspection, vehicles need to be completely covered with water resistant body panels such that no electrical component gets in contact with water. The vehicles with functioning of the kit hampered after coming in contact with water shall be considered DNF and disqualified.

D2.2.5 Accumulator Swapping Demonstration

Team shall carry the secondary accumulator to the Electrical technical Inspection Team to demonstrate the removal and installation of the setup on the vehicle. Based on the demonstration of the team, the decision to allow the team for accumulator swapping will be taken by the Technical Inspector in charge. Once the verification is done the secondary accumulator will be sealed with a unique number and battery swapping ok sticker will be pasted on the vehicle. The seal shall not be broken throughout the event any deviations or tampering found will lead to the team unfit to go for swapping, during the endurance. Teams shall ensure the secondary accumulator is fully charged before obtaining the seal. Difficulty in accessing the battery pack and accumulator setup interfering with the surrounding components, mountings or roll cage members while swapping will lead to disqualification of the team from accumulator swapping, during Endurance.
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 the three parts of the Technical inspection stickers, 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 tempered with (which is reasonably believed) may not be considered as complying with the rules.

D2.4 The college level Technical Inspection is optional for teams. Interested teams will have to register and pay certain charges for assigning of technical evaluator to carry inspection at college. Details regarding this will be communicated through forum.

Teams can carry self-evaluation. All teams should be thoroughly prepared for technical evaluation, using the check sheet as a reference for the process (which will be released through forum). Videos for panic braking and figure of eight need to be submitted, the details for submission and deadlines for the same will be updated on forum.

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, Drivetrain/Powertrain, 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 SAEINDIA 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.bajasaeindiaforum.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 8½” 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 SAEINDIA Design Spec Sheet must be submitted.

D3.4.2 The baja SAEINDIA 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 SAEINDIA 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 81/2” 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 submission must follow the guidelines specified on BAJA SAEINDIA Forum.

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 submission must follow the guidelines specified on BAJA SAEINDIA Forum.

D3.8.3 Design Comparison Document (For Old Teams only)
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 submission must follow the guidelines specified on BAJA SAEINDIA Forum.

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 CAE Report Document submission must follow the guidelines specified on BAJA SAEINDIA Forum.
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 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.bajasaeindiaforum.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 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.bajasaeindiaforum.com

D4.2.5 Cost Report – Submission Format
The Microsoft Excel format (with the extension .xls (no macros) or .xlsx), using the supplied template posted on the Baja SAEINDIA 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.

A PDF file with all the cost documentation should be complete as described above (D 4.2.1 to D 4.2.5). The Cost Report document submission must follow the guidelines specified on BAJA SAEINDIA Forum.

D4.2.6 Cost Report Submission Deadline
The Cost Report for BAJA SAEINDIA 2021 must be submitted online. The deadline for the cost report 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. 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 audited for cost report at the competition.

D4.2.8 Cost Correction
The judges may increase costs and/or fabrication time, if they believe that the figures submitted are below current prices / time duration for the item, source, or process involved. Prices or time considered by the team, 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 for “On-site cost judging” according to 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:

\[
\text{Prototype Cost Score} = 85 \times \frac{C_{\text{max}} - C_{\text{your}}}{C_{\text{max}} - C_{\text{min}}}
\]

Where:

- \(C_{\text{your}}\): Your Vehicle cost, as corrected
- \(C_{\text{low}}\): lowest vehicle cost, as corrected
- \(C_{\text{max}}\): 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). The cost report will be identified as not complete (based on review), or 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 SAEINDIA vehicle design and put it into production at the rate of 4000 units per year.

D5.1.1 For the presentation, teams should 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 Any team member on the presentation floor/stage may answer the questions asked by the judges.

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:

a) Presentation Content including company financials and break even analysis.

b) Presentation organization, effectiveness & team’s response to Judges’ questions.

c) USP coverage – Market research, analysis, SWOT.

d) Marketing Strategy.


D5.4.2 The team that make’s 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-breaker rounds for static events.

PART E: DYNAMIC EVENTS – 700 POINTS
The dynamic events are intended to determine how the Baja SAEINDIA vehicles perform under a variety of conditions. Note that the organizers may modify the dynamic events to address local conditions, weather or resources.

ARTICLE 1 – SCORING SUMMARY

<table>
<thead>
<tr>
<th>Dynamic Event Points</th>
<th>eBAJA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceleration</td>
<td>75</td>
</tr>
<tr>
<td>Hill Climb or Rock Crawl</td>
<td>75</td>
</tr>
<tr>
<td>Land Manoeuvrability</td>
<td>75</td>
</tr>
<tr>
<td>Water Wading</td>
<td>75</td>
</tr>
<tr>
<td>Endurance</td>
<td>400</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>700</strong></td>
</tr>
</tbody>
</table>

Figure D-1: Dynamic Events, Table of Points

ARTICLE 2 - PRACTICE

E.2.1 - Objective

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.

E.2.2 - Course

If the organizer provides a practice track, the course length and features are at the organizer’s discretion.

E.2.3 - Procedure

After a safety check, vehicles are signaled to enter the practice track. After a predetermined time set by the track worker, the vehicle is signaled to exit the practice track.

E.2.4 - Penalties

Teams may be signaled to exit the practice track or barred from using the practice track if the track worker or competition officials observe unsafe conditions or behaviors.
E.2.5 - Signals and Signage

See E.8.8 - Signals and Signage.

E.2.6 - Scoring

There is no score awarded for practice.

ARTICLE 3 - ACCELERATION

E.3.1 - Objective

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

E.3.2 - 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 pavement to loose dirt. The choice of course length and surface is at the organizer’s discretion.

E.3.3 - Procedure

After a safety check, vehicles are positioned at the start line of the course. The track worker will check that the driver is ready to begin. Once the driver is ready, the track worker will signal the driver to proceed down the course. After completing the run on the course, the vehicle will be directed to the course exit.

Each vehicle may make two (2) runs on the course.

E.3.4 - Penalties

- Stall At Start – Run DQ
- False Start – Run DQ
- Driving off Course – Run DQ

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

E.3.5 - Signals and Signage

See E.8.8 - Signals and Signage.
E.3.6 - Scoring

The maximum number of available points for the acceleration event is 75 points.

Scoring will be based on the better of the two attempts. Timing will be performed with an electronic timing system.

The following equation will be used for the acceleration score (Sac):

\[ Sac = 75 \times \frac{t_{\text{max}} - trun}{t_{\text{max}} - t_{\text{min}}} \]

Where:
- \( t_{\text{min}} \) is the lowest (fastest) time by any vehicle.
- \( trun \) is the time recorded for a vehicle’s run to be scored.
- \( t_{\text{max}} \) is the minimum of the following:
  - The longest (slowest) time by any vehicle, or
  - 1.5 times \( t_{\text{min}} \)

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 4 – WATER WADING

E.4.1 - Objective

This event tests the vehicle’s relative ability to run through a course comprising inclusive of accumulated water of up to 300 mm from ground level and an array of water jet spray from both sides) from a standing start.

E.4.2 - Course

The organizer’s will be free to decide the maximum depth of water level, continuous or progressively increasing / reducing nature and total length of the water puddle. Sufficient width of the water trench will be provided, so that a vehicle compliant with the maximum permissible width will be able to wade through the entire length (Start line to Finish Line).
E.4.3 - Procedure

After a safety check, vehicles are positioned at the start line of the course. The track worker will check that the driver is ready to begin. Once the driver is ready, the track worker will signal the driver to proceed down the course. After completing the run on the course, the vehicle will be directed to the course exit. A mathematical calculation method will be applied to check the resistance before and after the Water Wading Test. Team will be ready with the following data on:

- $V_s$ – System Voltage = 48 V,
- $V_B$ – Voltage between Battery pack Positive Terminal to Negative Terminal.
- $V_1$ – Battery Positive to Chassis before the test
- $V_2$ – Battery Negative to Chassis before the test
- $V_1'$ – Battery Positive to Chassis (measured with 24kOhm in parallel) {if $V_1 > V_2$}
- $V_2'$ – Battery Negative to Chassis (measured with 24kOhm in parallel) {if $V_2 > V_1$}

The above measurement will be done before and after the water wading tests to calculate as below:

\[
\text{Ohm/Voltage} = \frac{24000 \times V_B \times (V_1 - V_1')}{{V_1} \times {V_1'} \times V_s}
\]

OR

\[
\text{Ohm/Voltage} = \frac{24000 \times V_B \times (V_2 - V_2')}{{V_2} \times {V_2'} \times V_s}
\]

If Resistance rated with System Voltage as above is found to be

- Ohm / Volt > 500 before the test, Test will be allowed to be performed by the vehicle.
- Ohm / Volt > 100 after the test, Test will be allowed to be scored (as per E4.6.1 or E4.6.2 or E4.6.3) for the vehicle.

Vehicles may not continue the attempt after they have stopped on the course.

E.4.4 - Penalties

Driving Off Course – Score as maximum progress at point of exiting the course.

E.4.5 - Signals and Signage

See E.8.8 - Signals and Signage.

E.4.6 - Scoring

The maximum number of available points for the water wading event is 75 points.
Scoring will be based on the better of the two attempts. Timing will be performed with an electronic timing system. 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 will be scored for distance at that point. Decision of Organiser’s is final and binding on the team, including whether to allow them for the second attempt.

E.4.6.1 - Method 1 (Different Distances)

If none of the vehicles are able to complete the course, then: The following equation will be used for the traction score ($S_{ww}$):

$$S_{ww} = 75 \times \frac{drun - dmin}{dmax - dmin}$$

Where:
- $d_{min}$ is the shortest distance by any vehicle.
- $d_{run}$ is the distance traveled for the vehicle to be scored.
- $d_{max}$ is the longest distance by any vehicle.

E.4.6.2 - Method 2 (Fixed Distance, All Succeed)

If there is (a) a set maximum distance and (b) all teams succeed in completing a full distance, then the score will be based on the time for the full distance. The following equation will be used for the traction score ($S_{ww}$):

$$S_{ww} = 75 \times \frac{tmax - trun}{tmax - tmin}$$

Where:
- $t_{min}$ is the lowest (fastest) time by any vehicle.
- $t_{run}$ is the time recorded for a vehicle’s run to be scored.
- $t_{max}$ is the minimum of the following:
  - The longest (slowest) time by any vehicle, or
  - 2.5 times $t_{min}$

E.4.6.3 - Method 3 (Fixed Distance, Some Succeed)

If there is (a) a set maximum distance and (b) at least one team is able to clear through the full length test and others do not, then the vehicles going the full distance (Group I) will be scored based on time and the vehicles that fail clear full length of test (Group II) will be scored based on distance.

**Group 1**

$$S_{ww1} = 75 \times \frac{tmin}{trun}$$
Where:
\( t_{\text{min}} \) is the lowest (fastest) time by any vehicle
\( t_{\text{run}} \) is the time recorded for a vehicle’s run to be scored.

**Group 2**

\[ Sww2 = \min (Sww1) \times \frac{d_{\text{run}}}{d_{\text{course}}} \]

Where:
\( d_{\text{run}} \) is the distance recorded for a vehicle to be scored.
\( d_{\text{course}} \) is full length of the course to be run by the vehicle.

**ARTICLE 5 - MANOEUVRABILITY**

**E.5.1 - Objective**

Maneuverability is designed to assess each vehicle’s agility and handling ability over off-road terrain. Teams will attempt to maneuver through the course with a minimum time.

**E.5.2 - Course**

The course may consist of a variety of challenges at the organizer’s option, possibly including tight turns, pylon maneuvers, ruts, bumps, drop-offs, sand, rocks, gullies, logs, and inclines.

**E.5.3 - Procedure**

After a safety check, vehicles are positioned at the start line of the course. The track worker will check that the driver is ready to begin. Once the driver is ready, the track worker will signal the driver to proceed down the course. After completing the run on the course, the vehicle will be directed to the course exit.

Each vehicle may make two (2) attempts at the course.

**E.5.4 - Signals and Signage**

See E.8.8 - Signals and Signage.

**E.5.5 - Penalties**

The organizer will select penalty types imposed for different violations to account for differences in the length or design of specific event courses. Penalties are times added to the total time a vehicle took to complete the course for a given run. The organizer will announce penalties on their event website or at a mandatory team meeting.
Example Penalties:
Pylon or Obstacle 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.

E.5.6 - Scoring

The maximum number of available points for the maneuverability event is 75 points.

Scoring will be based on the best of the two attempts. 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.”

Maneuverability scoring is based on the vehicle’s time to complete the course. Penalties are added to the vehicle’s time for a given run.

The following equation will be used for the maneuverability score ($S_{man}$):

$$S_{man} = 75 \times \frac{t_{max} - trun}{t_{max} - t_{min}}$$

Where:
- $t_{min}$ is the lowest (fastest) time by any vehicle
- $t_{run}$ is the time recorded for a vehicle’s run to be scored.

$t_{max}$ is the minimum of the following:

- The longest (slowest) time by any vehicle, or
- 2.5 times $t_{min}$
ARTICLE 6 - SPECIALTY EVENTS

Specialty events are designed to test the vehicle under unique off-road conditions that might be unique or specific to a particular Baja SAE India® competition site.

Examples of specialty events are: Rock Crawl, Mud Bog, and Suspension.

The dynamic events at competitions differ. Teams should check the websites of the specific competitions they are planning to enter and consider any unique requirements that might affect the design and fabrication of their vehicle.

E.6.1 - Objective

Specialty events may require the vehicle to complete a course in a minimum time or proceed a maximum distance. The objective of specialty events is at the discretion of the event head.

E.6.2 - Course

The course of specialty events is at the discretion of the event head.

E.6.3 - Procedure

After a safety check, vehicles are positioned at the start line of the course. The track worker will check that the driver is ready to begin. Once the driver is ready, the track worker will signal the driver to proceed down the course. After completing the run on the course, the vehicle will be directed to the course exit.

Each vehicle may make two (2) attempts at the course.

E.6.4 - Penalties

Penalties for specialty events are at the discretion of the event head.

E.6.5 - Signals and Signage

See E.8.8 - Signals and Signage.

E.6.6 - Scoring

The scoring system and penalties employed by the event head must adhere to one of the options defined for either (a) the Maneuverability event, or (b) the Traction event. The maximum number of available points for the specialty event is 100 points.
ARTICLE 7 - ENDURANCE

E.7.1 - Objective

The endurance event assesses each vehicle’s ability to operate continuously and at speed over rough terrain with obstacles in potentially adverse weather conditions (rain, snow, etc.). The endurance event may be run for time or for distance. The default is four (4) hours and the vehicle with the most laps (orbits) around the course is declared the winner.

E.7.2 - Course

The endurance course is a closed loop measuring approximately 1.0 km to 4.0 km. The endurance course may feature different surfaces (e.g. dirt, grass, sand, mud, gravel, stone, and asphalt). The endurance course will feature various obstacles and terrain to test the vehicle’s durability, traction, and speed.

E.7.3 - Procedure

E.7.3.1 - Pre-Gridding

Teams will pre-grid before the endurance event and be placed into starting position based on each team’s performance in a previous dynamic event, or set of dynamic events, to be determined by the organizer. Pre-gridding will close at a pre-determined time by the organizer. Teams late to pre-grid will be gathered in the pit exit lane and released to the track after the race has started.

E.7.3.2 - Compliance Check

During pre-gridding, or after pre-gridding closes, vehicle engines will be started and the Technical Inspector 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
- Kill Switches
- Brake System

Unprepared drivers or out-of-compliance vehicles deemed unsafe or not ready to drive will be ordered out of the gridding line by Technical Inspectors and sent to the paddocks to make corrections. Vehicles not ready to drive must check in at the pit exit lane to be admitted to the track.
E.7.3.3 - Gridding

Once the compliance check is complete, vehicles begin to form the grid and approach the start line as marshalled by track workers or Technical Inspectors.

E.7.3.4 - Starting

The endurance event may be started by a funnel start, standing staggered start or rolling start. A funnel start is when cars are arranged in a conical formation and released all at once. A standing staggered start is used to release cars in groups of two with a delay in between groups. A rolling start allows a run-in distance to the start line. The rolling start may be performed on the course.

The start type will be determined by the organizer. 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.

E.7.3.5 - Running

Endurance will be run as either:

- A single two (2) hour race.
- A predetermined and published distance.
- Elimination hits followed by a final in which the total time of one elimination hit, plus the final is 2 hours. The organizer will announce the structure of the event prior to the start.

Vehicles will safely navigate the course and accrue laps (orbits) to be counted and scored.

E.7.3.6 - Driver Change

During the course of endurance event, if (so desired by the team) driver change is necessary vehicle can be taken to either race pit as per the instructions of the Dynamic team Lead. Here registered second driver can take charge and continue further in endurance event.

The organizer reserves the right to require at least one driver change during the endurance event.

E.7.3.7 – Swapping Station

Specific location assigned for Accumulator swapping will be informed to teams, before the Endurance event. The spare battery pack (certified for swapping and sealed by Technical Inspection member) for swapping shall be carried to the swapping station (by the team using the hand cart), before the event begins. The seal number on the sticker with the seal on the secondary accumulator will be cross verified by Technical Inspection member.
In addition to the driver, 2 members per team are allowed in the swapping station to carryout swapping of batteries.

When the vehicle has arrived at the station, the sticker on the vehicle and SOC % will be verified before allowing the vehicle into the swapping station. The kill switch should be activated before team can take over to swap the battery pack.

Note: If, SOC > 50% or any case of tampering with the seal on the secondary accumulator is observed, teams will not be allowed for swapping.

Once the spare accumulator is installed, for safety purposes the TSAL functionality will be verified, before sending the vehicle back into the Endurance event.

Failure of SOC update or TSAL functionality will lead to disqualification of the team from the race and teams will be sent back to the pits.

No work requiring a tool may be performed in the Swapping area other than Accumulator Swapping. Teams can make adjustments (after completion of swapping of Batteries, only) that do not require any tools. Examples include driver harness, seat position, spring-damper preload, etc.

During Swapping procedure driver should not be seated inside the vehicle.

Vehicle will be black flagged in case of any malpractices or unsafe actions noticed during the swapping process.

**E.7.3.8 - Service**

**E.7.3.8.1 - Remote Pit**

The organizers may elect to create a remote pit for endurance event. Any vehicle requiring minor repairs and adjustments can be attended in remote pit near the endurance track.

**E.7.3.8.2 - Paddocks**

Teams whose vehicle requires service and repairs may exit the track at the designated location and proceed at walking speed to their paddock. No repairs are permitted on the course at any time.

**E.7.3.9 - Recovery**

Vehicles disabled on the endurance course may be recovered by track workers, or by designated recovery crews. Track workers will attempt to assist disabled vehicles. It is the driver’s responsibility to assist and cooperate with the course marshals in removing the vehicle.
If track workers are unable to assist a disabled vehicle, a recovery crew will transport the disabled vehicle to the paddocks. Drivers being towed to the paddock are required to remain seated and secured in their vehicle with all safety equipment on.

Recovery crews are deployed and operate on a “first come, first serve” basis. No priority will be given to any team over another.

**E.7.3.10 - Finish**

The Endurance event is finished when the lead car crosses the finish line after the time limit or distance has been reached. Vehicles remaining on the track will be allowed to finish their lap. Vehicles in the fuel zone will not be allowed back on the track after this time.

As vehicles cross the finish line, track workers will direct vehicles to the paddocks or the impound area (if required). All post-event traffic shall be at walking-speed.

**E.7.3.11 - Impound**

The organizers reserve the right to impound and inspect any vehicle during or after the endurance event. The Technical Inspectors will direct and instruct teams, regarding how to proceed for impounding area.

**E.7.4 - Penalties**

Event captains are the only personnel permitted to call and assess penalties during the endurance event. Event Captains are distributed throughout the endurance course during the event. Penalties during the endurance event will be signaled to and vehicles ordered off the track into the black flag area. Event Captains may stop any vehicle, at any time, if they believe it no longer complies with the requirements and restrictions of the rules. All timed 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.

**E.7.4.1 - Driver Equipment**

Any driver that is not using all of the approved and required drivers’ equipment will be flagged.

**E.7.4.2 - Mechanical Faults**

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 or adjustments. If a vehicle is stopped by officials for a mechanical fault, the fault must be corrected before it may re-enter the event.
E.7.4.3 - Vehicle Assists

Certain areas of the endurance course have been identified as difficult obstacles. If a vehicle is assisted three times on the same obstacle, the vehicle may be black flagged, and the driver warned that one more assist will result in removal of the vehicle for the remainder of the event.

E.7.4.4 - Roll Over

If a vehicle rolls over (end over end, or over on its side) anywhere on the track two times (in any location, regardless of driver), the vehicle will be black flagged and the driver warned that one more roll over will result in removal of the vehicle for the remainder of the event. Roll overs will be judged at the discretion of the Event Captains. Any vehicle that rolls over must be inspected by the Technical Inspectors before returning to the track.

E.7.4.5 - Endurance Penalty Table

<table>
<thead>
<tr>
<th>Penalty Type</th>
<th>Infraction</th>
<th>1st Offense</th>
<th>2nd Offense</th>
<th>3rd Offense</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery Swap</td>
<td>Swapping on the track</td>
<td>DQ</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Battery Swap</td>
<td>More than 3 team members (including driver) in the swapping area</td>
<td>Warning</td>
<td>10 minutes</td>
<td>DQ</td>
</tr>
<tr>
<td>Driving</td>
<td>Vehicle Roll Over</td>
<td>-</td>
<td>Warning</td>
<td>DQ</td>
</tr>
<tr>
<td>Driving</td>
<td>Passing during a yellow flag</td>
<td>Warning</td>
<td>Discretionary</td>
<td>Discretionary</td>
</tr>
<tr>
<td>Driving</td>
<td>Failure to stop for black flag when signaled</td>
<td>10 minutes</td>
<td>Discretionary</td>
<td>Discretionary</td>
</tr>
<tr>
<td>Driving</td>
<td>Leaving the course and advancing</td>
<td>5 minutes</td>
<td>Discretionary</td>
<td>Discretionary</td>
</tr>
<tr>
<td>Driving</td>
<td>Aggressive driving</td>
<td>10 minutes</td>
<td>DQ</td>
<td>-</td>
</tr>
<tr>
<td>Driving</td>
<td>Speeding in the pit or paddocks</td>
<td>5 minutes</td>
<td>20 minutes</td>
<td>DQ</td>
</tr>
<tr>
<td>Driving</td>
<td>Team member on track</td>
<td>50 points/member/sighting</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Figure E-1: Endurance Event, Table of Penalties

E.7.5 - Signals and Signage

See E.8.8 - Signals and Signage

E.7.6 - Scoring

E.7.6.1 - Points

The maximum possible points for endurance are 400 points.
E.7.6.2 - Determination of Winner

1. The team that completes the distance of the competition first or the greatest number of scored laps in the time set for the competition will be declared the winner.
2. 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.
3. 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 in the order they cross the finish line.
4. 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.

E.7.6.3 - Scored Laps

Scored laps are the number of full laps actually completed during the endurance event. Only full laps count, partial laps do not count for score. A vehicle must cross the timing line under its own power for a lap to be counted.

E.7.6.4 - Finish Order

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.

E.7.6.5 - Bonus Points

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:

<table>
<thead>
<tr>
<th>Position</th>
<th>Lap</th>
<th>Bonus Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>48</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>47</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>46</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>45</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>44</td>
<td>0</td>
</tr>
</tbody>
</table>

Figure E-2: Endurance Event, Table of Bonus Points
E.7.6.6 – Final Endurance Score

Endurance scoring is based on number of laps the vehicle completes in the allowed time:

\[ S_{en} = \left( 400 \times \frac{l_{team} - l_{min}}{l_{max} - l_{min}} \right) + P_{bonus} \]

Where:
Lmax is the maximum number of laps completed by any vehicle.
Lteam is the number of laps completed by the vehicle to be scored.
Lmin is the minimum number of laps completed by any vehicle.
Pbonus is the number of bonus points awarded to a qualifying vehicle.

E.7.6.7 - HEAT Plus Final Scoring

When endurance is run as hits plus a final, the points for the event will be distributed between the hits and the final in proportion to the time/distance of each stage.

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 hit plus three hundred (300) points to the final.

ARTICLE 8 - GENERAL EVENT PROCEDURES AND REGULATIONS

E.8.1 - Safety

E.8.1.1 - Safety Vision

Safety is the primary consideration in the design of Baja SAE India® vehicles and the conduct of the competitions. No event or competition is so important that teams and organizers cannot take the time to work safely. All participants will strive to create a safe competition where all participants return home in the same condition in which they arrived.

E.8.1.2 - First Aid / CPR / AED

While medical services are always on-site at Baja SAE India® events, teams are encouraged to be familiar with or trained in first aid, CPR, and the use of AED machines.
E.8.1.3 - Approaching Others

All participants are empowered to directly and respectfully approach others if they see a hazardous or unsafe condition and notify the person in danger. Persons approached regarding a safety concern are obligated to respectfully acknowledge the situation and are encouraged to thank those who approached them for their concern.

E.8.1.4 - Responsibility

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.

E.8.1.5 - Personal SAFETY & Protective Equipment

Teams are required to furnish and use their own PPE for working on vehicle, appropriate for the task being performed as well as General PPE for everyone to safeguard self and others from the risk of COVID 19 or any infectious virus. This includes, but is not limited to:

- Masks: wear masks during your presence at event site and at college level activities.
- Wear safety gloves.
- Spitting is punishable offence.
- Follow safe distancing (2 m) during your presence at event site and at college level activities.
- Safety Glasses (applicable for machine shop & welding / Gas cutting)
- Gloves (applicable for machine shop & welding / Gas cutting)
- Closed Toe Shoes - compulsory
- Arc Flash Protection
- Hearing Protection

E.8.1.6 - Key Hazards

All participants are encouraged to pay careful attention to the following situations:

E.8.1.6.1 - Ascending and Descending

Maintain 3-point contact when ascending and descending stairs, ladders, steps, or tailgates. Watch for obstructions at the beginning and end of travel.

E.8.1.6.2 - Pinch Points

Stay clear of pinch points from rotating machinery, doors, and other equipment.
E.8.1.6.3 - Hazardous Release of Energy

Stay clear of sparks, chips, swarf, or other high-energy material. Check circuits for live wires before working on them. Depressurize high pressure air, oil, or water systems before working on them. Take care when working around presses, rams, or other hydraulic equipment. Use care when jacking or lifting vehicles or other objects.

E.8.1.6.4 - Vehicle Operations

Do not drive when distracted. Utilize a spotter when backing a vehicle.

E.8.1.6.5 - Walking / Path of Travel

Take care to keep all walking paths clear of slip, trip, and fall hazards.

E.8.2 - Rules of Conduct

E.8.2.1 - Sportsmanlike Conduct

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.

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’s points to expulsion of the entire team. Penalties of this type will only be imposed after a complete review of the incident by the organizers.

E.8.2.1.1 - Prohibited Material

Alcoholic beverages, fire arms, weapons of any type, and illegal materials are prohibited at Baja SAE India® sites. 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, Faculty advisors and any individuals working / accompanying with the team on-site.

E.8.2.1.2 - Tobacco Products and Electronic Cigarettes

The use of all tobacco products or using e-cigarettes on-site is prohibited.

E.8.2.1.3 - Footwear

All individuals on-site shall wear durable and sturdy closed toe shoes. Open-toed shoes, slippers, chappals etc. are explicitly prohibited.
E.8.2.1.4 - Parties
Disruptive parties either on or off-site must be prevented by the faculty advisor or team captain.

E.8.2.1.5 - Housekeeping
Clean-up of trash and debris is the responsibility of the teams. Please make an effort to keep the paddock area clean and uncluttered. At the close of the day, each team must clean their work /pit area. All Waste material must be thrown in to trsh bins only.

E.8.2.1.6 - Site Condition
Please help the organizers keep the site clean. The sites used for Baja SAE India® are generally private property and should be treated as such. Competitors are reminded that they are guests. 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 clean their areas after meals.

E.8.2.1.7 - Personal Transportation
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.

E.8.2.2 - Spectator Rules

E.8.2.2.1 - 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.

E.8.2.2.2 - Alcoholic Beverages
Spectators may not drink or possess alcoholic beverages at any competition location.

E.8.2.2.3 - Access Restriction
Spectators must keep-back a specified distance from the event areas as decided by the organizers and from any area where vehicles are operating under power. Motor vehicle competitions are potentially dangerous and safety rules will be strictly enforced.
E.8.2.4 - 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.

E.8.2.5 - Expulsion

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.

E.8.2.6 - Unsafe Conduct

All participants are required to exercise safe practices and avoid unsafe activities at all times during the competition. The event organizers have the discretionary authority to impose a just penalty for any conduct deemed unsafe. All team members will be held / apprehended to this rule.

E.8.3 - Paddock Rules

E.8.3.1 - Speed Limit

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 discretionary point penalties will be assessed for violations.

E.8.3.2 - Escort Required

When a vehicle is driven anywhere except within the practice area or on event courses, it must have a team member escort the vehicle. The escort shall walk with the vehicle on the right side (to stay close to the firewall kill switch) and shall remain in the view of the driver at all times. The escort should act as a spotter to the driver, paying special attention to the vehicle’s blind spots and other vehicles.
Under no circumstances may anyone other than the driver, ride in or on a vehicle.

Escorts shall remain clear and not touch the vehicle when it is in motion and remain within line-of-sight to the driver.

E.8.3.3 - Team Pit area

The team’s pit area should be kept uncluttered at all times. When a team leaves their area, it must be left clean.
E.8.3.4 - Team Vehicles

Only the Baja SAE India® vehicles themselves are allowed in the paddocks. Teams’ support trucks and trailers must be parked outside the competition site in a specially designated area.

E.8.3.5 - Access Restriction

The organizers may limit the paddocks to team members, faculty advisors and competition officials.

E.8.3.6 - Compressed Gases

Teams shall safely 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 52°C (125°F).

E.8.3.7 - Driving Restrictions

E.8.3.8.1 - Off Site Operation

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 the vehicle has passed technical inspection.

Driving off site is explicitly prohibited. Teams found to have driven their vehicle at an off-site location during the event may be expelled from the competition.

E.8.3.8.2 - Driver Equipment

Drivers not wearing the proper equipment will not be permitted to drive, and may have their competition driver’s privileges revoked.

E.8.4 - 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.
E.8.5 - Tie Breakers

E.8.5.1 - Non-Endurance Events

Ties for non-endurance dynamic events will be broken by comparing the score of the second best time or distance for the event in question. If the tie remains, the tie stands.

E.8.5.2 - Endurance Event

Ties in the endurance race will be judged by the endurance event judge and may remain a tie.

E.8.5.3 - Overall Event

Ties for the overall winner will be broken in the following order:

1. Endurance Score
2. Total Dynamic Events Score
3. Total Static Events Score

If a tie remains after the prescribed tie breakers, the tie stands for the overall winners.

E.8.6 - Pre Inspection Operation

Vehicles may not be started or driven prior to passing technical inspection, except as required as part of the inspection process itself.

E.8.7 - Inspection

Any vehicle may be impounded and inspected anytime during the competition. Any vehicle found to have: altered or substituted its parts or equipment since passing technical inspection or Drive train components / parts in violation of the rules may receive a point deduction of 75 points each time it is found in violation.

E.8.8 - Signals and Signage

Baja SAE India® competitions may use some or all of the signals and signage presented in this section.

E.8.8.1 Endurance - Command Flags
Command flags are just that - flags that the competitor must immediately obey without question.
E.8.8.1.1 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.

E.8.8.1.2 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.

E.8.8.1.3 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.

E.8.8.1.4 Black Flag (Furled and Pointed) –

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

E.8.8.1.5 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.
E.8.8.1.6 Chequered Flag –
The event has been completed. Exit the course as directed by event officials.

E.8.8.1.7 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.

E.8.8.1.8 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.

E.8.8.1.9 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.
E.8.8.1.10 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.

E.8.8.1.11 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.

E.8.8.1.12 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.

E.8.8.1.13 End Control Zone – This sign denotes the end of the control zone boundary.

E.8.8.1.14 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.
E.8.8.1.15 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.

ARTICLE 9 - VISAS

E9.1 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. They will not intervene on any matters concerning India or any other country.
PART F: NOTICE
ARTICLE 1: POSSIBLE RULE CHANGES FOR 2022

- A new frame fixture that will more closely follow the 95th percentile male.

PART G: DESIGN AND COST SUBMISSION PROCEDURES
ARTICLE 1: ONLINE SUBMISSIONS

New document submission process for Baja SAEINDIA competition.

Design and Cost Report submission process

Forms - The standard forms that are required for documentation and submissions at Baja SAEINDIA competition can be downloaded from www.bajasaeindiaforum.com

Account Signup for Online Submission - Teams registered for BAJA SAEINDIA event will receive their BAJA SAEINDIA Forum Login Credentials on their registered e-mail IDs.

ONLINE SUBMISSIONS
Web Based Submission -

Teams competing for Baja SAEINDIA competition must submit the following documents online as per guideline mentioned on 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 SAEINDIA 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 / upload documents with a new file at any time, between the "Submission Due Date" and the "No Submissions Accepted After date". Such replacements are classified as late submissions and appropriate penalties will be applied.

Documents not uploaded or replaced following the "No Submissions Accepted After" deadline, then late submission penalties will be applied.
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 SAE India 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
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
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 250 °C +/- 5 °C 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 250 °C +/- 5 °C 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 the 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 the range of ±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 10 hrs. 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 3 mm in Cell level and 20 mm 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

H.2.1 EVENT RELATED SAFETY ASPECTS FOR INDIVIDUAL TEAM MEMBERS:

- Teams are required to furnish and use their own PPE, appropriate for the task being performed, for example, gloves, safety glasses, closed toe shoes, arc flash protection, hearing protection, etc.
- All individuals on-site shall wear durable and sturdy closed toe shoes. Open-toed shoes, slippers, chappals etc. are explicitly prohibited.
- Alcoholic beverages, firearms, weapons of any type, and illegal materials are prohibited at Baja SAE India® sites. The penalty for violation of this rule is “immediate expulsion of the entire team, not just the individual(s) involved in it”.
- The use of motorcycles, quads, bicycles, scooters, skateboards, rollerblades or similar person-carrying or motor driven devices in any part of the competition area, including the paddocks is prohibited.
- Teams shall safely store compressed gas cylinders for vehicle control systems, crack detection and paint. Cylinders shall be upright and properly secured by chain or other method. It must be capped when not in use, and stored such that cylinder temperature is below 52 °C. If a Team is carrying such a compressed gas cylinder with them, they should report this matter at the time of Registration at the site.
- Drivers not wearing the proper safety equipment while driving or seated in driver’s seat will not be permitted to drive, and may have their competition driver’s privileges revoked.
• Trespassing in track area on all days from the day of Registration at site till end of the event, by any team members is strictly prohibited, under the pain of penalty.
• Team members are not allowed to carry knives, axes, crowbars, corrosives, poisons, toxics, thinner and any other hazardous materials at the event site.
• Team members should adhere to the dress code and carry their ID cards, on all days during their presence at the event site.

H.2.2 SAFETY ASPECTS RELATED TO PIT or Paddock AREA:

• Storage of Inflammable fluids of any type, exceeding more than half liter must not be available at any location with any team.
• Use of power tools inside the pit is strictly prohibited; they are to be used at designated place only.
• No welding work to be done at the pit. Welding work to be carried out at weld pit only.

H.2.3 EVENT RELATED SAFETY ASPECTS FOR STUDENT BAJA VEHICLE:

• Vehicles may not be started or driven prior to acceptance of technical evaluation.
• Before team passes technical evaluation, the team vehicle should only be moved around by being pushed by team members (maximum 4) walking besides the vehicle.
• Only after technical evaluation acceptance vehicle can be moved on t’s own power, but driven at walking speed. The speed violation will attract confiscation of vehicle for certain hours or days.
• 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. The walking speed rule will be strictly enforced and discretionary point penalties will be acceded / assessed for violations.
• Before entering into the event site, teams should ensure all technical requirements concerning compliance with Rule Book are met for their vehicles.
• Only the Baja SAE India® vehicles themselves are allowed in the paddocks. Teams’ support trucks and trailers must be parked outside the competition site in a specially designated area only.
• 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 the vehicle has passed technical inspection. Driving off site is explicitly prohibited.
• Any vehicle may be impounded and inspected anytime during the competition. Any vehicle found to have altered or substituted its parts or equipment since passing technical inspection will be considered as violation of the rules and hence liable for overall point deduction of 75 points, each time it is found in violation.
ARTICLE 3: VEHICLE TESTING

Important Note to all teams:
Team must make a note that, the Baja competition vehicles are not CMVR approved vehicles. Hence, they are not permitted to ply on public roads. Therefore, the testing of Baja competition vehicles and usage of public road for this purpose is strictly prohibited. This means that none of the teams will test or take 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-compliance or any implications of violation of laws by any team.

PART I:

ANNEXURE: GENERAL RECOMMENDATIONS FOR BRAKES DESIGN

1. How to incorporate Hydraulic Stop Lamp Switch (1 - Off for Tandem Brake Master Cylinder and 2 - Off for Two Brake Master Cylinders (Parallel Mount installations)): Variety of Hydraulic stop light switches developed by OEMs are available as OTC product with dealers / spares outlets. Teams must study the port details of their brake master cylinder(s) and develop a suitable adaptor to fit the hydraulic brake lamp switch(es).

2. Remote mounted Brake Fluid Reservoir(s) with two inlet rubber hose(s) to feed the Brake Master Cylinder(s) - Either Tandem Type or Twin Assembly: Almost on 95 % of the vehicles, off the shelf / Commodity products (Made out of Mineral Oil Processed - plain jane Vennila type rubber hoses meant for industrial machines) were used by team members. It is mandatory to use installation aids like appropriate end clips, clamps, bracket etc. They are usually found missing. The teams should look for OTC items used in cars, Small Commercial Vehicles, MUV, SUV etc., with remote mounted installations and try to incorporate the engineered products used by OEMs (with suitable interfaces if required).

3. Teams are recommended to do the following checks (Static Visual Check, System Rigidity Check and Subjective Test) at College Level as preparation for main event:

   Static Visual Checks:
   Teams to consider the following points for brakes design:
   - Front Axle weights
   - Rear Axle weights
   - Dynamic weight transfer and distribution of forces
   - Brake Circuit construction
   - Achievable deceleration and wheel lock details
   - Bundy tube routing/ clamping/ clearances adequacy
   - Brake Hose routing clearances for suspension and steering articulation
   - All the bleed ports shall be provided on top most point of caliper / wheel cylinder
• All the Banjo connections must be of good quality having flatness, perpendicularity, parallelism and concentricity with respect to its related axis, without any cracks.

• Only appropriate size and length of proper Banjo bolts must be used. Tighten (Not with low torque or very high torque) each of the Banjo bolt properly. Because, it may induce leakage of air in to the brake system.

• Use banjo washers made out of Copper metal only, at all locations. If, for some reasons any banjo bolt is loosened, please replace both the banjo washers for that bolt, with new copper washers. Many teams having used aluminum type banjo washers have failed in clearing the brake test.

• Flaring operation of end of Bundy tubes should be practiced till the students develop proficiency. Only then final flaring should be attempted. Check the conical flaring portion for evenness and concentricity, to achieve proper sealing when tightened.

• Three way or four way connectors /unions must be made from brass metal. Check for any cracks and any manufacturing defects, before using them. They should be positively fixed on to a suitable chassis portion.

• Brake Fluid reservoir shall be placed above the foundation brakes

System Rigidity Test:
For checking brake fluid leakage and pedal rigidity teams will be required to apply maximum pedal force and hold for 2 minutes.

Subjective Test for Evaluating Brakes at College Level:
Teams can carry out subjective brakes evaluation test (when the vehicle has achieved up to 20 kmph speed) by applying low brake pedal force only and check for brake functioning (apply pedal effort to achieve “start of wheels lock”).

4. Connecting all four brakes fully with steel impregnated rubber brake hoses is discouraged, because in that case compliance to cleanliness, continuous flow of brake fluid, adherence to 3F (Fit, Form & Function) and performance could be a great concern. Instead Bundy tube assemblies and flexible brake hoses at wheel end is recommended.

5. Dangling and Fouling of the brake hoses and Bundy tube assemblies due to improper installation: With suitable bending fixtures (Material: wood or Mild Steel) and portable flaring tool kit (Common garage equipment), it would be lot easier to address those mistakes which lead to significant concerns and failures.

6. Concerns w.r.t. improper clipping and clamping of Bundy tube assemblies and brake hoses: Drawing up an installation layout (with allied / associated parts) would enable the competing students to identify the clipping and clamping points for trouble free installation
7. **Usage of combination of installation fittings (Two / Three way unions, Banjo / Bolt assembly, running nuts etc.,) and cascading concerns:** Assortment of these installation aids are made out of materials like steel, brass, Zinc alloy, Aluminum etc. This bucket of parts - ranging from two wheelers to trucks demands different tightening torque requirement to mitigate distortions, deformations and to ensure effective sealing characteristics against leakage. Teams end up facing problems due to lack of awareness in dealing with different materials. Time tested and standard OEM approved parts would assure effectiveness. Teams are recommended to use copper washers and not to use aluminum washers for connections at brake calipers and master cylinder, also.

8. **Different orientation of both inlet and outlet ports of the Brake Master Cylinder(s), Brake Calipers, Limiting Valve(s) etc:** Angular orientations of ports (inlet / outlet) especially with aluminum parts are highly vulnerable for incorrect assembly / wrong fitment. This, in turn would result in concerns like brake fluid seepage, leakage, improper sealing, ineffective braking etc., Thus, these parts are to be dealt with utmost care!

9. **Variety of port sealing features (DIN, SAE, JASO) of the installation fittings, couplings and running nuts:** We had inherited European and Japanese engineering principles and philosophies in auto industry. Thus, three different port specifications are quite common with auto parts. While mixing / matching different brake aggregates, an eye for details w.r.t. the above features will definitely neutralize lot of build quality issues (minor to significant).

10. **Leakage, ineffective bleeding and poor brake performance due to items as listed in serial no 7.0 and 8.0:** Above complications really gets complicated when teams tend to extensively use TEFOLON / THREAD SEALING TAPES on connectors / running nuts to get over seepage and leakage complaints. This puts team to the grave risk of brakes failure. Added to this the above-mentioned tapes (Processed with Mineral Oil Materials) tend to cook and contaminate the entire brake system. These tapes do not go well with synthetic (Glycol) based Brake Fluid.

11. **Concerns with customized Brake Rotors, Brake Calipers, Brake Pads and Brake Master Cylinders:** Across the globe, these critical parts / assemblies are engineered and manufactured by leading brake manufacturing industries with multi-level process controls coupled with galaxy of manufacturing excellence and quality assurance checks. This is followed up with intense testing and validation processes (Rig tests - Track tests - Clinical Trials - Fleet tests - Road tests - Homologation / Type Approval / Certification / Safe Launch etc.). However, on the other hand students tend to make attempts on their own, with limited resources and using traditionally old manufacturing processes in setting up the above safety critical aggregates.

    Often proof of basic performance checks and outcome of tests are NOT EVIDENCED. This leads to piling up of buggies with brake complaints in main events in huge numbers year after year. From industry perspective, it is JUST NOT POSSIBLE for the teams to EVOLVE / DELIVER above four-brakes aggregates with the given resource constraints (Time / Manufacturing / Testing & Evaluation set up etc.). Flimsy, fragile, extensively slotted, deadly drilled with cross holed brake rotors made out of STEEL (BAD CONDUCTOR of HEAT). Instead teams can go for a robust CAST IRON BRAKE ROTORS to manage the HEAT in the FRONT and to manage the WHEEL LOCK CONCERNS in the REAR.
12. **CVT enabled buggies**: By virtue of their design CVT puts enormous constraints (like parasitic drag, hysteresis, poor response / return features) on to the brake caliper assembly - 1 Off, Inboard Mount / Integrated with CVT Housing (Traditionally a match box sized, value engineered- lightweight etc.,) assembled with biscuit-sized brake pads. In this case, often a tiny brake caliper is overburdened to deliver the output of two brake calipers. Also, energy consumed in braking and heat to be dissipated is high. If not engineered properly this type of installation (Inboard mounted Brake Caliper integrated with CVT housing) can lead to DANGER. Teams should use ROUBUST BRAKE CALIPER ASSEMBLY in this instance.

13. **For cases of bleed screw installation at the bottom**: It would not be possible to take out the trapped air out of the brake system. This leads to spongy / ineffective brake performance.

14. **Brake Master Cylinder Mounting(s)**: By default, if the brake caliper (LH / RH or Front / Rear) are mounted higher than the brake master cylinder(s), then, brake fluid from the brake caliper(s) will drain off into the brake fluid reservoir. Hence, it is important that the brake master cylinder(s) installation height must be higher than that of the brake caliper(s).

15. **Brake Biasing (For a given Pedal input to get more output from front and slightly low output from rear (To prevent premature wheel lock phenomenon)**: This will require a lot of iterations (With bouquet of brake master cylinders with different diameters) to comply with rule book requirements. In addition to this, adherence to installation requirements involves customized tools, jigs and fixtures.

16. **Brake Proportioning Valve(s) for Rear**: OEMs certified valves are available in the market. Teams to pick one to suit their requirements.

17. **Adjustable Brake Proportioning Valve(s) for Rear are NOT RECOMMENDED**, being complex and tedious.

18. **Teams are recommended to use lubricants at actuating members** to ensure swift response and faster return characteristics.

19. **Focus on Cost Management / Cost Efficiency**: It is observed that Expensive/Exclusive Imported parts were extensively used by teams. Teams are advised to make use of OEM parts manufactured in India for brakes system and thereby control the cost.

20. **Reference values for brake calculations**:
   * Dynamic test speed: 40.0 KMPH
   * Design Deceleration for Dynamic Brake Test: 0.8 g
   * Stopping distance: 8 Meters (26 feet)
   * Tyre to road adhesion or Coefficient of Friction: 0.7