



AUTONOMOUS BAJA(aBAJA) SAEINDIA 2024

2024 Collegiate Design Series

Baja SAEINDIA® Rules

DRAFT, 28 May 2023

Applicable for aBAJA event being conducted in 2024

Note: For any clarification on rules/articles mentioned in this draft rulebook, please wait till the release of Final Rulebook on BAJA SAEINDIA Forum.



Foreword

Welcome to aBAJA SAEINDIA 2024

The BAJA SAEINDIA® Rulebook Committee has come up with a new Rulebook for aBAJA for the 2024 season. BAJA SAEINDIA has introduced a new event from the 2024 season which will include building an autonomous vehicle capable of self-driving without a physical driver being present. This competition will witness the teams implementing autonomous driving technologies – including but not limited to pattern recognition, sensing, advanced computation methods, synchronization of sensor data and pattern recognition with software technologies to give controlled mechanical output, etc.

The event aims to upgrade the level of BAJA SAEINDIA competition in line with the new advancements in the field of vehicle technologies worldwide, with specific focus on autonomous vehicles. The participating teams would need to conceptualize, design, build and test an autonomous vehicle capable of self-driving with ability to switch to manual driven as well. This competition shall open new avenues of innovation and learning to the teams.

**Thorough and repeated reading of the rulebook is strongly recommended!
Wishing all the teams' good luck for an exciting BAJA SAEINDIA® season ahead!**

Read the Rules, thoroughly!

Please be sure to refer the [BAJA SAEINDIA® Website](#) and [BAJA SAEINDIA® Forum](#) for all the updates.

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Revision History

Date	Revision	Description	Author
27/05/2023	00	1 st Release – Draft copy	BAJA SAEINDIA Tech Team

i *Read all Rules thoroughly!*

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

Using this Document

 **Important Notes.**

i *Additional information and warnings.*

 *Reference to another article in this document.*

PART A: ADMINISTRATIVE REGULATIONS

ARTICLE A.1: BAJA SAE OVERVIEW

A.1.1 Program History

The BAJA SAE competition series 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.

A.1.2 Collegiate Design Series Objective

SAE International's Collegiate Design Series (CDS) programs prepare undergraduate and graduate engineering students in a variety of disciplines for future employment in mobility-related industries by challenging them with a real-world, engineering application.

Through the Engineering Design Process, experiences may include, but are not limited to:

- Project management, budgeting, communication, and resource management skills
- Team collaboration
- Applying industry rules and regulations
- Design, build, and test the performance of a real vehicle.
- Compete with other students from around the globe.
- Develop and prepare technical documentation.

Students also gain valuable exposure to and engagement with industry professionals to enhance 21st-century learning skills, build their network, and help prepare them for the workforce after graduation.

A.1.3 BAJA SAEINDIA® Program Objective

BAJA SAEINDIA® is an intercollegiate engineering design competition for undergraduate engineering students. The objective 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.

A.1.4 Design Subject

Each team's goal is to design and build a single-seat, all-terrain, sporting vehicle whose driver is contained within the structure of the vehicle. The vehicle is to be a prototype for a reliable, maintainable, ergonomic, and economical production vehicle that 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. The performance will be measured by success in the dynamic events which are described in the BAJA SAEINDIA® Rules and are subject to event-site weather and course conditions.

For the 2024 competition, the aBAJA teams have an option to incorporate 4WD/AWD or 2WD in their design. However, there will no bonus points for opting 4WD/AWD. Demonstration of 4WD/AWD in working conditions is a must.

ARTICLE A.2: COMPETITION INFORMATION

A.2.1 Competitions

SAE International will host up to three competitions within the United States and Canada in a given competition year. Locations will change yearly and are dependent on local support of SAE Sections, Universities, and Sponsor Companies.

Competitions outside the US and Canada include:

- BAJA SAE Brazil – hosted by SAE Brazil
- BAJA SAE Korea – hosted by Yeungnam University
- BAJA SAE South Africa – Sponsored by Sasol and hosted by the Gerotek Test Facility
- BAJA SAE Mexico – hosted by SAE Mexico
- BAJA SAEINDIA – Up to Three Event locations - Sponsored by SAEINDIA

A.2.1.1 BAJA SAEINDIA® Competition

BAJA SAEINDIA® shall be conducted for four vehicle categories:

1. mBAJA – I. C. Engine Vehicle
2. eBAJA – Battery Operated Vehicle
3. hBAJA – Transition from CNG to HCNG to Hydrogen fueled vehicle.
4. aBAJA – Autonomous Vehicle.

BAJA SAEINDIA 2024 Events will be conducted in 3 Phases –

1. Phase 1 - Preliminary Round
2. Phase 2 - Virtual Event
3. Phase 3 - Physical Dynamic Event

- Registrations for the aforementioned event phases would be common.**
- The participation of international teams will be allowed in all three phases of BAJA SAEINDIA 2024.**
- Locations will change yearly and are dependent on local support of SAE Sections, Universities and Sponsor Companies.**
- Please refer [BAJA SAEINDIA Forum](#) for details regarding event dates and schedules.**

A.2.2 Official Announcements

Teams are required to read the articles posted on the [BAJA SAEINDIA® Website](#) and [BAJA SAEINDIA Forum](#) published by BAJA SAEINDIA® Organizing Committee. Teams must also be familiar with all official announcements concerning the competitions and rules clarifications released by the BAJA SAEINDIA® Organizing Committee.

- [BAJA SAEINDIA Forum](#) accounts of the registered teams shall be created, and the credentials shall be shared to their official team e-mail ids given at the time of registration, in due time after the closure of registrations.**

A.2.3 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.

A.2.4 SAEINDIA Technical Standards Access

A list of accessible SAEINDIA Technical Standards can be found in Part G: Appendices - Article 2. For getting access to those standards registered teams may send the specific request to the Knowledge Centre of ARAI Pune / SAEINDIA Western Section Pune at mail id: executive-ws@saeindia.org

ARTICLE A.3: BAJA SAEINDIA® RULES AND ORGANIZER AUTHORITY

A.3.1 Rules Authority

The BAJA SAEINDIA® Rules are the responsibility of the BAJA SAEINDIA® Rules Committee and are issued under the authority of the BAJA SAEINDIA® Organizing Committee. Official announcements from the 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 the BAJA SAEINDIA® Rules Committee, Technical Inspectors, or Organizing Committee during the competition onsite.

A.3.2 Rules Validity

The newest version of the BAJA SAEINDIA® Rules posted on the [BAJA SAEINDIA® Website](#) and [BAJA SAEINDIA Forum](#) and dated for the calendar year of the competition are the rules in effect for the competition. Rule sets dated for other years or older versions of the current year are invalid.

A.3.3 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 the BAJA SAEINDIA® Rules Committee and the 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.

A.3.4 Rules Comprehension

Teams are responsible for reading, understanding, and comprehending 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. Questions regarding rules may be submitted by registered teams through [BAJA SAEINDIA Forum](#).

A.3.5 Rules Questions

A.3.5.1 Privacy

By submitting a rules inquiry on [BAJA SAEINDIA Forum](#), the submitter agrees that both question and the Organizing Committee's/Technical Evaluation Team's answer can be reproduced and distributed by SAEINDIA, in edited versions, in any medium or format anywhere in the world.

A.3.5.2 Duplication

The Organizing Committee/Technical Evaluation Team will answer questions that are not already answered in the rules or FAQs or that require new or novel rule interpretations. For example, if a rule specifies a minimum dimension for a part, the Technical Evaluation Team will not answer questions asking if a smaller dimension can be used.

A.3.5.3 Submission

If a registered team has any Questions regarding rules (except such that can be classified under [A.3.5.2](#)), it can submit the inquiry through [BAJA SAEINDIA Forum](#).

A.3.5.4 Documentation



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

A.3.5.5 Response Time

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

 **Please keep in mind that the final operating approval of any BAJA SAEINDIA® vehicle can only be given onsite at the competition.**

A.3.6 Loopholes

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

A.3.7 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 after the competition or earlier by withdrawing.

A.3.8 Violations of Intent

The violation 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.

A.3.9 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.

A.3.10 General Authority

BAJA SAEINDIA® Organizing Committee reserves the right to revise the schedule of any competition and/or interpret or modify the competition rules at any time and in any manner that is, in their sole judgment, required for the safe and efficient operation of the event or the BAJA SAEINDIA® series as a whole.

A.3.11 Force Majeure

The **BAJA SAEINDIA® Organising Committee** and **SAEINDIA** shall not be held responsible for the non-fulfillment of their obligations as the organizers of the BAJA SAEINDIA® event due to the exigency of one or more of the **Force Majeure** events such as but not limited to the acts of God, war, flood, earthquake, strikes, lockouts, pandemics, epidemics, riots, civil commotion, scarcity of water, electricity or other such basic facilities, etc., and shall inform the participating colleges on the occurrence and cessation of the event within one week of such decision being made. If the Force Majeure conditions continue beyond a reasonable period where running the event is not feasible either due to the Force Majeure conditions or any other reasons, the event may be canceled for the year.

"Force Majeure Events": -

- a. Earthquake, flood, inundation, landslide, storm, tempest, hurricane, cyclone, lightning, thunder, pandemics, epidemics or other extreme atmospheric disturbances, or any other act of God.
- b. Strikes, labor disruptions, or any other industrial disturbances not arising on account of the acts or omissions of the organizers, war, hostilities (whether declared or not), invasion, the act of a foreign enemy, terrorism, rebellion, riots, weapon conflict or military actions, civil war, ionizing radiation, contamination by radioactivity from nuclear fuel, any nuclear waste, radioactive toxic explosion, volcanic eruptions or other such occurrences beyond the control of the organizers.



- c. Acts of expropriation, compulsory acquisition, or takeover by any government agency of the said venue where the event is to be held or any part thereof.
- d. Any prohibitory order of any Court.

A.3.12 Protests and Appeals

It is recognized that hundreds of hours of work are put into the design and construction of a vehicle. In the heat of competition, emotions may peak, and disputes can arise. The BAJA SAEINDIA® Organising Committee will make every effort to fully review all questions and resolve problems quickly and efficiently.

A.3.12.1 Preliminary Review

If a team has a question about scoring, judging, policies, or any official action it must be brought to the attention of the Convener/Joint Convener (this may be designated) of the BAJA SAEINDIA® for an informal preliminary review.

A.3.12.2 Cause

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

A.3.12.3 Format and Forfeit

All protests must be filed in writing and presented to the relevant committee (there will be three committees - Technical Evaluation Committee, Static Events Committee, and Dynamic Events Committee) by the team captain or a designated student team member. 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.

 **Any of the above-designated committees of BAJA SAEINDIA, judges, or volunteers will not review any video footage as part of the protest.**

A.3.12.4 Protest Period

Protest related to the Event

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

Protest related to Scores

Protests concerning scores awarded to the teams in any of the events of the BAJA SAEINDIA competition must be filed within 30 minutes of the scores released on the BAJA SAEINDIA Forum.

 **The Scores will be released on BAJA SAEINDIA Forum only between 9:00 am and 9:00 pm IST. Teams are required to check BAJA SAEINDIA Forum regularly for any updates about the event or scores.**

A.3.12.5 Hearing

The time of protest will be noted and decided upon by the designated committee.

A.3.12.6 Decision

The decision regarding any protest is final.

ARTICLE A.4: PARTICIPATION REQUIREMENTS

A.4.1 Students

A.4.1.1 Eligibility

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

A.4.1.2 Student Status

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

A.4.1.3 Society Membership

Members of Indian Teams must be members of SAEINDIA (<https://saeindia.org/become-a-member/>).

It is mandatory for members who are enrolling for a new SAEINDIA Membership to select the current year+1 year type exclusively.

The SAEINDIA Membership year for new enrolment is considered from April 1st 2023 to March 31st 2024.

In case any BAJA SAEINDIA 2024 event takes place after 31st March 2024, registered SAEINDIA members whose membership is expiring will be considered participants only, if they have submitted their SAEINDIA membership cards before March 31st, 2024. This policy is applicable to already registered SAEINDIA members only.

Members of International Teams must be members of at least one of the following societies

- Local automotive associations like the Institution of Automotive Engineers, etc.
- SAE International ([SAE International](#)) or an SAE International affiliate society
- FISITA ([Join FISITA](#)) or societies that are members of FISITA ([FISITA Society Members](#))

 **In case any team willing to participate is not a part of any of the associations listed above, they must write to BAJA SAEINDIA® Organizing Committee at bajasaeindiacommunications@saeindia.org with a copy to saeindiaindore@saeindia.org for further clarification.**

Proof of membership, such as a valid membership card is required while registering for the event and also needs to be produced during the event to participate in the BAJA SAEINDIA® competition.

For more information regarding society membership, please contact saeindiaindore@saeindia.org (For SAEINDIA) or collegiatecompetitions@sae.org (For SAE International).

A.4.1.4 Age

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

A.4.1.5 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.

A.4.1.6 Indemnity Bond

All on-site participants and faculty are required to bring a notarized indemnity bond to be submitted at the time of registration on-site. All the members and faculty to be present on-site are required to sign the indemnity bond.



A.4.1.7 Insurance

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

A.4.2 Faculty Advisors

A.4.2.1 Faculty Advisor Status

Each team is expected and encouraged to have at least one and a maximum of two Faculty Advisors appointed by the college/university. The faculty advisor/s will be considered by competition officials to be the official university representative accompanying the team. Their presence during the competition is **mandatory** for all the event days on-site.

Faculty advisor/s of the participating Indian Teams must be members of SAEINDIA (<https://saeindia.org/become-a-member/>).

Faculty advisor/s of International Teams must be members of at least one of the following societies

- Local automotive associations like the Institution of Automotive Engineers, etc.
- SAE International ([SAE International](#)) or an SAE International affiliate society
- FISITA ([Join FISITA](#)) or societies that are members of FISITA ([FISITA Society Members](#))

 **In case any team willing to participate is not a part of any of the associations listed above, they must write to BAJA SAEINDIA® Organizing Committee at bajasaeindi.communications@saeindia.org with a copy to saeindiaindore@saeindia.org for further clarification.**

 **It is mandatory for faculty advisor(s) to accompany the team during the physical dynamic event and at least one Faculty Advisor must be present with the team for the entire event duration, the absence of which will lead to a penalty of 100 points, as per the discretion of BAJA SAEINDIA® Organizing Committee.**

A.4.2.2 Age

Faculty Advisors must be at least eighteen (18) years of age at the time of the competition.

A.4.2.3 Indemnity Bond

All on-site participants and faculty are required to bring a notarized indemnity bond to be submitted at the time of registration on-site. All the members and faculty to be present on-site are required to sign the indemnity bond.

A.4.2.4 Faculty Advisor Responsibilities

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

- Advise, review, and monitor the progress of the team for the overall design, development, manufacturing, and testing of the BAJA vehicle.
- Ensure the safety of the vehicle and facilitation of in-house manufacturing within the college premises.
- Support and assist the BAJA SAEINDIA® Organizing Committee to conduct the event peacefully and in case of any disputes arising during the competition, help to resolve those.
- Accompany the team at the main event site and be present with the vehicle during technical evaluation, brake test, static events, and dynamic events.

A.4.2.5 Faculty Advisor Limitations

Faculty advisors must not design any part of the vehicle or any system of the 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 may remain present during the technical inspection, cost audit, or design presentations. The team captain or other designated members of the team must do all the presenting work. However, Faculty Advisors may silently observe the process and work towards improvement in future participation years of the college/university.

Faculty Advisors cannot get involved directly in the design, build or repair of any part of the vehicle.

A.4.3 Visa Requests

International Teams can request a Registration Confirmation Letter for the individual event(s) that they will be attending, by sending an email to bajasaeindiacommunications@saeindia.org. In response to the same, they shall be provided personalized letter/s with the following information: Registered Student's Name, School's Name, the BAJA SAEINDIA® Event Name, Official Dates, and Location(s).

Caution: SAEINDIA cannot and will not intervene with, call or send personal letters to, the State Departments, Embassies, or Consulates of India or other governments on behalf of any meeting or event participant.

Caution: Apply early for visas.

Neither SAEINDIA staff nor any competition organizers are permitted to advise on visas, customs regulations, or vehicle shipping. Nor will they intervene on either matter concerning India or any other country.

ARTICLE A.5: VEHICLE ELIGIBILITY

A.5.1 Student Created

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

A.5.2 Professional Fabrication Limits

- Without exception, only those teams whose college management gives an undertaking allowing the use of their 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 and assemble the vehicle as per the design presented in the Preliminary Round of the BAJA SAEINDIA® event.
- During the actual manufacturing and fabrication process, the video clips that cover students working in a college facility need to be taken and written on a CD/ downloaded on a pen drive, to be furnished anytime throughout the project. The video clip is required to cover each of the manufacturing processes carried out in college.
- 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 a case, the registration fee would NOT be refunded.
- During the main event if any team is found to be receiving outside assistance at the event site, the team will be penalized with 100 points at the first incident and subsequent act will lead to Disqualification from the event.

A.5.3 Kit Vehicles Prohibited

Vehicles fabricated from a kit or published designs are ineligible to compete. Vehicles that have been professionally fabricated will be disqualified from the competition or receive a penalty. In case a team does not have access to machine shop facilities, the frame can be professionally fabricated without a penalty attached. Lack of access must be documented (letter from the faculty advisor, copy of policies that prohibit machine shop access, etc.).



A.5.4 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 prefabricated parts that may be allowed is – shock absorbers, coil springs, brake drum, brake disc, brake calipers, brake holding assembly, master cylinder, steering gear box, and steering column, steering wheel, wheel rims and 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 manufacturers/ designers.

Any outsourcing must be reflected in the cost report with supporting receipts from the outsourcing vendor.

A.5.5 Bills and Document

For all procured items, teams must submit original tax invoices. In case of an electronic copy of bills, the team **MUST** carry a printed copy signed by the Faculty Advisor, HOD, and Accounts Department of College, along with the college's stamp on it.

- For items whose original bills are retained by college authorities; teams must submit photocopied bills signed by the Faculty Advisor, HOD, and Accounts Section of the College, along with the college's stamp on them.**

A.5.6 Vehicle Usage Restrictions

Team must make a note that, the BAJA SAEINDIA® competition vehicles are not CMVR approved vehicle to ply on public road. Therefore, the testing and usage on public road is strictly prohibited. This means that none of the teams will test or make a trial on public road and public places/grounds, etc. The legal compliance is strictly team's responsibility and SAEINDIA or BAJA SAEINDIA® Organizing Committee is not responsible for any non-compliances or any implications of violation by any team.

ARTICLE A.6: REGISTRATION

A.6.1 Individual Registration

A.6.1.1 SAE Membership

A.6.1.1.1 SAEINDIA Membership (For Indian Teams)

Please note all student participants and faculty advisors of Indian teams must be SAEINDIA members to participate in the event.

All participating Institutes from India must have an operational SAEINDIA collegiate club with at least 50 active student members and 2 faculty advisors. ([SAEINDIA Collegiate Club Formation Guidelines](#))

For membership of student's/faculty advisors with SAEINDIA, visit - <https://saeindia.org/become-a-member/>

Faculty advisors should choose an option under the "Professional Registration" link.

A.6.1.1.2 SAE International Membership (For International Teams)

Please note all the student participants and faculty advisors of International Teams must be members of at least one of the following societies:

- Local automotive associations like the Institution of Automotive Engineers, etc.
- SAE International ([SAE International](#)) or an SAE International affiliate society

For membership of students with SAE International, visit - [SAE International](#) and click Join Today

Faculty advisors should choose an option under the "Professional Membership" link - [SAE International](#)

- FISITA ([Join FISITA](#)) or societies that are members of FISITA ([FISITA Society Members](#))

- In case any team willing to participate is not a part of any of the associations listed above, they must write to BAJA SAEINDIA® Organizing Committee at bajasaeeindiacommunications@saeindia.org with a**



copy to saeindiaindore@saeindia.org for further clarification.

A.6.2 Team Registration

A.6.2.1 Online Registration

Registration for the BAJA SAEINDIA® event held in India must be completed online on the [BAJA SAEINDIA Website](#). Online registration must be done by either (a) An SAEINDIA or SAE International (For International teams) or a member of other allowed societies (for international teams) or (b) the official faculty advisor connected with the university and recorded as such in the SAEINDIA or SAE International (For International Teams) or any other allowed societies (for international teams) record system.

An active SAEINDIA collegiate club is required for the Indian colleges to register the team. Also, the collegiate club should have an active SAEINDIA collegiate bank account and bank details must be available before the competition.

A.6.2.1.1 International team registration

Teams interested to participate in BAJA SAEINDIA®, shall visit the [BAJA SAEINDIA Website](#) and register as per the latest version of BAJA SAEINDIA® Registration Guidelines for the calendar year.

A.6.2.1.2 Multiple Event Participation

Teams willing to participate in more than one event of BAJA SAEINDIA with same team members can refer the below enclosed table.

Sr.No.	College Participating in	Common Team Members
1	mBAJA & hBAJA	Not Allowed
2	eBAJA & aBAJA	
3	mBAJA & eBAJA	
4	mBAJA & aBAJA	Allowed
5	eBAJA & hBAJA	
6	hBAJA & aBAJA	

*Only mBAJA and hBAJA Teams are not allowed to register common team members.

A.6.2.1.3 Onsite Registration

An Onsite verification will be done during phase 3 of the BAJA SAEINDIA event.

- i. Teams need to submit the indemnity bond on the [BAJA SAEINDIA Website](#). The format of the indemnity bond will be shared on [BAJA SAEINDIA Forum](#) closer to the event dates.
- ii. After verification teams will receive a confirmation mail about the successful online submission of documents.
- iii. The teams need to carry the printout of the successful online submission confirmation mail and submit it at the respective registration bay as per the slotting.
- iv. Any member of the team can submit the confirmation mail printout along with the indemnity bond, and letter of deviation if applicable and obtain their respective registration kit.

A.6.2.2 Team Size

Team Members	5 [Minimum]	25+5* [Maximum]
Faculty Advisors	1 [Minimum]	2 [Maximum]

- *To promote diversity amongst the teams; If the team has reached the 25 members limit, they can add 5 more girl team members without any additional amount in the registration fee. Thus, the number of total team members in such a case should not exceed 30.



- Registration of multiple teams from the same college on different event format will be allowed for BAJA SAEINDIA 2024 event under different heads.
- It is mandatory for faculty advisor(s) to accompany the team during the main physical event and a minimum of 1 Faculty Advisor must be present with the team for the entire event duration.
- eBAJA/aBAJA teams must contain a minimum of 2 members & maximum of 12 members from Electrical/ Electronics/ Instrumentation/ Mechatronics / Computer science and/or other similar backgrounds to successfully complete the registration process.
- eBAJA teams who participated in 2022 & 2023, or have registered for 2024 event can participate in aBAJA along with old/current eBAJA vehicle/s.
- **aBAJA and hBAJA teams can comprise of members pursuing undergraduate and postgraduate studies from the same college/institution / Deemed University within 25 members' limit.**

Note: - This is being done in line with the advent of Autonomous drive technology in the Automotive Industry, undergoing disruption is to learn towards latest trends in Mobility industry. Hence, BAJA SAEINDIA has taken this initiative to promote inter-disciplinary engineering among the teams.

 **Teams are advised to take proper care while forming the team before initial registration for Preliminary Round and refrain from further modification at a later date. Before Phase 1 Teams have to register atleast 5 Team members and 1 Faculty Advisor. Post Phase 1 Profile of all teams will be unlocked for 1 week for addition of remaining Team Members and Faculty Advisor. Exceptional cases such as death, natural calamity, etc. shall be dealt with separately. In such cases a letter on the Institution's/College's letterhead with a declaration from the Institution's 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.**

A.6.2.3 Registration Dates

Teams must register for the BAJA SAEINDIA® competition by the specified date as published in the latest version of BAJA SAEINDIA® Registration Guidelines for the calendar year.

A.6.2.4 Registration Fees

Registration fees must be paid to the organizer by the deadline specified on the latest versions of Registrations Guidelines for the calendar year. Registration fees are not refundable and not transferrable to any other competition. Registration fees for the BAJA SAEINDIA® event are taken in two phases, please refer to the latest version of BAJA SAEINDIA® Registration Guidelines at the time of registration.

The registration fee for BAJA SAEINDIA® must be paid through payment mode as mentioned in the latest version of BAJA SAEINDIA® Registration Guidelines at the time of registration. The exact deadlines for the payment of registration fees for each event phase shall be notified to the teams at the pertinent time, while the requisite fees to be paid for each event phase shall be as stated in the Registration Guidelines.

Registration fees are NOT refundable or transferable.

GST is applicable @ 18% for the registration fees and non- refundable, which means once SAE India collects the GST, the same will be remitted to the Government within the due date and not be returned to the teams under any circumstances GST invoice will be issued in the below two types

- Unregistered category (B to C) for which the college cannot avail ITC (Input Tax Credit)
- Registered Category (B to B) for which college can avail ITC – The respective college needs to submit the GST registration certificate details immediately after the registration to the email ID - praveen@saeindia.org as SAE needs to issue E-Invoice for the same. If there is a delay in the communication, SAE will treat the registration as Unregistered category and remit the GST to the government within the due date and cannot convert into B to B category



A.6.2.4.1 Registration Fees Waiver

- BAJA SAEINDIA aims to promote diversity by offering a waiver in the registration fee to encourage more girls to participate in the event. There would be a 50 % fee waiver in the registration fee at each phase for an All-Girls Team.
- Early Bird Offer: Teams who register and pay the fees for aBAJA or hBAJA event before a particular due date i.e., 31st May 2023 will get 5,000/- discount in registration fee for Phase 2 & 3.
- If an eBAJA team from a particular college is participating in the BAJA SAEINDIA 2024 event, then its aBAJA team (from the same college & same location) will get a 40% discount in the aBAJA registration fee of Phase 2 & 3.

A.6.2.5 Withdrawals

Registered teams for the BAJA SAEINDIA® events that determine they will not be able to attend the competition are required to officially withdraw by emailing bajasaesiadcommunications@saeindia.org with a copy to saeindiaindore@saeindia.org no later than 15 days before the event. Registration fees are NOT refundable or transferable.

A.6.2.6 Failure to Meet Deadlines -

All teams registered for the BAJA SAEINDIA® competition are required to submit all required documents before the competition. The required documents provide evidence their car complies with the frame rules, supports the technical inspection process, and provides material that the Cost and Design event judges need to evaluate the team during the competition. When these documents are not submitted, the judges cannot properly assess the vehicle or the team.

Additionally, failure to submit the required Cost, Design, Business Presentation Plan, and Technical Documents is a clear violation of the rules. Any blank document submitted to subvert the submission date will be treated as a failure to submit.

Therefore, it is the policy of BAJA SAEINDIA® that failure to submit the required Cost, Design, Sales Presentation Plan, or technical documents within five (5) days of the deadline will constitute an automatic withdrawal of your team from the respective static event.

A.6.2.7 International Participation – Vehicle Shipping and Customs

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

Vehicle shipments by the commercial carrier must comply with the laws and regulations of the 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, SAEINDIA Staff, nor the competition sites can be listed as the receiving party for your vehicle.

The vehicle shipping procedure for the BAJA SAEINDIA® competition shall be published on the [BAJA SAEINDIA Forum](#) and is incorporated into these rules by reference. Neither BAJA SAEINDIA® Organizing Committee nor SAEINDIA staff is permitted to provide advice on Indian Custom matters.



A.6.2.8 Mentoring

After successful registration, aBAJA teams will be assigned mentors for advising the teams on autonomous vehicle design, manufacturing and testing. Mentors shall guide the teams on sound engineering practices, application of various technologies that need to be integrated with the mechanical components of the vehicle in order to make it truly autonomous, and understanding of the rulebook, etc. Mentors will not directly assist the team in designing, manufacturing or testing, and only provide advisory inputs as and when required by the teams.

ARTICLE A.7: REQUIRED EVENT SUBMISSIONS

A.7.1 Required Event Submissions

All required reports or other documents and/or files shall be submitted through the [BAJA SAEINDIA Website](#). The standard forms and/or templates and/or guidelines that are required for documentation and submissions at BAJA SAEINDIA® competitions shall be posted on [BAJA SAEINDIA Forum](#).

A.7.1.1 Responsibilities and Restrictions

There will be only a single account for a team on the [BAJA SAEINDIA Website](#).

Uploading Documents - All the requisite documents and/or files can be submitted by the team only once on the [BAJA SAEINDIA Website](#). Teams to note that once submitted, they cannot replace or change the submitted documents and/or files.

Document Access - Uploaded documents can only be viewed by (1) members of the submitting team, (2) authorized judges, technical inspectors, and officials, and (3) BAJA SAEINDIA® staff.

Reminder - The website does not know what is intended for submission or what the submitter is thinking. Anything a team uploads to the site is considered to be an official action by the team.

A.7.1.2 Process

Teams competing in BAJA SAEINDIA® competitions must submit the required documents and/or files online through the [BAJA SAEINDIA Website](#).

Documents and/or files must be uploaded on the website from the time submission is started until the "No Submissions Accepted After Date" (which is 5 days after the due date).

A.7.1.3 Deadline

Submissions must be received by the due date listed on the [BAJA SAEINDIA Forum](#) and/or [BAJA SAEINDIA Website](#).

Submission will be acknowledged on the [BAJA SAEINDIA Website](#) with a visual indicator. Teams should have a printed copy of this acknowledgment available at the competition as proof of submission in the event of a discrepancy.

A.7.1.4 Late Submission / Non-Submission Penalty

Late submission or failure to submit the Design Report and/or Sales Presentation Plan and/or Cost Report and/or any other required submissions will be penalized up to ten (10) points per day, as per the discretion of the BAJA SAEINDIA® Organizing Committee. If either report is received more than five (5) days late it will be classified as "Not Submitted" and will constitute an automatic withdrawal of your team from the **respective static event**.



PART B: TECHNICAL REQUIREMENTS

ARTICLE B.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 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 following good engineering and construction practices.

B.1.4 All-Terrain Capability

B.1.4.1 Terrain Type

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

B.1.4.2 Clearance and Traction

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

B.1.5 Vehicle Configuration

B.1.5.1 Wheel Arrangement

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

B.1.5.2 Four-Wheel Drive / All-Wheel Drive

For the 2024 competition, the aBAJA teams have an option to incorporate 4WD/AWD or 2WD in their design. However, there will no bonus points for opting 4WD/AWD. To be considered a 4WD/AWD vehicle, the vehicle must have a powertrain system capable of providing power to all its wheels. 4WD/AWD may be full-time (AWD) or selectable (4WD); selectable AWD/ 4WD implies provision in a vehicle to switch between 4WD and 2WD. Both wheels on the front and rear of the vehicle shall be capable of being powered. Demonstration of 4WD/AWD capability in working conditions is a must.

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.

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



ARTICLE B.2: ROLL CAGE

B.2.1 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 a collision or rollover.

- Teams must build a new roll cage every year, teams using roll cage from previous competitions will not be allowed for the main event. The roll cage MUST have a unique signature on the RRH member of the roll cage, refer to 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 24161, car number 87 participating in BAJA SAEINDIA 2024 has the roll cage signature as,

24161 / 2024 / 087

Teams may reuse TYRES, shock absorbers/fox suspension, CVT, and driver's seat for a maximum period of three years. However, for every event, the original invoice needs to be showcased to the TEJ team at the competition site.

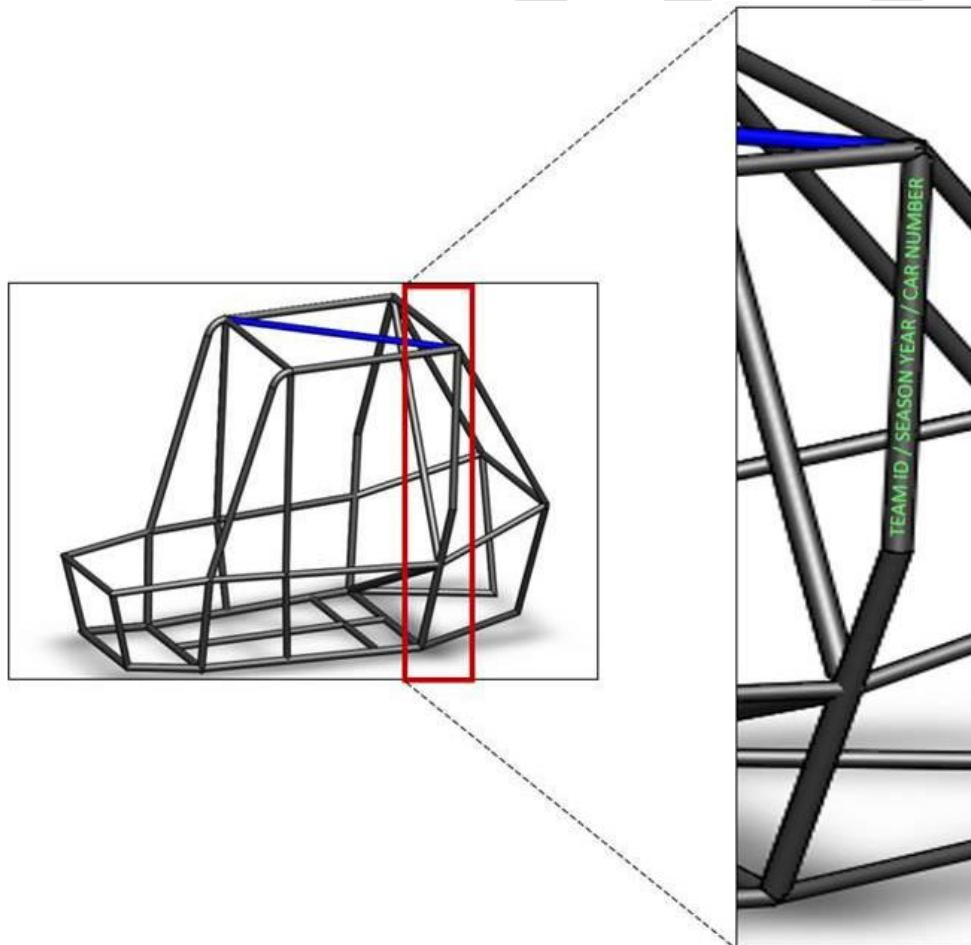


Figure B- 3: Roll Cage Signature

The signature on the roll cage is to be stamped using a 6 mm (0.25 inch) sized number punch. Refer to Figure B-4 for a tool that can be used for stamping.



Figure B- 4: Tool to be used for Roll cage Signature

B.2.2 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 to prevent inspection. Roll Cage Members that are bent must not exhibit any wrinkles, kinks, or any detrimental deformation to the cross-section. The 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 are used to protect the driver.
- **Member:** A Primary or Secondary required element beginning and ending at Named Points.
- **Named Point:** The intersection of the centerlines of two or more joining members.

B.2.2.1 Member Requirements

Roll cage members must be made of steel tubes 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.2.2.4 - 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.2.2.4 - 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 centrelines, 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.2.2.14 - 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.

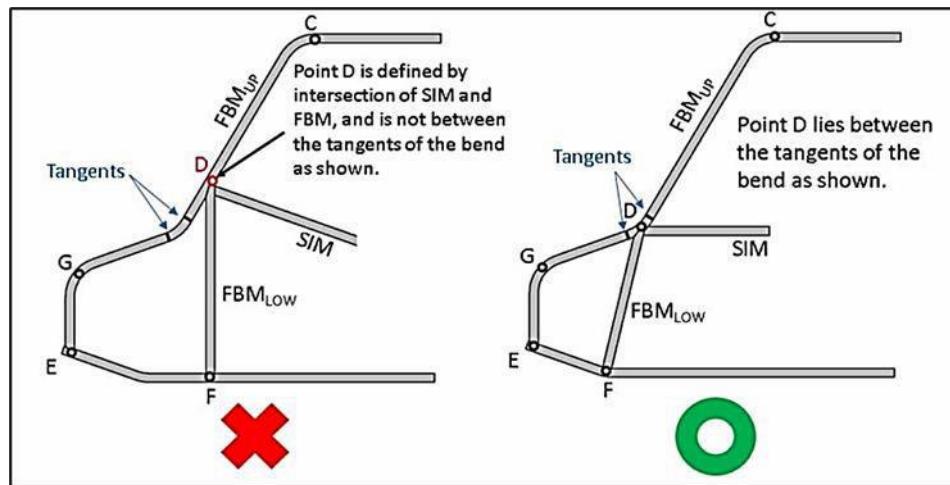


Figure B- 5: Roll Cage, Bend and Member Termination

B.2.2.2 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.2.2.16 - Roll Cage Materials.

Primary members are: -

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

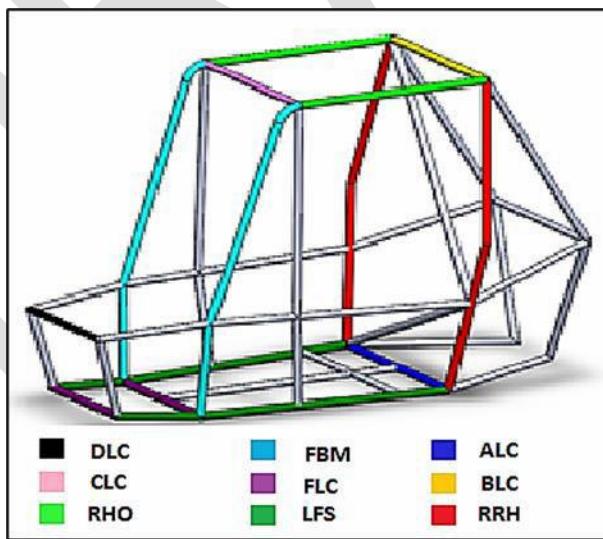


Figure B- 6: Roll Cage, Primary Members

B.2.2.3 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).

- LDB Lateral Diagonal Bracing
- SIM Side Impact Members
- FAB Fore/Aft Bracing Members
- USM Under Seat Member
- RLC Rear Lateral Cross Member
- Any tube that is used to mount the safety belts or fuel tank or protect the fuel system.

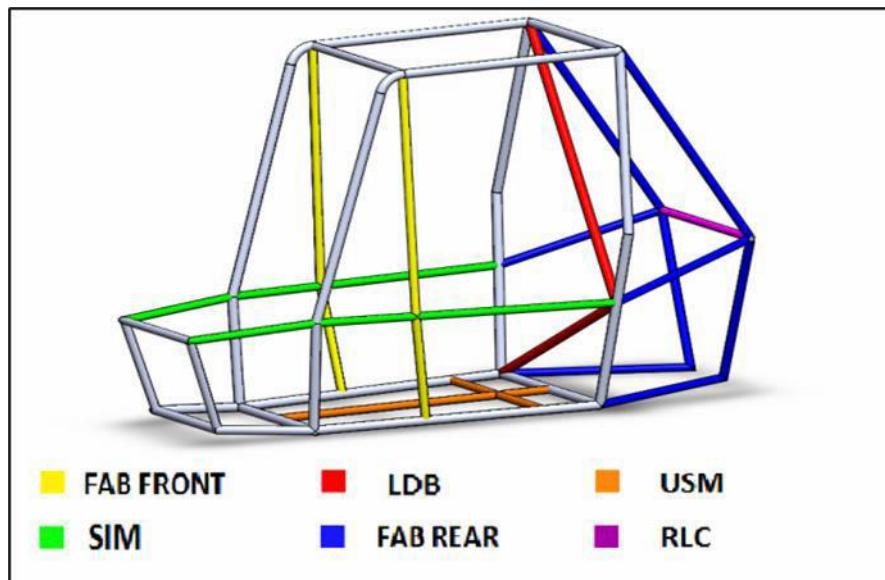


Figure B- 7: Roll Cage, Secondary Members

- The ends of the ALC member should be extended and left open for measurement purposes of the pipe cross-section.
- Any one member in the engine compartment area should also be left open for the same purpose.
- Colour coding is given only for a better understanding of the design and not to be related to primary and secondary members.

B.2.2.4 Additional Support Members

For bent or straight Primary 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. If Additional Support Members are used, the supported Roll Cage Member will be evaluated for length and/or additional bends between the Named Point and the location of the Additional Support Member. At no time may a bent member have a bend greater than 30°.

For bent or straight Secondary Roll Cage Members that exceed the maximum allowable length or bend angle, additional support members may be added. For members that exceed only the allowable length OR the allowable bend angle a single additional support member is required as described below. For members that exceed both the length AND bend angle limits, two additional support members are required as described below.

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.

SECONDARY MEMBERS ONLY			
Bend Angle \ Length	$\leq 838\text{mm (33in)}$	$>838\text{mm (33in) & }<1016\text{mm (40in)}$	$>1016\text{mm (40in)}$
0°	No Supports Required	No Supports Required	1 Support Member Required*
$\leq 30^\circ$	No Supports Required	1 Support Member Required*	1 Support Member Required*
$> 30^\circ$	1 Support Member Required**	2 Support Members Required**	2 Support Members Required**

* Required within 50mm (2in) of the midpoint of the overall tube length

** Required within the tangents of the bend

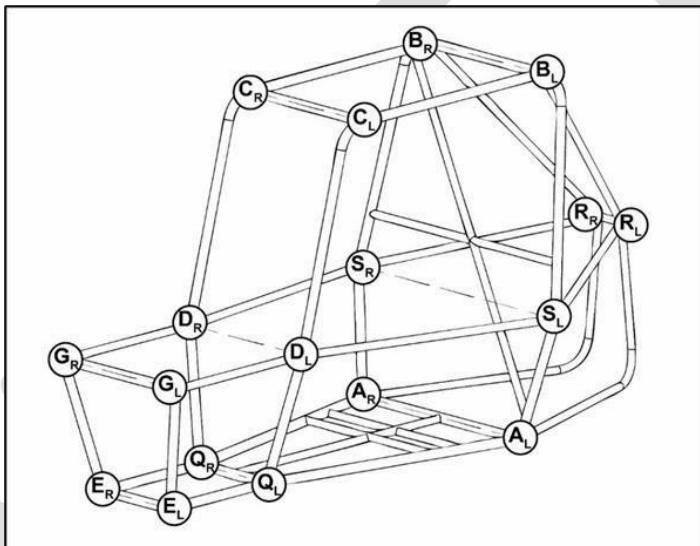


Figure B- 8: Roll Cage, Named Roll Cage Points, Rear Braced Frame.

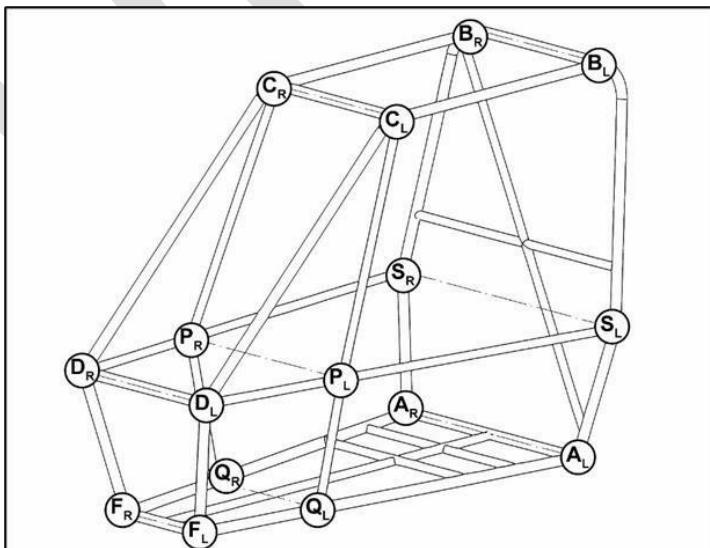


Figure B- 9: Roll Cage, Named Roll Cage Points, Front Braced Frame

B.2.2.5 LC-Lateral Cross Member

Lateral cross members cannot be less than 203.5 mm (8 in.) long. LCs 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) must be made of primary materials and shall meet the minimum required lengths. LCs 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.

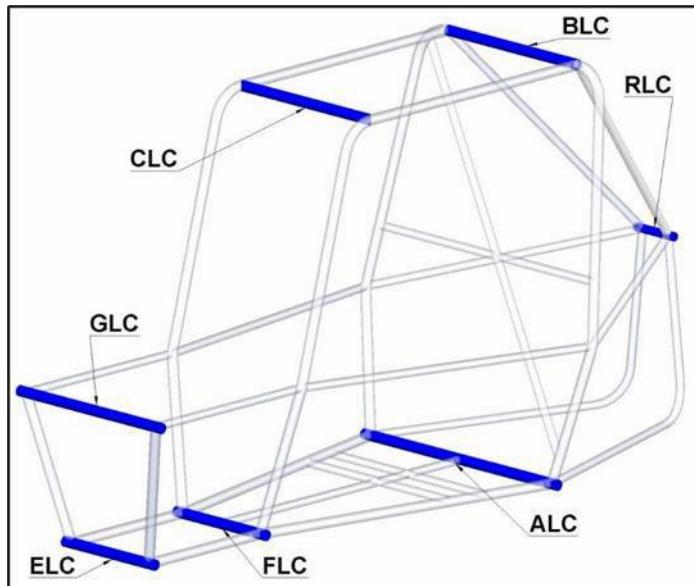


Figure B- 10: Roll Cage, LC

 **ALC member minimum length requirement should be 457mm (18in) and does not fall under the above clause of (8in) requirement.**

B.2.2.6 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, the minimum width of the RRH measured 14 above the inside seat bottom should be a minimum of 32 inches. 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.2.2.14 - Butt Joints. ALC, BLC, RRH members, LDB, and the shoulder belt tube must all be coplanar.

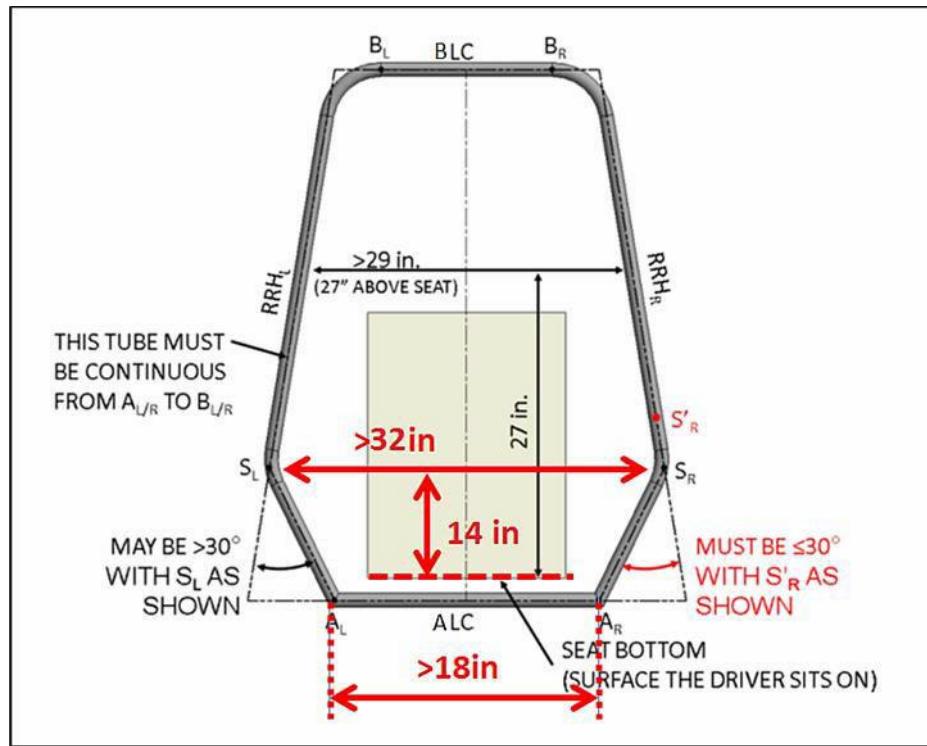


Figure B- 11: Roll Cage, RRH

B.2.2.7 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.2.2.1 - Member Requirements.

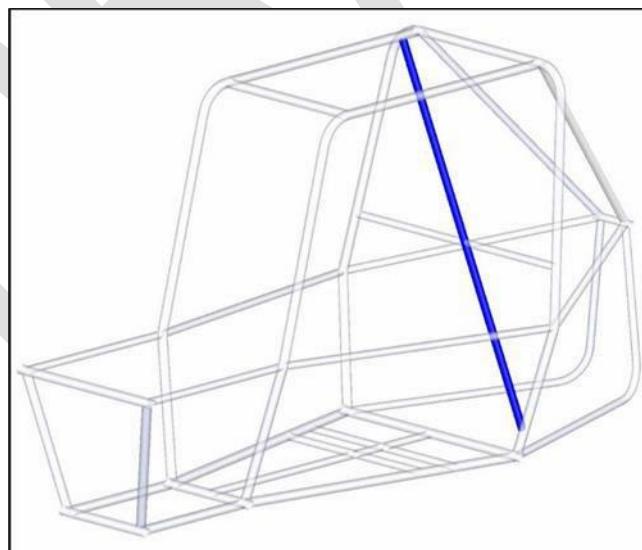


Figure B- 12: Roll Cage, LDB

- If more than one member is used for LDB (as shown in Figure B-13), both members must meet at the same point.

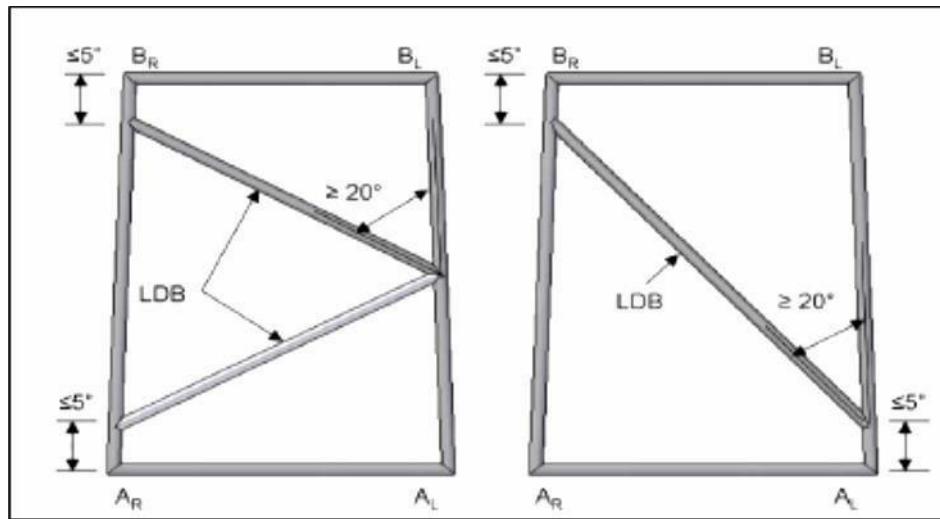


Figure B- 13: Roll cage, LDB

B.2.2.8 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.

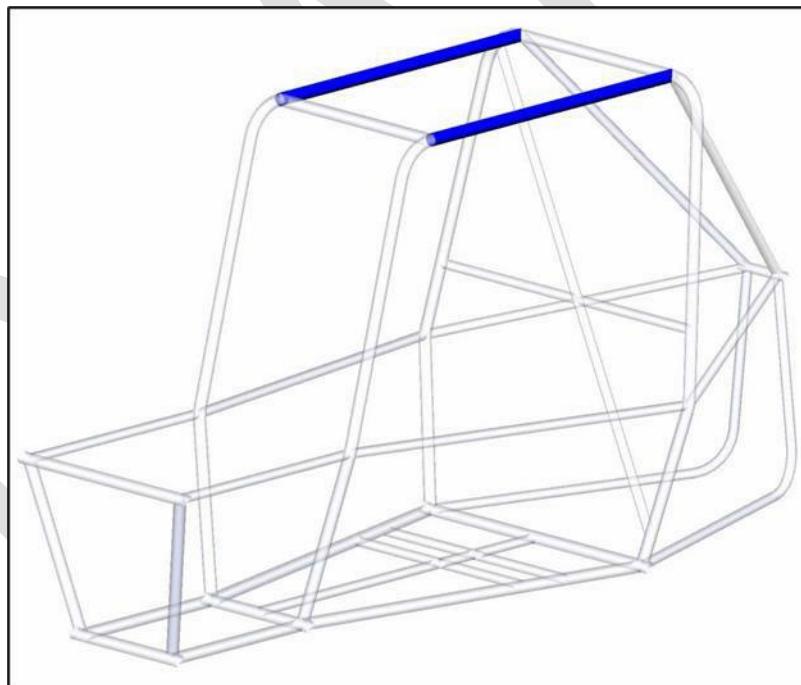


Figure B- 14: Roll Cage, RHO

When a bend is used at Point CR/CL or BR/BL these points are defined at the start of the bend on the top-most plane of the Roll Cage. The ends of the BLC define the location of points BL and BR. For cars constructed with bends at the top of the RRH, point B shall be on the inside end of the bend. Point B may not reside on the bend or a linear distance from the end of the bend.

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 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.2.3.1 - Lateral Space.

The top, longitudinal edge of the template shall be oriented exactly horizontally to gravity.

The two RHO members must be braced using a diagonal member confirming 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 the vehicle's longitudinal axis.

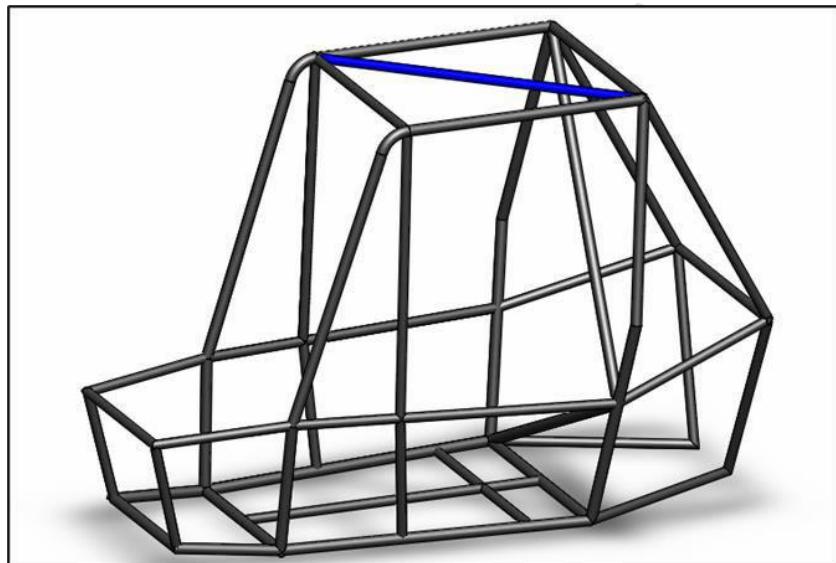


Figure B- 15: Diagonal Bracing for RHO members

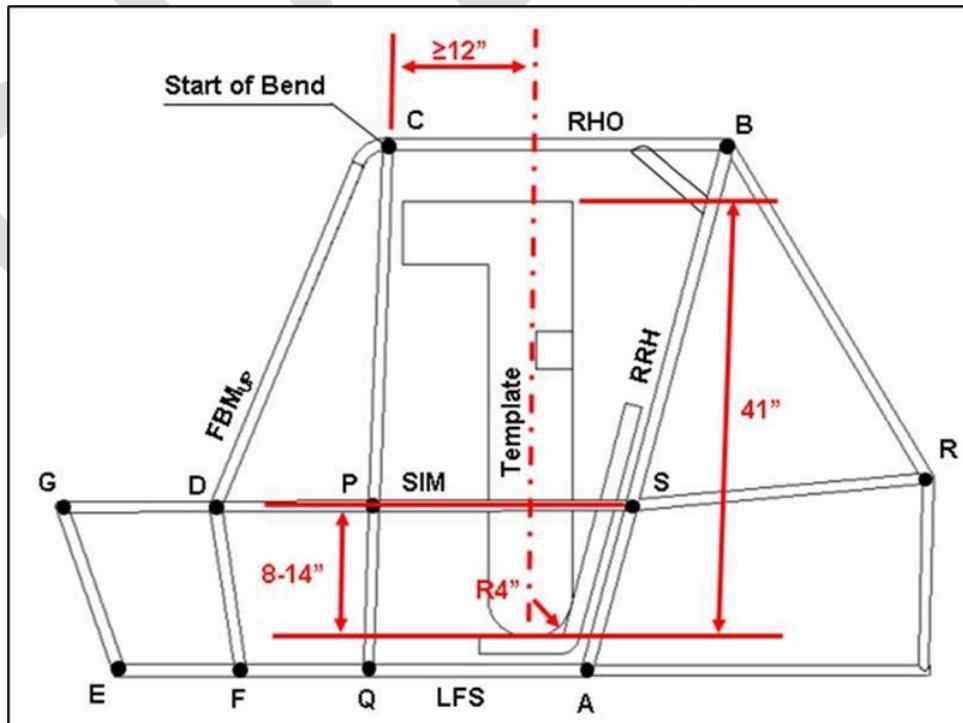


Figure B- 16: Roll Cage, Template Installation

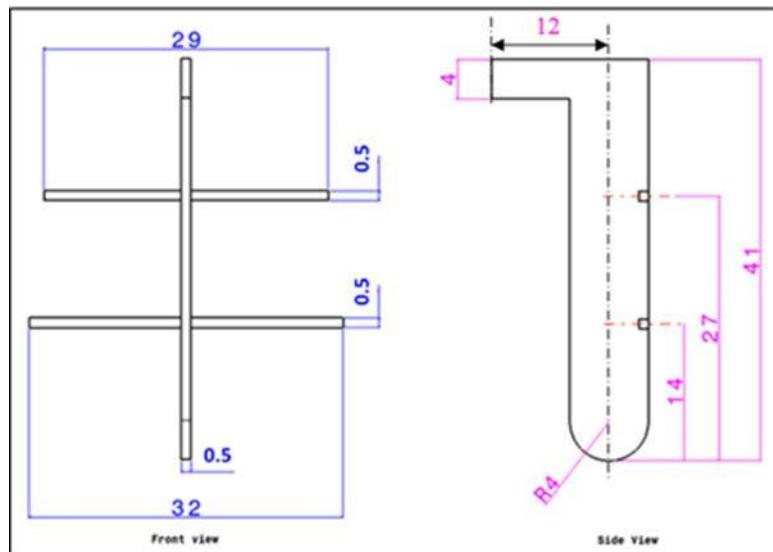


Figure B- 17: Roll Cage Template Drawing (All Dimensions are in inches)

B.2.2.8.1 Gussets for Lateral Clearance

If a gusset is used to brace the RHO and RRH to achieve the Lateral Clearance in Rule B.2.3.1 - Lateral Space the added members must be a primary material (B.2.2.16 - Roll Cage Materials); completely welded around the circumference of both ends of the gusset.

Gusset members connecting the SIM to RRH or FBM to achieve the Lateral Clearance in Rule B.2.3.1 - Lateral Space may be primary or secondary material (B.2.2.3 - Secondary Members) and must be closed in with Body Panels per Rule B.6.5 - Body Panels

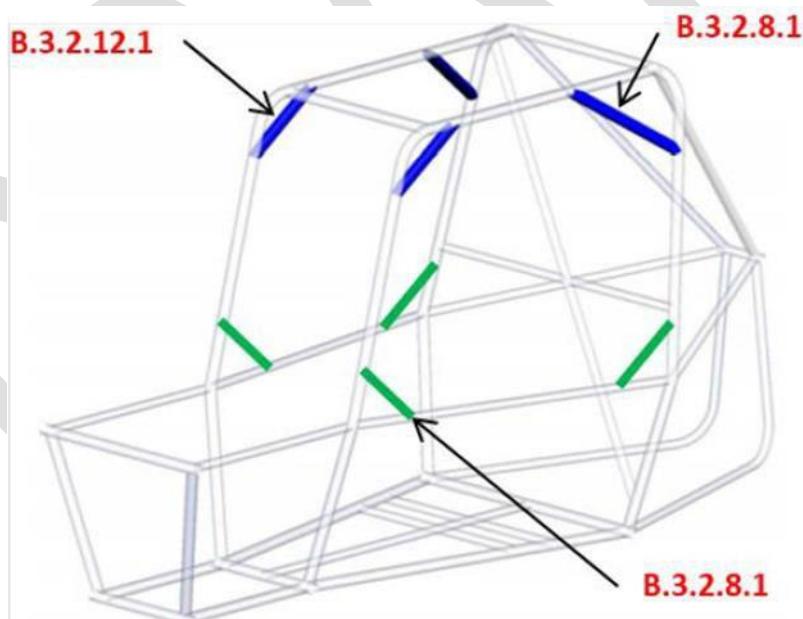


Figure B- 18: Roll Cage, Gussets

B.2.2.9 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 heel, when seated in a 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 defines 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).

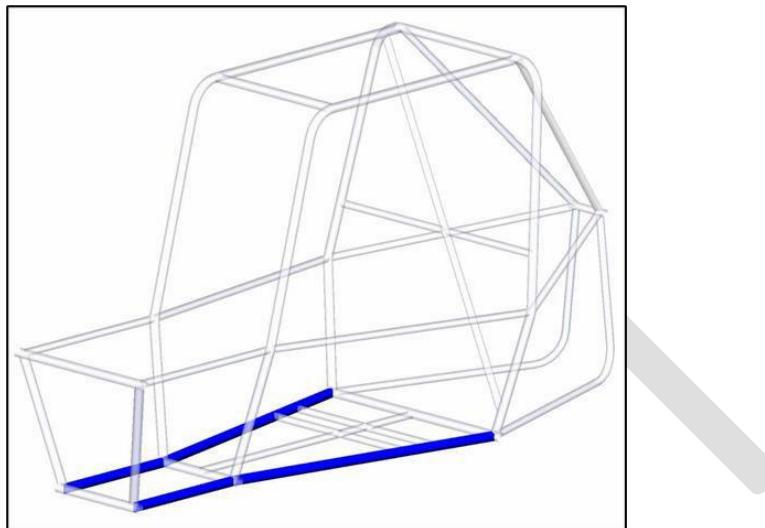


Figure B- 19: Roll Cage, LFS

B.2.2.10 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 toe, when seated in a 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 defines 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.

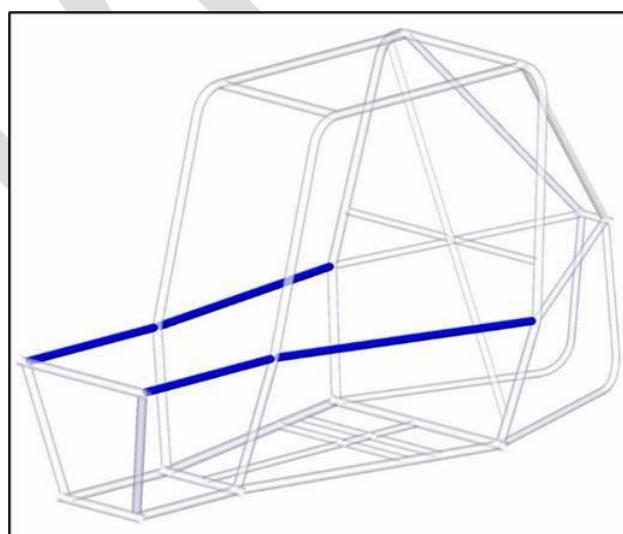


Figure B- 20: Roll Cage, SIM

 **Every driver's foot 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 foot 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.2.2.11 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.3.5.3 - Seat Mounting Points and B.3.2.6.3 - 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 a 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 centerline of the seat.

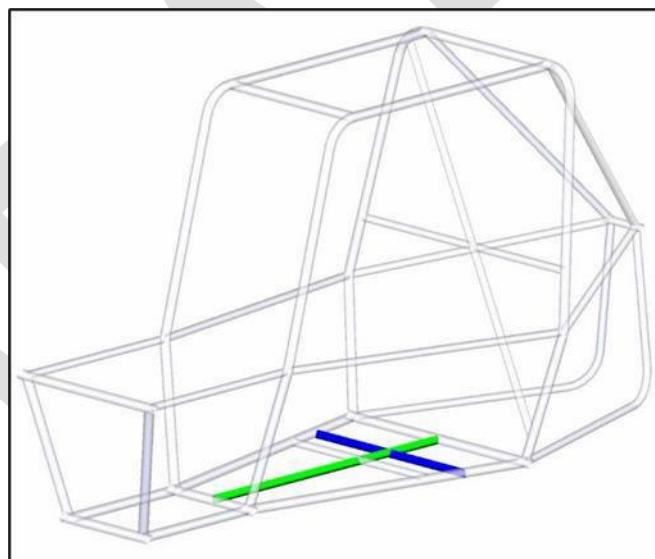


Figure B- 21: Roll Cage, USM

B.2.2.12 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 (FBMUP) must join points C on the RHO to point D on the SIM. The lower front Bracing Members (FBMLOW) must join point D to point F. The FBM must be continuous tubes. The angle between the FBMUP and the vertical must be less than or equal to 45 deg. If Front FAB, per Rule B.2.2.13.1 - Front Bracing, is used there is no angle requirement between FBM and vertical.

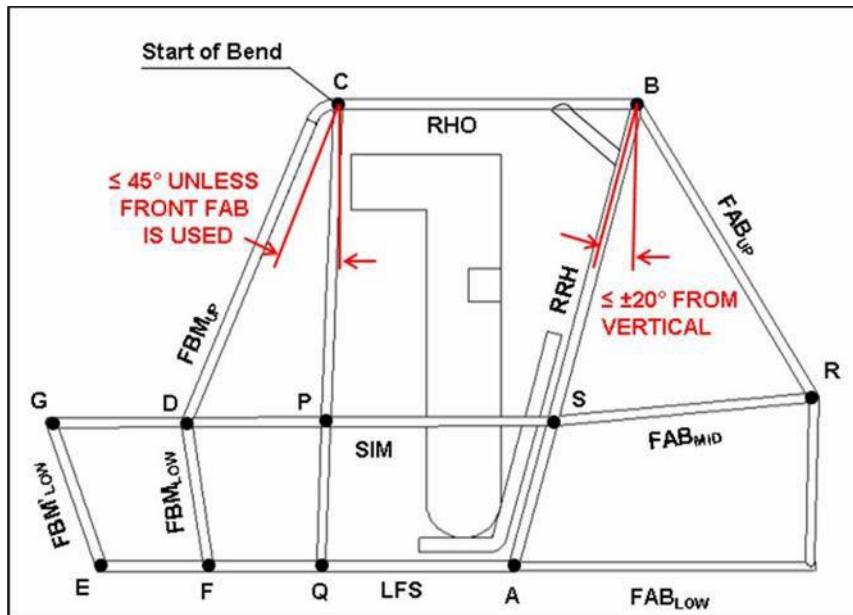


Figure B- 22: Roll Cage, FBM

B.2.2.12.1 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 the 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

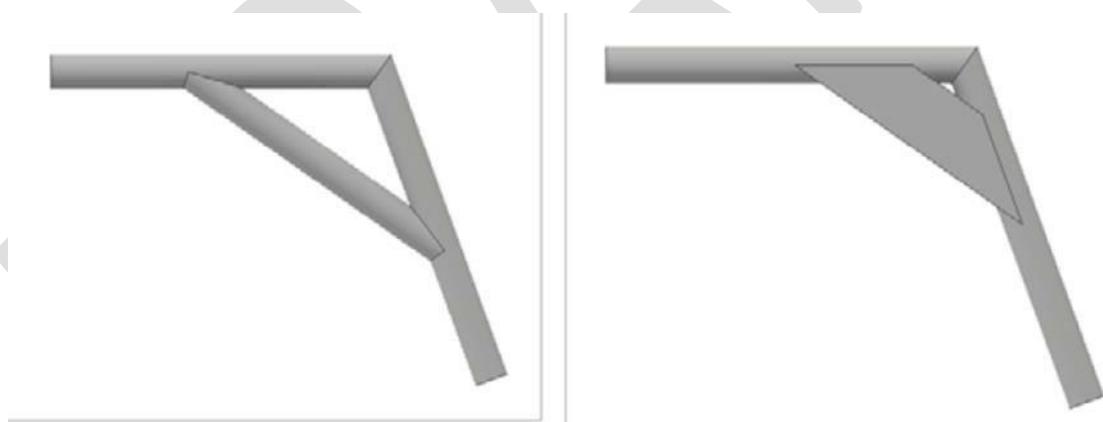


Figure B- 23: RHO / FBM Gussets

B.2.2.13 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.2.2.13.1 Front Bracing

Front systems of FAB must connect the FBMUP members to the SIM members (on the same sides). The intersection with the FBMUP 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 define point Q. Points P and Q exist only with complete Front Bracing.

B.2.2.13.2 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.2.2.1 - Member Requirements, but may be formed using multiple joined members, and this assembly of tubes, from endpoint to endpoint, may encompass a bend of greater than 30 deg.

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

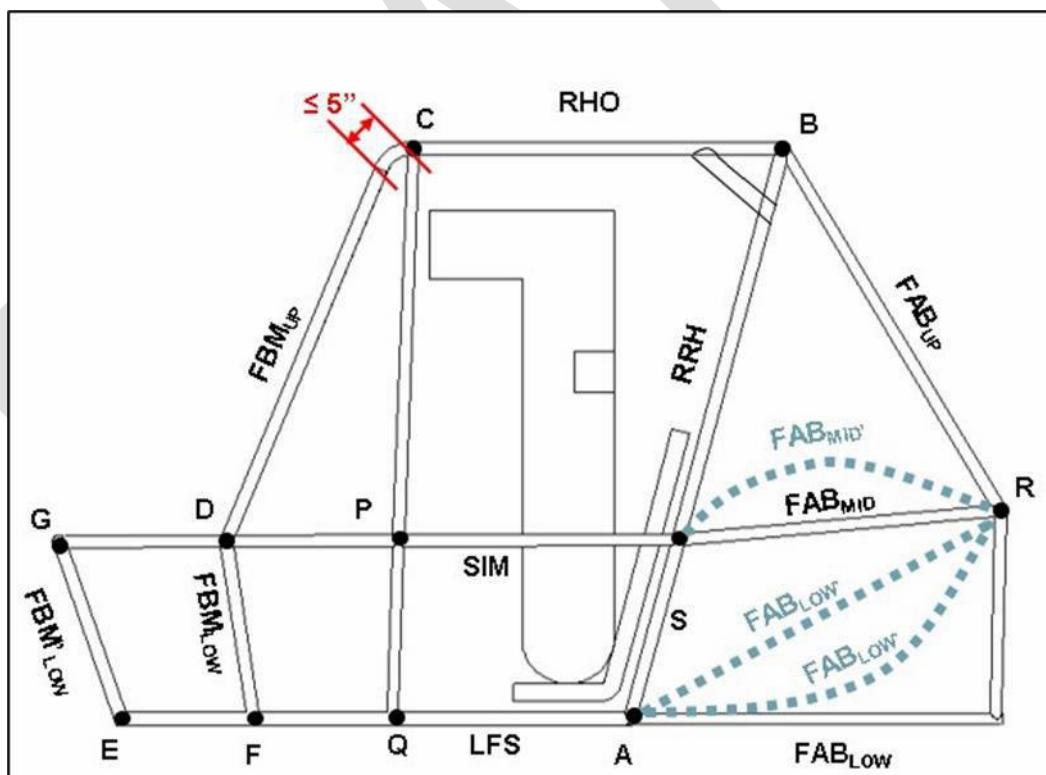


Figure B- 24: Roll Cage, FAB

B.2.2.14 Butt Joints

B.2.2.14.1 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 that 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.2.2.14.2 Size

Sleeves must be designed to fit tightly on the inside of 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.

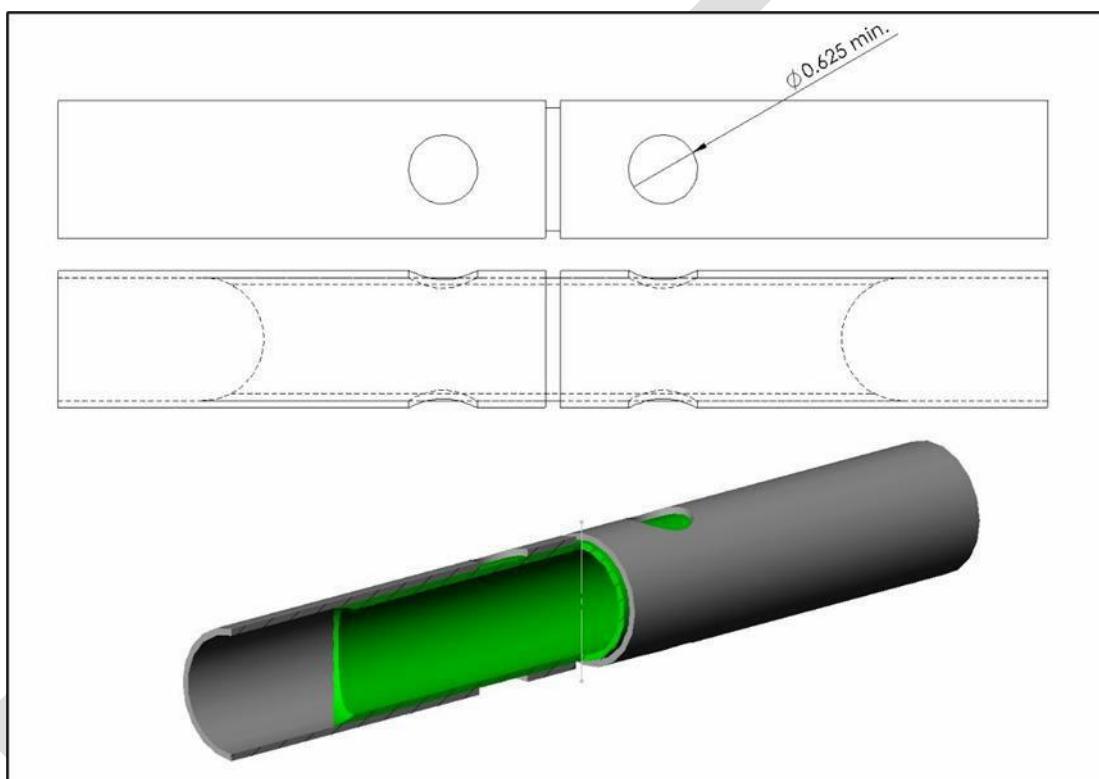


Figure B- 25: Roll Cage, Butt Joint Tube Sleeve

B.2.2.14.3 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 for 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 a linear weld is required to secure the sleeve inside the joint, including the butt joint and the rosette welds.

B.2.2.15 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 Tech Team Documentation Additional Guidelines and Resources Section.

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:

In 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.

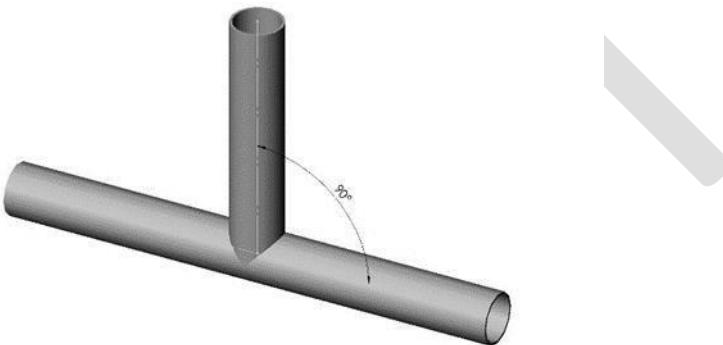


Figure B- 26: Roll Cage, Welding Sample 1

Sample 2 – Destructive Inspection

Two tubes are 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 the tube to reveal adequate and uniform weld penetration (Figure B-27).

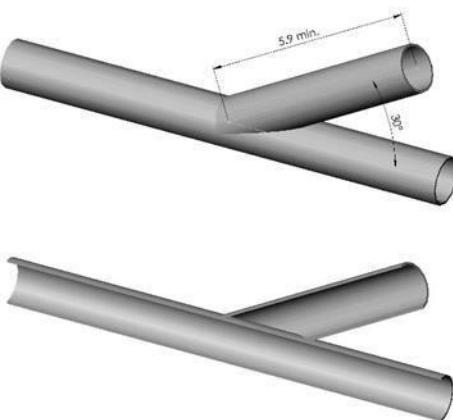


Figure B- 27: Roll Cage, Welding Sample 2

B.2.2.16 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 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.

Docol R8 tubing is permitted.

 **Docol R8 tubes are not intended to undergo any heat treatment after welding and sizing as any heat treatment may alter the mechanical properties of the material.**

- Bending stiffness, k_b , is given by:

Where:

$$k_b = EI$$

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 the neutral axis to extreme fiber

Documentation of the equivalency must include:

- 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.
- Invoices of the roll cage materials.
- Material tests or certifications, specify the carbon content and yield strength.

 **Teams are not allowed to use old test reports.**

B.2.3 Driver Clearance

B.2.3.1 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 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.2.2.2 - 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.2.2.2). If any triangulating members are joining the RHO to the vertical members of the Rear Roll Hoop, and these triangulating members conform to B.2.2.16 - Roll Cage Materials, then the virtual side surfaces may be extended by an outboard crease over the triangulating members.



Figure B- 28

B.2.3.2 Vertical Space

The driver's helmet shall have 152 mm (6 in.) minimum clearance from any two points among those members that make up the 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.2.4 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.2.5 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 the 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

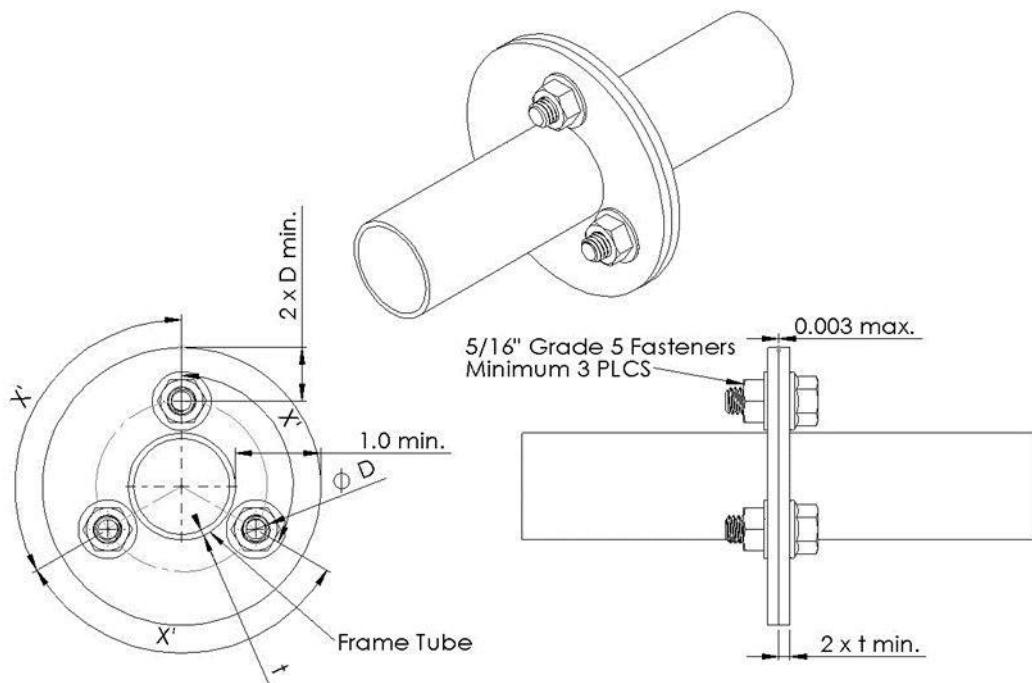


Figure B- 29: Roll Cage, Required Joint for Removable Members

B.2.6 Drilled Frame Members

B.2.6.1 Sleeved Joints

Frame members which need to be drilled for 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.

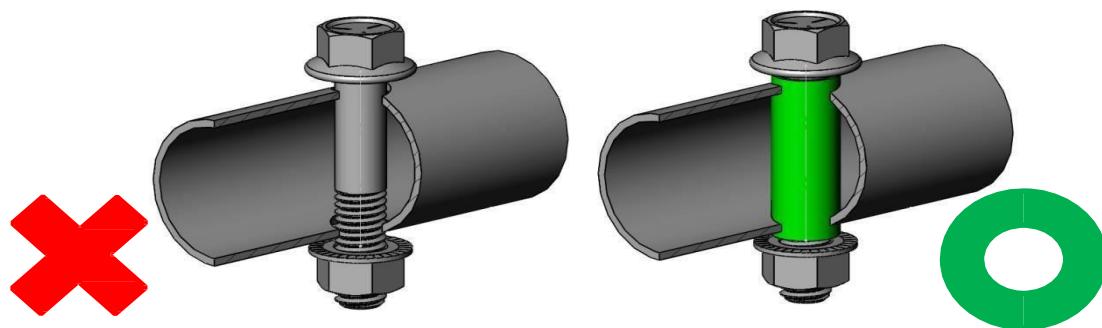


Figure B- 30: Roll Cage, Required tube sleeve for drilled holes

B.2.6.2 Drilled Holes

Single drilled holes in members with a diameter less than or equal to 5 mm (0.197 in) do not require a sleeve.

ARTICLE B.3: DRIVER RESTRAINT

B.3.1 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.3.2 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.

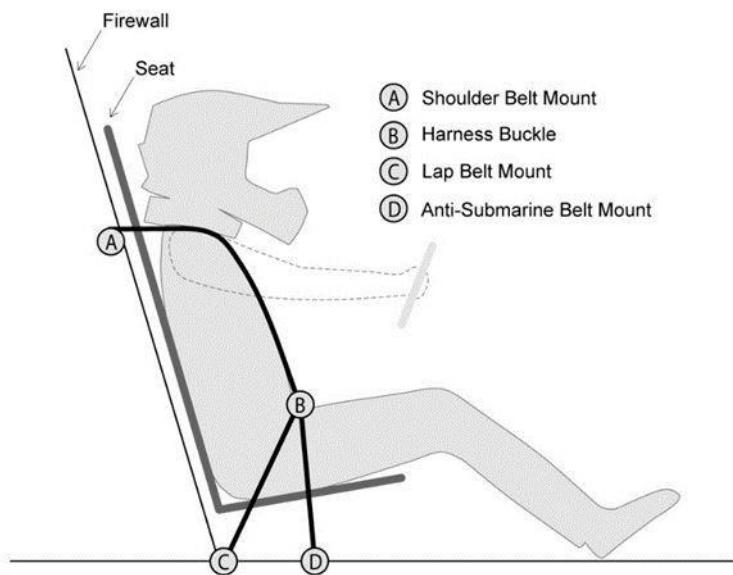


Figure B- 31: Driver Harness Schematic

B.3.2.1 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.).

Some 2.0-inch anti-submarine belts measure 1.75 in. actual minimum widths and are acceptable for use.

Refer to the link below for a list of approved manufacturers for SFI Rated driver restraint assemblies:

[SFI 16.1 Manufacturers List \(sfifoundation.com\)](http://sfifoundation.com)

B.3.2.2 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)

B.3.2.3 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.3.2.4 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.3.2.4.1 Positioning, Vertical

The shoulder belt mounting point (A) (see Figure B-33) shall be positioned no higher than vertical level with each driver's shoulders, and no lower than 102 mm (4.0 in.) vertically below each driver's shoulders.

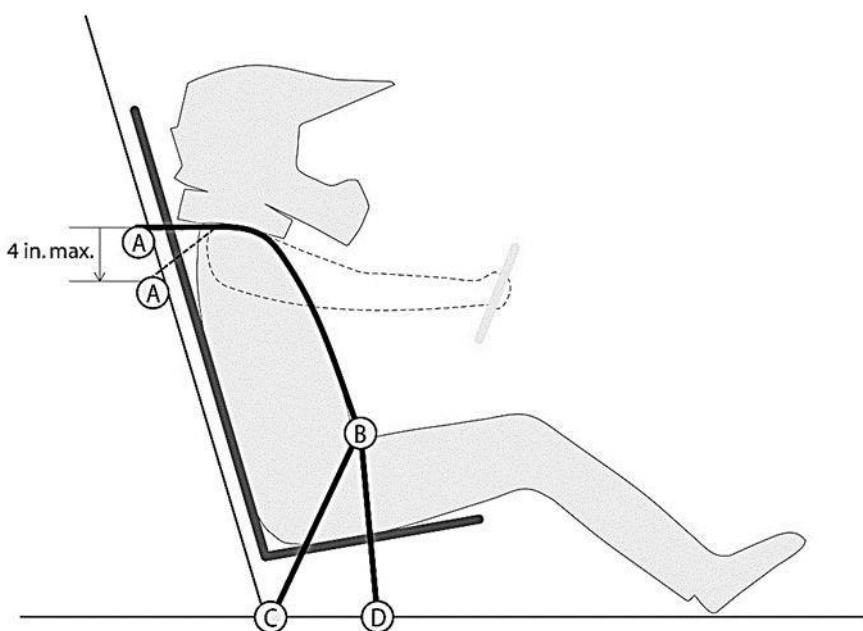


Figure B- 33: Driver Harness, Shoulder Harness Vertical Position

B.3.2.4.2 Positioning, Lateral

The lateral spacing of the shoulder belts shall be between 152 mm (6.0 in.) and 229 mm (9.0 in.) when measured center-to-center. See Figure B-34. The lateral position of the shoulder belts along their mounting tube must be restrained by a structure other than the firewall.

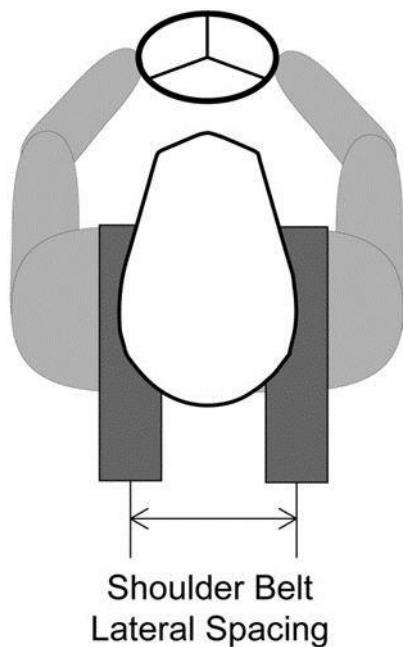


Figure B- 34: Driver Harness, Shoulder Harness Lateral Position

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.2.2.3 - 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

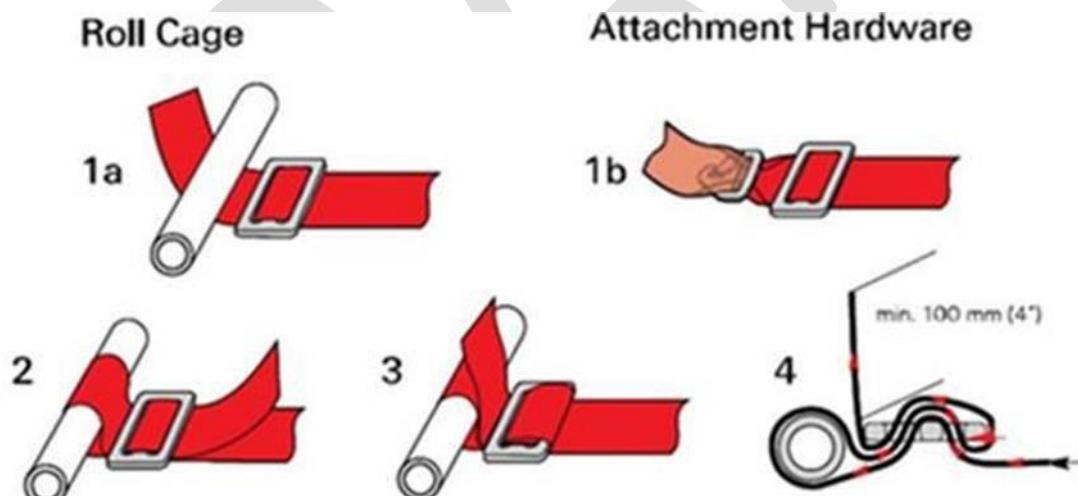


Figure B- 36: Driver Harness, Diagram of Proper Wrapping of Webbing

B.3.2.4.3 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.

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

B.3.2.4.4 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.3.2.4.5 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. Proper grommets should be provided to cover the cut in the firewall completely. Visible gaps to be avoided.

B.3.2.4.6 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.3.2.4.7 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 spine (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 degrees and 80 degrees 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.

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

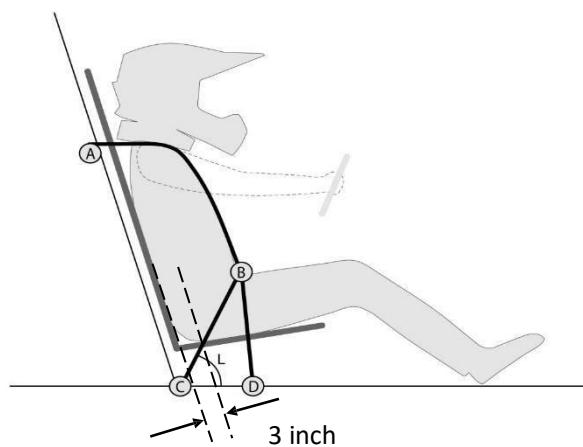


Figure B- 37: Driver Harness, Lap Belt Angle

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 eyebolts are explicitly prohibited. The webbing shall be wrapped per Figure B-36: 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:
- 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.
- 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.
- 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.)
- The frame lap belt tabs and lap belt shall be installed such that the lap belt tabs pivot freely.
- The frame lap belt tabs and their mounting shall be stiff and not readily deformed.
- No lightning holes or other cut-outs are permitted on the frame lap belt tabs.

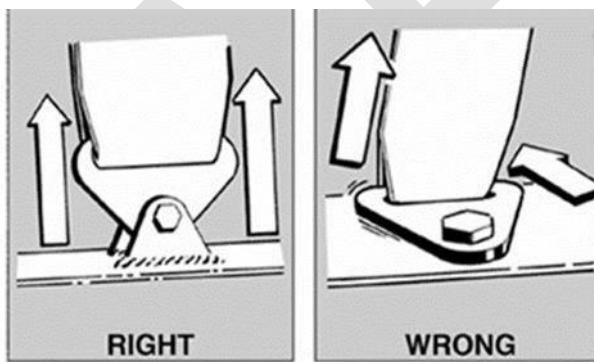


Figure B- 38: Driver Harness, Lap Belt Tab Orientation

B.3.2.4.8 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).

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

B.3.2.4.9 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.3.2.4.10 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.3.2.5 Anti-Submarine Belts

B.3.2.5.1 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.3.2.5.2 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 the 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.

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

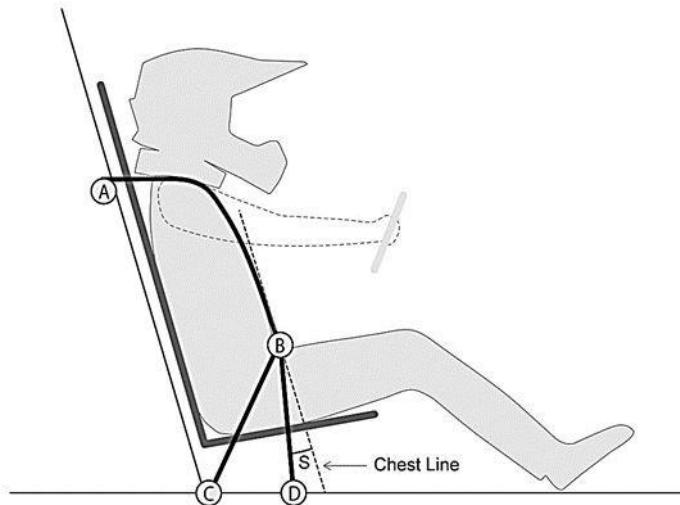


Figure B- 39: Driver Harness, Anti-Submarine Belt Angle

B.3.2.5.3 Attachment

The anti-submarine belts shall be securely attached to the vehicle frame by one of the following methods:

- Metal tabs are joined by a threaded fastener.
- Webbing wrapped around a frame member.
- Webbing wrapped around a bolt secured by metal tabs in double shear.

Anti-submarine belts secured with eyebolts are explicitly prohibited. The webbing shall be wrapped 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:

- 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.
- 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.
- 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).
- The frame anti-submarine belt tabs and lap belt shall be installed such that the lap belt tabs pivot freely.
- The frame anti-submarine belt tabs and their mounting shall be stiff and not readily deformed.
- No lightening holes or other cut-outs 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:

- The anti-submarine belt mounting tube shall have features designed to limit total lateral movement to 25.4 mm (1.0 in.) or less.
- The anti-submarine belt webbing shall be protected from sharp edges such as bolt threads, tab edges, and
- 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 LCs. The mounting tube may not be cantilevered off of another tube creating an undue bending moment.

B.3.2.5.4 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 degrees (Figure B-40). The redirecting member or edge must be designed to prevent chaffing or abrasion of the belt webbing.

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



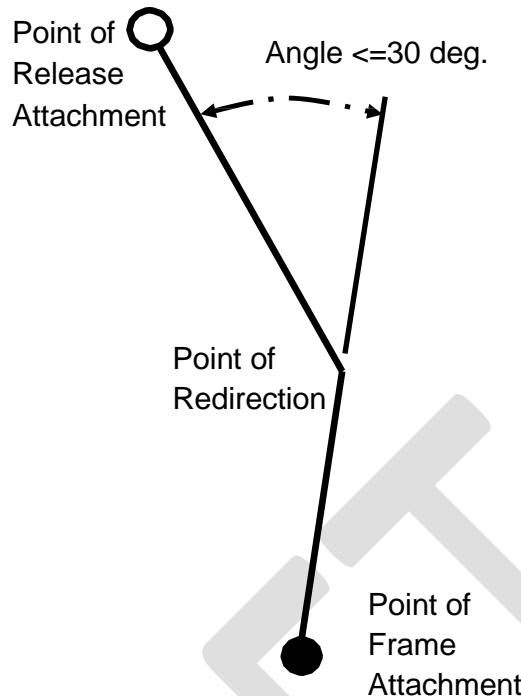


Figure B- 40: Driver Harness, Anti-Submarine Belt Redirection

B.3.2.5.5 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.3.2.5.6 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.3.3 Arm Restraints

In the event of a rollover, the driver's arms must be kept within the limits of the roll cage space (B.2.3.1 - 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 to the link below for a list of approved manufacturers for SFI 3.3 rated driver's accessories:

[SFI 3.3 Manufacturers List \(sfifoundation.com\)](http://sfifoundation.com)

B.3.3.1 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

-  **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.3.3.2 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.3.3.3 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.3.3.4 Attachment

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

B.3.4 Head Restraint

A head restraint must be provided to limit the 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 concerning nominal BAJA SAEINDIA® seat design and seating position.***

B.3.5 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.

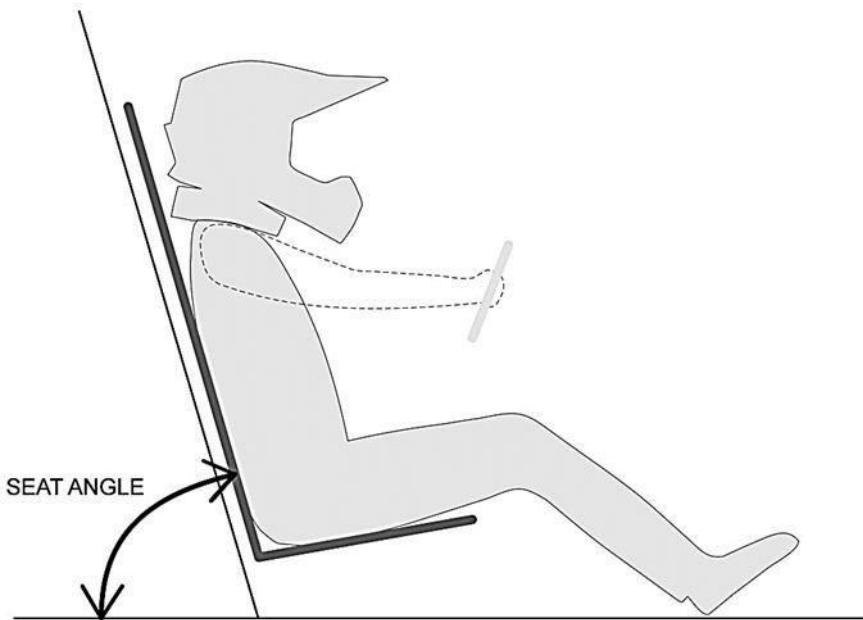


Figure B- 42: Seat Angle

B.3.5.1 Seat Construction

B.3.5.1.1 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 an 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.3.5.1.2 Suspension Seats

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

B.3.5.1.3 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.3.5.2 Seat Mounting Points (Conventional Seats)

B.3.5.2.1 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. The minimum fastener diameter for seat mounting points is 6.5 mm.

B.3.5.2.2 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 the vertical load.

B.3.5.2.3 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.2.6 - Drilled Frame Members.

ARTICLE B.4: DRIVER EQUIPMENT

- 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.
- Without markings, these items won't be considered valid.
- Thinner is strictly banned inside the main event premises.

Items to be marked with college name Initials:

- Driver's Helmet (B.4.1)
- Arm Restraint (B.3.3)
- Driver's Suit (both Upper and Lower Garments, for teams using split Driver's Suit B.4.4.3and B.4.4.4)

B.4.1 Helmet

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

All helmets used in BAJA SAEINDIA® competitions shall meet the requirements of the ratings: Snell M2015, Snell M2020, ECE R22-05, SA 2005, British Standards Institution BS 6658-85 types A or A/FR. Any helmets not meeting these standards are explicitly prohibited.

- i Do not rely on salespeople to determine if a helmet is Snell-rated.*
- i Check for the Snell sticker under the foam liner of the helmet.*
- i DOT, ISI, and DOT+ISI rated helmets are not allowed.*
- i This rule has no exceptions, and it will be strictly enforced. Helmets certified to other rating systems not specified above may not be worn.*





Figure B- 43: Driver's Helmet

- 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 systems is prohibited.
- 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.

B.4.2 Eye Protection

B.4.2.1 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.4.2.2 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 an unobstructed vision through their goggles. Teams must present their goggles and properly installed tear-offs or roll-offs at tech inspection. Teams without tear-offs or properly functioning roll-offs are subject to being black flagged.

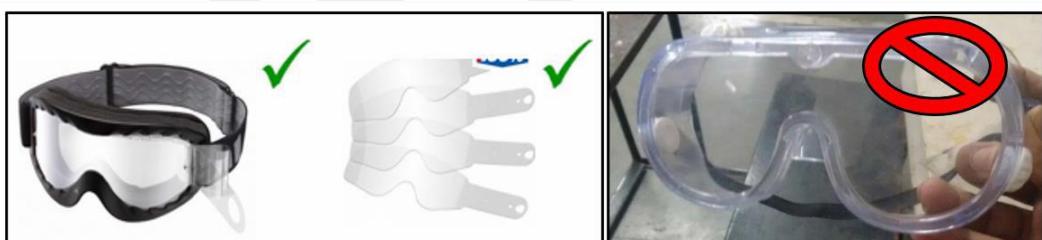


Figure B- 44: Eye protection

B.4.3 Neck Support

B.4.3.1 Certification

All drivers must wear a neck support/neck collar. The neck support must be a full circumference (360 deg.) and SFI 3.3 rating. Horseshoe collars are not allowed. Simpson, RCI, G-force, Deist, or Leaf Racing Products supply neck collars that meet this requirement. Refer to the link below for a list of approved manufacturers for SFI 3.3 rated driver's accessories,

[SFI 3.3 Manufacturers List \(sfifoundation.com\)](http://sfifoundation.com)

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, the year is no more than three years old.



Neck Support Permitted



Neck Support Not Permitted

Figure B- 45: Driver Equipment, Neck Restraint

B.4.3.2 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.

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.4.4 Clothing

Teams are allowed to use two-piece or single-piece driver suits complying with rulebook section B.4.4.3 and B.4.4.4

B.4.4.1 Gloves

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

B.4.4.2 Shoes

Drivers shall wear socks and shoes.

B.4.4.3 Upper Garments

Drivers shall wear a fire-resistant shirt. The shirt must have a factory label showing an SFI 3.2, SFI 3.3, SFI 3.4, FIA 8856-2000 fire-resistant rating. Refer to the link below for a list of approved manufacturers for SFI-rated Driver's Suits:

[SFI 3.2A Manufacturers \(sfifoundation.com\)](http://sfifoundation.com)

B.4.4.4 Lower Garments

Drivers must wear fire-resistant pants/suits having an SFI, FIA, NFPA 2112 fire-resistant rating.

Refer to the link below for a list of approved manufacturers for SFI-rated Driver's Suits,
[SFI 3.2A Manufacturers \(sfifoundation.com\)](http://sfifoundation.com)

B.4.4.5 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 B.5: VEHICLE CONTROLS

B.5.1 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 the same axle symmetrical to the longitudinal plane of the vehicle. The Brake system must achieve the prescribed 4 wheels locking within stopping distance (as a reference) specified in the dynamic test, without any abnormal noise, vibration, or 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 aluminium and be designed to withstand a minimum brake pedal force of 450 lbf (2000 N).

 Teams are advised to go through additional inputs for brakes design put up as an annexure labeled “GENERAL RECOMMENDATIONS FOR BRAKES DESIGN”

B.5.1.1 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 a minimum 50% prescribed dynamic performance requirement.

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

B.5.1.2 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.5.1.3 Cutting Brakes

Hand or feet operated “cutting brakes” are permitted provided section B.5.1 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 brakes, when actuated, shall cause the brake light to illuminate.

B.5.1.4 Brake Lines

All brake lines shall be securely mounted to the vehicle and not projected 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 a 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.5.1.5 Brake Pedal

Teams are recommended and advised to operate the brake pedal on the right foot, which requires the pedal to be placed to the right side of the steering column. This is a recommendation made considering the requirement of adequate foot pressure to be applied on the brake pedal for effective braking.

 **For use of the brake pedal and accelerator pedal on the same side (right side), There must be a minimum of 40 mm clearance between both the pedals. It is recommended that the driver does not use the brake and acceleration pedal simultaneously.**

B.5.2 Other Control Systems

B.5.2.1 Compressed Gas Systems

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

B.5.2.1.1 Gas Composition

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

B.5.2.1.2 Gas Storage

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

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

B.5.2.1.3 Gas Service Equipment

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

- Pressure Regulators shall be rated for compressed gas service and be mounted directly to the compressed gas cylinder.
- Any fittings or connectors in the compressed gas system shall be rated for the pressures and temperatures experienced downstream of the pressure regulator.
- Any hoses, tubing, or other conveyances in the compressed gas system shall be rated for the pressures and temperatures experienced downstream of the regulator.

- Any gauges, indicators, or other instrumentation in the compressed gas system shall be rated for the pressures and temperatures experienced downstream of the regulator.

B.5.2.1.4 Compressed Gas Mechanisms

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

DRAFT

ARTICLE B.6: COCKPIT

B.6.1 Design Objective

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

B.6.2 Cockpit Egress

Any 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 one hand of the driver is removed from the steering wheel to the instant the driver is clear of the vehicle with both feet on the ground.

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

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

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

B.6.3 Firewall

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

Multiple metal panels may be used to form the firewall, provided there are no gaps between the joints. Select cut-outs are allowed for control cables, brake lines, electrical cables, and 4WD/AWD components provided the cut-outs have proper grommets and sealing to prevent fuel from leaking into the cockpit.

Large cut-outs in the firewall are explicitly prohibited. Large cut-outs include those for CVT ventilation and other similar items. Air intakes may not penetrate the firewall and must remain within the roll cage envelope. Cut-outs for drivetrain components are permitted.

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

B.6.4 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).

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

B.6.5 Skid Plate

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

Skid Plates 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.
- Aluminium, is at least 3.0 mm (0.12 in.) thick, meeting or exceeding the strength of 6061-T6 aluminium.
- Fiber/plastic or equivalent, at least 5 mm (0.19 in.) thick



 **The belly pan should withstand the load of the driver in all conditions.**

B.6.6 Shielding for Legs and Feet

B.6.6.1 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 being struck during operation or a failure.

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

B.6.6.2 Universal Joints

Universal joints in the steering or 4WD/AWD system near the driver's feet must be shielded or sealed such that the driver's clothes or feet may not become entangled in the joint.

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

B.6.7 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 shall be familiar with the use and operation of fire extinguishers.

B.6.7.1 Rating and Required Features

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

B.6.7.2 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 spares.

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

B.6.7.3 Required Bracket

The only permitted fire extinguisher mounting brackets are the:

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

[Scott Drake FIREX-MNT-DAG Scott Drake Quick Release Fire Extinguisher Mount \(holley.com\)](#)

 **It is recommended teams keep a spare mount available.**

B.6.7.4 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 12, Fasteners.

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

B.6.7.5 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 completely below the driver's eye level, 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-54.1 for further clarification.

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

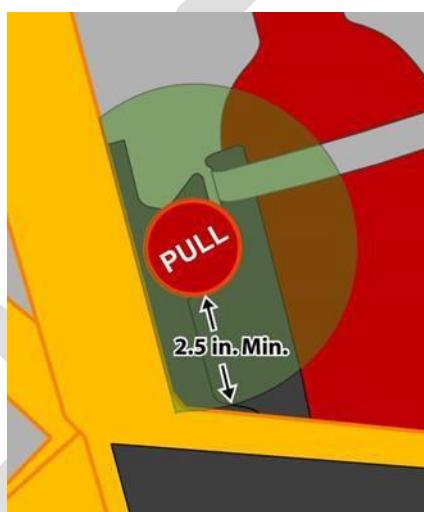


Figure B- 54.1: Fire Extinguisher, Diagram of Clearance around Pull Knob (green)



Figure B-54.2: Fire Extinguisher Mounting, Do's and Don'ts

ARTICLE B.7: POWERTRAIN GUARDS

B.7.1 Powertrain Guards and Finger protection

All rotating powertrain components (CVTs, Gears, Sprockets, Belts, and Chains) shall be shielded to prevent injury to the driver, track workers, or bystanders. Guards shall protect against the hazardous release of energy should 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.7.1 and B.7.2.

B.7.2 Hazardous Release of Energy (HROE)

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

 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.
- Aluminium, is at least 3.0 mm (0.12 in.) thick, meeting or exceeding the strength of 6061-T6 aluminum.

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

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

B.7.2.1 Belt, Gear, and Chain Drives

HROE guards shall be a continuous metal band extending around the entire periphery of the drive assembly. The width of the continuous metal band shall be wider than the entire width of the rotating component.
FIGURE B 55

HROE guards may contain ventilation ports along the path of the guard. Ventilation ports shall be constructed from the same material as the guard, be arranged in such a manner that no radial or tangential path exists for flying debris to exit the ventilation port. The ventilation port shall also be constructed to not allow a searching finger to contact the rotating components when the ventilation tube is removed.

B.7.2.2 Hydraulic Systems

Hydraulic systems shall protect against hazardous release of energy. Hydraulic hoses shall have jacketing that meets HYDRAULIC SPEC. Hydraulic relief valves shall safely vent to the tank and away from people.

Any hydraulic hoses running through the cockpit to the front axle shall be protected from damage by a driver entering or exiting the vehicle. Protection shall be made by a sturdy, robust cover. Note that hydraulic systems shall meet the requirements of B.2.6.1 - Hydraulic.

B.7.2.3 Axle shafts

Axle shafts and associated CV or universal joints forward of the firewall directly connecting the front wheels/uprights to the front differential do not require specific guarding for track workers and bystanders, but shall be separated from the driver and cockpit by way of methods meeting requirements of B.6.5 - Panels and B.6.6 - Skid Plate.

All other universal joints, CV joints, or similar shall be protected with HROE guarding extending 25.4 mm (1.0 in.) axially beyond the extent of the joint.

B.7.3 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 "Frog skin", Ceconite, and neoprene are unacceptable for use as finger guards. Powertrain covers fastened with adhesive, ratcheting tie-downs, and other temporary methods are explicitly prohibited. All powertrain covers shall have resilient



and durable mountings with easily accessed and actuated fastening devices.

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

This is also applicable to the Front differential casing and other rotating components on the front side of the cockpit.

 **Inboard Braking rotors should meet the rules of the powertrain Guard and should prevent the unintentional contact of hands with the rotor. Integrated CVT casing and brake rotor casing can be used.**

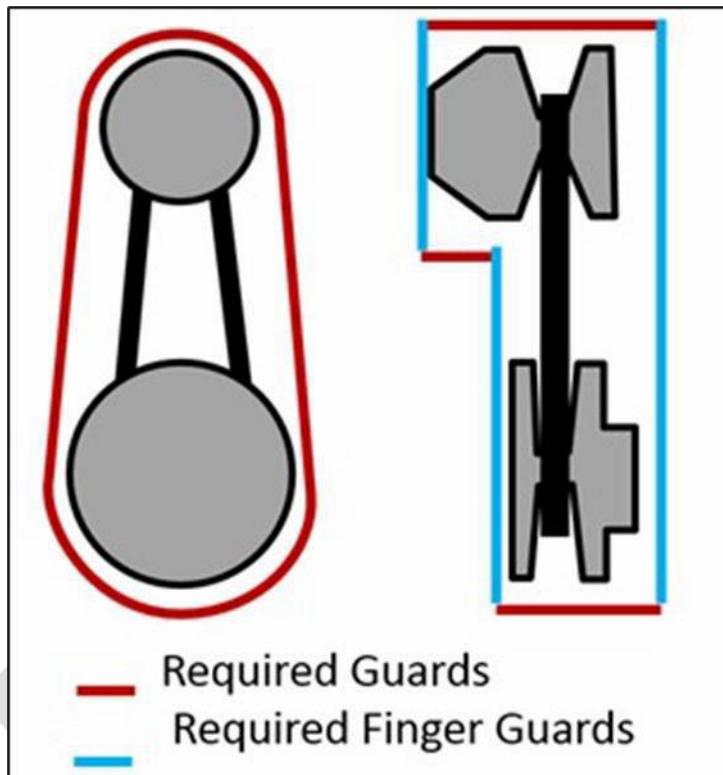


Figure B- 55: Powertrain Guard Extents

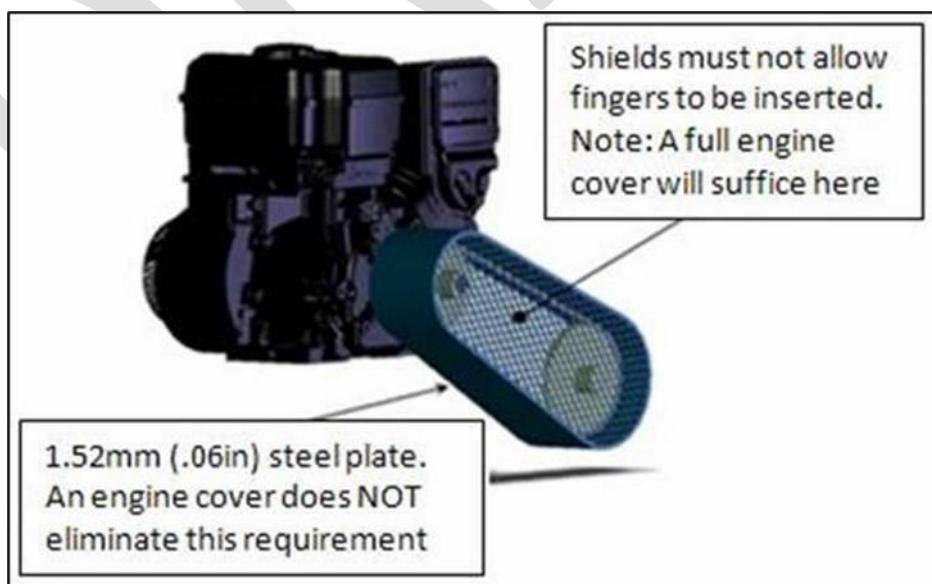


Figure B- 56: Powertrain Guard Example

 **All guards, whether Chain-drive or CVT, must maintain a clearance of at least 15mm from any nearby roll cage member or suspension component. This is applicable to the Front differential & steering**

components in the front side of the cockpit.

B.7.4 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 rules B.7.1 - Powertrain Guards and B.7.2 - Hazardous Release of Energy. OEM covers must still meet the requirements of B.7.3 - Pinch Points and Entanglement in way of the vent.

B.7.5 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 transporting 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 following B.2.6.1.1 – 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.

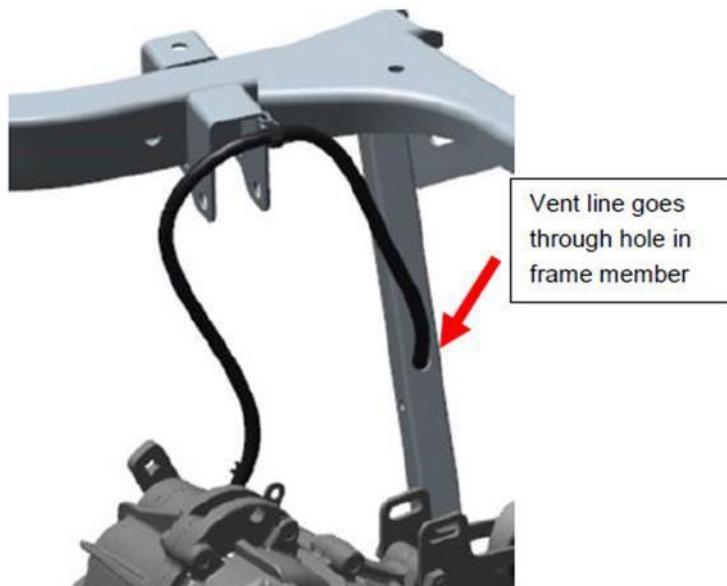


Figure B- 57: Example of a gearbox vent tube terminating inside a frame member.

B.7.6 Drive Shafts

Longitudinal drive shafts connecting the front and rear gearboxes/differentials in a 4WD/AWD system may be a hybrid of powertrain guards and finger protection as described in this section.

Any universal joint, CV joint, or similar joint (all referred to as “joint” for this rule) in the driveshaft assembly shall be surrounded by powertrain guarding following B.7.2 - Hazardous Release of Energy. The driveshaft hoops shall be a minimum of 30 mm wide to either side of the joint or up to the mating gearbox/differential, whichever is closer.

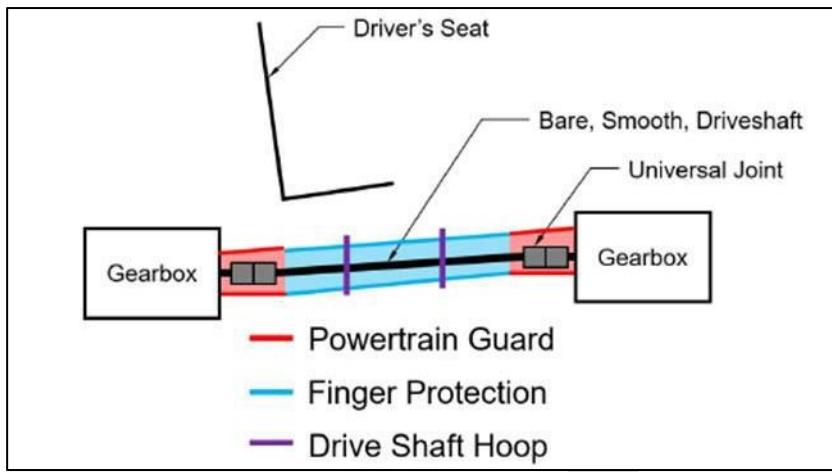


Figure B- 58: Driveshaft Guarding

The driveshaft will be constrained from failure via two drive shaft hoops, within 51 mm (2.0 in.) of the 1/3 length point and the 2/3 length point. Hoops should have minimal clearance to the driveshaft. The driveshaft hoops shall be 25 mm (1.0 in.) wide, meeting the same material requirements as B.7.2 - Hazardous Release of Energy, and shall be mounted by welding or fasteners.

If the used flanges or bearings that falls in the above specified lengths that can be itself considered as a support for the Drive shafts. Irrespective of any case, the guards used for protecting the driveshaft must be rigidly fastened and secured in place with additional hoops mounted to be made rigid.

Drive shafts on either side of the skid plate (driver's side or the ground side) shall meet the same requirements. The skid plate may be considered part of the finger protection.

Chain drives in the cockpit shall meet the existing rule B.7.2.1 - Hazardous Release of Energy.

Any hydraulic hoses running through the cockpit to the front axle shall be protected from damage by a driver entering or exiting the vehicle. Protection shall be made by a sturdy, robust cover. Note that hydraulic systems shall meet the requirements of B.2.6.1 - Hydraulic.

ARTICLE B.8: ELECTRICAL SYSTEM

B.8.1 Kill Switches

B.8.1.1 Required Switch

 For a BAJA kill switches specification refer to article C.2.2.3.

B.8.1.2 Location

B.8.1.2.1 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 is of the requisite type.

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

No other push button switches should be mounted near the Cockpit kill switch.

 **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 the kill switch mount does not hinder cockpit egress. Proper knee and elbow clearances are to be maintained as per Clause B.12.3.**

B.8.1.2.2 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 FABUP. The external kill switch shall be generally perpendicular to the firewall (± 15 deg), below frame point BR, and no further than 180 mm (7.0 inches), dimension "Z" in Figure B-61, below frame point 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.

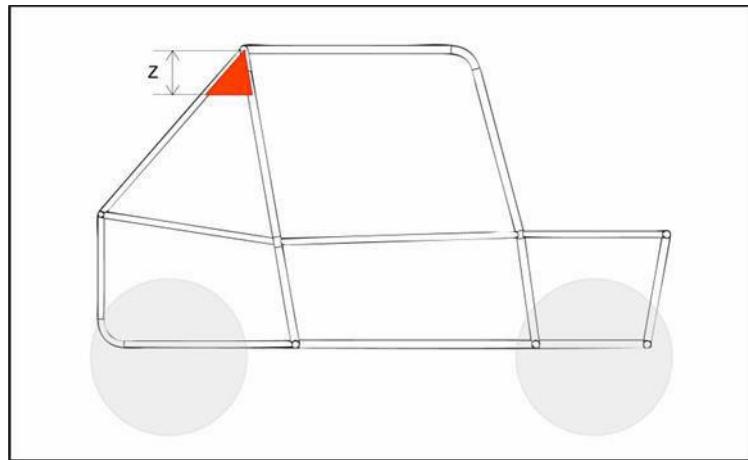


Figure B- 61: Engine Kill Switch Mounting Position

B.8.1.3 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 fasteners used to mount an engine kill switch shall meet the requirements of Article 12 - Fasteners.

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

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

B.8.2 Signaling

B.8.2.1 Brake Light

All vehicles are required to have a functional brake light to signal to other drivers the vehicle is stopping or slowing down. The brake light is strictly to be RED in colour and must be visible in the daytime (in any weather condition) for 20 meters. The wattage of the Brake light bulb should be as per AIS standard.

B.8.2.1.1 Required Brake Light

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

- Polaris Part # 2411450
- Polaris Part # 2411099
- Polaris Part # 2411092-432
- Haul-Master – Part # 93263

- Command Electronics Part # 003-6018R
- Command Electronics Part # 003-6016
- Haul-Master – Part # 93263
- Command Electronics Part # 003-6018R
- Command Electronics Part # 003-6016

 **Brake light must have homologation marking engraved on the lens/housing part of the lamp. (Not allowed with stickers pasted). An original bill copy would be needed for verification at the event site. In the case of SAE DOT ratings, DOT SAE XXXX markings are also acceptable. The most common lamps available in India would be with E4 and E9. (They are acceptable).**



Figure B-62: Brake Lights

B.8.2.1.2 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.8.2.1.3 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.

 **Teams can use a mechanical pressure switch for activating brake lights ensuring adherence to installation guidelines, proper connections, and checks to avoid leakages. Brake pressure switches of 2-wheelers are strictly prohibited.**

B.8.2.2 Reverse Light

Vehicles with reverse gear shall be equipped with 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. The wattage of Reverse light bulbs should be as per AIS standard.

B.8.2.2.1 Specification

Reverse lights shall be marked with an SAE “R” on the lens of the reverse light and be of an LED design, equal to or exceeding the SAE standard J759. Indian OEM Reverse lights are also permitted along with the SAE Rated Reverse Light.

Reverse light must have homologation marking engraved on the lens/housing part of the lamp. (Not allowed with stickers pasted). An original bill copy would be needed for verification at the event site. In the case of SAE

DOT ratings, DOT SAE XXXX markings are also acceptable. The most common lamps available in India would be with E4 and E9. (They are acceptable)

 **LED strips for reverse light are strictly prohibited.**

B.8.2.2 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.8.2.3 Reverse Alarm

Vehicles with 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.8.2.3.1 Specification

Required reverse alarms shall be rated to meet the SAE standard J1741 or J994. Indian OEM reverse alarms are also permitted along with the SAE Rated Reverse alarm.

B.8.2.3.2 Location

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

B.8.3 Instrumentation

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

B.8.4 Data Acquisition

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

B.8.5 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.8.5.1 Voice

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

B.8.5.2 Data

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 B.9: TOW POINTS

B.9.1 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 the 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.9.2 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-62 for further information.

- Front numbers may not interfere with tow-point.**
- The front or Rear Bumper can't be considered as a 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 a removable part and should be present from GO-NO-GO till the end of the event.**



Figure B- 62: Front Hitch Point Clearances

Examples of acceptable Front Hitches:



Figure B- 63: Acceptable Front Hitch Points

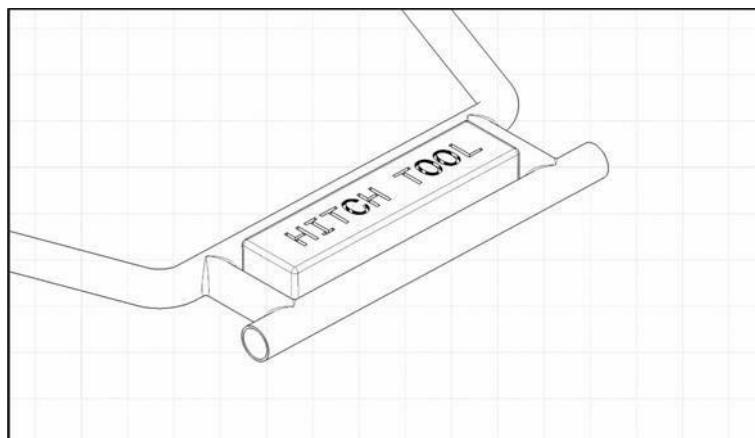


Figure B- 64: Tow Point, Inspection Tool Fitment

B.9.3 Rear Tow Point

Rear tow points shall be constructed from steel and meet the following requirements. See Figure B-66 for further information.

Dimension	Symbol	Minimum	Maximum
Tab Thickness	None	3.18 mm (0.125 in)	9.5mm (0.375 in.)
Hole Diameter	D	25.4 mm (1.0 in.)	31.75 mm (1.25 in.)
Hole-to-Tube Offset	X	19.0 mm (0.75 in.)	25.4 mm (1.0 in.)
Edge Distance	R	15.9 mm (0.625 in.)	25.4 mm (1.0 in.)
Width at Frame Connection	Y	76.2 mm (3.0 in.)	Unrestricted
Material	None	Steel 1018	

Figure B- 65: Tow Point, Table of Tow Point Dimensions

Material for Tow-Hitch plate is strictly restricted to steel. Use of Aluminium is prohibited.

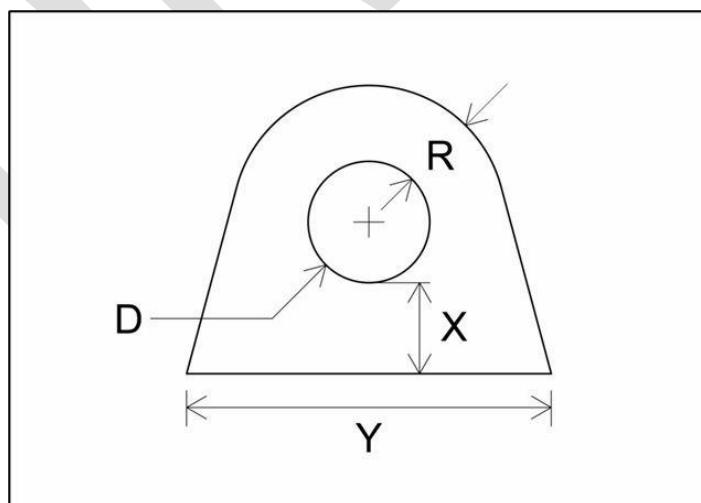


Figure B- 66: Tow Point, Rear Tab Dimensions

Rear Hitch Plate should be directly welded to the roll cage member. Latch-type rear hitch plates are not allowed.

B.9.3.1 Fixed Rear Tow Point

Fixed rear tow points shall be fully welded to the vehicle frame along the base line, dimension Y. The tab may be vertically or horizontally oriented.

B.9.3.2 Swivel Rear Tow Point

Swivel, or hinged, rear tow points shall be attached to the frame by way of a swivel mechanism. A swivel rear tow point may be horizontally or vertically oriented. The tabs for attaching the swivel mechanism to the frame shall be fully welded, a minimum thickness of 0.125 in thick, and have equal base line weld lengths totaling greater than or equal to dimension Y. Swivel pins shall be a graded fastener at least a 0.25inch diameter meeting the requirements of B.10.1 - Fastener



ARTICLE B.10: FASTENERS

B.10.1 Scope

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

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

B.10.2 Captive Fasteners

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

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

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

B.10.3 Thread Projection

To provide for proper thread engagement in the lock nut, threaded fasteners shall have at least two (2) threads projecting past the end of the nut.

B.10.4 Grade

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

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

Below depicts bolt markings meeting or exceeding the requirements above.

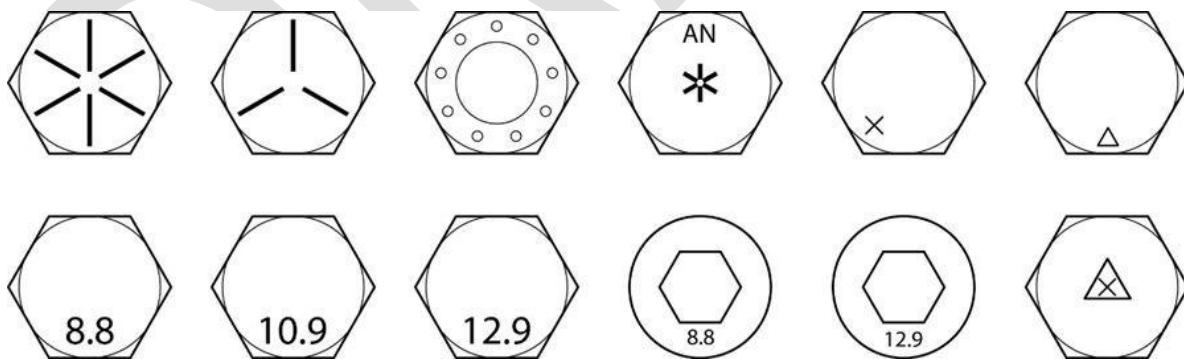


Figure B- 67: Fasteners, acceptable markings

B.10.5 Proof of Grade

For fasteners, without markings, as described above, proper documentation shall be supplied which requires a purchase receipt and manufacturer's specification (including markings) indicating the fastener strength exceeds or is equivalent to the requirements of B.10.4 - Grade.

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

B.10.6 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 show that the fastener exceeds the strength of a Grade 5 fastener of the same size.

B.10.7 Modified Fasteners

Fasteners that 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 B.11: VEHICLE IDENTIFICATION AND MARKINGS

B.11.1 Vehicle Number Assignment

Vehicle numbers shall be assigned as part of the final list of registered teams after the closure of the registrations. Assigned numbers shall be released on [BAJA SAEINDIA Forum](#).

B.11.2 Transponders

For all BAJA SAEINDIA® competitions, a transponder system is used for timing and scoring. All teams participating in the BAJA SAEINDIA® competition are required to have two transponders mounted on their vehicle throughout the event. Vehicles must carry two functional, properly mounted, and fully charged transponders of the specified type. Vehicles without the specified transponders will not be allowed to compete in any event for which a transponder is used for timing.

-  **Teams must register and 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.**
-  **Teams are allowed to use two same/different models of transponders provided they meet clause B.11.2.1**
-  **It is the team's responsibility to get an active transponder subscription and charge the transponders adequately for them to last the entire duration of the endurance event (for 4 hours).**



B.11.2.1 Required Transponder

All vehicles must be equipped with two MYLAPS rechargeable transponders. The only acceptable transponder types are:

- Classic MX
- Flex MX
- X2 MX



Figure B- 68: 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 before Transponder Check at Technical Inspection.

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

Allowed Transponders					
Transponder Name	MX Classic	MX Flex	X2 MX Rechargeable	X2 MX Direct Power	TR2 MX
Picture					
Price Model	One Time Purchase	1, 2 or 5 Year Subscription	1, 2 or 5 Year Subscription	1, 2 or 5 Year Subscription	1, 2 or 5 Year Subscription
Sales Availability	No Longer Available	No Longer Available	Currently Available	Currently Available	Currently Available
Renewal Availability	-- NA --	1, 2 or 5 Year	1, 2 or 5 Year	1, 2 or 5 Year	1, 2 or 5 Year
MyLaps' End of Support	1-6-2017	1-6-2017	Ongoing	Ongoing	Ongoing
MyLaps' End of Service	1-6-2019	1-6-2019	Ongoing	Ongoing	Ongoing
Insurance Included	No	Yes, With Subscription	Yes, With Subscription	Yes, With Subscription	Yes, With Subscription
Warranty Included	3-year Limited Warranty	Unlimited warranty	Unlimited warranty	Unlimited warranty	Unlimited warranty
Mounting Type	Classic Quick Release Clip	Classic Quick Release Clip	X2 Quick Release Clip	Direct Mount + Cable Harness	TR2 Holder
Power Source / Time on Battery	Rechargeable / 4 Days	Rechargeable / 5 Days	Rechargeable / 5 Days	Direct Power (12V) With Built in Battery Backup	Rechargeable / 5 Days
Time Needed to Charge	16 Hours	16 Hours	4 Hours	-- NA --	5 Hours
Charger Type	Black 12V Cradle	White 5V USB Cradle	5V USB X2 RaceKey	-- NA --	5V TR2 Charge Cradle

Figure B- 69: Chart of transponder information

B.11.2.2 Purchase

All teams are responsible for purchasing their transponder(s) directly through MyLaps.
<http://www.mylaps.com>

B.11.2.3 Mounting

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

B.11.2.3.1 Orientation

The transponder shall be installed vertically to the frame in the orientation shown in figure B-70. The transponder shall also be oriented so the transponder number can read “right-side up.”



B.11.2.3.2 Location

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

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

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

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

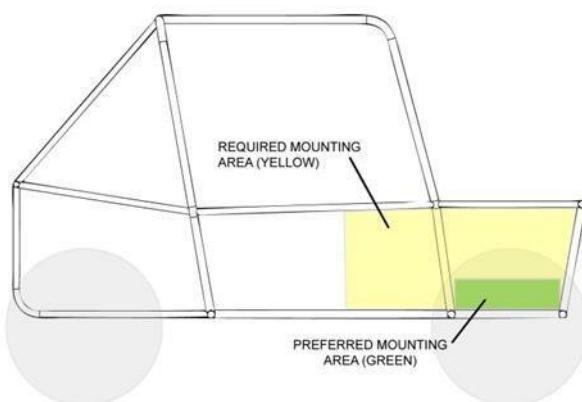


Figure B- 70: Transponder Mounting Location

B.11.2.3.3 Fastening

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

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

B.11.2.3.4 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.

 **The transponder equipment operates at a frequency of 3.59 MHz**

B.11.3 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.

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

B.11.3.1 Required Numbers

Two/Three 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 of the vehicle and strongly contrast with the number's background color. The use of adhesive to stick the numbers to the body panels is prohibited.

B.11.3.2 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- 71: Approved vehicle number font examples

B.11.3.3 Location

B.11.3.3.1 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.11.3.3.2 Front Number

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

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

B.11.3.4 Orientation

Numerals shall be aligned along a common horizontal line, and the entire number of panels shall be mounted in a generally horizontal orientation (+/- 3.0 degree tolerance) to facilitate fast vehicle identification. The number panels shall have 25.4mm (1.0 in.) spacing between numerals.

B.11.3.5 Number Size

The primary cut-out numbers must be at least 152 mm (6.0 in) high, dimension "H" in Figure B-73. The primary cut-out numbers shall have a stroke width in proper proportion to the font design for the given character height. The primary cut-out numbers shall be mounted such that the projecting face is a minimum of 13 mm (0.5 in) from the background panel.

Avoid sharp edges or points on the inner and outer edges of the cut-out numbers.

B.11.3.6 Backing Panel

Each number on the vehicle shall have a highly contrasting background to facilitate easy reading. The edges of the backing panel shall be no less than 25.4 mm (1.0 in.) from the edge of the numbers (dimension "D" in Figure B-73). Numbers may be outlined to provide enhanced contrast. Number backing panels must be securely fastened to the vehicle frame.



Figure B- 72: Vehicle Numbers, Example

B.11.3.7 Number Color

Teams are free to select their number and backing panel colors, provided that the colors are high contrast and facilitate fast vehicle identification. The number backing panel shall be all one color and all numerals shall be of matching color. See Figure B-73.

B.11.4 SAEINDIA Logo

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

B.11.5 Sponsor Identification

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

Teams must keep sufficient space (approximately 10 X 10 inches) unoccupied on the firewall, on the left

side of the driver (refer to the yellow highlighted region in Figure B-73). This region will be used for putting stickers as part of the Technical Evaluation (three stickers) and weighment (one sticker) process.



Figure B- 73: Portion for Technical Evaluation and Weighment Stickers (Highlighted in Yellow)

ARTICLE B.12: ERGONOMIC REQUIREMENTS FOR DRIVER SAFETY

B.12.1 Roll cage Requirements

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

B.12.2 Sub-System Requirements

B.12.2.1 Steering Wheel Clearances

There must be a minimum clearance (RA) of 220mm between the driver's chest or upper body/torso, whichever is closest to the steering wheel, as illustrated in Figure B-75.

 **Teams must ensure that their vehicle meets B14.2.2. Teams that do not meet this criterion will be marked as 'not cleared safety scrutiny'.**

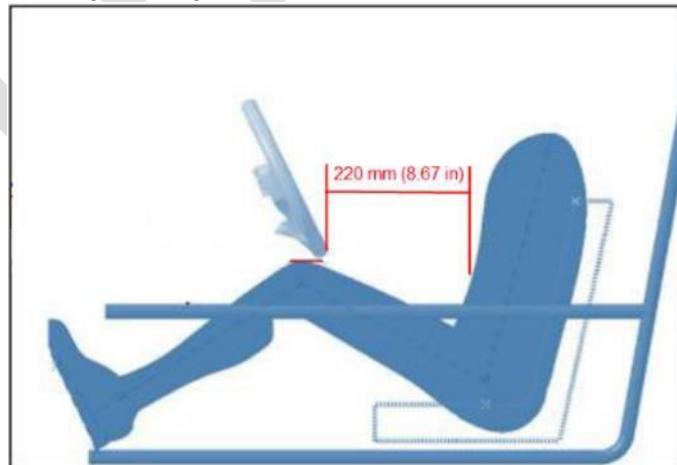


Figure B- 74: Driver's Chest Clearance

B.12.3 Driver Knee Safety Requirements

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

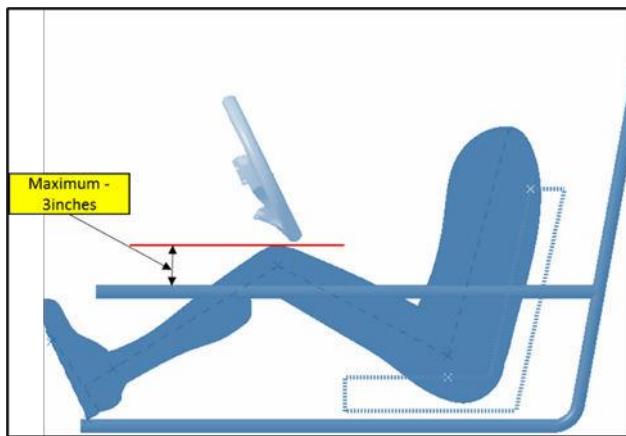


Figure B- 75: Driver Knee Safety Requirement

In line with the above rule, teams are required to meet the lateral clearance requirement of the knees. This is also measured when the driver's feet are on the pedals and hands on the steering wheel. The dimension "A" mentioned in figure B-77 should be a minimum of 76mm (3in) w.r.t SIM member inner surface.

Teams must ensure that their vehicle meets both the clearances mentioned under B14.3(as per Figure B-75 and Figure B-76), both the limits should be met simultaneously. Teams that do not meet these criteria will be marked as 'not cleared at safety scrutiny'.

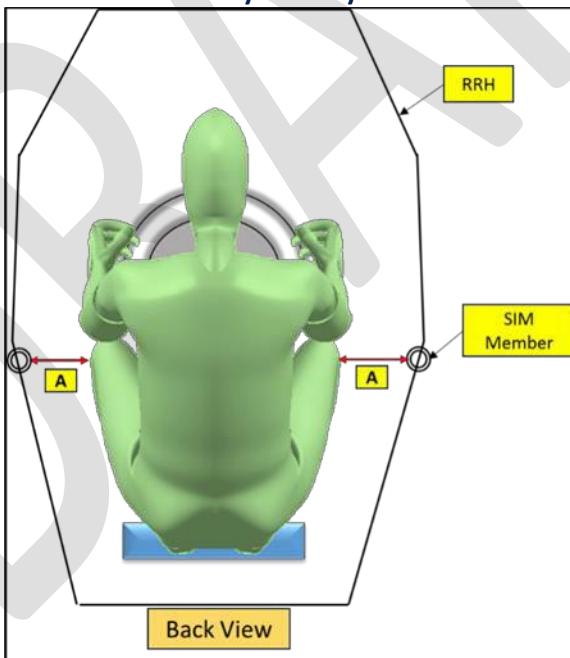


Figure B- 76: Driver Knee Safety Lateral Clearance

PART C: ELECTRICAL POWERTRAIN & SYSTEMS AND AUTONOMOUS SYSTEMS

ARTICLE C.1: ELECTRICAL SYSTEM DEFINITIONS

1 **HIGH VOLTAGE (HV):** In automotive engineering, “High Voltage” is defined as voltage in the range of 30 to 1000 VAC root mean square (RMS) or 60 to 1500 VDC.

 **The below definitions are defined only for eBAJA Vehicles.**

2 **TRACTIVE SYSTEM:** The tractive system of the vehicle is defined as complete electrical system of every part that is electrically connected to the motor(s) and tractive system Accumulator(s).

3 **TRACTIVE SYSTEM VOLTAGE:** The Voltage between any two terminals of the tractive system.

 **The tractive system voltage shall not exceed 60V DC in any condition.**

4 **TRACTIVE SYSTEM ACCUMULATOR:** The tractive system Accumulator(s) is defined as complete assembly / pack of all the battery cells that store the electrical energy to be used by the tractive system along with the corresponding contactor, fuse, and battery management systems/solutions.

5 **TRACTIVE SYSTEM ACCUMULATOR CONTAINER:** It is an enclosure/housing for the Tractive System Accumulator.

6 **ELECTRIC MOTOR:** An Electric Motor is an Electrical Machine that converts Electrical Energy into Mechanical Energy.

7 **HV RATED CUT-OFF SWITCH:** The HV rated cut-off switch shall operate on Tractive system voltage. When turned off, the Tractive System Accumulator shall not power the DC-DC Converter.

8 **ACCUMULATOR ISOLATION RELAY (AIR):** The Accumulator isolation relay should isolate the Accumulator from the tractive system.

9 **LOW VOLTAGE:** The low voltage (LV) system of the vehicle is defined as complete electrical system of every part that is not part of the tractive system. The Voltage between any two terminals of the Low Voltage system in the vehicle shall not exceed 15VDC in any condition.

10 **IGNITION/MASTER SWITCH:** The Ignition switch shall operate on <=15V DC. When turned off, the LV Power source should not power any LV components.

11 **KILL SWITCH:** The Kill switch shall operate on <=15V DC. Kill switch must de-energize the Tractive system, AIR, and TSAL, may de-energize the reverse light, and reverse alarm but shall not de-energize the Brake Light when brake pedal is pressed.

12 **TRACTIVE SYSTEM ACTIVE LIGHT (TSAL):** The TSAL shall operate on Low Voltage. TSAL should be continuously flashing/blinking with a frequency of 2Hz to 5Hz when the tractive system is active.

13 **BRAKE LIGHT:** The Brake Light shall operate on Low Voltage. Brake Light must glow continuously whenever the Brake pedal is pressed.

14 **REVERSE LIGHT:** The Reverse Light shall operate on Low Voltage. Reverse Light must glow continuously when the gear/FNR switch is in reverse mode.

15 **REVERSE ALARM:** The Reverse Alarm shall operate on Low Voltage. Reverse Alarm must turn on continuously when the gear/FNR switch is in reverse mode.

ARTICLE C.2: LOW VOLTAGE (LV) ELECTRICAL SYSTEM (<=15V DC)

The LV system must include at least two kill switches, a LV ignition/master switch, a brake light, TSAL, and RTDS. If the vehicle is equipped with reverse mode feature, then a reverse light and reverse alarm is mandatory and would need to be on the LV system only.



C.2.1 LV POWER SOURCE

All LV components shall use power source from either an auxiliary battery or step-down power from Tractive system accumulator using DC-DC Converter. Use of both DC-DC Converter & Auxiliary battery is strictly prohibited. In both cases, the use of an ignition key/master switch is mandatory. However, teams may use a separate DC-DC converter (<=9V) or separate auxiliary battery (<=9V) to power telemetry and logging/driving data equipment.

C.2.1.1 AUXILIARY BATTERY (Option 1)

1. An auxiliary battery used as LV Power Source shall not power any component in the tractive system.
2. Auxiliary Batteries shall not be recharged by traction Motor(s)/ alternator/ DC-DC Converter. The batteries shall be a spill or leak proof and in the case of lead acid chemistries - factory sealed (incapable of being opened or serviced) and should not leak in the event of a rollover.
3. Auxiliary batteries must be attached securely to the frame and shall be mounted with sound engineering practices and not become loose during normal operation, a collision, or rollover. The battery must be safely placed and concealed. Battery terminals shall be insulated and protected against an electrical short circuit.
4. Should the auxiliary battery feature lithium chemistry, then it must also include a dedicated BMS.

 **If auxiliary battery features Lithium chemistry, it must be installed behind the firewall.**

C.2.1.2 DC-DC CONVERTER (Option 2)

1. Teams shall use an automotive grade DC-DC Converter with a circuit designed with overvoltage and under voltage protection, overload and short circuit protection. The DC-DC Converter shall have sufficient rating to supply power consumption requirement of all the LV components.
2. The DC-DC Converter shall have an appropriate rating of fuse as defined in section C.7: – Fuse.
3. The DC-DC Converter should be treated as a tractive system component and accordingly must meet the requirements as specified in sections C.5.1 and C.5.3 It must be attached securely to the frame behind the firewall and shall be mounted with sound engineering practices, so that it does not become loose during normal operation, a collision, or rollover.
4. Installing the DC-DC Converter in the cockpit is prohibited.

 **HV rated cut-off switch is mandatory when DC-DC converter is used as LV Power source.**

C.2.2 Kill Switch

C.2.2.1 Kill Switches

1. Kill Switch shall be a Push Button E-Stop type as per ISO 13850. The said switch shall work as a HVIL, with the LV system triggering the Accumulator(s) relay to De-energizing the Tractive system. It is mandatory for both the Kill Switches to be “PUSH TO KILL” & ROTATE TO ENERGIZE” type.
2. Each vehicle shall be equipped with a minimum of two (2) kill switches to deactivate the Tractive System.

 [Refer to Article B.8.1.2 for Location of kill switches and Article B.8.1.3 for Mounting.](#)

C.2.3 LV System Specific Requirements

1. All LV components and their wiring harness must be neatly arranged, put into conduits, and mounted with fasteners as specified in ARTICLE B.10:- Fasteners. LV components that have open leads or that may be sensitive to moisture and dirt (e.g.: micro controllers, non-IP rated displays, etc.) must be housed in appropriately rated enclosures as defined in section C.5.3, with appropriate tool less

connectors and seals.

2. In the case of LV harness, if jumper wires are used, the end terminal must be soldered and sealed with glue or epoxy to insulate and protect it.
3. All electrical connections in the current path that rely on screwed connections must have a rigid locking mechanism as specified in ARTICLE B.10:- Fasteners.

C.2.4 SIGNALING

C.2.4.1 Brake Light

 Refer to Article B.8.2.1 for Brake Light requirements, specification, fastening and locations.

C.2.4.2 Reverse Light

 Refer to Article B.8.2.2 for Reverse Light requirements, specification and locations.

C.2.4.3 Reverse Alarm

 Refer to Article B.8.2.3 for Reverse Alarm requirements, specification and locations.

C.2.5 Instrumentation

 Refer to Article B.8.3.

C.2.6 Data Acquisition

 Refer to Article B.8.4.

C.2.7 Communication System

 Refer to Article B.8.5.

ARTICLE C.3: TRACTIVE SYSTEM – POWERTRAIN

C.3.1 E-KIT REQUIREMENTS

1. The e-kit Comprises of all major aggregates of electric powertrain such as Tractive System Accumulator, BMS, Motor/s, Motor Controller and Tractive System Accumulator Charger etc.
2. The traction motor or motors may be of any topology and used in any configuration.
3. Tractive System Accumulator chemistry will be limited to Lithium Ion based chemistries. Capacity shall not exceed **120 Ah** irrespective of the number of packs or modules used at a time on the vehicle. The peak voltage(at 100% SoC) of the battery or batteries shall not exceed 60 VDC. Similarly, the Charging system shallnot have a charging voltage exceeding 60 VDC.
4. All the e-kit components (excluding charger) shall compulsorily follow International Electro- Technical Commission (IEC) 60529 IP67 standards (related to dust and water entry) to achieve the required protection from failures when the tractive system comes in contact with water.
5. Regeneration is allowed and encouraged.

 **BAJA SAEINDIA is not responsible for providing any e-kit for any (new/old) aBAJA teams. It is teams responsibility to choose and purchase components from market/vendors compliant with the BAJA SAEINDIA 2024 Rulebook.**

 **If any of the e-kit components (excluding charger) are/is not certified for compliance with International Electro-Technical Commission (IEC) 60529 IP67, teams are solely responsible for making it IP67 compliant. Videos of testing in accordance with the standards and declaration of the same (from the college) shall be submitted to eBAJA Technical Committee.**

C.3.2 POWER AND VOLTAGE LIMITATION

1. The maximum voltage in the tractive system must not exceed the 60V, violating these values will lead to disqualification for the entire event.
2. The maximum power in the tractive system must not exceed 9kW at any instant as measured between the terminals of the battery / batteries or at the cumulative junction going to the Motor Controller Unit (MCU) or Motor Controller Unit(s). Violating these limits will lead to disqualification for the entire event.
3. Power limits shall be enforced by means of an EV grade Instant Fuse/DC MCB with a DC Voltage rating greater than or equal to the tractive system voltage and current rating as mentioned in the table below:

Sr.No.	Nominal Voltage of Tractive System Accumulator (V)	Current Rating of Fuse (A)
1.	≤ 50	≤ 180
2.	$50 < V \leq 53$	≤ 170
3.	$53 < V \leq 56$	≤ 160
4.	$56 < V < 60$	≤ 150

C.3.3 ACCELERATOR PEDAL

1. The accelerator must be a right-foot-operated foot pedal. The Traction Motor controller must be actuated by a foot pedal.
2. The foot pedal must return to its original position when released. The foot pedal must have positive stops at both ends of its travel.
3. Teams shall use a Hall effect type throttle pedal in addition to the above-mentioned regulations.

ARTICLE C.4: TRACTIVE SYSTEM - ENERGY STORAGE and CHARGING

C.4.1 BATTERY SPECIFICATIONS

For battery specifications, Refer to C.3.1.3

C.4.2 TRACTIVE SYSTEM ACCUMULATOR(S) – GENERAL REQUIREMENTS

1. All Accumulators shall comply with AIS 156. The battery pack that stores the tractive system energy will be built into Accumulator(s) (segments), and must be enclosed in an electrically insulated Accumulator(s) container(s).

 The below tests are mandatory to be performed on the Accumulators if AIS 156 compliance authentic Certification is unavailable:

- i) Physical verification of battery pack including BMS safety features.
- ii) Vibration test.
- iii) Over Charge protection.
- iv) Over Temperature Protection.

 Battery pack procured for eBAJA SAEINDIA 2023 or prior events having valid AIS048/156 Certificate, will be allowed for participation in aBAJA SAEINDIA 2024, without having to obtain fresh authentic Certificates.

1. The Accumulator(s) container(s) should be located behind the firewall and should be easily accessible anytime during the entire event for inspection or rectification of defects.

- 2 The Tractive System shall include at least one AIR and one Fuse, which will open the circuit and disconnect the energy flow from Accumulator(s) to the remaining tractive system whenever a fault is detected.

 **Should the Battery Pack(s) / Accumulator(s) be modified or reworked after its certification, its certification will thereby be deemed revoked, and considered null and void.**

C.4.3 TRACTIVE SYSTEM ACCUMULATOR(S) CONTAINER - ELECTRICAL CONFIGURATION

- 1 The tractive system Accumulator(s) container must be made from an insulating material. If the container is made from an electrically conductive material, then the Accumulator(s) container along with the mounting structure must be electrically insulated in all 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 gaps provided will not be considered as a suitable insulation material. Care must be taken to ensure conductive penetrations of any type.

 **Wood/Rubber is not permitted to be used for building the Accumulator(s) Containers or as a structural member.**

- 2 Interconnecting the two individual cells by soldering in the high current path is strictly prohibited.
- 3 Soldering of wires to cells for obtaining the voltage monitoring inputs to the BMS is allowed since these wires are not part of the high current path.
- 4 Every wire used in an Accumulator(s) container must be rated to the maximum tractive system voltage, irrespective of those wires being part of LV system or tractive system.

C.4.4 TRACTIVE SYSTEM ACCUMULATOR(S) CONTAINER - MECHANICAL CONFIGURATION

- 1 All Accumulator(s) containers must be rugged and rigidly mounted to the chassis to restrict their motion in all directions. If fasteners are used for mounting an Accumulator(s) container, they must comply with ARTICLE B.10:- Fasteners.



Figure C-3: Accumulator(s) Container Mounting

- 2 Accumulator(s) containers must be placed strictly behind the firewall. Usage of any type of Belts/Ropes to support or hold the Accumulator(s) container is prohibited. Accumulator(s) container mounting positions that are strictly prohibited are shown in the picture below:



Figure C-4: Prohibited Accumulator(s) container Positions

- 3 All Accumulator(s) containers must be protected from the side or rear impact collisions, by providing equivalent structure as defined in B.2.2.
- 4 The Accumulator(s) container must be built from a mechanically robust material. The container material must be fire resistant.
- 5 Holes (both internal and external) in the container are permitted for the wiring-harness, ventilation & fasteners. External holes must be thoroughly sealed.
- 6 A proper cooling system if needed, should be designed to dissipate excessive heat and maintain an adequate temperature of the tractive system accumulator for deriving optimum performance of the vehicle.

C.4.5 ACCUMULATOR(S) ISOLATION RELAY(S) (AIR)

- 1 The Accumulator(s) isolation relays should be provided to isolate the Accumulator(s) from the Tractive system and must be "Normally Open Type".
- 2 The fuse for protecting the Accumulator(s) and tractive system circuit must have lower rating than the peak current of the isolation relays.

C.4.6 BATTERY MANAGEMENT SYSTEM (BMS)

- 1 The BMS shall be powered by the Tractive System Accumulator, to continuously monitor the Individual cells and battery pack with regard to all the parameters such as current drawn, Temperature, Voltage etc., such that BMS should be able to trigger a shutdown in the event of any abnormal behavior.
- 2 The BMS must feature Overvoltage, Under Voltage, overcurrent protection and short circuit protection at every cell. If individual cells are directly connected in parallel, only one voltage measurement is needed.
- 3 The BMS shall not be able to trigger the AIR when the Ignition or Kill Switch is in the off position.
- 4 All LV connections to the BMS must run through a separate conduit, including any connections to external devices such as laptops.
- 5 The temperature of the cells should be monitored and if the temperature exceeds the permissible battery temperature specification, BMS should shut down the entire tractive system.
- 6 Should the BMS fail or loss of power is detected, entire tractive system should be de-energized.
- 7 BMS must be rigidly fastened to sustain vibrations in dynamic conditions.
- 8 Teams shall take necessary care to ensure that Tractive System Accumulator(s) does not get discharged fully during idle/non-operational conditions.

 **Teams will have to submit technical specifications of the BMS being used as well as wiring diagrams, and its images.**

C.4.7 CHARGING

- 1 Accumulator(s) can be charged inside or outside the vehicle.
- 1 At least one team member who knows the charging process must stay with the Accumulator(s) / vehicle, during charging. All the Accumulator(s) containers must have a label with the following data during charging: Team name and phone number(s) of Electrical Head of the respective Team.
- 2 When the Accumulator is being charged inside the vehicle, no work is allowed on any of the vehicle's systems.
- 3 No grinding, drilling, etc. are allowed in the charging area.
- 4 The charging circuit may include an external Kill Switch.
- 5 The vehicle's Kill Switch must be engaged (in off position) to de-energize the tractive system when the Accumulator is charging.

C.4.8 CHARGERS

- 1 The charger shall not exceed a charging voltage of 60V.
- 2 Chargers presented and sealed by the Electrical TEJ at Electrical Tech. Inspections are permitted for usage at the event site. All connections of the charger(s) must be isolated and covered. No open connections are allowed.
- 3 All chargers including those built by the team, must be built to high standards and confirm to all electrical requirements for the vehicle tractive system.
- 4 The charger must incorporate an interlock such that the connectors become live only if, it is correctly connected to the Accumulator.
- 5 Tractive System Accumulator charging leads must be in orange color.
- 6 During the process of charging the Accumulator, the BMS must be live and able to turn off the charger, if a fault is detected.
- 7 For charging the accumulator externally, Use only static equipment.

 **Teams are allowed to charge the Battery Pack using standard AC Power socket of rating 230V, 16A provided within the pit.**

ARTICLE C.5: TRACTIVE SYSTEM & LV SYSTEM – GENERAL REQUIREMENTS and HANDLING

C.5.1 POSITIONING OF TRACTIVE SYSTEM PARTS

- 1 All parts belonging to the tractive system, including cables and wiring must be contained within the envelope of the frame and/or an additional envelope of tubing which meets the minimum specification defined in B.2.2 or equivalent, such that they are protected against being damaged in case of a crash or roll-over situation.

If tractive system parts are mounted in a position where damage could occur from a rear/side impactor have 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 as defined in B.2.2.
- 2 When observed from the side view or front view, any part of the tractive system should not be projected below the bottom surface of the frame.



C.5.2 TRACTIVE SYSTEM FIREWALL

- 1 The tractive system firewall must comply with the main firewall regulations as defined in B.6.3. Firewall must separate the driver compartment from all tractive system components.
- 2 The firewall must be made from an electrically insulating material. In case the firewall is made from an electrically conductive material, it should be completely covered by an electrically insulating material on all sides. The firewall shall act as an insulating barrier between all the tractive system components and the driver.
- 3 The firewall must be resistant to puncture, scratch and fire, It should be made of UL94-V0, FAR25, or equivalent grade.

C.5.3 TRACTIVE SYSTEM ENCLOSURES

- 1 All Enclosures used must be constructed out of UL94-V0/FAR25 equivalent or better thermally and electrically insulating material.
- 2 There must be no conductive path or electrical connection between the frame of the vehicle (or any other conductive surface that might be inadvertently touched by a crew member or spectator) or any part of any electrical component and the tractive system component/enclosure, may it be via its fasteners, mounting brackets or other means. Insulating coatings of the conductive fastener surfaces will not be considered a suitable means of isolation.
- 3 Connectors and seals used must ensure Ingress protection.
- 4 If fasteners are used for mounting, they must comply with ARTICLE B.10:- Fasteners.
- 5 All housings or enclosures containing parts of the tractive system must be labeled with a 2.0" x 2.0" sized sticker(s) with a red or black lightning bolt on a yellow background or a red lightning bolt on white background. The sticker must also contain the text "High Voltage".



Figure C-5: High Voltage Indication Sticker



This sticker is used for identifying the Tractive system voltage and to caution users and bystanders.

C.5.4 TRACTIVE SYSTEM SPECIFIC REQUIREMENTS

- 1 All cables operating on voltage greater than LV specified voltage must be multi-stranded copper, single core cables with HV class insulation. High-temperature silicone wires are highly recommended.
- 2 All tractive system connections must be designed to use intentional current paths (through conductors such as copper or aluminium). Metal bolts should not be used as the primary conductor. Lugs must be directly and firmly seated on each other with the use of metallic washers and spring washers to ensure sufficient contact pressure. All electrical connections in the high current path of the tractive system that rely on screwed connections must have a rigid locking mechanism as defined in ARTICLE B.10:- Fasteners. The connections must not include soft compressible material (such as plastic and rubber).

spring washers in the stack-up).

-  **Extension of Tractive System cables is not acceptable. Only single-length cables are acceptable, with no intermediary junctions and extensions.**

C.5.5 ACTIVATING THE TRACTIVE SYSTEM

- 1 Ready-to-Drive-Mode: In this mode, Motor(s) will respond to the input of the torque encoder/accelerator pedal.
- 2 The driver must be able to (re-)activate or reset the tractive system without the assistance of any other person, except for situations in which the BMS has shut down the tractive system and non-cockpit kill switch is engaged (in off position).
- 3 Sequence of activating the tractive system:



Activating the
Tractive System.pdf

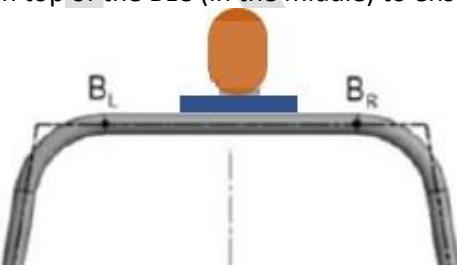
-  **After the kill switch has been engaged, the vehicle should exit the Ready-to-Drive-Mode. To activate/enter into Ready-to-Drive-Mode above process shall be followed.**

C.5.6 TRACTIVE-SYSTEM-ACTIVE LIGHT (TSAL)

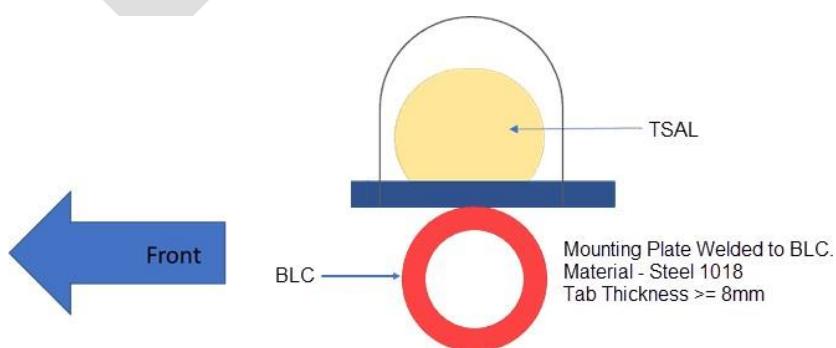
- 1 TSAL should be continuously flashing/blinking (when the vehicle is in “Ready to Drive Mode”). The TSAL must be a round beacon type and an amber flashing light (> 350 Lumens per unit) with a frequency of 2Hz-5Hz. It must be clearly visible in all directions to a person standing up to 20m away from the vehicle even in very bright sunlight. Refer below image for some of the allowed and not allowed TSAL.



- 2 The TSAL must be fitted on top of the BLC (in the middle) to ensure visibility from all directions.



- 3 A metal plate (min. 6 mm thickness) needs to be welded on top of the BLC member as shown in the figure below. The TSAL should be securely mounted to this welded base plate using screws/bolts.



- 4 It is suggested that the TSAL be protected on all sides by a cage to lend it protection in case of a roll-over. The cage needs to be designed such that it allows for the replacement of the TSAL if a need arises.

- 5 It is prohibited to mount/place other lights/objects/stickers within 100 mm proximity of the TSAL.

 **In case of any malfunction or improper visibility of the TSAL on any dynamic event tracks, the vehicle will be black flagged and sent back to the pit until the problem is resolved.**

- 6 An indicator needs to be placed in the cockpit within the driver's peripheral vision to make him/her aware of the "ready to drive" status of the vehicle. It must always mimic the status of the TSAL. Teams are free to choose the size and intensity of the light, but it must always be visible to the driver even in bright sunlight.

C.5.7 READY-TO-DRIVE-SOUND (RTDS)

- 1 The vehicle must make a characteristic sound, to be maintained at a minimum level of 70dB (fast weighting) in a radius of 2m around the vehicle, only once but not continuous (for at least 1 second and a maximum of 3 seconds) immediately afterwards vehicle is set in ready to drive mode every time.
- 2 The sound (Buzzer) type used by the team must be easily recognizable. But, animal voices, song parts and offensive sounds are not permitted.

C.5.8 DRIVER DISPLAY

- 1 Tractive System Accumulator Voltage, Temperature, and State of Charge (SOC in %) shall be displayed (at all times) on the dashboard, when the Ignition/Master Switch 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/information to the driver or the team, for tracking must be included in the Cost Report. Additionally, any batteries used to power the Auxiliary/accessories must comply with the battery rules in Section C.2.1.
- 2 The vehicle must also have an indication to the driver, regarding the state of the LV and Tractive System (when the vehicle is in ready to drive mode). This indication may be either via a series of light indicators or messages in the driver display. Additional indicative systems that can help diagnose and detect operational states are allowed and encouraged.
- 3 Teams are encouraged to log parameters such as current, voltage (RMS and dc), temperatures, throttle position, brake applications, motor speed, vehicle speed etc., to understand its importance, for carrying out analysis and improve system efficiency and design performance in subsequent events. There is a large scope for fine-tuning and race-driving strategy.

C.5.9 TRACTIVE SYSTEM HANDLING and WORKING

The recommendations below are advisable to be followed while the team members are working at their institute or during their presence at the event site for the eBAJA competition:

- 1 The Electrical head will be responsible for all electrical work carried out on the vehicle and must accompany the vehicle during all times at the event site.
- 2 Activities on the Tractive System must take place in the pit. In case of measurements on the active Tractive System or its activation within the pit for testing purposes, the following steps must be followed:
 - i. The vehicle must be barred from anyone not involved in the work.
 - ii. The vehicle must be jacked up.



- iii. One team member must be prepared to push a shutdown button at any time.
 - iv. The Tractive System must only be activated for as long as necessary.
 - v. Appropriate PPE and tools must be worn/used by those involved in the work.
 - vi. No other work on the vehicle is permitted when the Tractive system is active.
- 3 It is highly recommended that 1000V VDE, IEC 60900 standard insulated tools be used whenever work is being carried out on the Accumulator(s) or the tractive system.
- 4 Safety glasses with side shields and CLASS 00 or better HV safety gloves (meets or exceeds ASTM D120 or EN 60903 standard) must be worn by all participating team members when:
- i. Parts of the tractive system are exposed while it is active
 - ii. Work is being done on the Accumulator(s).

ARTICLE C.6: GENERAL REQUIREMENTS

- 1 All LV and Tractive systems, especially live wires, contacts, etc. of the tractive system need to be isolated by non-conductive materials or covers to protect each of them from being touched. The LV and Tractive System Accumulator terminals and other Tractive system contact points shall be properly insulated with best engineering practices.
 - 2 LV and Tractive system components must be protected from moisture in the form of rain or splashes through the use of a properly insulated harness, connectors, enclosures, and insulating caps.
 - 3 Duct taping and bubble wrap will not be accepted as suitable means of IP protection.
 - 4 All wires and terminals and other conductors used must be sized appropriately for the continuous 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 a serial number of wires printed on the wire is sufficient.
- Sizing of the conductors for the ‘continuous current’ can take account of the maximum electrical current that will be a pass / used for the anticipated duration of time.**
- 5 The use of zip ties is only allowed for appropriate segregation of wiring harnesses. All wiring must be done as per professional standards with appropriately sized conductors, lugs, and connectors with adequate strain relief and protection from loosening due to vibration, etc. Wiring shall be routed away from sources of excessive heat, abrasion, chafing, and possible short circuit.
 - 6 Usage of insulation tape or rubber-like paint (or similar coating products) for insulation purposes is prohibited for both LV and Tractive System components and their associated wiring harness, fasteners, and mountings.
 - 7 All connections must terminate with corrosion-proof copper/aluminium ring lugs. Teams are strongly recommended to procure a Lug Crimping kit that can meet all the sizes and diameters required. Once the lug is crimped, the cable should be soundly held, and the exposed metal insulated using appropriately colored heat shrink sleeves of suitable thickness and quality. Exposed conductive fasteners and washers must then be insulated with rubber caps. Insulating coatings of the conductive fastener surfaces will not be considered a suitable means of isolation.
 - 8 All cables operating on voltage greater than LV specified voltage must be in orange color. All the LV wires shall be color coded to differentiate between the positive and negative current paths; with all those in the positive current path being color-coded other than orange and those in the negative path

(grounding if applicable) color coded as black with appropriately color-coded shrink wrap, caps and insulation materials.

- 9 Any wiring harness passing through the driver's cockpit must be routed along the floor and the LFS member behind a panel or with an enclosed channel in such a way that it does not interfere with the driver and their ingress/egress and functioning.
 - 10 Any component using a heat sink must be mounted such that there is at least 50 mm clearance between itself and any other surface or component adjacent to it, albeit excluding the mounting of a cooling fan, heat exchanger, cooling fluid interface, or cooling duct. (e.g., the heat sink of the controller cannot rest flush against the firewall or a mounting plate).
 - 11 All wiring must be shielded against damage by rotating and/or moving parts by using appropriately sized conduits that follow the color nomenclature.
 - 12 All components in the tractive system must be rated for the maximum tractive system voltage.
 - 13 The tractive system motor(s) must be connected to the Accumulator(s) through a motor controller (Traction Controller). Bypassing the control system and connecting the tractive batteries directly to the motor(s) is strictly prohibited.
 - 14 The complete layout of the electric circuit designed by the team must be documented accurately in the ESS (shared down the line)
 - 15 The Accumulator(s) Isolation Relays (AIRs) and the main fuse must be separated with an electrically insulated and fireproof material from the Accumulator(s) Container(s). Air (providing small gaps) is not considered to be a suitable insulation material in this case.
 - 16 Traction system and LV circuits must be physically segregated such that they are not run through the same conduit, except for interlock circuit connections.
 - 17 Traction system components shall be rigidly mounted ensuring electrical insulation and fire resistance. Components and cables capable of movement must be positively restrained to maintain safe spacing.
 - 18 The vehicle's electrical system shall be designed and constructed following best engineering and electrical practices.



ARTICLE C.7: FUSE

- 1 Each of the electrical systems (both LV and Tractive system) must be protected by providing a 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 peak current cut-off rating (i.e., the fuse current defined for the component by the manufacturer) of any electrical component, for example, wire, bus bar, cell, or other conductors that it protects. All fuses should be instant blow /trip type with a time delay of less than 500 mS. All instant fuses must be rated as automotive fuses with suitable specifications and conformity.
- 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.



Figure C-8: Fuses

- 3 All fuses must have an interrupt current rating which is higher than the theoretical short circuit current of the Tractive system that it protects.
- 4 If multiple Tractive accumulators or LV batteries are used, then each parallel 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. The 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.
- 5 Accumulator Cells with internal over-current protection may be used (if suitably rated), without an external fuse or fusible links.
- 6 DC MCBs of suitable automotive grade and resettable automotive thermal fuses may be used as long as they meet the requirements as defined in C.7.1.

- 7 The Tractive System Fuse / MCB must be situated behind the firewall in proximity to the Accumulator in a location that is easy to service and that is visible for inspection. Teams may use appropriate fuses that can survive the IP requirements, or house them in suitable, housings with transparent lids or viewing panels.
- 8 Once the Tractive System Fuse / MCB is blown/tripped, teams shall be escorted off the track to the pits. Once reset/replaced under the supervision of a BAJA technical official, teams will be allowed to continue.

ARTICLE C.8: GROUNDING

C.8.1 GROUNDING REQUIREMENTS

- 1 All electrically conductive parts of the vehicle (and also any driver harness mounting points, seat mounting points, and driver controls and excluding Tractive system components) which are within 100mm of LV component, must have a resistance below 300 mΩ (measured with a current of 1A to LV system ground).
- 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 LV component, must have a resistance below 5 Ohm to LV system ground.
- 3 The electrical conductivity of any part which is likely to be conductive may be tested, for example, the driver's harness attachment bolt. But wherever no convenient conductive point is available then an area of the coating may be removed.



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

- 4 All Tractive system components should have a very high contact resistance (i.e., the resistance between the enclosure of Tractive system components and ground), above 10MΩ. The DC-DC Converter will be regarded as a Tractive system component and should accordingly be treated as such.

ARTICLE C.9: ACCUMULATOR(S) SWAPPING (For Endurance Race only)

C.9.1 NON-PRIMARY ACCUMULATOR(S)

- 1 Teams may have spare Tractive System Accumulator(s) which will be referred to Non-Primary Accumulator(s). The Non-Primary Accumulator(s), 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(s), if the team so desires during the endurance event. All Accumulators are required to be presented with 100% SOC at the time of Technical Inspection and must seek approval by demonstrating swapping process.
- 2 The Non-Primary Accumulator(s) set up must be compliant with Clause / Rule no. C.4.1. It should be of the same size, capacity, and specification, identical cells, BMS, electrically wiring, and having identical mounting design as per the primary tractive system Accumulator(s), which will be replaced.
- 3 The Non-Primary Accumulator(s) must be stored in an electrically insulated container made of fire- retardant material, as per Accumulator(s) Container guidelines (Refer Clause / Rule no. C.4.2, C.4.3, and C.4.4).

C.9.2 SWAPPING MECHANISM / PROCESS

- 1 Teams shall avail the option of Accumulator(s) Swapping as many times as they choose during the Endurance race.
- 2 Accumulator(s) shall be easily accessible and removable from the vehicle for the team to qualify to be allowed for swapping during the endurance race. The same shall be demonstrated by the team during the Electrical Technical Inspection. Teams should have HV insulated tools and PPE to execute the swapping activity.
- 3 The removal, dismantling, or dislocation of the drivetrain (compromising the tractive powertrain, gearbox, transmission, differentials, drive axles, wheels), suspension struts, members, and mounts is strictly prohibited. Any swappable design that compromises the mechanical structure, safety, and function will not be acceptable.
- 4 Before swapping, the Tractive system should be de-energized 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.
- 5 The Accumulator(s) setup shall be carefully removed and installed without interfering with the surrounding components at any time during the entire process.
- 6 Removing the Accumulator(s) setup shall be restricted to the respective plane in which the setup is mounted. Refer to figures C- 9 mentioned below,
 - i. If Accumulator(s) container is placed completely below plane S-R, its removal is allowed only via a horizontal path through the side or rear of the vehicle below plane S-R (i.e., Path of removal should be such that no part of Accumulator(s) container is raised above plane S-R during the process of battery removal.)
 - ii. If Accumulator(s) container is placed completely or partially above SR plane, the path of Accumulator(s) 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(s) more than 10 inches during removal process is prohibited.

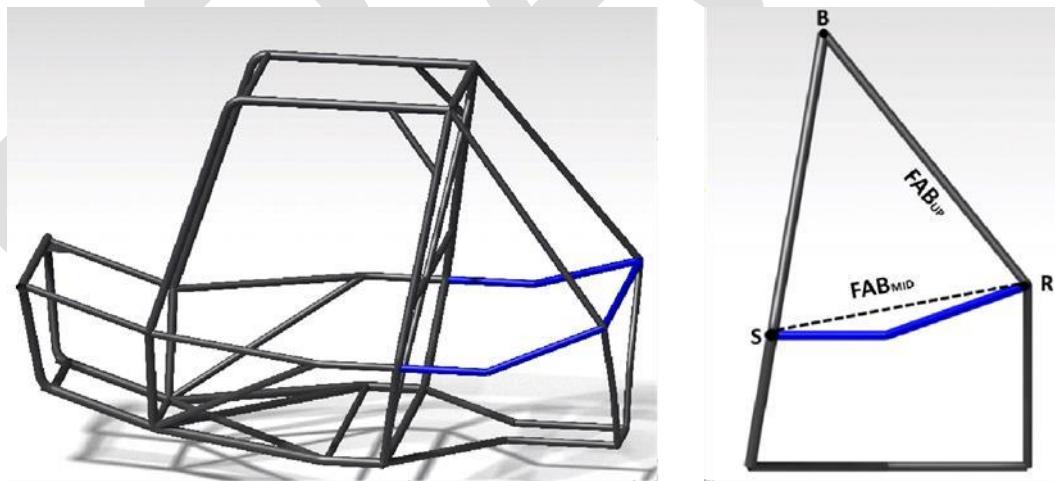


Figure C-9: Reference plane for Accumulator(s) removal

- 7 During the complete path of removal min. 2-inch clearance is mandatory against any roll cage member or component of the vehicle (excluding Accumulator(s) mounting and removal mechanism). For ease of removal and faster Accumulator(s) Swapping process, it is allowed to use mechanism and linkages, but it should be ensured that Accumulator(s) container should be rigidly connected and mechanically locked to arrest any motion during normal operation of a vehicle as mentioned in C.4.4.

- 8 Teams should follow the same process for reinstalling the secondary Accumulator(s) as executed whileremoving the setup.
- 9 The Secondary Accumulator(s) shall be installed, and the positive terminal is connected first followedby the negative terminal. One team member must be in a ready position holding an extra/spare fire extinguisher apart from one in the vehicle while the Accumulator(s) Swapping process is going on.
- 10 Only four (4) people from any given team, including driver/s, are allowed within the Swappable Area (SA) at any one time.
- 11 The time spent on swapping the Battery pack is considered as a continuation/part of the Endurance Race. The Driver can neither exit the vehicle nor be allowed to remove any safety gear while the Accumulator(s) Swapping process is going on.

However, if a driver change is necessary, as per instructions the registered second driver can take charge and continue further in the endurance event. (Refer to Clause F.8.3.6)

C.9.2.1 Driving in the Swappable Area

All cars must operate at a walking speed while in the Swappable Area and when entering/exiting the area. Anyteam found speeding in the swappable area will be assessed a penalty.

Cars may not be pushed into the Swappable Area (SA) without a driver being present and prepared to drive(i.e., wearing all required safety equipment).

C.9.2.2 ACCUMULATOR HAND CART

- 1 Teams shall use a hand cart for transporting the secondary Accumulator(s) around the competition site.
- 2 The hand cart must sport stubby terrain tires with a minimum diameter of 8".
- 3 The hand cart must have a mechanism or anchor to restrict the motion of the accumulator, even in the event of the hand cart tipping / rolling over.
- 4 Internal surfaces of the hand cart must be constructed out of UL94-V0/FAR25 standard recognized orequivalent thermally and electrically insulating materials. Similarly, the handle of the cart must also be insulated.



Wood is not an acceptable material.

- 5 The cart must have an enclosed compartment in which the accumulator is housed and protected fromdust, mist, and debris.
- 6 The team must ensure that those members using the cart and performing swapping must wear propergloves and shoes as defined in C.5.9

ARTICLE C.10: AUTONOMOUS SYSTEMS

C.10.1 Autonomous System Specification Sheet

1. Hardware Integration Overview: teams will need to provide details about the sensors/components they are considering in their design and a preliminary plan on how they will execute their design including any mounting, cooling, wiring, and testing they feel is necessary-or relevant to the project to meet the Year 1 objectives of the competition.
2. Software Architecture Design: based on the software(s) given to teams how will your team work to integrate them into the project including testing, or integration of components.

C.10.2 Autonomous System Requirements

1. If certain hazardous conditions occur, there should be a facility for Vehicle Stop, wherein the vehicle comes to a standing still and switches off all the powertrain systems.

2. The maximum speed of the autonomous vehicle shall be restricted to 30 kmph.
3. There should be a switch in the vehicle easily accessible to the driver, to switch between Manual Mode and Autonomous Mode.
4. Manual Mode: Driver has full control of the vehicle, overrides autonomous functionality.
5. Autonomous Mode: Vehicle has self-driving ability, and can drive without the requirement of a manual driver being present.
6. Wiring of all the sensors must be proper, without any open ends and all the wiring must be contained within the roll cage envelope.

C.10.3 Blue Autonomous Warning Light

C.10.3.1 Exterior Blue Light

- Teams shall mount 2 blue lights to their vehicle that are on when Autonomous Mode is active and off when the car is in Manual Drive Mode.
- The first light shall be on the exterior of the vehicle mounted to the roof. The exterior blue light serves as a warning to others around the vehicle that Autonomous Mode is active.
- The light shall be visible in daylight conditions by an observer on any side of the vehicle. Teams may mount the Exterior Blue Light on CLC or BLC member of the roll cage. Teams shall design a mechanism to enable the light when in Autonomous Mode and disable the light when not in Autonomous Mode. For example, teams might have an output from their control system that drives a relay that switches the lights on/off.

C.10.3.2 Interior Blue Light

- The second light shall be on the interior of the vehicle mounted on the dashboard. The interior blue light serves as an indicator to judges and passengers that autonomous mode is active. The light shall be visible from any seat in

The functionality of both lights will be checked during the Technical Evaluation Phase.

C.10.4 Indicator Lights

Indicator Lights must be mounted on the vehicle on both the sides on front as well as rear, to indicate while lane changing.

C.10.5 Remote Kill Switch

aBAJA vehicles need to incorporate a remote kill switch, which must be operational when the vehicle is in autonomous mode, considering the safety aspects.

C.10.6 Autonomous Components

C.10.6.1 Servo Motors

Servo Motors need to be mounted for components like accelerator, brake and steering, etc. being operational components of aBAJA vehicle.

Teams can select the servo motors based on their aBAJA vehicle design requirements.

Isolating of all the servo motors from the physical driver must be taken care of, especially in case of accelerator, brake and steering, etc.

C.10.6.2 Premium Long-Range Radar - ARS 548 RDI

ARS548 RDI is a high performance 3D/4D premium long range radar sensor which enables highly automated driving in combination with other technologies.



- Easy to implement and optimized anti-collision protection for vehicles of every description (particularly autonomous)
- Area monitoring system for far-field, e.g., of hazardous or non-accessible areas
- Non-radar-reflecting object detection by affixing a protective cover
- Classification of objects (> 120 single cluster)
- Object detection, e.g., in confusing or unclear areas
- Distance and speed monitoring
- Road traffic technology e.g., parking area surveillance

C.10.6.2.1 Typical areas of application

- Collision warning
- Area monitoring system for far range
- Classification of objects
- Height measuring
- Object detection

C.10.6.2.2 Technical Specifications

- Dimensions: 137 x 90 x 39 mm (w/o con.)
- Mass: 526 g
- Distance Range: 0.2 - 301 m
- Field of View: ± 60°
- Operating Temp. Range: -40° to +85°
- Power Dissip.: ~23 W max.
- Supply Voltage: 12 V (nominal)
- Operation Freq.: 76...77 GHz
- Interface: BRR BroadR Reach Ethernet 100 Mbit/s

This particular will be provided by Continental Corporation, the costing and ordering details for which will be released further on [BAJA SAEINDIA Forum](#).

C.10.6.3 Camera

Camera for image processing needs to be mounted on the vehicle, in order to identify various lane markings, road signs/markers, stationary/moving object identification, other vehicles/pedestrians on track, etc.

C.10.6.4 Central Computing Unit

All of the electronic components like Radar, Camera, sensors, BMS, need to be integrated with a central computing unit, in order to make the vehicle truly autonomous.

Additional details regarding Autonomous Systems shall be added in this section of the Final aBAJA SAEINDIA rulebook.

PART D: Preliminary Round - 40 Points + 10 Points

Preliminary Round will be the first round of the event aBAJA SAEINDIA event. The scores obtained in this round will be added to the total score obtained by the team in all the respective phases of the aBAJA SAEINDIA event.

- The objectives of the Preliminary Round are as follows:
 - To acquaint the teams with the objectives of the aBAJA SAEINDIA Event.
 - The teams should have fundamental knowledge of Automotive Engineering like Chassis, Body, Suspension, Steering, Brakes, Engine, Transmission, CVT, Driveline, Electricals, Electronics, Hardware Integration, Software Architecture Design, Sensors, etc. and Design Criteria, Manufacturing Criteria, Materials, Calculations, CAD/CAE Analysis, EMI/EMC Simulation, Vehicle Dynamics, Ergonomics, DFMEA/PFMEA, Performance Testing, Validation & Certification for the above components/ systems and vehicle as a whole.
 - The teams are required to familiarize themselves with the technical guidelines and limits for the design of the aBAJA Vehicle as per the latest *aBAJA SAEINDIA rulebook as applicable*.
 - To make various concepts and lay down complete technical specifications of the proposed vehicle along with a CAD model, CAE Analysis, selection of sub systems and execution of team plans.
 - To understand Make or Buy Decisions based on facilities & confidence available and perform estimated Cost Analysis, Weight Analysis, Team building, MS Project Planning, etc.
- Entire evaluation process will be conducted digitally on a Video Conferencing Portal. Standard Operating Procedure (SOP) of the Video Conferencing Software will be released separately.
- Maximum 5 team members per team which must include either Captain or Vice-Captain will be allowed for this round.
- One Faculty member, in addition to the team members, will be allowed only as a silent observer.
- Teams must strictly adhere to their respective timelines.
- Teams must prepare for the two sub-events i.e., Presentation of vehicle design and Quiz;
 - **Presentation (40 Points)** - Maximum of 25 mins will be allotted per team to present their vehicle design which includes,
 - Allowing of Team Members and setting up of their presentation: 05 mins
 - Presentation by team to showcase their design: 15 mins
 - Questions put up by panel to be answered by the Team: 05 mins
 - **Quiz (10 points)** - will consist of questions from General Engineering/ Automotive Engineering and aBAJA SAEINDIA Rulebook.

Further details regarding the Preliminary Round shall be released on [BAJA SAEINDIA® Forum](#).



PART E: STATIC EVENTS – 275 POINTS + 90 Points (Finals)

ARTICLE E.1: SCORING

Event	Description	Points
Phase II: Virtual Static Events	Design Evaluation	100
	Cost Evaluation	50
	Sales Evaluation	50
	Social Responsibility Report	25
	EMI/EMC Simulation	25
	Safety Report	25
#Bonus regarding Static Event finals	Design Event Finals (On Site)	30
	Cost Event Finals (On Site)	15
	Sales Event Finals (On-site) (NEW)	15
	EMI/EMC Finals (On-Site)	15
	Innovation Event	15
Total Marks		275 + 90 (Finals)

 Any change in scoring pattern shall be informed to the teams through [BAJA SAEINDIA Forum](#).

ARTICLE E.2: ENGINEERING DESIGN EVENT - 100 Points + 30 Points (Finals)

E.2.1 Engineering Design Event Overview and Objective

- 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 Program Objective A1.1 and 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, Ergonomics, Hardware Integration (Sensors and related components) and Software Architecture Design.
- 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 based 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 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.

- 3 The engineering design event guidelines and scoring criteria shall be published on [BAJA SAEINDIA](#)



Forum.

- 4 The engineering design event consists of two parts: A design Evaluation and a Design Report that will be used as a part of the design evaluation.

E.2.2 Design Report – Required Submission

- 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 the on-site Design Evaluation.
- 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, 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.
- 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 backup data should be brought to the competition and should be made available, on request, for review by the judges.
- 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.

 **While the Design Report is scored and is considered to be the “Resume of your car”, preparing your 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 the Failure of your design judges to be impressed by your success.**

E.2.3 Design Report – Vehicle Drawings

- 1 The Design Report must include one set of three (3) view drawings showing the vehicle, from the front, top, and side.
- 2 Each drawing shall appear on a separate page. The drawings can be manually, or computer generated.
- 3 Photos should be placed on the optional page and will not be counted as drawings.

E.2.4 Design Spec Sheet - Required Submission

- 1 Design Spec Sheet - A completed BAJA SAEINDIA® Design Spec Sheet must be submitted.
- 2 The BAJA SAEINDIA® Design Spec Sheet template shall be published on [BAJA SAEINDIA Forum](#). Do not alter or re-format the template before submission.
- 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.
- 4 The Design Report and the Design Spec Sheet, while related, are independent documents and must be submitted as two (2) separate files.

E.2.5 Design Comparison Requirement (For Old Teams)

Teams with vehicles that participated in the previous year's BAJA SAEINDIA® competitions are required to provide a comparison, using the template to be published on [BAJA SAEINDIA Forum](#), of their current design with their previous year's design.



- 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.

E.2.6 Changes in Design with respect to the initial design

Any changes made in the final design of the vehicle, as compared to the initial design at the time of first design submission, needs to be documented with justification. This must follow the template to be published on [BAJA SAEINDIA Forum](#) and should be accompanied by 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).

E.2.7 Format for Document Submission

Document	Submission	File Type	Remarks
Design Report	Compulsory	.pdf	Single File (text, drawings and optional content are all-inclusive)
Design Specification Sheet	Compulsory	.xlsx	The format of the Spec Sheet MUST NOT be altered.
Design Comparision Sheet	Only for Returning Teams	.pdf	Single File (text, drawings and optional content are all-inclusive)
DVP&R and DFMEA	Compulsory	.xlsx	The format of the DVP&R and DFMEA sheets MUST NOT be altered.

E.2.8 Document Submission Deadline

E.2.8.1 Design Report Submission Deadline

Submissions must be received by the due date listed on the [BAJA SAEINDIA Forum](#) and/or [BAJA SAEINDIA Website](#).

Submission will be acknowledged on the [BAJA SAEINDIA Website](#) with a visual indicator. Teams should have a printed copy of this acknowledgment available at the competition as proof of submission in the event of a discrepancy.

E.2.8.2 Penalty for Late Submission or Non-submission

Late submission or failure to submit the Design Report will be penalized up to ten (10) points per day, as per the discretion of the BAJA SAEINDIA® Organizing Committee. If the design report is received more than five (5) days late it will be classified as “Not Submitted” and will constitute an automatic withdrawal of your team from the **Engineering Design Event**.

No request from any defaulter team will be entertained under any circumstances in the case of non-submission or delayed submission.

 **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.**



E.2.8.3 Excessively Sized 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 the first optional page will be read and evaluated by the judges.

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

E.2.9 Static Evaluation

- 1 The design judges will evaluate the engineering effort based on the team's Design Report, their responses to the judges' questions, and/or an inspection of their car.
- 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 outlined in the rules).
- 3 The judges would give the score depending on the ability of a team to explain the engineering and construction of the car.

E.2.10 Judging Process

The actual format and process of the Engineering Design Event may change from year to year as determined by the organizing body. The engineering design event guidelines shall be released on [BAJA SAEINDIA Forum](#).

E.2.11 Design Finals – 30 points

E.2.11.1 Overview

The purpose of Design Finals is to reward and call attention to those vehicles judged to have the best engineering designs. Design Finals are held after the conclusion of Design Evaluation so that the finalists may be chosen, and then judged as described in section D.3.11.2 - Presentation Format. The number of finalists may vary and is determined by the number of entries and the results of the Design Evaluation.

E.2.11.2 Presentation Format

The Design Finals format and timing may change from year to year as determined by the Organizing Committee. The Design Finals format, timing, and instructions will be released in on the [BAJA SAEINDIA Forum](#).

Any team member on the presentation floor may answer the questions from the judges even if that member did not speak during the presentation. For onsite events, it is recommended teams bring a laptop computer, binders, or posters to communicate their design work. No projectors will be allowed.

E.2.11.3 Support Material

Teams are required to bring three (3) color copies of the submitted design documents (As per D.3.8) to the Design Finals event on-site. Failure to bring the hard copies of the design documents at the Design Finals may result in disqualification from the design finals event. Teams may also bring with them to Design Finals any photographs, drawings, plans, charts, posters, 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. The use of laptops or notebook computers might be allowed to support any additional information which teams may like to give. Use of projectors is not permitted. Teams are required to bring their vehicle during the presentation.

ARTICLE E.3: COST EVENT - 50 Points + 15 Points (Finals)

E.3.1 Cost Event Objective

Cost is one of the most critical aspects of any commercial entity but the event here, is to not only report the most optimum cost of the component in the prototype or production stage, but instead focusing on how well the team understands what has gone into their part and applying their learning of procurement and manufacturing



techniques to optimize the cost, labor, time, material wastage and various overhead costs. Cost Event consists of two related sections: 1. Cost Report: The cost report provides all the background information to verify the vehicle's actual cost and also if the teams want to present any design features or fabrication processes that are innovative or are expected to result in significant cost savings. 2. Prototype Cost: The prototype cost is the actual cost gone in fabrication of the vehicle and the points related thereto.

E.3.2 Cost Event - Documents

E.3.2.1 Cost Report (Required Submission)

The Cost Report may contain three sections:

1. Overview
2. Cost Documentation
3. Engineering Drawing

The Cost presentation guidelines and template shall be released at [BAJA SAEINDIA Forum](#).

E.3.3 Cost Report Submission

E.3.3.1 Cost Report Submission Deadline

Submissions must be received by the due date listed on the [BAJA SAEINDIA Forum](#) and/or [BAJA SAEINDIA Website](#).

Submission will be acknowledged on the [BAJA SAEINDIA Website](#) with a visual indicator. Teams should have a printed copy of this acknowledgment available at the competition as proof of submission in the event of a discrepancy.

E.3.3.2 Penalty for Late Submission or Non-submission

Late submission or failure to submit the Cost Reports will be penalized up to ten (10) points per day, as per the discretion of the BAJA SAEINDIA® Organizing Committee. If the cost reports are received more than five (5) days late they will be classified as "Not Submitted" and will constitute an automatic withdrawal of your team from the Cost Event.

No request from any defaulter team will be entertained under any circumstances in the case of non-submission or delayed submission.

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.

E.3.4 Judging Process

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.

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

E.3.5 Cost Finals - 15 points

E.3.5.1 Overview



The purpose of Cost Finals is to evaluate the accuracy of the team's documentation and the adjustments made to the prototype cost, if any, after the fabrication of their vehicle. Cost Finals are judged as described below. The number of finalists may vary and is determined by the number of entries and the results of the Cost Report Evaluation.

E.3.5.2 Presentation Format

The Cost Finals format and timing may change from year to year as determined by the BAJA SAEINDIA® Organizing Committee. The Cost Finals format, timing, and instructions will be released on the [BAJA SAEINDIA Forum](#). For onsite events, it is recommended teams bring a laptop computer, binders, or posters to communicate their work. No projectors will be allowed.

E.3.5.3 Cost Adjustment

E.3.5.3.1 Cost Correction

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

E.3.5.3.2 Cost Adjustment Form

The purpose of the cost adjustment form is to make additions to the 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 a hard copy of the Cost Adjustment Form during the Cost Finals Event.**

E.3.5.4 Support Material

Teams must bring a hard copy of their cost report to the cost judges on-site. The cost summary sheet should be duly verified and attested by Team Faculty Advisor. Teams are required to bring their vehicle during the presentation.

ARTICLE E.4: SALES PRESENTATION EVENT - 50 Points + 15 Points (Finals)

E.4.1 Sales 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.

For the presentation, teams are to assume that the judges are following 2 sets of people –

Group 1 - Perspective Buyers

Group 2 - Investors (who need to be convinced that the factory set up by the teams will make a profit).



E.4.2 Sales Presentation - Documents

E.4.2.1 Presentation Format

The Sales presentation guidelines and template shall be released at [BAJA SAEINDIA Forum](#).

E.4.3 Sales Presentation - Submission

E.4.3.1 Presentation Submission Deadline

Teams are required to submit their presentation through the [BAJA SAEINDIA Website](#).

E.4.3.3 Penalty for Late Submission or Non-submission

Late submission or failure to submit the Sales Presentation will be penalized up to ten (10) points per day, as per the discretion of the BAJA SAEINDIA® Organizing Committee. If the Sales Presentation is received more than five (5) days late it will be classified as “Not Submitted” and will constitute an automatic withdrawal of your team from the Sales Event.

No request from any defaulter team will be entertained under any circumstances in the case of non-submission or delayed submission.

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.

E.4.4 Judging Process

E.4.4.1 Judging Criteria

The presentation event will be scored based on the following five categories:

- Presentation Content including company financials and break-even analysis
- Presentation organization, effectiveness, and team's response to Judges' questions.
- USP coverage – Market research, analysis, SWOT.
- Marketing Strategy.
- Project Schedule – Timelines, Project Execution, Capital, Materials.

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

E.4.4.2 Sales Presentation - Scoring - Bonus

The presentation judges shall apply bonus points to the top three (3) teams of the sales 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 the allotment of bonus points lies with the BAJA SAEINDIA® Organizing Committee.

E.4.5 Sales Finals - 15 points

E.4.5.1 Overview

The details regarding Sales Finals shall be released at [BAJA SAEINDIA Forum](#).

E.4.5.2 Presentation Format



The Sales Finals format and timing may change from year to year as determined by the BAJA SAEINDIA® Organizing Committee. The Sales Finals format, timing, and instructions will be released on the [BAJA SAEINDIA Forum](#). For onsite events, it is recommended teams bring a laptop computer, binders, or posters to communicate their work. No projectors will be allowed.

E.4.5.3 Support Material

Teams may bring with them to the 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.

ARTICLE E.5: INNOVATION EVENT - 15 Points (Bonus)

Innovation Event has been conducted in BAJA SAEINDIA with the sole purpose to drive the student towards new development, and idea generation and inculcating a positive problem-solving attitude with their engineering abilities. BAJA SAEINDIA has always pushed the team towards new innovative ideas whether it be in their vehicle design, improved manufacturing process, and cost reduction techniques through events such as design, manufacturing & cost. The focus of this event is to push the teams to generate ideas, solve a problem and bring a Proof of Concept to the event site.

Details for the INNOVATION EVENT shall be separately released on the official [BAJA SAEINDIA Forum](#).

ARTICLE E.6: EMI/EMC Simulation – 25 Points

EMI (Electromagnetic Interference) and EMC (Electromagnetic Compatibility) tests are required for autonomous vehicles to ensure that the electromagnetic emissions generated by the vehicle's electrical and electronic systems do not interfere with the operation of other devices, and that the vehicle's systems are not affected by external electromagnetic emissions. These tests ensure that the vehicle's systems are functioning safely and properly, and that they can maintain their performance in real-world conditions.

- The key part of this event to demonstrate the test values and positions of E/E components in a vehicle.
- Team will showcase the virtual results and conclusion which are performed in different environment like, HYPERWORKS, ANSYS, COMSOL etc.
- Teams will secure marks as per quality of the simulation, parameters taken and sound engineering practice.

Further Details for EMI/EMC Simulation Event shall be separately released on the official [BAJA SAEINDIA Forum](#).

ARTICLE E.7: SOCIAL RESPONSIBILITY REPORT - 25 Points

- There is growing public-concern over the benefits of this emerging technology and some argue that "driverless cars" pose critical moral dilemmas that need to be addressed prior to advancing technology in this area.
- As a part of the aBAJA SAEINDIA Competition teams will need to address these issues and provide a research-based analysis on the social responsibility of their design for an autonomous driving all-terrain vehicle.
- Each team is to prepare an 8-15-page report along with a presentation that addresses the complex issues of social responsibility and the development of autonomous driving technologies. This analysis must examine the case for developing autonomous driving technologies through the three critical aspects of sustainability (economic, environmental and social) and examine the case for a "shared value" definition of Corporate Social Responsibility within a "new mobility ecosystem".
- Each team should examine how they should respond to concerns over autonomous driving all-terrain vehicles from the three aspects of sustainability: economic, environmental, and social:
 1. What are the benefits and risks of autonomous driving technology in terms of environmental impact?
 2. What are the benefits and risks of autonomous driving technology in terms of economic impact?
 3. What are the benefits and risks of autonomous driving technology in terms of social impact?



4. How can a case be made that autonomous driving technology is more of a benefit than a cost to business and society from a social responsibility standpoint?
5. Make a specific recommendation that outlines a plan of action for increasing support among key stakeholder groups (e.g., consumers, government, business, communities) for the team's specific design.

Further Details for Social Responsibility Report shall be separately released on the official [BAJA SAEINDIA Forum](#).

ARTICLE E.8: SAFETY REPORT - 25 Points

The purpose of this report is to demonstrate that the team has put together a safety concept to reflect all aspects related to their vehicle's integration of autonomous components and software.

E.8.1 Safety Records

Safety records will be maintained by the teams throughout the duration of the aBAJA Competition. Teams will be asked to keep records on the following and additionally the date, time, and incident description.

E.8.2 Interface Analysis Report

The purpose of this analysis document is to: identify the potential functional interactions between the system and other vehicle systems; postulate failures and determine if they are safety critical (i.e., If they can lead to any of the identified critical hazards in the Preliminary Hazard Analysis) by analyzing the potential safety implications of these interactions being corrupted.

Further Details for Safety Report shall be separately released on the official [BAJA SAEINDIA Forum](#).

ARTICLE E.9: TIE BREAKERS

There will be no tie-breakers for static events.



PART F: TECHNICAL EVALUATION

F.1 Technical Evaluation - Pass/Fail

All BAJA SAEINDIA® vehicles must pass the technical inspection before they are permitted to operate under power.

- 1 The evaluation will determine if the vehicle satisfies the requirements and restrictions of the BAJA SAEINDIA® rules.
- 2 If vehicles are not ready for technical evaluation when they arrive at the inspection site, they will be sent away.
- 3 Any vehicle may be re-inspected at any time during the competition and correction of any non-compliance will be required.

F.2 Technical Evaluation Procedure

Technical inspection will consist of three (3) separate stages – eKIT and autonomous system check, Safety Scrutiny, and Panic Braking, and one sticker will be issued for completing each of these critical stages (i.e., a total of three stickers to be issued for clearing all three stages of technical evaluation). The Technical inspection check sheet which consists of all the check points will be issued to all teams before the Physical dynamic event. Teams are supposed to evaluate/verify all the check points and must carry the same self-evaluated sheet for the technical inspection. Two attempts will be given for every team for clearing each stage.

- Only after attempting all the sub-stages (if applicable) in each stage once will be considered as one attempt.**
- Teams will get respective stage sticker only after clearing all the sub-stages/check points which are mentioned in that stage.**

F.2.1 Weight measurement

The tare weight of the vehicle will be measured and recorded.

F.2.2 eKIT Check

All the Electrical Systems of an eBAJA vehicle shall be inspected for safety & compliance according to **Article C.1 to C.10: ELECTRICAL POWERTRAIN AND SYSTEMS.** eKit check will happen in two sub-stages.

1. Tractive system & its components: In this stage all the Tractive System components rating, working, compliance for certifications as mentioned in this rulebook, wiring and mounting will be verified.

- Teams will have to bring all the necessary documents and tools for verification during eKit Check.**

2. LV System: In this stage all the LV components rating, working, wiring, mounting, sequence of activating the tractive system shall be verified.

- If the team has a plan to opt for swapping during endurance, they need to demonstrate the Swapping process during the TI.**

F.2.3 Autonomous Systems Check

All the Autonomous Systems of an ABAJA vehicle shall be inspected for safety & compliance according



to Article C.10: AUTONOMOUS SYSTEMS

Detailed TI process for autonomous systems check shall be updated at later stage.

F.2.4 Technical Safety Scrutiny

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

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

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.

-  **Any major rework suggested during the technical inspection must be carried on in respective vehicle pits and not in any other place (Refer to Part H: Miscellaneous Topics – Article 1).**

F.2.5 Dynamic/panic brake test

The objective of this test is to ensure the vehicle is safe for driving, while it goes up to the speed of 30 kmph. The test requires the vehicle to attain a predefined minimum speed and should be capable of stopping with all four wheels locked within a specified distance.

-  **All four tyres must be marked with a radial strip of 25 mm (1.0 in) width using white paint (on the outer side of tyres) for wheel lock check. The markings should be done by the teams. Refer to the region highlighted within the red box in Figure C-1.**





Figure C- 1: Tyre Markings for Wheel Lock Check

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 specified by the inspectors. If a vehicle fails to pass any part of the inspection, it must be corrected/modified and brought into compliance with the rules before it is permitted to operate.

Only two attempts are permitted for the 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 to be submitted to brakes, technical evaluator.

- FOR IN-BOARD BRAKES:** Since teams are using inboard brakes which are mounted on the shaft, the other side of the shaft is connected with UJ, or the CV joint creates play while the brake is in action. This results in a delay in brakes being applied on one of the rear wheels and further rotation in it.
- In such a case only half turn rotation (max 180 degrees) will be considered. Brake effectiveness will be allowed only if the rotation of all 4 wheels stops, and the vehicle comes to stop at a place instantly.
- Juddering of wheels due to reactive forces on rotor and brake caliper will be considered ineffective braking. Generally, two-wheeler brake systems show this characteristic. Therefore, it is not recommended to use on BAJA SAEINDIA® vehicles.

F.3 Inspection Stickers

- 1 A multi-part inspection sticker will be issued in sections to each vehicle as each of the three parts of the technical evaluation is completed. The inspectors will place the inspection sticker on the right side of the firewall above the driver's shoulder. The inspection sticker must remain on the vehicle throughout the competition. Vehicles without all parts of the inspection sticker must not be operated under power.
- 2 Any or all parts of the inspection sticker may be removed from any vehicle that has been damaged or which is reasonably believed to not comply with the rules.

PART G: VIRTUAL DYNAMIC EVENT- 150 POINTS

ARTICLE G.1: OVERVIEW

Under the partnership with a virtual automotive testing software provider (to be finalized at later stage of the event) for the 2024 season, BAJA SAEINDIA will provide a set of 5 software licenses per team. An extensive training will also be provided to the teams in order to help model their vehicle, build off-road terrains, and simulate the vehicle in race conditions on the software. This value addition of vehicle optimization using virtual automotive testing solution shall aid the teams to design and build a vehicle at par with professional racing teams.

ARTICLE G.2: OBJECTIVE

The goal of the Virtual Dynamic Event is to develop a single seat, all-terrain vehicle designed by the team in a virtual environment and maximize the virtual vehicle's performance in race-oriented scenarios.

ARTICLE G.3: SCORING

All the teams will get an equal chance to showcase their vehicle performance in eight different Virtual Dynamic Events:

Sr.No.	Dynamic Event Name	Points
1	Autonomous Emergency Braking (AEB)	20
2	Adaptive Cruise Control (ACC)	20
3	Vehicle to stationery object	10
4	Vehicle to pedestrian	10
5	Lane Departure Warning (LDW)	10
6	Lane Keep Assist (LKA)	10
7	Object Detection and Avoidance	20
8	Endurance Performance	50
Total Points Allocated for Virtual Dynamic Events		150

ARTICLE G.4: EVENT CONDUCT

All the teams will get an equal chance to showcase their vehicle performance in eight different Virtual Dynamic Events.

The Virtual Dynamic Events will be live-streamed; hence the teams will get a unique opportunity to witness and enjoy the event holistically.

All teams must strictly note that the value of the parameters, to be defined in the Vehicle Model that shall be designed in the software, must comply with the set of rules defined in the latest version of aBAJA SAEINDIA® Rulebook for the calendar year.

The virtual vehicle parameterization must be identical to the values in the Design Spec Sheet submitted by the team. All the values to be defined by the teams must have proper justification concerning the team's vehicle design, which might be asked to be produced for review by BAJA SAEINDIA® judges at any point of time during the event. Any teams found deviating from the Design Spec Sheet and/or insufficient in justifying the specified values for their vehicle shall be penalized.

 **Teams are required to visit the [BAJA SAEINDIA Forum](#) for the rules and updates about the set of guidelines for Virtual Dynamic Events.**



PART H: DYNAMIC EVENTS – 525 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 H.1: SCORING SUMMARY

DESCRIPTION	POINTS
Autonomous Emergency Braking (AEB)	25
Adaptive Cruise Control (ACC)	30
Vehicle to stationery object	30
Vehicle to pedestrian	30
Lane Departure Warning (LDW)	30
Lane Keep Assist (LKA)	30
Object Detection and Avoidance	50
All Terrain Performance	200
Validation Event	100
Total Dynamic Events	525

Figure E- 1: Dynamic Events, Table of Points

 Any change in scoring pattern shall be informed to the teams through [BAJA SAEINDIA Forum](#).

ARTICLE H.2: PRACTICE

H.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.

H.2.2 Course

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

H.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.

H.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.

H.2.5 Signals and Signage

See F.8.9 - Signals and Signage.

H.2.6 Scoring

There is no score awarded for practice.

ARTICLE H.3: TRACK RULES FOR aBAJA VEHICLES

H.3.1 Track Markings



For the autonomous vehicle to identify the track limits, the course will have solid lane lines/markings painted on both sides of the track. These lane lines will be approximately 0.1 – 0.15 m wide, while the minimum track width will be 2.5 m.

H.3.2 Procedure

H.3.2.1 Start

After a safety check, vehicles are positioned at the start line of the course. The track worker will check that the autonomous vehicle is ready to begin with remote kill switch in working condition, and then direct the team member to activate the Autonomous Mode for the vehicle to start. Once the vehicle is ready, the track worker will signal the green flag to be waived for the vehicle to proceed down the course.

Each vehicle may make two (2) runs on the course, with a maximum top speed not exceeding 30 kmph.

H.3.2.2 Stop

At the end of the course, there will be a Stop Sign and a Finish Line of approx. 15 - 20 in. width. The vehicle has to come to an immediate halt after crossing the Finish Line, within 8 m (2 ft.). Once the vehicle stops on its own, the manual driver will approach the vehicle to exit the autonomous mode and then manually drive the vehicle off the track.

H.3.3 Penalties

The following penalties shall apply for all the physical dynamic events, over and above the specific penalties mentioned for each event.

H.3.3.1 Failing to stop for a stop sign

A 5-point penalty will be deducted each time the vehicle does not completely stop for a stop sign. (i.e., rolling stop)

H.3.3.2 Stopping beyond the stop sign

A 2-point penalty will be deducted each time the vehicle stops after the stop line but within one vehicle length measurement past the sign.

Anything past one vehicle length is considered a failure to stop.

H.3.3.3 Failing to remain stopped for 5 seconds

A 5 second lap time penalty will be added to the lap time score for each time the vehicle fails to remain stopped for at least 5 seconds at the stop signs.

H.3.3.4 Stalled & Disabled Vehicles

If a vehicle stalls and cannot restart without external assistance, the vehicle will be deemed disabled.

Disabled vehicles are scored as a DNF for that run.

H.3.3.5 Obstacles and Collisions

Any collision is considered a DNF

H.3.3.6 Manual Driver Takeover

Any manual take over will be a DNF for the ongoing lap of any physical dynamic event.

ARTICLE H.4: AUTONOMOUS EMERGENCY BRAKING (AEB) – 25 POINTS

H.4.1 Objective

The Autonomous Emergency Braking (AEB) Event is designed to measure each vehicle's ability to come to an immediate halt / execute panic braking from a minimum speed of 25 kmph.

H.4.2 Course



The distance taken to halt within a predefined flat, straight course from a minimum speed of 25 kmph [to be achieved within 30.48 m (100 ft)] will be measured. The course surface may vary from pavement to loose dirt. The choice of course length and surface are at the organizer's discretion.

H.4.3 Procedure

Refer Article H.3.2.

H.4.4 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.

H.4.5 Signals and Signage

See H.13.8 - Signals and Signage.

H.4.6 Scoring

The maximum number of available points for Autonomous Emergency Braking (AEB) Event is 25 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 Autonomous Emergency Braking (AEB) score (S_{aeb}):

$$S_{aeb} = 25 \times \frac{d_{max} - d_{run}}{d_{max} - d_{min}}$$

Where:

d_{min} is the shortest dist. by any vehicle

d_{run} is the dist. recorded for a vehicle's run to be scored.

d_{max} is the minimum of the following:

- The longest (farthest) dist. by any vehicle, or
- 1.5 times d_{min}

Vehicles with Autonomous Emergency Braking (AEB) distances that are more than 1.5 times that of the shortest distance by a vehicle will not receive a score for this event. Teams attempting the event, but exceeding the dist. limit will be classified as "Excess Dist."

ARTICLE H.5: ADAPTIVE CRUISE CONTROL (ACC) – 30 POINTS

H.5.1 Objective

The Adaptive Cruise Control (ACC) Event is designed to measure each vehicle's ability to come up to speed quickly from a standing start.

H.5.2 Course

The time taken to complete a 30.48 m (100 ft.) or 45.72 m (150 ft.) flat, straight course from a standing start will be measured. The course surface may vary from pavement to loose dirt. The choice of course length and surface are at the organizer's discretion.

H.5.3 Procedure

Refer Article H.3.2.

H.5.4 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.

H.5.5 Signals and Signage

See H.13.8 - Signals and Signage.

H.5.6 Scoring

The maximum number of available points for Adaptive Cruise Control (ACC) Event is 20 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 Adaptive Cruise Control (ACC) score (S_{acc}):

$$S_{acc} = 20 \times \frac{t_{max} - t_{run}}{t_{max} - t_{min}}$$

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
- 1.5 times t_{min}

Vehicles with Adaptive Cruise Control (ACC) 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 H.6: OBJECT DETECTION & AVOIDANCE – 50 POINTS

H.6.1 Objective

This event tests the autonomous vehicle's ability to detect and avoid any stationary/moving objects placed within the track limits and maneuver successfully to the finish line. This track will also assess each autonomous vehicle's agility and handling ability over off-road terrain.

H.6.2 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, inclines, stationary objects, and moving objects.

H.6.3 Procedure

Refer Article H.3.2.

H.6.4 Penalties

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

H.6.5 Signals and Signage

See H.13.8 - Signals and Signage.

H.6.6 Scoring

The maximum number of available points for the traction event is 50 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 the attempt is scored for



distance at that point.

H.6.6.1 - Method 1 (Different Distances)

If none of the vehicles are able to complete the course, then: The following equation will be used for the object detection & avoidance score (S_{oda}):

$$S_{oda} = 50 \times \frac{d_{run} - d_{min}}{d_{max} - d_{min}}$$

Where:

d_{min} is the shortest distance by any vehicle

d_{run} is the distance travelled for the vehicle to be scored

d_{max} is the longest distance by any vehicle

H.6.6.2 - Method 2 (Fixed Distance, All Succeed)

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

The following equation will be used for the object detection & avoidance score (S_{oda}):

$$S_{oda} = 50 \times \frac{t_{max} - t_{run}}{t_{max} - t_{min}}$$

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}

H.6.6.3 - Method 3 (Fixed Distance, Some Succeed)

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

Group 1

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.

$$S_{oda1} = 50 \times \frac{t_{min}}{t_{run}}$$

Group 2

$$S_{oda2} = \min(S_{oda1}) \times \frac{d_{run}}{d_{course}}$$

Where:

d_{run} is the distance recorded for a vehicle to be scored

d_{course} is full length of the course to be run by the vehicle.

ARTICLE H.7: VEHICLE TO STATIONARY OBJECT – 30 POINTS



H.7.1 - Objective

Designed to assess the vehicle's ability to identify stationary objects on track and display avoidance maneuver within the track limits.

Further details regarding the 'Vehicle to Stationary Object' Event related to course design, penalties and scoring shall be worked out.

ARTICLE H.8: VEHICLE TO PEDESTRIANS – 30 POINTS

H.8.1 - Objective

Designed to assess the vehicle's ability to identify pedestrians on track and display avoidance maneuver within the track limits.

Further details regarding the 'Vehicle to Pedestrians' Event related to course design, penalties and scoring shall be worked out.

ARTICLE H.9: LANE KEEP ASSIST (LKA) – 30 POINTS

H.9.1 - Objective

Designed to assess the vehicle's ability to maintain a specific driving lane on the track.

Further details regarding the Lane Keep Assist Event related to course design, penalties and scoring shall be worked out.

ARTICLE H.10: LANE DEPARTURE WARNING (LDW) – 30 POINTS

H.10.1 - Objective

Designed to assess the vehicle's ability to display caution when departing a specific driving lane on the track.

The workability of vehicle's indicator lights will form a crucial part of this event.

Further details regarding the Lane Departure Warning (LDW) Event related to course design, penalties and scoring shall be worked out.

ARTICLE H.11: VALIDATION EVENT – 100 POINTS

- The objective of the Validation Event is to authenticate a system-level coherence of the Virtual Vehicle with the Physical Vehicle built by the teams participating in Phase 3 of BAJA SAEINDIA® event. The Validation Event for aBAJA will be conducted through real-time HIL interface with physical vehicle controllers.

The Validation Event guidelines will be released on [BAJA SAEINDIA Forum](#).

ARTICLE H.12: ENDURANCE PERFORMANCE - 200 POINTS

H.12.1 - Objective

The Endurance Performance event assesses each vehicle's ability to operate continuously and at speed over a normal terrain. The Endurance Performance event may be run for time or for distance. The vehicle with the most laps (orbits) around the course shall be declared the winner.



H.12.2 - Course

The Endurance Performance course is a closed loop measuring approximately 1.0 km. The Endurance Performance course may feature plain road with stationary and moving obstacles.

H.12.3 – Procedure

H.12.3.1 - Pre-Gridding

Teams will pre-grid before the Endurance Performance 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.

H.12.3.2 - Compliance Check

During pre-gridding, or after pre-gridding closes, for aBAJA vehicles should be kept in “Autonomous & Ready to Drive” mode, 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:

- Fire Extinguisher
- Kill Switches
- Brake System
- e-KIT including Fuse
- Blue Lights

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.

H.12.3.3 - 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.

H.12.3.4 - Starting

The Endurance Performance 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.

H.12.3.5 - Running

Endurance Performance will be run as either:

- A single fixed time race
- A predetermined and published distance

- Elimination heats followed by a final in which the total time of one elimination heat plus the final shall be fixed. 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.

H.12.3.6 Accumulator(s) Swapping

Please refer to *Part C – Article 9: Accumulator(s) Swapping*.

H.12.3.7 – Service

H.12.3.7.1 - Remote Pit

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

H.12.3.7.2 - 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.

H.12.3.8 - Recovery

Vehicles disabled on the Endurance Performance course may be recovered by track workers, or by designated recovery crews. Track workers will attempt to assist disabled vehicles.

If track workers are unable to assist a disabled vehicle, a recovery crew may transport the disabled vehicle to the paddocks.

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

H.12.3.9 - Finish

The Endurance Performance 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 Accumulator(s) Swapping area 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.

H.12.3.10 - Impound

The organizers reserve the right to impound and inspect any vehicle during or after the Endurance Performance event. The Technical Inspectors will direct and instruct teams in impound how to proceed.

H.12.4 - Penalties

Event captains are the only personnel permitted to call and assess penalties during the Endurance Performance event. Event Captains are distributed throughout the Endurance Performance course during the event. Penalties during the Endurance Performance race will be signalled from and vehicles ordered off the track from 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.

H.12.4.1 - 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.

H.12.4.2 - Vehicle Assists

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

H.12.4.3 - Roll Over

If a vehicle rolls over (end over end, or over on its side) anywhere on the track two times (in any location), the vehicle will be black flagged and 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.

H.12.4.4 - Endurance Performance Penalty Table

Penalty Type	Infraction	1 st Offense	2 nd Offense	3 rd Offense
Driving	Vehicle Roll Over	-	Warning	DQ
Driving	Passing during a yellow flag	Warning	Discretionary	Discretionary
Driving	Failure to stop for black flag when signalled	10 minutes	Discretionary	Discretionary
Driving	Leaving the course and advancing	5 minutes	Discretionary	Discretionary
Driving	Aggressive driving	10 minutes	DQ	-
Driving	Speeding in the pit or paddocks	5 minutes	20 minutes	DQ
Driving	Team member on track	50 points/member/sighting		

Figure E- 1: All-Terrain Performance Event, Table of Penalties

H.12.5 - Signals and Signage

See H.13.8 - Signals and Signage

H.12.6 – Scoring

H.12.6.1 - Points

The maximum possible points for Endurance Performance are 200 points.

H.12.6.2 - 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.

H.12.6.3 - Scored Laps

Scored laps are the number of full laps actually completed during the Endurance Performance event. Only full

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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.

H.12.6.4 - 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.

H.12.6.5 - 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:

Position	Lap	Bonus Points
1	48	4
2	48	3
3	48	2
4	48	1
5	47	0

Figure E- 2: Endurance Performance Event, Table of Bonus Points

H.12.6.6 - Score

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

$$Sep = \left(200 \times \frac{l_{team} - l_{min}}{l_{max} - l_{min}} \right) + P_{bonus}$$

Where:

l_{max} is the maximum number of laps completed by any vehicle.

l_{team} is the number of laps completed by the vehicle to be scored

l_{min} is the minimum number of laps completed by any vehicle.

P_{bonus} is the number of bonus points awarded to a qualifying vehicle.

H.12.6.7 - Heat Plus Final Scoring

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

Thus, if Endurance Performance is run as one (1) hour eliminations plus a three (3) hour final, the two hundred (200) total points will be allocated as seventy-five (75) points to each elimination heat plus one hundred twenty five (125) points to the final.



ARTICLE H.13: GENERAL EVENT PROCEDURES AND REGULATIONS

H.13.1 – Safety

H.13.1.1 - Safety Vision

Safety is the primary consideration in the design of BAJA SAEINDIA® 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.

H.13.1.2 - First Aid / CPR / AED

While medical services are always on-site at BAJA SAEINDIA® events, teams are encouraged to be familiar with or trained in first aid, CPR, and the use of AED machines.

H.13.1.3 - 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.

H.13.1.4 - 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.

H.13.1.5 - Personal Protective Equipment

Teams are required to furnish and use their own PPE, appropriate for the task being performed. This includes, but is not limited to:

- Safety Glasses
- Gloves
- Closed Toe Shoes
- Arc Flash Protection
- Hearing Protection

H.13.1.6 - Key Hazards

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

H.13.1.6.1 - 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.

H.13.1.6.2 - Pinch Points

Stay clear of pinch points from rotating machinery, doors, and other equipment.

H.13.1.6.3 - 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.

H.13.1.6.4 - Vehicle Operations

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

H.13.1.6.5 - Walking / Path of Travel

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

H.13.2 - Rules of Conduct

H.13.2.1 - Sportsmanlike Conduct

All BAJA SAEINDIA® 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.

H.13.2.1.1 - Prohibited Material

Alcoholic beverages, firearms, weapons of any type, and illegal materials are prohibited at BAJA SAEINDIA® 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, advisors and any individuals working with the team on-site.

H.13.2.1.2 - Tobacco Products and Electronic Cigarettes

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

H.13.2.1.3 - Footwear

All individuals on-site shall wear durable and sturdy closed toe shoes. Open-toed shoes, slippers, chappals etc. are explicitly prohibited.

H.13.2.1.4 - Parties

Disruptive parties either on or off-site must be prevented by the faculty advisor or team captain.

H.13.2.1.5 - 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 area.

H.13.2.1.6 - Site Condition

Please help the organizers keep the site clean. The sites used for BAJA SAEINDIA® 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.



H.13.2.1.7 - 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.

H.13.2.2 - Spectator Rules

H.13.2.2.1 - 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.

H.13.2.2.2 - Alcoholic Beverages

Spectators may not drink or possess alcoholic beverages at any competition location.

H.13.2.2.3 - 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.

H.13.2.2.4 - 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.

H.13.2.2.5 - 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.

H.13.2.2.6 - 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 to this rule.

H.13.3 - Paddock Rules

H.13.3.1 – Accumulator(s) Swapping

Please refer *Part C – Article 9: Accumulator(s) Swapping*.

H.13.3.2 - 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 manual driver driving the vehicle and 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.

H.13.3.3 - Escort Required

When a vehicle is driven anywhere except within the practice area or on event courses it must move at walking speed with a manual driver driving the vehicle and a team member walking along side to 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.

H.13.3.4 - 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.

H.13.3.5 - Team Vehicles

Only the BAJA SAEINDIA® vehicles themselves are allowed in the paddocks. Teams' support trucks and trailers must be parked outside the competition site in a specially designated area.

H.13.3.6 - Access Restriction

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

H.13.3.7 - 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 deg. C (125 deg F).

H.13.3.8 - Driving Restrictions

H.13.3.8.1 - Off Site Operation

During the competition, BAJA SAEINDIA® 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.

H.13.3.8.2 - Driver Equipment

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

H.13.4 - 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.

H.13.5 - Tie Breakers

H.13.5.1 - Non-All-Terrain Performance Events

Ties for non-All-Terrain Performance 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.



H.13.5.2 - All-Terrain Performance Event

Ties in the All-Terrain Performance race will be judged by the All-Terrain Performance event judge and may remain a tie.

H.13.5.3 - Overall Event

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

1. Endurance Performance 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.

H.13.6 - 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.

H.13.7 - 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 an engine in violation of the rules may receive a point deduction of 75 points each time it is found in violation.

H.13.8 - Signals and Signage

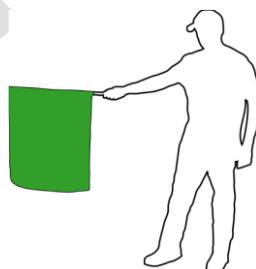
BAJA SAEINDIA® competitions may use some or all of the signals and signage presented in this section.

H.13.8.1 All-Terrain Performance - Command Flags

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

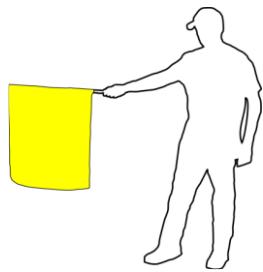
H.13.8.1.1 Green Flag -

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.



H.13.8.1.2 Yellow Flag –

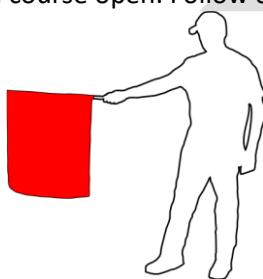
When displayed, there is a dangerous situation on the track beyond the flag station. Reduce speed and be prepared to take evasive action or stop on the track. Passing is not permitted, unless directed by the course workers.



H.13.8.1.3 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.

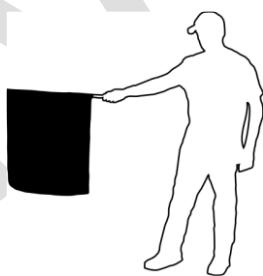


H.13.8.1.4 Black Flag (Furled and Pointed) –

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

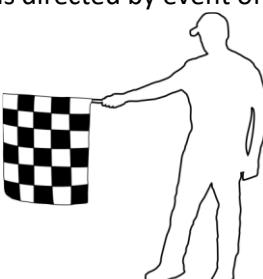
H.13.8.1.5 Black Flag (Displayed) –

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.



H.13.8.1.6 Chequered Flag –

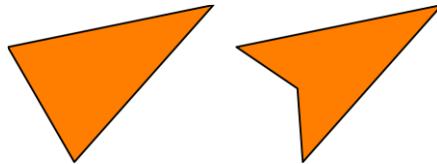
The event has been completed. Exit the course as directed by event officials.



H.13.8.1.7 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.



H.13.8.1.8 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.



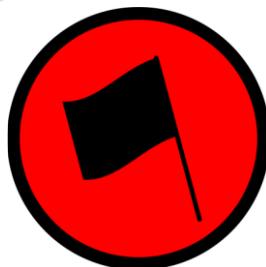
B

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.



H.13.8.1.10 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.



H.13.8.1.11 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.



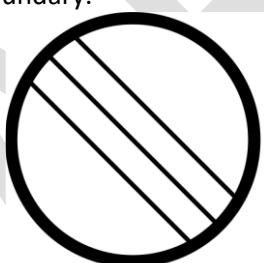
H.13.8.1.12 Stop Line –

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.



H.13.8.1.13 End Control Zone –

This sign denotes the end of the control zone boundary.



H.13.8.1.14 Begin Fuel Zone –

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



H.13.8.1.15 End Fuel Zone –

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



H.13.8.1.16 Begin Service –

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



H.13.8.1.17 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.



DRAFT

PART I: APPENDICES

ARTICLE I.1: OVERALL EVENT SCORING SUMMARY

Event	Description	Points	Total Points	Remarks
Phase I: Preliminary Round	Presentation	40	50	
	Online Quiz	10		
Phase II: Virtual Static Events	Design Evaluation	100	275	
	Cost Evaluation	50		
	Sales Evaluation	50		
	Social Responsibility Report	25		
	EMI/EMC Simulation	25		
	Safety Report	25		
Phase II: Virtual Dynamic Events	Autonomous Emergency Braking (AEB)	20	150	
	Adaptive Cruise Control (ACC)	20		
	Vehicle to stationery object	10		
	Vehicle to pedestrian	10		
	Lane Departure Warning (LDW)	10		
	Lane Keep Assist (LKA)	10		
	Object Detection and Avoidance	20		
	All Terrain Performance	50		
Phase III: Physical Dynamic Events	Validation Event	100	525	
	Autonomous Emergency Braking (AEB)	25		
	Adaptive Cruise Control (ACC)	30		
	Vehicle to stationery object	30		
	Vehicle to pedestrian	30		
	Lane Departure Warning (LDW)	30		
	Lane Keep Assist (LKA)	30		
	Object Detection and Avoidance	50		
	Endurance Performance	200		
#Bonus regarding Static Event finals	Design Event Finals (On-site)	30	100	To be added in Respective Event Score
	Cost Event Finals (On-site)	15		To be added in Overall Event Score
	Sales Event Finals (On-site)	15		
	EMI/EMC Finals (On-site)	15		
	Innovation Event	15		
	Build Quality Bonus	10		
Grand Total		1000+100(Bonus)	1100	

 Any change in scoring pattern shall be informed to the teams through BAJA SAEINDIA Forum.

ARTICLE I.2: SAE TECHNICAL STANDARDS

The SAE Technical Standards Board (TSB) has made the following SAE Technical Standards available online, 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 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 SAEINDIA have access to all the standards listed below - including standards not specific to your competition.

SAE Technical Standards included in the CDS Rules

BAJA SAE

J586 - Stop Lamps for Use on Motor Vehicles Less Than 2032 mm in Overall Width

J759 - Lighting Identification Code

J994 - Alarm - Backup - Electric Laboratory Tests

J1741 - Discriminating Back-Up Alarm Standard

Formula Hybrid

J1318 - Gaseous Discharge Warning Lamp for Authorized Emergency, Maintenance and Service Vehicles

J1673 - High Voltage Automotive Wiring Assembly Design

Formula SAE

SAE 4130 steel is referenced but no specific standard is identified

SAE Grade 5 bolts are required but no specific standard is identified

Super-mileage

J586 - Stop Lamps for Use on Motor Vehicles Less Than 2032 mm in Overall Width

SAE Technical Standards for Supplemental Use

Standards Relevant to BAJA SAE

J98 - Personal Protection for General Purpose Industrial Machines. Standard

J183 - Engine Oil Performance and Engine Service Classification - Standard

J306 - Automotive Gear Lubricant Viscosity Classification - Standard

J429 - Mechanical and Material Requirements for Externally Threaded Fasteners - Standard

J512 - Automotive Tube Fittings - Standard

J517 - Hydraulic Hose - Standard

J1166 - Sound Measurement - Off-Road Self-Propelled Work Machines Operator-Work Cycle

J1194 - Rollover Protective Structures (ROPS) for Wheeled Agricultural Tractors



- J1362 - Graphical Symbols for Operator Controls and Displays on Off-Road Self-Propelled Work Machines - Standard
- J1614 - Wiring Distribution Systems for Construction, Agricultural and Off-Road Work Machines
- J1703 - Motor Vehicle Brake Fluid - Standard
- J2030 - Heavy Duty Electrical Connector Performance Standard
- J2402 - Road Vehicles - Symbols for Controls, Indicators and Tell-Tales - Standard

Standards Relevant to Formula SAE

- J183 - Engine Oil Performance and Engine Service Classification - Standard
- J306 - Automotive Gear Lubricant Viscosity Classification - Standard
- J429 - Mechanical and Material Requirements for Externally Threaded Fasteners - Standard
- J452 - General Information - Chemical Compositions, Mechanical and Physical Properties of SAE Aluminium Casting Alloys - Information Report
- J512 - Automotive Tube Fittings - Standard
- J517 - Hydraulic Hose - Standard
- J637 - Automotive V-Belt Drives - Recommended Practice
- J829 - Fuel Tank Filler Cap and Cap Retainer
- J1153 - Hydraulic Cylinders for Motor Vehicle Brakes - Test Procedure
- J1154 - Hydraulic Master Cylinders for Motor Vehicle Brakes - Performance Requirements - Standard
- J1703 - Motor Vehicle Brake Fluid - Standard
- J2045 - Performance Requirements for Fuel System Tubing Assemblies - Standard
- J2053 - Brake Master Cylinder Plastic Reservoir Assembly for Road Vehicles – Standard

Standards Relevant to autonomous vehicles

- Draft AIS-185/D4 – Approval of Vehicles with regard to the Advanced Emergency Braking System (AEBS) for M1 and N1 vehicles
- Draft AIS-184/DF – Driver Drowsiness and Attention Warning Systems for M, N2 and N3 category vehicles
- Draft DF AIS 188 – Approval of vehicles with regards to Lane Departure Warning System (LDWS)
- Draft DF/AIS 191 (Part 1) – Approval of vehicles with regards to Emergency Lane Keeping System (ELKS)
- ISO 15622 – Intelligent transport systems – Adaptive cruise control systems – Performance requirements and test procedures

ARTICLE I.3: OFFICIAL SOCIAL MEDIA HANDLES

Following are the official social media handles of BAJA SAEINDIA®:

- [BAJA SAEINDIA \(@bajasaeindia\) • Instagram photos and videos](#)
- [BAJA SAE India - Home | Facebook](#)
- [BAJA SAEINDIA \(@BAJASAEINDIA\) / Twitter](#)
- [BAJA SAEINDIA: Overview | LinkedIn](#)



ARTICLE I.4: LIST OF ABBREVIATIONS

AED	Automatic External Defibrillator	LED	Light Emitting Diode
AN/MS	Army/Navy Military Standard	MB	Megabyte
CDS	Collegiate Design Series	OEM	Original Equipment Manufacturer
CPR	Cardiopulmonary Resuscitation	PDF	Portable Document Format by Adobe
CV	Constant Velocity	RF	Radio Frequency
CVT	Continuously Variable Transmission	RPM	Revolutions per minute
DF	Design Finals	SAE	Society of Automotive Engineers
DQ	Disqualified	SFI	SEMA Foundation Inc.
FA	Fuel Area	XLS	Excel Spreadsheet by Microsoft
FEA	Finite Element Analysis	FZ	Fuel Zone
FQ	Fuel Quarantine	ID	Inside Diameter
HV	High Voltage	MCU	Motor Controller Unit
LV	Low Voltage	EV	Electric Vehicle/s
VAC	Alternating Voltage	MCB	Miniature Circuit Breaker
RMS	Root mean square	AIS	Automotive Industry Standards
VDC	Direct Voltage	UL	Underwriters Laboratories
DC	Direct Current	LED	Light Emitting Diode
GLV	Grounded Low Voltage	FAR	Federal Acquisition Regulation
TSAL	Tractive System Active Light	ESS	Electrical Safety Sheet
RTDS	Ready To Drive Sound	F-N-R	Front-Neutral-Rear
BMS	Battery Management System	ASTM	American Society for Testing and Materials
AIR	Accumulator Isolation Relay	EN	European Standards
HVIL	High Voltage Inter-Lock	TS	Tractive System
SoC	State of Charge	Ms	millisecond
DOT	Department of Transportation	PPE	Personal Protective Equipment/s
ISO	International Organization for Standardization	for IEC	International Electrotechnical Commission
SA	Swappable Area		