INFI LEAGUE
MOTOR SPORTS

Presents

Aravalli Terrain Vehicle Championship, India

(ATVC, INDIA)

Regulation Manual Book

(Applicable for Combustion + Electric type, ATVC 2024)

ATVC 2024

SEASON 7

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PREFACE

WELCOME TO ATVC INDIA 2024!!
(DIRT, GUTS, GLORY)

Welcome to the ATVC INDIA Rulebook for the 2024 season! The ATVC INDIA Rulebook Committee has released an updated Rulebook for the 2024 season, incorporating a substantial number of revisions, several of which have been influenced by the experiences and lessons learned during the 2023 ATVC season.

This rulebook serves as a comprehensive guide for participants in the ATVC INDIA competition, outlining the regulations, requirements, and guidelines that will govern the event. It reflects the collective efforts of the ATVC community and has been meticulously crafted to ensure a fair and exciting competition.

In the following pages, you will find detailed information on vehicle specifications, safety standards, technical inspections, and event procedures. We have incorporated valuable insights from past seasons and have made necessary updates to enhance the overall experience for all participants.

The ATVC competition is not just about building off-road vehicles; it's about fostering innovation, teamwork, and engineering excellence. We encourage all teams to embrace the spirit of competition while upholding the highest standards of sportsmanship and professionalism.

As you embark on this exciting journey for the 2024 season, we wish you the best of luck in your endeavours. May this rulebook be your trusted companion as you design, build, and race your vehicle.

Remember, success lies in not just reaching the finish line but also in the knowledge and skills you gain along the way.

Drive safe, push boundaries, and enjoy the adventure that is ATVC INDIA!

❖ Section A: OPERATIONAL POLICIES

Part A.1. Summary of ATVC India Event

A.1.1. The Program Background

The origins of this magnificent event can be traced back to 2018, when Infi League Motorsports was established and successfully orchestrated ATVC Season 1 in Kota, Rajasthan. This inaugural event attracted the participation of over 30 teams hailing from various corners of India. This National Level All-Terrain Vehicle design and racing competition has been held in collaboration with esteemed entities such as AICTE (All India Council for Technical Education), Indian Oil Corporation Limited (IOCL), Apollo Tires, Federation of Gujarat Industries (FGI), Vadodara Chamber of Commerce and Industries (VCCI), Rajasthan Technical University (RTU), and others, both in Vadodara (Gujarat) and Kota (Rajasthan). The ATVC track has gained a reputation as one of the most challenging terrains in the country.

A.1.2. Aim of ATVC INDIA event

The primary objective of the event is to promote the principle of "Learn, Implement, and Share" among students enrolled in diverse disciplines across various universities. Through the process of engineering design, possible experiences encompass a range of possibilities, not confined to specific instances,

i. Promoting Engineering Creativity
ii. Hands-On Learning
iii. Teamwork and Collaboration
iv. Exposure to Industry Standards
v. Enhancing Leadership Skills
vi. Promoting Sustainable Practices
vii. Community Engagement
viii. Showcasing Innovation

In essence, this competition serves as an enriching journey that amalgamates theoretical knowledge, hands-on experience, teamwork, innovation, and networking. It equips students with skills and attributes that extend beyond the competition arena, preparing them for the multifaceted demands of the engineering profession.

A.1.3. Design discipline of the event

Every team's objective is to conceptualize and construct a single-seat, all-terrain sports vehicle that envelops the driver within its framework. This vehicle prototype should exemplify the qualities of reliability, maintainability, ergonomic design, and economic viability, envisioning it as a potential production vehicle catering to recreational users. The

vehicle's ambition is to establish itself as a market leader, boasting unparalleled performance metrics encompassing speed, handling, ride comfort, and durability across challenging terrains and off-road environments. The evaluation of its performance will be gauged through success in a series of dynamic events, meticulously detailed in the ATVC Rules, and influenced by on-site weather conditions and the course's ruggedness.

Part A.2. Event Particulars

A.2.1. The Competition and Official Announcements

ATVC India hosts the competition in two distinct vehicle categories:

i. Combustion Type (I.C. Engine Vehicle)
ii. Electric Type (Battery Operated Vehicle)

The ATVC competition in 2024 is open for international teams too. The hosting locations can vary annually in India, contingent upon the backing received from local authorities, universities, and sponsor companies. For precise event dates and schedules, kindly consult the ATVC website. Teams must ensure thorough comprehension of the articles featured on the ATVC Website, authored by the ATVC Organizing Committee, and accessible through the Team Dashboard of their respective teams. Additionally, teams are expected to acquaint themselves with all official announcements related to the competitions and any rule clarifications issued by the ATVC Organizing Committee.

A.2.2. The Official Language

English is the designated official language of ATVC India. All stages of the event welcome document submissions, presentations, and discussions conducted solely in English.

Part A.3. The Organizer's Authority

A.3.1 Rules Authenticity

The most recent edition of the ATVC India Rules, published on the ATVC website and specifically marked for the 2024 calendar year, holds authority over the competition's regulations. Rules designated for different years or previous versions of the current year's rules are considered void.

- **It is highly advisable for teams to verify the edition of the rulebook they are employing and tailor their vehicle design accordingly.**

A.3.2. Rules Compliance

Upon participating in the ATVC India competition, all team members, faculty advisors, and other university/college affiliates associated with the participating institution acknowledge

their commitment to uphold and adhere to the regulations. This encompasses abiding by the rules, as well as any clarifications or protocols issued by the ATVC India Rules Committee and the Organizing Committee. It is mandatory for all team members, faculty advisors, and other representatives from the university/college to collaborate and comply with instructions from competition organizers, officials, and judges.

A.3.3. Understanding of the Rules

It is the teams' responsibility to thoroughly read, comprehend, and grasp the complete set of rules for ATVC India. While the section and paragraph headings are included to enhance readability, they may not encompass the entirety of each paragraph's contents.

A.3.4. Ambiguities

Creating a set of rules that encompasses every conceivable query about the vehicle's design parameters or competition conduct is nearly unattainable. It's crucial to remember that safety takes precedence throughout the ATVC event. Therefore, if any potential ambiguities arise, they should be addressed in a manner that enhances safety and aligns with the competition's concept. Students are urged to bring attention to any perceived gaps in the rules to the ATVC rule committee, thereby preventing conflicts during events.

A.3.5. Being Involved in the Event

From the moment they arrive at the event location until they depart following the competition or an earlier withdrawal, individuals affiliated with a registered university – including teams, team members, faculty advisors, and other representatives are categorized as actively "engaged in the competition" on-site.

A.3.6. Breach of Purpose

Deviation from the intended purpose of a rule will be treated as a direct violation of the rule itself. Any inquiries regarding the intended interpretation of a rule can be directed to the ATVC Organizing Committee or Technical Judges.

A.3.7. Right to Impound

The ATVC India Organizing Committee holds the authority to impound any vehicle registered on-site during a competition, at any given point, for the purpose of inspection and assessment by the organizers, officials, and technical inspectors.

A.3.8. Inclusive Power

The ATVC Organizing Committee retains the prerogative to alter the timetable for any competition and/or construe or adjust the rules of the competition at any point and in any manner that they deem necessary, solely to ensure the secure and effective conduct of the event or the entirety of the ATVC series.

A.3.9. Force Majeure

The ATVC Organising Committee will not be held accountable for failing to meet their responsibilities as event organizers for the ATVC event due to unforeseeable circumstances, including but not limited to force majeure events such as acts of God, war, floods,

earthquakes, strikes, lockouts, pandemics, epidemics, riots, civil unrest, shortages of essential resources such as water and electricity, and more. They will promptly communicate the occurrence and conclusion of such events to participating colleges within one week of the decision. If the force majeure conditions persist beyond a reasonable duration, where hosting the event becomes impractical due to these circumstances or other factors, the event may be cancelled for the year.

Any of the below mentioned events can be classified under the "Force Majeure "events:

i. Natural disasters such as earthquakes, floods, landslides, storms, hurricanes, cyclones, lightning, thunder, pandemics, epidemics, or any other severe weather phenomena, as well as other unforeseen acts of nature.
ii. Industrial strikes, labour disruptions, or any other disturbances in the workplace unrelated to the organizers' actions, war, hostilities (whether officially declared or not), invasions, actions by foreign enemies, acts of terrorism, rebellions, riots, armed conflicts, civil wars, exposure to ionizing radiation, contamination from nuclear sources, nuclear waste, radioactive explosions, volcanic eruptions, and similar occurrences beyond the organizers' control.
iii. Acts of expropriation, compulsory acquisition, or government takeover of the event venue or any part thereof.
iv. Restrictive orders issued by any Court.

A.3.10. Objections and Grievances

We acknowledge that a significant amount of time and effort goes into designing and building a vehicle. Amid the intensity of competition, emotions might run high, potentially leading to disagreements. The ATVC Organising Committee is committed to thoroughly examining all inquiries and addressing issues promptly and effectively.

A.3.10.1. Initial Assessment

Should a team have inquiries regarding scoring, judging, policies, or any official actions, these concerns must be presented to the ATVC Organising Committee for an initial informal assessment.

A.3.10.2. Protests

Written protests must be submitted and delivered to the appropriate committee (consisting of three committees: Technical Evaluation Committee, Static Events Committee, and Dynamic Events Committee) by the team captain or a designated student team representative.

A.3.10.3 Protest Timeframe

Any protests regarding any aspect of the competition must be lodged within 45 minutes following the conclusion of the relevant event.

Protests pertaining to the scores granted to teams in the ATVC competition must be submitted within 45 minutes after the public release of the scores during the competition.

- **All participating teams are highly encouraged to monitor their respective team's scores in the static/dynamic events after the scores have been publicly disclosed. Should there be any discrepancies or issues for which a team intends to raise a**

protest, they are advised to do so within the 45-minute timeframe provided. This time window is meant as a cushion, and it is recommended that teams submit protests promptly if needed.

- **Once the designated 45-minute period has passed, no team will be accommodated for the reconsideration of their protests.**
- **The timing of the protest will be recorded and determined by the assigned committee.**
- **The verdict concerning any protest is ultimate.**

Part A.4. Inclusion Prerequisites for the Participants

A.4.1. Students

A.4.1.1. Eligibility Criteria

Participation is restricted to undergraduate students to maintain the focus of this event as an engineering competition rather than a race.

A.4.1.2. Educational Standing

Team members must be actively enrolled as undergraduate students pursuing a degree at a college or university. Individuals who have graduated prior to the competition are NOT eligible to take part.

A.4.1.3. Age

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

A.4.1.4. Driver's License

Team members who will drive a competition vehicle at any point during the event must possess a valid driver's license issued by the government.

A.4.1.5. Liability Waiver/Indemnity Bond

All individuals present on-site, including participants and faculty, must provide a notarized liability waiver agreement upon registration at the event venue. Each member and faculty member in attendance at the location are obliged to sign the liability waiver.

A.4.1.6. Insurance

Participants are required to have individual medical and accident insurance coverage, which remains their exclusive responsibility.

- **Note that the drivers of the team have the option to apply for a FMSCI license, which includes medical insurance coverage as well. Comprehensive details are available on the FMSCI website.**

A.4.2. Faculty Advisors

A.4.2.1. Faculty Advisor Status

Every team is anticipated and recommended to designate a minimum of one and a maximum of two Faculty Advisors assigned by the college/university. The faculty advisor/s will serve as the official university representative accompanying the team, as acknowledged

by competition officials. Their attendance throughout the competition is obligatory for all on-site event days.

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. Responsibilities

Faculty Advisors are anticipated to provide guidance to their teams concerning general engineering principles and the theory of engineering project management. He or she may:

i. Offer advice, review, and oversee the team's progress throughout the entire process of designing, developing, manufacturing, and testing the vehicle.
ii. Ensure the vehicle's safety and oversee in-house manufacturing within the college premises.
iii. Collaborate with and aid the ATVC Organizing Committee in ensuring a peaceful event, and if any disputes arise during the competition, assist in their resolution.
iv. Accompany the team at the primary event site and remain present with the vehicle during technical evaluations, brake tests, static events, and dynamic events.

A.4.2.4. Limitations

i. Faculty advisors are prohibited from directly designing any vehicle components or systems, as well as participating directly in the creation of documentation or presentations.
ii. Neither faculty advisors nor college staff should engage in fabricating, assembling, or aiding in the preparation, maintenance, testing, or operation of the vehicle.
iii. During technical inspection, cost audits, or design presentations, faculty advisors are permitted to be present. However, the team captain or other designated team members must handle all aspects of presentation. Nevertheless, faculty advisors can silently observe these processes and work toward enhancing future participation by the college/university.
iv. It is essential to note that faculty advisors are not permitted to directly involve themselves in the design, construction, or repair of any vehicle components.

Part A.5. Vehicle Admissibility

A.5.1. Student Crafted

The vehicle and its related documentation should be conceived, designed, manufactured, and assembled by the team members, excluding any direct contributions from professional engineers, faculty, or experts within the off-road and racing domains. Teams might be asked to provide evidence of the manufacturing location if requested by the officials during the event.

A.5.2. Specialized Manufacturing Boundaries

i. Under no circumstances will participation be allowed unless the college management provides a formal commitment permitting the utilization of their workshop facilities.
ii. In addition, teams are required to furnish a comprehensive list of operational facilities and equipment available at the college, which will be used for the fabrication and assembly of

the vehicle in accordance with the presented design during the static events of the competition.

iii. Throughout the actual manufacturing and fabrication processes, it is essential to capture video clips depicting students working within the college facility. These clips should be saved on a CD or downloaded onto a USB drive, to be available at any point during the project. The video content should cover each stage of the manufacturing processes conducted at the college.

iv. Excessive reliance on pre-assembled subcomponents may result in significant penalties.

v. Vehicles that have undergone professional fabrication could face substantial penalties or even disqualification from the competition. The final decision of the organizing committee in this matter will be definitive. In such instances, registration fees will not be refunded.

vi. During the main event, if any team is found to be seeking external assistance on-site, penalties will be imposed for the initial incident, with subsequent infractions leading to disqualification from the event.

- **Under special exceptional cases where, if a team faces restrictions in accessing machine shop or workshop facilities and is unable to manufacture specific components in-house, those components alone can be professionally fabricated without incurring penalties. Nonetheless, proper documentation (such as a letter from the faculty advisor or copies of policies that restrict machine shop or workshop access) must be provided to validate the lack of access.**

A.5.3. Prohibition of Kit Vehicles

Vehicles that have been assembled from kits or based on published designs are not eligible for participation in the competition.

A.5.4. Prefabricated Subassemblies

These regulations do not prohibit the utilization of prefabricated or modified sub-assemblies. Nonetheless, excessive reliance on premanufactured subassemblies might result in penalties.

The roster of permissible prefabricated components includes shock absorbers, coil springs, brake drums, brake calipers, brake holding assemblies, master cylinders, steering columns, wheel rims, tires, and tie rod ends. For teams using combustion engines, this also encompasses the engine, fuel tank, and exhaust system.

However, all other components must be produced in-house and cannot be sourced from external professional manufacturers or designers. If any outsourcing is undertaken, it should be accurately accounted for in the cost report, substantiated by supporting receipts from the outsourcing vendor.

A.5.5. Bills and Documentation

Teams are required to provide authentic tax invoices for all purchased items. In cases where the original invoices are held by college authorities, teams must furnish photocopies of the invoices with the signatures of the Faculty Advisor, Head of Department (HOD), and the College's Accounts Section, along with the official stamp of the college.

Part A.6. Registration

A.6.1. Team Registration

Online registration for the ATVC event in India is mandatory and should be carried out through the provided link on the ATVC Website.

REGISTER NOW

A.6.1.1. Multiple Registrations

It's important for teams hailing from the same College/University/Institution/Club/Society and aiming to partake in multiple events (combustion and electric types) to take note of the following:

i. Multiple teams originating from the same College/University/Institution/Club/Society are restricted from joining the identical event. For instance, if a College/University/Institution/Club/Society fields two teams for participation in the event, it is obligatory that only one of the teams competes in the combustion category, while the other engages in the electric category, or vice versa.

ii. Although the restriction of participation in a single event still applies to multiple teams, there are no restrictions on individual team members who wish to participate in multiple events. In other words, team members participating in the combustion category from their own College/University/Institution/Club/Society, if applicable, can also partake in the electric category if another team from their College/University/Institution/Club/Society is participating in that event.

A.6.1.2. Onsite Registration

i. During the ATVC INDIA event, on-site verification will be conducted. Teams must furnish the indemnity bond in hard copy during their on-site registration. The exact format of the indemnity bond will be communicated to the Teams as the event dates approach. Any team member is authorized to present the indemnity bond and, in order to obtain their respective registration kit.

ii. In conjunction with the hard copy of the indemnity bond, teams must also possess hard copies of the driver's insurance documents (for both primary and secondary drivers) and the driving licenses.

iii. Before the event, teams are mandated to provide soft copies of all the requisite documents. Following this submission, teams will receive a confirmation email acknowledging the document submission. Subsequently, teams will need to furnish the hard copy of the successful document submission while registering on-site, which they will receive via email.

- **Furthermore, if a team finds itself without the presence of their college's faculty advisor, a letter elucidating the faculty advisor's non-attendance, duly endorsed with the signatures of the Director, HOD, and accompanied by the college stamp, is required.**

A.6.1.3. Team Composition

i. A team must consist of at least 5 members and a maximum of 30 members.
ii. A team is required to have a minimum of 1 faculty advisor and can have a maximum of 2 faculty advisors.

A.6.1.4. Enrolment Deadline

Teams are required to complete their registration for the ATVC competition prior to the indicated date as presented on the ATVC website for the respective calendar year.

A.6.1.5. Registration Fees

The registration fee for ATVC INDIA should be settled using the online mode as outlined in the instructions presented on the website.

- **The organizing committee of ATVC wholeheartedly recognizes that the teams taking part are comprised of students who might encounter financial challenges in building their buggy and participating in the event. In light of this consideration, as a special measure, the organizing committee has opted to offer flexibility in terms of paying the registration fee. Teams are now eligible to choose an instalment-based payment approach, with the option to divide the total amount (including GST) into a maximum of 3 instalments.**
- **Should any team opt for the instalment-based payment method, it is imperative that they formally compose an email and communicate with the organizing committee. This email should include the payment details as an attachment, following the successful payment of each instalment.**
- **Furthermore, it's important for teams to ensure that they settle their entire registration fees well in advance of the main event. Teams failing to fulfil the complete payment will regrettably not be permitted to take part in the event.**
- **A GST rate of 18% is applicable to the registration fees, and these fees are non-refundable and not transferrable.**

A.6.1.6. Withdrawals

If in case due to any reason a team wants to withdraw from the main event, they can officially withdraw by emailing the reason of withdrawal on the official mail id of ATVC, at least 10 days prior to the event. Registration fees are NOT refundable or transferable.

A.6.1.7. Missing Timelines

Every participating team in the competition must ensure the submission of all necessary documents prior to the commencement of the event. These mandatory documents serve as proof that their vehicle adheres to the frame regulations and facilitate the technical inspection process. The absence of these documents hampers the judges' ability to thoroughly evaluate both the vehicle and the team. Failure to provide any of the mandated documents may result in substantial penalties affecting the teams' scores.

❖ SECTION B: ENGINEERING PREREQUISITES

Part B.1. Overall Design Specifications

B.1.1. Fundamental Specifications

The vehicle should have the capacity to accommodate a single individual measuring 190 cm (75 inches) in height and weighing 113 kg (250 lbs).

B.1.2. Ergonomic Design

Every driver must adhere to the specified roll cage clearances and comfortably assume a suitable driving posture while wearing the complete mandatory driver's gear. It's essential that all drivers can easily access and operate all of the vehicle's controls without any difficulty. Teams need to be ready to exhibit their adherence to this prerequisite during the design event.

B.1.3. Sound Engineering Principles

Vehicles participating in the ATVC INDIA competition are required to be designed and constructed following established engineering and construction standards.

B.1.4. Versatility Across All Terrains

The vehicle should be able to operate safely across challenging terrains, encompassing obstacles like rocks, sand, logs, steep inclines, mud, and shallow water, either individually or in various combinations. This capability should extend to all weather conditions, including rainy conditions.

B.1.5. Vehicle Setup

B.1.5.1. Wheel Configuration

The vehicle should possess four (4) or more wheels arranged in a non-linear fashion.

B.1.5.2. 4WD/AWD

For the 2024 competition, teams are given the choice to integrate either 4WD/AWD (Four-Wheel Drive/All-Wheel Drive) or 2WD (Two-Wheel Drive) into their design. However, there will be no additional points awarded for opting for 4WD/AWD.

To qualify as a 4WD/AWD vehicle, the powertrain system of the vehicle must have the capability to deliver power to all of its wheels. 4WD/AWD can be either full-time (AWD) or selectable (4WD), with selectable AWD/4WD indicating the ability to switch between 4WD and 2WD modes in the vehicle. Both the front and rear wheels of the vehicle must be capable of being powered. It is essential to demonstrate the functionality of the 4WD/AWD system under operational conditions.

B.1.6. Restrictions

The vehicle's maximum dimensions must fit within the range of 162 cm (64 inches) in width and 274 cm (108 inches) in length.

Weight: Unrestricted

Part B.2. Roll Cage

B.2.1. Aim

The roll cage serves the function of preserving a minimum area around the driver. It is imperative that the cage's design and construction ensure the integrity of the cage remains intact both during regular operations and in the event of a collision or rollover.

- **Every year, teams are required to construct a new roll cage. Teams using Roll Cages from previous year's competitions will not be eligible for participation in the main event.**
- **Teams have the flexibility to reuse components such as Tires and Rims, Shock Absorbers, CVT, Driver's Seat, and Safety Equipment without any imposed time limit, as long as these components remain functional, maintain optimal conditions, and comply with other rules outlined in the rulebook.**
- **It is recommended that teams routinely maintain and service these reusable components to extend their longevity. While teams have the autonomy to determine the usability duration of these components, it is compulsory that every team provides the original purchase, service (if applicable) invoices of the component to the Technical Inspectors/Judges at the competition site.**

B.2.2. Roll Cage Anatomy

The roll cage should constitute a tubular steel space frame. The subsequent section delineates the criteria for the physical components and methods of connection within the roll cage. The roll cage and frame members must be solidly welded, and no welds should be altered, sanded, or modified to evade scrutiny. Roll cage members that are bent should show no signs of wrinkles, kinks, or any adverse distortions of the cross-section. The terminology used in the rulebook regarding the roll cage design is provided below.

i. **Frame:** The complete tubular framework, encompassing all tubes that are not cantilevered.
ii. **Roll Cage:** Primary and secondary components are employed to ensure driver safety.
iii. **Members:** A Primary or Secondary required element beginning and ending at Named Points.
iv. **Named Points:** The point where the centrelines of two or more connecting members intersect.

B.2.2.1. Member Criteria

i. Roll cage members must adhere to specific guidelines regarding their composition and dimensions. Steel tubes are mandated for these members, which can be either straight or bent in their configuration. If opting for straight members, they must not exceed a length of 1016 mm (40 in.) between Named Points or comply with Rule B.2.2.4., (Additional Support Members). Bent members, on the other hand, must not exhibit a bend that exceeds 30 degrees unless it aligns with a Named Point. Additionally, the length of bent members must not surpass 838 mm (33 in.) between Named Points, unless they conform to Rule B.2.2.4., (Additional Support Members)

ii. Instances of small bend radii (less than 152 mm or 6 in.) terminating at Named Points are to be anticipated and are not classified as bent members, irrespective of the angle. It is important to note that a bend concluding at a Named Point signifies that the point lies at or between the points of tangency of the bend. The stipulated dimensions between roll cage members are determined by measurements taken between the centrelines of these members, unless stated otherwise. The intersections of Primary and Secondary members, as described below, should be located within a proximity of 51 mm (2.0 in) from the Named Point, with exceptions as specified.

iii. Tubing joints that are Mitered and have an angle exceeding 5 degrees will be considered as bends. Conversely, Mitered joints with an angle below 5 degrees will be regarded as butt joints.

iv. Mandatory members that are assembled using multiple individual elements, such as the SIM and LFS, will be evaluated as seamless, uninterrupted components spanning from one Named Point to another, with exceptions detailed as specified.

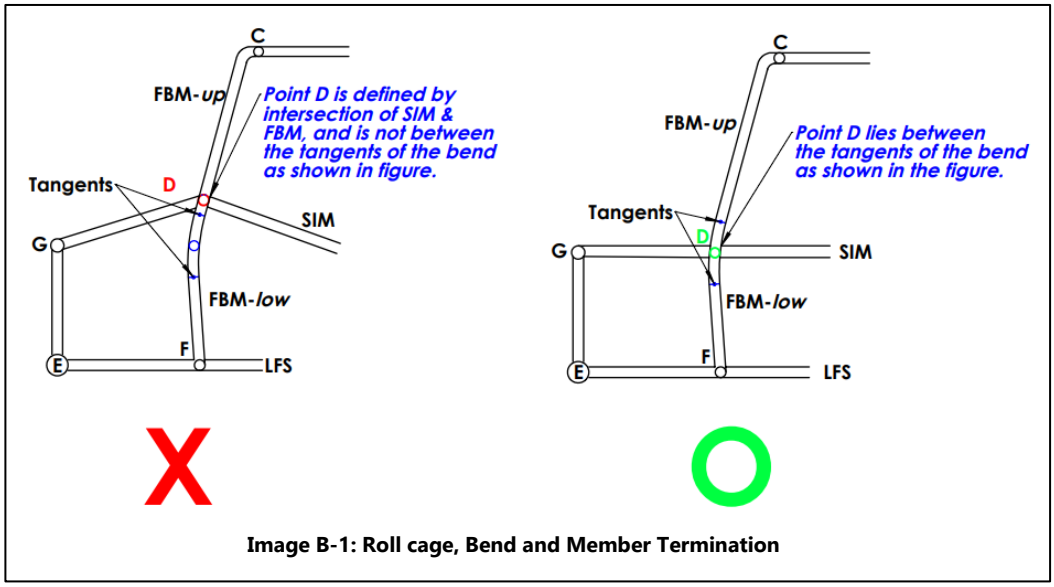


Image B-1: Roll cage, Bend and Member Termination

B.2.2.2. Primary Members

Figure B-1 and Figure B- depict the essential constituents of the roll cage. Primary members are mandated to adhere to the specifications outlined in B.2.2.15. (Roll Cage Materials).

Sr.No.	Abbreviation	Full Name
1.	ALC	Aft Lateral Cross Member
2.	BLC	Overhead Lateral Cross Member
3.	CLC	Upper Lateral Cross Member
4.	DLC	SIM Lateral Cross Member
5.	FBM	Front Bracing Members
6.	FLC	Front Lateral Cross Member
7.	LFS	Lower Frame Side Members
8.	RHO	Roll Hoop Overhead Members

9.	RRH	Rear Roll Hoop

- **The ends of the ALC member should be extended and left open for measurement purposes of the pipe cross-section.**

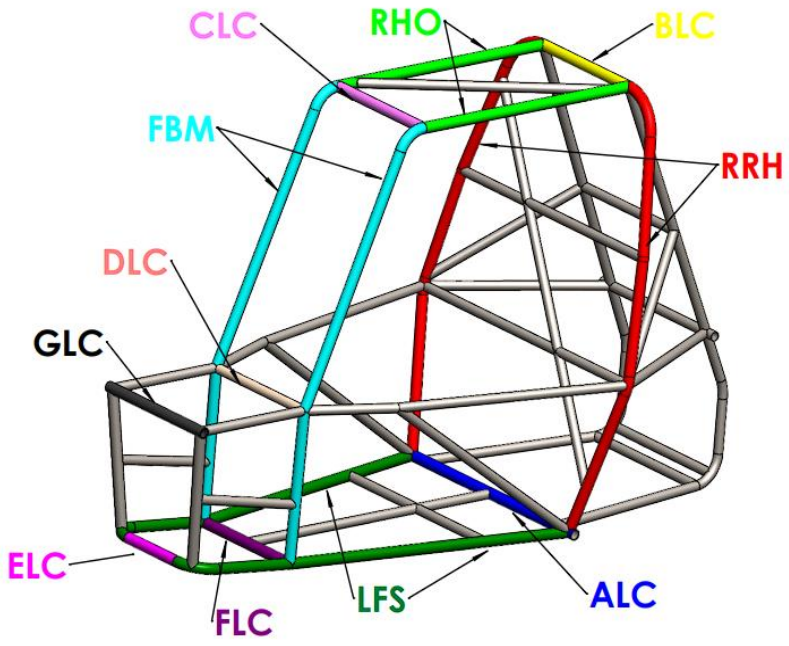


Image B-2: Roll Cage, Primary Members, Rear Bracing

B.2.2.3. Secondary Members

Secondary members must consist of steel tubes with a minimum wall thickness of 0.89 mm (0.035 in) and a minimum outer diameter of 25.4 mm (1.0 in). Alternatively, they can be rectangular steel tubes with a minimum wall thickness of 0.89 mm (0.035 in) and a minimum outer dimension of 25.4 mm (1.0 in).

Sr.No.	Abbreviation	Full Name
1.	FAB	Fore/Aft Bracing Members
2.	LDB	Lateral Diagonal Bracing
3.	RLC	Rear Lateral Cross Member
4.	SIM	Side Impact Members
5.	USM	Under Seat Member
Any tube employed for the installation of safety belts, securing the fuel tank, or safeguarding the fuel system.		

- **In the engine compartment area, it's necessary to leave at least one member open to enable measurement of the pipe cross-section.**

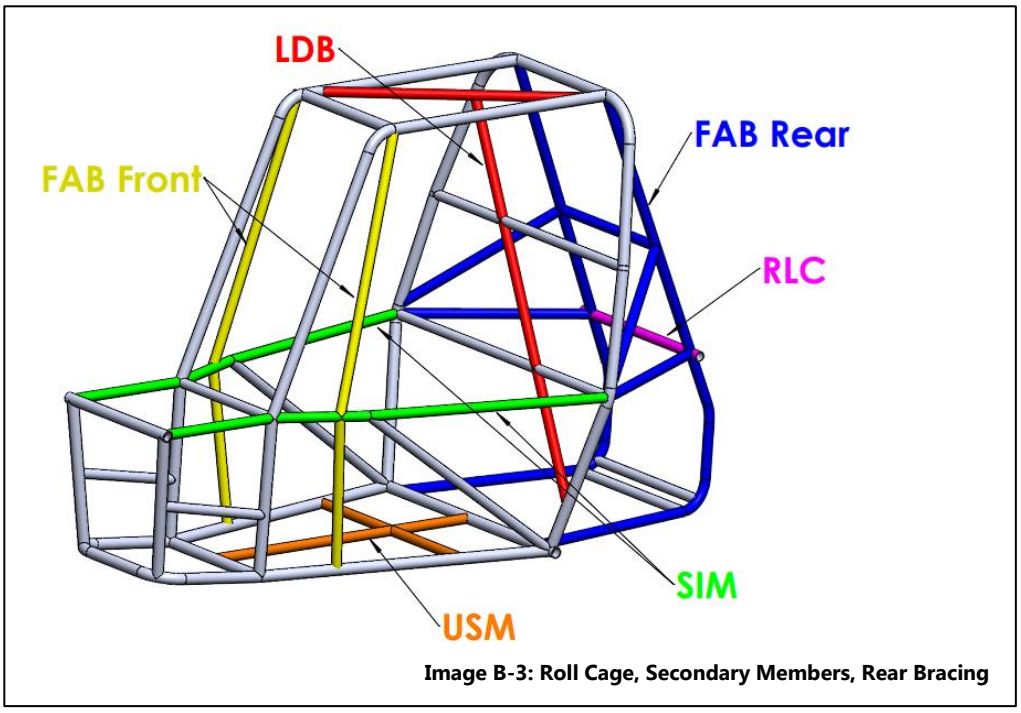


Image B-3: Roll Cage, Secondary Members, Rear Bracing

- **The provided colour coding serves the purpose of enhancing the comprehension of the design.**

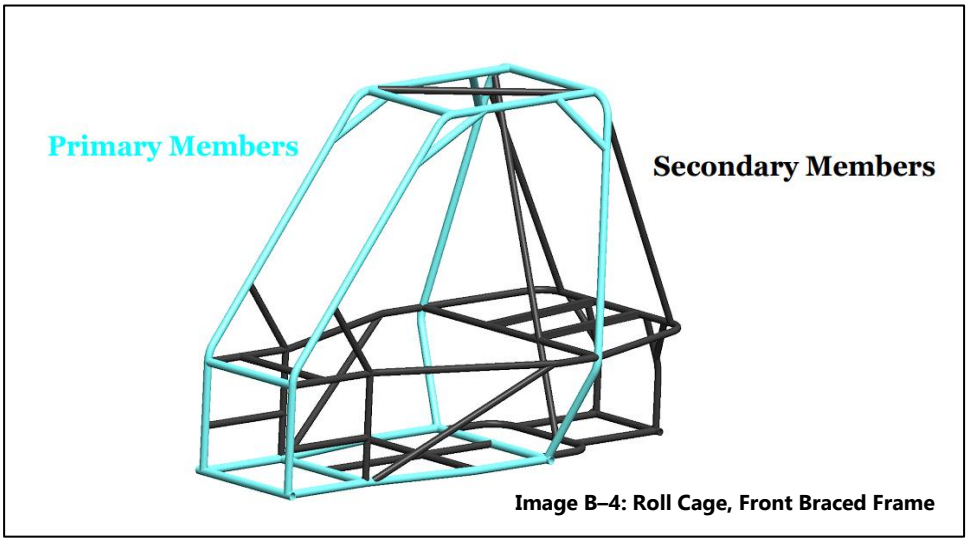


Image B–4: Roll Cage, Front Braced Frame

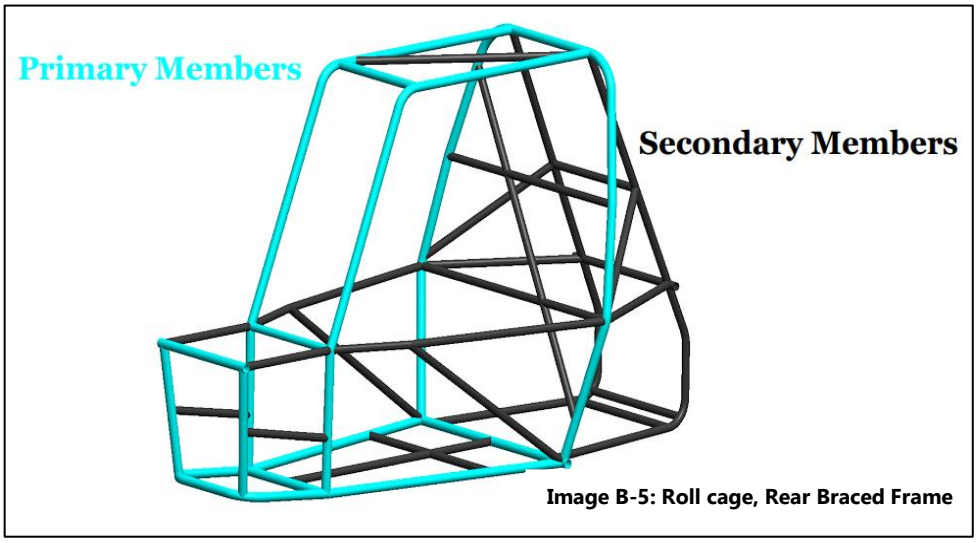


Image B-5: Roll cage, Rear Braced Frame

B.2.2.4. Additional Support Members

i. When Primary Roll Cage Members, whether bent or straight, surpass the maximum permissible length, it is admissible to incorporate supplementary support members. For straight members, a solitary secondary member ought to extend from the midpoint (+/- 127 mm or 5 in.) to a Named Point. In the case of bent members, a single secondary member should link the points between the bend's tangents and a Named Point. If Additional Support Members are introduced, the supported Roll Cage Member will be assessed for any deviations in length and/or additional bends between the Named Point and the position of the Additional Support Member. It is crucial to note that bent members must never have a bend exceeding 30°.

ii. Similarly, in situations where Secondary Roll Cage Members, whether bent or straight, exceed the maximum allowable length or bend angle, the option exists to include additional support members. If a member exceeds either the length limit OR the bend angle limit, a single supplementary support member is mandated, as described below. However, if a member transgresses both the length and bend angle limits, the requirement becomes two additional support members, as outlined 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 Image B.6. and Figure B.7.

SECONDARY MEMBERS ONLY			
Length / Bend Angle	≤ 838 mm (33”)	> 838 mm (33”) & ≤ 1016 mm (40”)	> 1016 mm (40”)
0°	No Supports Required	No Supports Required	1 Support Member Required*
≤ 30°	No Supports Required	1 Support Member Required*	1 Support Member Required*
> 30°	1 Support Member Required**	2 Support Members Required**	2 Support Members Required**
*Required within 50 mm (2”) of the midpoint of the overall tube length			
**Required within the tangents of the bend			

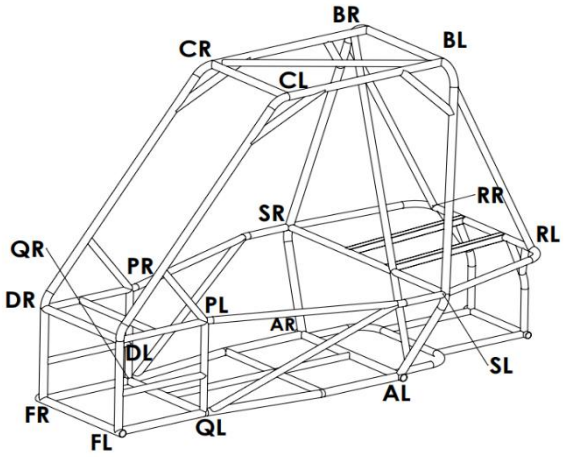


Image B-6: Roll Cage, Named Points, Front Bracing

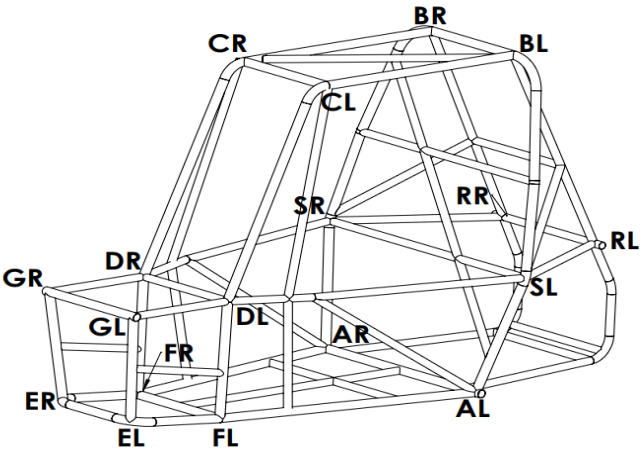


Image B-7: Roll Cage, Named Points, Rear Bracing

B.2.2.5. Lateral Cross Members (LCs)

Lateral cross members (LCs) are required to be at least 203.5 mm (8 inches) in length. These LCs should not have bends individually; however, they can be part of a larger tube system with bends, as long as the minimum length requirement is met between the tangents of the bends. 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. The LC at the Rear FAB low/bottom should be more than or equal to 6 in.

- **The ALC member has a distinct minimum length requirement of 457 mm (18 inches) and should not be considered under the B.2.2.5. (LCs, 8-inch requirement).**

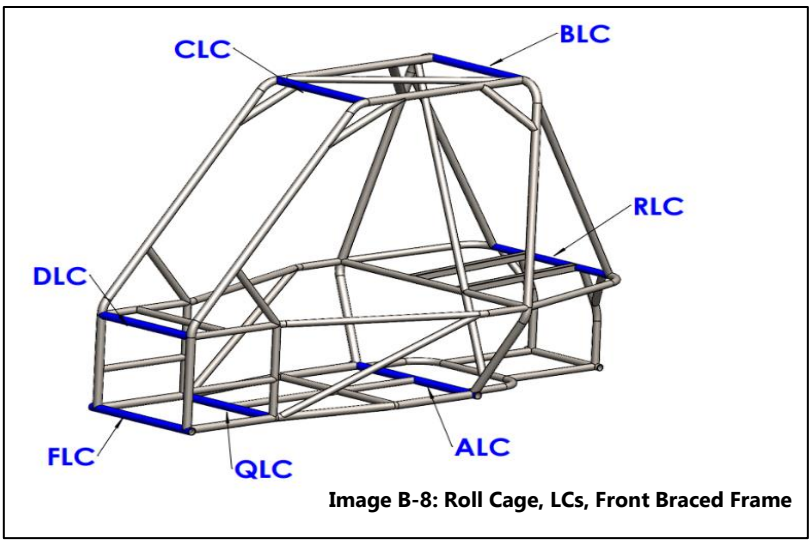


Image B-8: Roll Cage, LCs, Front Braced Frame

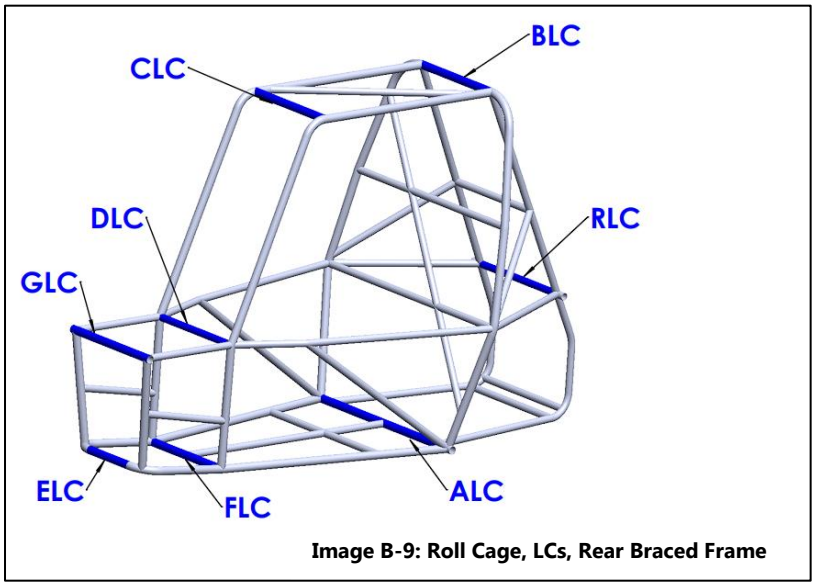


Image B-9: Roll Cage, LCs, Rear Braced Frame

B.2.2.6. Rear Roll Hoop (RRH)

i. The Rear Roll Hoop (RRH) is a flat structure situated behind the driver's seat, delineating the boundary between the front (fore) and rear (aft) sections of the roll cage. It's imperative that both the driver and their seat are positioned entirely forward of the RRH and Firewall

Panel. The RRH is primarily oriented vertically but can have a maximum inclination of up to 20 degrees from the vertical position.

ii. The RRH must meet specific width requirements: at a point 686 mm (27 inches) above the inside seat bottom, its minimum width should be 736 mm (29 inches).

iii. The RRH incorporates vertical members that can either be straight or bent. These vertical members are defined as starting and ending where they intersect with the top and bottom horizontal planes, denoted as points AR and AL, and BR and BL in Image B.11. Importantly, these vertical members must consist of continuous tubes, meaning they should not be segmented and joined through welding.

iv. To ensure structural integrity, the vertical members must be connected by ALC and BLC members at both the bottom and top. These ALC and BLC members should also be continuous tubes. Lastly, the ALC, BLC, RRH members, LDB, and the shoulder belt tube must all lie within the same plane.

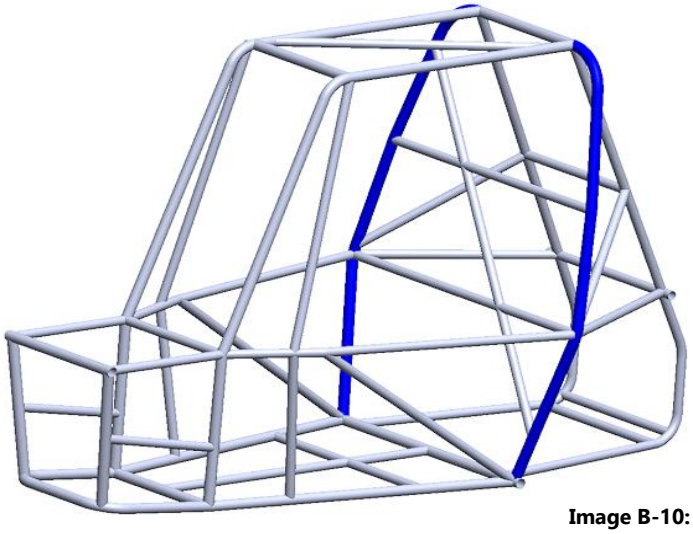


Image B-10: Roll Cage, RRH

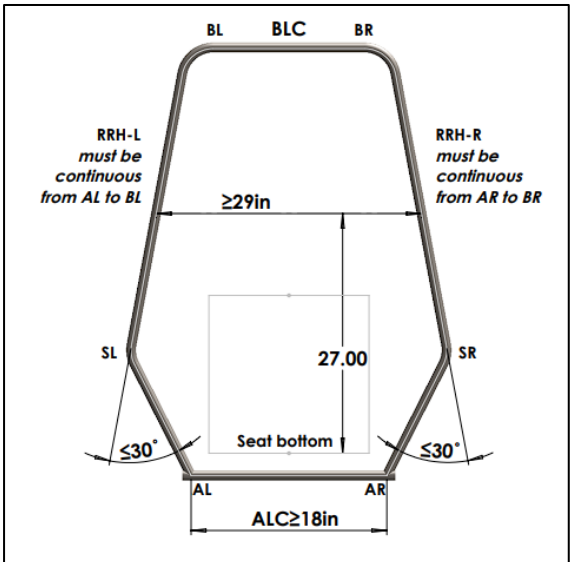


Image B-11: Roll Cage, RRH Conditions

B.2.2.7. Lateral Diagonal Bracing (LDB)

The Rear Roll Hoop (RRH) necessitates diagonal bracing, and these diagonal brace elements should extend from one vertical RRH member to the other. Crucially, the intersections at both the top and bottom of the LDB members and the vertical RRH members must not exceed a distance of 127 mm (5 inches) from points A and B. Additionally, the angle formed between the LDB members and the RRH vertical members should be equal to or greater than 20 degrees. It's noteworthy that the lateral bracing can involve multiple members.

It's important to note that if you employ a single straight LDB, it is exempt from the maximum length requirement stipulated in B.2.2.1 (Member Criteria).

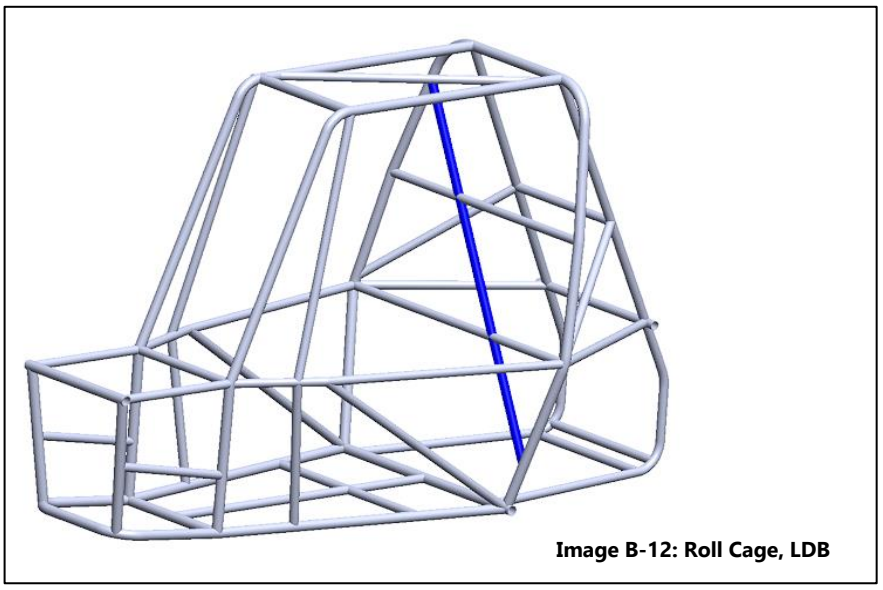


Image B-12: Roll Cage, LDB

- **In the case of utilizing multiple members for the Lateral Diagonal Brace (LDB), as depicted in Image B-13, it's imperative that all these members converge at a common point.**

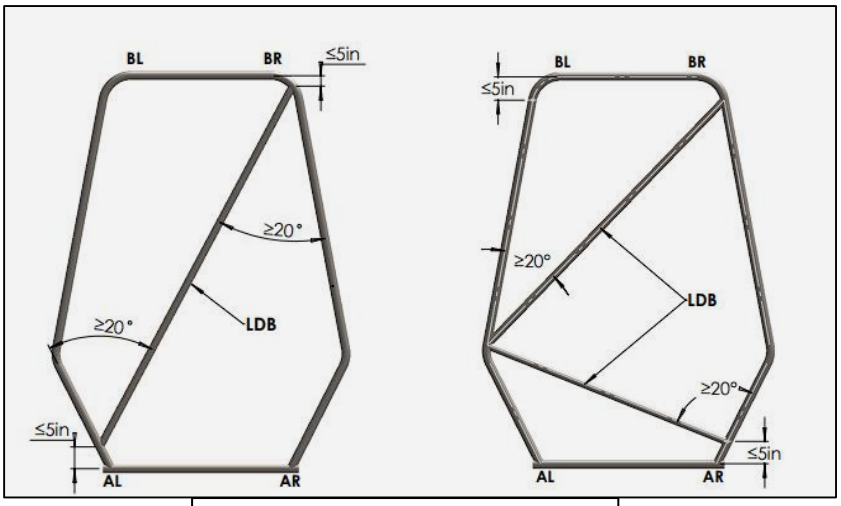


Image B-13: Roll cage, LDB Conditions

B.2.2.8. Roll Hoop Overhead Members (RHO)

The rear ends of the RHO members connect with the RRH within a 51 mm (2.0 in.) proximity of Points BR and BL, as determined by the BLC. On the other hand, the front ends of the RHO members, where they intersect with the CLC, establish points CR and CL as illustrated in Image B-14. It's essential to ensure that the CLC, BLC and RHO members all lie within the same plane. Moreover, bends at the rear ends of the RHO members are not permitted.

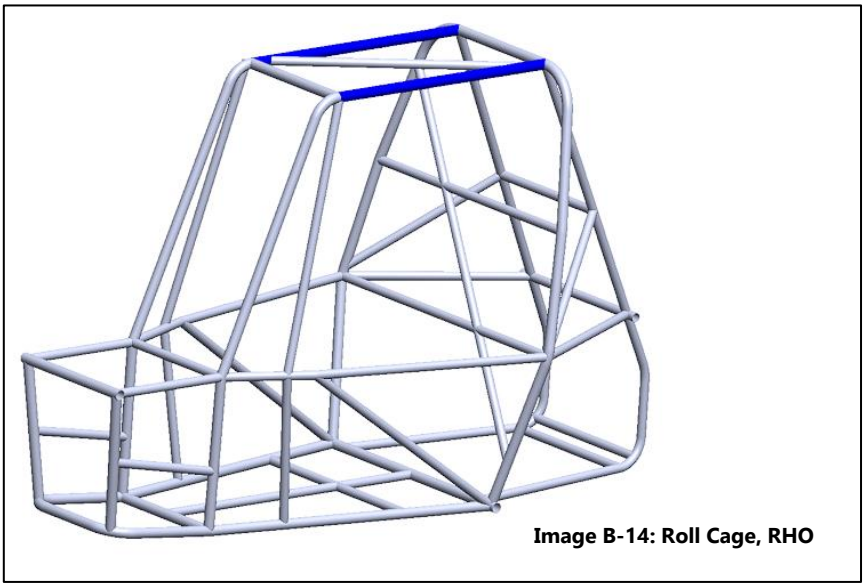


Image B-14: Roll Cage, RHO

When a bend is incorporated at Point CR/CL or BR/BL, these points are determined at the initiation of the bend, specifically on the top-most plane of the Roll Cage. The positions of points BL and BR are established by the ends of BLC.

For vehicles that are designed with bends at the upper section of the RRH, Point B must be situated at the innermost end of the bend. It's crucial to note that Point B should not be located directly on the bend or at a linear distance from the bend's end.

Furthermore, Points CR and CL should be positioned at least 305 mm (12 inches) forward of a point, as seen from the side view of the vehicle. This specific point is defined by the intersection of the RHO members and a vertical line extending from the aft end of the seat bottom.

The identification of this point on the seat is based on the intersection of the seat bottom with a circle having a 101 mm (4 in.) radius. This circle touches both the seat bottom and the seat back. To ensure precision, the top edge of the template is perfectly aligned horizontally with the force of gravity.

In addition, Points CR and CL, as well as Points BR and BL, are mandated to be positioned no lower than the top edge of the template, which stands at a height of 1016 mm (40 inches) above the seat. These positioning requirements are essential to comply with the Lateral Space regulations outlined 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 are required to be reinforced using a diagonal member, in accordance with Rule 2.2.1, which is represented by the blue highlight in Image B - 15. The termination points of these welded diagonal members should be situated within the same plane as the RHO members. Furthermore, these termination points must be positioned at a distance of less than 3 inches from points CR/CL and BR/BL, respectively. This measurement should be made in the direction of the vehicle's longitudinal axis.

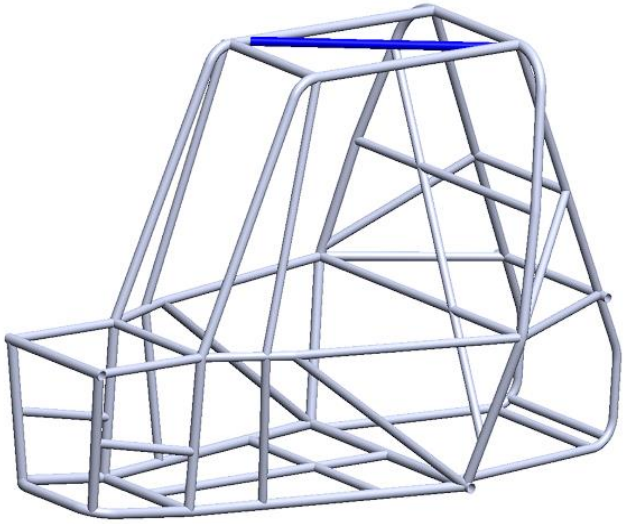


Image B-15: Diagonal Bracing for RHO Members

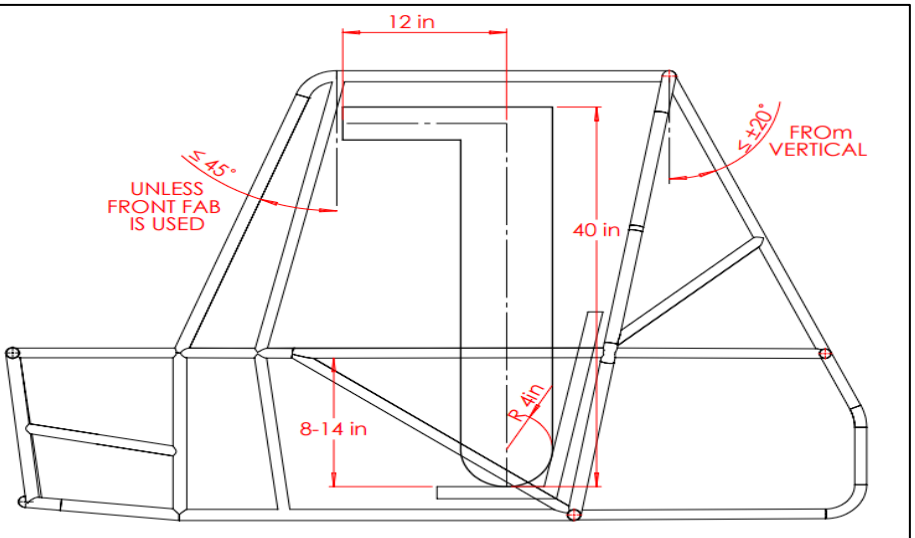


Image B-16: Roll Cage, Template Installation

B.2.2.8.1. Gussets for Lateral Clearances

If a gusset is employed to provide bracing between the RHO and RRH or FBM to meet the Lateral Clearance requirements outlined in Rule 2.3.1. (Lateral Space), the additional members introduced must be constructed from primary materials as per B.2.2.15. (Roll

Cage Materials). These additional members should be fully welded around both ends of the gusset, encompassing its entire circumference.

When gusset members are used to connect the SIM to RRH or FBM to satisfy the Lateral Clearance criteria specified in Rule B.2.3.1 (Lateral Space), they must be secondary material as described in B.2.2.3. (Secondary Members). Furthermore, these gusset members must be enclosed with Body Panels in adherence to Rule B.5.5. (Body Panels).

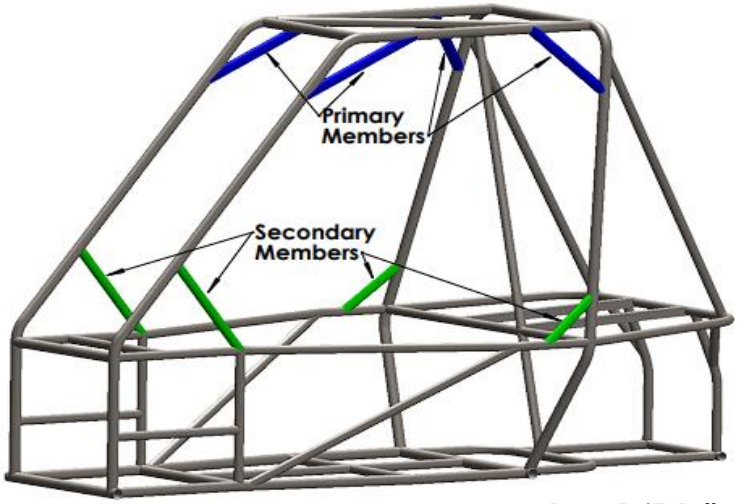


Image B-17: Roll cage, Gussets

B.2.2.9. Lower Frame Side Members (LFS)

The two Lower Frame Side members serve as the lower boundaries of the roll cage, outlining its left and right edges. These members originate from the base of the RRH at Point A and extend generally forward. They should reach at least as far as a point ahead of the driver's heel when seated in a standard driving position.

Towards the front, the forward ends of the Lower Frame Side (LFS) members are connected by a lateral cross member, referred to as FLC, as depicted in Image B-9. The juncture between the LFS members and the FLC establishes the positions of points FR and FL.

In 'Nose' design configurations, illustrated in Image B-18, the LFS extends forward to Point E and is linked by both a lateral cross member, FLC, and an additional one named ELC (Image B-9).

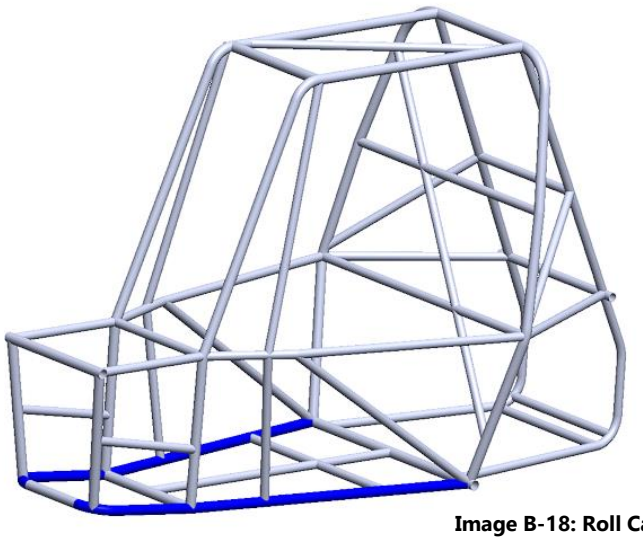


Image B-18: Roll Cage, LFS

B.2.2.10. Side Impact Members (SIM)

The two Side Impact Members establish a horizontal mid-plane within the roll cage. These members are connected to the RRH, defining Point S, and extend generally forward. They should reach at least as far as a point ahead of every driver's toe when seated in a standard driving position of an ATV. Towards the front, the forward ends of the SIM members are linked by a lateral cross member, known as DLC. The point where the SIM and DLC intersect designates the positions DR and DL.

Throughout the section between points S and D, the SIM members must maintain a height between 203 mm (8 inches) and 356 mm (14 inches) above the inside seat bottom, as depicted in Image B-16. In 'Nose' design configurations, as illustrated in Image B-20, the SIM extends forward to Point G. It is associated with a lateral cross member named GLC (Image B-9). In this scenario, DLC can be omitted if GLC provides sufficient protection for the driver's toes, as explained below.

- **SIM defines horizontal mid-plane in the Roll Cage but not necessarily to be coplanar between points D/G and S, i.e., it can be 3D bended but must conform to the Rule B.2.2.1. and at that bend braced with support member to named points, provided that the Teams ensure the proper FEA analysis of the same.**

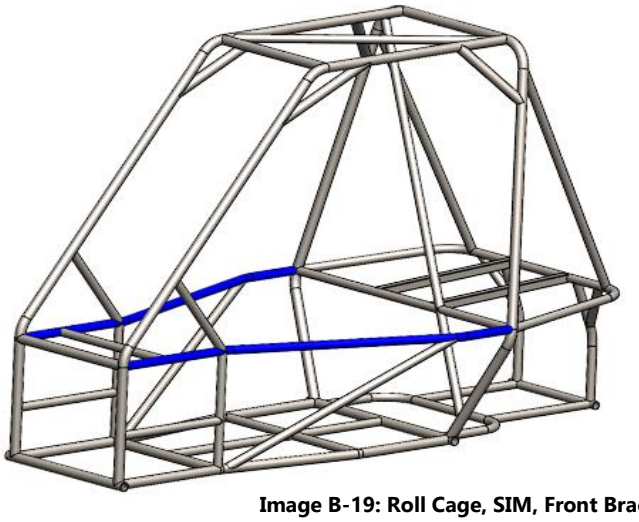


Image B-19: Roll Cage, SIM, Front Braced Frame

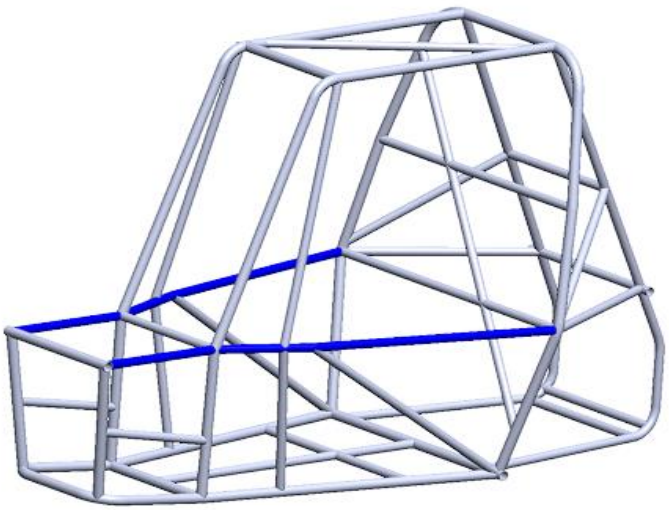


Image B-20: Roll Cage, SIM, Rear Braced Frame

- **Each driver's foot should be positioned entirely to the rear of the plane formed by points FR, FL, DR, and DL. In cases where the lateral cross member DLC falls below the level of the driver's toes, an extra lateral cross member constructed from primary materials must be installed between the FBM members above the driver's toes.**
- **For 'Nose' designs, it's crucial that each driver's foot is positioned entirely to the rear of the plane established by points GR, GL, ER, and EL. If the GLC falls below the level of the driver's toes, an extra lateral cross member made of primary materials must be installed between the FBM or SIM above the driver's toes.**

B.2.2.11. Under Seat Member (USM)

The Under Seat Member (USM) must be positioned strategically to prevent the driver from passing through the plane defined by the Lower Frame Side (LFS) members in case of seat failure. Additionally, the USM can serve as the mounting point for the seat and/or the

attachment of anti-submarine belts, following the guidelines in Rules B.3.5.3.(Seat Mounting Points) and B.3.2.5. (Anti-Submarine Belt Attachment).

Two options are provided for the USM member:

i. **Lateral USM:** In this option, the two LFS members are connected by the Under Seat Member, ensuring that the USM passes beneath the driver within the fore-aft envelope of the part of the template indicated in Image B-16, where it intersects the seat bottom.

ii. **Longitudinal USM:** Alternatively, the ALC and FLC members are joined longitudinally by the Under Seat Member. The forward end of the USM can also terminate at an additional cross member crafted from primary materials, linking the LFS members between Point A and Point F. This Longitudinal USM must pass within the fore-aft envelope of the template specified in Image B-16, where it intersects both the seat bottom and the lateral centreline of the seat.

iii. For a front braced frame, the longitudinal USM design must be of two separate members if QLC is present, i.e., the first member connecting from ALC to QLC and second from QLC to FLC. For a rear braced frame, the USM design must be of two separate members if FLC is present, i.e., first connecting from ALC to FLC and second from FLC to ELC.

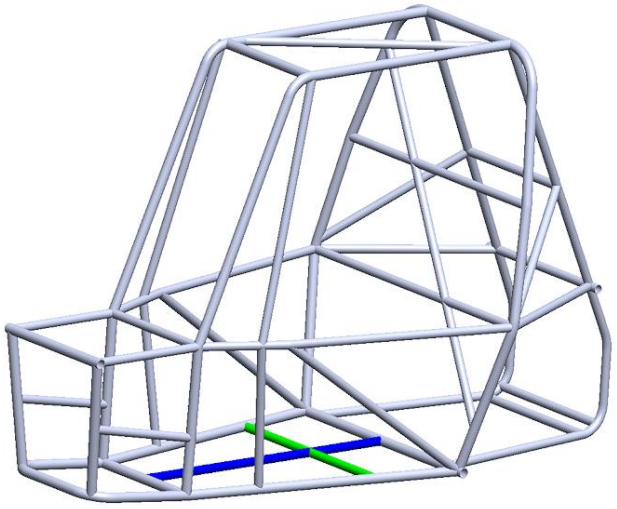


Image B-21: Roll Cage, USM

B.2.2.12. Front Bracing Members (FBM)

The Front Bracing Members have the critical task of connecting the RHO, the SIM, and the LFS as depicted in Image B-22. They must establish connections at Points C, D, and F.

Specifically, the upper Front Bracing Members FBM_{UP} should link Point C on the RHO to Point D on the SIM. On the other hand, the lower Front Bracing Members FBM_{LOW} are responsible for connecting Point D to Point F.

It's crucial to emphasize that the FBM must be constructed as continuous tubes. Additionally, the angle between the FBM and the vertical must not exceed 45 degrees.

However, if Front FAB, in accordance with Rule 2.2.13.1. (Front Bracing), is implemented, there is no angle requirement between the FBM and the vertical.

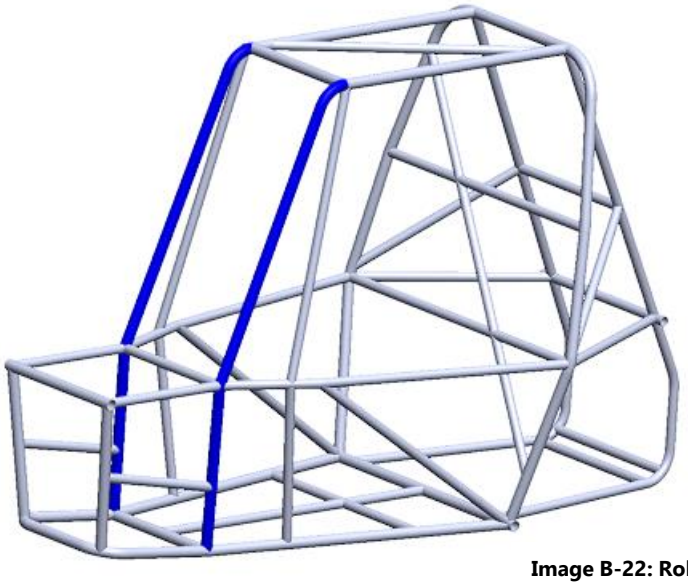


Image B-22: Roll Cage, FBM

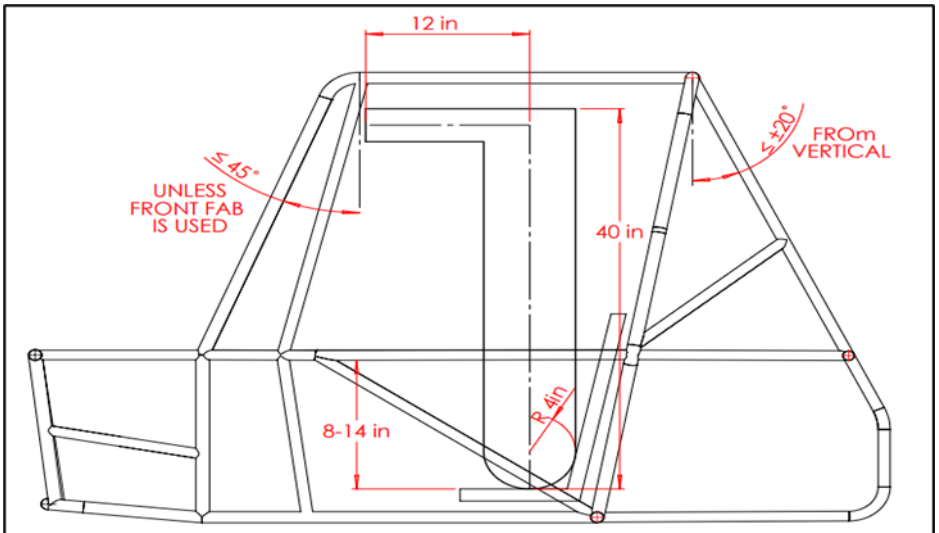


Image B-23: Roll Cage, FBM Constraints

B.2.2.12.1. Gussets for RHO and FBM

In the scenario where the RHO and FBM on one side of the vehicle do not consist of a single tube, bent at Point C, the inclusion of a gusset at Point C is mandatory. This gusset is necessary to provide support at the junction between the RHO and the FBM.

In cases where a tube is employed to reinforce both the FBM and RHO, it must be crafted from primary material. Alternatively, plate gussets can be utilized if the material thickness matches or surpasses that of the primary material used. Please refer to Image B-18 for a visual representation of RHO / FBM Gussets.

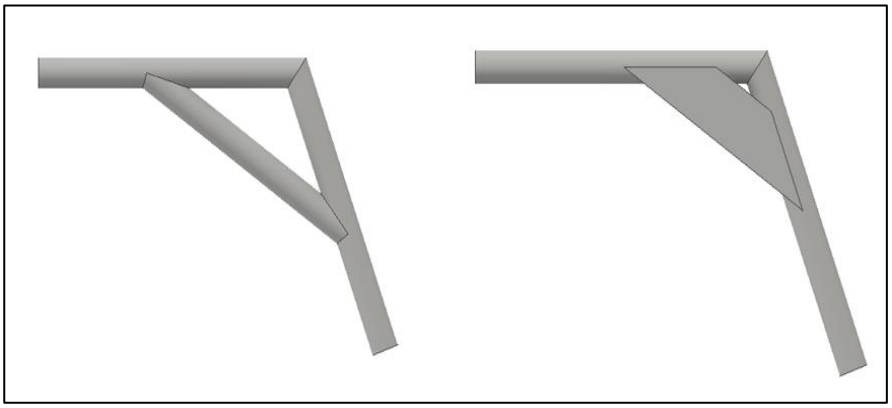


Image B-24: Roll Cage, RHO/FBM Gussets

B.2.2.13. Fore-Aft Bracing (FAB)

The RRH must be effectively prevented from rotating and bending when viewed from the side. In FAB systems, the individual members should not extend more than 1016 mm (40 inches) in unsupported length. Additionally, when examining these systems from a side view, the triangulation angles between members should measure at least 20 degrees. This is achieved through a system of triangulated bracing, which can be categorized as either front bracing or rear bracing:

B.2.2.13.1. Front Bracing

FAB front bracing is responsible for restraining both points C to prevent both longitudinal and vertical displacement. This, in turn, provides support to points B through the RHO members.

In FAB systems located at the front, it's essential that they establish connections between the FBM_{UP} and the SIM members on the same sides of the vehicle. The point where these systems intersect with the FBM_{UP} members must be positioned within a 127 mm (5 inches) straight-line distance, measured from the centreline of point C to the centreline of the intersection.

Furthermore, the intersection point with the SIM members defines Point P, which must be adequately supported in a vertical manner. This support should be achieved by adding additional members that link the SIM members to the LFS members, which in turn define Point Q. It's important to note that Points P and Q only come into play when the complete Front Bracing system is in use.

This bracing serves the purpose of directly restricting both points B to prevent longitudinal displacement, especially in the event of joint failure at points C.

Achieving an improved design is more likely when both front and rear FAB bracing methods are utilized. It's important to note that the Front FAB is obligatory when the angle between the vertical from 'C' point and the FBM exceeds 45 degrees and FAB should be made up of two separate parts (FAB_{UP}) above the SIM and (FAB_{LOW}) below the SIM.

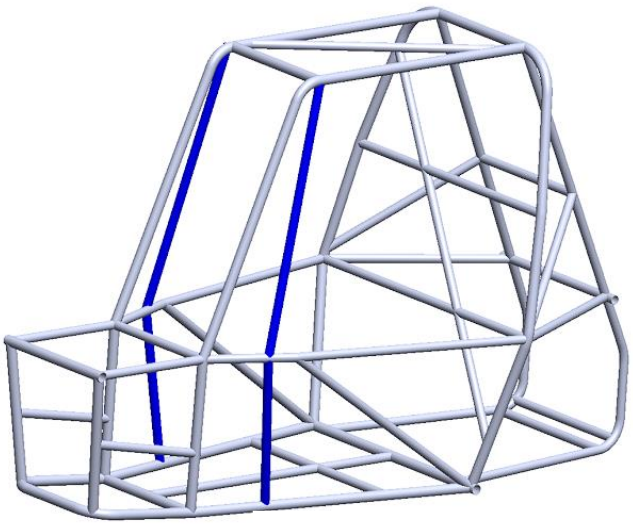


Image B-25: Roll Cage, FAB, Front Bracing

B.2.2.13.2. Rear Bracing

In the case of the Rear FAB systems, it's crucial that they establish structural triangles in the side view on each side of the vehicle. These triangles should be positioned to the rear of the RRH and should incorporate the RRH vertical side as one of their members. Each triangle should have one vertex at Point B and another vertex at either Point S or Point A.

The tubes forming these structural triangles must be continuous members, although bends of less than 30 degrees are permissible.

Additionally, the third (aft) vertex of each rear bracing triangle, referred to as Point R (as shown in Image B-26), should be structurally linked to whichever of the two points, S or A, is not part of the existing structural triangle. This extra connection forms an integral part of the FAB system and must comply with the requirements outlined in B.2.2.1 (Member Criteria). However, it may be constructed using multiple interconnected members, and this assembly of tubes, from endpoint to endpoint, may include a bend exceeding 30 degrees.

The attachment of the rear system FAB should be situated within a distance of 51 mm (2 inches) from Point B, Point S, and Point A on each side of the vehicle.

These distances are determined by measuring in a straight-line manner from the centreline of each respective point to the centreline of the FAB attachment.

To complete the structure, the aft vertex of each rear bracing triangle defines Point R. It must be connected by a Lateral Cross Member (LC) that spans a minimum length of 203.5 mm (8 inches) in accordance with B.2.2.5 (Lateral Cross Members).

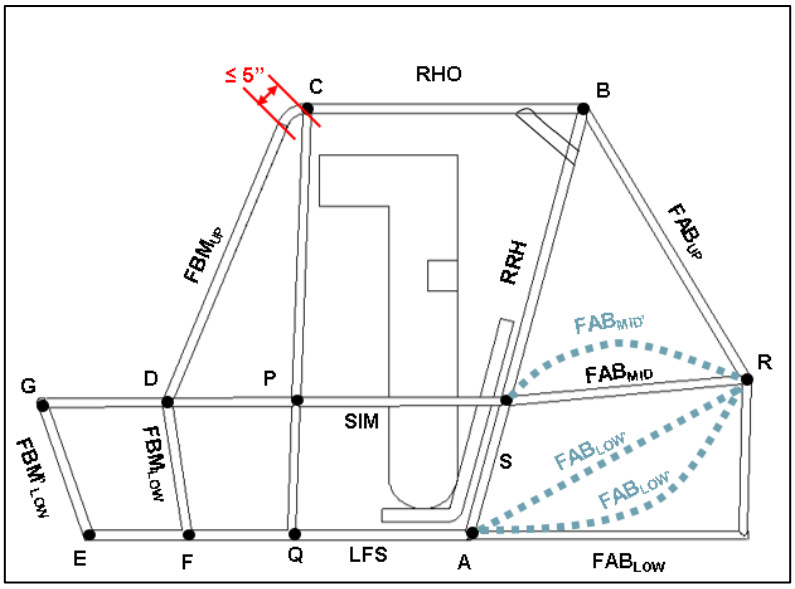


Image B-26: Roll Cage, FAB Constraints

B.2.2.14. Welding

Every individual responsible for welding joints on the vehicle's roll cage components must create two welding samples. These samples should be produced using the same materials and welding processes employed in the roll cage element welds. All welding samples must be presented during the Technical Inspection phase. Failure to provide complete sets of welding samples or if any of the welding samples are deemed subpar, the vehicle will not be eligible to participate in dynamic or endurance events.

The welding samples must precisely match the tube material, diameter, and thickness used in the welds created by each individual on the roll cage components. Each weld sample should be clearly marked using a permanent method such as engraving, etching, or stamping. The following information must be included on the label:

i. Name of the College or College Initials
ii. Name of the Welder or Welder Initials
iii. Date when the weld sample was constructed

Specimen -1: Destructive Testing

In a 90-degree joint, the length of the legs is restricted (as shown in Image B-27). This joint must undergo a destructive test, leading to the failure of the joint in the base material rather than the weld metal. The testing method is flexible - it can be either tensile or bending failure, but it's essential that the highest stress point is situated at the weld. In case of a bending failure, it's important to ensure that the greatest bending moment occurs precisely at the weld.

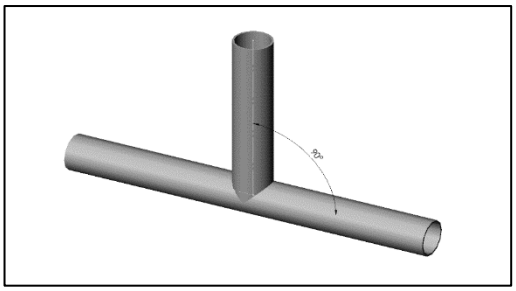


Image B-27: Roll Cage, Weld Specimen - 1

Specimen -2: Destructive Assessment

Two tubes are connected at a 30-degree angle with a minimum length of 150 mm (5.9 in.) measured from the centre of the joint (as shown in Image B-28). The specimen must be sectioned along the length of the tube to expose sufficient and consistent weld penetration (as depicted in Image B-28).

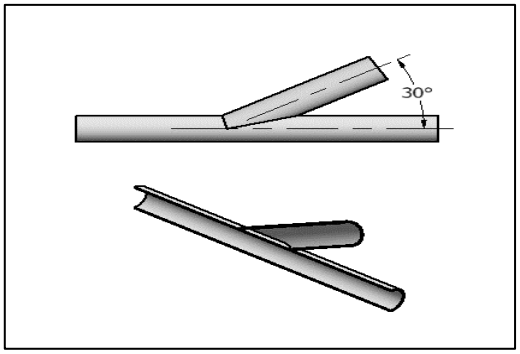


Image B-28: Roll Cage, Welding Specimen - 2

- **Teams should be aware that if they incorporate tubes other than circular ones in the Roll Cage, like square or rectangular tubes (but not limited to), for any purpose, such as mounting or for support, these tubes will be deemed an essential component of the roll cage. Consequently, welding samples of these tubes will be mandatory for inspection.**

B.2.2.15. Primary Member Material

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

A steel shape with bending stiffness and strength exceeding that of circular steel tubing with an outside diameter of 25.4 mm (1.0 in) and wall thickness of 2 mm (0.08 in). The wall thickness must be at least 1.57 mm (0.062 in) (for circular member) and carbon content at least 0.19%, regardless of the material or section size. The bending stiffness and bending strength must be calculated about a neutral axis that gives the minimum values.

- **The use of Docol R8 tubing is allowed. It's important to note that Docol R8 tubes should not undergo any heat treatment following welding and sizing, as any heat treatment could potentially alter the material's mechanical properties.**

To determine the dimensions and materials needed for constructing various components of the vehicle, teams can refer the following section for calculations regarding the mechanical properties of the materials:

i. Bending Stiffness (K_b):

$$K_b = E\,I$$

where, E – Modulus of Elasticity (205 GPa for all Steels)
I - Second moment of area for the structural cross-section

ii. Bending Strength (S_b):

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

where, Sy - Yield strength (0.365 GPa for 1018 steel)
c - Distance from the neutral axis to extreme fibre

The documentation of equivalency should encompass the following:

i. Handwritten/Typed calculations, to be presented during Technical Inspection, demonstrating ample bending stiffness and bending strength. All calculations must be in SI units and accurate to three significant figures based on the specified nominal tube sizes in the invoice.
ii. Teams are required to provide calculations for the specified steel grade (e.g., 1018, 4130, etc.) and the substitute material.
iii. Invoices for the roll cage materials.
iv. Material tests or certifications, specifying the carbon content and yield strength.

- **Teams are strictly prohibited from presenting old test reports.**

B.2.3. Driver Clearances

B.2.3.1. Lateral Space

The minimum space requirement is determined by measuring the distances between the driver and a straight edge placed at any two points on the outer edge of the roll cage structure. Specifically, there should be a 127 mm (5 in.) clearance for the driver's helmet, and a 76 mm (3 in.) clearance for the driver's shoulders, torso, hips, thighs, knees, calves, arms, elbows, and hands. These clearances are determined concerning any driver of the team selected during technical inspection, while they are seated in a regular driving position and wearing all mandated safety equipment.

To qualify as a part of the roll cage, any given member must be listed in B.2.2.2 (Primary Members). Otherwise, it is assumed to have no structural contribution. Examples of members that do not conform to B.2.2.2 include suspension components, additional gussets, and cross members.

B.2.3.2. Vertical Space

The driver's helmet must maintain a minimum distance of 127 mm (5 in.) from any two points located on the uppermost portions of the roll cage. These upper sections include the RHO members (excluding any covering or padding), the upper part of the RRH, the LC, and the LC connecting points C (both left and right). In a side view, no part of the driver's body, including shoes and clothing, should extend beyond the confines of the roll cage.

B.2.4. Sharp Edges

There should be no exposed sharp edges on the entire vehicle, including the roll cage, that could pose a danger to the driver, track workers, or individuals in proximity to the vehicle, regardless of its orientation (static, dynamic, upside-down, etc.).

B.2.5. Bolted Roll Cages

Bolted roll cage joints are acceptable, provided they meet the following requirements (refer to Image B-29):

i. Flanges or tabs must be twice (2x) the thickness of the frame tube and constructed from the same material. These flanges must be correctly welded to each tubing part intended for joining. The flange's surface should be perpendicular to the axis of the frame tube.
ii. The radius of the flange should be at least 25 mm (1.0 in.) larger than the outer radius of the frame tube.
iii. The gap between the flange faces, before tightening, should not exceed 0.07 mm (0.003 in).
iv. Flanges must be secured with a minimum of 3 bolts, each having a diameter no less than 8 mm (0.313 in.). These bolts should be evenly spaced on the flanges. The minimum distance from the edge of the flanges to the bolt holes should be twice the bolt diameter.

v. The use of pin joints is not allowed.

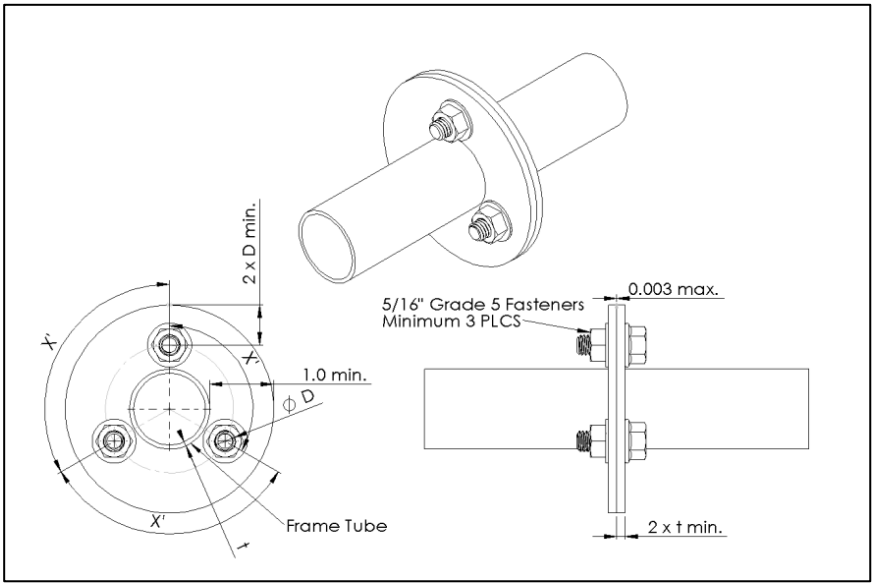


Image B-29: Roll Cage, Mandatory Connection for Detachable Member

Part B.3. Driver Restraint

B.3.1. Purpose

The driver's safety restraint system is designed to effectively secure the driver within the confines of the vehicle's roll cage, ensuring their safety. It must also allow for a swift and complete disengagement when necessary, enabling the driver to exit the vehicle quickly. This system comprises a safety harness, arm restraints, and the vehicle's seat. Whenever the driver is seated in the vehicle, they must wear the driver restraint system in its entirety and ensure it is functioning correctly.

B.3.2. Driver Harness

The driver's harness must include a 5-point or more system, which includes two shoulder belts (one for the left side and one for the right side), two lap belts (again, one for each side), and one or more anti-submarine belts. All these components connect to a single central buckle, which is also the disconnect point. The anti-submarine belt's role is to securely position the buckle and prevent the driver from sliding beneath the lap belts.

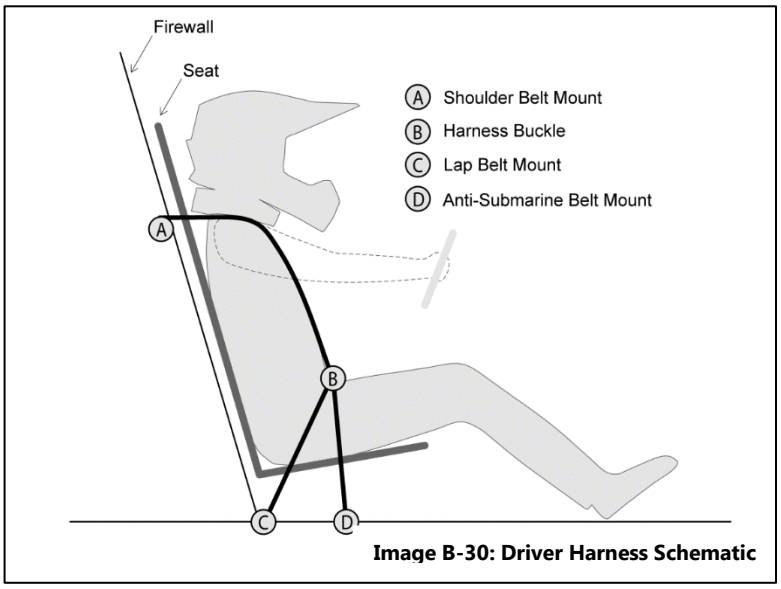


Image B-30: Driver Harness Schematic

B.3.2.1. Certification

Every driver restraint system must conform to either SFI Specification 16.5/16.1 or FIA specification 8853/98. The shoulder and lap belts should be made of Nylon or Dacron polyester, be in new or like-new condition, have a width of 76 mm (3.0 in.), and be free from harmful defects. Anti-submarine belts must adhere to the same requirements but should have a minimum width of 51 mm (2.0 in.).

- **Anti-submarine belts with a stated width of 2.0 inches may have an actual minimum width of 1.75 inches and are considered acceptable for use.**
- **Consult the following links for a roster of authorized manufacturers for SFI Rated driver restraint systems and FIA Specifications:**

SFI Authorized Vendors

FIA Specifications

B.3.2.2. Release Mechanism

Every belt within the driver harness should connect to a solitary, centrally located, metal-to-metal, lever-operated quick-release buckle. The use of Cam-Lock and similar enclosed buckles, which could potentially become obstructed by tiny debris like sand particles, is expressly forbidden. Furthermore, the release mechanism (buckle) must be safeguarded against unintentional disengagement resulting from a direct pull, rollover, or lateral sliding motion.

B.3.2.3. Shoulder Belts

The shoulder harness should be of the over-the-shoulder style, and only individual shoulder straps are allowed. "Y"-type shoulder straps are strictly prohibited.

B.3.2.3.1. Shoulder Belt Positioning, Vertical and Lateral

The mounting point (A) for the shoulder belt (as shown in Image B-31) should be situated at a level no higher than the vertical position of the driver's shoulders and no lower than 102 mm (4.0 in.) vertically below the driver's shoulders.

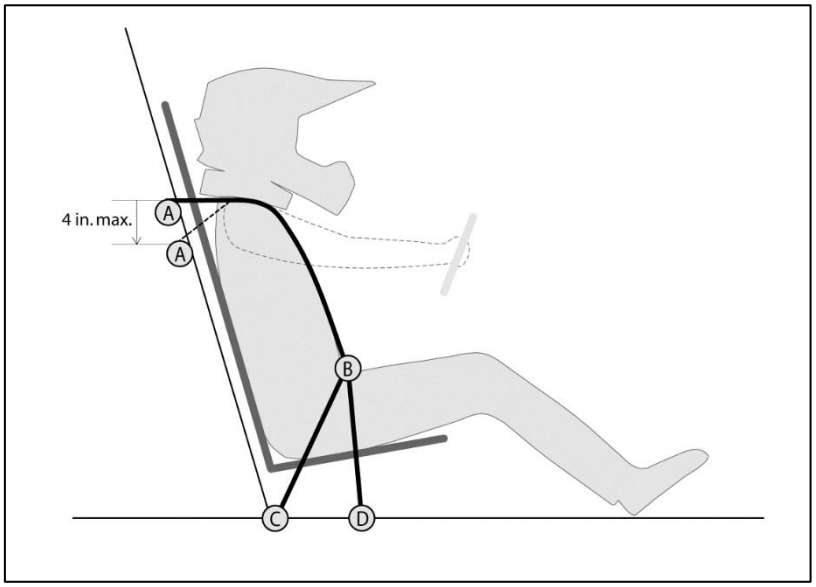


Image B-31: Driver Harness, Shoulder Belt Vertical Positioning

The lateral gap between the shoulder belts should measure between 152 mm (6.0 in.) and 229 mm (9.0 in.) when measured from the centre of one belt to the centre of the other. Refer to Image B-32 for clarification. It's important to note that the lateral positioning of the shoulder belts along their mounting tube must be secured by a structure separate from the firewall.

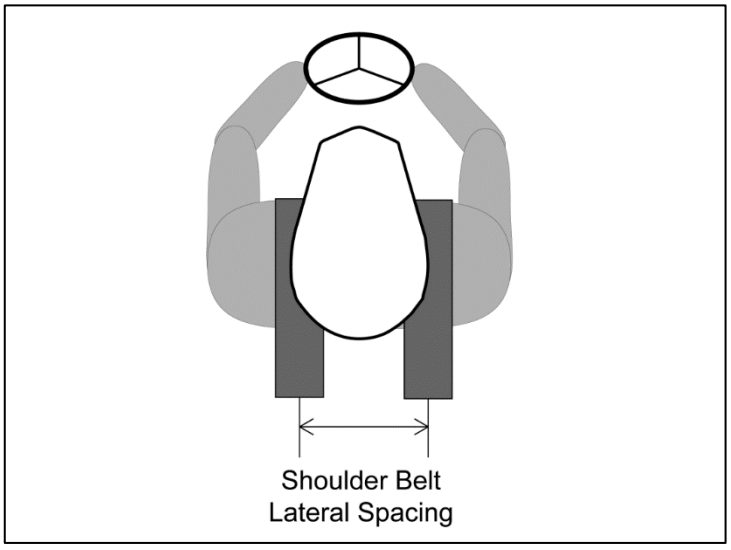


Image B-32: Driver Harness, Shoulder Belt Lateral Positioning

The shoulder belts must be threaded through and fastened around a straight, horizontal tube located within the RRH plane. This tube must meet the criteria specified for secondary members as outlined in B.2.2.3 (Secondary Members). It is essential to include features that ensure lateral position restraint, and it's important to note that firewall material is not suitable for this purpose. Refer to Image B-33 for a visual representation of these requirements.

Image B-33: Driver Harness, Shoulder Harness, Lateral Restraint

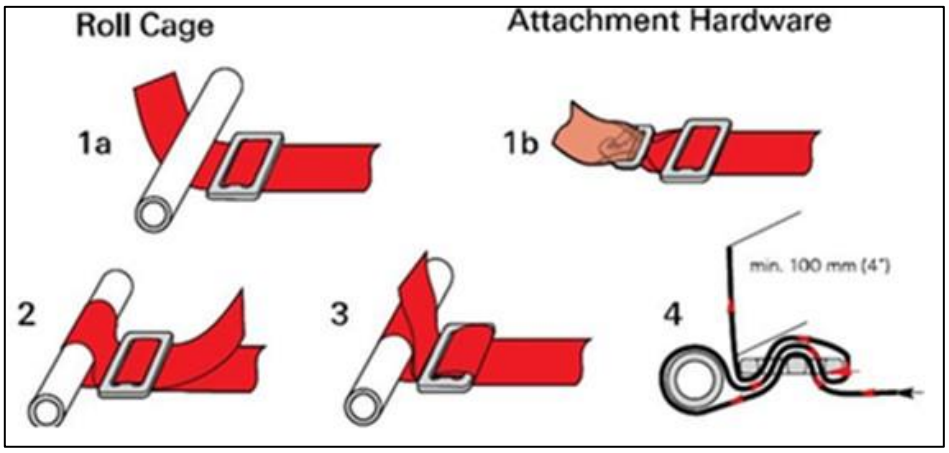


Image B-34: Driver Harness, Diagram of Proper Wrapping of Webbing

B.3.2.3.2. Redirection

The shoulder belts should follow a direct path from their attachment points to the driver's shoulders, without any alteration by any part of the vehicle or its components, including the seats. The webbing must remain untwisted and unrotated along the entire route of the shoulder belt.

B.3.2.3.3. Adjustment

The shoulder belts must always be properly adjusted to fit the driver. When the driver harness is in use, each buckle or adjuster within the system should have extra adjustment capacity to accommodate all drivers. The minimum amount of excess shoulder harness webbing required is 102 mm (4.0 in). Refer to Image B-34 for visual guidance.

B.3.2.3.4. Protection

The shoulder belts must be shielded from potential damage from behind the RRH, and the firewall must serve as protection for the shoulder belts. The firewall can be designed with pockets or extensions to fulfil this requirement, provided there are no open spaces. Any surplus shoulder belt webbing should be neatly secured within the vehicle's roll cage area. Adequate grommets must be used to fully cover any openings in the firewall, and visible gaps must be prevented.

B.3.2.4. Lap Belts

The lap belt segments should extend in a straight path from the buckle, across the driver's hips, and attach to their designated mounting points without being redirected by any part of the vehicle or its components, including the seat. To secure the lap belts, use the provided bracket that comes with the safety harness to attach them to frame tabs; avoid mounting them by looping them around tubes.

B.3.2.4.1. Positioning

The lap belt (from point B to point C) in Image B-35 should be situated so that it goes over the driver's pelvic region below the Anterior Superior Iliac spine (the hip bones). It is important not to fasten the lap belt over the driver's intestines or abdomen.

When viewed from the side, the lap belt should have a slight angle (referred to as "angle L" or angle BCD) ranging between 45 degrees and 80 degrees relative to the horizontal. This requirement implies that the lap belt's centreline at the seat bottom will be roughly 76 mm (3.0 in.) ahead of the bottom of the seat back.

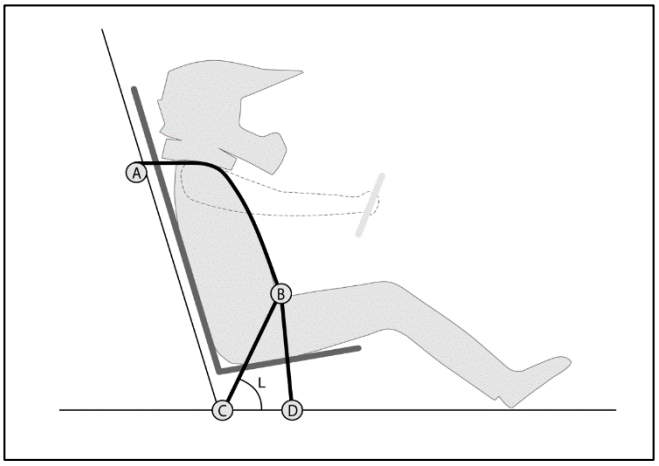


Image B-35: Driver Harness, Lap Belt Angle

- **The use of quick disconnect fasteners for body panels is advisable and simplifies the technical inspection process, making it quicker.**

B.3.2.4.2. Connection

The lap belts must be firmly affixed to the vehicle frame using metal tabs connected by threaded fasteners. It is explicitly forbidden to secure lap belts by wrapping them around tubes or using eyebolts. Follow the webbing wrapping guidelines outlined in Image B-34 which details the correct way to wrap the webbing.

Threaded fasteners utilized in the driver restraint system must adhere to the specifications found in Part B.11. (Fasteners). Additionally, these threaded fasteners should match the nominal diameter of the mounting holes in the lap belt mounting bracket. For instance, if a lap belt mounting tab is designed for a 13 mm (0.5 in.) hole, both the fastener and the frame lap belt tab should have a diameter of 13 mm (0.5 in.).

The inclusion of frame tabs that accommodate the metal lap belt tabs must adhere to the following criteria:

i. The frame lap belt tabs must have a minimum thickness of 2.3 mm (0.090 in.) and designed for double shear mounting. Frame lap belt tabs designed for bending are strictly prohibited (refer to Image B-36).
ii. Each frame lap belt tab should be securely welded to the frame, with a minimum weld length of 38 mm (1.5 in.) per tab.
iii. There must be a minimum edge distance of 6.4 mm (0.25 in.) for the frame lap belt tabs. (Edge distance is measured from the bolt hole's edge to the outer edge of the tab.)
iv. The installation of the frame lap belt tabs and the lap belt should allow for free pivoting of the lap belt tabs.
v. The frame lap belt tabs and their mounting must be rigid and resistant to deformation.
vi. No perforations, such as lightning holes or other cut-outs, are permitted on the frame lap belt tabs.

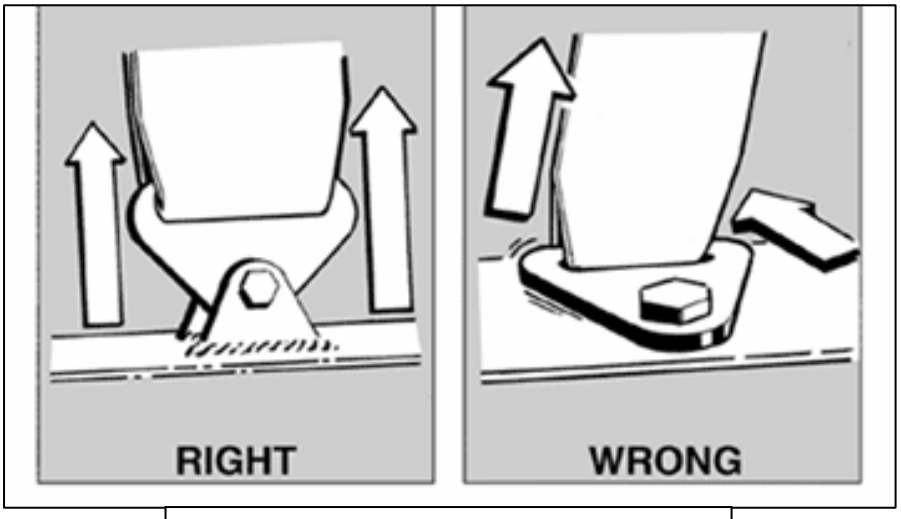


Image B-36: Driver Harness, Lap Belt Tab Orientation

B.3.2.4.3. Adjustment

The lap belts must always be correctly fitted to the driver. When the driver harness is worn, each buckle or adjuster in the system should have extra capacity for making adjustments as needed.

B.3.2.4.4. Shielding

The lap belts must be shielded from possible harm by the vehicle's body panels. Any surplus lap belt webbing should be neatly secured and kept within the vehicle's roll envelope.

B.3.2.5. Anti-Submarine Belts

B.3.2.5.1. Number of Points

The anti-submarine belt (referred to as Line BD in Image B-38) must have a minimum of a single-point mount, conforming to the 5-point configuration of the driver harness. Driver harnesses with 6-point and 7-point configurations are also allowed, with the former utilizing two mounting points for the anti-submarine belt and the latter employing three mounting points for it.

B.3.2.5.2. Positioning

Anti-submarine belts must be attached to the vehicle frame at a position located behind the chest line, as indicated by a positive angle "S" in Image B-37. The mounting point for the anti-submarine belt should be positioned in front of the lap belt mounting points. The chest line, which runs through point B and is parallel to the driver's sternum, serves as a reference. It is recommended that the angle (angle S) for the anti-submarine belt be set at 20 degrees. You can secure the anti-submarine belt either to a frame tab or by wrapping it around a frame member that meets at least the secondary member requirement.

For the installation of 6-point and 7-point harnesses, it is essential to follow the manufacturer's instructions. Teams must be prepared to provide documentation of the mounting instructions to Judges during the technical inspection.

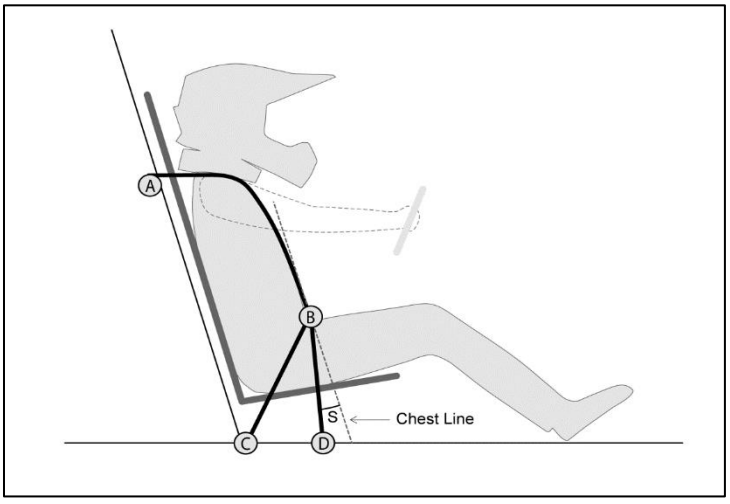


Image B-37: Driver Harness, Anti-Submarine Belt Angle

B.3.2.5.3. Connection

The anti-submarine belts must be firmly fastened to the vehicle frame using one of these methods:

i. Metal tabs connected by a threaded fastener.
ii. Webbing wrapped around a frame member.
iii. Webbing wrapped around a bolt secured by metal tabs in a double shear configuration.

The use of eyebolts to secure anti-submarine belts is expressly prohibited. Follow the webbing wrapping guidelines provided in Image B-34: Driver Harness, which illustrates the proper way to wrap the webbing. Any threaded fastener used within the driver restraint system must comply with the requirements outlined in Part B.11. (Fasteners).

The frame tabs that receive the metal anti-submarine belt tabs must adhere to the following criteria:

i. The frame's anti-submarine belt tabs must have a minimum thickness of 2.3 mm (0.090 in.) and be designed for double-shear mounting. Frame tabs configured for bending are expressly prohibited.
ii. Each frame's anti-submarine belt tabs should be securely welded to the frame, with a minimum weld length of 38 mm (1.5 in.) per tab.
iii. There must be a minimum edge distance of 6.4 mm (0.25 in.) for the frame's anti-submarine belt tabs. (Edge distance is measured from the bolt hole's edge to the outer edge of the tab.)
iv. Ensure that the installation of the frame's anti-submarine belt tabs and the lap belt allows for unrestricted pivoting of the lap belt tabs.
v. The frame's anti-submarine belt tabs and their mounting must be rigid and resistant to deformation.
vi. No perforations, such as lightening holes or other cut-outs, are allowed on the frame's anti-submarine belt tabs.

If the anti-submarine belt is wrapped around a frame member or a bolt, it must adhere to the following conditions:

i. The anti-submarine belt mounting tube must have features designed to restrict total lateral movement to 25.4 mm (1.0 in.) or less.
ii. Ensure that the anti-submarine belt webbing is safeguarded against sharp edges, such as those found on bolt threads or tab edges.
iii. The anti-submarine belt mounting tube or the tabs holding the tube must meet the frame requirements equivalent to those of a secondary member. The mounting tube can either be constructed from a single tube with bends or constructed with no more than three tubes and two mitered joints (excluding connections to the LFS). The anti-submarine belt mounting tube must connect both of the vehicle's LFS members and be oriented parallel

to the LCs. It is not allowed for the mounting tube to extend unsupported from another tube, creating an excessive bending moment.

B.3.2.5.3. Rerouting

Rerouting the anti-submarine belt through a sturdy frame, seat component, or the seat's edge is permissible. The rerouted belt webbing should not exceed a bend angle of 30 degrees, as depicted in Image B-38. The component or edge used for rerouting must be designed to avoid chafing or causing abrasion to the belt webbing.

The belt webbing must remain untwisted throughout the entire course of the anti-submarine belt.

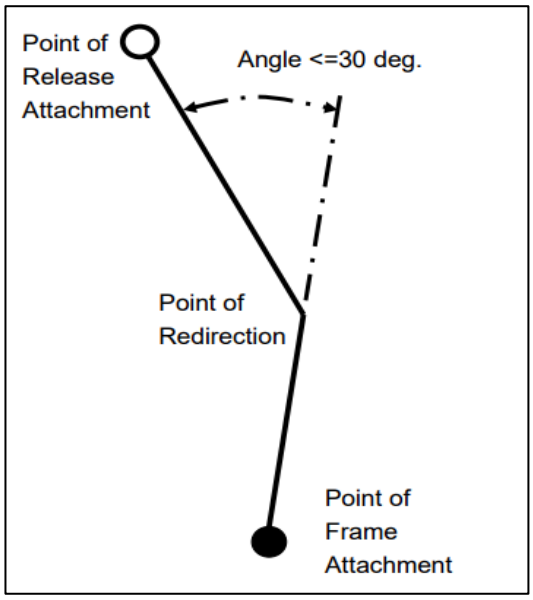


Image B-38: Driver Harness, Anti-Submarine Belt Redirection

B.3.2.5.4. Adjustment

The anti-submarine belts must be correctly adjusted for the driver at all times. When the driver wears the harness, each buckle or adjuster within the system should have extra adjustment capacity available.

B.3.2.5.5. Shielding

All anti-submarine belts must be shielded by the vehicle's skid plate. Any surplus anti-submarine belt webbing should be neatly secured and stored within the vehicle's roll envelope.

B.3.3. Arm Restraints

During a rollover incident, the driver's arms must remain within the confines of the roll cage space, as outlined in section B.2.3.1 regarding lateral space. To achieve this, arm restraints must be employed, and they should be securely attached to the driver restraint system. Only commercially available arm restraints that meet the SFI 3.3 standards are permitted

for use. These arm restraints should be connected separately to the safety belts. For a list of approved manufacturers offering SFI 3.3 rated driver's accessories, please refer to the provided link below:

SFI 3.3. Manufacturer's List

B.3.3.1. Certification

The restraints must be in excellent condition, displaying no indications of wear, such as cuts, chafing, or deterioration. Additionally, the restraints should have the relevant labels attached.

Image B-39: Driver Harness, Arm Restraints

- **Manufacturers must make sure that the belts are marked with a manufacturing date. This date tag can be distinct from the SFI tag.**

B.3.3.2. Positioning

Arm restraints must be installed in a manner that allows the driver to release the harness and exit the vehicle independently, irrespective of the vehicle's orientation. These arm restraints should be worn by the driver on the forearm, positioned just below the elbow. While wearing the arm restraint, the driver should still have the capability to reach the cockpit kill switch and steering wheel, but should not be able to extend their arms outside the cockpit.

B.3.3.3. Attachment

When assembled, the arm restraints must be affixed to the driver harness buckle.

B.3.4. Head Restraint

A head restraint is required to restrict the driver's head's backward movement while in a standard driving posture. Ideally, this head restraint should be securely attached to the vehicle, preferably to the vehicle frame. The use of hook-and-loop or adhesive methods for this purpose is not allowed. Head restraints can also be securely fastened to or integrated into the driver's seat.

B.3.5. Seats

The seat should cooperate with the safety harness to effectively restrain the driver within the roll cage's protective space. Seats can be either of the conventional or suspension (sling) design, but they must be specifically designed for an upright seating position. In this context, the upright seating position is determined by the angle of the driver's back relative to a horizontal line, with the back angle exceeding 65 degrees. To provide a reference, a fully upright driver would have a back angle of 90 degrees.

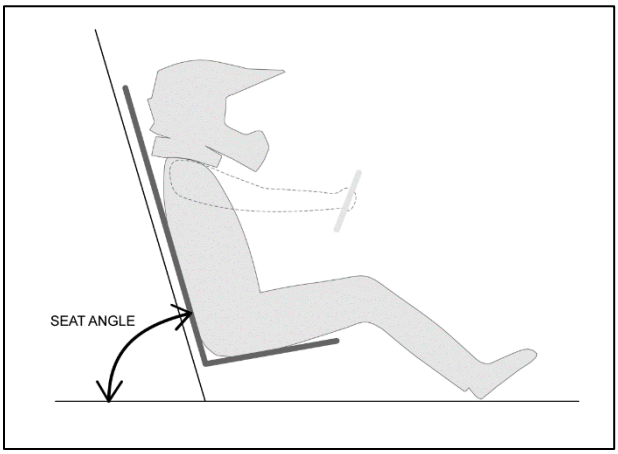


Image B-40: Seat Angle

B.3.5.1. Seat Fabrication

B.3.5.1.1. Conventional Seats

Conventional seats must typically possess a sturdy and robust structure, primarily crafted from materials such as metal or composites like fiberglass or carbon fibre. Seats made of thermoplastic materials are not allowed. Both the bottom and back panels of seats should incorporate a minimum of 2 inches of non-removable foam (measured when uncompressed and without the driver seated). Additionally, conventional seats may include a detachable seat cover. These seats can either be procured from a manufacturer or fabricated by the teams themselves.

B.3.5.1.2. Suspension Seats

Suspension seats must be made from strong and long-lasting woven materials. The stitching used should be tidy and robust, ensuring that all seat components are effectively connected and capable of safely directing the forces from the driver to the vehicle frame.

B.3.5.2. Seat Design

Seats should be designed with at least two mostly planar surfaces when the driver is seated in the vehicle. When viewed from the side, the seat back's plane should be inclined at an angle between 65 and 90 degrees from horizontal, as indicated in Image B-40 (Seat Angle). The seat bottom's plane should be situated below the driver and should either be horizontal or generally sloped in a way that the front edge of the seat bottom is level with or higher than the point where it intersects with the back plane.

Furthermore, seats may incorporate vertically oriented material along the sides of both the seat bottom and the seat back planes. This material is intended to aid in laterally restraining the driver.

B.3.5.3. Seat Mounting Points

Each seat must have a minimum of six (6) mounting points connecting it to the vehicle frame. There should be a minimum of four (4) mounting points originating from the seat bottom plane, and at least two (2) mounting points stemming from the seat back plane. The seat mounting points must have a minimum fastener diameter of 6.0 mm.

B.3.5.3.1. Layout

Mounting points on the seat bottom plane and seat back plane should exhibit a general symmetry concerning the longitudinal centre line of either the seat or the vehicle. Mounting points on the seat back plane should align with or be positioned close to the plane of the RRH. All seat mounting points must connect to the LFS, USM, RRH, or other tubes that meet the standards of secondary frame members. Each seat bottom mount should be engineered to evenly distribute the vertical load.

B.3.5.3.2. Framework

Tabs used for seat mounting must have a minimum thickness of 2.3 mm (0.090 in) and should have a weld length of at least 38 mm (1.5 in) per tab.

These mounting tabs should not display visible deformation when subjected to a load. The average distance from the tab hole to the main weld line of the tab must not exceed 25.4 mm (1.0 in).

Part B.4. Driver Gear

B.4.1. Helmet

Every driver is required to wear a correctly sized motocross-style helmet that includes an integrated (one-piece composite shell) chin/face guard.

In ATVC INDIA competitions, all helmets must comply with the following standards: Snell M2015, Snell M2020, ECE R22-05, SA 2005, British Standards Institution BS 6658-85 types A or A/FR. Helmets that do not meet these standards are strictly forbidden.

- **Please do not depend on salespeople to confirm if a helmet has a Snell rating. Instead, check for the Snell sticker located beneath the foam liner of the helmet.**

- **Helmets rated as DOT, ISI, or DOT+ISI are not permissible. There are no exceptions to this rule, and it will be rigorously enforced. Helmets certified to any other rating systems not explicitly mentioned above are also prohibited from use.**

- **Certain Motocross helmets feature elongated chin guards that do not come into contact with the mandatory neck collars when the head is bent forward. The use of this combination of helmet and collar systems is not allowed.**

- **Any helmets that do not meet the specified requirements will be taken by the Judges during the event and held until the conclusion of the endurance race. At the end of the race, all confiscated items will be made available for pickup.**

Image B-41: Driver Gear, Snell Sticker Example

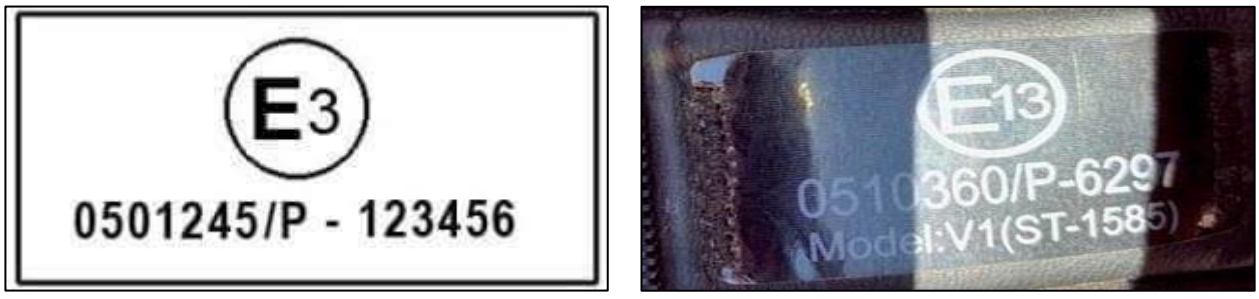


Image B-42: Driver Gear, ECE tags Example

B.4.2. Eye Protection

B.4.2.1. Classification

Every driver is required to wear motocross-style goggles equipped with a full-circumference elastic band that encircles the entire perimeter of the driver's helmet. The use of "Quick Straps" or any other quick-release systems is strictly forbidden.

B.4.2.2. Lens Protection

All drivers must have goggles equipped with tear-off or roll-off lens protectors. These tear-offs or roll-offs are essential to guarantee unobstructed vision for the driver. During technical inspection, teams must provide their goggles with properly installed tear-offs or roll-offs. Teams found to be without tear-offs or with malfunctioning roll-offs may be issued a black flag.

B.4.3. Neck Support

B.4.3.1. Certification

Every driver is required to wear a neck support or neck collar that has a full 360-degree circumference and carries an SFI 3.3 rating. Neck collars in a horseshoe shape are not permitted. Approved manufacturers such as Simpson, RCI, G-force, Deist, or Leaf Racing Products provide neck collars that meet this specification. The support or collar must be in good condition, free from any signs of wear or potentially harmful defects. For a list of authorized manufacturers for SFI 3.3 rated driver's accessories, please refer to the link provided below:

SFI 3.3. Manufacturer's List

Image B-43: Driver Gear, Neck Support

B.4.4. Clothing

Teams have the option to utilize either two-piece or single-piece driver suits.

B.4.4.1. Upper Garments

Drivers are required to wear a fire-resistant shirt with a factory label indicating it meets the fire-resistant standards of SFI 3.2, SFI 3.3, SFI 3.4, or FIA 8856-2000. Please consult the provided link for a list of manufacturers approved for SFI-rated Driver's Suits.

SFI 3.2A Manufacturer's List

B.4.4.2. Lower Garments

Drivers are mandated to don fire-resistant pants or suits that bear an SFI, FIA, or NFPA 2112 fire-resistant rating. For a comprehensive list of approved manufacturers specializing in SFI-rated Driver's Suits, kindly refer to the link provided below:

SFI 3.2A Manufacturer's List

B.4.4.3. Gloves

Drivers are required to wear gloves for hand protection. These gloves must be durable and resistant to abrasion.

B.4.4.4. Shoes

Drivers are obligated to have on both socks and shoes.

B.4.4.5. Flammable Material

During competition, the use of jerseys, gloves, socks, or any other clothing items constructed from nylon or other synthetic materials that can melt or catch fire when exposed to open flame or extreme heat is strictly forbidden.

Part B.5. Cockpit

B.5.1. Aim

The design of the cockpit must ensure the driver's safety and enable quick exit in case of an emergency.

B.5.2. Cockpit Egress

All drivers must be capable of exiting the vehicle from either side within a five-second timeframe. The egress test will involve drivers starting in the vehicle with all safety gear on, securely seated, and hands on the steering wheel. The timing of the egress test begins when one hand is removed from the steering wheel and ends when the driver is completely clear of the vehicle with both feet on the ground.

The Judges will choose one or more drivers to perform the cockpit egress test. Failure to successfully demonstrate egress will result in the revocation of the driver's status. Each team is required to designate a minimum of two drivers.

B.5.3. Firewall

Every vehicle must incorporate a firewall that separates the cockpit from the engine and fuel tank compartments. This firewall must be constructed from metal with a minimum thickness of 0.50 mm (0.02 in.). The firewall should align with the RRH plane and cover the area between the ALC and BLC.

Teams can use multiple metal panels to create the firewall as long as there are no gaps at the joints. It is permissible to include cut-outs for control cables, brake lines, electrical

cables, and 4WD/AWD components, provided these cut-outs are equipped with appropriate grommets and seals to prevent any fuel leakage into the cockpit.

However, the firewall must not have large cut-outs, including those for CVT ventilation or similar purposes. Air intakes must not breach the firewall and must remain within the roll cage boundaries. Cut-outs for drivetrain components are allowed.

Please note the updated requirement to use metal fasteners exclusively. Plastic screws, snap-fit plugs, or zip ties are not acceptable.

B.5.4. Front or Mid-Engine Vehicles

If the engine mounting points are entirely forward of the RRH, then it is not necessary to have a firewall covering the area within the RRH plane and between the LCs of RRH. However, when the engine mounting points are completely forward of the RRH, the following requirements must be met:

i. The fuel tank must be enclosed within a sealed container that prevents fuel leakage in case of a tank failure.
ii. Splash shields must be in place to prevent fuel from spilling into the cockpit area during refuelling.
iii. The engine must be entirely enclosed, with the enclosure made of metal and meeting the specifications outlined in Part B.8. (Powertrain Protection.) The engine enclosure must also provide driver protection in case of an engine failure.
iv. Engine enclosures must be designed to prevent fuel from spilling into the cockpit in the event of a collision or rollover.
v. All engine compartment vents must direct airflow away from the cockpit.
vi. The driver must have the ability to exit the vehicle from both sides.
vii. The engine exhaust must not exit in the direction of the driver and must be adequately shielded to prevent contact by track workers and competition officials.
viii. Additionally, a 300 mm x 300 mm (12 in. x 12 in.) panel must be securely attached to the vehicle within the RRH plane, positioned on the right side of the driver's head and above the shoulder height of the tallest driver. This panel serves the purpose of affixing the Technical Inspection sticker and must be easily visible to both track workers and competition officials.

B.5.5. Body Panels

The cockpit area must be safeguarded by body panels that provide complete coverage from the LF) to the SIM. There should be no openings larger than 6.35 mm (0.25 in), which will be inspected using a 6.35 mm (0.25 in) dowel rod. These panels must be constructed from materials that are resistant to punctures, such as plastic, fiberglass, metal, or similar substances. Their design must effectively prevent the entry of debris and foreign objects into the driver compartment.

Furthermore, these panels must be securely attached to the frame using robust engineering methods. The use of cable ties or hook-and-loop fasteners is not acceptable.

- **Utilizing quick disconnect or readily accessible fasteners for body panels is advisable and streamlines the technical inspection process.**

B.5.6. Skid Plate/Belly Pan

A skid plate, or belly pan, must be installed across the entire length of the cockpit to ensure that the driver remains elevated from the ground and is shielded from debris while seated in their normal position. These skid plates must be designed to effectively prevent any debris or foreign objects from entering the driver compartment. Materials such as expanded metal, fabric, or perforated panels are not permissible. Furthermore, the belly pan must be structurally capable of supporting the driver's weight under all conditions.

Skid plates must be fabricated from one or both of the materials listed below:

i. Steel, with a minimum thickness of 1.5 mm (0.06 in.)
ii. Aluminium, with a minimum thickness of 3.0 mm (0.12 in.)
iii. Fiber, plastic, or an equivalent material, with a minimum thickness of 5 mm (0.19 in.).

B.5.7. Guarding for Legs and Feet

B.5.7.1. Linkages

Any exposed steering or suspension linkages within the cockpit area must be encased in a durable metal covering. This covering should effectively safeguard against the possibility of the driver's legs and feet making contact, becoming entangled, or being struck in the event of operation or a failure.

- **Using quick disconnect or readily accessible fasteners for cockpit steering and suspension covers is advisable and can expedite the technical inspection process.**

B.5.7.2. Universal Joints

Universal joints located in the steering or 4WD/AWD system near the driver's feet must have adequate shielding or sealing to prevent the risk of the driver's clothing or feet getting caught in the joint. Please be cautious, as loose shoelaces have been known to become entangled in universal joints and can impede the driver's ability to exit the cockpit.

B.5.8. Fire Extinguisher

Every vehicle must carry a fully filled and operational fire extinguisher in case of a fire occurring on the vehicle, in the paddocks, or on the track. All team members must have knowledge of how to use and operate these fire extinguishers.

B.5.8.1. Classification and Essential Attributes

Any fire extinguishers intended for vehicle use must possess a minimum UL rating of 5BC. These fire extinguishers must come equipped with a factory-installed dial pressure gauge that is easily visible and indicates proper charging. Additionally, each fire extinguisher must bear labelling that includes the college name and vehicle number.

B.5.8.2. Count

Every team must possess at least two fire extinguishers that meet the specified requirements. One of these fire extinguishers should be permanently installed on the vehicle, while the others will serve as backups.

- **It is important to note that both the vehicle-installed fire extinguisher and the spare fire extinguisher must be of the same size.**

B.5.8.3. Clamping

Teams have the option to either create their own mounting bracket for the fire extinguisher or utilize the provided OEM brackets:

i. Drake FIREX-MNT-DOR
ii. Drake FIREX-MNT-S-DOR
iii. Drake FIREX-MNT-DAG
iv. Drake FIREX-MNT-S-DAG

Drake Mount

- **It is highly recommended that teams have a backup mount readily available.**

B.5.8.4. Installation

The mounting bracket for the fire extinguisher must be positioned within the plane of the vehicle's RRH. It should be attached to the RRH using steel tabs with a minimum thickness of 3 mm (0.125 in.).

The hardware utilized for mounting should consist of flat socket head cap screws with a countersink angle and head diameter that matches the specifications of the required bracket. Hardware employed to secure the bracket to the vehicle frame must adhere to all the criteria outlined in Part B.11. (Fasteners).

To affix the fire extinguisher to the mount, hose clamps can be used. The adjusters on the hose clamps should be positioned in a way that does not hinder the operation of the pull-knob on the bracket. Additionally, the hose clamp adjusters and any protruding material

should be installed in a manner that prevents them from catching on a driver's clothing during vehicle egress.

B.5.8.5. Position and Margin

The fire extinguisher must be situated on the right side of the driver within the cockpit, ensuring that it is positioned entirely below the driver's line of sight, with the top half of the extinguisher above the SIM. Additionally, the fire extinguisher should be easily accessible to track workers.

The pull knob on the required bracket must be easily operable, and to facilitate this, there should be a minimum radial clearance of 64 mm (2.5 in.) around the pull knob. It's acknowledged that the space behind the pull knob may be less than 64 mm (2.5 in.) due to the bracket's design. For further clarification, please refer to Image B-44.1.

Radial clearance refers to the empty space between the outer edge of the pull knob and the closest obstruction. The measurement is taken from the edge of the pull knob, not its centre.

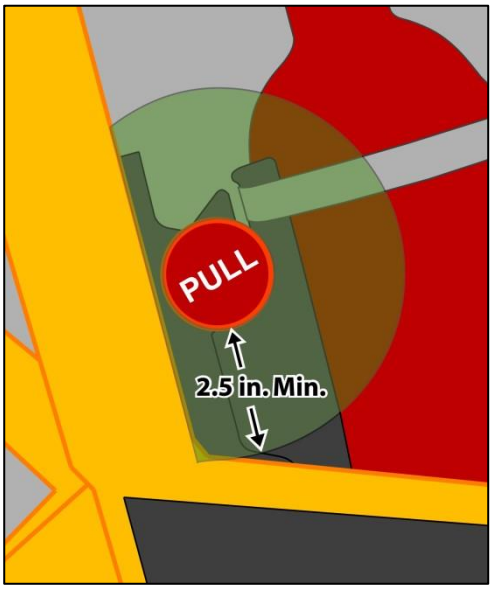


Image B-44.1: Fire Extinguisher, Diagram of Clearance around Pull Knob (green)

Image B-44.2: Fire Extinguisher, Incorrect orientation of extinguisher clamps

Image B-44.3: Fire Extinguisher, Incorrect routing of hose clamps

Part B.6. Driver Ergonomics (Design Considerations for Safety)

B.6.1. Roll Cage Specifications

i. Teams are encouraged to prioritize driver safety in the design of the driver's cockpit, with a secondary focus on minimizing weight and compactness of the roll cage.
ii. Weld brackets and mountings into the roll cage with filleted joints to eliminate sharp edges that could pose injury risks to team members or the driver.
iii. Ensure optimal driver visibility through the FBM.
iv. Incorporate triangular bracing in areas where additional strength is needed.

B.6.2. Sub-System Specifications

B.6.2.1. Steering Wheel Spacing

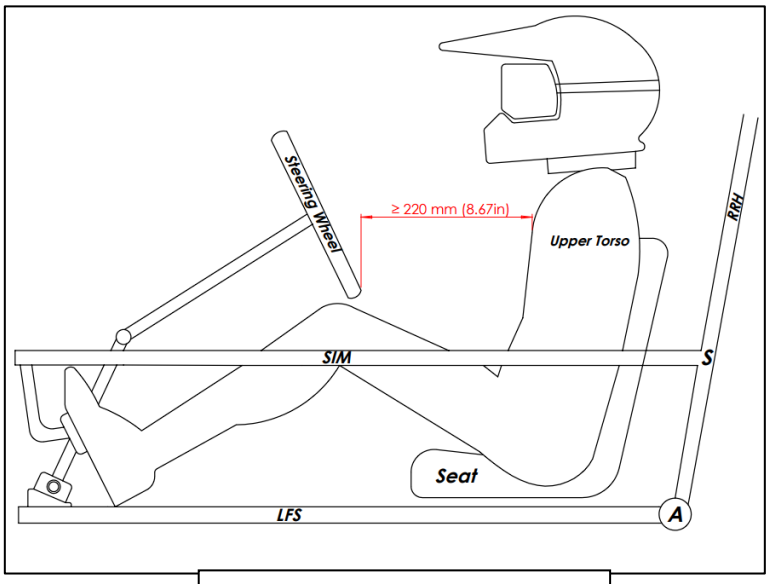


Image B-45: Driver's Chest Clearance

A minimum distance of 220mm should be maintained between the steering wheel and the driver's chest or upper body, whichever is in closer proximity, as depicted in Image B-45.

B.6.3. Driver Knee Safety Specifications

This safety requirement pertains to preventing the driver's knees from protruding beyond the roll cage. When viewed from the side, the maximum allowable height of the knees above the SIM member is 76mm (3 inches), as illustrated in Image B-46. This check will be conducted with the driver's feet on the pedals, hands on the steering wheel, and in a comfortable pedal operating position.

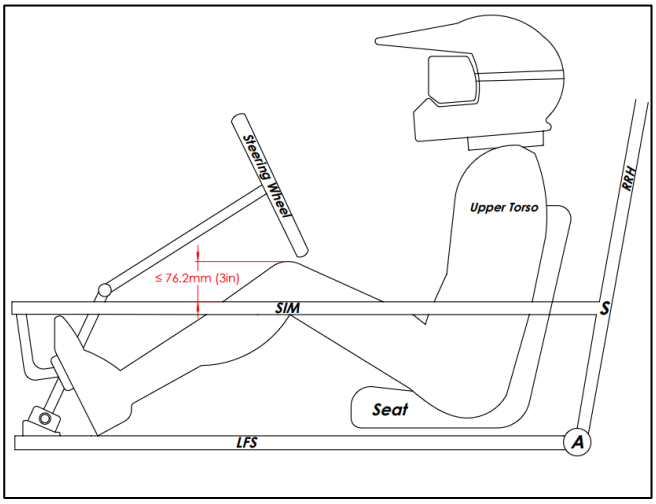


Image B-46: Driver Knee Safety Criteria

Consistent with the previous regulation, teams must adhere to the lateral knee clearance requirement. This measurement is taken with the driver's feet on the pedals and hands on the steering wheel. The dimension denoted as "A" in Figure B-47 should be at least 76mm (3 inches) in relation to the inner surface of the SIM member.

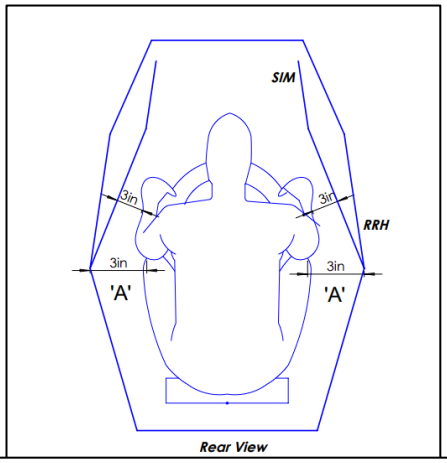


Image B-47: Driver Knee Safety Lateral Clearance

- **Teams are required to ensure that their vehicle complies with both clearances specified in B.6.3., as shown in Images B-46 and Figure B-47. Both of these limits must be met simultaneously. Teams failing to meet these criteria will receive a designation of 'not cleared at safety scrutiny.**

Part B.7. Tow Points

B.7.1. Basic Prerequisites

Every vehicle is required to be equipped with front and rear towing hitch points located along its longitudinal centreline. These hitch points serve dual purposes, being utilized for both dynamic events and vehicle recovery operations. They must be securely attached to the vehicle's frame and designed to accommodate both longitudinal and lateral towing forces. Towing forces will be applied to the tow point through the use of a hook or clevis. Additionally, these tow points must possess adequate strength to function as a vertical lifting point for the vehicle.

The design of these hitch points should adhere to sound engineering principles, ensuring the absence of any sharp edges. Furthermore, the hitch points must be painted in a contrasting colour to facilitate easy identification, i.e., it's important to note that the hitch points should not share the same colour as the majority of the vehicle. For instance, if the vehicle's primary colour is black, the hitch/tow points should be painted white, and vice versa.

B.7.2. Front Tow Point

The front tow points must be constructed using tubular steel, with a diameter ranging from 25.4 mm (1.0 in.) to a maximum of 31.75 mm (1.25 in.). The tubing thickness should not be less than 0.89 mm (0.035 in.).

These front tow points should be positioned no higher than the vehicle's SIM (Single Impact Member) and no lower than the vehicle's LFS (Lowest Frame Surface).

Additionally, the front tow point must allow unobstructed passage of a gauge measuring 50.8 mm in height, 50.8 mm in depth, and 203.2 mm in width (2.0 in. x 2.0 in. x 8.0 in.) behind the front tow point tube. Further details can be found in Image B-49.

- **Front numbers should not obstruct the tow-point.**
- **It's important to clarify that neither the front nor the rear bumper can serve as a hitch point. When using tubes for the same, they must be constructed from primary structural members. Additionally, there should be lateral constraints in place to ensure that the hook or clevis is securely positioned for effective transmission of vehicle loads during lifting operations. It's worth noting that any bumper on the vehicle must be a permanent, fixed component and not a removable part.**

Acceptable examples of Front Hitch Points:

Image B-48.1 & 48.2: Tow points, Acceptable Front Hitch Points

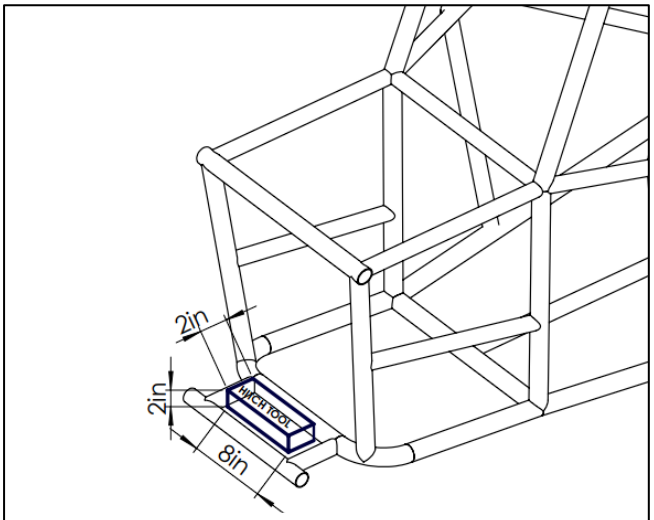


Image B-49: Tow Point, Inspection Tool Fitment

B.7.3. Rear Tow Point

Rear tow points must be fabricated using steel and must adhere to the specifications outlined in the table below for additional details.

Measurements	Representation	Least	Maximum
Tab Thickness	T	3.18 mm (0.125 in.)	9.5 mm (0.375 in.)
Hole Diameter	D	25.4 mm (1.0 in.)	31.75 mm (1.25 in.)
Hole-to-Tube Offset	L	19.0 mm (0.75 in.)	25.4 mm (1.0 in.)
Edge Distance	O	15.9 mm (0.625 in.)	25.4 mm (1.0 in.)
Frame Junction Width	W	76.2 mm (3.0 in.)	Unrestricted

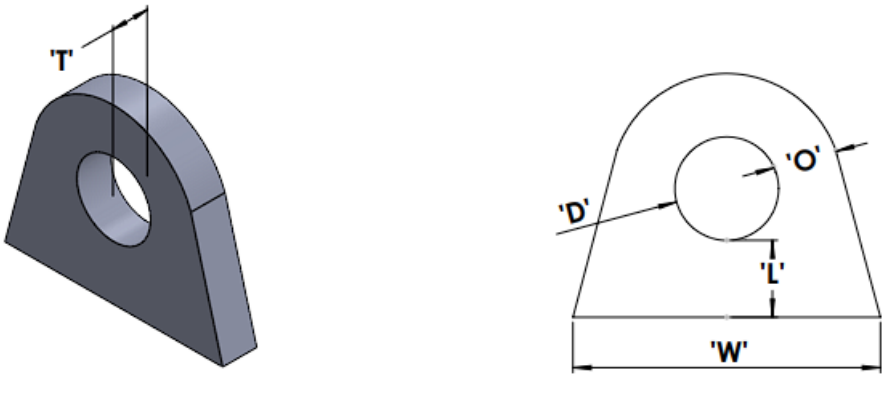


Image B-50: Tow Point, Rear Tab Dimensions

- **The rear hitch plate must be securely welded directly to the roll cage member. The use of latch-type rear hitch plates is prohibited.**

B.7.3.1. Fixed Rear Tow Point

Rear tow points that are designated as fixed must undergo complete welding to the vehicle frame along the base line, dimension Y. The tab may have either a vertical or horizontal orientation.

B.7.3.2. Swivel Rear Tow Point

Rear tow points with swivel or hinged configurations must connect to the frame using a swivel mechanism. A swivel rear tow point can have either a horizontal or vertical orientation. The tabs responsible for attaching the swivel mechanism to the frame should undergo full welding, ensuring a minimum thickness of 0.125 inches and equal weld lengths along the base line, totalling dimension Y or more. Swivel pins must be graded fasteners with a diameter of at least 0.25 inches, meeting the criteria outlined in B.11. (Fasteners).

Part B.8. Powertrain Protection

B.8.1. Powertrain Protection and Finger Guards

Rotating powertrain components, including CVTs, Gears, Sprockets, Belts, and Chains, must have protective shields in place to prevent harm to the driver, track workers, or bystanders. These guards should effectively mitigate the risk of hazardous energy release in case these rotating parts malfunction. Additionally, measures for finger protection must be in place to prevent fingers, loose clothing, or other objects from becoming entangled in constriction points created by these rotating components. It's important to note that certain components such as universal joints, CV joints, hubs, rotors (excluding Inboard Brakes),

wheels, and exposed shaft sections are exempt from the requirements outlined in B.8.1 and B.8.2.

B.8.2. Hazardous Energy Discharge

Powertrain guards are required to effectively manage and disperse sudden, dangerous energy releases emanating from powertrain components, both in radial and tangential directions. These guards, designed to mitigate hazardous energy release, must adhere to robust engineering standards, withstand vibrations and shocks and be durably installed.

Furthermore, guards and shields safeguarding against the potentially dangerous energy discharge should encompass the complete periphery of rotating components, such as chains, gears, sprockets, belts and like the complete periphery of the primary CVT pulley, not just limited to the width of the belt. These protective measures should have a width greater than the respective rotating part they are shielding.

B.8.2.1. Powertrain Guard Materials

All powertrain guards must be constructed using one or both of the specified materials:

i. Steel, with a minimum thickness of 1.5 mm (0.06 in.),
ii. Aluminium, with a minimum thickness of 3.0 mm (0.12 in.).

The inclusion of holes and/or vents in the section of the powertrain guard surrounding the rotating components is acceptable, as long as they are designed in a way that ensures no parts can escape in the event of a powertrain failure. Additionally, there should be no direct path tangent to any of the rotating components.

B.8.2.2. Safeguarding Characteristics

B.8.2.2.1. Belt, Gear and Chain Drives

Guards must form an uninterrupted metal enclosure that surrounds the entire periphery of the drive assembly. The width of this continuous metal enclosure should exceed the total width of the rotating component. (Refer Image B-51)

In the case of guards intended to prevent hazardous energy release, they may incorporate ventilation openings along their path. These ventilation openings should be made from the same material as the guard itself. Their arrangement should ensure that there are no radial or tangential pathways for any debris to escape through the ventilation openings.

Additionally, the construction of these ventilation openings should prevent the possibility of a probing finger coming into contact with the rotating components when the ventilation tube is removed.

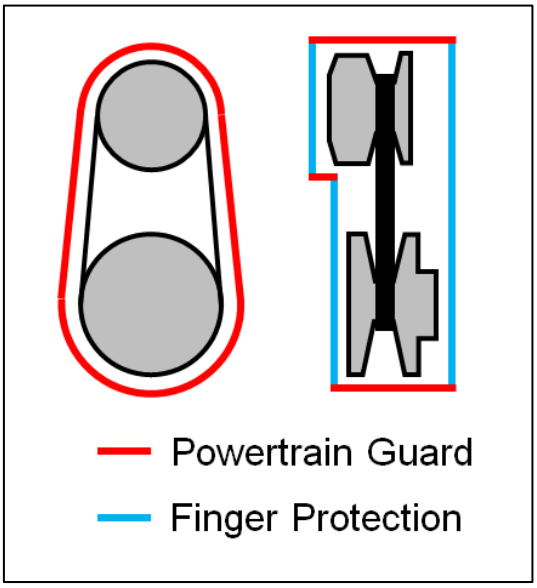


Image B-51: Powertrain Guard Extent for CVT

B.8.2.2.2. Driveshafts

Drive shafts that link the front and rear gearboxes/differentials in a 4WD/AWD system can have a combination of features that serve both as powertrain guards and finger protection, as elaborated in this section.

Any joint in the driveshaft assembly, whether it's a universal joint, CV joint, or a similar type of joint (referred to as "joint" for this rule), must be enclosed by powertrain guarding in accordance with the specifications laid out in B.8.2 (Hazardous Energy Discharge). The driveshaft hoops must extend a minimum of 30 mm in width on either side of the joint, or up to the point where they meet the mating gearbox or differential, whichever is closer.

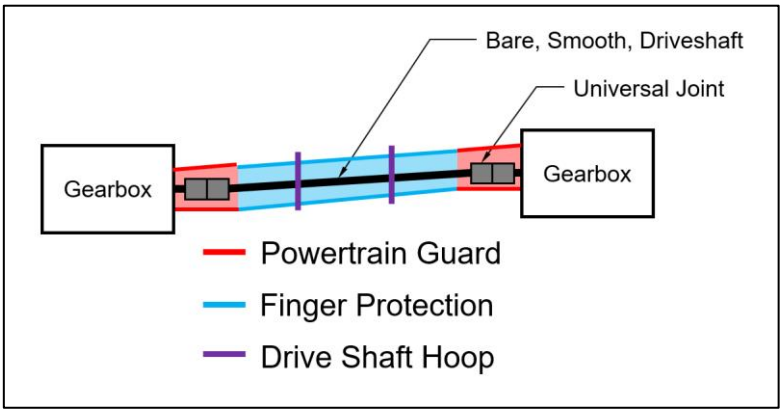


Image B-52: Driveshaft Guarding

The drive shaft will be safeguarded against potential failure through the use of two drive shaft hoops, strategically positioned within 51 mm (2.0 in.) of both the 1/3 length point and the 2/3 length point along the drive shaft. These hoops should snugly fit around the driveshaft with minimal clearance. Each of these drive shaft hoops should measure 25 mm

(1.0 in.) in width and comply with the same material specifications outlined in B.8.2.1 (Powertrain Guard Materials). They must be securely mounted through either welding or fasteners.

In cases where the flanges or bearings fall within the specified lengths mentioned above and can themselves be considered as support for the drive shafts, it's important to note that regardless of the scenario, the guards used to protect the driveshaft must be firmly secured in place. This can be achieved by adding additional hoops that are mounted to ensure rigidity.

Furthermore, the drive shafts on both sides of the skid plate (whether on the driver's side or the ground side) must meet the same requirements. It's worth mentioning that the skid plate itself may be considered as part of the finger protection system.

B.8.2.2.3. Hydraulic Systems

Hydraulic systems are required to prevent the dangerous discharge of energy. Additionally, hydraulic relief valves must effectively release pressure into the tank and away from individuals.

For hydraulic hoses that run from the cockpit to the front axle, measures must be taken to safeguard them against damage caused by a driver entering or exiting the vehicle. This protection should be provided by a strong and durable cover. Please note that hydraulic systems need to adhere to the specifications outlined in Part B.14.3.1. (Hydraulic).

B.8.2.2.4. Axle Shafts

Axle shafts and the accompanying CV or universal joints that connect the front wheels/uprights directly to the front differential in front of the firewall do not necessitate dedicated guards for the protection of track workers and bystanders. However, they must be adequately separated from the driver and the cockpit using methods that comply with the requirements specified in B.5.5 (Body Panels) and B.5.6 (Skid Plate).

For all other universal joints, CV joints, or similar components, they must be shielded with guarding designed to prevent hazardous energy discharge. This guarding should extend 25.4 mm (1.0 in.) axially beyond the furthest point of the joint.

B.8.3. Constriction Points and Snagging

Rotating components within the powertrain system, especially those spinning faster than the final drive, must be enclosed with guards on all sides, in addition to the perimeter guard. These guards, designed to prevent constriction points, must effectively block the possibility of small, probing fingers from becoming entangled in any moving part.

It's important to note that flexible, non-rigid coverings such as "Frog skin," Ceconite, and neoprene are not acceptable as finger guards. Furthermore, powertrain covers secured with adhesive, ratcheting tie-downs, or other temporary methods are explicitly prohibited. All

powertrain covers must feature resilient and robust mountings, along with easily accessible and operable fastening mechanisms.

While a comprehensive cover around the engine and drivetrain can serve as an effective shield against constriction points, it's essential to understand that this doesn't exempt the requirement for ensuring the safe release of hazardous energy.

These guidelines are also relevant to the front differential casing and other rotating components located on the front side of the cockpit.

- **Inboard braking rotors are required to adhere to the regulations outlined for powertrain guards. They must effectively prevent accidental contact between hands and the rotor. The use of integrated CVT casings and brake rotor casings is permissible to meet these requirements.**
- **All guards, whether designed for chain-drive or CVT systems, must maintain a minimum clearance of 15mm from any adjacent roll cage member or suspension component. This requirement also applies to the front differential and steering components located on the front side of the cockpit.**

B.8.4. Drivetrain Breather/Vent System

Gearboxes and transmissions equipped with a breather or vent system must effectively prevent fluid loss in rollover situations or due to thermal expansion. This can be achieved through the use of a vent tube or other suitable methods.

Any vent line connected to a gearbox or transmission should be made from a material suitable for transporting the type of oil used in the gearbox or transmission. It must maintain a minimum clearance of 100 mm (3.94 in.) from the exhaust, be securely fastened without being compressed, and terminate within a non-primary frame member. Importantly, the termination point should not create a through-hole. If the hole exceeds 8.0 mm (5/16 in.) in diameter, a reinforcing plate (scab plate) must be installed around the hole. Every element of the vent system must be contained within the vehicle's roll cage structure. The inspection process for this requirement will be conducted in the same manner as it is for the fuel system.

There is an exception to this rule: Vent lines located more than 457 mm (18.0 in.) away from the engine or exhaust are not required to terminate inside a frame member. However, the entire vent line must be positioned at a distance greater than 457 mm (18.0 in.) from the nearest engine or exhaust component to qualify for this exception.

B.8.5. OEM Guards, Stock

Original Equipment Manufacturer (OEM) factory stock guards must adhere to the stipulations outlined in this section. Unaltered OEM factory stock guards are not subject to

the provisions detailed in rules B.8.1 (Powertrain Protection) and B.8.2 (Hazardous Energy Discharge). Nevertheless, OEM covers must still comply with the requirements set forth in B.8.3 (Constriction Points and Snagging), particularly in relation to vents.

Part B.9. Vehicle Controls

B.9.1. The Braking System

The vehicle should be equipped with a primary hydraulic braking system that engages all four wheels and is operated using a single foot pedal. This pedal should directly connect to the master cylinder through a rigid link, (cables are not allowed). The braking system should effectively distribute its braking force among the axles, ensuring symmetrical distribution across the wheels of the same axle relative to the vehicle's longitudinal axis.

The service braking system must be capable of achieving four-wheel locking within the specified stopping distance during dynamic testing, and it should do so without producing any abnormal noise, vibration, or juddering.

Furthermore, the brake system must have the capacity to lock and slide all wheels, whether the vehicle is stationary or moving on both paved and unpaved surfaces. Brake pedals must be constructed from steel or aluminium and designed to withstand a minimum force of 450 pounds (2000 Newtons) applied to the brake pedal.

B.9.1.1. Independent Circuits

The brake system must be divided into a minimum of two separate hydraulic circuits. This division ensures that if there is a leak or failure in one circuit, the vehicle will still maintain effective braking power on at least two wheels. Teams are advised to create each circuit with its distinct fluid reservoir. Each individual brake circuit should be engineered to meet at least 50% of the specified dynamic performance requirement.

Each hydraulic circuit should possess its dedicated fluid reservoir, which can be achieved either by having physically separate reservoirs or by incorporating a full-height dam within an OEM-style reservoir.

B.9.1.2. Brake Positioning

The brake(s) on the driven axle must function via the final drive. It is allowed to have inboard braking through universal joints. However, the use of braking on a jackshaft through an intermediate reduction stage is not permitted.

B.9.1.3. Bias Brakes

Hand or foot-operated "bias brakes" are allowed, given that they also meet the requirements specified in Part B.9.1. The primary brake system should have the capability to lock all four wheels using a single foot. If employing two separate pedals to lock two

wheels each, these pedals must be positioned closely enough to enable the use of one foot to lock all four wheels.

- **Whenever any brakes are engaged, they must activate the brake light and cause it to illuminate.**

B.9.1.4. Brake Hoses

i. Brake lines must be securely mounted to the vehicle, with no projection below the vehicle frame or suspension components.
ii. Brake lines should be routed and oriented to prevent pinching by steering or suspension parts and to avoid contact with sharp edges. Brake lines must allow for a full range of motion within the steering and suspension system. To accommodate relative movements of the steering, suspension, and other components, IS 7079-compliant flexible hydraulic brake hose assemblies should be used.
iii. Teams are advised to consider the use of Bundy tubes in situations where there are no relative motions of components in the circuit routing. This minimizes volume expansions in the tubes.
iv. Brake lines should never be subjected to tension loads or come into contact with the vehicle's tires and wheels.
v. All brake lines must be designed to handle the expected pressures within the braking system and must be chemically compatible with the brake fluid, adhering to IS 8654 standards.

- **It's important to note that plain plastic tubing should not be used in the construction of any brake lines.**

B.9.1.5. Brake Pedal

Teams are encouraged to position the brake pedal on the right side of the steering column, requiring the driver to operate it with their right foot. This recommendation is based on the need for sufficient foot pressure to ensure effective braking.

- **In cases where both the brake pedal and accelerator pedal are on the same side (right side), there should be a minimum clearance of 40 mm between the two pedals. It is advisable that the driver avoids using both the brake and accelerator pedals simultaneously.**

B.9.2. Throttle Configuration

The vehicle's throttle system must have the ability to engage the throttle arm to achieve full throttle (100%) on the engine and smoothly return to idle (0% throttle) when released. It is imperative that the throttle remains in its initial inspected condition throughout the entire event. The use of "Throttle-by-wire" or any other electronic throttle controls is strictly prohibited.

B.9.2.1. Accelerator Pedal

Only mechanical throttle controls operated by foot pedals are permitted. The throttle pedal must be connected to a throttle cable.

Foot pedals should be positioned in a way that prevents the driver's foot from getting trapped in any position. The use of mechanical extensions, such as thick pads or blocks, on the pedal or the driver's feet is prohibited.

- **The accelerator pedal should only be operated by the driver's right foot.**

B.9.2.2. Pedal Stop

A robust mechanical wide-open throttle stop must be affixed to the pedal. The use of body panels or any flexible materials for this purpose is strictly forbidden.

B.9.2.3. Throttle Cable

The throttle cable should be protected with a sheath or jacket from its starting point in the cockpit to the vehicle's firewall.

Throttle cables can be constructed in a "bicycle style," where the cable operates solely under tension, or in an "aircraft style," where the cable can handle both push and pull (tension-compression) actions.

Avoid severe bends or redirections of the throttle cable near the engine or the throttle pedal to prevent binding or restricted operation. It is not advisable to have redirections exceeding 15 degrees from the centreline of the cable jacket.

B.9.2.4. Fault Tolerant

All throttle controls must be engineered to automatically return to the idle position in case of a failure. To prevent the entry of debris, the throttle cable must be enclosed with a protective sheath from its forward mounting point to the firewall.

B.9.3. Additional Control Systems

B.9.3.1. Compressed Gas Systems

The use of compressed gas systems is permitted for vehicle control applications. For instance, these systems may be employed to facilitate transmission state changes, such as

shifting gears. However, it's important to note that compressed gas systems are strictly prohibited from enhancing engine power, cooling functions, or vehicle propulsion.

The Judges retain the authority to mandate additional safety measures or protective features for any compressed gas system.

B.9.3.1.1. Gas Content

Compressed gas systems are restricted to the use of gases that are non-flammable and non-oxidizing. Acceptable gases include air, nitrogen, and carbon dioxide. Unacceptable gases, on the other hand, include methane, propane, and oxygen.

B.9.3.1.2. Gas Storage

Compressed gases must be stored in containers that adhere to the following criteria:

i. These gases should be stored in cylinders (tanks) that are specifically designed and manufactured for the purpose of storage. These cylinders must be certified by an accredited testing laboratory in the country where they were produced, and they should bear appropriate labels or stamps.
ii. The compressed gas cylinder should be positioned within the vehicle's roll envelope and located behind the RRH to shield it from rollovers and potential collisions.
iii. Adequate protection measures should be in place to safeguard the compressed gas cylinder from potential damage caused by malfunctioning rotating equipment.
iv. The cylinder must be securely fastened to the vehicle frame, engine, or transmission, and its orientation should ensure that the cylinder's longitudinal axis is not aligned with the driver's position.
v. To prevent exposure to excess heat from sources like the engine or exhaust, the compressed gas cylinder should be insulated appropriately.

B.9.3.1.3. Gas Service Equipment

All service equipment within the compressed gas system must adhere to the following criteria:

i. Pressure regulators must have a rating suitable for compressed gas service and should be directly affixed to the compressed gas cylinder.
ii. Any fittings or connectors used in the compressed gas system must be rated to withstand the pressures and temperatures encountered downstream of the pressure regulator.
iii. All hoses, tubing, or other conduits employed in the compressed gas system should have ratings that are compatible with the pressures and temperatures experienced downstream of the regulator.
iv. Any gauges, indicators, or additional instrumentation integrated into the compressed gas system must have ratings that are appropriate for the pressures and temperatures encountered downstream of the regulator.

v. Every compressed gas component, including cylinders, slides, actuators, or motors, must have ratings suitable for the pressures and temperatures encountered downstream of the regulator.

- **It is crucial to emphasize that if a team intends to integrate compressed gas system controls into their vehicle, they must diligently prepare and submit the required documentation (details on the type of gas used and its placement within the roll cage etc), to the judges in accordance with the rules.**
  Should it come to light during the Technical Inspection Process that a team is utilizing the compressed gas systems for any purpose other than what is explicitly stated in the aforementioned rules, immediate disqualification will be enforced. Under no circumstances will the team be permitted to continue participating in the competition.

Part B.10. Vehicle Identification and Markings

B.10.1. Transponder

In the ATVC INDIA competition, a transponder system is employed for timing and scoring purposes. All participating teams are obligated to have transponders securely mounted on their vehicles throughout the duration of the event. It is imperative that these transponders are in proper working condition, correctly affixed to the vehicles, and fully charged, adhering to the specified type. Vehicles lacking the specified transponders will be ineligible to participate in any event where transponders are utilized for timing purposes.

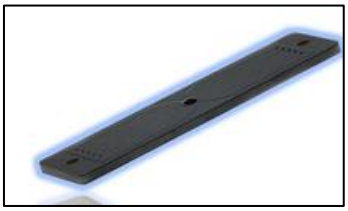
- **Starting this year, for the ATVC INDIA competitions, all participating teams are required to obtain the transponder directly from the vendor specified by ATVC in the following section.**
- **It is highly advisable for teams to equip their vehicles with a minimum of two transponders. This redundancy ensures that if one transponder experiences a malfunction, the data recorded by the other fully functional transponder can still be utilized. The placement of these two transponders should have a separation distance of 300 mm. Teams must guarantee that there are no obstructions along the path between the transponder(s) and the ground.**
- **The team bears the responsibility of acquiring an active transponder and ensuring that the transponders are adequately charged to sustain their functionality throughout the entire 4-hour endurance event.**

B.10.1.1. The Essential Transponders

There are two different models of transponders for use in the competition, each designed with its own specific function:

i. AGBAT
ii. BHIFT STRONG

- **Teams have the flexibility to choose either of the two available transponders based on the competition's specified requirements.**
- **It's important to note that teams opting for BHIFT STRONG type must use a minimum of 2 transponders as a mandatory requirement. On the other hand, teams selecting AGBAT type can utilize just 1 transponder, (but it is strongly advised that they have at least 2 of this type on hand in case the primary one fails due to unforeseen circumstances.)**
- **To prevent any last-minute complications and ensure a smooth experience for both themselves and the competition organizers, teams are highly recommended to consider the AGBAT type of transponder. This choice helps minimize the risk of interference or signal issues associated with transponders.**

Allowed Transponders		
SPECIFICATIONS	 BHIFT STRONG	 AGBAT
Dimensions in mm (L×B×H)	92 x 24 x 3	73 x 50 x 22
Weight (grams)	7	110
Protection Class	IP 65	IP 67 (Waterproof)
Temperature Range (°C)	-20 to +85	-20 to +50
Charging Time (hrs)	-	5

B.10.1.2. Supplier and Procurement Information

Teams can acquire the necessary transponders by visiting the provided link and reaching out to the supplier, BIT TO BYTE ROBOTICS, for additional information or details related to the specified transponders.

http://bbr.org.in/

B.10.1.3. Positioning

Each vehicle transponder must be installed in the appropriate position, with the correct alignment, and secured adequately using suitable fastening techniques.

B.10.1.4. Location

It is advisable to install the transponders on the right-hand side of the vehicle, located ahead of the seat, and preferably within the lower horizontal plane of the front suspension. The transponders should not be positioned more than 61 cm (24 in) above ground level. There should be a clear, unobstructed path between the antenna on the underside of the transponders and the ground.

- **Please note that metal and carbon fibre materials may interfere with the transponder signal, whereas fiberglass and plastic typically allow the transponder signal to pass through without issues.**

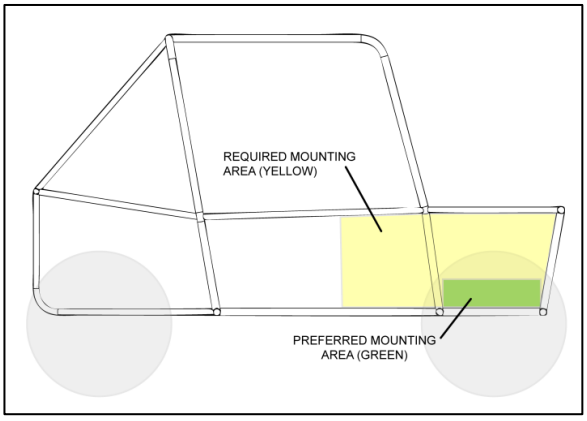


Image B-53: Advised Transponder Mounting Location

B.10.1.5. Fastening

Teams are encouraged to affix the transponder mounting bracket to their frame by either welding a small plate or utilizing M4 pan or flat head bolts with lock nuts, or using wire for secure attachment.

B.10.1.6. Interference

RF systems that transmit voice and/or data have the potential to create detrimental disruptions in the signal emitted by the transponder. Therefore, caution should be exercised when designing, constructing, or servicing RF systems in proximity to the transponder.

B.10.2. Vehicle Numbers

Vehicle numbers serve as a means for organizers and officials to definitively identify team vehicles. Teams are required to design these numbers to remain clearly visible under all

racing conditions or ensure they are kept clean and easily noticeable. Importantly, the numbers must not be hidden or obstructed by any other part of the vehicle.

- **If numbers are not readily legible, the vehicle may receive a black flag, and it may not receive scores during the endurance event.**

B.10.2.1. Mandatory Numbers

The vehicle must have three primary numbers securely attached. These numbers should be easily seen from the vehicle's left, right, and front sides, and they should strongly contrast with the background colour. It is not allowed to use adhesive to attach the numbers to the body panels.

- **Teams are granted the flexibility to choose any font for displaying of their vehicle numbers, as long as they adhere to the rules outlined in this part. It is recommended that teams consider using either the "Highway Gothic Regular" font or the "Century Gothic Bold" font.**

B.10.2.2. Position

B.10.2.2.1. Side Numbers

The side numbers, which are affixed to both the left and right sides of the vehicle, should be positioned above the SIM and to the rear of the RRH plane. It is imperative that the side numbers remain unobstructed from view and are not visually blocked by any part of the vehicle.

B.10.2.2.2. Front Numbers

When attaching front-facing numbers above the SIM, their plane's angle should not exceed 45 degrees from vertical. Conversely, when affixing front numbers below the SIM, their plane's angle should not exceed 15 degrees from vertical.

B.10.2.3. Alignment

The numerals should be arranged in a uniform horizontal line, and all number panels must be mounted with a generally horizontal orientation, with a tolerance of ± 3.0 degrees, to ensure quick and easy vehicle identification. There should be a spacing of 25.4mm (1.0 in.) between the numerals.

B.10.2.4. Number Size

The primary cut-out numbers must have a minimum height of 152 mm (6.0 inches), as indicated by dimension "H" in Image B-54. These primary cut-out numbers should feature a stroke width that is proportionate to the font design corresponding to the character height.

Additionally, the primary cut-out numbers should be mounted in a way that ensures the projecting face is at least 13 mm (0.5 inches) away from the background panel.

- **It is important to eliminate any sharp edges or points along both the inner and outer edges of the cut-out numbers.**

B.10.2.5. Backing Panel

Every number displayed on the vehicle must feature a background with a high level of contrast to ensure easy readability. The edges of the backing panel should not be less than 25.4 mm (1.0 in.) away from the edges of the numbers, as indicated by dimension "D" in Image B-54. Teams have the option to outline the numbers to enhance the contrast. It is imperative that the number backing panels are securely affixed to the vehicle frame.

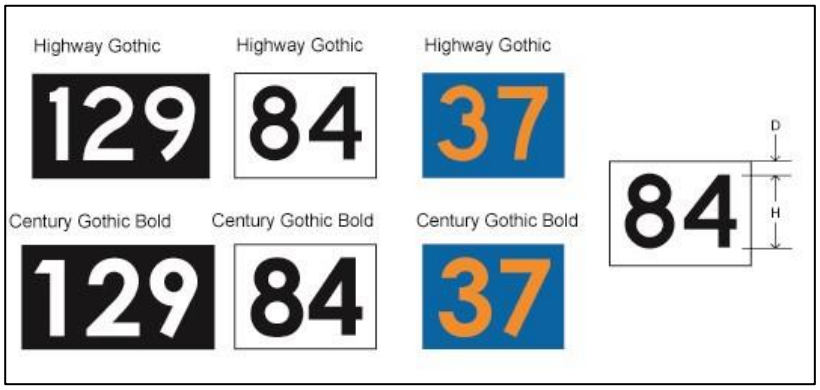


Image B-54: Vehicle Numbers, Example

B.10.2.6. Number Colours

Teams have the liberty to choose the colours for their backing panels, as long as these colours offer a high level of contrast that enables quick vehicle identification. It's important to note that the backing panel should consist of a single colour, and all numerals must be of the same matching colour. Refer to Image B-54 for visual guidance.

B.10.3. Sponsor Identification

Teams have the flexibility to showcase advertising or graphics of their choice, provided that such displays are in good taste and do not conflict with the event or its organizers. The organizers retain the authority to prohibit specific graphics if they are deemed inappropriate or disrespectful.

- **Teams are required to ensure there is an empty space of approximately 10 x 10 inches on the firewall, positioned above the driver's shoulders. This area will be utilized for**

the placement of stickers as part of the Technical Evaluation, and for the weighment process.

Part B.11. Fasteners

B.11.1. Purview

This article outlines the requirements that fasteners must adhere to in the following vehicle systems:

i. Driver Harness
ii. Fuel System
iii. Fire Extinguisher
iv. Engine Kill Switches
v. Steering, Suspension, and Brake System
vi. Battery and Powertrain mounts

B.11.2. Retained Fasteners

To ensure that fasteners remain secure, the following methods shall be employed:

i. Utilization of nylon locknuts
ii. Insertion of cotter pins
iii. Application of safety wire (specifically for blind hole applications) It's important to note that using lock washers or thread sealants does not meet the criteria outlined in this regulation.

B.11.3. Thread Protrusion

To ensure secure thread engagement within the lock nut, threaded fasteners must extend beyond the nut's end by a minimum of two (2) threads.

B.11.4. Grade

Threaded fasteners should meet or surpass the strength grades listed below:

i. SAE Grade 5
ii. Metric Grade 8.8
iii. Specifications as per AN/MS standards.

The following represents the bolt markings that satisfy or exceed the aforementioned criteria.

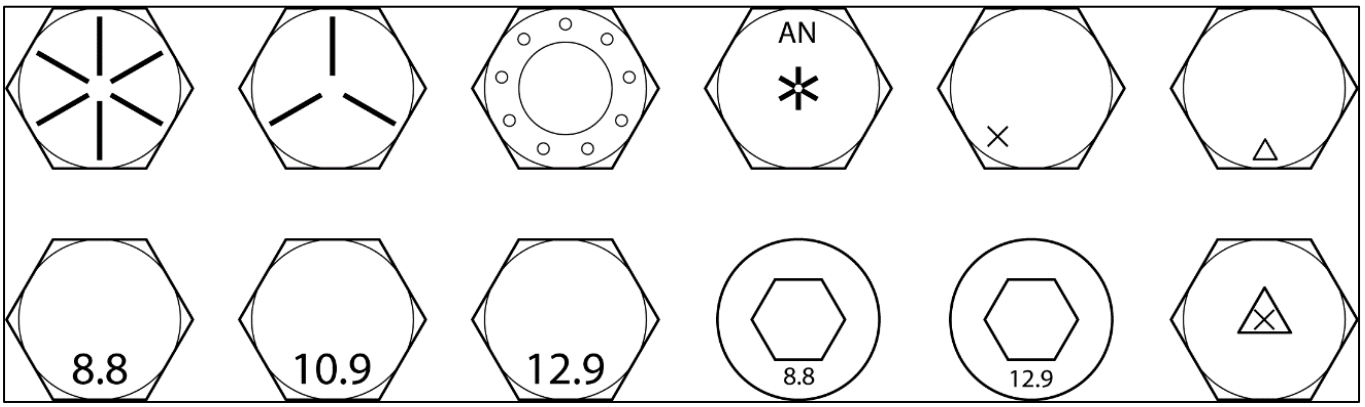


Image B-55: Fasteners, Acceptable Markings

B.11.5. Grade Certification

For unmarked fasteners, as described earlier, it is essential to provide adequate documentation. This documentation should include a purchase receipt and the manufacturer's specifications, which must indicate that the fastener's strength meets or surpasses the standards outlined in B.11.4. (Grade).

- **Teams using fasteners with clearly visible grade markings will expedite their technical inspection process, saving time.**

B.11.6. Non-Standard (Unmarked/Custom Fasteners)

Any threaded fastener, including threaded rods, eye bolts, titanium bolts, etc., lacking identifiable markings as listed must be accompanied by one or both of the following forms of documentation:

i. A purchase receipt and manufacturer's documentation certifying that the fastener meets or surpasses Grade 5 standards for its size.
ii. Equivalency calculations, supported by a purchase receipt or test data, demonstrating that the fastener's strength surpasses that of a Grade 5 fastener of the corresponding size.

- **Teams that utilize customized or modified fasteners tailored to their specific needs, such as shank shortening or altered lengths etc., must demonstrate to the judges their compliance with the regulations outlined in this section.**

Part B.12. Electrical Systems

A basic electrical system must consist of a minimum of two kill switches, a brake light, a brake switch, a battery, and the necessary wiring. The vehicle's electrical system should adhere to the highest engineering and electrical standards. Brake lights must remain operational independently of the kill switch settings and must always have power, ensuring continuous functionality.

B.12.1. Power Sources (Combustion Vehicles Only)

B.12.1.1. Batteries (Auxiliary Battery)

All electronic components or devices on the vehicle can now operate solely on battery power, eliminating the need for the alternator and its associated horsepower consumption. Any battery used for safety features, such as the brake light, reverse light, or reverse alarm, must possess ample electrical capacity to endure the entire duration of the endurance event.

B.12.1.1.1. Installation

Every battery must be securely installed using sound engineering practices to ensure it remains firmly in place during regular operation, as well as in the event of a collision or rollover. Additionally, battery terminals must be adequately insulated and safeguarded to prevent electrical shorts.

B.12.1.1.2. Sealing

All batteries must be originally sealed from the factory and designed to be maintenance-free. These batteries should not be accessible for opening or servicing, and they must remain leak-proof even in the event of a collision or rollover.

B.12.2. Wiring and Connectors (Combustion Vehicles Only)

The installation of all vehicle wiring and connectors must be done with precision, ensuring a tidy and orderly arrangement. Wiring should maintain a safe distance from potential heat sources, abrasion, chafing, and any areas where a short circuit could occur. It is imperative that wiring does not obstruct the driver when entering or exiting the vehicle. All wiring must be adequately shielded at every juncture, using either electrical tape or heat shielding, and there should be no exposed wiring visible anywhere on the vehicle.

B.12.3. Kill Switch

B.12.3.1. Quantity

Every vehicle must have at least two (2) kill switches.

B.12.3.2. Required Switch (Combustion Vehicles Only)

The vehicle must be fitted with at least one of the specified obligatory switches from the following options:

i. Polaris Part 4015321 or 4019114
ii. Ski-Doo Part 01-171 (http://www.mfgsupply.com/01-171.html)
iii. WPS 27-0152 (http://www.parkeryamaha.com/skidoostopswitch.aspx)
iv. WPS 27-0154 (http://www.parkeryamaha.com/skidoostopswitch.aspx)

- **Previous generations of the authorized switches are permissible.**

B.12.3.3. Position

B.12.3.3.1. Cockpit Switch

A minimum of one cockpit kill switch is required as defined by this rule. Additional cockpit kill switches are permitted provided the switch meets rule B.12.3.2 (Required Switch).

- **The cockpit kill switch shall be mounted on the Left 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.14.3. (Driver Knee Safety Specifications).**

B.12.3.3.2. Exterior Switch

One of the mandatory kill switches must be positioned for easy access by track workers. This switch should be located on the right side of the vehicle, positioned behind the plane of the RRH (Rollover Protective Structure) and ahead of the right FABUP (Front Anti-Brake Unintentional Pedal Application). The external kill switch should be oriented approximately perpendicular to the firewall, with a tolerance of ±15 degrees, and it should be situated below frame point BR. This switch should also be within a maximum distance of 180 mm (7.0 inches) in dimension "Z" as shown in Image B-56, and it must be mounted on a tab

directly connected to the RRH. Additionally, the external kill switch should not be set back by more than 51 mm (2.0 inches) from the outer edge of the RRH tube.

B.12.3.4. Installation

Every engine kill switch must be securely affixed to the vehicle frame, ensuring unobstructed access to the switch. These switches must also be free from any sharp edges or other potential hazards to both track workers and the driver. Mechanical fastening to

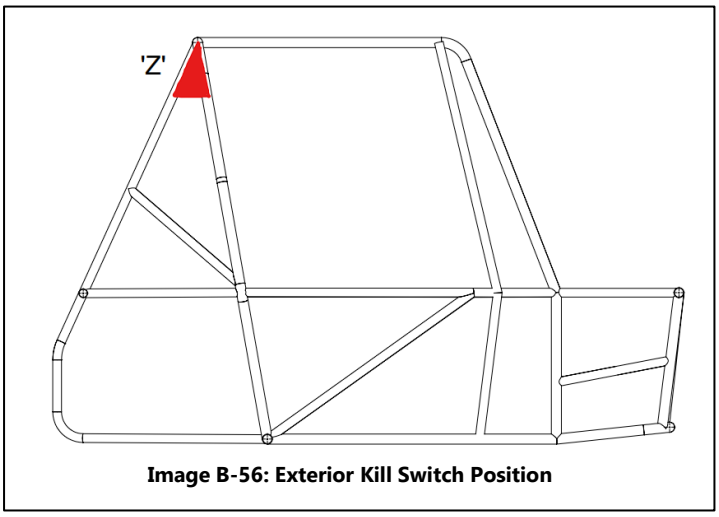


Image B-56: Exterior Kill Switch Position

the frame is mandatory, with a strict prohibition on the use of adhesives. In the event that threaded fasteners are employed for mounting an engine kill switch, they must adhere to the requirements outlined in Part 11 (Fasteners).

- **It's worth noting that robust, captive methods such as rivets are acceptable for fastening kill switches to the mounting tab. The evaluation of these designs will be conducted individually by technical judges.**
- **Both kill switches must be positioned within the roll envelope and safeguarded against potential damage resulting from rollovers or collisions.**

B.12.4. Signalling

B.12.4.1. Brake Light

Every vehicle must be equipped with a fully operational brake light, serving the purpose of indicating to other drivers that the vehicle is either slowing down or coming to a stop. The brake light must be exclusively red in colour and should remain visible during daylight hours, regardless of weather conditions, for a distance of 20 meters. The wattage of the brake light bulb must adhere to the AIS standard.

All brake lights must be set up to illuminate entirely when the brakes are engaged and to turn off completely when the brakes are released. Only unaltered stock OEM brake lights are permitted, and no modifications to them are allowed. While teams are not obligated to

use a specific brake light model (provided that model adheres to the rules), it is highly recommended that they consider using the following brake light models:

i. Polaris Part # 2411450
ii. Polaris Part # 2411099
iii. Polaris Part # 2411092-432
iv. Haul-Master – Part # 93263
v. Command Electronics Part # 003-6018R
vi. Command Electronics Part # 003-6016

B.12.4.1.1. Positioning and Alignment

The brake light on the vehicle should have a robust and long-lasting mounting, incorporating lock nuts if required. It must be situated at a minimum height of 1 m (39.4 inches) above the ground. The orientation of the vehicle's brake light must ensure visibility to the trailing vehicles, with the light shining either parallel to the ground or at a slightly downward angle. Brake lights directed above a horizontal plane are not allowed.

B.12.4.1.2. Brake Light Switch

The brake light should exclusively activate through the use of hydraulic pressure switches integrated into the brake hydraulic lines. Each distinct hydraulic brake circuit must feature its own hydraulic pressure switch. In the case of cutting brakes, they must activate the brake light via a hydraulic pressure switch.

- **It's important to note that the use of brake pressure switches designed for two-wheelers is strictly forbidden, as are any mechanical switches, whether they operate by pushing or pulling.**

B.12.4.2. Reverse Light

Vehicles equipped with a reverse gear must have a reverse light. This reverse light should activate when the vehicle is shifted into reverse gear and turn off when the vehicle is shifted out of reverse gear.

B.12.4.2.1. Criteria

Reverse lights must feature an "R" marking on their lens. While there is no compulsion for a specific reverse light (as long as it adheres to all the rules), teams are strongly encouraged to consider the following recommendations:

- **The Teams are advised to utilize LED technology, meeting or surpassing the SAE standard J759.**

- **Additionally, Indian OEM reverse lights are acceptable in addition to those rated according to the SAE standard. The most common lamps available in India would be with E4 and E9 which are acceptable)**

B.12.4.2.2. Positioning and Alignment

The reverse light must be securely and sturdily mounted, with a minimum height of 700 mm (27.6 inches) above the ground. The orientation of the reverse light should ensure visibility to following vehicles, emitting light generally parallel to the ground.

B.12.4.3. Reverse Alarm

Vehicles equipped with reverse gear must have an audible reverse alarm. This alarm should activate when the vehicle is shifted into reverse gear and deactivate when the vehicle is shifted out of reverse gear.

B.12.4.3.1. Criteria

Although there is no mandatory requirement for a particular reverse alarm (as long as it complies with all the rules), teams are strongly recommended to ensure that their reverse alarms are rated to meet the SAE standards J1741 or J994. In addition to SAE-rated reverse alarms, Indian OEM reverse alarms are also acceptable.

B.12.4.3.2. Positioning

Reverse alarms must be affixed to the vehicle frame behind the RRH plane.

B.12.5. Monitoring Systems

Vehicles have the option to feature monitoring systems that provide the driver with operational or performance data. However, it's important to note that all vehicle instrumentation must be accounted for in the cost report.

B.12.6. Data Acquisition

Vehicles have the option to incorporate data acquisition (data logging) systems. If these data acquisition systems offer real-time feedback to the driver or transmit telemetry data to the team, they must be accounted for in the cost report. However, data acquisition systems that do not provide real-time data to the driver or telemetry data to the team may be excluded from the cost report.

B.12.7. Communication Systems

Teams are allowed to utilize radio-frequency (RF) communication systems. However, teams using RF systems must adhere to the relevant Indian, state, and local regulations based on the event's location. It is imperative that a team's RF systems do not, under any

circumstances, create harmful interference with the voice or data systems used by competition officials or emergency responders.

B.12.7.1. Voice

Vehicles have the option to utilize RF voice communication systems. These RF voice communication systems and associated equipment may be exempted from inclusion in the cost report.

B.12.7.2. Data

Vehicles are allowed to employ RF data communication systems. All RF data communication systems and related equipment must be accounted for in the cost report.

Part B.13. Fuel Systems (Only for Combustion Vehicles)

B.13.1. Purpose

Every vehicle must possess a fuel system consisting of a fuel tank, fuel hose, fittings, and protective splash shields. This fuel system's primary function is to securely store and regulate fuel and effectively transport fuel to the engine carburettor. It's important to note that the entire engine is regarded as an integral component of the fuel system.

B.13.2. Fuel Type

In ATVC INDIA competitions, only automotive gasoline grades composed of hydrocarbon compounds are allowed. This gasoline is permitted to include antioxidants, metal deactivators, or corrosion inhibitors.

- **Fuel supply at the ATVC INDIA venue is accessible, therefore, the use of external fuel sources is restricted.**

B.13.2.1. Forbidden Additives

The use of additives containing nitrogen or additives intended to release oxygen is expressly forbidden. The use of leaded gasoline is strictly prohibited.

- **Lead alkyl compounds, including tetra-ethyl lead, are explicitly banned.**

B.13.3. Positioning

The complete fuel system, which encompasses the carburetor, air cleaner cover, splash shield, and engine (except for intake air hoses), must be positioned within the envelope of the vehicle's roll cage. To verify this, the envelope is assessed using a straight edge that connects any two points on the outer part of the vehicle frame. The mounts for the fuel tank must be engineered to withstand continuous vibrations and shocks.

B.13.4. Fuel Tank

Only one fuel tank is allowed for the vehicle, and it must remain in its original, unmodified condition without any harmful defects. All fuel tanks shall be remote mounted, and not affixed to the engine. The use of removable tanks is strictly forbidden. Additionally, the retail cost of the fuel tank must be documented in the cost report.

B.13.4.1. Installation

Fuel tanks must be affixed to a tube or tubes that meet at least the criteria of serving as a secondary member. These tubes must be securely supported at both ends, and any form of cantilevered mounting is strictly forbidden.

Every mounting hole on the fuel tank must be utilized for attaching the fuel tank to the vehicle frame. All fasteners employed for securing the fuel tank must conform to the specifications outlined in Part 11 (Fasteners).

- **The teams are advised to install the fuel tank by securely attaching it directly to two square or rectangular tubes that meet the criteria of secondary members.**

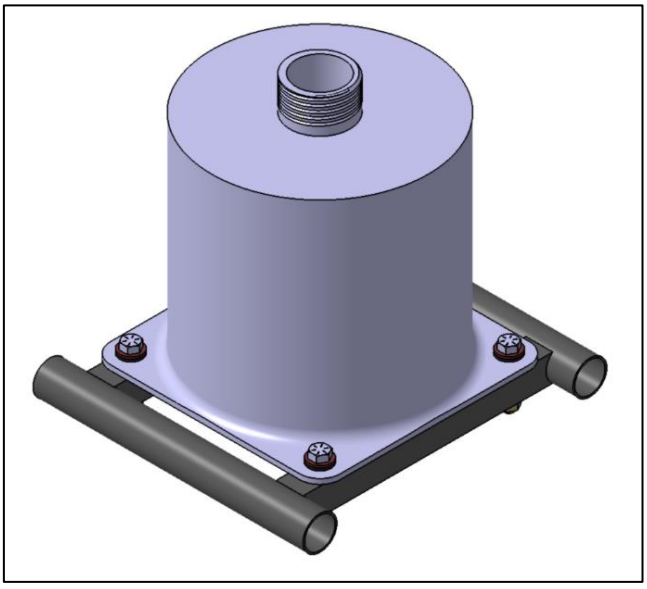


Image B-57: Fuel tank mounted to square/rectangular tubes (Recommended mounting design)

The fuel tank mounts must adhere to the following specifications:

i. The thickness of the mounting tabs on the frame for the fuel tank should be at least 1.6 mm (0.063 inches).

ii. The length of the mounting tabs on the frame for the fuel tank should not exceed 50.8 mm (2.0 inches) when measured from the centre of the bolt hole to the outer edge of the attached frame component.

iii. The mounting tabs for the frame's fuel tank and their attachment should be rigid and resistant to deformation.
iv. Frame fuel tank mounting tabs must not have any openings or cut-outs for weight reduction purposes.

B.13.5. Fuel Lines and Filters

B.13.5.1. Positioning

Fuel lines must be positioned at a safe distance from sharp edges and hot engine parts, and they should be shielded from both hot engine components and potential sources of chafing or abrasion. The use of grommets is mandatory when the lines pass through any member of the vehicle. It's important to note that fuel lines are not allowed in the cockpit area. Additionally, ensure that there is enough slack in the fuel lines so that they are not under tension.

- **For added security and to relieve strain on the fuel line, it is recommended to affix a snug-fitting clamp to the engine with an outer diameter matching that of the fuel line. Example McMaster-Carr part #3177T52.**

B.13.5.2. Rating

Every fuel line must conform to SAE J30R14 or 30R7-RP standards and display OEM labels with the necessary rating details.

B.13.5.3. Size

The fuel lines should match the dimensions of the stock fuel lines supplied with the engine. The fuel lines should have an outer diameter not exceeding 12.7 mm (0.5 inches) and an inner diameter not exceeding 6.3 mm (0.25 inches). The recommended nominal or trade size for the necessary fuel line is "1/4 inch."

B.13.5.4. Fuel Filter

If a fuel filter is employed, it should be a stock Briggs and Stratton filter and must be positioned above the splash shield. Only one (1) fuel filter is allowed at any given time.

B.13.5.5. Fuel Sensors

Fuel level gauges and sensors are permissible provided that no alterations are made to the fuel tank. These gauges and sensors should not be installed in a way that increases the fuel system's capacity.

B.13.6. Splash Shields

To prevent accidental fuel spillage onto the engine or exhaust during refuelling or fuel preparation, the installation of splash shields is mandatory. These shields should be made of metal, with a thickness greater than 0.5 mm or 0.02 inches. They must possess a generally

rigid structure and be designed in a way that directs any spilled fuel away from the vehicle's interior, ensuring it doesn't accumulate on the shield or any part of the vehicle, including skid plates.

Splash shields must be permanently mounted and non-adjustable to remain effective at all times. They should be positioned lower than the structural member supporting the fuel tank. Importantly, the splash shield should maintain a distance from the muffler and should not come into contact with exhaust emissions. Splash shields must maintain a minimum vertical clearance of 3 inches from the exhaust finger guard and should consistently provide full coverage over the exhaust area when viewed from above. Additionally, any sharp edges must be smoothed or eliminated.

In cases where the fuel line traverses through the splash shield, it must do so via a sealed and grommeted opening in the shield to prevent fuel leakage onto the engine. The use of bulkhead fittings for this purpose is not permitted. There is no necessity to install a spill pan for the competition.

There are two acceptable methods for preparing the splash shield:

i. Integrated Splash Shield with Drip Pan: In this method, the splash shield is combined with a drip pan, ensuring that liquid flows towards a single drainage pipe without any liquid accumulation.

ii. Alternatively, a separate splash shield can be used to cover the entire engine and exhaust area.

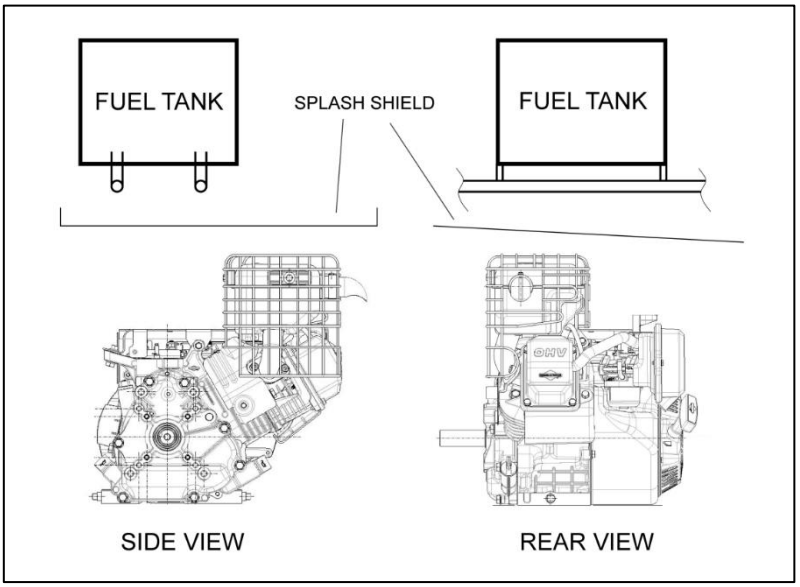


Image B-58: Fuel System, Splash Shield Installation Example

- **In the case of 20-Series B&S engines with the default engine-mounted fuel tank, the vehicle must be equipped with both a drip pan and a splash shield, meeting the specified requirements outlined below:**

B.13.6.1. Drip Pan Mounting

The installation of drip pans must adhere to proper engineering standards. Simply attaching the drip pan to the fuel tank filler neck is not adequate and is prohibited. Drip pans must be designed with a slope or incline to ensure that any spilled fuel flows out of the pan, and there should be no accumulation of fuel within the pan.

B.13.6.2. Drip Pan Outlet

Fuel within the drip pan should be directed to exit through a drain line constructed from either pipe or tubing. This drain line should extend to the underside of the vehicle for fuel release. The tubing used must have the appropriate fuel-rated markings and be suitable for fuel applications. Under no circumstances should fuel be discharged onto the belly pan, flotation, or any other vehicle component.

The connection between the drain line and the drip pan should be robust and can be achieved through a threaded connection, a hose barb and hose clamp, or a combination of these methods. The use of adhesive connections is explicitly prohibited. All materials employed within the drip pan system must be either fuel-rated or resistant to fuel.

The nominal minimum inside diameter of the drain line should be 12.7 mm (0.5 inches), while the minimum inside diameter of fittings should be 9.5 mm (0.375 inches).

B.13.6.3. Drain Line Material

The drain lines must be crafted from materials that are resistant to fuel or made from other pipe or tubing that does not deteriorate when in contact with fuel. The connection between the drain line and the drip pan must be securely sealed and durable. The pipe's cross-sectional area should remain consistent and not diminish along its length when subjected to compression.

- **The use of M-seal is strictly forbidden for both drip pans and splash shields.**

B.13.7. Fuel Tank Access Panels

Any panels or doors that require removal or opening for access to the fuel tank should be designed to be easily operable by track workers wearing gloves. To ensure visibility for track safety personnel, an observer positioned directly behind the vehicle must have a clear line of sight to the fuel tank and its related components.

Part B.14. The Engine (Combustion Vehicles)

B.14.1. Engine Specifications and Limitations

Teams participating in ATVC 2024 are not constrained to a particular Briggs and Stratton engine model. They have the flexibility to select any model from the company's lineup, as long as the chosen engine adheres to the regulations outlined in this section. In order to maintain uniformity among all teams in the event, specific criteria have been specified that every team must ensure their engine meets.

The teams must make sure to include the engine model number and specifications in the static reports and have separate documentation readily available for this purpose.

- **The Model 19 engine originally includes a separate fuel tank. Teams are required to affix the fuel tank independently and separately from the engine.**
- **The team are instructed to utilize an engine that meets the following specifications:**

i. **Engine Cubic Capacity: 305 CC**
ii. **Gross Horsepower: 10 HP**
iii. **Engine Fuel: Gasoline**
iv. **Torque Power: 12.7 Lb/f**

- **The process of blueprinting, which involves reworking an engine to meet the manufacturer's precise specifications, is regarded as a modification and is explicitly prohibited.**
- **The engine must remain entirely unmodified in every aspect.**

B.14.1.1. Replacement Parts

Teams are strongly advised to utilize exclusively genuine Briggs and Stratton Original Equipment replacement parts.

B.14.1.2. Piston Rings

Teams are recommended to utilize solely standard-sized, genuine Briggs and Stratton piston rings.

B.14.1.3. Intake Ports

It is not allowed to clean or remove aluminium flashing from intake or exhaust ports.

B.14.1.4. Valves

Valve clearance settings between the tappet and valve stem are flexible and can be adjusted as desired. Valves can be lapped to ensure effective sealing. The recommended angle for the intake valve seat must be maintained at 45 degrees, and the recommended angle for the exhaust valve seat must also remain at 45 degrees.

B.14.1.5. Shafts and Rods

The camshaft, crankshaft, connecting rod, and flywheel must remain in their original, unaltered condition and should not undergo any modifications or changes.

B.14.1.6. Spark Plugs

It is advisable for teams to use the RC12YC spark plug.

B.14.1.7. Armature

Teams have the freedom to set the armature air gap as per their preference. However, it is not permitted to modify the armature mounting holes by slotting or elongating them to either advance or retard the ignition timing.

B.14.1.8. Flywheel Rotation

Rotating the flywheel to either advance or retard the timing is strictly prohibited.

B.14.1.9. Engine Governor

Each engine comes equipped with a governor, and during the competition, each governor will be adjusted to ensure a maximum speed of 3,800 rpm or lower. Random inspections of the governor may occur at any time. Any effort to bypass or disable the engine governor in order to raise the engine speed will result in immediate disqualification.

- **GOVERNOR SETTING NOT TO EXCEED 3,800 RPM.**

The governor's functionality must be unobstructed at all times, and the area around the governor must be protected from debris. If the fuel tank is mounted remotely, a debris shield covering the exposed governor area is mandatory. Teams are advised to consider using a Briggs and Stratton part numbered 697326 Control Cover. Alternatively, teams have the option to fabricate a control cover, and it is suggested that it should preferably serve an equivalent function to part 697326.

B.14.1.10. Idle Speed

Idle speed adjustments are permissible, and the recommended range is 1,750 RPM ± 100 RPM.

B.14.1.11. Air Cleaner

The air intake cleaner can be repositioned, and it's advisable for teams to use Briggs and Stratton components for this purpose. Recommended parts for relocation include 592251 (remote kit), 695329 (choke shaft), and 699960 (base). The supplied intake air hose can be shortened to a minimum of 152 mm (6.0 inches). Teams are also allowed to add extra pre-filters to the top of the air intake. These components must be accounted for in the cost report. Any alterations to the air filter must undergo inspection and are subject to approval by the technical inspectors.

- **Moving air filters or altering the cleaner housing can potentially reduce engine performance.**

B.14.1.12. Carburetor

B.14.1.12.1. Jetting

It is not allowed to make modifications to the carburetor jet or to perform any re-jetting of the carburetor.

B.14.1.12.2. Float

The carburetor float is fixed and should not undergo any adjustments or modifications.

B.14.1.12.3. Venturi

Altering the carburetor venturi in any way is not allowed.

B.14.1.13. Exhaust System

B.14.1.13.1. Muffler Repositioning

If the vehicle design necessitates a reconfiguration of the exhaust system to prevent interference with any part of the vehicle, the re-routing should be accomplished using tubing with an inner diameter (ID) of 32 mm (1.25 inches). Any remote-mounted exhaust system must retain the original muffler and be securely mounted to prevent any loosening or vibrations during the competition.

B.14.1.13.2. Muffler Support

Exhaust pipe and muffler supports are mandatory and should be affixed solely to the engine.

B.14.1.13.3. Exhaust Pipe Port

The exhaust pipe must not extend into the exhaust port in a manner that changes the port's configuration.

B.14.1.13.4. Exhaust Pipe Length

Any exhaust pipe length is permitted, but it must be fixed and non-adjustable.

B.14.1.13.5. Continuous Exhaust Piping

Additional openings or tubes are prohibited within the exhaust pipe. It must have one inlet and one outlet as a requirement.

B.14.1.13.6. Exhaust Robustness

The exhaust pipe and muffler must maintain durability, resilience, and full functionality throughout the competition. If any vehicle is discovered to have an exhaust system that is loose or leaking, it will be temporarily disqualified from the competition until the problem is resolved.

B.14.1.13.7. The Exhaust Setup

The entire exhaust system must be positioned in such a way that its outermost points are at least 100 mm (3.93 in.) inside the vehicle's perimeter. (The vehicle's perimeter is defined by the outline formed by the planes of the roll cage members) Refer Image B-59.1.

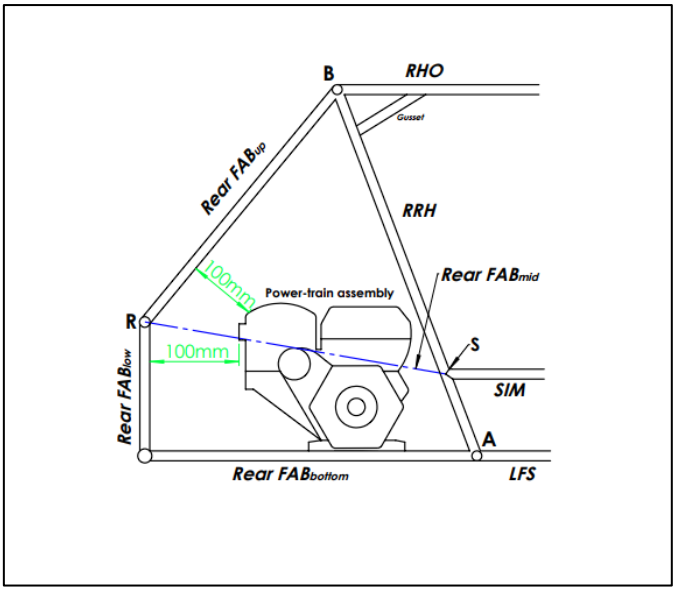


Image B-59.1: Exhaust Clearance for Vehicle Perimeter

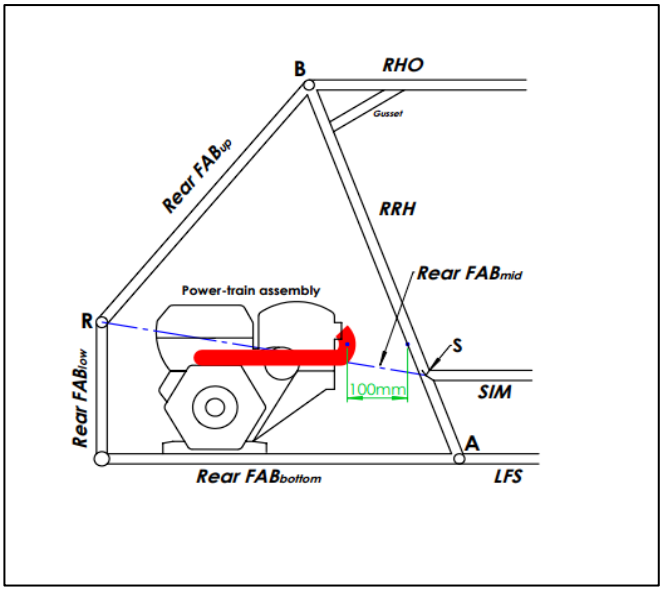


Image B-59.2: Exhaust – Firewall Clearance

- **Engines must not be oriented in a manner where the exhaust faces the firewall. If the exhaust faces the firewall, teams are responsible for ensuring there is a minimum 100 mm (3.93 in.) clearance between the exhaust and the firewall after rerouting, which will be verified by Technical Judges during the main event. Teams may need to modify the routing if it does not meet the competition's requirements.**
- **In Image B-59.2, you can observe the engine placement, and the exhaust is directed towards the driver, with a red pipe used for rerouting. A green arrow highlights the necessary clearance between the outer edge of the exhaust rerouting pipe and the RRH, which must exceed 100mm.**

B.14.1.13.8. Muffler Cage

Teams are advised to keep the protective wire cage that surrounds the muffler to minimize the risk of burns.

B.14.1.14. The Starter

The starter pull rope can be lengthened to allow the driver to start the engine while seated. However, the use of starter motors is strictly forbidden.

B.14.1.15 The Alternator

The engine can be equipped with an authorized alternator for electrical power generation. Teams are encouraged to choose alternators that are approved by Briggs and Stratton for their specific engine model. Some of the Available alternators are sized in 3, 10, and 20 Ampere versions.

B.14.2. Hybrid Electric Systems

The use of hybrid-electric drivetrain systems is strictly forbidden. Additionally, employing a starter motor for vehicle propulsion is explicitly prohibited.

B.14.3. Energy Storage Systems

B.14.3.1. Hydraulic

The use of hydraulic accumulators is the sole permissible option for incorporating stored energy devices into the vehicle for propulsion purposes. Hydraulic power systems must be adequately protected, and documentation confirming the shielding measures must be accessible for review.

B.14.3.2. Kinetic

The use of kinetic energy storage devices like flywheels is strictly forbidden.

B.14.3.3. Electric

The use of batteries or any other electric energy storage devices for vehicle propulsion is expressly forbidden.

B.14.3.4. Compressed Gas

The use of compressed gas systems for vehicle propulsion is strictly prohibited.

❖ SECTION C: ELECTRICAL POWERTRAIN AND SYSTEMS (FOR ELECTRIC TYPE VEHICLES ONLY)

Part C.1. Electrical System Interpretations

i. High Voltage (HV)

In the field of automotive engineering, the term "High Voltage" pertains to voltage levels falling within the spectrum of 30 to 1000 VAC root mean square (RMS) or 60 to 1500 VDC.

ii. Tractive System

The tractive system of the vehicle encompasses the entire electrical network, comprising all components electrically linked to the motor(s) and the tractive system accumulator(s).

iii. Tractive System Voltage

The voltage measured across any two terminals of the tractive system.

- **Under no circumstances should the tractive system voltage surpass 60V DC.**

iv. Tractive System Accumulator

The tractive system accumulator(s) is described as a comprehensive assembly or pack comprising all the battery cells responsible for storing the electrical energy utilized by the tractive system, in addition to the associated contactor, fuse, and battery management systems/solutions.

v. Tractive System Accumulator Enclosure

It serves as a housing or enclosure for the tractive system accumulator.

vi. Electric Motor

An electric motor is an electrical device that transforms electrical energy into mechanical energy.

vii. HV Rated Cut-Off Switch

The high-voltage rated cut-off switch should function based on the tractive system voltage. When switched off, the tractive system accumulator should not supply power to the DC-DC Converter.

viii. Accumulator Isolation Relay (AIR)

The isolation relay for the accumulator should separate the accumulator from the tractive system.

ix. Low Voltage (LV)

The vehicle's low-voltage (LV) system encompasses the entire electrical network of components that are distinct from the tractive system. The voltage across any two terminals within the vehicle's Low Voltage system should not surpass 15V DC under any circumstances.

x. Kill Switch

The kill switch must be functional within a voltage range of ≤15V DC. It is required to deactivate the tractive system, AIR, and TSAL, and may also deactivate the reverse light and reverse alarm. However, it should not deactivate the brake light when the brake pedal is engaged.

xi. Ignition/Master Switch

The ignition switch should function within a voltage range of ≤15V DC. When in the "off" position, the low-voltage power source should not supply power to any low-voltage components.

xii. Tractive System Active Light (TSAL)

The TSAL should function using low voltage. It should maintain a continuous flashing or blinking pattern at a frequency ranging from 2Hz to 5Hz while the tractive system is operational.

xiii. Brake Light

The Brake Light should function using low voltage. It is required to emit a continuous glow whenever the brake pedal is pressed.

xiv. Reverse Light

The Reverse Light should operate using low voltage. It is mandated to emit a continuous glow when the gear/FNR switch is set to reverse mode.

xv. Reverse Alarm

The Reverse Alarm should function using low voltage. It is required to activate continuously when the gear/FNR switch is in reverse mode.

Part C.2. Low Voltage (LV) Electrical System (≤15 V DC)

The LV system should comprise a minimum of two kill switches, a LV ignition/master switch, a brake light, TSAL, and RTDS. In the event that the vehicle is equipped with a reverse mode feature, the inclusion of a reverse light and reverse alarm is compulsory, and these components should exclusively be part of the LV system.

C.2.1. LV Power Source

All LV components are required to draw power from either an auxiliary battery or receive step-down power from the Tractive system accumulator via a DC-DC Converter. It is strictly forbidden to utilize both the DC-DC Converter and the auxiliary battery simultaneously. In either scenario, the presence of an ignition key/master switch is obligatory. Nevertheless, teams have the option to employ a separate DC-DC converter (with a voltage limit of ≤9V) or a separate auxiliary battery (with a voltage limit of ≤9V) specifically for powering telemetry, logging, and data equipment while adhering to the rule.

C.2.1.1. The Auxiliary Battery (Choice 1)

i. An auxiliary battery used as the LV Power Source must not provide power to any component within the tractive system.
ii. Two auxiliary batteries should not receive recharging from the traction motor(s), alternator, or DC-DC Converter. These batteries must be designed as spill or leak-proof, and in the case of lead-acid chemistry, they should be factory sealed, preventing any access or servicing, and should remain leak-free even in the event of a rollover.
iii. The auxiliary batteries must be securely fastened to the vehicle's frame using sound engineering practices to ensure they remain firmly in place during regular operation, collisions, or rollovers. These batteries must be safely positioned and concealed, and their terminals should be insulated and protected to prevent electrical short circuits.
iv. If the auxiliary battery employs lithium chemistry, it must also include a dedicated Battery Management System (BMS).

- **Additionally, if the auxiliary battery utilizes lithium chemistry, it should be installed behind the firewall.**

C.2.1.2. DC-DC Converter (Choice 2)

i. Teams are required to utilize an automotive-grade DC-DC Converter equipped with a circuit incorporating safeguards such as overvoltage and undervoltage protection, overload protection, and short circuit protection. This DC-DC Converter should have a rating that sufficiently meets the power consumption demands of all low-voltage (LV) components.
ii. Additionally, the DC-DC Converter must be equipped with a fuse rated appropriately, as specified in section C.7: (The Fuse)
iii. It's important to treat the DC-DC Converter as an integral tractive system component, adhering to the stipulated requirements in sections C.5.1. and C.5.3. Furthermore, it should be securely affixed to the vehicle's frame behind the firewall, employing sound engineering practices to ensure it remains firmly in place during regular operation, collisions, or rollovers.

- **Lastly, it is strictly prohibited to install the DC-DC Converter within the cockpit area.**

C.2.2. Kill Switch

The Kill Switch must adhere to the Push Button E-Stop type specifications outlined in ISO 13850. This switch should function as a High Voltage Interlock Loop (HVIL) device, with the Low Voltage (LV) system initiating the deactivation of the Tractive system by triggering the Accumulator(s) relay. Both Kill Switches must be of the "PUSH TO KILL" and "ROTATE TO ENERGIZE" type.

Each vehicle must be equipped with a minimum of two (2) Kill Switches to deactivate the Tractive System.

Please consult Part B.12.3.3 for the placement of the kill switches and Part B.12.3.4 for the installation instructions.

C.2.3. LV System Specific Criteria

i. All low-voltage (LV) components and their wiring harnesses must be organized in a tidy manner, placed within conduits, and secured with fasteners in accordance with the guidelines outlined in Part B.11. (Fasteners). LV components susceptible to moisture and dirt, such as microcontrollers and non-IP rated displays, should be enclosed within appropriately rated enclosures as defined in section C.5.3. These enclosures should feature suitable tool-less connectors and seals.
ii. When using jumper wires within the LV harness, the termination points must undergo soldering and sealing with glue or epoxy to provide insulation and protection.
iii. Any electrical connections within the current path that depend on screw-type connections must incorporate a robust locking mechanism as detailed in Part B.11. (Fasteners).

C.2.4. Signalling

C.2.4.1. Brake Light

Please consult Part B.12.4.1 and B.12.4.1.1 for details regarding the Brake Light criteria, specifications, attachment methods, and placement locations.

C.2.4.2. Reverse Light

Kindly refer to Part B.12.4.2 for information pertaining to the Reverse Light specifications, criteria, and designated positions.

C.2.4.3. Reverse Alarm

Please consult Part B.12.4.3. for details regarding the Reverse Alarm criteria, specifications, attachment methods, and placement locations.

C.2.5. Monitoring Systems (Instrumentation)

Kindly refer to Part B.12.5.

C.2.6. Data Acquisition

Kindly refer to Part B.12.6.

C.2.7. Communication Systems

Kindly refer to Part B.12.7.

Part C.3. The Tractive System (Powertrain)

C.3.1. E-Kit Specifications

i. The E-Kit includes all major components of the electric powertrain, such as the Tractive System Accumulator, BMS (Battery Management System), Motor(s), Motor Controller, and Tractive System Accumulator Charger, among others.
ii. The traction motor or motors may adopt various topologies and configurations as needed.
iii. The Tractive System Accumulator chemistry is restricted to Lithium-Ion-based formulations. The capacity shall not exceed 120 Ah, regardless of the number of packs or modules in use on the vehicle. The peak voltage (at 100% State of Charge) of the battery or batteries must not exceed 60 VDC. Similarly, the charging system should not exceed a charging voltage of 60 VDC.
iv. All E-Kit components (excluding the charger) must adhere to the International Electrotechnical Commission (IEC) 60529 IP67 standards, which relate to protection against dust and water ingress. This standard is essential to ensure the required level of protection against failures when the tractive system comes into contact with water.
v. Regeneration is both permitted and actively promoted.

- **ATVC INDIA does not bear the responsibility of supplying E-Kits to teams, whether they are new or established. However, ATVC can offer assistance to teams by guiding them on vendor details and any technical help related to procuring of the technical necessary components if needed. It is the team's duty to select and purchase components from the market or vendors in alignment with the ATVC INDIA 2024 Rulebook.**
- **In the event that any of the E-Kit components (excluding the charger) lack certification for compliance with the International Electrotechnical Commission (IEC) 60529 IP67 standard, it is solely the team's responsibility to ensure IP67 compliance. Teams should conduct testing in accordance with the standards and provide a declaration of compliance from their respective colleges to the ATVC committee.**

- **ATVC allows the use of E-Kit components from any supplier, as long as these components meet the applicable AIS (Automotive Electric Vehicle) standards. Certificates verifying compliance with these standards must be submitted to the ATVC Technical Team through ESF Part-1.**
- **It's important to note that only components approved by the ATVC Technical Committee are permitted for use by teams in constructing their vehicle's powertrain.**

C.3.2. Power and Voltage Restrictions

i. Exceeding the 60V limit in the tractive system is strictly prohibited and will result in disqualification from the entire event.

ii. The tractive system's maximum power output should not surpass 9kW at any given moment, whether measured between the battery/batteries' terminals or at the cumulative junction leading to the Motor Controller Unit (MCU) or Motor Controller Unit(s). Violating these power limits will result in disqualification from the entire event.

iii. To enforce these power limits, an EV-grade instant fuse or DC MCB (Miniature Circuit Breaker) must be used. This component should have a DC voltage rating equal to or greater than the tractive system voltage and a current rating as specified in the table below:

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

C.3.3. The Accelerator Pedal

The accelerator should be a foot pedal operated by the right foot, and it must be used to control the Traction Motor controller.

Upon release, the foot pedal must automatically return to its initial position. Additionally, the foot pedal should have definite stopping points at both extremes of its travel.

- **The Teams are strongly recommended to consider the utilization of a Hall effect type throttle pedal in conjunction with the regulations mentioned earlier.**

Part C.4. The Tractive System (ENERGY STORAGE and CHARGING)

C.4.1. The Battery Specifications

Kindly refer to the Part C.3.1. (E-Kit Specifications)

C.4.2. Tractive System Accumulator(s) - Basic Prerequisites

All Accumulators must adhere to AIS 156 standards. The battery pack responsible for storing energy for the tractive system will be integrated into Accumulator(s) segments and must be enclosed within electrically insulated Accumulator(s) container(s).

- **If authentic AIS 156 certification is not available, the following mandatory tests must be conducted on the accumulators:**

i. **Conduct a physical examination of the battery pack, including an assessment of the Battery Management System (BMS) safety features.**
ii. **Perform a vibration test.**
iii. **Verify the overcharge protection.**
iv. **Verify the over-temperature protection.**

- **For battery packs acquired for ATVC INDIA 2023 or earlier events that possess valid AIS 048/156 certificates, they will be eligible for participation in ATVC INDIA 2024 without the requirement of obtaining new authentic certificates.**

The accumulator container(s) must be positioned behind the firewall and remain readily accessible throughout the entire event to facilitate inspection and defect rectification.
The tractive system must incorporate a minimum of one AIR and one fuse. These components are designed to open the circuit and interrupt the energy flow from the accumulator(s) to the rest of the tractive system in the event of a fault detection.
The accumulator isolation relays must be of the Normally Open type and should serve to disconnect the accumulators from the high-voltage (HV) system. Additionally, the rating of the fuse safeguarding the accumulator tractive system circuit should be lower than the maximum current at which the isolation relays switch off.

- **Any modification or rework conducted on the battery pack(s) or accumulator(s) subsequent to their initial certification will result in the automatic revocation of their certification status, rendering it null and void.**

C.4.3. Tractive System Accumulator(s) Container

C.4.3.1. Electrical Configuration

i. The tractive system accumulator container must be constructed from an insulating material. If, by any chance, the container is made from an electrically conductive material, it is imperative that the accumulator container and its mounting structure are electrically insulated in all directions using appropriate material (meeting UL 94-V0 Grade standards). This insulation is crucial to prevent arc flashes resulting from contact with any other parts or tools. It is essential to note that air gaps are not considered suitable insulation material, and any conductive penetrations must be carefully managed.
ii. The practice of soldering to interconnect two individual cells in the high-current path is strictly forbidden.
iii. Soldering wires to cells to obtain voltage monitoring inputs for the BMS is permitted, as these wires are not part of the high-current path.
iv. All wires employed within an accumulator container must have a voltage rating that matches the maximum tractive system voltage, regardless of whether these wires are part of the low-voltage (LV) system or the tractive system. The voltage rating must be appropriate for both LV and tractive system applications.

- **The use of wood or rubber for constructing accumulator containers or as structural members is not allowed.**

C.4.3.2. Mechanical Configuration

i. Every accumulator container must be robust and securely affixed to the chassis to prevent any movement in any direction. If fastening methods are employed for attaching an accumulator container, they should adhere to the guidelines outlined in Part B.11. (Fasteners). The use of belts or ropes for supporting or securing the accumulator container is strictly forbidden.
ii. To shield the accumulator containers from side or rear impact collisions, they must incorporate structural members that meet the criteria defined in B.2.2.
iii. The accumulator container must be constructed from a mechanically robust material that is also fire-resistant. It is permissible to have holes, both internally and externally, in the container for purposes such as wiring harnesses, ventilation, and fasteners. However, any external openings must be meticulously sealed.
iv. If deemed necessary, a suitable cooling system should be designed to dissipate excess heat and maintain the tractive system accumulator at an optimal temperature, ensuring peak performance of the vehicle.

C.4.4. Accumulator Isolation Relay(s) (AIR)

i. Accumulator isolation relays must be installed to disconnect the accumulators from the tractive system, and these relays must be of the "Normally Open Type."

ii. The fuse safeguarding both the accumulator(s) and the tractive system circuit must be rated lower than the peak current of the isolation relays.

C.4.5. The Battery Management System (BMS)

i. The Battery Management System (BMS) must be powered by the Tractive System Accumulator and continuously monitor individual cells and the battery pack for parameters such as current consumption, temperature, voltage, etc. The BMS should have the capability to initiate a shutdown in the event of any abnormal behaviour.
ii. The BMS must include protections against Overvoltage, Under Voltage, overcurrent, and short-circuit incidents for each cell. If individual cells are directly connected in parallel, a single voltage measurement is sufficient.
iii. The BMS should not have the ability to activate the AIR when the Ignition or Kill Switch is in the off position.
iv. All the LV connections to the BMS, including connections to external devices like laptops, must be routed through a separate conduit.
v. The BMS should monitor cell temperatures, and if any temperature exceeds the allowable battery temperature specification, it should initiate a shutdown of the entire tractive system.
vi. In the event of a BMS failure or detection of power loss, the entire tractive system should be de-energized.
vii. The BMS must be securely fastened to withstand vibrations under dynamic conditions.
viii. Teams must take necessary precautions to prevent complete discharge of the Tractive System Accumulator(s) during periods of idleness or non-operation.

- **Teams are required to provide technical specifications for the BMS in use, along with wiring diagrams and accompanying images.**

C.4.6. Charger

i. The charger must not exceed a charging voltage of 60V.
ii. Chargers that have been presented, inspected, and sealed by the Electrical Technical Judge are permissible for use at the event site. All connections of the chargers must be properly isolated and covered, with no exposed connections allowed.
iii. It is mandatory for all chargers, including those constructed by the team, to meet high-quality standards and adhere to all electrical requirements specified for the vehicle's tractive system.
iv. The charger must feature an interlock mechanism that activates the connectors only when it is correctly connected to the accumulator.
v. Charging leads for the Tractive System Accumulator must be coloured orange.

vi. Throughout the accumulator charging process, the Battery Management System (BMS) must remain operational and capable of shutting off the charger in case of a detected fault.
vii. When charging the accumulator externally, only static equipment should be used.

- **Teams have the option to charge the Battery Pack using a standard AC power socket rated at 230V, 16A, which is provided within the pit area.**

C.4.6.1. Charging

i. Charging of the accumulators can take place either within or outside the vehicle. During the charging process, it is mandatory for at least one team member who is knowledgeable about the charging procedure to remain with the accumulators or the vehicle. Additionally, all accumulator containers must display a label containing the following information while charging:
   Team name and contact number(s) of the Electrical Head of the respective team.
ii. When the accumulator is undergoing charging within the vehicle, no work or maintenance activities are permitted on any of the vehicle's systems.
iii. Activities such as grinding, drilling, or similar processes are strictly prohibited in the charging area.
iv. The charging circuit may incorporate an external Kill Switch.
v. To deactivate the tractive system while the accumulator is charging, the vehicle's Kill Switch must be engaged, placing it in the off position.

Part C.5. The Tractive System and LV System (General Specifications and Management)

C.5.1. Location of Tractive System Components

All components within the tractive system, including cables and wiring, must be securely contained within the framework or an additional tubing enclosure meeting the specifications outlined in B.2.2 or equivalent standards. This safeguard ensures their protection in the event of a collision or rollover.

In cases where tractive system components are situated in a manner that makes them vulnerable to damage from a rear or side impact and are located less than 350mm from the ground, they must be shielded by a fully triangulated structure constructed from tubing with a minimum outer diameter of 25.4 mm and a minimum wall thickness of 1.25 mm, or an equivalent design as specified in B.2.2.

From both side and front perspectives, no part of the tractive system should extend below the lower surface of the frame.

C.5.2. Tractive System Firewall

The tractive system firewall must adhere to the primary firewall regulations outlined in B.5.3, which mandate the separation of the driver compartment from all tractive system elements. This firewall should be constructed using an electrically insulating material. In the event that the firewall is crafted from an electrically conductive material, it must be entirely covered with an electrically insulating material on all surfaces.

The firewall's role is to serve as an insulating barrier, ensuring complete separation between the driver and all tractive system components.

Moreover, the firewall must possess robust resistance against punctures, scratches, and fires. It should be fabricated from materials meeting the UL94-V0, FAR25, or an equivalent-grade standard.

C.5.3. Tractive System Enclosures

i. All enclosures utilized must be crafted from materials that meet or surpass the thermal and electrical insulation standards of UL94-V0/FAR25 or higher.

ii. There should be no conductive path or electrical connection between the vehicle's frame (or any other conductive surface that might come into accidental contact with a crew member or spectator) and any part of an electrical component within the tractive system, whether through fasteners, mounting brackets, or any other means. The application of insulating coatings to conductive fastener surfaces will not be considered an adequate method of isolation.

iii. Connectors and seals must be employed to guarantee protection against the ingress of foreign materials.

iv. In cases where fasteners are used for mounting purposes, they must adhere to the specifications outlined in Part B.11. (Fasteners).

v. All enclosures or housings containing components of the tractive system must be affixed with a sticker measuring 2.0" x 2.0". This sticker should display a red or black lightning bolt on a yellow background, or a red lightning bolt on a white background. Additionally, the sticker must include the text "High Voltage."

- **This sticker serves the purpose of indicating the voltage of the tractive system and providing a warning to users and bystanders.**

Image C-1: High Voltage Indication Stickers

C.5.4. The Tractive System (Particular Criteria)

i. Cables handling voltages exceeding the specified LV level must consist of multi-stranded copper with a single core, featuring HV class insulation. It is strongly recommended to use high-temperature silicone wires.

ii. All connections within the tractive system must be designed to establish intentional current pathways, employing conductors like copper or aluminium. The primary conductor should not be metallic bolts. Lugs must be securely and directly seated on one another, utilizing metallic washers and spring washers to ensure adequate contact pressure. For all high-current path electrical connections within the tractive system that rely on threaded connections, a robust locking mechanism as defined in Part B.11. (Fasteners) must be employed. These connections should not involve soft, compressible materials such as plastic or rubber spring washers in the assembly.

- **Extending Tractive System cables is not permissible. Only cables of a single length are acceptable, and no intermediate junctions or extensions should be utilized.**

C.5.5. Enabling the Tractive System

i. Ready to Drive Mode: Ensure the motor(s) respond to the torque encoder or accelerator pedal input.

ii. The driver should have the capability to (re)activate or reset the tractive system independently, without requiring assistance from anyone else. The only exception is when the Battery Management System (BMS) has deactivated the tractive system and the non-cockpit kill switch is engaged in the "off" position.

iii. To activate the tractive system, follow this sequence:

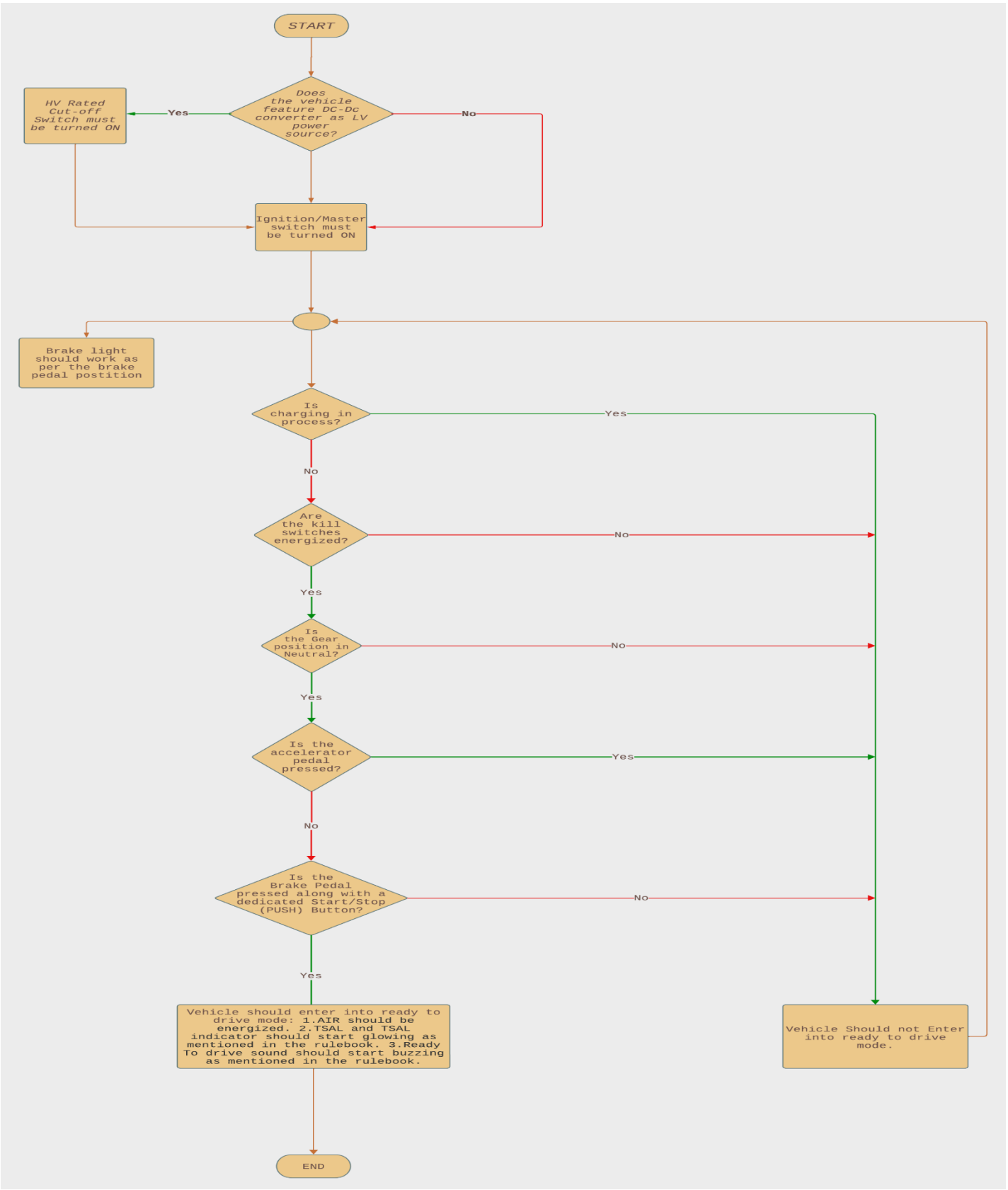


Image C-2: The Sequence for activating the Tractive System

- **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)

The TSAL must maintain a continuous flashing or blinking pattern when the vehicle is in "Ready to Drive Mode." The TSAL should be of a round beacon type, emitting an amber flashing light with a brightness exceeding 350 Lumens per unit, with a frequency between 2Hz and 5Hz. It must be conspicuously visible from all angles to a person standing up to 20 meters away from the vehicle, even in extremely bright sunlight.

Please consult the image below to see examples of TSALs that are permitted.

Image C-3: The only Permitted TSALs

C.5.6.1. Positioning and Installation

i. To guarantee visibility from all angles, the TSAL must be installed at the central position on top of the BLC.

ii. The TSAL must be securely affixed to the roll cage to safeguard it from potential damage in the event of a rollover. Teams have the freedom to decide how to attach the TSAL to the BLC member, as long as it ensures robust protection in case of a rollover. However, it is highly advisable for teams to employ a metal plate with a minimum thickness of 6 mm (0.23 in.). This metal plate should be welded onto the top of the BLC member, and the TSAL should be firmly secured to this welded base plate using screws or bolts.

iii. The TSAL must be enclosed on all sides by a protective cage to safeguard it in the event of a rollover. This cage should be designed in a way that permits the replacement of the TSAL when necessary. It is strictly forbidden to install or affix any other lights, objects, or stickers within a 100 mm (3.93 in.) distance from the TSAL.

iv. Within the driver's field of view in the cockpit, an indicator must be positioned to inform them of the "ready to drive" status of the vehicle. This indicator should consistently display

the status of the TSAL. Teams have the flexibility to select the size and brightness of the light, but it must always remain visible to the driver, even under bright sunlight conditions.

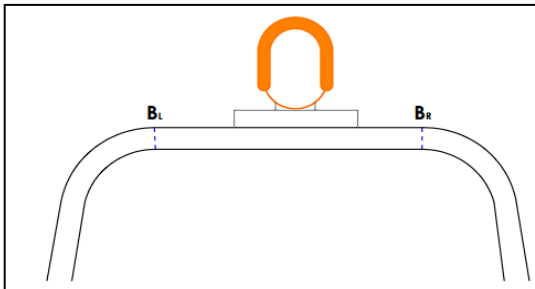


Image C-4: Positioning and Installation of the TSAL on BLC

- **If the TSAL experiences any malfunction or is not adequately visible during any dynamic event on the track, the vehicle will be issued a black flag and will be required to return to the pit area until the issue is rectified.**

C.5.7. Ready to Drive Sound (RTDS)

The vehicle is required to emit a distinctive sound, which should reach a minimum level of 70dB (fast weighting) within a 2-meter radius around the vehicle. This sound should occur just once, not continuously, for a duration of at least 1 second but no more than 3 seconds immediately after the vehicle is set in "ready to drive" mode each time.

The chosen sound type, typically a buzzer, must be easily identifiable but should not resemble animal noises, musical song fragments, or offensive sounds.

C.5.8. Driver Display

i. The dashboard must consistently display the Tractive System Accumulator Voltage, Temperature, and State of Charge (SOC in %) whenever the Ignition/Master Switch is turned ON. Teams have the freedom to choose any additional information displayed to the driver using the Data Acquisition system. Any systems providing data or information to the driver or the team for tracking must be included in the Cost Report. Furthermore, any batteries utilized to power Auxiliary/accessories must adhere to the battery rules in Part C.2.1.

ii. When the vehicle is in "ready to drive" mode, there must also be an indication to the driver regarding the state of both the LV and Tractive System. This indication can be achieved through a series of light indicators or messages in the driver display. Additional diagnostic and detection systems that can aid in identifying operational states are allowed and encouraged.

iii. Teams are strongly encouraged to log parameters such as current, voltage (RMS and DC), temperatures, throttle position, brake applications, motor speed, vehicle speed, and more. This data is essential for understanding its significance, conducting analysis, and enhancing system efficiency and design performance in subsequent events. There is considerable room for fine-tuning and optimizing race-driving strategies.

C.5.9. Tractive System Operation and Functioning

The following recommendations should be adhered to while team members are working at their institute or during their presence during the event:

i. The Electrical head will hold responsibility for all electrical work performed on the vehicle and must be present with the vehicle at all times during the event.

ii. Activities involving the Tractive System should occur within the pit area. If measurements or testing on the active Tractive System are necessary within the pit, the following steps must be followed:
   - Restrict access to the vehicle to team members involved in the work.
   - Elevate the vehicle using a jack.
   - Designate one team member to be prepared to activate a shutdown button if required.
   - Activate the Tractive System only for the duration necessary.
   - Ensure that those involved in the work wear appropriate personal protective equipment (PPE) and use the necessary tools.
   - No other work on the vehicle is allowed while the Tractive System is active.

iii. It is highly recommended to the teams to use insulated tools that comply with the 1000V VDE and IEC 60900 standards whenever work is conducted on the Accumulator(s) or the tractive system.

iv. All participating team members must wear safety glasses with side shields and HV safety gloves of CLASS 00 or better (meeting or exceeding ASTM D120 or EN 60903 standards) when:
   - Parts of the tractive system are exposed while it is active.
   - Work is being carried out on the Accumulator(s).

Part C.6. The Fundamental Criteria

i. All components within the LV and Tractive systems, especially live wires and contacts, must be shielded with non-conductive materials or covers to prevent physical contact. Proper insulation, following best engineering practices, is mandatory for LV and Tractive System Accumulator terminals and other Tractive system contact points.

ii. To safeguard LV and Tractive system components from moisture such as rain or splashes, they should be shielded using appropriately insulated harnesses, connectors, enclosures, and insulating caps.
iii. The use of duct tape and bubble wrap is not acceptable as a suitable means of IP protection.
iv. All wires, terminals, and conductors must be sized in accordance with the continuous current requirements. Wires should be marked with details such as wire gauge, temperature rating, and insulation voltage rating. Alternatively, a data sheet with specified wire characteristics for a serial number of wires printed on the wire is acceptable.
v. Zip ties are allowed solely for organizing and segregating wiring harnesses. Wiring must adhere to professional standards with appropriately sized conductors, lugs, and connectors, ensuring adequate strain relief and protection against loosening due to vibration, among other factors. Wiring paths should be planned to avoid sources of excessive heat, abrasion, chafing, and potential short circuits.
vi. The use of insulation tape or rubber-like paint for insulation purposes is strictly prohibited for both LV and Tractive System components, including their associated wiring harnesses, fasteners, and mountings.
vii. All connections must terminate with corrosion-proof copper/aluminium ring lugs. Teams are strongly encouraged to obtain a Lug Crimping kit that meets all required sizes and diameters. After crimping, exposed metal should be insulated using appropriately coloured heat shrink sleeves of suitable thickness and quality. Exposed conductive fasteners and washers must also be insulated with rubber caps. Coating conductive fastener surfaces with insulating materials is not considered suitable.
viii. Cables operating at voltages higher than LV must be coloured orange. All LV wires must be color-coded to differentiate between positive and negative current paths. Positive wires should have colours other than orange, while negative (grounding if applicable) wires should be black, with appropriately coloured shrink wrap, caps, and insulation materials.
ix. Any wiring harness passing through the driver's cockpit must be routed along the floor and the LFS member behind a panel or within an enclosed channel to ensure it does not interfere with the driver during ingress/egress or operation.
x. Components utilizing a heat sink must be mounted with at least 50 mm (1.96 in.) clearance from adjacent surfaces or components, excluding cooling fans, heat exchangers, cooling fluid interfaces, or cooling ducts. For example, the heat sink of the controller should not rest directly against the firewall or a mounting plate.
xi. All wiring must be shielded against damage from moving parts by using appropriately sized conduits following the designated colour code.
xii. All components within the tractive system must be rated for the maximum tractive system voltage.

xiii. The tractive system motor(s) must be connected to the Accumulator(s) through a motor controller (Traction Controller). Directly connecting the tractive batteries to the motor(s) and bypassing the control system is strictly prohibited.
xiv. The team must accurately document the complete layout of the electric circuit in the ESF.
xv. The Accumulator(s) Isolation Relays (AIRs) and the main fuse must be separated from the Accumulator(s) Container(s) by electrically insulated and fireproof material. The use of air gaps is not considered suitable insulation in this case.
xvi. Tractive system and LV circuits must be physically separated to avoid running them through the same conduit, except for interlock circuit connections.
xvii. Tractive system components must be securely mounted, ensuring both electrical insulation and fire resistance. Components and cables capable of movement must be properly restrained to maintain safe spacing.
xviii. The vehicle's electrical system must adhere to best engineering practices and electrical standards in its design and construction.

- **Sizing of conductors for the 'continuous current' should consider the maximum electrical current that will pass or be used for the expected duration.**

Part C.7. The Fuse

C.7.1. The Fuse Criteria

i. Each electrical system, including both LV and Tractive systems, must incorporate a fuse rated higher than the current rating of the respective electrical system. The current rating of a fuse should not exceed the peak current cut-off rating (i.e., the fuse current defined for the component by the manufacturer) of any electrical component it protects, such as wires, bus bars, cells, or other conductors. All fuses must be of the instant blow/trip type with a time delay of less than 500 milliseconds. Instant fuses must adhere to automotive fuse standards and possess suitable specifications and compliance.
ii. Furthermore, all fuses and fuse holders must meet automotive standards and should be rated for the highest voltage within the systems they protect. For DC applications, fuses must be specifically rated for DC and carry a DC rating equal to or greater than the system voltage.
iii. Each fuse must possess an interrupt current rating that exceeds the theoretical short-circuit current of the Tractive system it safeguards.
iv. In cases where multiple Tractive accumulators or LV batteries are employed, each parallel string must have its own individual fuse to protect all components within that string. This includes conductors, wires, bus bars, cells, and any other components carrying the total current for that string (inclusive of all parallel strings). The fuse should be appropriately

sized to handle the total current that the individual string could transmit. Alternatively, an additional fuse may be utilized to safeguard the conductors.

v. Accumulator cells equipped with internal over-current protection, provided they are suitably rated, can be used without the need for an external fuse or fusible links.

vi. DC MCBs (Miniature Circuit Breakers) of suitable automotive grade and resettable automotive thermal fuses may be utilized, as long as they meet the requirements as defined in Part C.7.1.

vii. The Tractive System Fuse / MCB must be positioned behind the firewall, close to the Accumulator, in a serviceable location that is easily accessible for inspection. Teams have the option to utilize fuses that can withstand the requirements for IP or encase them in appropriate housings with transparent lids or viewing panels.

viii. If the Tractive System Fuse / MCB is blown or tripped, teams will be required to leave the track and return to the pits. Once the fuse/MCB is reset or replaced under the supervision of a technical official, teams will be permitted to resume their activities.

Image C-5: Examples of Fuses

Part C.8. Grounding

C.8.1. Grounding Criteria

i. All electrically conductive parts of the vehicle, including driver harness mounting points, seat mounting points, and driver controls (excluding Tractive system components), that are located within 100mm (3.93 in.) of LV components, must exhibit a resistance below 300 mΩ (measured with a 1A current to LV system ground).

ii. Any parts of the vehicle that have the potential to become electrically conductive, such as fully coated metal parts or carbon fibre components, located within 100mm (3.93 in.) of any LV component, should maintain a resistance below 5 ohms to LV system ground.

iii. The electrical conductivity of any part that is likely to conduct electricity may be tested, such as the driver's harness attachment bolt. However, if there is no convenient conductive point available, an area of the coating may need to be removed.

- **Special measures, like using copper mesh or similar materials, may be necessary for carbon fibre parts to ensure the ground resistance remains below 5 ohms.**

iv. All Tractive system components, should exhibit very high contact resistance (i.e., resistance between the enclosure of Tractive system components and ground), exceeding 10 MΩ. The DC-DC Converter should be treated as a Tractive system component in accordance with this requirement.

Part C.9. The Accumulator(s) Swapping (Applicable for the Endurance Event Only)

C.9.1. The Secondary/Non-Primary Accumulator(s)

i. Teams may possess spare Tractive System Accumulator(s) referred to as Secondary/Non-Primary Accumulator(s). If available, these Secondary/Non-Primary Accumulator(s) can be used, provided they have been cleared through Technical Inspection, as per competition rules, to replace the primary tractive system Accumulator(s) during the endurance event. All Accumulators must be presented with a 100% State of Charge (SOC) during Technical Inspection and require approval by demonstrating the swapping process.
ii. The setup of the Secondary/Non-Primary Accumulator(s) must adhere to Part C.4.1. They should match the size, capacity, and specifications of the primary tractive system Accumulator(s) they are intended to replace. This includes using identical cells, Battery Management System (BMS), electrical wiring, and following the same mounting design.
iii. The Secondary/Non-Primary Accumulator(s) must be stored in an electrically insulated container constructed from fire-retardant material, in accordance with the Accumulator(s) Container guidelines outlined in Part C.4.2, C.4.3.1. and 4.3.2.

C.9.2. The Secondary/Non-Primary Accumulator Swapping Approach

i. Teams are permitted to opt for Battery Swapping only when the SOC falls below 50% during the Endurance race. However, teams can choose to perform Accumulator(s) Swapping as many times as they deem necessary during the Endurance race.
ii. For a team to be eligible for swapping during the endurance race, the Accumulator(s) must be easily accessible and removable from the vehicle. The team must demonstrate this accessibility during the Electrical Technical Inspection. Additionally, teams should have HV insulated tools and PPE to carry out the swapping process.
iii. Any actions that involve the removal, dismantling, or dislocation of the drivetrain components (such as the tractive powertrain, gearbox, transmission, differentials, drive axles, and wheels) or suspension struts, members, and mounts are strictly prohibited.

Swappable designs that compromise the mechanical structure, safety, or functionality will not be accepted.

iv. Prior to swapping, the Tractive system must be de-energized by activating the kill switch. The Negative terminal of the battery should be the first to be removed and insulated with caps, followed by removing the positive terminal.

v. When removing and installing the Accumulator(s) setup, extreme care must be taken to avoid interference with surrounding components throughout the entire process.

vi. The removal of the Accumulator(s) setup must adhere to the specific plane in which the setup is mounted. Please refer to image C-6 mentioned below for details:

- If the Accumulator(s) container is entirely situated below plane S-R, its removal is permitted only via a horizontal path through the side or rear of the vehicle below plane S-R. This means that no part of the Accumulator(s) container should be raised above plane S-R during the battery removal process.
- If the Accumulator(s) container is positioned either entirely or partially above the S-R plane, the path for removing the Accumulator(s) setup should be completely above plane S-R. This path of removal can involve both vertical and horizontal motion, but vertical movement of the Accumulator(s) exceeding 254 mm (10 in.) during the removal process is not allowed.

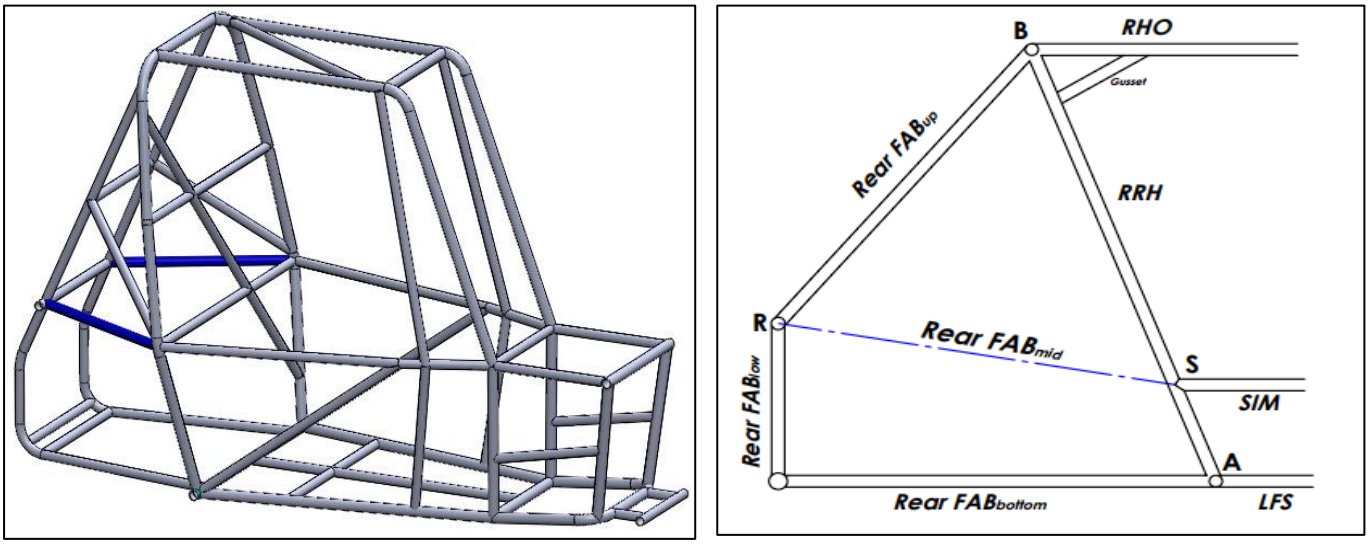


Image C-6: Reference Plane for Accumulator(s) removal

vii. Throughout the entire removal process, a minimum 2-inch clearance must be maintained from any roll cage member or vehicle component (excluding the Accumulator(s) mounting and removal mechanism). To facilitate easier Accumulator(s) Swapping and faster processes, the use of mechanisms and linkages is allowed. However, it must be ensured that the Accumulator(s) container remains rigidly connected and mechanically locked to prevent any movement during the normal operation of the vehicle, as specified in Part C.4.3.2.

viii. Teams should follow the same procedure for reinstalling the secondary/non-primary Accumulator(s) as they did during the removal process.
ix. When installing the Secondary/Non-primary Accumulator(s), the positive terminal should be connected first, followed by the negative terminal. During the Accumulator(s) Swapping process, one team member must be ready with an additional fire extinguisher, in addition to the one already presents in the vehicle.
x. At any given time, only four (4) individuals from a team, including the driver(s), are allowed within the Swappable Area.
xi. The time spent on swapping the Battery pack is considered an integral part of the Endurance Race. The driver cannot exit the vehicle or remove any safety gear while the Accumulator(s) Swapping process is underway. However, if a driver change becomes necessary, the registered second driver can take charge and continue in the endurance event, following the instructions provided in Part E.6.3.6. (Driver Change)

C.9.2.1. Driving in the Swappable Area

All vehicles must move at a walking pace while inside the Swappable Area and when entering or exiting this zone. Teams found exceeding the speed limit in the Swappable Area will incur a penalty.

- **Cars should not be pushed into the Swappable Area unless a driver is present and fully prepared to operate the vehicle, including wearing all the necessary safety equipment.**

C.9.2.2. The Secondary/Non-Primary Accumulator(s) Hand Trolley

i. Teams are required to utilize a manual cart for transporting the secondary Accumulator(s) within the competition site.
ii. While it is not mandatory, it is strongly recommended that the hand cart be equipped with sturdy terrain tires, each having a minimum diameter of 8 inches.
iii. The hand cart must be equipped with a mechanism or anchor designed to restrain the movement of the accumulator, even in the event of the hand cart tipping over or rolling.
iv. The internal surfaces of the hand cart must be constructed using materials that meet the UL94-V0/FAR25 standard or are equivalent in terms of thermal and electrical insulation properties. Similarly, the handle of the cart must also be insulated. Wood is not an acceptable material for construction.
v. The cart should feature an enclosed compartment in which the accumulator is securely housed and protected from dust, mist, and debris.
vi. It is the responsibility of the team to ensure that all members using the cart and participating in the swapping process adhere to proper glove and shoe requirements as defined in C.5.9.

❖ SECTION D: STATIC EVENTS (300 Points)

Part D.1. Scoring

Contest	Description	Credits
STATIC EVENTS	Design Assessment	150
	CAE Assessment	50
	Cost Assessment	50
	Business Plan Assessment	50
	Total	**300**

Part D.2. The Design Assessment (150 points)

D.2.1. Purpose and Outline

i. The primary purpose of the engineering design competition is to assess the engineering effort dedicated to the creation of the vehicle and its alignment with the market's objectives, as outlined in Program Background A.1.1 and Design Discipline A.1.3. Students will be evaluated based on their ability to establish design specifications and successfully adhere to them. This includes proficiency in computer-aided drafting, analysis, testing, development, manufacturability, serviceability, system integration, and the overall functionality of the vehicle.

ii. Judging will occur across various subsystems, including Vehicle Dynamics, Drivetrain, Powertrain, Roll Cage and Ergonomics. The winning team will be the one that demonstrates the most effective application of engineering principles to achieve the design objectives and exhibits a profound understanding of their design concept among its team members.

- **Teams should bear in mind that ATVC INDIA is fundamentally an engineering design competition. In the Engineering Design Event, teams are assessed primarily based on their design choices. Components and systems integrated into the design as finished products are not evaluated as independently student-designed units. Instead, their assessment focuses on the team's selection and effective application of these components.**

  For instance, teams that both design and manufacture their shocks receive evaluation not only on the shock design itself but also on how well they incorporate the shocks into the suspension system. In contrast, teams using commercially available shocks are assessed solely on their ability to select and properly integrate these shocks within the suspension system.

iii. The engineering design event comprises two components: a Design Evaluation and a Design Report, which will serve as an integral part of the design evaluation.

D.2.2. Design Report

D.2.2.1. Essential Submission

i. The assessment of your design will commence with the submission of a Design Report before the event. This Design Report will undergo scrutiny by the design judges who will ultimately evaluate both your team and your vehicle during the on-site Design Evaluation. The Design Report should include a concise overview of the vehicle, along with an examination of your team's design objectives, vehicle concepts, and an exploration of significant design features.

ii. It's important to note or describe the utilization of analysis and testing techniques such as FEA (Finite Element Analysis), part/system/vehicle testing, and so on. Any evidence of this analysis and supporting data should be brought to the competition and be made available upon request for review by the judges.

iii. The quality of the Design Report will play a crucial role in the judges' classification of teams into appropriate design groups.

iv. The design report file should adhere to the following naming convention: Vehicle Number_Institution Name (Full Name)_Competition_DesignReport.pdf
For instance, an example filename would be: Vehicle Number 001_XYZ University_ATVC 2024_DesignReport.pdf.
Please ensure that the file size does not exceed 25 megabytes. In the event that the video file exceeds this size limit, you should share it via Google Drive.

- **While the Design Report is a scored component and can be thought of as the "resume" of your car, its primary purpose is to prepare your Design Evaluation judges to view your design efforts in the most favourable light. Failure to effectively highlight your design achievements in the Design Report is likely to result in your design judges being less impressed by your accomplishments.**

D.2.2.2. Vehicle Drawings

The Design Report should incorporate a series of three (3) view drawings that depict the vehicle from the front, top, and side perspectives.

D.2.3. Modifications/Changes to the Design compared to the Original Design

Any alterations made to the vehicle's final design, in contrast to the initial design presented during the first design submission, must be recorded along with a valid rationale.
In cases where design changes are implemented to address issues identified during validation, a comprehensive analysis of the root causes of the failure and the theoretical basis behind the new design must be provided. This documentation, containing the

modified changes, should be appended to the design report as an addendum and submitted electronically in Adobe Acrobat Format (PDF).

This document should be a single file that encompasses text, drawings, and any optional content.

D.2.4. Design Specification Sheet

D.2.4.1. Essential Submission

You are required to submit a fully filled ATVC INDIA Design Spec Sheet. Please refrain from making any alterations or formatting changes to the template prior to submission.

The design judges acknowledge that final refinements and vehicle development may lead to slight variations in the figures compared to those of the completed vehicle. In cases where specifications are subject to tuning, it may be suitable to provide an anticipated range of values.

It's essential to emphasize that the Design Report and the Design Spec Sheet, although interconnected, are distinct documents and should be submitted as two (2) separate files.

The Design Spec Sheets should be electronically submitted in Microsoft Excel Format (*.xlsx file). It is imperative that the format of the Spec Sheet remains unchanged.

Just like the Design Report, the Design Spec Sheet file should adhere to the following naming convention: Vehicle Number_Institution Name (Full Name)_Competition_Design Specs.xlsx

For instance, an example filename would be: Vehicle Number 001_XYZ University_ATVC 2024_Specs.xlsx.

D.2.5. Design Comparison Specification (Only for Old Teams)

Teams with vehicles took part in the previous year's ATVC INDIA competitions must furnish a comparison, using forthcoming template provided by ATVC INDIA, that highlights the differences between their current design and the design from the previous year.

As an integral part of the design event, the judges will assess this comparison documentation. In cases where the judges determine that the design changes are either (A) not substantial, (B) lacking detailed analysis, or (C) inadequately documented, there may be a significant penalty of up to 100 points imposed on the design score.

D.2.6. Format for Document Submission

Document	Submission	File Type	Notations
Design Report	Mandatory	.pdf	Single File (Text, Drawings and optional content all are inclusive)

Design Specification Sheet	Mandatory	.xlsx	The format of the spec sheet must not be altered.
Design Comparison Sheet	Only for Returning Teams	.pdf	Single File (Text, Drawings and optional content all are inclusive)
DVP & R and DFMEA	Mandatory	.xlsx	The format of the DVP & R and DFMEA sheet must not be altered.

D.2.7. Document Submission Deadline

D.2.7.1. Design Report

The Engineering Design event documents must be submitted through the online platform on or before the specified submission deadline. Failure to meet this requirement will result in the team's disqualification from participating in the design event. Information regarding the deadline for submitting the design event documents and the submission procedure will be provided on the ATVC website. Teams are strongly advised to regularly check the website for updates concerning submission deadlines.

Once the Design Report is submitted, teams will receive an acknowledgment, which will be made available either on the competition website or sent via email. Teams should ensure they have a printed copy of this acknowledgment on hand during the competition as proof of their submission, in case any discrepancies arise.

- **The ATVC INDIA Organizing Committee reserves the right to apply penalties in the form of a deduction of points for late submissions or failure to submit the Design Report, at their discretion. If the Design Report is received more than five (5) days beyond the specified deadline, it will be treated as "Not Submitted," leading to an automatic withdrawal of your team from the Engineering Design Event.**
- **Please be aware that no requests from teams that fail to meet the submission deadline or submit late will be entertained under any circumstances. It is the team's responsibility to verify the time when the report is received by the organizers, and the submission time will be determined based on when the organizers receive the report.**
- **While it is not mandatory, teams are strongly encouraged to adhere to the guideline that the Design Report should not exceed eight (8) pages in total. This allocation should consist of no more than four (4) pages of text, three (3) pages dedicated to drawings, and one (1) optional page where teams can include additional content such as photos or graphs. All pages should conform to either the 81/2" x 11" or A4 size standard.**

This recommendation is made to facilitate the evaluation process, considering that the judges have to assess reports from a substantial number of teams simultaneously. Excessively detailed reports can pose challenges for both teams and judges in this regard.

D.2.8. Static Assessment

The design judges will assess the team's engineering endeavour by considering the information provided in the Design Report, the team's responses to the judges' inquiries, and potentially through an examination of their vehicle.

During the vehicle inspection, the judges will assess whether the design concepts align with the objectives set forth in the rules and whether they are suitable for their intended application.

The judges will assign scores based on the team's capacity to effectively elucidate the engineering and construction aspects of their vehicle.

D.2.9. On-Site Presentation

During the presentation, any team member present on the floor is eligible to respond to questions posed by the judges, regardless of whether they were a speaker during the initial presentation. For on-site events, it is advisable for teams to have a laptop computer, binders, or posters at their disposal to effectively convey their design work. Please note that projectors will not be permitted.

- **Teams must ensure that they bring three (3) colour copies of the design documents originally submitted to the Design Finals event on-site. Neglecting to provide these hard copies of the design documents during the Design Finals may lead to disqualification from the event.**
- **Furthermore, teams have the option to bring along any supplementary materials they deem necessary to enhance the presentation of their vehicle and the discussion of their development process. This can include photographs, drawings, plans, charts, posters, binders, example components, or other relevant materials. Teams may also use laptops or notebook computers to support their presentation with additional information. However, the use of projectors is not permitted.**
- **Additionally, teams are required to have their vehicle present during the presentation.**

Part D.3. The CAE Assessment (50 points)

D.3.1. Purpose and Outline

The primary objective of ATVC INDIA CAE Event is to challenge engineering students to apply advanced simulation and analysis tools to optimize the design and performance of off-road vehicles. By emphasizing innovation, efficiency, safety, interdisciplinary collaboration, and effective communication, it equips participants with essential CAE skills and prepares them for real-world engineering challenges in the automotive industry.

The CAE report is expected to provide comprehensive information for each analysis, including the purpose, methodology, modelling, pre-processing parameters, constraints, boundary conditions, solver configurations, and the resulting outcomes presented through contours, diagrams, plots, graphs, and more.

D.3.2. CAE Report

D.3.2.1. Essential Submission

The CAE evaluation process commences with the submission of a CAE Report prior to the event. This report will undergo scrutiny by CAE design judges, who will subsequently assess both the team and the vehicle during the on-site Design Evaluation.

The content of the CAE Report can encompass various analyses, including but not limited to Roll Cage (including Meshing, Analysis, and Justification), Static and Dynamic Analyses on the Roll Cage, Torsional Rigidity and Bending Stiffness Calculations related to the Roll Cage, Computational Fluid Dynamics Analysis (CFD), Multi-Body Dynamics Analysis (MBD), Thermal Analysis, and Analysis of Components fabricated by the team, along with Fatigue Analysis.

Teams are encouraged to provide detailed information for each analysis, including input parameters, boundary conditions, simulation methods, simulation results, and conclusions drawn from the simulations.

Additionally, teams should be prepared to present evidence of their analysis and provide backup data during the competition if requested by the judges. It is recommended that dedicated CAE software be used for conducting these analyses.

- **While it is not mandatory, teams are strongly encouraged to adhere to the guideline that the CAE Report should not exceed eight (10) pages in total. All pages should conform to either the 81/2" x 11" or A4 size standard. This recommendation is made to facilitate the evaluation process, considering that the judges have to assess reports from a substantial number of teams simultaneously. Excessively detailed reports can pose challenges for both teams and judges in this regard.**

D.3.2.2. Document Format

The CAE Report should be electronically submitted in Adobe Acrobat Format (PDF), and it must be a single, all-inclusive file containing text, drawings, and optional content. Please ensure that the design report file follows this naming convention: Vehicle Number_Institution Name (Full Name)_Competition_CAEReport. For instance, an illustrative filename would be: Vehicle Number 001_XYZ University_ATVC 2024_CAE Report.pdf. Please note that the file size should not exceed 5 megabytes.

D.3.3. Document Submission Deadline

The CAE event documents must be submitted through the online platform on or before the specified submission deadline. Failure to meet this requirement will result in the team's disqualification from participating in the design event. Information regarding the deadline for submitting the CAE event documents and the submission procedure will be provided on the ATVC website. Teams are strongly advised to regularly check the website for updates concerning submission deadlines.

Once the CAE Report is submitted, teams will receive an acknowledgment, which will be made available either on the competition website or sent via email. Teams should ensure they have a printed copy of this acknowledgment on hand during the competition as proof of their submission, in case any discrepancies arise.

- **The ATVC INDIA Organizing Committee reserves the right to apply penalties in the form of a deduction of points for late submissions or failure to submit the CAE Report, at their discretion. If the CAE Report is received more than five (5) days beyond the specified deadline, it will be treated as "Not Submitted," leading to an automatic withdrawal of your team from the CAE Event.**
- **Please be aware that no requests from teams that fail to meet the submission deadline or submit late will be entertained under any circumstances. It is the team's responsibility to verify the time when the report is received by the organizers, and the submission time will be determined based on when the organizers receive the report.**

D.3.4. Static Assessment

The addition of the final round in the CAE evaluation event aims to assess the team's comprehensive understanding of CAE analysis, optimization studies, and their practical application in designing a lightweight and robust vehicle.

During the vehicle inspection, the judges will assess whether the CAE concepts align with the objectives set forth in the rules and whether they are suitable for their intended application.

The judges will assign scores based on the team's capacity to effectively elucidate CAE aspects of their vehicle.

D.3.5. On-Site Presentation

During the presentation, any team member present on the floor is eligible to respond to questions posed by the judges, regardless of whether they were a speaker during the initial presentation. For on-site events, it is advisable for teams to have a laptop computer, binders, or posters at their disposal to effectively convey their design work. Please note that projectors will not be permitted.

- **Teams must bring A1 size posters for on-site evaluation, in addition to the hard copy of the CAE Report submitted online.**
- **Furthermore, teams have the option to bring along any supplementary materials they deem necessary to enhance the presentation of their vehicle and the discussion of their development process. This can include photographs, drawings, plans, charts, posters, binders, example components, or other relevant materials. Teams may also use laptops or notebook computers to support their presentation with additional information. However, the use of projectors is not permitted.**
- **Additionally, teams are required to have their vehicle present during the presentation.**

Part D.4. The Cost Assessment (50 points)

D.4.1. Purpose and Outline

Cost is undeniably a critical factor for any commercial entity. However, in this event, the focus is not solely on reporting the most efficient component cost in either the prototype or production phase. Instead, the emphasis is on how well the team comprehends the elements contributing to their component's cost and their ability to apply their knowledge of procurement and manufacturing techniques to optimize various aspects, including cost, labour, time, material utilization, and overhead expenses. The Cost Event comprises two interconnected sections:

i. **Cost Report:** The cost report serves as a comprehensive document that offers background information for validating the actual cost of the vehicle. It also provides an opportunity for teams to showcase any innovative design features or fabrication processes that are expected to yield significant cost savings.
ii. **Prototype Cost:** The prototype cost encompasses the real expenses incurred during the fabrication of the vehicle and its associated factors.

D.4.2. Cost Report

D.4.2.1. Essential Submission

The Cost Report consists of a maximum of two sections:

i. **Report Section -1: The Overview**

The overview section provides teams with the chance to highlight and briefly discuss any innovative design features or fabrication processes expected to yield substantial cost reductions. Teams can also use this section to provide explanations for any elements that might appear as discrepancies within the report. The overview section should not exceed four (4) pages and must be incorporated into the Cost Documentation PDF file.

ii. **Report Section – 2: The Cost Documentation**

In this section, you should provide supporting evidence such as copies of receipts, invoices, price tags, catalogue pages, online prices, or any other relevant documentation to validate the costs of components and materials for items exceeding Rs. 200 in cost. It's essential to emphasize that the cost documentation should reflect full retail prices in the Indian market. Please refrain from using foreign receipts or making purchases from discount platforms like Craig's List, eBay, or junkyards, as these are not permissible. The report is expected to be thorough, meticulously documented, truthful, and precise.

Prototype Cost:

The Costing Sheets

The central component of the report consists of a set of costing sheets, which should include a one-page summary sheet that breaks down into individual subsystems. Each subsystem should have its individual sub-assembly sheet (Form A). It's important to clarify that the Vehicle Assembly Labor cost accounts for the labour needed to assemble a subassembly onto the frame. Additionally, for all fabricated parts listed on the sub-assemblies' sheets (Form A), a Form B is required. Please note that the sub-system assembly time denotes the time required to assemble all the components within that assembly.

D.4.2.2. Cost Component Classifications

Teams are required to categorize specified items correctly within the designated component categories and subcategories; otherwise, these items will not be taken into consideration. For additional information on component categories, please refer to the Cost Template.

You can find comprehensive Cost Event guidelines on the **ATVC** website under the login section.

D.4.3. Format for Document Submission

Document	Submission	File Type
Cost Report	Mandatory	.xlsx/.xls
Cost Documentation and Cost Overview	Mandatory	.pdf

The cost report must be submitted in the Microsoft Excel format, either with the .xls extension (without macros) or .xlsx extension, utilizing the provided template accessible on the ATVC website.

It's essential to refrain from making any modifications to the document, including password protection and macro embedding, as doing so will result in a score of zero (0) points for the Cost section.

Additionally, a PDF file containing all the described cost documentation must be included. Ensure that the cost report file is named in the following format: Vehicle Number_Institution Name (Full Name)_Competition_Cost Report. For instance, an illustrative filename would be: Vehicle Number 001_XYZ University_ATVC 2024_Cost Report.pdf.

D.4.4. Document Submission Deadlines

D.4.4.1. The Cost Report

The Cost event documents must be submitted through the online platform on or before the specified submission deadline. Failure to meet this requirement will result in the team's disqualification from participating in the Cost event. Information regarding the deadline for submitting the Cost event documents and the submission procedure will be provided on the ATVC website. Teams are strongly advised to regularly check the website for updates concerning submission deadlines.

Once the Cost Report is submitted, teams will receive an acknowledgment, which will be made available either on the competition website or sent via email. Teams should ensure they have a printed copy of this acknowledgment on hand during the competition as proof of their submission, in case any discrepancies arise.

- **The ATVC INDIA Organizing Committee reserves the right to apply penalties in the form of a deduction of points for late submissions or failure to submit the Cost Report, at their discretion. If the Cost Report is received more than five (5) days beyond the specified deadline, it will be treated as "Not Submitted," leading to an automatic withdrawal of your team from the Cost Event.**
- **Please be aware that no requests from teams that fail to meet the submission deadline or submit late will be entertained under any circumstances. It is the team's responsibility to verify the time when the report is received by the organizers, and**

the submission time will be determined based on when the organizers receive the report.

D.4.5. Cost Rectification

The judges have the authority to adjust costs and/or fabrication time if they determine that the submitted figures are lower than the current market prices or time required for the item, source, or process in question. However, if the team's prices or time estimates are higher than what the judges expect, no corrections will be made. Any mathematical errors will incur penalties.

Reports that exhibit significant inaccuracies, are notably incomplete, or lack substantiated cost data may be rejected in their entirety, and scoring will reflect this. Teams are obligated to have their vehicle present for "On-site cost judging" at their scheduled appointment time. Failure to appear at the scheduled time will result in an automatic zero score for the event. If teams need to reschedule their appointment, this must be arranged before the commencement of the cost event evaluation.

D.4.6. Static Assessment

The cost evaluation judges will assess the team's overall cost, any adjustments made, and the extent of effort invested in optimizing the vehicle's cost while employing suitable pricing for different vehicle components.

D.4.7. On-Site Presentation

The on-site presentation is to assess the precision of the team's documentation and to review any modifications made to the prototype cost, if applicable, following the fabrication of their vehicle.

During the presentation, any team member present on the floor is eligible to respond to questions posed by the judges, regardless of whether they were a speaker during the initial presentation. For on-site events, it is advisable for teams to have a laptop computer, binders, or posters at their disposal to effectively convey their design work. Please note that projectors will not be permitted.

- **It is mandatory for teams to provide a physical copy of their cost report to the cost judges during the on-site evaluation. Teams that do not furnish a hard copy at the event will be assigned a score of zero (0) for their cost evaluation.**
- **Furthermore, teams have the option to bring along any supplementary materials they deem necessary to enhance the presentation of their vehicle and the discussion of their development process. This can include photographs, drawings, plans, charts, posters, binders, example components, or other relevant materials. Teams may also**

- **use laptops or notebook computers to support their presentation with additional information. However, the use of projectors is not permitted.**
- **The cost summary sheet must be officially verified and certified by the Team Faculty Advisor.**
- **Additionally, teams are required to have their vehicle present during the presentation.**

D.4.8. Cost Modification Form

The purpose of the cost modification form is to introduce additions to a previously submitted report. While items can be added, it's important to note that the adjustments for individual component categories must always result in a positive increase in cost; cost deductions are not permitted. This allows teams to include items that were not initially planned but should not be used as an opportunity to completely overhaul the entire report. Crucially, the total adjustments made should not surpass 10% of the total cost of the previously submitted vehicle. If the adjustment exceeds this threshold, the additional amount will be multiplied by a factor of 3 (3x). If the adjustment surpasses 25%, the report will be considered incomplete and will not receive a grade. Teams are required to bring a hard copy of the Cost Modification Form during the Cost Event.

D.4.9. Cost Entitlement

After a thorough examination of the data, the cost evaluation judge retains the authority to disqualify cost reports that lack sufficient validation, which may arise from inadequate documentation or the use of outdated receipts. In such cases, the cost report may be deemed as incomplete (following the review process) or as significantly deviating from a reasonable cost range in comparison to other vehicles in the competition, whether excessively high or exceptionally low.

Part D.5. The Business Plan Assessment (50 points)

D.5.1. Purpose and Outline

The Business Presentation Event offers students a valuable opportunity to gain practical experience in presenting a conceptual proposal for support, whether it's for funding or other forms of backing. This skill is crucial, as all students will eventually need to transition their concepts from the drawing board to boardroom discussions for approval, often competing with other entities in the process.

The Business Presentation event assesses the team's capacity to construct and present a comprehensive case, encompassing aspects of business, logistics, production, or technical aspects, with the aim of persuading external parties to invest in the team's concept.

The goal of the Presentation is for the team to persuade a panel of "executives" from a hypothetical manufacturing company to invest in and put into production the team's ATVC vehicle design at a rate of 2000 units per year. For the presentation, teams should approach the judges with the understanding that there are two distinct groups they need to address:
Group 1 - Potential Buyers
Group 2 - Investors (who need assurance that the factory established by the teams will yield a profit)

D.5.2. Business Plan Presentation

D.5.2.1. Essential Submission

The Business Plan evaluation process commences with the submission of a Business Plan Presentation prior to the event. This presentation will undergo scrutiny by the judges, who will subsequently assess both the team and the vehicle during the on-site Evaluation.

D.5.2.2. Presentation Format

A maximum of four (4) team members are permitted to deliver the presentation to the judges.

D.5.2.2.1. Stipulated Time for Presentation

Presentation: 10 minutes
Q&A: 15 minutes
You can access the Sales presentation guidelines and template through the ATVC website's login panel.

- **The ATVC INDIA Organizing Committee reserves the right to apply penalties in the form of a deduction of points for late submissions or failure to submit the Business Plan Presentation, at their discretion. If the Business Plan Presentation is received more than five (5) days beyond the specified deadline, it will be treated as "Not Submitted," leading to an automatic withdrawal of your team from the Business Plan Presentation.**
- **Please be aware that no requests from teams that fail to meet the submission deadline or submit late will be entertained under any circumstances. It is the team's responsibility to verify the time when the report is received by the organizers, and the submission time will be determined based on when the organizers receive the report.**
- **Any team member present on the presentation floor or stage is eligible to respond to the questions posed by the judges.**

D.5.3. Static Assessment

This event aims to foster an entrepreneurial mindset among students in relation to the production of their ATVs. By amalgamating a comprehensive presentation encompassing the non-technical dimensions of a business plan with their technical knowledge and hypotheses, it establishes an immersive and experimental platform. This competition tests students in various areas, including their presentation abilities, creative thinking, managerial outlook, and their understanding of essential business elements such as forecasting, financing, marketing, and management, among other aspects.

D.5.4. On-Site Presentation

Teams must have their presentation prepared on a laptop and bring a "Clean & Formatted" pen drive with them. Please note that there will be no provision for laptops or projectors on-site. Students should ensure that their laptops are fully charged and that their presentation is loaded and ready in accordance with their scheduled sales evaluation slot.

- **The teams have the option to bring along any supplementary materials they deem necessary to enhance the presentation of their vehicle and the discussion of their development process. This can include photographs, drawings, plans, charts, posters, binders, example components, or other relevant materials. Teams may also use laptops or notebook computers to support their presentation with additional information.**
- **Additionally, teams are required to have their vehicle present during the presentation.**

D.5.5. The Business Plan Presentation – Scoring

The presentation event will be evaluated based on five key categories:

i. Presentation Content, encompassing company financials and break-even analysis.
ii. Presentation organization, effectiveness, and the team's responses to Judges' questions.
iii. Coverage of Unique Selling Proposition (USP), including market research, analysis, and SWOT assessment.
iv. Marketing Strategy.
v. Project Schedule, which includes timelines, project execution, capital requirements, and materials.

- **The team that delivers the most outstanding presentation will be awarded the highest score, irrespective of the finished quality of their actual vehicle.**

❖ SECTION E: DYNAMIC EVENTS (700 Points)

The dynamic events are designed to assess the performance of ATVC vehicles in diverse conditions.

- **It's important to acknowledge that organizers may make adjustments to the dynamic events based on factors such as local conditions, weather, or available resources.**

Part E.1. Scoring

Contest	Description	Credits
DYNAMIC EVENTS	Acceleration	50
	Manoeuvrability	150
	Suspension and Traction	100
	Endurance Race	400
	Total	**700**

Part E.2. Practice

E.2.1. Purpose

Organizers have the option to furnish teams with a practice track. This practice track enables teams to experiment with and fine-tune their vehicles while adhering to the established rules and regulations.

E.2.2. The Track

The organizer has the authority to determine both the duration of the course and the characteristics of the practice track if they choose to offer one.

E.2.3. The Process

Following a safety inspection, vehicles receive a signal to access the practice track. Subsequently, after a specific duration determined by the track worker, the vehicle is signalled to depart from the practice track.

E.2.4. Forfeit

If the track worker or competition officials observe unsafe conditions or behaviours, teams may receive a signal to leave the practice track or be denied access to it.

E.2.5. Scoring

No scores are awarded for any type of practice.

Part E.3. Acceleration (50 Points)

E.3.1. Purpose

The purpose of the Acceleration Event is to assess how rapidly each vehicle can reach its maximum speed starting from a standstill.

E.3.2. The Track

The measurement of acceleration involves the time it takes to traverse a flat, straight course of either 30.48 meters (100 feet) or 45.72 meters (150 feet) from a stationary position. The surface of the course can range from pavement to lose dirt, and the organizer has the authority to determine both the course length and surface type.

E.3.3. The Process

Following a safety inspection, vehicles are lined up at the starting line of the course. A track worker ensures the driver is prepared to start, and once ready, signals the driver to begin the run down the course. Upon completing the run, the vehicle is directed to exit the course. Each vehicle is allowed a maximum of two (2) runs on the course.

E.3.4. Forfeit

Stall At Start – Run DQ
False Start – Run DQ
Driving off Course – Run DQ
The organizer reserves the right to adjust these penalties to accommodate variations in the length or layout of specific event courses.

E.3.5. Scoring

The Acceleration event can earn a maximum of 50 points. The scoring will take into account the better of the two attempts. Timing will be conducted using an electronic timing system. The following formula will determine the acceleration score (S_{ac}):

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

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
1.5 times t_{min}

If a vehicle's acceleration time is more than 1.5 times the fastest vehicle's time, they will not be awarded a score for this event. Teams that attempt the event but go beyond the set time limit will be labelled as having "Excess Time."

Part E.4. Manoeuvrability (150 Points)

E.4.1. Purpose

Manoeuvrability is intended to evaluate how agile and well a vehicle handles itself in off-road conditions. Teams will aim to navigate the course as swiftly as possible.

E.4.2. The Track

The course, as determined by the organizer, can encompass a range of obstacles. These obstacles may include sharp turns, navigating around pylons, traversing ruts and bumps, encountering drop-offs, manoeuvring through sand and rocks, crossing gullies, negotiating logs, and ascending inclines.

E.4.3. The Process

Following a safety inspection, vehicles are placed at the starting line of the course. A track worker verifies the driver's readiness to commence. Upon confirmation, the track worker signals the driver to proceed along the course. After completing the run on the course, the vehicle will receive guidance to exit the course. Each vehicle is allowed a maximum of two (2) tries on the course.

E.4.4. Forfeit

The organizer will designate specific penalty types for different rule violations, taking into account variations in the length or design of individual event courses. Penalties entail adding extra time to the total duration a vehicle takes to complete a run on the course. The organizer will communicate penalty details either through their event website or during a mandatory team meeting.

Here are some example penalties:

Moving a Pylon or Obstacle: Adds 2 seconds to the time.

Missing a Gate: Incurs a 10-second penalty. (Missing a gate is defined as having 2 or more wheels outside the course.)

Excessive Driving Off Course + "Run DNF" (Did Not Finish). (Excessive driving off the course refers to a situation where any one wheel of the vehicle extends beyond the boundary line of the course for a significant distance. The exact distance will be determined by the course captain.)

False Start: For the first occurrence, the vehicle will have a rerun at the end of the line. For the second occurrence, the run will be designated as "Run DNS" (Did Not Start).

- **Teams should be aware that, for the manoeuvrability event, penalties and their types are subject to the judgment of the Dynamic Event Team. The provided examples are for reference purposes only. The definitive penalties will either be conveyed to the teams or posted at the event site.**

E.4.5. Scoring

The maximum available points for the manoeuvrability event stand at 150 points. Scoring will depend on the best performance out of two attempts. Only vehicles completing the manoeuvrability course within a time not exceeding 2.5 times that of the fastest vehicle will be eligible for scoring. If a vehicle surpasses this 2.5 times limit during its run, the attempt may be terminated, and the vehicle could be removed from the course, with a score of "Excess Time" awarded.

The manoeuvrability score (S_{man}) is determined based on the time taken by the vehicle to finish the course. Penalties are added to the vehicle's time for a given run.

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

$$S_{man} = 150 \times \frac{t_{max} - t_{run}}{t_{max} - t_{min}}$$

Where,

t_{min} represents the shortest (quickest) time recorded by any vehicle.

T_{run} denotes the time recorded for a vehicle's run that is being scored.

t_{max} is determined as the minimum of the following two values:

The longest (slowest) time recorded by any vehicle or

2.5 times the value of t_{min}.

Part E.5. Suspension and Traction (100 Points)

E.5.1. Purpose

The Suspension and Traction events in ATVC INDIA serve to assess the off-road performance, durability, and safety of student-designed all-terrain vehicles (ATVs). These events simulate rugged, real-world off-road conditions to validate design choices, identify weaknesses, and ensure the vehicle can handle rough terrain. They are essential components of the competition, providing practical learning experiences and contributing to the overall scoring and ranking of teams, ultimately promoting innovation and engineering excellence among participating students.

E.5.2. The Track

The layout of the suspension and traction events is determined by the event head. However, to familiarize teams with the event, detailed information will be provided to them on the opening day of the competition.

E.5.3. The Process

Following a safety inspection, vehicles are placed at the starting line of the course. A track worker ensures that the driver is prepared to start. Once the driver is ready, the track worker signals the driver to commence the run down the course. Upon finishing the run, the vehicle will receive guidance to exit the course. Each vehicle is allowed a maximum of two (2) tries on the course.

E.5.4. Forfeit

The event head has the authority to determine penalties for the Suspension and Traction events. Nonetheless, prior to team participation in the event, the penalty rules will be prominently displayed at the event site. This allows teams to plan and strategize accordingly based on the provided penalty guidelines.

E.5.5. Scoring

The scoring system and penalties determined by the event head must align with the Manoeuvrability event. While the maximum available points for the S & T event are set at 100 points, guidelines similar to those of the Manoeuvrability event will be provided to teams to ensure clarity regarding the scoring process for S & T events.

Part E.6. The Endurance Race (400 Points)

E.6.1. Purpose

The endurance event evaluates how well each vehicle can operate without interruption at high speeds over challenging terrain, which may include obstacles and unfavourable weather conditions such as rain, etc. The endurance event can be based on either time or distance. By default, it lasts for a duration of four (4) hours, and the vehicle that completes the most laps or orbits around the course within that time frame is declared the winner.

E.6.2. The Track

The endurance course is a circuit that is roughly 1.5 km to 4.5 km in length, forming a closed loop. This course may incorporate diverse surfaces like dirt, grass, sand, mud, gravel, stone, and asphalt. Throughout the endurance course, a variety of obstacles and terrain challenges are incorporated to evaluate the vehicle's durability, traction, and speed.

E.6.3. The Process

E.6.3.1. Pre – Staging

Teams will gather in a pre-staging area before the endurance event, and their starting positions will be determined by their performance in a preceding dynamic event or a series of dynamic events, as specified by the organizer. The pre-staging process will conclude at a predetermined time set by the organizer. Teams that arrive late for pre-staging will be assembled in the pit exit lane and allowed to enter the track after the race has commenced.

E.6.3.2. Compliance Check

Before the start of the race, either during the pre-staging phase or after it has concluded, combustion vehicles will have their engines started, while electric vehicles should be in "Ready to Drive" mode. At this time, a Technical Inspector will conduct a compliance check. Throughout the compliance check and staging, only one team member is permitted to accompany the driver and vehicle.

The compliance check encompasses various inspections, including but not limited to the following:

i. Verification of helmet certification
ii. Checking the fit and securement of helmets
iii. Ensuring the safety harness is in order
iv. Confirming the driver's equipment is appropriate
v. Checking the driver's wristband
vi. Verifying the presence and condition of a fire extinguisher
vii. Inspecting the functionality of kill switches
viii. Assessing the brake system
ix. Verifying the e-KIT, including the fuse (for Electric Type vehicles only)

Drivers who are unprepared or have vehicles that do not comply with safety standards or are not ready to drive will be instructed to exit the staging line by Technical Inspectors. They will be directed to the paddocks to address any necessary corrections. Vehicles that are not ready to drive must proceed to the pit exit lane for admission to the track.

E.6.3.3. The Staging

Upon the conclusion of the compliance check, vehicles proceed to organize themselves for staging and approach the start line under the guidance of track workers or Technical Inspectors.

E.6.3.4. Starting

The endurance event can commence using one of three methods: a funnel start, a standing staggered start, or a rolling start. A funnel start involves arranging cars in a conical formation and releasing them all together. A standing staggered start releases cars in pairs with a time delay between each pair. A rolling start allows vehicles a run-in distance to the

start line and may take place on the course. The choice of start type will be made by the organizer.

Regardless of their actual position in the staging area, all vehicles will be considered to have officially begun the race simultaneously at the moment when the starter releases the first vehicle onto the course.

E.6.3.5. The Format

The endurance event can take one of the following formats:

i. A continuous single race lasting four (4) hours.
ii. A race covering a predetermined distance that has been published in advance.

For the event involving elimination heats leading to a final, the total duration, including one elimination heat and the final, will be limited to 4 hours in total. The specific event structure will be communicated by the organizer before the start.

During the event, vehicles will traverse the course safely, accumulating laps (orbits) that will be counted and used for scoring.

E.6.3.6. Driver Change

Throughout the duration of the endurance race, in the event that a driver change becomes necessary, the vehicle may be directed to either the race pit or the fuelling station (for combustion vehicles), or to the Accumulator(s) Swapping area (for electric vehicles) as per provided instructions. In these designated areas, the second registered driver can assume control of the vehicle and continue participating in the endurance event.

It's important to note that the organizer retains the authority to mandate at least one driver change during the course of the endurance event.

E.6.3.7. Refuelling (Combustion Vehicles Only)

E.6.3.7.1. Location

The Fuelling Zone (FZ) comprises several designated areas: the Fuelling Area (FA), Fuel Quarantine Area (FQ), Crew Area (CA), and Harness Check Area (HC).

At any given time, a maximum of three (3) individuals from a single team, including drivers, are permitted to be present within the Fuelling Zone (FZ).

The actual process of refuelling takes place in the Fuelling Area (FA), while any unused stored fuel is kept in the Fuel Quarantine Area (FQ). After refuelling or necessary checks, vehicles and drivers must proceed to the Harness Check Area (HC) before returning to the track.

E.6.3.7.2. The Process

Vehicles that require refuelling will exit the track at the designated location and proceed at a walking pace to reach the fuelling area.

Before the refuelling process begins, the vehicle must come to a complete stop, the engine must be turned off, and the driver must exit the vehicle entirely. The driver should not be tethered in any way, whether by a harness, communication equipment, or clothing.
Prior to initiating refuelling, a pit crew member from the team must be prepared with a fire extinguisher in hand, aimed at the fuel transfer point on the vehicle. Only the exiting driver is allowed to remove the fuel tank cap.
Any team that starts refuelling while the driver is still near the vehicle or fails to have a fire extinguisher ready and directed at the fuel transfer point will be subject to penalties.
The fuelling area should be kept clear of anyone who is not directly involved in servicing a vehicle.
It's important to note that a fire extinguisher must be present and directed at any point where fuel is being transferred, including when refilling a smaller container from a larger one when a vehicle is not present.

E.6.3.7.3. Operating in the Fuel Area

All vehicles must move at a walking pace when within the Fuelling Area and when entering or exiting this zone. Teams found exceeding the prescribed speed limit in the fuelling area will face penalties.
Cars are not allowed to be pushed into the Fuelling Area (FA) unless a driver is present and fully prepared to operate the vehicle, including wearing all required safety equipment.

E.6.3.7.4. Fuel Containers

Teams are strictly prohibited from bringing their own fuel to the event. The event organizers will supply the fuel, and it will be available in a specially designated fuel bunk. Fuelling activities are exclusively allowed within the designated Fuelling Zone (FZ) area.
Any team discovered with fuel in the paddocks during the event will face disqualification from participating in any ongoing or upcoming events, and any points accrued up to that point will be nullified.

E.6.3.7.5. Mending in the Fuel Area

Performing any work that necessitates the use of tools is strictly prohibited within the Fuelling Area. However, teams are permitted to make adjustments that do not require any tools. These adjustments may include modifying the driver's harness, seat position, spring-damper preload, and similar tasks.
It's important to note that the Fuelling Area has specific restrictions in place. The use of tools, backpacks, wagons, extra driver equipment, and coolers is explicitly forbidden within this area. While additional driver equipment may be brought to the Fuelling Area for immediate use, it should not be stored within the Fuelling Area.

E.6.3.8. The Accumulator Swapping (Only for Electric Type)

Refer to Part C.9. (The Accumulator Swapping)

E.6.3.8.1. The Swapping Area (SA)

Teams will receive information about the specific location designated for Accumulator swapping prior to the start of the Endurance event. To facilitate swapping, the team should transport a spare battery pack (certified for swapping and sealed by a Technical Inspection member) to the swapping area using a handcart before the event commences. The seal number on the sticker affixed to the secondary accumulator will undergo cross-verification by a Technical Inspection member.

In the swapping area, in addition to the driver, two team members are permitted to engage in the battery swapping process. Upon the vehicle's arrival at the area, verification will take place, including checks of the sticker on the vehicle and the SOC % before granting access to the swapping area. Activation of the kill switch must occur before the team can proceed with the battery pack replacement.

- **If the SOC is greater than 50%, or if there is any evidence of tampering with the seal on the secondary accumulator, teams will be prohibited from proceeding with the swapping process.**
- **If any malpractices or unsafe actions are observed during the swapping process, the vehicle will be flagged as black, indicating a violation of rules or safety protocols.**

Once the spare accumulator is successfully installed, a safety check will be conducted to verify the functionality of the TSAL(S) before allowing the vehicle to rejoin the Endurance event. In the event of a failure in SOC update or TSAL(S) functionality, the team will be disqualified from the race and directed back to the pits.

E.6.3.8.2. Mending in the Swapping Area

Within the Swapping area, no tasks that require tools other than Accumulator Swapping are permitted. Teams may only make adjustments (after completing the battery swapping) that do not necessitate the use of tools. Examples of such adjustments include modifications to the driver's harness, seat position, spring-damper preload, and similar tasks. It's important to note that the driver should not be seated inside the vehicle during the swapping procedure.

E.6.3.9. Maintenance

E.6.3.9.1. Remote Pit

The organizers have the option to establish a distant pit area for the endurance event. This remote pit will be available for addressing minor repairs and adjustments needed by vehicles, conveniently situated near the endurance track.

E.6.3.9.2. Paddocks

Teams with vehicles in need of servicing and repairs should exit the track at the specified location and move at a walking pace to their designated paddocks. It's important to note that no repairs are allowed on the track at any point during the event.

E.6.3.10. Retrieval

Malfunctioned vehicles on the endurance course can be retrieved either by track workers or designated recovery teams. Track workers will initially attempt to aid the malfunctioned vehicles, and it's the driver's responsibility to assist and cooperate with course marshals in the removal process. Drivers should not exit the vehicle to start the engine. Instead, they must remain seated and securely fastened inside the vehicle before track workers attempt to restart the engine.

In cases where track workers are unable to assist a malfunctioned vehicle, a recovery crew will transport the malfunctioned vehicle to the paddocks. During this towing process, drivers inside the disabled vehicle are required to stay seated and properly secured with all safety equipment in place.

- **It's important to note that recovery crews operate on a "first come, first serve" basis, and no preferential treatment will be given to any team over another.**

E.6.3.11. Conclusion of the Event

The Endurance event concludes when the leading car crosses the finish line either after reaching the time limit or the designated distance. Vehicles that are still on the track at this point will be permitted to finish their current lap. However, vehicles located in the fuel zone or Accumulator(s) Swapping area will not be allowed to return to the track after this point. Upon crossing the finish line, track workers will guide vehicles to either the paddocks or, if necessary, the impound area. All movement of vehicles after the event must proceed at a walking pace.

E.6.3.12. Impound

The organizers maintain the authority to confiscate and examine any vehicle during or following the endurance event. Technical Inspectors will provide guidance and instructions to teams in impound regarding the necessary steps.

For combustion vehicle teams, it may be necessary to relinquish their engine for inspection.

E.6.4. Forfeit

Event co-ordinators have exclusive authority to declare and evaluate penalties throughout the endurance event. These event captains are strategically positioned across the endurance course during the event. Penalties during the endurance race will be indicated, and vehicles will be directed to leave the track from the designated black flag area. Event

co-ordinators possess the discretion to halt any vehicle at any moment if they suspect it no longer adheres to the stipulated rules and regulations.

It's important to note that all timed penalties are enforced from the moment the vehicle enters the black flag area. Therefore, the time spent being towed back to the pits is not counted towards the penalty duration.

E.6.4.1. Endurance Penalty Table

Violation Category	Breach	1st Penalty	2nd Penalty	3rd Penalty
Fuel	Possession of Fuel	DQ	-	-
Fuel	On-track refuelling	DQ	-	-
Fuel	Use of tools on the vehicle within the fuel area	Warning	10 minutes	DQ
Fuel	Exceeding the limit of 3 individuals in the fuel area	Warning	10 minutes	DQ
Fuel	Fuelling with the driver inside the vehicle	30 minutes	DQ	
Fuel	Failure to have a ready fire extinguisher during fuelling	10 minutes	20 minutes	DQ
Fuel	Running out of fuel on the track	5 minutes	5 minutes	5 minutes
Battery Swap	On-track swapping	DQ	-	-
Battery Swap	Exceeding the 3-person limit (including the driver) in the swapping area	Warning	10 minutes	DQ
Driving	Vehicle Roll Over	-	Warning	DQ
Driving	Passing during a yellow flag	Warning	Discretionary	Discretionary
Driving	Failure to heed the black flag signal	10 minutes	Discretionary	Discretionary
Driving	Deviating from the course and advancing	5 minutes	Discretionary	Discretionary
Driving	Aggressive Driving	10 minutes	DQ	-
Driving	Speeding within the pits or paddocks	5 minutes	20 minutes	DQ
Driving	Presence of a team member on the track	50 Points		

The penalties displayed in the table are subject to the organizer's discretion.

E.6.5. Driver Gear

Any driver who is not utilizing all of the approved and mandatory drivers' gear will be signalled or flagged for non-compliance.

E.6.5.1. Mechanical Issues

Every vehicle must maintain its as-approved condition to be eligible for competition. Any condition that is found not to meet this requirement will be flagged for the necessary repairs or adjustments. If a vehicle is halted by officials due to a mechanical fault, the fault must be rectified before the vehicle is permitted to re-enter the event.

E.6.5.2. Vehicle Aid

Specific sections of the endurance course have been recognized as challenging obstacles. In the event that a vehicle receives assistance two times while tackling the same obstacle, it may receive a black flag, and the driver will be cautioned that an additional assist will lead to the vehicle being withdrawn for the remainder of the event.

E.6.5.3. Roll-Over

If a vehicle experiences two rollovers, whether they are end-over-end or on its side, at any point on the track, it will receive a black flag. The driver will be cautioned that another rollover will lead to the vehicle's removal from the event. The determination of rollovers will be made by the Event Co-ordinators, and any vehicle that undergoes a rollover must undergo inspection by the Technical Inspectors before being allowed back on the track.

E.6.6. Scoring

The highest attainable score for the endurance event is 400 points.

Endurance scoring depends on the number of laps the vehicle finishes within the allocated time.

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

Where:

L_{max} represents the highest number of laps completed by any vehicle

L_{team} signifies the laps completed by the vehicle under consideration for scoring

L_{min} stands for the lowest number of laps completed by any vehicle

P_{bonus} indicates the quantity of bonus points granted to an eligible vehicle.

E.6.6.1. Deciding the Winner

i. The team that either completes the competition's distance first or achieves the highest number of laps within the designated time will be declared the victor.

ii. In competitions with a predefined distance, the chequered flag will be initially waved for the leading car, followed by the remaining finishers as they cross the finish line.

iii. For timed competitions, the chequered flag will be displayed initially for the leading car as it crosses the finish line either at or after the specified time limit. Subsequently, it will be presented to the other participants in the order they complete the race.
If the leading car is not operational when the time limit expires, the chequered flag will be awarded to the next highest-ranking car that is still running, following the same protocol.

E.6.6.2. Completed Laps

The score for laps is determined by the total number of complete laps completed during the endurance event. Only complete laps are taken into consideration, while partial laps are not included in the score. To have a lap counted, the vehicle must autonomously cross the timing line.

E.6.6.3. Placement

"Finish order" refers to the order in which vehicles cross the finish line once the lap scoring period concludes. It is used to establish the ranking of teams that have completed the same number of laps. For instance, if the leading four teams all finish with an equal number of laps, their ranking from 1st to 4th will be determined by the sequence in which they crossed the finish line.

E.6.6.4. Bonus Points

Bonus points are extra points granted to the top ten (10) vehicles on the leading (winning) lap, as determined by their finish order, primarily to distinguish among teams that have completed the same number of scored laps. A maximum of 10 bonus points can be earned, and they will be given in reverse order of finish. In other words, the first vehicle to cross the finish line in the highest lap group will receive bonus points equivalent to the total number of cars on the lead lap (up to a maximum of 10). The second vehicle will receive one less bonus point, and so on. Here's an example to illustrate this process:

Standing	Lap	Additional Points
1	32	5
2	32	4
3	32	3
4	32	2
5	32	1

E.6.6.5. Heat Plus Scoring

In the case of endurance races structured with preliminary heats followed by a final, the event's points will be divided between the heats and the final based on the duration or distance covered in each stage.

For example, if the endurance event consists of one (1) hour eliminations followed by a three (3) hour final, the total of four hundred (400) points will be distributed as follows: one hundred (100) points allocated to each elimination heat and three hundred (300) points assigned to the final.

❖ SECTION F: THE TECHNICAL INSPECTION

Part F.1. Outline

Before ATVC vehicles are allowed to operate with power, they must undergo a technical inspection. This inspection aims to ascertain whether the vehicle adheres to the rules and regulations set forth by ATVC. If a vehicle isn't prepared for the technical inspection upon arrival at the inspection site, it will be turned away. Teams that are turned away must make the necessary preparations for their vehicle and then return to the inspection site when it's ready for inspection. Throughout the competition, any vehicle may be subject to re-inspection, and if any non-compliance is found, corrections will be mandated.

Part F.2. The Process

The technical inspection process will be divided into three distinct stages: the Engine check (applicable to Combustion vehicles) or eKIT check (for Electric vehicles), Safety Scrutiny, and Panic Braking. A sticker will be awarded upon successful completion of each of these critical stages, totalling three stickers for clearing all three technical evaluation stages. Prior to the Physical dynamic event, a technical inspection checklist containing all the required checkpoints will be provided to all teams. Teams are responsible for reviewing and confirming all the checkpoints and must bring the self-evaluated checklist to the technical inspection. Each team will have two opportunities to pass each stage.

- **An attempt will be counted only after a team has tried all the sub-stages (if applicable) within each stage at least once.**
- **Teams will receive the respective stage sticker only upon successfully clearing all the sub-stages and checkpoints specified within that particular stage.**

F.2.1. Weight Measurement

The vehicle's tare weight will be measured and documented.

F.2.2. Engine Inspection and Governor setting (Governor Setting Verification) (Combustion Vehicles only)

The Technical Representatives will be responsible for configuring the governors of all vehicles. To have the governor set, vehicles must be presented with the engine output shaft

exposed, the drivetrain disengaged, and the throttle cable disconnected from the engine, with functional kill switches. The technical staff will undertake the following procedures for each vehicle engine:

i. Confirm its compliance with the regulations.
ii. Set the governor to the specified rpm, which is 3800. Upon successful completion of these steps, the technical team will affix an "Engine OK" sticker. Following this, teams are strictly prohibited from making any alterations to the engine governor settings. Any team found in violation of this rule will face disqualification.

F.2.3. eKit Verification (Electric Type Only)

The electrical systems of an electric vehicle must undergo safety and compliance inspections as outlined in SECTION C: ELECTRICAL POWERTRAIN AND SYSTEMS (FOR ELECTRIC TYPE VEHICLES ONLY). The eKit check will be conducted in two stages:

i. Tractive System & Components Inspection: In this phase, the focus is on verifying the ratings, functionality, compliance with certifications stipulated in the rulebook, as well as the quality of wiring and mounting for all Tractive System components.

- **Teams must bring all the necessary documentation and tools for verification during the eKit Check.**

ii. Low Voltage (LV) System Inspection: During this phase, the inspection will cover all aspects of the LV system, including the ratings, functionality, wiring, mounting, and the correct sequence for activating the tractive system.

- **If a team plans to perform battery swapping during the endurance event, they are also required to demonstrate the swapping process during the Technical Inspection (TI).**

F.2.4. The Technical Safety Scrutiny

Each vehicle will undergo an inspection to ensure compliance with ATVC INDIA rules, including an examination of the driver's equipment, such as helmets and arm restraints. The inspection will also include testing the driver's ability to exit the vehicle promptly and confirming that all drivers meet the rule requirements. Each team is required to bring the following items for inspection:

i. Documentation of Frame Material: Receipts that prove the materials used to construct the frame, including material certificates from suppliers and certificates of material composition and mechanical properties confirmed by tests at an authorized laboratory.

Test reports from roll cage tube material suppliers and local test reports must also be provided.

ii. Roll Cage Specification Sheet: A fully completed Roll Cage Specification Sheet. If a higher grade of steel is used, calculations demonstrating adequate cross-section, bending stiffness, and strength must be provided.

iii. Technical Inspection Check Sheet: At the college level, teams are expected to comply with the Self-Technical Inspection check sheet, which should be submitted during the technical evaluation.

iv. Presence of Drivers: Both drivers must be present during the technical inspection, possessing valid licenses and complete safety gear.

Safety scrutiny will also cover electrical systems, kill switches, lighting, reverse lamps, buzzers (if installed), horns, wiring, and their mounting. Both external and internal cockpit kill switches will be tested for functionality, and the system must pass these tests.

All hardware fasteners and their attachments must meet the fundamental requirements.

- **If significant modifications are recommended during the technical inspection, they must be performed exclusively within the designated vehicle pits and not in any other location.**

F.2.5. The Dynamic/Panic Brake Check

The objective of this test is to verify the vehicle's safety at its maximum speed, ensuring it can complete a 30-meter stretch within a maximum time of 8 seconds. Additionally, the vehicle should demonstrate the capability to come to a complete stop with all four wheels locked within a distance of 3 meters. Each team must showcase the effectiveness of all four-wheel brakes during high-speed braking.

- **Each of the four tires must have a 25 mm (1.0 inch) wide radial strip painted in white on their outer side for the purpose of conducting a wheel lock check. These markings should be applied by the teams themselves, as indicated in the red box within Image F-1.**

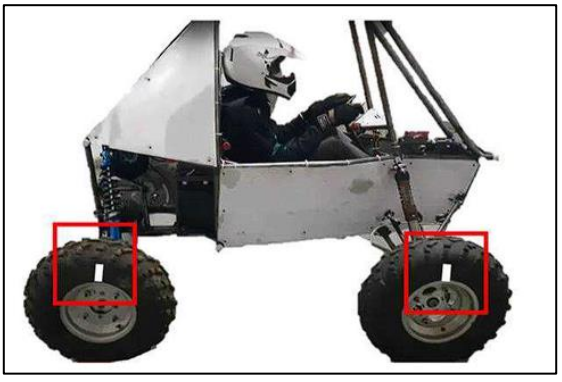


Image F-1: Tire Markings for Wheel Lock Check

Every team must demonstrate the effectiveness of all four-wheel brakes during high-speed braking. During the Dynamic Brake Check, both the external and cockpit kill switches will undergo functionality testing before allowing the vehicle to proceed. If both switches pass the test, the vehicle will undergo a dynamic brake test. During this test, each vehicle must come to a stop in an approximately straight line, as specified by the inspectors.

If a vehicle fails any part of the inspection, it must be corrected or modified to comply with the rules before it can be permitted to operate.

Teams are allowed only two attempts for the brake test.

Upon successful completion of the brake test, the vehicle will be considered for a 'Technical Evaluation OK,' and a third sticker will be affixed to the vehicle. The Log Sheet must be submitted to the brakes, technical evaluator.

- **Concerning in-board brakes, as teams may use brakes mounted on the shaft, it's important to acknowledge that the opposite end of the shaft is linked with either a U-joint (UJ) or a CV joint, which can introduce some play when the brake is engaged. This play can cause a delay in applying brakes to one of the rear wheels, resulting in further rotation of that wheel.**

  In such a scenario, only a half-turn rotation, with a maximum of 180 degrees, will be taken into consideration. Brake effectiveness will only be recognized if the rotation of all four wheels comes to a complete stop, bringing the vehicle to an immediate halt.
- **It should be noted that if the wheels exhibit juddering or shaking due to reactive forces on the rotor and brake caliper, this will be considered ineffective braking. This characteristic is commonly observed in two-wheeler brake systems. Therefore, it is not advisable to use such systems in ATVC INDIA vehicles.**

F.2.6. Preparedness

Teams submitting Technical Inspection Sheets that are incomplete, inaccurate (meaning they do not accurately reflect the actual condition of the vehicle), contain four (4) or more violations of the rules, or appear to lack a genuine effort at pre-inspection will not be inspected at that time. Instead, they will be directed to return to the end of the inspection line.

F.2.6.1. Technical Inspection Sheet

F.2.6.1.1. Pre-Inspection Criteria

Prior to presenting their vehicle for technical inspection, each team is required to:

i. Conduct a preliminary inspection of the vehicle to ensure compliance with the rules.
ii. Fill out the official technical inspection sheet.

iii. Obtain the signature of both the faculty advisor and team captain on the completed inspection checklist.

F.2.6.1.2. Technical Sheet Version

Teams are required to ensure that they are using the most recent version of the inspection sheet, which will either be accessible in the teams' login section or sent to them via email within two weeks of the competition. They should then conduct a thorough examination of their vehicle in accordance with this updated technical inspection sheet.

F.2.7. Inspection Stickers

A multi-part inspection label will be provided in segments to each vehicle as each of the three stages of the technical evaluation is finished. It is mandatory for the inspection label to stay affixed to the vehicle throughout the competition. Vehicles lacking any portion of the inspection label should not be operated under power.

Furthermore, any or all segments of the inspection label may be taken off from any vehicle that has sustained damage or is reasonably suspected of not meeting the stipulated rules.

F.2.8. In Authorized State

F.2.8.1. Modifications

After a vehicle successfully completes the technical inspection, its setup cannot be altered. This includes all accessory components, which are regarded as integral to the configuration and must be retained on the vehicle at all times.

F.2.8.2. Fixing

Vehicles that have received approval must maintain their "as-approved" condition for the duration of the competition. Any replacement of a component that differs from the broken part must be granted prior approval before the repair is carried out.

F.2.8.3. Non-Identical Components

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

F.2.8.4. Tuning

Modifications do not include minor adjustments allowed by the rules or routine vehicle maintenance and tuning.

❖ SECTION G: THE OVERALL EVENT PROTOCOLS AND POLICIES

Part G.1. Safety

G.1.1. Safety Perspective

The paramount concern in the design of ATVC INDIA vehicles and the execution of competitions is safety. No event or competition should ever be prioritized over the importance of ensuring safety. Every participant is committed to fostering a secure competition environment, ensuring that all participants leave in the same condition as when they arrived.

G.1.2. Medical Assistance

Although medical services are consistently available at ATVC INDIA events, teams are urged to have knowledge of or receive training in first aid, CPR, and the operation of AED machines.

G.1.3. Approaching Individuals

Every participant has the authority to directly and courteously communicate with others when they observe a hazardous or unsafe situation and inform the individual at risk. Individuals who are approached about a safety issue are expected to acknowledge the concern respectfully and are encouraged to express gratitude to those who raised the issue.

G.1.4. Commitment

During all performance events, the team is obligated to ensure that both the vehicle and driver conform to and adhere to all the stipulated requirements and restrictions of the rules.

G.1.5. Personal Protective Equipment (PPE)

Teams must utilize Personal Protective Equipment (PPE) suitable for the specific task they are performing. This encompasses, among other things:

i. Safety Glasses
ii. Gloves
iii. Closed Toe Shoes
iv. Arc Flash Protection
v. Hearing Protection

G.1.6. Primary Risks

We encourage all participants to be particularly attentive to the following circumstances:

G.1.6.1. Ascending and Descending

When going up or down stairs, ladders, steps, or tailgates, ensure you maintain three point contact. Be vigilant for any obstacles at the start and end of your journey.

G.1.6.2. Pinch Points

Avoid getting near areas where there's a risk of being caught in the moving parts of machinery, doors, or other equipment.

G.1.6.3. Hazardous Energy Discharge

Keep a safe distance from sparks, chips, swarf, or any other high-energy materials. Always verify circuits for live wires before conducting any work on them. Before commencing any work on high-pressure air, oil, or water systems, make sure to depressurize them. Exercise caution when working in the vicinity of presses, rams, or other hydraulic equipment. Additionally, use care when utilizing jacks or lifting vehicles or other objects.

G.1.6.4. Vehicle Activities

Avoid driving while distracted, and when you need to reverse a vehicle, make sure to have a spotter assisting you.

G.1.6.5. Path of Travel/Walking

Ensure that you maintain walking paths free from potential slip, trip, and fall hazards.

Part G.2. Ethical Guidelines

G.2.1. Sporting Conduct

All participants in ATVC INDIA can take pride in the exceptional sportsmanship and collaboration displayed among teams, which are two key characteristics of the series. Demonstrating good behaviour and adhering to the rules and official instructions are both expectations and requirements for every team member.

Unsportsmanship like conduct may encompass disputes with officials, non-compliance with official instructions, and the use of offensive or threatening language towards any official or fellow participant. Depending on the severity of the violation, the consequences for such actions can range from a deduction of team points (up to fifty percent or 50%) to the complete expulsion of the entire team. Such penalties will only be imposed following a thorough review of the incident by the organizers.

G.2.1.1. Forbidden Material

Alcoholic beverages, firearms, any form of weapons, and illegal substances are strictly forbidden at ATVC INDIA venues. Violation of this rule will result in the immediate expulsion of the entire team, encompassing all team members, advisors, and any individuals

collaborating with the team on-site. The consumption of any tobacco products or the use of e-cigarettes is not allowed on-site.

G.2.1.2. Footwear

Everyone present on-site must wear sturdy and durable closed-toe footwear. The use of open-toed shoes, slippers, sandals, and similar footwear is expressly forbidden.

G.2.1.3. Parties

The faculty advisor or team captain should take measures to prevent disruptive parties, whether they occur on-site or off-site.

G.2.1.4. Cleanliness

Teams are expected to be responsible for cleaning up trash and debris, ensuring the paddock area remains tidy and clutter-free. At the end of the day, it is mandatory for each team to clean their designated work area.

Kindly assist the event organizers in maintaining the cleanliness of the site. The locations used for ATVC INDIA events are typically private properties, and they should be respected as such. Participants are reminded that they are guests at these venues. All litter should be properly disposed of in the provided containers, and it's important to note that glass is prohibited on the premises. Failure to keep the area clean may lead to penalties for unsportsmanlike conduct. Competitors are strongly encouraged to clean up their spaces after meals.

G.2.1.5. Individual Mobility

Team members and spectators are not allowed to use motorcycles, quads, bicycles, scooters, skateboards, rollerblades, or any similar personal or motor-driven devices anywhere within the competition area, including the paddocks.

G.2.2. Spectator Regulations

G.2.2.1. Generic Rules

Organizers typically do not maintain direct communication channels with spectators, except when they are present at the competition. Therefore, competitors, faculty, and volunteers are anticipated to take on the responsibility of conveying safety regulations to spectators and ensuring that spectators stay within designated spectator areas.

G.2.2.2. Alcoholic Beverages

At any competition location, spectators are prohibited from consuming or possessing alcoholic beverages.

G.2.2.3. Access Limitations

Spectators are required to maintain a designated distance from the event areas, as determined by the organizers, and to stay away from any areas where motor vehicles are

actively in operation. Motor vehicle competitions pose potential dangers, and strict adherence to safety rules will be enforced.

G.2.2.4. Children

The competition site is not a secure environment for children and unaccompanied young individuals. Spectators who do not effectively supervise their children will be requested to exit the premises.

G.2.2.5. Expulsion

The course officials and organizers possess the full authority to limit spectator access to specific areas of the site and to remove individuals who breach safety regulations or disregard the instructions provided by officials.

G.2.2.6. Reckless Actions

Every participant must consistently follow safe practices and refrain from engaging in any hazardous activities throughout the competition. The event organizers hold the discretionary power to apply a fair penalty for any behaviour considered unsafe, and this rule applies to all team members.

Part G.3. Paddock Regulations

Refuelling or swapping of fuel is strictly prohibited within the paddock area. For detailed instructions, please consult Part E.6.3.7. (Refuelling) and Part E.6.3.8. (Swapping).

G.3.1. Speed Regulation

Whenever a vehicle is operated outside of the practice area or event courses, it must maintain a speed no faster than that of a person walking, with a team member walking alongside at a normal pace. This requirement is especially critical during high-excitement performance events within the paddocks. Strict enforcement of the walking speed rule will be in effect, and point penalties may be applied at the discretion of the organizers for any violations.

G.3.2. Supervision Mandated

When a vehicle is operated outside the designated practice area or event courses, it must be accompanied by a team member serving as an escort. The escort's role is to walk on the right side of the vehicle, staying close to the firewall kill switch, and maintaining continuous visibility to the driver. The escort's primary responsibility is to act as a spotter, particularly attentive to the vehicle's blind spots and the presence of other vehicles.

Under no circumstances are individuals other than the driver allowed to ride inside or on the vehicle. Escorts must maintain a safe distance from the moving vehicle and should not

make physical contact with it while it's in motion. They must also stay within the driver's line of sight.

G.3.3. Team Pit Area

The team's pit area must be maintained in an uncluttered condition at all times. Whenever a team vacates their designated space, it should ensure that the area is left clean.

G.3.4. Team Vehicles

In the paddocks, only ATVC INDIA vehicles are permitted. Teams' support trucks and trailers must be parked in a designated area outside the competition site.

G.3.5. Entry Limitation

Paddock access may be restricted by the organizers to include only team members, faculty advisors, and competition officials.

G.3.6. Compressed Gases

Teams are required to securely store compressed gas cylinders. These cylinders should be kept in an upright position, adequately fastened using a chain or a suitable method, capped when not in use, and stored in a manner that maintains the cylinder temperature below 52 degrees Celsius (125 degrees Fahrenheit).

G.3.7. Driving Constraints

G.3.7.1. Off-Site Functioning

Throughout the competition, ATVC INDIA vehicles are solely allowed to be driven within specific areas: between the paddocks and event sites, during official practice sessions, and within the designated event courses. Additionally, these vehicles can be operated in events only after successfully passing technical inspection. Driving off-site is strictly forbidden. Teams discovered to have driven their vehicles off-site during the event may face expulsion from the competition.

G.3.7.2. Driver Gear

Drivers who fail to wear the appropriate gear will not be allowed to operate a vehicle and may risk having their competition driver's privileges withdrawn.

Part G.4. Meetings

Every team member holding the position of captain or driver, as well as all faculty advisors, are required to attend all designated meetings. Attendance at these meetings is

compulsory, and failure to do so may lead to the disqualification of individual members or the entire team.

Part G.5. Tie-Breakers

G.5.1. Dynamic Events (Other than Endurance)

In the case of ties in non-endurance dynamic events, the tiebreaker will involve comparing the scores based on the second-best time or distance achieved in the specific event. If the tie persists after this comparison, the tie will be considered valid.

G.5.2. Endurance Event

Ties in the endurance race will be assessed by the endurance event judge and may be upheld as ties.

G.5.3. Overall Event

In the case of ties for the ultimate winner, the tiebreaking process will follow this sequence:

i. Endurance Score
ii. Cumulative Dynamic Events Score
iii. Cumulative Static Events Score

If a tie persists even after going through these specified tiebreakers, the tie will be considered valid for the overall winners.

Part G.6. Signals and Communications

G.6.1. Directive Flags (Endurance Race)

G.6.1.1. The Green Flag

When displayed at the starting line or upon re-entering the course: The event is in progress; please proceed onto the course under the guidance of the starter.

When running on the course: The course is free of obstructions; you may continue.

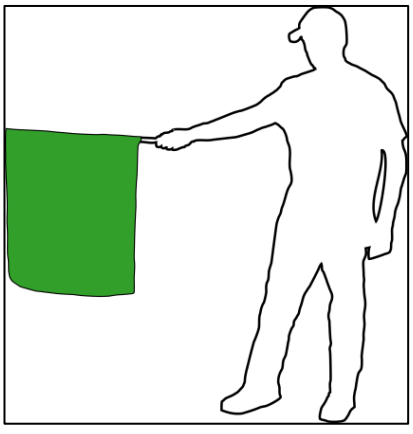


Image G-1: Signals and Communications, Green Flag

- **Green flags may alternatively be symbolized by green lights at designated locations, subject to the organizing committee's discretion.**

G.6.1.2. The Yellow Flag

When this signal is shown, it indicates a hazardous condition exists further along the course beyond the flag station. Please decrease your speed and be ready to manoeuvre to avoid any potential danger or come to a stop on the track if necessary. Passing is only allowed if instructed to do so by the course workers.

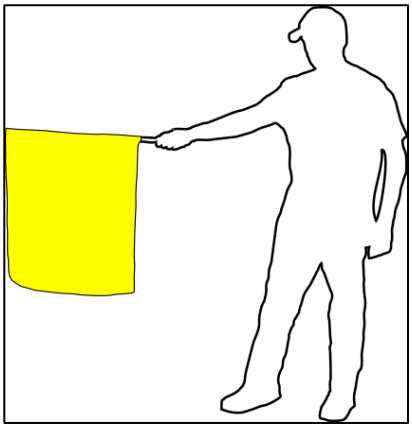


Image G-2: Signals and Communications, Yellow Flag

- **Yellow flags may alternatively be symbolized by yellow lights at designated locations, subject to the organizing committee's discretion.**

G.6.1.3. The Red Flag

When shown, this signal indicates a hazardous situation exists somewhere on the track that necessitates a complete stop of all participants. Quickly and safely bring your vehicle to a complete halt on the course. Passing is strictly prohibited. Pull over to the side of the track

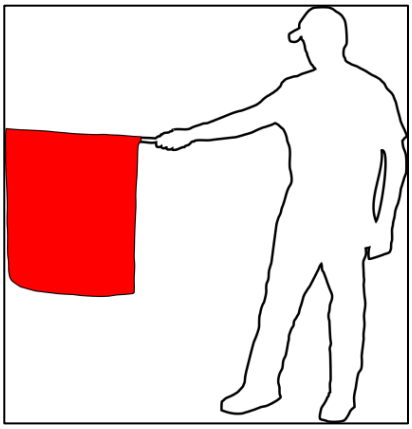


Image G-3: Signals and Communications, Red Flag

as far as possible to ensure the course remains open. Comply with instructions from course workers.

- **Red flags may alternatively be symbolized by red lights at designated locations, subject to the organizing committee's discretion.**

G.6.1.4. The Black Flag

G.6.1.4.1. The Black Flag (Displayed)

Proceed to the penalty box for a conversation with the Technical Inspector or another official regarding an incident. There may be a penalty imposed for the incident.
Drive into the penalty box for a vehicle inspection; a safety concern has been identified with your car.

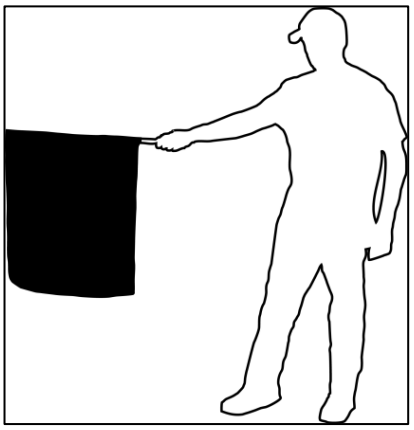


Image G-4: Signals and Communications, Black Flag (Displayed)

G.6.1.4.2. The Black Flag (Rolled-Up and Aimed)

Caution: The vehicle's driving is under close scrutiny by the officials - please adhere to the event rules.

G.6.1.5. The Chequered Flag

The event has concluded. Please leave the course as instructed by event officials.

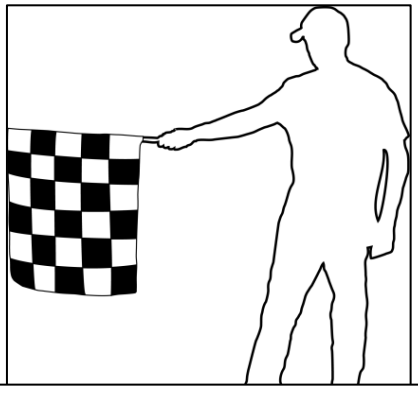


Image G-5: Signals and Communications, Chequered Flag

G.6.2. The Directional Arrow

A triangular shape in orange, having a height-to-base ratio of 1.5:1, with or without a split or forked base. The choice of white or black border is optional. The minimum width for the base is 6 inches.

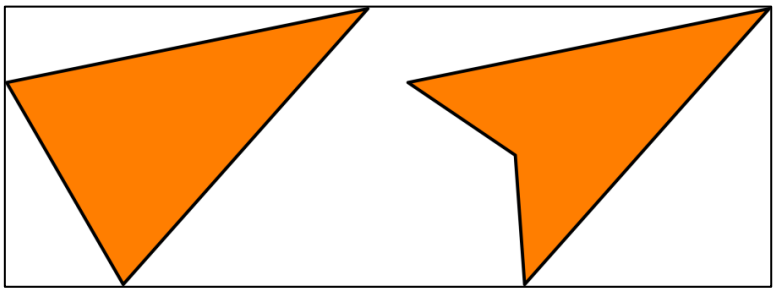


Image G-6: Signals and Communications, Directional Arrow

G.6.3. Perimeter of the Control Zone

This sign marks the commencement of the control zone surrounding the event. Once past this sign, the vehicle and driver must be fully prepared to participate in the event. The driver must have all necessary equipment in place, and the vehicle should not undergo any further adjustments. Additionally, beyond this sign, only one team member is permitted to accompany the vehicle. Teams entering the control zone unprepared or with more than one attendant may be directed to the end of the queue.

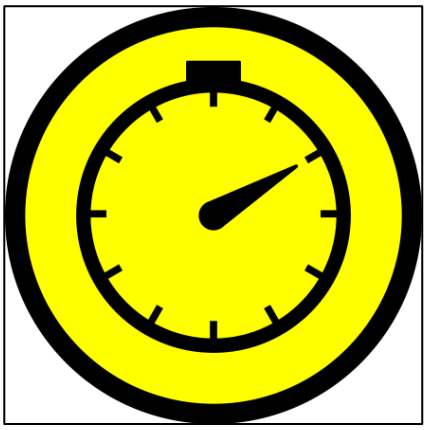


Image G-7: Signals and Communications, Perimeter of the Control Zone

G.6.4. Time Control Supervisor

This sign indicates the whereabouts of the time control supervisor, who will guide your vehicle to the event's starting point. At this position, a Technical Inspector may conduct a final compliance inspection of your vehicle.

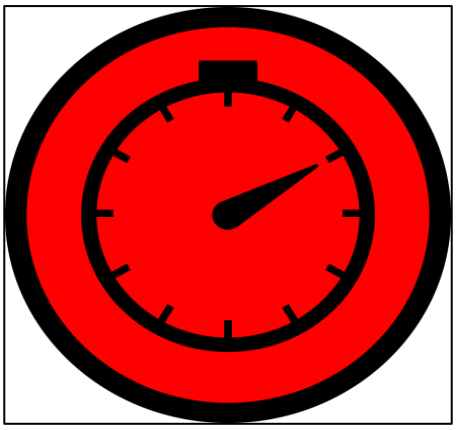


Image G-8: Signals and Communications, Time Control Supervisor

G.6.5. The Starting Line

This sign indicates the position of the starting line for the event. Here, the driver will receive the signal from the starting line supervisor to initiate the run.

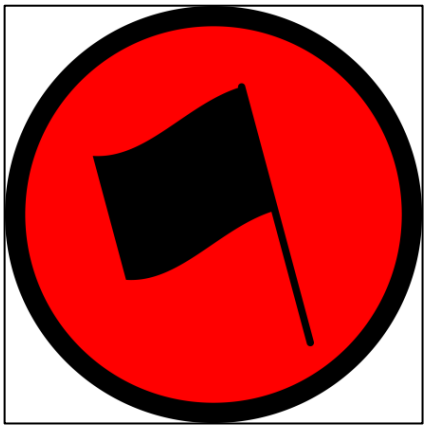


Image G-9: Signals and Communications, Starting Line

G.6.6. The Finish Line

This sign marks the conclusion of the run, where your time or distance will be recorded. Continue past the finish line to register your score.

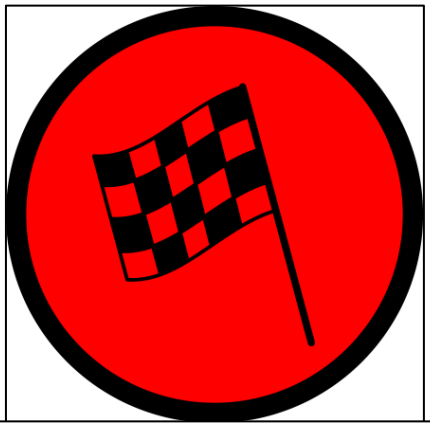


Image G-10: Signals and Communications, Finish Line

G.6.7. The Stop Line

Every vehicle must come to a halt at the stop line at the end of the run. At this point, you should only advance when directed by the Finish Line Supervisor.

Image G-11: Signals and Communications, Stop Sign

G.6.8. End of the Control Area

This sign marks the conclusion of the perimeter for the control zone.

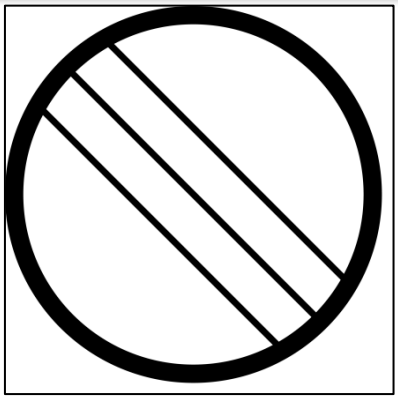


Image G-12: Signals and Communications, End of the Control Area

G.6.9. The Fuel Zone Perimeter

This sign marks the start of the fuel zone where refuelling is allowed.

Image G-13: Signals and Communications, Fuel Zone Perimeter

G.6.10. The Fuel Zone End

This sign signifies the conclusion of the fuel zone. After passing this sign, refuelling is prohibited unless authorized by the Fuel Zone Official.

Image G-14: Signals and Communications, Fuel Zone End

G.6.11. The Service Zone

This sign indicates the start of the service area, which includes paddocks and/or the hot pit. After passing this sign, you are allowed to make vehicle adjustments, perform service, and/or conduct maintenance.

Image G-15: Signals and Communications, The Service Zone

G.6.12. The Service Zone End

This sign signifies the conclusion of the service area, encompassing paddocks and/or the hot pit. After passing this sign, making vehicle adjustments, providing service, or conducting maintenance is no longer allowed.

Image G-16: Signals and Communications, Service Zone End

❖ SECTION H: POSTSCRIPT

Part H.1. Comprehensive Event Score Overview

Contest	Description	Credits	Total Credits	Comments
STATIC EVENTS	Design Assessment	150	300	
	CAE Assessment	50		
	Cost Assessment	50		
	Business Plan Assessment	50		
DYNAMIC EVENTS	Acceleration	50	700	Bonus Points (if applicable) will be added to the respective event scores.
	Manoeuvrability	150		
	Suspension and Traction	100		
	Endurance Race	400		
	GRAND TOTAL		1000	

Part H.2. Miscellaneous Subjects

- **It's crucial to emphasize that teams should grasp the intricacies of constructing the vehicle. This involves not only meeting the competition's requirements but also adhering to industry standards commonly employed in the automotive sector. This approach not only encourages sound engineering practices but also ensures that students are well-prepared for the industry.**
- **As part of this procedure, we highly recommend that students visit the following link, which provides comprehensive information on SAE standards applicable to the automotive sector. This resource will greatly enhance the manufacturing standards of their vehicle.**

SAE Technical Standards

Part H.3. Evaluation and Analysis

H.3.1. AIS 041

This standard pertains to depicting the curve as a function of motor speed, as well as the power at full load specified by the vehicle or motor manufacturer for electric drive train motors.

H.3.1.1. Estimation of Net Power

i. Prior to commencing the test, the entire motor/vehicle and its equipment assembly should be preheated to a temperature of 250 °C with a tolerance of +/- 5 °C. This preheating should be sustained for a minimum duration of two hours.
ii. The net power test will involve operating the power controller at its full setting.
iii. Immediately before initiating the test, the vehicle/motor should be run on the chassis/bench dynamometer for three minutes, delivering power equivalent to 80% of the manufacturer's recommended maximum power at the specified speed.
iv. To accurately define the power curve across the full range of speeds recommended by the manufacturer, measurements must be taken at a minimum of four different motor speeds.
v. The entire testing process must be completed within a five-minute timeframe. It may be necessary to recharge the batteries once to complete the power curve measurement.

H.3.1.2. Assessment of Peak 30-Minute Power

i. The motor/vehicle, along with its entire equipment assembly, should be conditioned at a temperature of 250 °C with a tolerance of +/- 5 °C for a minimum duration of four hours before the test. Subsequently, the electric motor/vehicle should be operated on the bench dynamometer/chassis dynamometer, utilizing the power level specified by the manufacturer for the maximum 30-minute power.
ii. During this process, it is essential to record both the speed and power. The power must remain within the range of ±5% of the initial power value at the outset of the test. The maximum 30-minute power is determined by calculating the average power over the 30-minute duration.

H.3.2. AIS 048

This standard is relevant to the batteries used as driving power sources in battery-operated vehicles.

H.3.2.1. Electrical Safety Testing Criteria

- Short Circuit Test (Cell Level, Battery Module, or Battery Pack):
  This test may be conducted on a battery cell (if the electrodes are accessible) or on a battery module or battery pack. Upon completing the test, the following conditions must be met:

i. The casing or other mechanical parts should not exhibit any physical damage.
ii. No components should melt.
iii. There should be no instances of fire or explosions. It is permissible for the battery to become dry at the conclusion of the test.

- Overcharge Test (Cell Level, Battery Module, or Battery Pack): The battery is subjected to overcharging at a constant charging current of 0.1(C10) for a duration of 10 hours. At the conclusion of the test, the following conditions must be met:

i. The casing or other mechanical parts should not exhibit any physical damage.
ii. No components should melt.

iii. There should be no instances of fire or explosions.

H.3.2.2. Mechanical Safety testing Criteria

- Vibration Test:
  At the outset of the vibration test, the battery module should be charged to 100% state of charge (SOC). The battery module must undergo sinusoidal vibration with an acceleration of 3 g in both axes and a frequency ranging from 30 to 150 Hz, with a sweep rate of 1 octave per minute. This testing should be conducted for a duration of 2 hours in each axis. The battery's rated capacity should not deteriorate by more than 10%. At the conclusion of the test, the following conditions must be met:

i. No physical damage should be evident on the casing or other mechanical parts.
ii. Components should not exhibit any signs of melting.
iii. There should be no occurrences of fire or explosions.

- Mechanical Shock Test: At the commencement of the shock test, the battery module should be fully charged to 100% SOC. The battery must undergo ten shocks in each axis using a half-sine wave, with an amplitude of 30 g and a duration of 15 ms. The battery's rated capacity should not deteriorate by more than 10%. At the conclusion of the test, the following conditions must be met:

i. The casing or other mechanical parts should show no physical damage.
ii. Components should not display any signs of melting.
iii. There should be no instances of fire or explosions.

- Nail Penetration Test (Cell Level or Battery Module): For this test, a mild steel (conductive) pointed rod, electrically insulated from the test fixture, should be used to penetrate the battery cell module. The penetration rate should be nominal at 8 cm/s. In the case of cell-level testing, the rod's diameter and depth of penetration must be 3 mm, whereas, for battery module-level testing, the depth should be 20 mm. At the conclusion of the test, the following conditions must be met:

i. No physical damage should be observed on the casing or other mechanical parts.
ii. Components should not exhibit any signs of melting.
iii. There should be no occurrences of fire or explosions.

H.3.3. Vehicle Testing

- **It is imperative for each team to acknowledge that the vehicles designed for the ATVC INDIA competition do not possess approval under the Central Motor Vehicles Rules (CMVR) for operation on public roads. Consequently, any form of testing or usage on public roads, public areas, or grounds is strictly prohibited. This implies that no team should conduct trials or testing on public roads or in any public spaces. Compliance with legal regulations is entirely the responsibility of each team, and the**

ATVC INDIA Organizing Committee bears no responsibility for any non-compliance or consequences arising from violations by any team.

❖ SECTION G: APPENDIX

Part G.1. Recommendations for Braking System Design

i. **Incorporating a Hydraulic Stop Lamp Switch (with two modes: Off for Tandem Brake Master Cylinder and Off for Two Brake Master Cylinders in Parallel Mount installations) can be challenging:** There is a range of Hydraulic stop light switches available from OEMs as over-the-counter (OTC) products through dealers and spare parts outlets. Teams need to carefully examine the port details of their brake master cylinder(s) and design appropriate adapters to accommodate these hydraulic brake lamp switches.

ii. **Additionally, when dealing with remote mount Brake Fluid Reservoirs that feature two inlet rubber hoses to supply the Brake Master Cylinder(s) – whether they are of the Tandem Type or Twin Assembly:** Around 95% of the readily available vehicles and commodity products use plain Venial-type rubber hoses designed for industrial machinery, which may not be ideal for the task. Moreover, essential installation aids like proper end clips, clamps, brackets, etc., are often missing. To overcome these challenges, teams are encouraged to explore vehicles such as cars, Small Commercial Vehicles, MUVs, SUVs, etc., that already have remote mount installations in place. By doing so, teams can consider incorporating engineered products provided by OEMs, possibly with the need for suitable interfaces to ensure compatibility.

iii. **Teams are advised to conduct the following checks at the college level to prepare for the main event:**

Static Visual Checks:

During the static visual checks, teams should focus on the following aspects related to brake design:

- Front axle weight
- Rear axle weights
- Dynamic weight transfer and distribution of forces
- Brake circuit construction
- Achievable deceleration and wheel lock characteristics
- Adequacy of Bundy tube routing, clamping, and clearances
- Brake hose routing clearances concerning suspension and steering articulation
- Ensuring that all bleed ports are located at the highest point of the caliper or wheel cylinder
- Positioning the brake fluid reservoir above the foundation brakes

System Rigidity Test:

To assess brake system integrity and performance, teams will be required to perform a system rigidity test. This involves applying maximum pedal force and maintaining it for a duration of two minutes. This test helps identify brake fluid leakage and ensures pedal rigidity.

Subjective Test for Brake Evaluation at the College Level:

Teams can also conduct a subjective test to evaluate brake performance. This test involves driving at a speed of 20 km/h and applying a low brake pedal force while checking the brake functioning. The objective is to determine how well the brakes respond, with a focus on initiating wheel lock with minimal pedal effort.

iv. Connecting all four brakes with steel-impregnated rubber brake hoses is discouraged due to potential issues related to cleanliness, continuous brake fluid flow, adherence to the principles of Fit, Form, and Function (3F), and overall performance. Instead, it is recommended to use Bundy tube assemblies and flexible brake hoses at the wheel end.

v. **Preventing Dangling and Fouling:** Improper installation can lead to issues such as dangling and fouling of brake hoses and Bundy tube assemblies. To address these problems effectively, teams can utilize suitable bending fixtures, which can be made from materials like wood or mild steel, along with a portable flaring tool kit commonly found in garage equipment. This approach makes it easier to rectify mistakes that may otherwise result in significant concerns and system failures.

vi. **Addressing Clipping and Clamping Concerns:** To avoid problems arising from improper clipping and clamping of Bundy tube assemblies and brake hoses, teams can create an installation layout that includes all associated parts. This layout helps competing students identify the precise locations for clipping and clamping, ensuring trouble-free installation and enhancing overall system reliability.

vii. **The utilization of a mix of installation fittings such as two-way or three-way unions, Banjo/Bolt assemblies, running nuts, and others can introduce a range of issues:** These installation components come in various materials, including steel, brass, zinc alloy, and aluminium. This diverse assortment of parts is used across a spectrum of vehicles, from two-wheelers to trucks, and each material demands different tightening torque specifications. This is essential to prevent distortions, deformations, and ensure effective sealing to prevent leaks. Teams often encounter challenges stemming from a lack of familiarity with handling different materials in these components. To enhance the effectiveness and reliability of the brake system, it is advisable for teams to opt for well-established and OEM-approved standard parts. Additionally, teams are encouraged to use copper washers instead of aluminium washers when making connections at brake calipers and master cylinders.

viii. **The orientation of inlet and outlet ports in components like Brake Master Cylinders, Brake Calipers, and Limiting Valves is critical.** Inattention to the proper alignment of

angular ports(inlet/outlet), especially when dealing with aluminium parts, can lead to incorrect assembly and improper fitment. This, in turn, can result in concerns such as brake fluid seepage, leakage, inadequate sealing, and reduced braking effectiveness. Therefore, it is imperative to handle these parts with great care to ensure their correct orientation and assembly.

ix. **Additionally, there is a variety of port sealing features found in installation fittings, couplings, and running nuts, including standards such as DIN, SAE, and JASO.** These port specifications have their roots in European and Japanese engineering principles and philosophies adopted in the automotive industry. Given the prevalence of three different port specifications in auto parts, it is crucial to pay meticulous attention to these features when mixing and matching various brake components. This attention to detail will significantly mitigate a wide range of build quality issues, ranging from minor to significant concerns.

x. **Issues related to leakage, ineffective bleeding, and poor brake performance, as mentioned in points vii. and viii.**, become more complex when teams rely extensively on TEFLON or THREAD SEALING TAPES to address seepage and leakage problems. This approach poses a significant risk of brake failure. Furthermore, the use of these tapes, which are often processed with mineral oil materials, can lead to the contamination of the entire brake system, affecting it from end to end. It's important to note that these tapes are not compatible with synthetic (Glycol) based brake fluid.

xi. **Concerns related to customized Brake Rotors, Brake Calipers, Brake Pads, and Brake Master Cylinders are noteworthy.** These critical components are typically engineered and manufactured by leading brake manufacturing industries worldwide. They undergo a rigorous process that includes multi-level quality controls, extensive manufacturing excellence, and quality assurance checks. Following this, intensive testing and validation processes are conducted, encompassing various tests such as rig tests, track tests, clinical trials, fleet tests, road tests, and procedures for homologation, type approval, certification, and safe launch. However, in contrast, students often attempt to create these safety-critical assemblies using limited resources and traditional manufacturing methods. Unfortunately, they frequently lack evidence of basic performance checks and test outcomes. Consequently, this leads to a high number of brake-related issues during main events year after year, as their efforts may not meet the industry standards.

From an industry perspective, it is virtually impossible for teams to develop and deliver the aforementioned four-wheel-end aggregates with the constraints they face, which include limitations in terms of time, manufacturing capabilities, and testing and evaluation setups. Brake rotors, in particular, are sometimes crafted with extensive slots and cross-holes, making them prone to issues and heat management challenges due to steel's poor heat conductivity.

Instead of these approaches, teams are encouraged to opt for robust CAST IRON BRAKE ROTORS. These cast iron rotors can effectively manage heat in the front brake system and help postpone concerns related to wheel lock in the rear.

xii. **CVT-enabled buggies pose significant challenges due to their design characteristics.** CVTs introduce substantial constraints, such as parasitic drag, hysteresis, and poor response/return features, on the brake caliper assembly. In these buggies, the brake caliper is typically in an inboard mount position or integrated with the CVT housing. These calipers are traditionally small, resembling matchbox-sized units and are often designed with a lightweight approach. They are equipped with biscuit-sized brake pads.

In such setups, the small brake caliper can become overwhelmed as it is tasked with delivering the output equivalent to that of two standard brake calipers. Additionally, there is an elevated level of energy that needs to be dissipated, resulting in high heat generation. If not engineered correctly, this type of inboard-mounted brake caliper integrated into the CVT housing can lead to hazardous conditions.

Hence, it is advisable for teams to opt for a robust and durable brake caliper assembly when dealing with CVT-enabled buggies to ensure safe and efficient braking performance.

xiii. When bleed screws are installed at the bottom of the brake system, it becomes challenging to remove trapped air from the system, resulting in brake performance that feels spongy and ineffective.

xiv. **Brake Master Cylinder Mounting(s):** It's important to note that brake calipers (left/right or front/rear) should not be mounted higher than the brake master cylinders by default. Doing so would cause brake fluid from the calipers to flow back into the brake fluid reservoir. Therefore, it's crucial to ensure that the brake master cylinders are installed at a higher position than the brake calipers.

xv. **Brake Biasing:** Achieving the desired brake bias, where more braking force is applied to the front and slightly less to the rear (to prevent premature wheel lock), is a complex task. This requires numerous iterations and experimenting with a variety of brake master cylinders with different diameters to meet the rule book requirements. Moreover, it involves adhering to specific installation requirements that may necessitate customized tools, jigs, and fixtures.

xvi. **Brake Proportioning Valve(s) for the Rear:** Teams have the option to select an OEM-certified brake proportioning valve from the market to suit their specific needs. These valves are readily available and can help achieve the desired brake proportioning for the rear wheels.

xvii. Adjustable Brake Proportioning Valves for the rear are discouraged due to their complexity and the potential for tedious adjustments.

xviii. Teams are encouraged to apply lubricants to actuating components to ensure a swift response and faster return characteristics in the brake system.

xix. **Teams should prioritize cost management and efficiency.** Instead of extensively relying on expensive or exclusive imported parts, it is advisable to utilize OEM parts that are manufactured in India for the brake system. This approach helps control costs effectively.

❖ TECHNICAL SUPPORT/CONTACT DETAILS

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