

# Consolidated Rules for 2020 Baja SAE® KOREA at Yeungnam University

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2020 Baja SAE® KOREA at Yeungnam University

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Consolidated Rules for  
2020 Baja SAE® KOREA  
at Yeungnam University

# 2020 Collegiate Design Series Baja SAE® Rules Table of Contents

PART A: ADMINISTRATIVE REGULATIONS	
ARTICLE 1: BAJA SAE OVERVIEW	4
ARTICLE 2: BAJA SAE SERIES	4
ARTICLE 3: BAJA SAE RULES AND ORGANIZER AUTHORITY	5
ARTICLE 4: INDIVIDUAL PARTICIPATION REQUIREMENTS	6
ARTICLE 5: ELIGIBILITY – VEHICLES	7
ARTICLE 6: REGISTRATION	8
PART B: TECHNICAL REQUIREMENTS	
ARTICLE 1: GENERAL DESIGN REQUIREMENTS	8
ARTICLE 2: REQUIRED ENGINE	8
ARTICLE 3: EXHAUST SYSTEM	9
ARTICLE 4: ELECTRICAL SYSTEM	9
ARTICLE 5: TOWING HITCH POINT	11
ARTICLE 6: VEHICLE IDENTIFICATION	12
ARTICLE 7: ELECTRIC VEHICLE REQUIREMENTS (Other Session)	14
ARTICLE 8: ROLL CAGE	16
ARTICLE 9: COCKPIT AND THROTTLE	27
ARTICLE 10: DRIVER RESTRAINT	28
ARTICLE 11: BRAKING SYSTEM	33
ARTICLE 12: FUEL SYSTEM & FUEL	34
ARTICLE 13: STEERING, SUSPENSION AND FLOTATION SYSTEMS	37
ARTICLE 14: FASTENERS	37
ARTICLE 15: GUARDS	39
ARTICLE 16: DRIVER EQUIPMENT	39
PART C: COMPETITION PROCEDURES AND REGULATIONS	
ARTICLE 1: RULES CLARIFICATION AND PROTESTS	41
ARTICLE 2: COMPETITION PROCEDURES AND REGULATION –GENERAL	42
ARTICLE 3: RULES OF CONDUCT	43
ARTICLE 4: SPECTATOR RULES	43
ARTICLE 5: UNSAFE PRACTICES & CONDUCT	44
ARTICLE 6: FLAGS	44
ARTICLE 7: PENALTY	45
PART D: EVENT DESCRIPTION & SCORING	
ARTICLE 1: TECHNICAL AND SAFETY INSPECTION	46
ARTICLE 2: STATIC EVENTS AND REQUIRED REPORTS	47
ARTICLE 3: DYNAMIC EVENTS	48
#APPENDIX	53

2020 Baja SAE® KOREA at Yeungnam University  
Rules  
Partial List of rule updates/changes

This introduction list to the 2020 Baja SAE® rules is intended to highlight areas of the 2020 Baja SAE® Rules that you may find of interest or a change that has been made to a rule.

**These are not the complete changes**---Caution – Neither this list of updates/changes nor any summary to the rules is a substitute for thoroughly reading and understanding the rules. You are responsible for knowing and following all the Baja SAE® rules.

**(List of updates/changes)**

**B.7.2 Battery update**

**B8.2.2.1 Elements of the Roll Cage update**

**B8.2.2.1.1 Roll Cage Member Requirements update**

**B8.2.2.8.1 RHO/FBM Gusseting update**

**B8.2.2.9.2 Rear Bracing update**

**B8.2.2.10.1 Tube Joints update**

**B10.3.2 Lap Belt Mounting update**

**B12.1.2 Fuel Tank Mounting update**

**B12.4.4 Splash Shields update**

**B12.7 Fuel Sensors update**

**B12.8 Fuel Tank Access Panels update**

**B9.9 Leg and Foot Shielding update**

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## APPENDIX

### ROLL CAGE SPECIFICATION SHEET 2020 Baja SAE® COMPETITIONS

#### 2020 Baja SAE® Rules

## PART A: ADMINISTRATIVE REGULATIONS

### ARTICLE 1: Baja SAE® Overview

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

#### A.1.1 Baja SAE® Program Objective

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

#### A.1.2 Design Subject

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

#### A.1.3 Good Engineering Practices

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

### ARTICLE 2: Baja SAE® Series

#### A.2.1 The Baja SAE® Series will consist of six competitions. Three competitions are held in North America under the sponsorship of SAE International:

Baja SAE® Tennessee Tech

Hosted by Tennessee Tech University

Baja SAE® California

Baja SAE® Rochester

Hosted by the Rochester Institute University

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

Baja SAE® Brazil – Sponsored and hosted by SAE BRASIL

Baja SAE® Korea – Sponsored and hosted by Yeungnam University

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

Baja SAE® Mexico – Sponsored and hosted by SAE Mexico

**A.2.2** All Baja SAE® competitions have open registration policies and accept teams of university students from any country.

**A.2.2.1** Some sections of rules governing Baja SAE® events held outside North America are specific to these competitions. Such variations are published on the individual websites.

**A.2.2.2** The dynamic events at competitions differ. Teams should check the websites of the specific competitions they are planning to enter and consider any unique requirements that might affect the design and fabrication of their vehicle.

**A.2.3 Official Communications**

All teams are required to read and follow any official announcements concerning the competitions and the rules that are sent from the SAE or organizers to the team captain and/or the Faculty Advisor.

Official announcements from SAE may be posted to any, or all, of the Baja SAE® Series websites. To access the Baja SAE® Korea websites, go to:

<http://race.yu.ac.kr/>

**ARTICLE 3: Baja SAE® Rules AND Organizer Authority**

**A.3.1 Rules Authority**

The Baja SAE® Rules are the responsibility of the Baja SAE® Rules Committee and are issued under the authority of the SAE University Programs Committee. Official announcements from the Baja SAE® Rules Committee, SAE or the other Baja SAE® Organizers shall be considered part of and have the same validity as these rules. Ambiguities or questions concerning the meaning or intent of these rules will be resolved by the Baja SAE® Rules Committee, SAE Staff or a group of peers during competition onsite.

**A.3.2 Rules Validity**

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

**A.3.3 Rules Compliance**

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

**A.3.4 Understanding the Rules**

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

**A.3.4.1 Loopholes**

It is virtually impossible for a set of rules to be so comprehensive that it covers all possible questions about the vehicle's design parameters or the conduct of the competition. Please keep in mind that safety remains paramount during Baja SAE®, so any perceived loopholes should be resolved in the direction of increased safety/ concept of the competition

**A.3.5 Participating in the Competition**

Teams, team members as individuals, faculty advisors and other representatives of a registered university who are present on-site at a competition are considered to be "participating in the competition" from the time they arrive at the event site until they depart the site at the conclusion of the competition or earlier by withdrawing.

**A.3.6 Violations of Intent**

The violations of the intent of a rule will be considered a violation of the rule itself. Questions about the intent or meaning of a rule may be addressed to the Baja SAE® rules committee, Technical Inspectors or

SAE staff.

### **A.3.7 Right to Impound**

SAE and the other competition organizing bodies reserve the right to impound any on-site registered vehicle at any time during a competition for inspection and examination by the organizers, officials and technical inspectors.

### **A.3.8 General Authority**

SAE and the competition organizing bodies reserve the right to revise the schedule of any competition and/or interpret or modify the competition rules at any time and in any manner that is, in their sole judgment, required for the efficient operation of the event or the Baja SAE® series as a whole.

### **A.3.9 Penalties**

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

### **A.3.10 SAE Technical Standards Access**

A cooperative program of SAE's Education Board and Technical Standards Board is making some of SAE's Technical Standards available to teams registered for any North American CDS competition at no cost. The Technical Standards referenced in the Collegiate Design Series rules, along with other standards with reference value, will be accessible online to registered teams, team members and faculty advisors.

To access the standards (1) your team must be registered for a competition in North America and (2) the individual team member or faculty advisor wanting access must be linked to the team in SAE's system.

Access Procedure - Once your team has registered there will be a link to the technical standards titled "Design Standards" on the main registration screen where all the required onsite team information is added. On the technical standards webpage you will have the ability to search standards either by J-number assigned or topic of interest such as brake light.

A list of accessible SAE Technical Standards can be found in Appendix S.

## **ARTICLE 4: Individual Participation Requirements**

### **A.4.1 Individual Participant Requirements**

Individual members of teams participating in this competition must satisfy the following requirements:

- (a) Student Status: Team members must be enrolled as degree seeking undergraduate or graduate students. Team members who have graduated during the seven (7) month period prior to the competition remain eligible to participate.
- (b) More than 2 students per a team must be members of at least one of the following societies : (1) SAE or an SAE affiliate society (2) ATA (3) IMechE for participating in 2011 competition in Korea. Join SAE at <http://www.sae.org/students>
- (c) Liability Waiver and Insurance: All on-site participants and faculty are required to sign a liability waiver upon registration. Individual medical and accident insurance coverage is the sole responsibility of the participant.

#### **A.4.1.1 Driver Requirements and Limitations**

Each team must register two drivers.

- (a) Submit a copy of a valid driver's license at registration.
- (b) Insurance for medical and accident coverage is not required.
- (c) Drivers must hold a valid government issued driver's license at any time during a competition (2019)

#### **A.4.1.2 Ringers Prohibited**

In order to maintain the credibility of fair competition at Baja SAE® competitions, the Faculty Advisor must prohibit "ringers." A ringer is someone that has exceptional skills related to the competition who cannot be a legal member of the team.

### **A.4.2 Faculty Advisor**

Each team is expected to have a Faculty Advisor appointed by the university The Faculty advisor is expected

to accompany the team to the competition and will be considered by competition officials to be the official university representative.

Faculty Advisors may advise their teams on general engineering and engineering Project management theory, but may not design any part of the vehicle nor directly participate in the development of any documentation or presentation.

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

Faculty Advisors are not allowed to participate during technical inspection or design Presentation. The team captain or other designated members of the team must do all the presenting in brief. Faculty Advisors may not design, build or repair any part of the vehicle.

Each team's faculty advisor must stay during competition. The authorized professor or assistant from the faculty advisor have to be in attendance at competition, if the faculty advisor can't. (Faculty advisor or authorized professor must attend competition one day.)

#### **A.4.3 International Participation**

International participants requiring visa letters in order to participate in Korea must contact the organizer of the Baja SAE® KOREA at Yeungnam University directly.

#### **A.4.4 International Participation -Vehicle Shipping**

SAE & Baja SAE®. Organizers strongly recommend that you ship your vehicle early in order to allow enough time to compensate for any delays that may occur in clearing Korean Customs. Please check with the Korean Customs Service concerning the regulations governing the temporary importation of racing vehicles. You may want to consider using the services of a freight forwarder who is familiar with the international shipping of racing vehicles.

Neither SAE staff nor the Baja SAE®. Event Organizers are permitted to provide advice on Korean Customs matters

### **ARTICLE 5: Eligibility – Vehicle**

#### **A.5.1 Student Created**

The vehicle and associated documentation must be conceived, designed and fabricated by the team members without direct involvement from professional engineers, faculty or professionals in the off-road and racing communities.

#### **A.5.2 Professional Fabrication Limits**

Vehicles which have been professionally fabricated may be disqualified from competition. If a team does not have access to machine shop facilities, the frame can be professionally fabricated without penalty. Lack of access must be documented (letter from faculty advisor, copy of policies which prohibit machine shop access, etc.).

A

#### **A.5.3 Kit Vehicles -Prohibited**

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

#### **A.5.4 Prefabricated Subassemblies**

These rules do not exclude the use of prefabricated or modified sub-assemblies.

#### **A.5.5 Previously Entered Vehicles**

Vehicles that have competed in a previous Baja SAE® competition or an intercollegiate Auto Festival at Yeungnam University cannot be used without significant modification.

## ARTICLE 6: Registration

### A.6.1 Registration Deadline

The official registration form must be completed by each entrant and submitted to the competition organizer by Friday, June 16, 2019. Late entries will not be accepted.

### A.6.2 Registration Fee

<http://race.yu.ac.kr/>: The registration fee information is posted on the web site.

### A.6.3 Registration Limits

There are no registration limits for Baja SAE® Korea 2019.

## PART B: TECHNICAL REQUIREMENTS

### ARTICLE 1: General Design Requirements

#### B1.1 Vehicle Design Objective

The vehicle design should be attractive to consumers because of its visual appearance, performance, reliability and ease of operation and maintenance. It should also be manufacturable using predominantly semi-skilled labor and standard machine tools. Safe operation must be an essential consideration in your design.

#### B.1.2 Vehicle Configuration

The vehicle must have four (4) or more wheels not in a straight line. Three (3) wheeled vehicles are expressly prohibited from the competition. The vehicle must be capable of carrying one (1) person (with a height of 190cm (6 foot 3 inches) and weighing 113kg (250 lb).)

##### B.1.2.1 Maximum Vehicle Dimensions

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

Length : Unrestricted, but see the note below.

NOTE : Teams should keep in mind that Baja SAE® courses are designed for vehicles with maximum dimensions of 64 in width by 108 in length.

#### B.1.3 All-Terrain Capability

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

### ARTICLE 2: Required Engine

All vehicles must use a gasoline engine: (a) less than 125cc displacements, (b) made in Korea. For Foreign Teams, they can use Non-Korean Engine except that made in Japan, and (c) one cylinder with four strokes. The following types of engines will NOT be allowed; rotary engine.

**Any kind of engine tuning or modification is PROHIBITED; except for mapping**

#### B.2.1 Air-Cooled 4 Cycle Engine

##### B.2.1.1 Replacement part

Only original parts will be permitted.

##### B.2.1.2 Air cleaner

Original air cleaner for the selected engine must be used.

##### B.2.1.2 Carburetor

All vehicles must use a Carburetor made in Korea. The maximum Carburetor diameter is less than or equal to 30mm



### **B.2.1.3 Oil cooler / Radiator**

Original oil cooler or radiator for the selected engine must be used.

Using oil cooler fan is possible. Diameter of fan is less than oil cooler's shorter length. (Only original radiator is allowed.)

## **B.2.2 Water-Cooled Type or Scooter Type Engine (CVT Type Engine)**

### **B.2.2.1 Intake System Restrictor (water-cooled engine)**

In order to limit the power capability from the engine, a single circular restrictor must be placed in the intake system between the throttle and the engine and all engine airflow must pass through the restrictor.

**B.2.2.2** The maximum restrictor diameter is less than or equal to 25mm

**B.2.2.3** The restrictor must be located to facilitate measurement during the inspection process.

**B.2.2.4** The circular restricting cross section may NOT be movable or flexible in any way, e.g. the restrictor may not be part of the movable portion of a barrel throttle body.

**B.2.2.5** Only water can be used on the cooling water. (water-cooled engine)

## **ARTICLE 3: Exhaust System**

### **B.3.1 Muffler**

Original muffler with the selected engine must be used, but may be relocated. Tuned exhaust systems are prohibited. All exhaust gas must pass through a single muffler. Multiple mufflers are not allowed. Noise level must NOT exceed 95dB at 6,000 rpm when it is measured at 2 meters from the exhaust. Exhaust hole must face rear.

### **B.3.2 Muffler Support**

Supports of the exhaust pipe and muffler are strongly recommended.

### **B.3.3 Extra Hole & Tube**

No extra holes or tubes are allowed in exhaust pipe and muffler.

### **B.3.4 Starter**

Only self-starting device to start motor is allowed.

### **B.3.5 Tachometer**

Instrument panel MUST include tachometer to indicate engine rpm.

### **B.3.6 Engine Inspection**

The engine service experts from Daelim and Hyosung Company will be on-site during the competition and allowed to inspect any engine at any time.

## **ARTICLE 4: Electrical System**

### **B.4 General Electrical System Overview**

The electrical system must include at least two kill switches, a brake light, and a battery power source. The kill switches must deactivate the engine ignition. The kill switches must NOT deactivate the brake light or reverse light. The brake light must operate regardless of the kill switch setting. The brake light, and any reverse light and alarm, must be powered whenever the vehicle is in motion. **The brake light, and any reverse light and alarm,**

**must be powered and functional at all times. Cut-out or disabling switches to the brake light and reverse light (if so equipped) are prohibited.**

### B.4.1 Battery Requirements

The batteries must be sealed and not leak in the event of a roll over. A sealed battery is one that is incapable of being opened or serviced. The batteries can only provide power to accessories on the vehicle (brake light, reverse light & beeper, data acquisitions, and other instrumentation). Final approval on any batteries used will come from the National Technical Inspectors. The battery must be able to provide power to safety items for the duration of the entire event. Cars will be black flagged if safety equipment is not functioning. Batteries must be mounted with sound engineering practice. The mounting must prevent the battery from coming loose during a roll over.

## B.4.2 Onboard Instrumentation/Data Acquisition/Electronic Controls

Onboard instrumentation, data acquisition, and electronic controls of the suspension and transmission are all allowed; the power for these components must come from approved batteries per 22.1 if the battery is being charged by a Briggs alternator.

#### B.4.2.1 Electronic Controls

Electronic control of suspension and transmission systems is allowed. All power must come from the engine itself. The power can come from an approved battery if the battery is being charged by a alternator.

### B.4.3 Kill Switches

Each vehicle must be equipped with two (2) easily accessible kill switches turning off the ignition and entire electrical system of the car. These switches must also disconnect an auxiliary fuel pump if fitted. The Kill switch must not de-energize the Brake.

### B.4.3.1 Kill Switch – Type

The kill switches must be one of the following:

(A) 01-171 Ski-Doo kill switch available at <http://www.mfgsupply.com/m/c/01-171.html?id=UxSI4Vzn>

(B) After market WPS#27-0152 or 27-0124

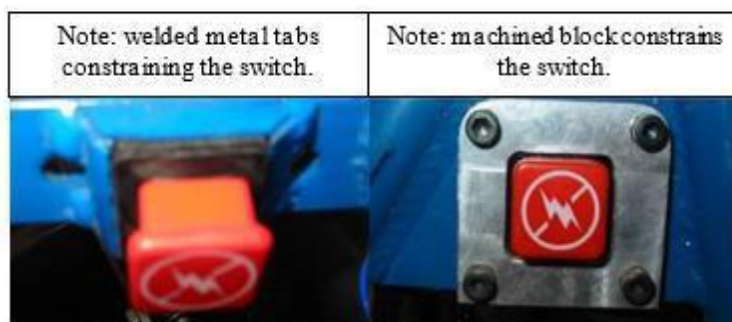
<http://www.parkeryamaha.com/index.asp?PageAction=PRODSEARCH&txtSearch=27-0152&Page=1>

(C) A Stock Polaris # 4110106

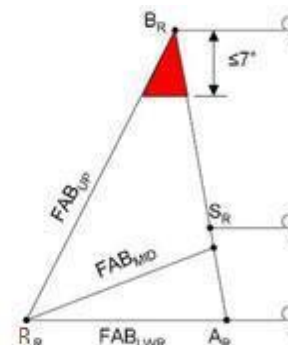
#### B.4.3.2 Kill Switch -Locations and Orientation

(a) Cockpit Switch -The cockpit switch must be located in the front of the cockpit within easy reach of the driver when strapped into the seat. The switch may not be mounted on a removable steering wheel assembly.

(b) External Switch -One of the required kill switches shall be located within easy access to track workers on the right side of the vehicle, aft of the plane of the RRH, and forward of the right FABUP. The external kill switch shall be generally perpendicular to the firewall ( $\pm 15$  deg), below frame point BR, and no further than 180 mm (7.0 inches), dimension "Red" in Figure 2 , below frame point BR, and shall be mounted on a tab connected directly to the RRH. The external kill switch shall not be recessed more than 51 mm (2.0 inches) from the outside edge of the RRH tube.



### Figure 1



### Figure 2

### **B.4.3.3 Kill Switch -Labels**

Both switches must be clearly labeled as the "kill switch." The cockpit switch must also have "run" and "kill" positions labeled.

### **B.4.3.4 Wiring**

All wiring must be sealed, protected or securely attached to the frame to prevent the wires from being entangled with the driver or obstacles. Sound engineering practices must be used.

## **B.4.4 Brake Light**

- B.4.4.1** The vehicle must be equipped with a red brake light that is mounted such that the light shines parallel to the ground, not up at an angle. The brake light must be mounted at a minimum of 1 meter (39.4 in) off of the ground, generally between half and the top third of the height of the firewall. The determination of whether or not a brake light meets the required standards rests with the National Technical Inspectors.

### **B.4.5 Brake Light Switch**

The brake light must be activated by hydraulic pressure switches. Each independent brake hydraulic circuit must be equipped with a brake light switch, so that no brake, including cutting brakes may be activated without lighting the brake light. This means each vehicle is required to have a minimum of two (2) hydraulic pressure switches.

Note: **Push style or momentary switches are not allowed.**

## **B4.6 Reverse Light and Alarm**

Vehicles with reverse must be equipped with a backup light marked with an SAE "R" on the lens **and be of LED design**, equal to, or exceed the SAE standard J759. The reverse light must be mounted at a minimum of 70 cm (27.6 in) above the ground. Vehicles with reverse must also be equipped with a backup alarm. The alarm must be rated per SAE standard J1741 or J994 and sound whenever the vehicle is in reverse.

## **B4.7 Instrumentation and Data Acquisition**

### **B4.7.1 Live Data or Driver Feedback Instrumentation and Data Acquisition**

Systems that provide live information about the cars operation or performance are allowed.

### **B4.7.2 Data Loggers and Event Recorders**

Systems that do not provide live information about the cars current operation or performance are allowed.

## **ARTICLE 5: Towing Hitch Point**

- B.5.1** Each vehicle must have towing hitch points at the front and rear, along its longitudinal centerline. When in use hitch plates must be rigidly affixed to the vehicle's main frame. adjustable/ repositionable hitch plates are permitted.

NOTE: Towing hitch points are requirements for both competition events and vehicle recovery

### **B.5.2 Front and Rear Hitch Points**

The hitch points must be strong enough to serve as a vertical lift points for the vehicle. The hitch points, when not attached to a tow rope, may not present a danger of penetration in the event of a collision.

#### **B5.2.1 Front Hitch Point Requirements – Maximum and Minimum**

Front Hitch Point Requirements –Maximum and Minimum

Maximum diameter 31.75 mm (1.25 in.), Minimum diameter 25.4mm (1 in.)

Minimum wall thickness of 0.89 mm (.035 in)

Hitch point height must be no higher than the SIM and no lower than the LFS

The hitch gauge shown in Figure 3. 50.8 X 50.8 X 203.2 mm (2" X 2" X 8" in.) must be able to pass completely behind the front hitch.

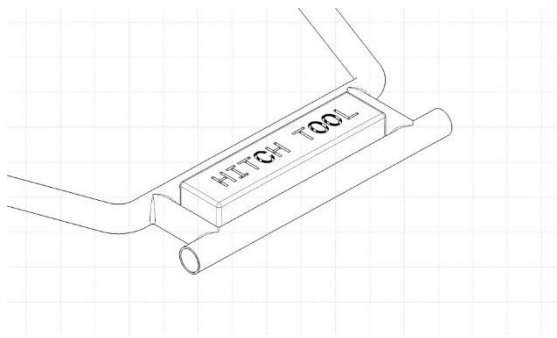


Figure 3

### B.5.3 Rear Hitch Plate

The rear hitch point must be a plate complying with the requirements of B.5.4

### B.5.4 Hitch Plate Requirements – Maximum and Minimum

Towing plate **Minimum / Maximum** thickness – 3.18 mm (.125 in) / 9.5 mm (.375 in)

Hole diameter **Minimum / Maximum** – 25.4 mm (1.0 in) / 31.75 mm (1.25 in)

Radial clearance **Minimum / Maximum** from hole – 15.875 mm (0.625 in) / 25.4 mm (1.0 in)

Hole to tube **Minimum / Maximum** clearance – 19.0 mm (.75 in) / 25.4 mm (1.0 in)

Hitch plate **Minimum** width where connected to frame – 76.2 mm (3.0 in)

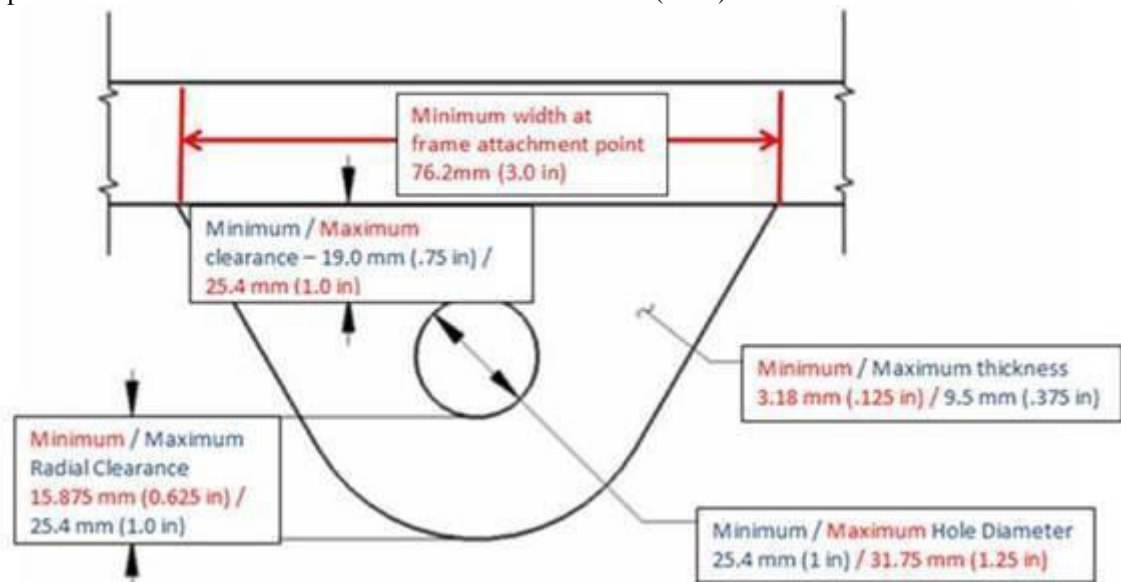


Figure 4

## ARTICLE 6: Vehicle Identification

### B.6.1 Number Assignment

It is each team's responsibility to provide its vehicle number. The numbers must be clearly visible from both sides, the front and rear of the vehicle. Additionally the team must see that the numbers remain readable throughout the competition. If a vehicle's numbers are illegible then it may not be scored.

**Comment:** Schools that are entering more than one vehicle should consider painting them in individually distinctive colors to facilitate in lap counting.

### B.6.2 Vehicle Number-Primary Cutout

Each vehicle must have numbers where the outer face is a minimum of (one half inch) .5 inches from the backing panel of contrasting color an example of which is shown in the figures. The number must be a block style numeral that is clear and easy to read. Vehicles with numbers that are hard to read, missing, damaged or obscured may not be scored and may be black flagged. It is recommended that the numbers be outlined as well to further provide contrast.

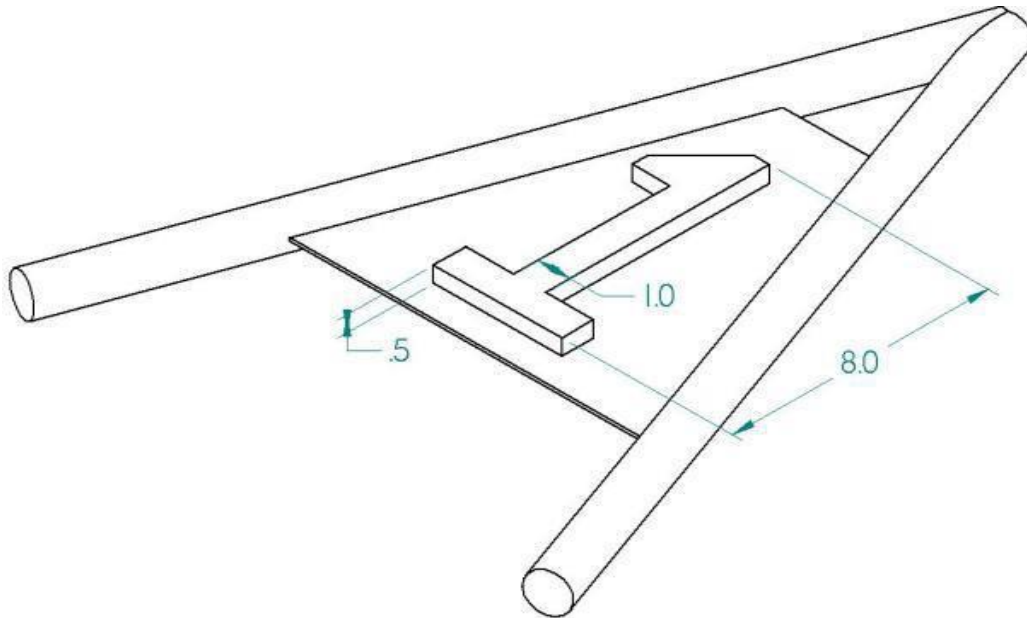


Figure 5

#### **B.6.2.1 Number Location**

Three primary numbers are required to be securely affixed to the car. One on both of the upper sides of the frame behind the roll hoop, clearly visible in a side view. One must also be visible from a front view.

#### **B.6.2.2 Number Size**

The cutout numbers must be at least 203 mm (8 in) high. These have a minimum line width of 25mm (1 in.) and 102 mm (4 in) wide. The numbers must strongly contrast with the numeral background color.

COMMENT: Avoid having sharp edges or points on the outer sides of the cutout numbers.

#### **B.6.3 Vehicle Number - Body**

All vehicles must display their assigned number in block numerals on the front and both sides. These numbers must be at least 203.2 mm (8 inches) high, have a minimum line width of 25.4 mm (1 inch) and must strongly contrast with the background vehicle color.

#### **B.6.4 School Name**

All vehicles must display their school name or initials, in roman characters, if unique and generally recognized, on each side in characters at least 25.4 mm (1inch) high. Teams may also display their school name in non-roman characters provided that the roman character set is highest on the car.

#### **B.6.5 Sponsor logos**

##### **B.6.5.1 SAE Logo**

Two (2) SAE logos must be displayed on the vehicle in prominent locations.

##### **B.6.5.2 Sponsor Identification**

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

#### **B.6.6 Vehicle Flag**

A whip-mounted blaze orange warning flag located a minimum of 2.134 m (7 feet) and a maximum of 2.438 m (8 feet) above the ground is MANDATORY. The top must have a blunt end and 50.8 mm (2 inch) diameter is recommended. A school pennant or flag may be added, but the orange warning flag shall be the highest position.

Flag size : width 300 mm ~ 350 mm

length 250 mm

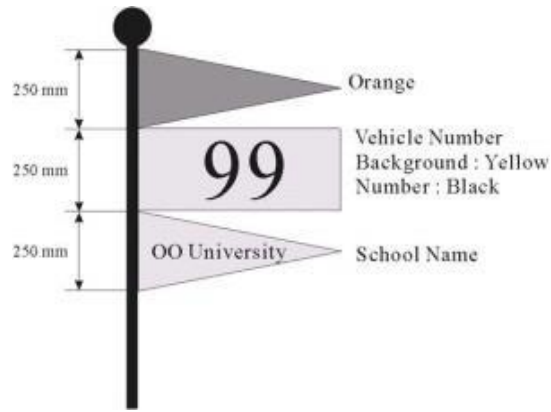


Figure 6

## ARTICLE 7: Electric Vehicle Requirements (Other Session)

Electric Vehicle Competition is a new program from 2019 Baja SAE® Korea. This year, it would be run as other demonstration session with rewards. All EV Baja Car must pass every Baja safety rules such as structure, braking and others without Electric Power Train. And they will have a same static and dynamic event but 1 lap of endurance event.

### B.7.1 Motor

Any type of motors is allowed, but nominal power must not exceed 10kW and maximum power must not exceed 22 kW.

### B.7.2 Battery

Battery capacity must not exceed 4kWh.

### B.7.3 Electrical Throttle Actuation

If electrical throttle actuation is used, the throttle actuation system must be of a fail-safe design to assure that any single failure in the mechanical or electrical components of the throttle actuation system will result in a closed throttle. Teams are strongly encouraged to use commercially available electrical throttle actuation systems.

### B.7.4 Electrical Rules

Note: It is strongly recommended that SAE Standard J1673 “High Voltage Automotive Assembly Wiring Design” be complied with wherever possible. Disregarding these engineering and construction practices can cost a team design points. Where there are differences between SAE J1673 and the Formula Hybrid rules, the Formula Hybrid rules will take precedence.

#### B.7.4.1 High-Voltage (HV) Isolation

High Voltage is defined as any system (individually or in series) containing or producing a voltage greater than 30V. There must be no connection between the frame of the vehicle (or any other conductive surface that might be inadvertently touched by a crew member or spectator), and any part of any HV circuits. HV and low-voltage circuits must be physically segregated:

Not run through the same conduit.

Where both are present within an enclosure, separated by insulating barriers such as Nomex, Formex, or other moisture resistant, UL recognized insulating materials.

If both are on the same circuit board, they must be on separate, clearly defined areas of the board.

##### B.7.4.1.1 Ground Fault Detectors

All vehicles shall be equipped with an on-board Ground Fault detector. This must be a Bender IR486, IR475LY3 or equivalent if approved by the organizers. The output relay of this device must be wired in series with the shutdown buttons such that a ground fault will cause an immediate shutdown of all electrical systems. The ground fault detector should be accessible, or have a remote LED indicator to show when it has tripped.

##### B.7.4.1.2 Ground Fault Detector Test

The ground fault detector will be tested during tech. inspection, by connecting, a 40,000  $\Omega$  resistor between

multiple points on the HV circuit and the grounded frame with the HV systems at full charge. (See Figure7). This must cause the Ground Fault detector to trip, and the vehicle electrical systems to shut down. This test may be repeated by the electrical inspectors at any time during the competition. Once the Ground fault test has been satisfactorily completed, the scrutineers will seal the High Voltage enclosures. If the seals are broken, the vehicle may not participate in any dynamic events until the Ground Fault test has been satisfactorily re-done. (If a repair is simple, and done in the presence of an Electrical Inspector, the Chief Electrical Inspector may choose to waive the re-testing requirement.)

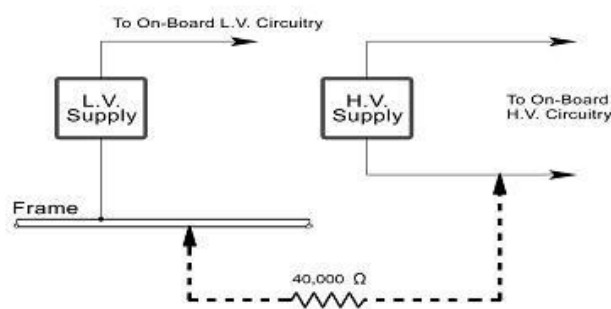


Figure 7

#### **B.7.4.1.3 Rain Certification**

A vehicle may not be operated in wet conditions unless Rain Certified. To become Rain Certified, a vehicle must first pass the Ground Fault test outlined in 25.4.1.2. It must then survive a 30 second water spray with all systems energized without tripping the Ground Fault Detector.

#### **B.7.4.2 No Exposed Connections**

No HV connections may be exposed. Non-conductive covers must prevent inadvertent human contact. This would include crew members working on or inside the vehicle.

HV systems and containers must be protected from moisture in the form of rain or puddles for any car that is certified to run rain or wet conditions. (See section B.7.4.1.3)

There will be no HV connections behind the instrument panel or any cockpit switch or control panels. All controls, indicators and data acquisition connections must be isolated using optical isolation, transformers or the equivalent.

#### **B.7.4.3 HV Insulation, Wiring and Conduit**

All insulation materials used in HV systems must be rated for the maximum temperatures expected. Insulated wires must be commercially marked with a wire gauge, temperature rating and insulation voltage rating. Other insulation materials must be documented. All HV wiring must be done to professional standards with appropriately sized conductors and terminals and with adequate strain relief and protection from loosening due to vibration etc.

All HV wiring that runs outside of electrical enclosures must be enclosed in orange non-conductive conduit, such as Electric-flex LNMP or equivalent<sup>5</sup>. The conduit must be securely anchored at least at each end, and must be located out of the way of possible snagging or damage. All external heat sinks must be securely grounded.

#### **B.7.4.4 Fusing**

All electrical systems (both low and high voltage) must be appropriately fused. Any wiring protected by a fuse must be adequately sized and rated for current equal to the fuse rating (See wire requirements in B.7.4.3)

#### **B.7.4.5 Accumulator Type and Size**

Total accumulator voltage may not exceed 400V. Accumulator capacity may not exceed 7,250 Wh. Teams must state, as accurately as possible, their accumulator capacity. There is a \$6,000.00 limit on the "standardized" cost of the accumulator system. An equivalency table will be published. Energy accumulators must be of an approved type. At this time only batteries and capacitors are permitted.

#### **B.7.4.6 Energy Storage Container Electrical Configuration**

All energy storage must be in closed containers containing normally open isolation relays wired in such a way that when an incoming "energize" signal is interrupted no voltages will be present outside of the containers. The boxes must also include an appropriately rated fuse or circuit breaker. The relays must be rated to interrupt

the rated fuse current at the maximum expected voltage. Contactors and relays containing mercury are not permitted.

Multiple energy storage containers connected in series may be isolated by a total of two relays, provided that interconnects between the containers are protected by non-conductive conduit (See Section B.7.4.3) anchored solidly to the containers. All voltages outside the energy storage container must decay to below 30 V within ten seconds of when the relays are disconnected. For example, filter capacitors must have bleeder resistors across them.

The energy storage containers must have closable access ports allowing a 6" electrical probe to make contact with each extreme of the HV system. These will be used to permit testing the isolation stipulated in section B.7.4.1.2. Optionally, access to the same electrical nodes may be provided at another point. Each energy storage container must have a prominent indicator, such as an LED that will illuminate whenever that container contains a voltage greater than (at a maximum) 30V. This must be clearly visible in direct sunlight. As an alternative, the battery container may contain an "embedded" analog meter clearly visible from the outside.

#### **B.7.4.7 Energy Storage Container Mechanical Configuration**

The energy storage container and mounting system must be sturdy, considering forces encountered during on-course competition and the possibility of a rollover accident. The materials used to construct the container should ideally be electrically insulating, mechanically robust, fireproof, and transparent to allow easy inspection. Not all of these properties are available in a single material, but the following are required:

At least one layer of fireproof material between the driver and the energy storage container.

Mechanically robust, fireproof insulating material (e.g., Nomex) between live electrical parts and any conductive portions of the container.

Adequate structural robustness for the weight of the accumulator. There must be no unintentional electrical conduction paths through any of the walls of the container. (Metal screws, rivets, etc.) The container must be prominently labeled with high voltage signs, at least 30 in<sup>2</sup>, with a red (or white on red) lightning bolt and the text "High Voltage" or "Danger High Voltage" Systems capable of venting H<sub>2</sub> gas (batteries) must have an active ventilation system that is active whenever the system is charging, whether from on-board or off-board sources.

#### **B.7.4.8 Low-Voltage Circuits**

Low-voltage (< 30 V) circuits must be grounded to the frame of the car. (This ensures that, in the event of a fault in the isolation of the HV circuit, no HV will be present between controls or anything else that personnel might touch and the frame.) If the low-voltage circuits are powered by a battery or other source that is not inherently current limited, proper fusing must be used. Low-voltage and HV circuits must be segregated and isolated as described in Section B.7.4.1 The capacity of the Low Voltage battery need not be included in the overall vehicle accumulator capacity calculations.

#### **B.7.4.9 Charging Equipment**

All charging equipment must be maintained in safe working condition. High Voltage chargers and/or power supplies must be marked with appropriate High Voltage stickers. If any voltage remains outside the charger after the power is turned off then any open connections must be securely covered. All chargers must be UL (Underwriters Laboratories) listed. The vehicle must be de-energized while charging from external sources (as much as possible while still allowing charging), and no other activities (including any mechanical or electrical work) shall be allowed.

### **ARTICLE 8: Roll cage**

#### **B.8.1 Introduction**

The following design requirements apply to all Baja competitions. A few of the regulations may not pertain to all events. For example, the rules concerning deep water only apply to Mini Baja East. These design and technical rules will be strictly enforced. It is the responsibility of each team to meet all technical requirements. Failure to do so may mean disqualification from the competition. If you have any doubts about any technical requirement, present your questions, by email, to the National Technical Inspectors who will make their best efforts to respond within 2 weeks.

##### **B.8.1.1 Rules Requirements and Restrictions**



### **B.8.1.1.1 Technical Inspection**

All Baja SAE® vehicles must pass a technical inspection before they are permitted to compete. Once a vehicle has passed technical inspection it must remain in "as approved" condition throughout the competition. Repairs must be made with identical parts.

### **B.8.1.1.2 Required Modifications**

All installations and construction are subject to the approval of the technical inspectors, who may require modifications at their discretion. All competitors should be prepared to note these modifications during technical inspections.

### **B.8.1.1.3 Unsafe Vehicles**

Any vehicle exhibiting handling or other vehicle dynamics that are deemed unsafe or unstable by the technical inspectors will not be permitted to participate in the dynamic events.

## **B.8.2 Roll Cage**

### **B.8.2.1 Objective**

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

#### **B.8.2.1.1 Lateral Space**

Minimum space is based on clearances between the driver and a straight edge applied to any two points on the roll cage. The driver's helmet shall have 152 mm (6 in.) clearance, while the driver's shoulders, torso, hips, thighs, knees, arms, elbows, and hands shall have 76 mm (3 in.) clearance. Clearances are relative to any driver selected at technical inspection, seated in a normal driving position, and wearing all required equipment

For any member to be a part of the roll cage, that member must conform to B8.2.2.1, otherwise it is assumed to have no contribution (a-arms are an example of members which do not conform to B8.2.2.1)

If there are any triangulating members joining the SIM or the RHO to the vertical members of the Rear Roll Hoop (RRH-B8.2.2.2), and these triangulating members conform to B8.2.2.12, then the virtual side surfaces may be extended by an outboard crease over the triangulating members.

**The driver's helmet shall have 152 mm (6 in.) clearance to the side surfaces.**

The driver's shoulders, torso, hips, thighs, knees, arms, elbows, and hands shall have 76 mm (3 in.) clearance to the side surfaces.

#### **B.8.2.1.2 Vertical Space**

The driver's helmet shall have 152 mm (6 in.) clearance to the top of the roll cage, defined by the top surface (not centerline) of: the RHO members (exclusive of any covering); the RRH upper, LC; and the LC between points C. In an elevation (side) view, no part of the driver's body, shoes, and clothing may extend beyond the envelop of the roll cage.

## **B.8.2.2 Roll Cage Structures**

### **B.8.2.2.1 Elements of the Roll Cage**

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

**Frame:** The entire tubular structure including all non-cantilevered tubes.

**Roll Cage:** Primary and Secondary Members used to protect the driver.

**Member:** A Primary or Secondary required element beginning and ending at Named Points.

The required members of the roll cage are illustrated in RC1.

Primary members must conform to B8.2.2.12.

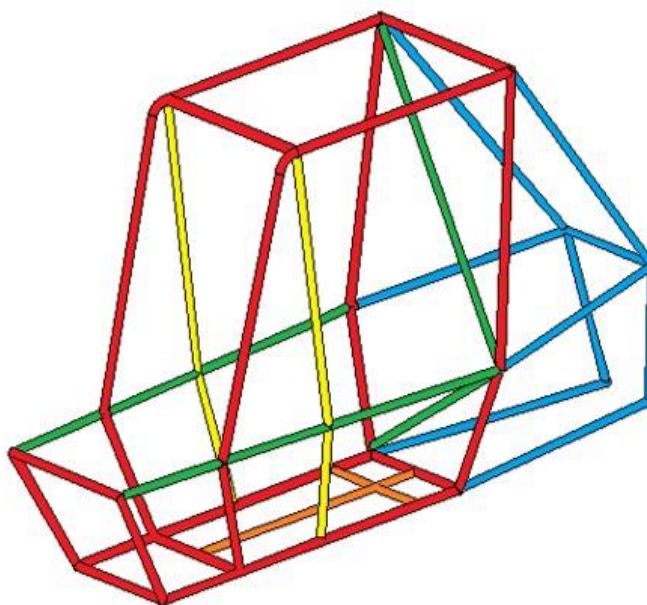
### Primary members are:

RRH: Rear Roll Hoop  
RHO: Roll Hoop Overhead Members  
FBM: Front Bracing Members  
ALC: Aft Lateral Cross Member in Rule B8.2.2.3  
BLC: Overhead Lateral Cross Member  
FLC: Front Lateral Cross Member in Rule B8.2.2.4  
CLC: Upper Lateral Cross Member  
DLC: SIM Lateral Cross Member  
LFS: Lower Frame Side Members

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

### Secondary members are:

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



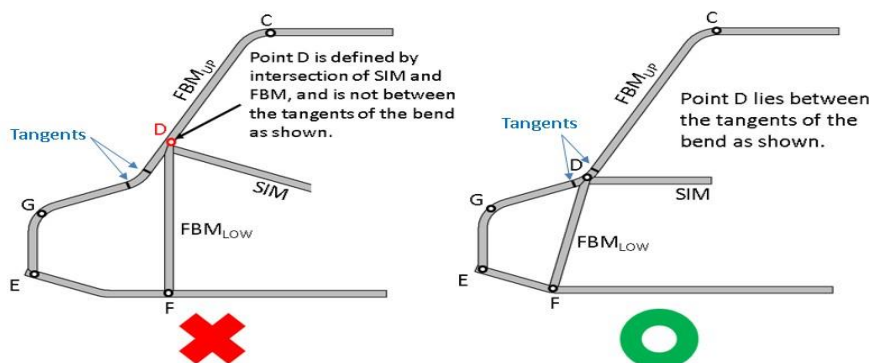
- Primary Members
- Secondary Members
- Secondary Members FAB (B8.2.2.9.1)
- Secondary Members FAB (B8.2.2.9.2)
- Secondary Members USM (B8.2.2.7)

*RC 1*

### B8.2.2.1.1 Roll Cage Member Requirements

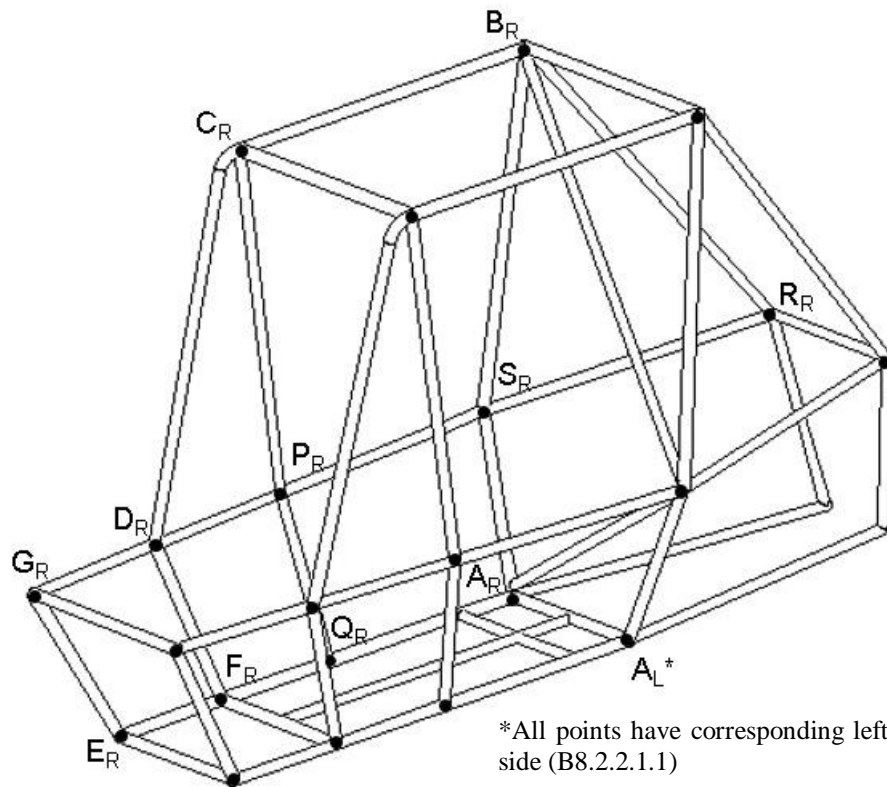
Roll cage members must be made of steel tube, and may be straight or bent. Straight members may not extend longer than 1016mm (40 in.) between Named Points. Bent members may not have a bend greater than 30° that does not occur at a Named Point; and may not extend longer than 838 mm (33 in.) between Named Points. Small bend radii (<152 mm, 6 in.) that terminate at Named Points are expected, and are not considered to make a member bent, regardless of angle. A bend that terminates at a Named Point implies the point lies between the tangents of the bend, as shown in RC2. Required dimensions between roll cage members are defined by measurements between member centerlines, except where noted.

**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



*RC 2*

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 RC3.



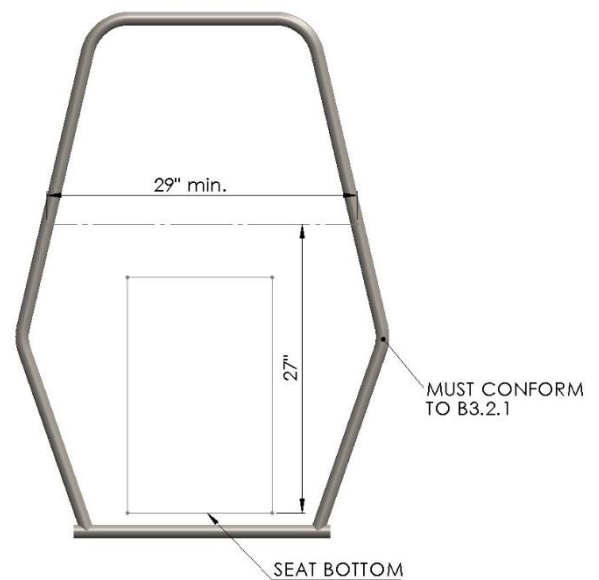
### RC 3

#### B8.2.2.2 Lateral Cross member Requirements

Lateral cross members cannot be less than 203.5 mm (8 in) long. They cannot have a bend; however they can be a part of a larger, bent tube system, provided the minimum length is met between bend tangents. The cross members which connect the left and right points A, B, C, D, F and E/G for 'Nose' cars (in which case DLC may be omitted) must be made of primary materials. LCs are denoted by the points they connect (*e.g.* ALC, FLC, etc.).

#### B.8.2.2.3 Rear Roll Hoop (RRH)

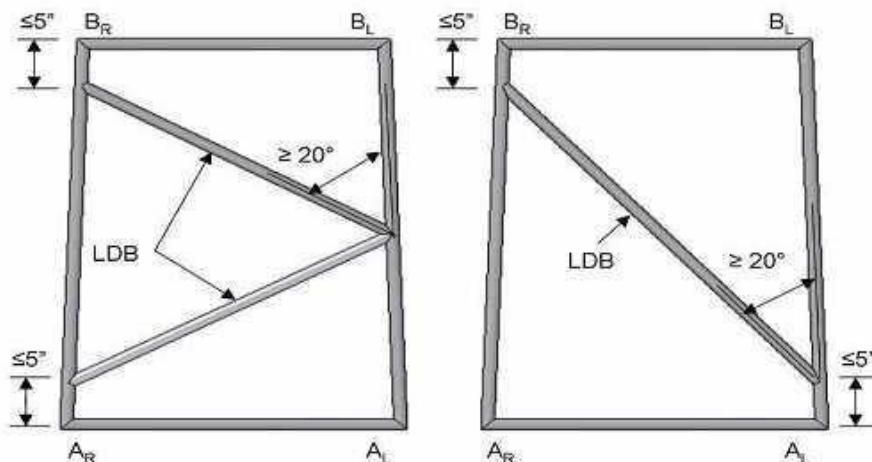
The RRH is a structural panel behind the driver's back, and defines the back side of the roll cage. The driver and seat must be entirely forward of this panel. The RRH is substantially vertical, but may incline by up to 20° from vertical. The minimum width of the RRH, measured at a point 686 mm (27 in.) above the inside seat bottom, is 736 mm (29 in.). The vertical members of the RRH may be straight or bent, and are defined as beginning and ending where they intersect the top and bottom horizontal planes (points AR and AL, and BR and BL in RC4). The vertical members must be continuous tubes (i.e. not multiple segments joined by welding). The vertical members must be joined by ALC and BLC members at the bottom and top. ALC and BLC members must be continuous tubes or adhere to B8.2.2.10. ALC, BLC, both RRH members, LDB and the shoulder belt tube must all be coplanar.



### RC 4

#### B.8.2.2.3.1 Rear Roll Hoop Lateral Diagonal Bracing (LDB)

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



#### B.8.2.2.4 Roll Hoop Overhead members (RHO)

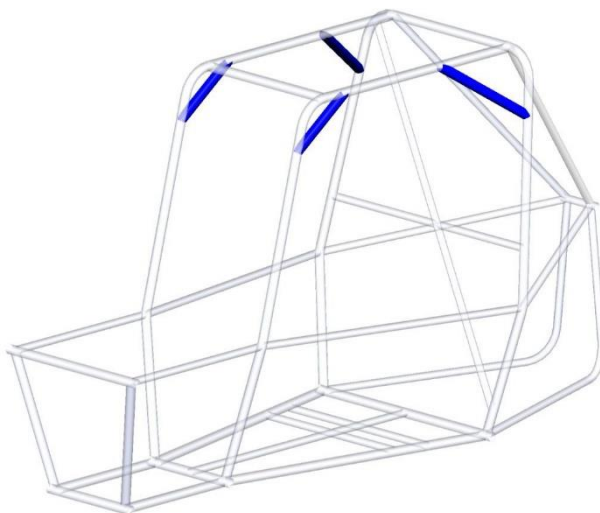
The forward ends of the RHO members (intersection with the CLC) define points CR and CL (RC3). Points CR and CL must be between at least 305 mm (12 in.) forward of a point, in the vehicle's side view, defined by the intersection of the RHO members and a vertical line rising from the aft end of the seat bottom. This point on the seat is defined by the seat bottom intersection with a 101 mm (4 in.) radius circle which touches the seat bottom and the seat back. The top edge of the template is exactly horizontal with respect to gravity.

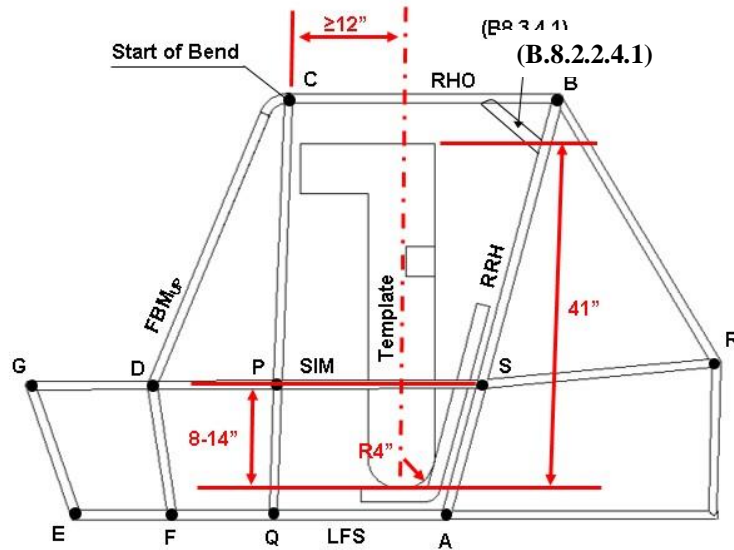
Points CR and CL must also be no lower than the top edge of the template, 1041.4 mm (41 in) above the seat.

Note: The top edge of the template is exactly horizontal with respect to gravity.

#### B8.2.2.4.1 RHO/RRH Gusseting

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

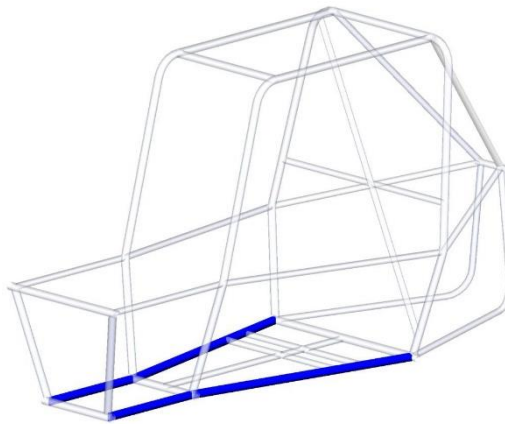




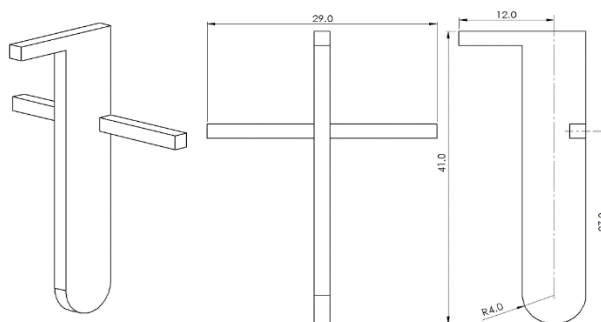
**RC 5**

### B.8.2.2.5 Lower Frame Side members (LFS)

The two Lower Frame Side members define the lower right and left edges of the roll cage. These members are joined to the bottom of the RRH at Point A and extend generally forward, at least as far as a point forward of every driver's heels, when seated in normal driving position. The forward ends of the LFS members are joined by a lateral cross member, FLC (RC6). The intersection of the LFS members and the FLC define the points FR and FL. In 'Nose' designs, as shown in RC5, the LFS extends forward to Point E, and is joined by a lateral cross member FLC and ELC (RC3).



**RC 6**





#### B.8.2.2.6 Side Impact members (SIM)

The two Side Impact Members define a horizontal mid-plane within the roll cage. These members are joined to the RRH, defining Point S, and extend generally forward, at least as far as a point forward of every driver's toes, when seated in normal driving position. The forward ends of the SIM members are joined by a lateral cross member, DLC. The intersection of the SIM and DLC define the points DR and DL. The SIM members must be between 203 mm (8 in.) and 356 mm (14 in.) above the inside seat bottom (RC3) at all positions between points S and D. In 'Nose' designs, as shown in RC5, the SIM extends forward to Point G, and is joined by a lateral cross member GLC (RC3). In this case, DLC may be omitted if GLC provides adequate protection for the driver's toes as noted below.

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

#### B8.2.2.7 under Seat Member (USM)

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

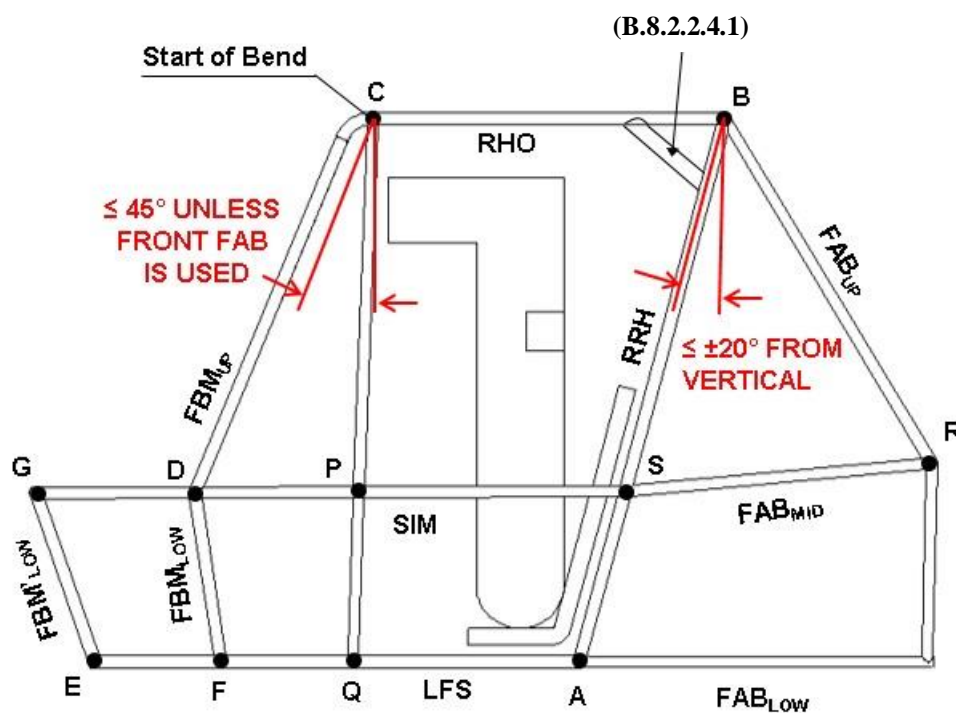
(1) The two LFS members must be joined by the Under Seat Members. The USM must and pass directly below the driver where the template in RC3 intersects the seat bottom.

Or

(2) The ALC and FLC members must be joined longitudinally by the Under Seat Member. The USM must and pass directly below the driver where the template in RC3 intersects the seat bottom.

#### B.8.2.2.8 Front Bracing members (FBM)

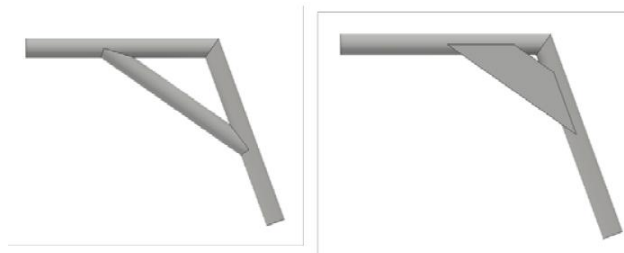
Front Bracing Members must join the RHO, the SIM and the LFS (Fig. RC 7) at Points C, D and F. The upper Front Bracing Members (FBM<sub>UP</sub>) must join points C on the RHO to points D on the SIM. The lower Front Bracing Members (FBM<sub>LOW</sub>) must join points D to points F. The FBM must be continuous tubes. The angle between the FBM<sub>UP</sub> and the vertical must be less than or equal to 45 degrees. If Front FAB, per Rule B8.2.2.9.1, is used there is no angle requirement between FBM and vertical.



RC 7

### B8.2.2.8.1 RHO/FBM Gusseting

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



### B.8.2.2.9 Fore/Aft Bracing (FAB)

The RRH must be restrained from rotation and bending in the side view by a system of triangulated bracing. Bracing must either: 1) Rear Bracing - directly restrain both points B from longitudinal displacement in the event of failure of the joints at points C; or 2) Front Bracing - restrain both points C from longitudinal and vertical displacement, thus supporting points B through the RHO members. Better design will result if both front and rear bracing are incorporated. Members used in the FAB systems must not exceed 1016 mm (40 in.) in unsupported length. Triangulation angles (projected to the side view) must be at least 20° between members.

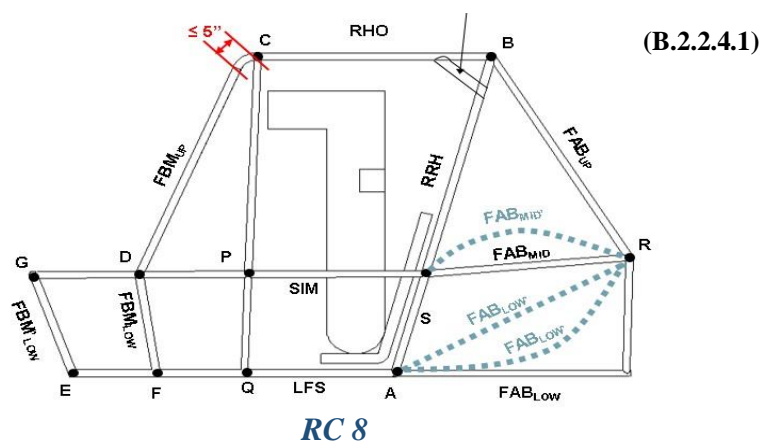
#### B.8.2.2.9.1 Front Bracing

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

#### B.8.2.2.9.2 Rear Bracing

Rear systems of FAB must create a structural triangle, in the side view, on each side of the vehicle. Each triangle must be aft of the RRH, include the RRH vertical side as a member, and have one vertex at Point B and one vertex at either Point S or Point A. The tubes forming this structural triangle must be continuous members; but bends of less than 30° are allowable. The third (aft) vertex of each rear bracing triangle, Point R (Fig. RC8), must additionally be structurally connected to whichever Point, S or A, is not part of the structural triangle. This additional connection is considered part of the FAB system, and is subject to B8.2.2.1, but may be formed using multiple joined members, and this assembly of tubes, from endpoint to endpoint, may encompass a bend of greater than 30 degrees.

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



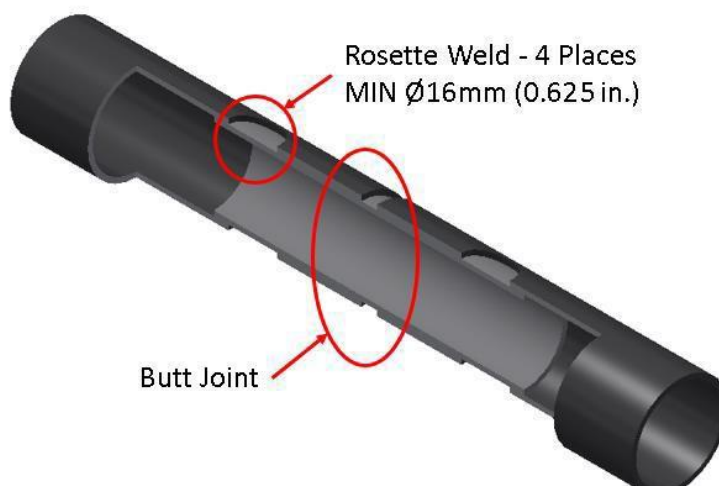
### B8.2.2.10 Tube Joints

**B8.2.2.10.1** Roll cage element members which are made of multiple tubes, joined by welding, must be reinforced with a welding sleeve. Many roll cage members are required to be continuous tubes, and may not be made of multiple pieces. Tubes which are joined at an angle greater than 5 deg. need not be sleeved; angles of less than 5 deg. will be considered butt joints.

**B8.2.2.10.2** Sleeves must be designed to fit tightly on the inside on the joint being reinforced. External sleeves are not allowed. Sleeves must extend into each side of the sleeved joint, a length of at least two times the diameter of the tubes being reinforced, and be made from steel at least as thick as the tubes being reinforced.

**B8.2.2.10.3** The general arrangement of an acceptable sleeved joint is shown in Fig.RC9. A butt weld and four (4) rosette welds (two (2) on each tube piece, on holes of a minimum diameter of 16 mm (0.625 in.) are required.

**B8.2.2.10.4** A minimum of 4 linear inches of weld is required to secure the sleeve inside the joint, including the butt joint and the rosette welds.



*RC 9*

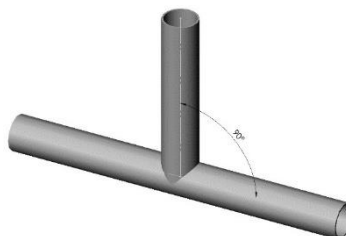
### B8.2.2.11 Welding Process Check

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

Welding samples must be made from the same tube material, diameter, and thickness as the welds made by each person on the roll cage elements.

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

- School Name or School Initials
- Welder Name or Welder Initials
- Date of construction of weld sample



*RC 10*

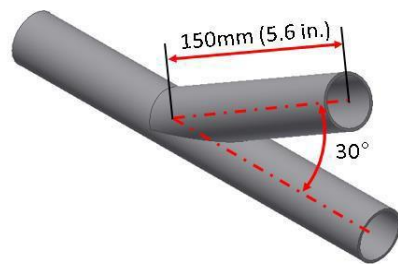


**(A) Sample 1 – Destructive Testing:**

A 90 degree joint, the leg length free (RC10). This joint must be destructively tested causing the joint to fail in the base material (as opposed to the weld metal). The testing method is free-either tensile or bending failure may be induced; however the peak stress must be located at the weld. In the case of bending failure, take care that the largest bending moment is located at the weld.

**(B) Sample 2 – Destructive Inspection:**

Two tubes joined at a 30 degree angle with a length of at least 150 mm (5.9 in.) from the center of the joint (RC11). The sample must be sectioned along the length of tube to reveal adequate and uniform weld penetration (RC12).



**RC 11**



**RC 12**

**B.8.2.2.12 Roll Cage & Bracing Materials**

The material used for all of the required roll cage members must, as a minimum, be either:

- (a) Circular steel tubing with an outside diameter of 25mm (1 in) and a wall thickness of 3 mm (0.120 in) and a carbon content of at least 0.18%.

OR

- (b) A steel shape with bending stiffness and bending strength exceeding that of circular steel tubing with an outside diameter of 25mm (1 in.) and a wall thickness of 3 mm (0.120 in.). The wall thickness must be at least 1.57 mm (0.062 in.) and the carbon content must be at least 0.18%, regardless of material or section size. The bending stiffness and bending strength must be calculated about a neutral axis that gives the minimum values.

Bending stiffness is considered to be proportional to:

$$EI$$

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

$I$  Second moment of area for the structural cross section

Bending strength is given by:

$$\frac{S_y I}{C}$$

where

$S_y$  = Yield strength (365Mpa for 1018 steel (53.7 ksi))

$c$  = Distance from the neutral axis to the extreme fiber

Documentation of the equivalency must include:

1. Typed calculations must be presented at Technical Inspection which proves sufficient bending stiffness and bending strength. All calculations must be in SI units, to three significant figures to the nominal tube sizes as specified by the invoice.
2. Invoices of the roll cage materials

3. Material tests or certifications, which specify the carbon content and yield strength.

Note: For 1018 steel the values are: (  $S_y = 365 \text{ Mpa}$  (53.7 ksi)  $E = 205 \text{ GPa}$  (29,700ksi):

NON-STEEL ROLL CAGES ARE PROHIBITED

### B.8.3.1 Roll Cage Specification Sheet

All teams must submit a copy of the Baja SAE® Roll Cage Specification Sheet (See Appendix) to the National Tech Board by the date specified in the website. ( <http://race.yu.ac.kr> ) Complete roll cage specifications must be supplied with the Roll Cage Specification Sheet. Teams that do not submit a Roll Cage Specification Sheet will not be allowed to compete.

### B.8.3.2 Head Restraint

A head restraint must be provided on the car to limit rearward motion of the head in case of an accident. The restraint must have a minimum area of 232 sq. cm (36sq. inches), be padded, with a non-resilient, energy absorbing material such as Ethafoam or Ensolite. There must be a minimum thickness of 38 mm (1.5inches), and be located no more than 25.4 mm (1 inch) away from the helmet in the uncompressed state. The head restraint must meet the above requirements for all drivers.

### B.8.3.3 Inspection Holes

The National Technical Inspectors will instruct the students where to drill two 4.5mm diameter holes during initial tech inspection.

### B.8.3.4 Sharp Edges on Roll Cage - Prohibited

All sharp edges which might endanger the driver, crew, officials and safety staff must be eliminated by shielding and/or padding. This includes brackets, gussets, sheet stock, fastener ends, clamps, "ty-raps" or other features accessible during servicing, judging or competition impact or roll over.

### B.8.3.5 Materials -Documentation

Teams are required to bring with them to Technical Inspection documentation (invoices, bills, etc.) of the materials used in the roll cage and bracing.

## B.8.4 Bolted Roll Cages

**B.8.4.1** Bolted Roll cages joints are acceptable only if the following requirements are met (RC 13):

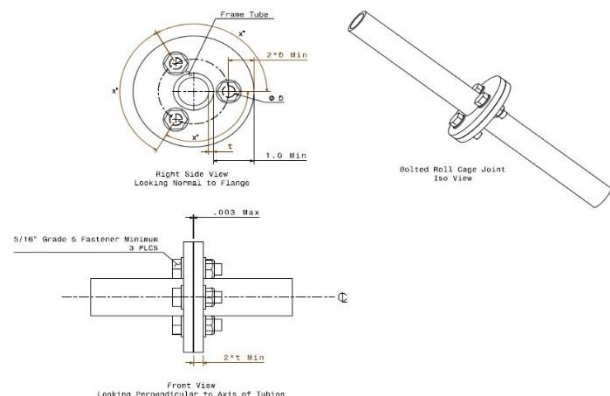
(A) Flanges or tabs must be twice (2X) the thickness of the frame tube, and made of the same material. They must be properly welded to each tubing part to be joined. The face of the flange must be perpendicular to the axis of the frame tube.

(B) The radius of the flange must be at least 25mm (1 in) larger than the outer radius of the frame tube.

(C) The gap between faces of the flanges (before being tightened) must be no greater than 0.07 mm (0.003 in).

(D) The flanges must be attached with at least 3 bolts with a minimum diameter of 8 mm (5/16 in), equally spaced on the flanges. The minimum edge distance between the bolt holes and the edge of the flanges must be twice the bolt diameter.

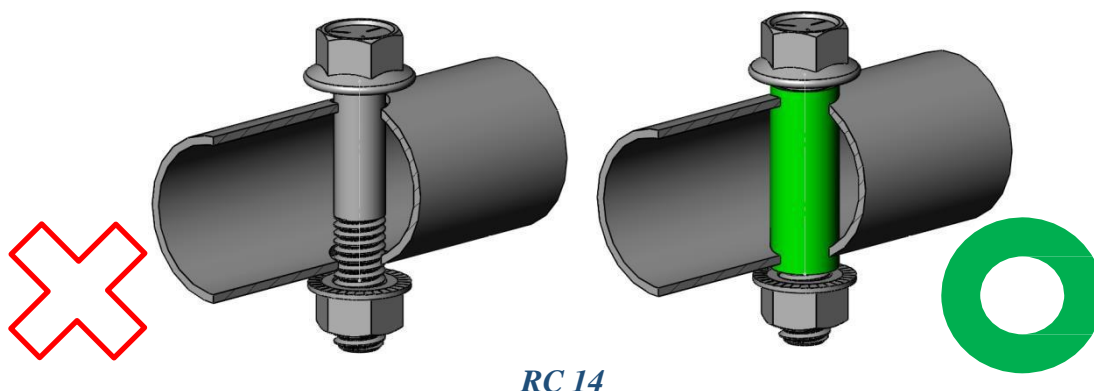
(E) Pin Joints and not permitted



## B8.5 Drilled Frame Members

### B8.5.1 Sleeved Joints

Frame members which need to be drilled for the purpose of mounting fasteners or routing accessories must be reinforced with a welding sleeve. Sleeves must be designed to fit tightly on the inside of the hole or joint being reinforced. Sleeves must extend beyond the tube on both sides and be welded to the tube all the way around as shown in RC14.



## ARTICLE 9: Cockpit and Throttle

### B.9.1 Design Objective

The cockpit must be designed to (1) protect the driver and (2) permit easy driver exit in an emergency.

### B.9.2 Driver Exit Time

All drivers must be able to exit on either side of the vehicle within five (5) seconds. Exit time begins with the driver in the fully seated position, hands in driving position on the connected steering wheel, and wearing the required driver equipment. Exit time will stop when the driver has both feet on the ground. Driver's exit time must be demonstrated by a team driver, as selected at technical inspection

### B.9.3 Firewall

There must be a firewall between the cockpit and the engine and fuel tank compartment. It must cover the area between the lower and upper lateral cross members (LCA and LCB) on the Rear Roll Hoop.

**B.9.4** The firewall must be metal, at least 0.50 mm (0.020 in.) Thick, and must completely separate the engine compartment and fuel tank from the cockpit.

**B.9.5** Multiple panels may be used to form the firewall but there must be no gaps between the joints. Cutouts in the firewall are allowed, but they must have grommets or boots that prevent large amounts of fuel from getting into the cockpit. Cutout for the pull starter will be allowed, only if their design meets sidewall standards.

### B.9.6 Front or Mid-engine vehicles

If the engine is not placed in the rear of the vehicle, then a firewall is not required to cover the area between the RRH lateral cross members. Instead, the firewall must meet the following standards:

(A) Fuel tank must be in a sealed container that prevents fuel from leaking in the event of fuel tank failure.

(B) Splash shields must prevent fuel from being poured anywhere in the cockpit area during fueling. (See rule B.12.4 "Spill Prevention")

(C) Engine must be completely enclosed and protect the driver in the event of an engine failure. Shielding must meet guarding requirements. This shielding must be made of metal. . (See rule B.15.1 "Powertrain Guards").

(D) All engine compartment venting must be directed away from driver area.

(E) Driver must be able to still egress from either side of the vehicle.

(F) The exhaust must not exit towards the driver and must be shielded.

(G) There must be a place to mount the Technical Inspection sticker (30cm x 30cm or 12 in x 12 in) on the RRH. It must be located on the driver's right side above the shoulders in easy view of track workers.

**Note: Engine enclosures must prevent fuel from spilling onto driver area during any vehicle upset.**

### **B.9.7 Body Panels**

The cockpit must be fitted with body panels that cover the area between the lower frame side member and the side impact member. No gaps can exist that are larger than 6.35 mm (0.25 in). These panels must be made of plastic, fiberglass, metal or similar material. They must be designed to prevent debris and foreign object intrusion into the driver compartment. The panels must be mounted securely to the frame using sound engineering practices (zip ties and Velcro are not acceptable).

### **B.9.8 Belly Pan**

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

### **B.9.9 Leg and Foot Shielding**

All steering or suspension links exposed in the cockpit shall be shielded with a sturdy, robust, metal cover. The shielding shall be continuous and extend the full width of the cockpit (from the left body panel to the right body panel) and shall prevent the driver's legs and feet from coming in contact, becoming entangled, or struck by the steering or suspension components during operation or a failure. No gaps may exist that are larger than 6.35 mm (0.25 in).

### **B.9.10 Fire Extinguisher - Size and location**

Each vehicle must have two identical fire extinguishers with a minimum UL rating of 5 B-C (KR rating of B-C or A-B-C and no less than 500g, powder extinguisher for vehicle). One must be mounted in the cockpit below the driver's head, with the top half above the side impact member on the right side of the firewall and be easily accessible by course workers. The manufacturer mounts must be used; they must be metal and have a metal draw latch. This mount must be securely fastened to the vehicle frame (RRH) and it must resist shaking loose over rough terrain, while allowing the course workers to remove it easily if necessary. The second must be brought to technical inspection with mounting accessories; it will be used as a replacement if needed. All fire extinguishers must be equipped with a manufacturer installed dial pressure gauge. The gauge must be readable by the National Technical Inspectors. Fire extinguishers must be labeled with school name and vehicle number.

### **B.9.11 Throttle**

Only foot operated throttle controls are allowed. A wide-open throttle stop must be mounted at the pedal. Mechanical, hydraulic or other throttle controls must be designed to return to idle-stop in the event of a failure. Foot pedals must be positioned so as to avoid foot entrapment in any position.

#### **B.9.11.1 Throttle Extensions**

Teams may not add any type of extension to either the control surfaces or to the driver in order to operate the vehicle. For example, drivers may not add blocks of wood to their feet so that they can reach the controls of the vehicle.

## **ARTICLE 10: Driver Restraint**

### **B.10.1 Minimum Five Strap System Required**

A safety harness system of at least 5 points must be worn by all drivers. The lap belt and shoulder belts must be approximately 76 mm (3 in.) wide. The fifth ("anti-submarine") belt must be worn between the legs to prevent the lap belt from riding up along the driver's torso. The safety harness must be installed using good engineering practice. The safety harness must be worn snugly (one finger width maximum gap).

As an alternative to a five point harness, a six or seven point safety harnesses may be used if properly installed and worn.

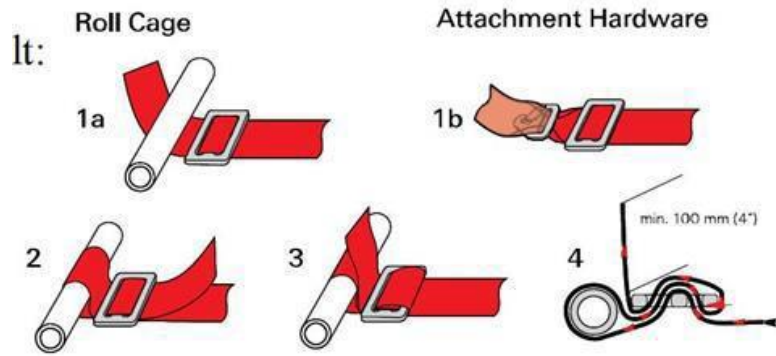


Figure 8

**NOTE:** If the belts do not have enough adjustment capacity, the vehicle may not be operated.

### B10.1.1 Release Mechanism

All belts must join with a single metal-to-metal quick release lever type buckle. No camlock systems are allowed.

### B10.1.2 Safety Harness Expiration

The material of all straps must be of Nylon or Dacron polyester and in new or perfect condition. The belts must bear the appropriate dated labels, and on Jan 1st of the competition year be no more than three years old.

### B.10.2 Shoulder Harness

The shoulder harness must be of the over-the-shoulder type. Only separate shoulder straps are permitted (i.e. “Y”-type shoulder straps are not allowed).

#### B.10.2.1 Vertical Location

Shoulder belt mounts must be no higher than vertically level with each driver’s shoulders, and no lower than 102 mm (4 in.) vertically below each driver’s shoulders. Shoulder belt mounts must be entirely on the cockpit side of the firewall, and be protected by the firewall. The shoulder belts must run directly from their mountings to the driver’s shoulders, without redirection by any part of the vehicle or its equipment (Fig. 10).

#### B10.2.2 Lateral Spacing

The shoulder harness mounting points must be between 178 mm (7 in) and 229 mm (9 in) apart (Fig 9).

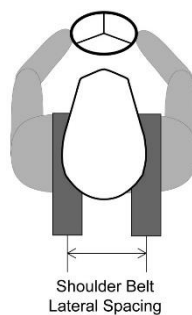


Figure9

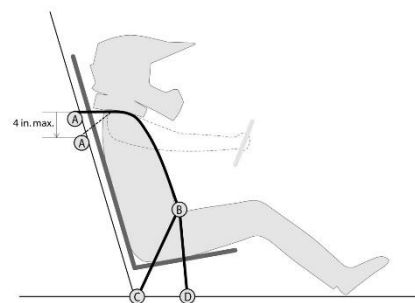


Figure10

#### B10.2.3 Harness Attachment Points

The shoulder belts must be looped around a horizontal tube welded within the RRH that meets the Roll Cage Secondary Member requirements of B8.2.2.1 Lateral motion of the belts along their mounting tube must be restrained. The firewall must protect the entire shoulder belt. The firewall may be pocketed to facilitate this, as long as no open gaps result.



Figure 11

### B.10.3 Lap Belts

**B10.3.1** The lap belt must pass around the driver's pelvic area below the Anterior Superior Iliac Spines (the hip bones – Fig.12). The lap belt must not be worn over the driver's intestines or abdomen. In side view, the lap belt must be at an angle of between 45 degrees and 65 degrees to the horizontal (Fig. 12). This means that the centerline of the lap belt at the seat bottom should be approximately 76 mm (3 in.) forward of the bottom of the seat back. The lap belt halves must run directly from the driver's hips to their mounting points without redirection by any part of the vehicle or its equipment(including the seat). The lap belt halves must be mounted to frame tabs using the bracket supplied with the safety harness

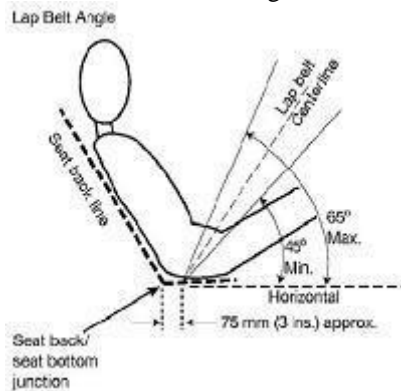


Figure 12

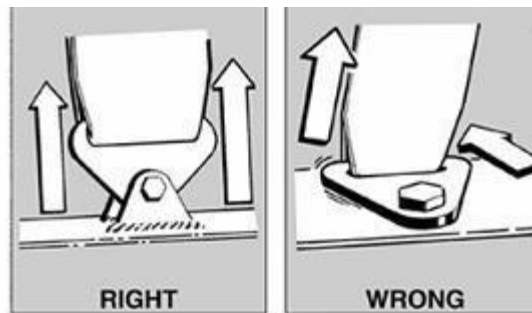


Figure 13

**Eye bolt lap belt connections are specifically prohibited.** The lap belts must freely pivot to fit drivers of differing statures correctly. The lap belt bracket must not be loaded in bending (see Fig.13 above).





Figure 14



Figure 15

### **B10.3.2 Lap Belt Mounting**

The frame tabs which accept the lap belt mounting brackets must meet the following requirements:

- 1) The lap belt tabs and anti-submarine belt tabs must be mounted in double-shear. Tab material must be no less than 2.3 mm (0.090 in.) thick.
- 2) Tabs must be attached to the frame with no less than 38 mm (1.5 in.) of weld length per tab.
- 3) Tabs must have no less than 6.4 mm (0.25 in.) of material width from the edge of the mounting hole to the outside edge of the tab.
- 4) Mounting bracket must pivot freely (i.e., not bear on screw threads, or be pinched by the tab).
- 5) Tab mounting must be stiff (i.e., not noticeably deform when pulled).
- 6) 6 and 7 point mountings should meet manufactures' requirements
- 7) No cutouts are allowed on the seat belt tab other than the hole for the lap belt mounting bolt.
- 8) All hardware in the driver restraint system shall match the nominal diameter of the mounting holes in the harness side tabs. The mounting tabs to the chassis must have holes of the same size. For example, a seat belt harness tab with a 0.5 inch hole may only use a bolt with a 0.5" diameter and be mounted to a frame tab with a hole of 0.5" diameter.
- 9) The frame lap belt tabs and their mounting shall be stiff and not readily deformed.
- 10) No lightening holes or other cutouts are permitted on the frame lap belt tabs.

## **B.10.4 Anti-Submarine Belts**

### **B10.4.1 Mounting**

Anti-submarine belts must be mounted aft of a vertical plane that intersects the leading edge of the seat, and must be mounted a minimum of 254 mm (10 in.) forward of the lap belt mounting points. The anti-submarine belt may be mounted either to a frame tab, or wrapped around a frame member.

**B10.4.1.1** If mounted to a frame tab, then the tab must conform to the rules for the lap belt tabs above.

#### **B10.4.1.2 If wrapped around a frame member, then:**

- 1) The mounting tube must have features designed to limit the lateral belt movement along the tube to less than 25 mm (1 in.)
- 2) The anti-sub mount must be directly connected to a LC, it cannot be "cantilevered" off another tube or otherwise create a torque from an offset mounting point.

### **B10.4.2 Six and Seven Point Harnesses**

6-point and 7-point harness mountings must meet the requirements in items 1, 6, & 7 (both mounts), and the mounting points must be laterally spaced by at least 203 mm (8 in.).

### B10.4.3 Redirection

Redirection of the anti-submarine belt by a one rigid frame or seat member is allowed. Redirected belt webbing must not contain a bend of more than 30 degrees (Fig.16). The redirecting member must be designed to prevent chaffing of the belt webbing by use of edge treatment to sharp edges with molding, plastic, heavy duty tape or other similar material.

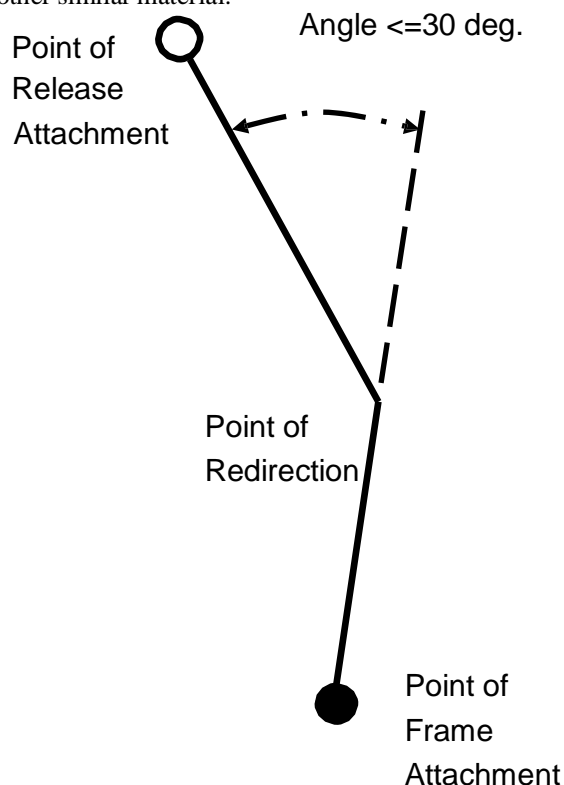


Figure 16

### B.10.5 Belts – GENERAL

When adjusted, no part of the belt must project beyond the cockpit area, and must not come into contact with rotating components of the chassis, or terrain features.

Loose ends of the belt must be restrained, but must not be wrapped around the buckle in such a manner as to prevent proper operation. Both the largest and smallest drivers on a team must meet these restraint requirements.

The shoulder belt adjusters/buckles must be adjusted so that they are sufficiently clear of the webbing to permit further tightening by the safety officials.

NOTE: If the belts do not have enough adjustment capacity the vehicle will be pulled from the competition until the matter is corrected.

### B.10.6 Arm Restraints

In the event of a rollover, the driver's arms must be kept within the limits of the roll cage space (B8.2.1.1) by use of arm restraints. Arm restraints must be securely fastened to the driver restraint system.

Only commercially available arm restraints meeting SFI 3.3 are allowed. The arm restraints must independently connect to the safety belts



Figure 17

#### B.10.6.1 Arm Restraint – Installation



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

#### **B10.6.2 Arm Restraint – Expiration**

The belts must be in overall good condition and show no signs of wear, no cuts chaffing or wear. There must not be any damage to the fabric or stitching.

#### **B.10.7 Installations – General**

All installations must prevent accidental unfastening from a direct pull, rollover or slide along the side.

#### **B10.8 Seats**

The seat shall work in concert with the safety harness to secure the driver within the envelope of the roll cage. Seats may be of conventional or suspension (sling) design. All seats shall be designed for the upright seating position. The upright seating position is defined by the angle of the driver's back to a horizontal line. The back angle for an upright seating position is more than 65 degrees. As a reference, a completely upright driver will have a back angle of 90 degrees.

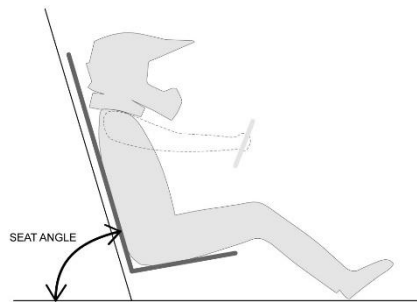


Figure 18

### **ARTICLE 11: Braking System**

#### **B.11.1 Foot Brake**

The vehicle must have hydraulic braking system that acts on all wheels and is operated by a single foot pedal. The pedal must directly actuate the master cylinder through a rigid link (i.e., cables are not allowed). The brake system must be capable of locking ALL FOUR wheels. The brake system must be capable of stopping the vehicle at a speed higher than 20km/h with the 4-wheel locking condition in a static condition and dynamically on pavement AND an unpaved surface.

#### **B.11.2 Independent Brake Circuits**

The vehicle must have at least two (2) independent hydraulic systems such that in case of a leak or failure at any point in the system, effective braking power shall be maintained on at least two wheels. Each hydraulic system shall have its own fluid reserve either through separate reservoirs or by the use of a dammed, OEM-style reservoir.

#### **B.11.3 Brake(s) Location**

The brake(s) on the driven axle must operate through the final drive. Inboard braking through universal joints is permitted.

**Braking on a jackshaft or through an intermediate reduction stage is prohibited.**

#### **B.11.4. Cutting Brakes**

Hand or feet operated "cutting brakes" are permitted provided section B.10.1 "Foot Brake" is also satisfied. A primary brake must be able to lock all wheels with a single foot. If using two separate pedals to lock 2 wheels apiece; the pedals must be close enough to use one foot to lock all four wheels. No brake, including cutting brakes, may operate without lighting the brake light.

#### **B.11.5. Brake Lines**

All brake lines must be securely mounted and not fall below any portion of the vehicle (frame, swing arm, A-

arms, etc) Ensure they do not rub on any sharp edges. Plastic brake lines are prohibited.

## ARTICLE 12: Fuel system & Fuel

### B.12.1 System Location

The entire fuel system, including splash shield, drip pan, and engine (excluding intake air hoses) must be located within the envelope of the vehicle's roll cage (members defined in B8.2.2.1, and any extra primary or secondary members). The fuel tank mountings must be designed to resist shaking loose. All fuel tank mounting points shall be used.

#### Fasteners must meet rule B14 – Fasteners or be OEM

Fuel tanks must be mounted on the original OEM mounts with OEM fasteners or directly to the roll cage directly using at a minimum, secondary members and. Cantilever mounts are specifically prohibited. The tabs that mount the fuel tank must be welded to the roll cage secondary members and hold the tank rigid. Tabs must be less than 2" in length from the mounting hole to the outside of the secondary member it is welded to.

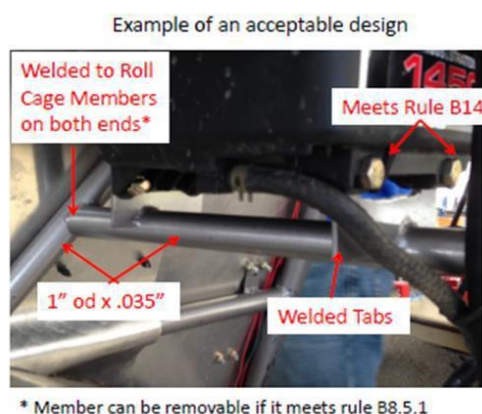


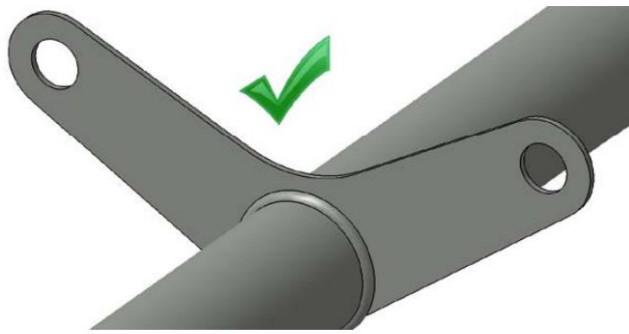
Figure 19

### B.12.1.2 Fuel Tank Mounting

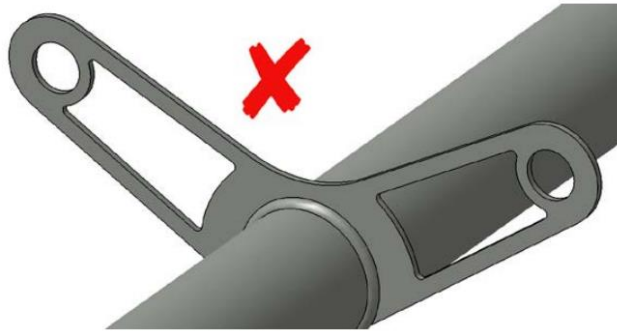
Fuel tanks shall be mounted directly to a tube or tubes meeting the requirements of at least a secondary member. Cantilever mounting of fuel tanks to the vehicle frame is explicitly prohibited. All mounting holes on the fuel tank shall be used to mount the fuel tank to the vehicle frame. Any and all fasteners used to mount the fuel tank to the vehicle frame shall meet the requirements in Article 12 – Fasteners.

Taps used to mount the fuel tank to the tubes of the vehicle frame shall meet the following requirements:

1. Minimum Thickness: 1.6mm (0.063 in.) for single shear, 0.9mm (0.035 in.) for double shear.
2. Maximum Edge Distance: 6.4mm (0.25 in.) measured from the edge of the bolt hole to the nearest outside edge of the tab.
3. Maximum Length: 50.8mm (2.0 in.), measured along the tab from the bolt hole center to the closest edge of the tube the tab is welded to.
4. Minimum Cross Section: 19mm (0.75 in) X 1.6mm (0.063 in.), evaluated between the edge of the bolt hole and the edge of the tube the tab is welded to.
5. Minimum Weld Length: 25mm (1.0 in.) per tab, per bolt hole. (Example: One tab connecting two tank bolt holes to the tube shall have 2.0 inches of weld length.)
6. Lightening holes or cutouts other than the bolt hole are explicitly prohibited.



**Figure B-40: Acceptable fuel tank mounting tab.**



**Figure B-41: Unacceptable fuel tank mounting tab.**

## **B.12.2 Fuel Tank**

Fuel tanks are provided or you have to buy a fixed model. Fuel tanks are not allowed in the cockpit. If the fuel tank is located over the engine, a drip pan must be used to prevent dropping fuel over the head of engine.

### **B.12.2.1 Fuel Tank Vent**

The fuel tank shall incorporate a vent, and shall be designed to prevent fuel spillage in the event of a rollover. A) a check valve in the fuel cap that prevents fuel from leaking in a rollover or the car being on its side or, b) a vent line routed above the tank assembly and extend beyond the lateral edges of the tank before extending down to the bottom of the car. The vent tube is to be mounted to the tank (not the filler cap).

## **B.12.3 Fuel Lines**

All fuel lines must be located away from sharp edges, hot engine components, and be protected from chafing. Grommet is required where the lines pass through any member of the vehicle. Fuel lines are not allowed in the cockpit. All lines must be attached securely.

### **B.12.3.1 Fuel Line Size Limits**

All fuel lines must be no larger than the stock lines supplied with the engine (i.e.  $\frac{1}{2}$  " O.D. and  $\frac{1}{4}$  " I.D.).

### **B.12.3.2 Fuel Filter**

Fuel filter is permitted.

## **B.12.4 Spill Prevention**

The fuel tank must be mounted so if fuel spills it will not come in contact with the driver or the engine. Complying with this rule will require a drip pan that is at least 203.2 mm (8 inches) in diameter (or equivalent area) and have sides of at least 38 mm (1.5 inches) high above the top edge of the tank.

#### B.12.4.1 Spill Prevention Mounting

Mounting the drip pan and/or splash shield(s) directly to the fuel tank with a connection only around the fuel cap is insufficient and will not be allowed. Drip pans must be mounted using sound engineering practices. Drip pans must be graded or inclined such that all spilled fuel drains from the drip pan – fuel must not pool anywhere in the pan.

#### B12.4.2 Drip Pan Drain

Fuel must drain from the drip pan through a drain line composed of pipe or tubing that carries fuel to the bottom of the vehicle and releases under the vehicle. Tubing shall be rated for fuel use, and shall have appropriate fuel rated markings. Fuel may not be released onto the belly pan, flotation, or any other part of the vehicle. The minimum inside diameter of the drain line is 12.7 mm (.5 in.) and minimum inside diameter of fittings is 9.5mm (.375 in.).

#### B12.4.3 Drain Line Material

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

#### B.12.4.4 Splash Shields

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

The splash shield shall be constructed of metallic material.

**Note: (BELOW) The following are examples of approved spill/splash shields:**



Figure 20

**Note: (BELOW) The following spill/splash shield is NOT acceptable:**



Figure 21

#### B.12.4.5 Filler Cap

The caps must be capable of preventing fuel from leaking in the event of a rollover. The gasket inside the cap must be replaced with a gasket that does not breakdown in fuel, does not have any holes and prevents fuel from spilling. The cap must not come loose during Dynamic events or allow fuel to spill out. Caps mechanically

prevented from rotating are no longer required.

#### **B.12.5 Fuel**

All teams must use automotive gasoline supplied by the host organization.

#### **B.12.6 Fuel Containers**

All fuel must be carried in, and put into vehicle fuel tanks, from approved unmodified containers.

#### **B.12.7 Fuel Sensors**

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

#### **B.12.8 Fuel Tank Access Panels**

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

### **ARTICLE 13: Steering, Suspension AND Flotation Systems**

#### **B.13.1 Wheel Stops**

All vehicles must be equipped with positive wheel lock-to-lock stops. These stops must be located at the wheel kingpins and behind the centerline of the wheel. Wheel stops must function at full jounce, full rebound and all points in between. No straps or cables are allowed.

#### **B.13.2 Tie Rod Protection**

The tie rods of all vehicles must be protected from frontal impact. A bumper may be required, at the technical inspector's discretion, depending on the design and installation.

#### **B.13.3 Adjustable Tie Rod Ends**

Adjustable tie rod ends must be constrained with a jam nut to prevent loosening.

### **ARTICLE 14: Fasteners**

#### **B.14.1 Locking Requirements**

All threaded fasteners in the steering, suspension, braking (caliper & master cylinder mounting and non OEM rotors & hubs system) and driver restraint systems must be captive. This is defined as requiring NYLON locknuts, cottered nuts or safety wired bolts (in blind applications). Lock washers or thread sealant do not meet this requirement.

EXAMPLE: A team using a custom hub with an OEM rotor must meet the locking requirements, but a team using an OEM hub and OEM rotor would be exempt.

The following figure illustrates the procedure for using lock wire:

Lock Wire Procedure Detail

A. Above illustrations assume right hand threads.

B. No more than three (3) bolts may be safe-tied together.

C. Bolt heads may be safe-tied as shown only when the female thread receiver is captive, or the nuts meet previous lock nut requirements.

D. Nuts (pre-drilled) may be safe-tied in similar fashion to the illustrations with the following conditions:

1 Nuts are heat treated.

2 Nuts are "factory drilled" for use with lock wire.

E. Lock wire MUST fill a minimum of 75% of the drilled hole provided for the use of lock wire.

F. Lock wire must be aircraft quality stainless steel of 0.020" Dia., 0.032" Dia., or 0.042" Dia. Diameter of lock wire is determined by the thread size of the fastener to be satisfied:

- 1 Thread sizes of 1/4" and smaller use 0.020" wire.
- 2 Thread sized of 1/4" to 1/2" use 0.032" wire.
- 3 Thread sizes > 1/2" use 0.042" wire.
- 4 The larger wire may be used in smaller bolts in cases of convenience, but smaller wire must not be used in larger fastener sizes.

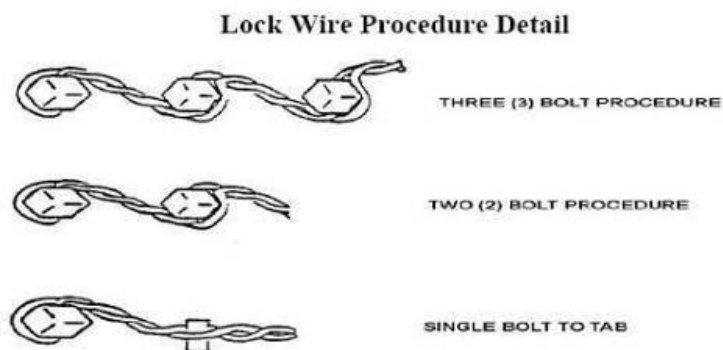


Figure 22

### B.14.2 Fastener Grade Requirements

All bolts used in the systems designated in Section 37.1 must meet SAE grade 5, metric grade M8.8 or AN military specifications. See Figure below, ""Bolt Head Markings."" Any threaded fastener components not shown in Figure below (including threaded rod) must have supporting documentation. (For example, stock drivetrains, suspension components, steering and braking or driver restraint systems.)

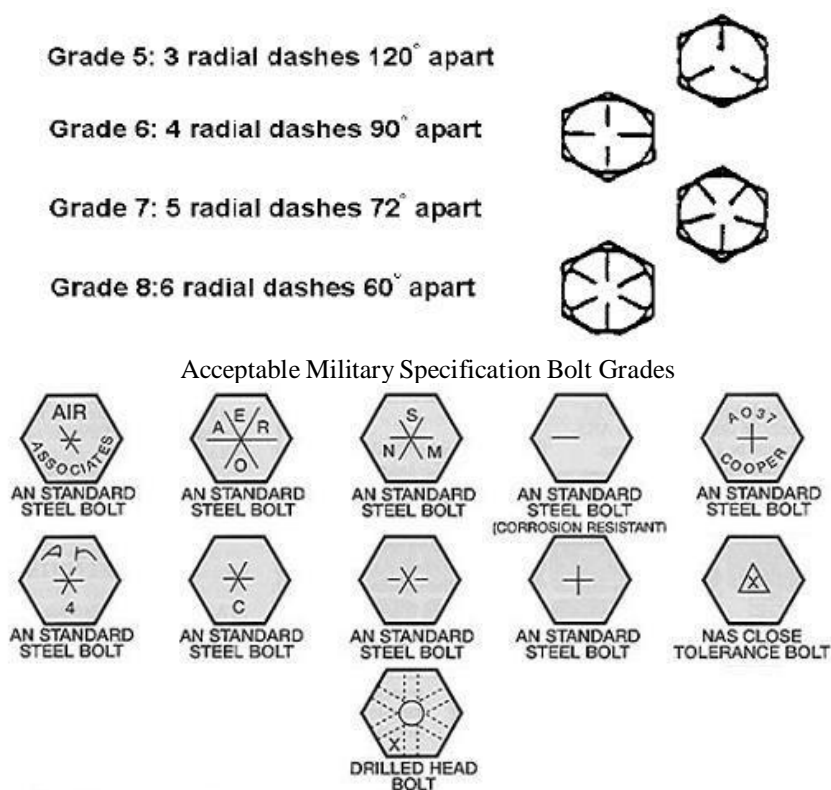


Figure 23

### B.14.3 Thread Exposure

All threaded fasteners must have at least two (2) threads showing past the nut.

#### **B.14.4 Single Shear Connections**

All ball joints or tie rods in single shear must have a factory steel safety washer. OEM ball joints are the only exception. See figures below.

### **ARTICLE 15: Guards**

#### **B.15.1 Powertrain Guards**

All rotating parts such as belts, chains, and sprockets that rotate at the rate of the drive axle(s) or faster, must be shielded to prevent injury to the driver or bystanders should the component fly apart due to centrifugal force.

These guards/shields must extend around the periphery of the belt or chain and must be wider than the rotating part they are protecting. They must be mounted with sound engineering practice, in order to resist vibration.

They must use:

Made of at least AISI 1010 strength steel at least 1.5 mm (0.06 in) thick – 16 Gauge is allowed. Or

Made of at least 6061-T6 strength aluminum at least 3.0 mm (0.12 in) thick

#### **B.15.2 Finger Guards**

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

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



Figure 24

#### **B.15.3 Factory Stock Guards**

Factory stock guards must be demonstrated to be equal to those described in B15.1. OEM Polaris CVT covers that are not modified are allowed. These covers must still meet the finger guard requirements and need a periphery guard (meeting the requirements of B.14.1) in way of the vent.

#### **B.15.4 Propeller Guards**

Propellers, if used for water propulsion, must be located or shrouded so that direct contact with the propellers is not possible, with the vehicle in an position

### **ARTICLE 16: Driver Equipment**

#### **B.16.1 Helmet, Neck Support/Collar & Goggles**

All drivers must wear a well-fitting Motocross style helmet with an integrated (one piece composite shell) chin/face guard and a rating of: Snell(SA2005, SA2010, M2005, M2010), Austral industrial standard AS(1609,



1698), European Standard(ECE), Japanese Industrial Standards(JIS, SG), Korea Standard(KC, KS). Goggles must incorporate the use of tear-offs or roll-off systems.



Figure 25

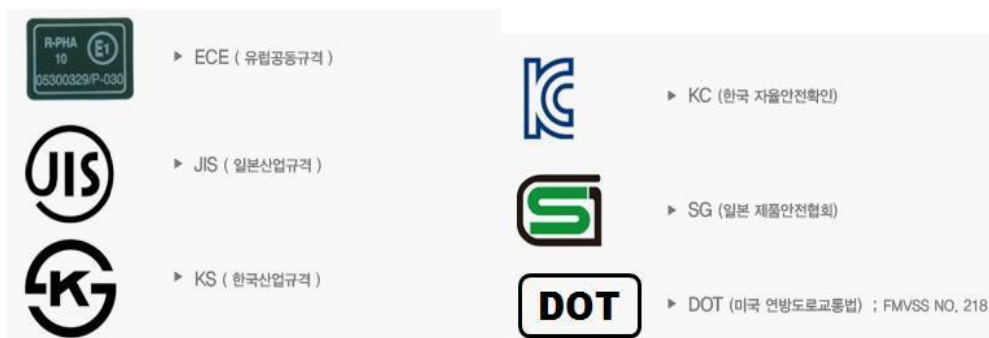


Figure 26



MOTOCROSS STYLE



Full Face Helmets

Figure 27

All drivers must wear a neck support/collar. The neck support must be a full circle (360°) and SFI 3.3 rated. Horseshoe collars are not allowed (see figure). Simpson, RCI, GForce, Deist or Leaf Racing Products supply neck collars that meet this requirement. There must not be any damage to the fabric or stitching and must not show any cuts, chaffing or wear.



Neck Support Permitted



Neck Support Not Permitted

Figure 28  
40



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

### **B.16.2 Clothing**

Drivers must wear appropriate clothing, including long pants, socks, shoes, gloves, and a long sleeved upper garment.

## **PART C: COMPETITION PROCEDURES AND REGULATIONS**

### **ARTICLE 1: Rules Clarification AND Protests**

#### **C.1.1 Technical Questions**

Questions about the rules requirements and restrictions must be submitted by e-mail to the National Technical Inspectors of the Mini Baja SAE competitions. Only the National Technical Inspectors are authorized to interpret the technical sections of the rules. Technical questions are to be posted website at <http://race.yu.ac.kr/>. Questions and answers will be posted. Teams are advised that the technical inspector approval of any vehicle, including those constructed based on responses to rules questions, is contingent on the proper fabrication of the vehicle and its design as an integrated unit.

NOTE: Please keep in mind that final operating approval of a Baja SAE® vehicle can only be given at the competition by the .technical inspectors

#### **C.1.2 Event Related Questions**

Questions pertaining to the operation and schedules of specific Baja SAE® competitions should be emailed to the respective organizers at the addresses given in the appendix.

#### **C.1.3 Protests**

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

##### **C.1.3.1 Preliminary Review**

If a team has a question about scoring, judging, policies or any official action it must be brought to the organizer's or SAE staff's attention for an informal preliminary review before a protest can be filed.

##### **C.1.3.2 Cause for Protest**

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

##### **C.1.3.3 Protest Format and Forfeit**

All protests must be filed in writing and presented to the organizer or SAE staff by the faculty advisor or team captain. In order to have a protest considered, a team must post a twenty-five (25) point protest bond which will be forfeited if their protest is rejected.

##### **C.1.3.4 Protest Period**

Protests concerning any aspect of the competition must be filed within one hour (60minutes) of the end of the event to which the protest relates.

##### **C.1.3.5 Decision**

The decision of the competition protest committee or National Technical Inspectors regarding any protest is final.

## **ARTICLE 2: Competition Procedures AND Regulation -General**

### **C.2.1 Drivers Meetings**

All team members identified as drivers and their support personnel **MUST** attend all drivers meetings. Attendance at drivers meeting is mandatory. Failure to attend drivers meetings can result in disqualification of members or the entire team.

### **C.2.2 Pre-inspection Operation Prohibited**

Except as required as part of the inspection process itself, vehicles may not be started or driven prior to passing safety inspection.

### **C.2.3 Competition Fuel Supply**

Fuel at the competition will either (1) be provided by the organizers or (2) the organizers will specify acceptable fuel providers.

#### **C.2.3.1 Refueling**

All refueling of the cars done in the pit area or on the course must be done with (1) the engine shut-off and (2) the driver out of the car. Any violations of this rule will be subjected to severe penalties. A fire extinguisher must be on hand whenever a vehicle is being refueled.

### **C.2.4 Post Endurance Inspection**

At the end of the endurance event, the top ten (10) vehicles will be impounded. Some or all of these vehicles will be inspected. Any vehicle found to have a modified engine will be disqualified from the entire competition.

The organizers reserve the right to impound and inspect any vehicle. No one except technical inspectors and officials are permitted in the impound area without specific authorization from the organizers. **NO EXCEPTIONS**

### **C.2.5 Pit Rules**

#### **C.2.5.1 Vehicle Movement -Walking Pace Required**

When a vehicle is driven anywhere except the practice area or competition events, it must move at walking speed with a team member walking along side at a normal pace. During the performance events when the excitement is high, it is particularly important that vehicles be moved at a walking pace in the pits. The walking speed rule will be strictly enforced and point penalties will be assessed for violations. Under no circumstances may anyone other than the driver ride on a vehicle.

#### **C.2.5.2 Team Work Area**

The team's work area should be clearly defined and should be kept uncluttered at all times. When a team leaves their area, it must be left clean.

#### **C.2.5.3 Vehicles in the Pits**

Only the Baja vehicles themselves and the teams' support trucks and trailers are allowed in the pits. Team members may not operate bicycles, skateboards, scooters, motorcycles, quads, or other person carrying or motor propelled vehicles in the pits or competition areas

#### **C.2.5.4 Occupancy Restrictions**

The organizers, at their sole discretion, may limit the pits to team members, faculty advisors and competition officials.

### **C.2.6 Driving Restrictions**

During the competition Baja SAE® vehicles may only be driven between the pits and an event site, during official practice or the events themselves.

**DRIVING OFF-SITE IS ABSOLUTELY PROHIBITED. TEAMS FOUND TO HAVE DRIVEN THEIR VEHICLE AT AN OFF-SITE LOCATION MAY BE EXPELLED FROM THE COMPETITION.**

### **C.2.7 Loopholes**

It is virtually impossible for a set of rules to be so comprehensive that it covers all possible questions about the vehicle's design parameters or the conduct of the competition. Please keep in mind that safety remains paramount during Baja, so any perceived loopholes should be resolved in the direction of increased safety. Technical questions about the rules should be emailed to the National Technical inspectors at the address

shown in the appendix. Questions about the specific Baja SAE® competitions should be emailed to the organizer of the event at the address listed in the appendix.

### **C.2.8 Penalties**

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

## **ARTICLE 3: Rules OF Conduct**

### **C.3.1 Sportsmanship**

All Baja SAE® participants can be proud of the excellent sportsmanship and cooperation among teams that are two of the hallmarks of the series. Good conduct and compliance with the rules and the official instructions are expectations and requirements for every team member. On those extremely rare occasions where there is an incident of unsportsmanlike conduct the organizer is authorized to impose an appropriate penalty. Unsportsmanlike conduct can include arguments with officials, disobedience of official instructions and the use of abusive or threatening language to any official or other participant. Depending on the seriousness of the infraction the penalty for such actions can range from a deduction of up to fifty percent (50%) of the team's points to expulsion of the entire team. Penalties of this type will only be imposed after a complete review of the incident by the organizer and SAE staff.

### **C.3.2 Alcohol and Illegal Material**

Alcoholic beverages, firearms, weapons of any type and illegal materials are prohibited at Baja SAE® sites during the competition. The penalty for violation of this rule is the immediate expulsion of the entire team, not just the individual(s) involved. This rule applies to team members, advisors and any individuals working with the team on-site.

### **C.3.3 Parties**

Disruptive parties either on or off-site should be prevented by the faculty advisor.

### **C.3.4 Trash Clean-up**

Clean-up of trash and debris is the responsibility of the teams. Please make an effort to keep your pit area clean and uncluttered. At the end of the day, each team must clean their work area.

### **C.3.5 Site Condition**

Please help the organizers keep the site clean. The sites used for Baja SAE® are private property and should be treated as such. Competitors are reminded that they are guests of the owners. All trash should be placed in the receptacles provided. Glass is not allowed on the grounds. Failure to clean the premises will result in an unsportsmanlike conduct penalty. Competitors are encouraged to police their areas after meals.

## **ARTICLE 4: Spectator Rules**

#### **C.4.1 General**

The organizers typically do not have a direct line of communication with spectators other than on-the-spot at the competition; thus, the competitors, faculty and volunteers are expected to help inform the spectators of the safety rules and help restrict spectators to the spectator areas.

#### **C.4.2 Alcoholic Beverages**

Spectators may not drink alcoholic beverages at any event location.

#### **C.4.3 Access Restrictions**

Spectators must keep well back from the event and practice tracks and from any area where vehicles are operating under power. Motor vehicle competitions are potentially dangerous and safety rules will be strictly enforced.

#### **C.4.4 Children**

A competition site is not a safe place for children and unsupervised young people. Spectators who fail to strictly control their children will be asked to leave the site.

#### **C.4.5 Removal of Spectators**

The course officials and organizers have the absolute right to restrict spectator access to any parts of the site and to eject anyone who violates safety rules or ignores the instructions of officials.

### **ARTICLE 5: Unsafe Practices AND Conduct**

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

#### **C.5.1 Miscellaneous**

##### **C.5.1.1 Driver Equipment**

Drivers must wear all of the equipment specified in Section 39" Driver Equipment Requirements" and a properly fastened restraint system at all times when the vehicle is running in any event or on the test track. Drivers not wearing the proper equipment will not be permitted to drive, and may have their competition driver's privileges revoked.

#### **C.5.2 Practice Area**

Practice may only take place in designated areas. Practicing outside of the designated practice area will result in a minimum fifty (50) point penalty and/or the revocation of driving privileges depending on the extent of the infraction.

#### **C.5.3. Safety – Team Responsibility**

Safety is the primary consideration in the design of Baja vehicles and the conduct of the competitions. Teams need to include safety considerations in all parts of their program. At all performance events, it is the responsibility of the team to ensure both the vehicle and driver meet and follow all the requirements and restrictions of the rules.

### **ARTICLE 6: Flags**

#### **C.6.1 Flags**

All flags shall be used in accordance with Appendix H of the FISA International Sporting Code as follows:

GREEN - The course is clear and the event is started.

YELLOW - Motionless - Caution Slow down and prepare to stop.

    An unsafe condition is present. NO PASSING until safely by this area. RED - STOP IMMEDIATELY.

CHECKERED - You have finished.

BLACK - You are creating an unsafe condition. Stop at the pits for consultation.

## **ARTICLE 7: Penalty**

After each competition day there is a meeting for judges to review penalties, assess penalty violations and calculate the total penalty for each team.

### **C.7.1 10 point**

1. You must follow all the competition instructions
2. Vehicle movement has no power.  
One power movement - 10 point penalty. Elimination after two power movements.
3. No smoking in competition area except for the smoking area -10 point penalty each time.
4. Good dress code (i.e. no slippers, shorts, sleeveless shirts) - 10 point penalty each time.  
Note: A caution will be given and failure to comply immediately will result in a 10 point penalty each time.
5. The faculty advisor needs to sign the attendance book for every competition (7/13 ~ 7/16). If the faculty advisor doesn't sign - 10 point penalty each day.
6. If you register after the official competition register date - 10 point penalty per hour. [Official register date: 7/14 09:00 ~ 12:00]
7. If the team volunteer is late for official meetings - 10 point penalty each time.

### **C.7.2 20 point**

1. Off-site driving offence.  
20 point penalty for first offence.  
Elimination after 2 offences.
2. If the team volunteer is not present during competitions or is not diligent in performing duties - 20 point penalty each day.
3. If the team volunteer does not attend official meetings i.e. rule meetings and volunteer training - 20 point penalty each time.
4. Non-compliance with one way direction in pit - 20 point penalty each time.
5. During the endurance race, only the driver can repair the vehicle. The driver must make passage (i.e. adequate room) so that other vehicle can pass.  
Obstructing passage - 20 point penalty each time.
6. Submitting reports after deadline - 20 point penalty.

### **C.7.3 25 point**

1. All protests must be filed in writing and presented to the organizer or SAE staff by the faculty advisor or team captain. In order to have a protest considered, a team must post a twenty-five (25) point protest bond which will be forfeited if their protest is rejected.

### **C.7.4 30 point**

1. Non-compliance to red flags and black flags - 30 point penalty each time.
2. Power driving in pit - 30 point penalty each time.
3. Not following the instructions of the safety personnel in the pit - 30 point penalty each time.
4. Faculty advisor or professor doesn't attend the competition for at least one of the days - 30 point penalty.

## PART D: EVENT DESCRIPTION & SCORING

### D.4 EVENT SCORING

#### 2020 Baja SAE® KOREA SCORE

STATIC EVENTS - 250 Points		
Design Report		100
Mechanical Design		150
Safety		-100 to 0
DYNAMIC EVENTS - 670 Points		
Speed		
	Acceleration	80
Power		
	Mud Event	80
Suspension		
	Land Maneuverability	80
Specialty		
	Rock Crawling	80
Durability		
	Endurance	350
TOTAL POINTS		920

### ARTICLE 1: Technical AND Safety Inspection

#### D.1.1 Safety and Technical Inspection Pass/Fail -Not Scored

Each vehicle must pass a safety and technical inspection before it will be permitted to compete. The inspection will determine if the vehicle satisfies the Baja design and safety requirements set forth in these rules and if, taken as a whole, the vehicle appears to be safe to operate. If the vehicle fails to pass inspection the team must make corrections/ modifications to bring it into compliance and have it re-inspected. Each team must be prepared to document that the materials used to fabricate the vehicle's frame satisfies the rules requirements. Receipts documenting the materials purchased for the frame must be brought with you to technical inspection.

##### D.1.1.1 Technical Inspection Sheet -Required

Each team must complete the technical inspection sheet (#Appendix) and bring it to technical inspection with them. Technical inspection sheets may be updated throughout the year, teams must download the current sheet within one week of each competition. No team will be inspected until this sheet has been completed. The technical inspectors and organizers have the authority to re-inspect any vehicle at any time.

##### D.1.1.2 Inspection Stickers

The inspection stickers and/or tags that are issued upon passing (1) technical and safety inspection and the inspection stickers must remain on the vehicle throughout the competition.

### **D.1.1.3 "As -approved" Condition**

Once the vehicle has passed the Safety and Technical Inspection its configuration cannot be modified. Approved vehicles must remain in "as-approved" condition throughout the competition. Necessary repairs that do not significantly change the configuration of the vehicle are permitted. Minor vehicle adjustments permitted by the rules, and normal vehicle tuning, are not considered to be modifications.

### **D.1.2 Brake Test Pass/Fail - Not Scored**

Baja vehicles must be capable of locking up all wheels (see section 34. Braking System) If lock-up of all four wheels is not demonstrated, or if the vehicle deviates from an approximately straight line, then the team must adjust or modify the brake system and have the vehicle re-tested until lock-up and straight line braking is achieved.

## **ARTICLE 2: Static Events AND Required Reports**

### **D.2.1 Engineering Design**

Engineering design assessment consists of two events: Design Report and Design Evaluation.

#### **D.2.1.1 Design Report**

The design report should clearly explain the engineering and design process that was used in developing each system of the team's Baja vehicle. The process for each system could include: objectives, customer requirements, alternatives considered (e.g. independent rear suspension vs. single rear swing arm, manual transmission vs. CVT, etc.), improvements over last year's design, the result(s) of design calculations, stress analysis, testing, etc.

Additionally, the design report should include 'Summarized specification sheet' (See appendix)

#### **D.2.1.2 Design Report -Format & Submission**

Format & submission of design report is FREE.

#### **D.2.1.3 Design Report -Page limit**

The page limit is changed to 10 pages except technical drawings and references.

#### **D.2.1.4 Design Report -Deadline**

Design reports must be received no later than the due date by the individual/address listed in the website.( <http://race.yu.ac.kr/> )

Do not submit your design report to SAE. Any Design Report not received by the due date will be subject to a penalty of ten (10) points for each day after the deadline.

Teams that do not submit a Design Report will not be judged in either part of the Design Event and will receive zero (0) points.

**Comment: We recommend that you ship your design report by a service that confirms the date of delivery.**

#### **D.2.1.5 Design Evaluation**

Design Evaluation will be conducted at the event site on the first full day of the competition. Cars are expected to be presented for Design Evaluation in essentially finished condition, i.e. fully assembled, complete and ready-to-run.

Vehicles presented in an unfinished condition may receive lower, or zero points, for any incomplete areas that cannot be fully assessed by the design judges.

Additionally, the judges have the right to refuse to evaluate incomplete vehicles.

Teams that are refused judging because of incompleteness will receive zero points for Design Evaluation.

During design evaluation team members are expected to be able to fully explain and discuss all aspects of their vehicle's design and the rationale behind their design decisions. Teams that are unable to adequately explain the various aspects of their design to the judges satisfaction will receive lower scores down to, and



including, zero (0) points.

## ARTICLE 3: Dynamic Events

The dynamic events are intended to determine how the Baja vehicles perform under a variety of conditions. Please note that the organizers have the right to modify the dynamic events to address local conditions, weather or resources.

### D.3.1 Speed Events

#### D.3.1.1 Acceleration

##### D.3.1.1.1 Acceleration -Objective

Acceleration determines the time it takes the vehicle to accelerate along a 100 ft (30.48 m) or 150 ft (45.72m) flat course. The choice of course length is at the organizer's discretion.

##### D.3.1.1.2 Acceleration -Procedure

Each team may make two (2) attempts. Scoring will be based on the best of the two attempts. Timing may be done using either electronic systems or stop watches.

##### D.3.1.1.3 Acceleration-Penalties

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

False Start or Stall at Start

First - Rerun at end

Second - Run disqualification

Leaving Course

Run disqualification

##### D3.1.1.4 Acceleration - Scoring

Teams with Acceleration times that are more than twice that of the fastest car will not receive a score for this event. Teams attempting the event, but exceeding the time limit will be classified as "Excess Time". The following equation will be used for the acceleration score:

$$\text{Acceleration score} = 80 \times [(T \text{ longest} - T \text{ yours}) / (T \text{ longest} - T \text{ shortest})]$$

Where: "T shortest" is the fastest time by any team "T longest" is either (a) the slowest time by any team or (b) 2x the fastest time whichever is the shorter interval "T yours" is your team's best time

### D.3.2 Power Event

The power events are designed to demonstrate the vehicle's ability to use its power to accomplish various tasks. The power event will be either the hill climb or a pulling event. The organizer will decide if the power event will be run as a hill climb or pulling event.

#### D.3.2.1 Mud Event

##### D.3.2.1.1 Mud Event- Objective

The pulling event tests the vehicle's relative ability to pull a designated object, e.g. "eliminator skid", vehicle, or chain, or mud along a flat surface. The organizer will determine the object to be pulled.

##### D.3.2.1.2 Mud Event -Procedure

Each vehicle will be allowed to have only one attempt. Two minutes are given to each vehicle on the Pulling Event. Once the vehicle stops moving forward the attempt is over and the attempt is scored for distance at that point. Vehicles may not continue the attempt after they have stopped on the course.

##### D.3.2.1.3 Mud Event –Scoring

Method A: "Pulls to Different Distances" -In the most common instance where the vehicles pull the object to a variety of distances the score will be determined by the following formula:

$$\text{Mud Event Score} = 80 \times [(\text{D yours} - \text{D shortest})/(\text{D longest} - \text{D shortest})]$$

Where: "D shortest" is the shortest pull by any team "D longest" is the longest pull by any team "D yours" is your team's best pull

Method B: "Fixed Distance-All Succeed" - Where there is (a) a set maximum pulling distance and (b) all teams succeed in completing a full distance pull, then the score will be based on the time of the pull and calculated by the following formula:

$$\text{Mud Event Score} = 80 \times [(\text{T longest} - \text{T yours})/(\text{T longest} - \text{T shortest})]$$

Where: "T longest" is the longest time by any team "T shortest" is the shortest time by any team "T yours" is your team's best time

Method C: "Fixed Distance-Some Succeed" - Where there is (a) a set maximum pulling distance and (b) at least one team makes a full pull and others do not, then the vehicles making the full pull (Group I) will be scored based on time and the vehicles that fail to make a full pull (Group II) will be scored based on distance. Scoring will be by the following formulas:

**Group I - Teams that make the full pull will be scored by the following:**

$$\text{Group I Score} = 40 \times (\text{T fastest} / \text{T yours}) + 40$$

Where: "T yours" is your team's best time "T fastest" is the fastest time by any team

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

$$\text{Group II Score} = 40 \times (\text{D yours} / \text{D course})$$

Where: "D yours" is the distance traveled by your vehicle "D course" is the distance from the starting line to the finish line.

### D.3.3 Maneuverability/Suspension

#### D.3.3.1 Maneuverability/Suspension -Objective

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

#### D.3.3.2 Maneuverability/Suspension –Procedure

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

#### D.3.3.3 Maneuverability/Suspension -Penalty Default Values

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

Obstacle/Pylon moved	2 seconds Missed
gate	10 seconds
Deliberate course violation	Run disqualification
False Start	First - Rerun at end
	Second - Run disqualification

#### D.3.3.4 Maneuverability/Suspension -Time Limit

Only vehicles that complete the maneuverability/suspension course within a time not exceeding two and a half times (2.5) that of the fastest vehicle will receive a score. If a vehicle is on the course for a time that exceeds twice the fastest time recorded to that point then the Event Captain may declare the attempt over, remove the car from the course and score the attempt as "Excess Time".

#### D.3.3.5 Maneuverability/Suspension -Scoring

Maneuverability/Suspension scoring is based on the vehicle's time through the course including any penalties.

**Maneuverability/Suspension Score =**

$$80 \times [(T \text{ longest} - T \text{ yours}) / (T \text{ longest} - T \text{ shortest})]$$

Where: "T longest" is the longest time through the course by any team or (b) 2.5x "T shortest" whichever is the shorter time "T shortest" is the shortest time through the course by any team "T yours" is your team's time through the course.

### **D.3.4 Specialty Events – 80 Points**

Specialty events are designed to test the vehicle under unique off-road conditions that might be available at some Baja SAE® competition sites. Organizers may modify the specialty events provided that participating teams are given at least four (4) months advance notice.

#### **D.3.4.1 Rock Crawling – Objective**

The rock crawling event will be one that combines vehicle low speed, power, suspension travel, and traction. The terrain may include large boulders, steps, potholes, and generally rough terrain.

#### **D.3.4.2 Rock Crawling – Procedure**

Each team may make two (2) attempts with the best time, including penalties counting for score. Vehicles will be timed from a stopped position at the beginning of the track to the end or until the vehicle stops moving forward. Teams will go on a walk through prior to the event.

#### **D.3.4.3 Rock Crawling – Stopped Vehicle**

Vehicles are declared stopped and distance measured for score if:

- 1 -Stuck in place -A vehicle is stuck in place for more than twenty (20)seconds.
- 2 -External assistance -A vehicle receives assistance on the course.
- 3- Off course -If a vehicle leaves the course it will be declared stopped at the point first exited.
- 4 -Roll over – Vehicles that roll over will be considered stopped at the point of roll over.

#### **D.3.4.4 Rock Crawling – Penalties**

Missed Gate – 8 seconds or 8 feet

Cone Hit – 5 seconds or 5 feet

#### **D.3.4.5 Rock Crawling – Scoring**

NOTE: For vehicles that do not compete the full course, the distance traveled is measured from the starting line to the center of the front wheel.

Method A: “ All Vehicles Succeed” -If all vehicles complete the rock crawling course, scoring will be by the following formula:

$$\text{Score} = 80 \times [T \text{ fastest} / T \text{ your}]$$

Where: “ "T yours" " is your team' 's best time “ "T fastest" " is the fastest time by any team

Method B: “ No Vehicles Succeed” -If no vehicle completes the rock crawling course, scoring will be by the following formula:

$$\text{Score} = 80 \times [D \text{ your} / D \text{ longest}]$$

Where: “ D yours” is your team' 's best distance “ D longest” is the longest distance traveled by any team

Method C: “ Some Teams Succeed” -If(a) at least one team completes the course while (b) other teams do not, then the vehicles completing the course (Group I) will be scored based on time and the vehicles that do not finish (Group II) will be scored based on distance traveled. Scoring will be by the following formulas:

Group I – Teams that complete the rock crawl will be scored by the following:

$$\text{Group I Score} = 40 \times (T \text{ fastest} / T \text{ yours}) + 40$$

Where: “ T yours” is your team' 's best time “ T fastest” is the fastest time by any team

Group II – Teams that stop on the course will be scored by the following:

**Group II Score = 40 x (D yours/D course)**

Where: “D yours” is the distance traveled by your vehicle “D course” is the total length of the rock crawling course.

### **D.3.5 Endurance**

#### **D.3.5.1 Endurance -Objective**

The endurance event assesses each vehicle's ability to operate continuously, at speed, over rough terrain containing obstacles.

#### **D.3.5.2 Endurance -General Description**

Endurance will be run as either (A) a single 3.5 hour race or as (B) elimination heats followed by a final in which the total time of one elimination heat plus the final is 3.5 hours. The organizer will announce the structure of the event prior to the start. The endurance final will be considered to have ended when the announced time period for the event has expired regardless of the actual position of vehicles on the course.

#### **D.3.5.3 Endurance - Starting**

The starting grid for endurance will be based on each team's performance in an acceleration event to be determined by the organizer. All vehicles will be considered to have begun the race simultaneously at the time when the starter releases the first vehicle onto the course regardless of their actual position in the grid.

#### **D.3.5.4 Endurance -Stalled or Disabled Vehicles**

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

Cars may only be started with the driver seated with all safety belts properly fastened. The driver may not exit the vehicle to execute a restart. Course marshals, volunteers or team members may assist drivers in restarting their vehicles. Safety officials and course marshals may stop any vehicle, at any time, if they believe it is in a condition that might pose a danger to the driver, volunteers or spectators. If a vehicle is stopped by a safety official for a mechanical fault, the fault must be corrected/repared before it may reenter the event.

#### **D.3.5.5 Endurance -Repairs**

The organizer will announce the rules governing repairs that are permitted to be made during the endurance event. If repairs along the course are permitted then vehicles under repair must be removed well off the course, away from the outside of turns and away from any natural run-off areas.

#### **D.3.5.6 Endurance Event -Penalty Default Values**

The organizer has the right to modify the penalties imposed for different violations to account for differences in the length or design of the course Failure to stop for Black Flag 10 minutes or 1 lap per flag whichever the official determines is the greater penalty.

Passing under a Yellow Flag = 1 lap penalty

Deliberate Ramming  
First time = 10 minutes  
Second time = Disqualification

Deliberate Forcing another  
First time = 10 minutes

Vehicle Off Course Second  
time = 20 minutes Third time  
= Disqualification

Leaving Course and Advancing = 5 minutes

Driving in an Unauthorized Area = 10 minutes  
Failure to Yield to Traffic on Entering Track = 5 minutes

Speeding in Pit Area = 5 minutes

Fueling: Fueling will not be allowed = 30 minutes

Until the engine is turned off, the driver is out of the car, and a fire extinguisher is ready. No work will be done on the car when fueling.

### **D.3.5.7 Endurance – Scoring**

The endurance event score is determined by (a) the number of laps each team completes during the endurance final and (b) the finish order of teams at the end of the event.

"Scored laps" are the number of full laps actually completed during the endurance event final. Only full lap count, partial laps do not count for score.

A vehicle must cross the counting/timing line under its own power for a lap to be counted.

"Finish order" is the sequence in which vehicles cross the finish line after the lap scoring period has ended. Finish order determines the ranking of teams completing the same number of laps. For example, if the top four teams finish with the same number of laps, then they will be ranked 1st to 4th based on their finish order.

The organizer may at his/her sole option set a period for "finish order" determination after lap counting

ends. "Bonus points" are additional points awarded to the ten (10) vehicles with the highest lap

counts, as separated by finish order as required, in part to differentiate teams finishing with the same number of scored laps. From 1 to 10 bonus points will be awarded in the inverse order of finish. Thus the first vehicle to cross the finish line in the highest lap group will receive 10 bonus points; the second vehicle will receive 9 bonus points etc. Teams finishing below tenth place in endurance will not receive bonus points.

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

**Endurance Score =  $[350 \times (L \text{ yours} - L \text{ lowest}) / (L \text{ highest} - L \text{ lowest})] + \text{bonus pts}$**

Where: "L highest" is the highest number of laps completed by any team "L lowest" is the lowest number of laps completed by any team "L yours" is the number of laps completed by your team

### **D.3.6 Tie breakers**

There will be no tie breakers for static events. Tie breakers for dynamic events will be the second best run time or score for the given tied event. If both scores for tied teams in the event are equal then the tie remains. Ties in the endurance race will be judged by the endurance event judge and may remain a tie. Ties for overall winner will be broken by the following criteria:

1. Endurance score
2. Total dynamic events score
3. Total static events score

If a tie remains after all the above tie breakers then the tie remains for the overall winner(s).

# Baja SAE® ROLL CAGE SPECIFICATION SHEET

## 2020 Baja SAE® COMPETITIONS

SCHOOL NAME \_\_\_\_\_ CAR NUMBER \_\_\_\_\_

This sheet MUST be completed and submitted in accordance with the event rules.  
Failure to do so will result in penalty.

Purpose: The purpose of this sheet is to facilitate verification of roll cage materials/construction, and to provide a means of tracking the age of older vehicles. This is being done in the interest of safety and good engineering practice.

1. Academic year the cage was constructed?

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2. Material (type, condition, size)?

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3. Equivalency calculations if needed (attach to this sheet).

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4. All welds and/or other attachment methods must be checked for integrity

Date of inspection

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NOTE: It is extremely important that such an inspection be made, and for those constructed of materials (i.e. aluminum) which do not exhibit an endurance limit.

WE HAVE EXAMINED THE ABOVE INFORMATION AND TO THE BEST OF  
OUR KNOWLEDGE DEEM IT TO BE ACCURATE.

TEAM CAPTAIN \_\_\_\_\_  
(SIGNATURE) (DATE)

Team Captain e-mail: \_\_\_\_\_

FACULTY ADVISOR \_\_\_\_\_  
(SIGNATURE) (DATE)

Faculty Advisor e-mail: \_\_\_\_\_

BRING A COMPLETED COPY OF THIS FORM WITH YOU TO TECHNICAL INSPECTION