# LAMPIRAN

1. 2008 Baja SAE Competition Rules
2. 2006 Car Weight Data
3. Perhitungan Parameter Suspensi
4. Spesifikasi Rod End
5. Gambar Desain

# 2008 BAJA SAE® SERIES

## BAJA SAE BRASIL 2008 - Information
## 13 - 16 March, 2008

- **FOR INFORMATION REGARDING BAJA SAE BRASIL 2008, CHECK THE OFFICIAL WEBSITE at http://www.saebrasil.org.br/ or contact the organizer at baja@saebrasil.org.br.**

## BAJA SAE KOREA 2008 – Information
## 2008

- **FOR INFORMATION REGARDING BAJA SAE KOREA 2008, CHECK THE OFFICIAL WEBSITE at http://yu.ac.kr/~race/spboard/board.cgi?id=main**

## SECTION 1 GENERAL INFORMATION

# 10. Overview

The SAE Mini Baja ® 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.

### 10.1 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, 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.

### 10.2 Competition Goals

Each team's goal is to design and build a prototype of a rugged, single seat, off-road recreational vehicle intended for sale to the non-professional weekend off-road enthusiast. The vehicle must be safe, easily transported, easily maintained and fun to drive. It should be able to negotiate rough terrain in all types of weather without damage.

### 10.3 The Baja SAE Series

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

Baja SAE Tennessee – Hosted by Tennessee Tech University
Baja SAE Illinois – Hosted by Central Illinois Section
Baja SAE Montreal – Hosted by Ecole de Technologie Superieure

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

Baja SAE Brazil – Sponsored and hosted by SAE Brazil
Baja SAE Korea – Sponsored and hosted by Yeungnam University
Baja SAE South Africa – Sponsored by Sasol and hosted by the University of Pretoria

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

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

The dynamic events at competitions may 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.

### 10.4 Official Announcements and Competition Information

Teams are required to read the newsletters published by SAE and the other organizing bodies. Teams must also be familiar with all official announcements concerning the competitions and rule interpretations released by the Baja SAE Rules Committee.

The monthly SAE Collegiate Design Newsletter is published on-line and can be found at:
http://students.sae.org/competitions/newsletters/.

### 10.5 Baja SAE Email Listserv

The Baja SAE Listserv operated by majordomo@autox.team.net may from time to time be used for official communications from the organizers and the Baja SAE Rules Committee. We recommend all teams subscribe to the Baja SAE Listserv. Instructions for subscribing can be found at: http://www.sae.org/students/mbemail.htm.

### 10.6 Official Languages

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

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

| | |
|---|---|
| Baja SAE Tennessee | English |
| Baja SAE Illinois | English |
| Baja SAE Montreal | English |
| Baja SAE Brazil | Portuguese and English |
| Baja SAE Korea | Korean and English |
| Baja SAE South Africa | Afrikaans and English |

## 11. Baja SAE Rules and Organizer Authority

**11.1 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 National Technical Inspectors, Baja SAE Rules Committee or SAE.

**11.2 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.

**11.3 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, these rules and all rule interpretations or procedures issued or announced by SAE, the Baja SAE Rules Committee and the 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.

**11.4 Understanding the Rules**

Teams are responsible for reading and understanding the rules in effect for the competition in which they are participating. The section and paragraph headings in these rules are provided to facilitate reading; they do not affect the paragraph contents.

**11.5 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.

**11.6 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 or by the individual competition organizers as appropriate.

**11.7 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.

**11.8 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.

# 12. Eligibility

### 12.1 Individual Participant Requirements

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

#### 12.1.1 Student Status

Team members must be enrolled as a degree seeking undergraduate or graduate student in a college or university. Team members who have graduated during the last seven (7) month period prior to the competition remain eligible to participate.

#### 12.1.2 Society Membership

Team members must be members of at least one of the following societies: (1) SAE or an SAE affiliate society, (2) ATA, or (3) IMechE. Proof of membership, such as a membership card, is required at the event.

Students who are members of one of the societies listed above are not required to join any of the other societies in order to participate in any SAE competition.
Join SAE at: www.sae.org/students

#### 12.1.3 Age

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

#### 12.1.4 Driver's License

Team members who will drive a competition vehicle at any time during a competition must hold a valid, government issued driver's license.

#### 12.1.5 Liability Waiver and Insurance

All on-site participants and faculty are required to sign a liability waiver upon registering on-site. Individual medical and accident insurance coverage is required and is the sole responsibility of the participant.

#### 12.1.6 Individual Registration Requirements – ACTION REQUIRED

All participating team members and faculty advisors must be sure that they are individually linked to their respective school / college / university on the SAE website. You can confirm or correct your school / college / university affiliation by going to www.sae.org and logging into "MySAE" with your username and password. If you do not have a current username, you will need to create one by selecting the "Need a User ID and Password to Login?" link. If you are already an SAE member, select the "MyMember Info" button and then select the "Update School Information" link. You will then be prompted to update your education information.

If you are not an SAE member, go to www.sae.org and select the "Join SAE / Membership Renewal" link under "Quicklinks", then select the "Join SAE" link under "Join SAE International". Students will need to select the "Student Membership" link and then follow the series of questions that are asked. Faculty members that wish to become an SAE member should choose the "Professional Membership" link and proceed to the series of questions. Please note all student participants must be an SAE member to participate in the event.

Once you've obtained an SAE member number and have linked yourself to your respective school, all affiliated students and faculty must complete the following information on the SAE website:

1) Medical insurance (provider, policy/ID number, telephone number)
2) Driver's license (state/country, ID number)
3) Emergency contact data (point of contact (parent/guardian, spouse), relationship, phone number)

To do this you will need to go to Student Central on the SAE homepage, then click on the "2008 Competition Date and Registration Information" link under "Student Competitions". Proceed by selecting the "Competition Schedule/Registration" link and then the event(s) you wish to register for. Choose the "Register" link (or "Update" link if after December 27, 2007) next to your desired competition(s) and then select your team link to add yourself to the team profile. The "Add New Member" button will allow individuals to include themselves with the rest of the team.

PLEASE BRING YOUR OFFICIAL DRIVER'S LICENSE OR PHOTO I.D./PASSPORT FOR NON-DRIVERS AS WELL AS YOUR MEDICAL INSURANCE CARD TO ONSITE REGISTRATION.

All international student participants, or unaffiliated faculty advisors, who are not SAE members are required to complete the International Student Registration form per team found under "Competition Resources" on the event specific webpage. Upon completion, email the form to CollegiateCompetitions@sae.org.

All students, both domestic and international, must affiliate themselves online or submit the International Student Registration form by February 28, 2008. For additional assistance, please contact CollegiateCompetitions@sae.org.

**NOTE: When your team is registering for a competition, only the student or faculty advisor completing the registration needs to be linked to the school. All other students and faculty can affiliate themselves after registration has been completed, however this must be done on or before February 28, 2008.

**12.2 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 presentations. 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.

**12.3 International Participation – U.S. Visa Letters**

International teams requiring visa letters to enter the United States must fill out the on-line form a minimum of four (4) weeks prior to the competition in which they are competing at: http://students.sae.org/ (Visa Invitation)

**12.4 International Participation – Vehicle Shipping/ U.S. Customs**

SAE and the Baja SAE organizers strongly recommend international teams ship their vehicles early in order to allow enough time to compensate for any delays that may occur in clearing U.S. Customs. Please check with the United States 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 U.S. Custom matters.

## 13. Eligibility – Vehicles

**13.1 Student Created**

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

**13.2 Professional Fabrication Limits**

Vehicles which have been professionally fabricated may be disqualified from the 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 the faculty advisor, copy of policies which prohibit machine shop access, etc).

**13.3 Kit Vehicles – Prohibited**

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

**13.4 Prefabricated Subassemblies**

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

**13.5 Top Ten Teams – Design Comparison Requirement**

Teams with vehicles that finished in a top ten position in any of the previous year's Baja SAE competitions are classified as having created a "successful design". Teams that created such successful vehicles are required to provide a comparison of their current design with their previous year's design even if the current design is entirely new.

As part of the design event, the judges will evaluate the comparison documentation of the top ten teams. Team representatives must be present during the comparison to discuss the design changes. If the judges find that the design changes are (A) not significant, (B) not supported by a detailed analysis or (C) have not been sufficiently documented, then a penalty of up to one hundred (100) points may be assessed against the design score.

**13.6 Redesign/Design Comparison Document**

The redesign/design document may be in the form of either, or both, (A) posters or (B) report. The documentation should be a year to year comparison of the major structure and/or systems of the vehicle and may consist of any, or all, of the following, supported by appropriate captions: (1) plans (2) drawings or (3) photographs. Design changes to correct failures of the previous design should be accompanied by a thorough analysis of why the failure occurred and the theoretical data supporting the new design, etc.

**13.7 Duplicate Designs**

Teams are reminded that the objective of Baja SAE is to provide students with a design challenge that will enhance their engineering and engineering project management skills. Participating teams must be able to demonstrate their engineering knowledge either by designing a vehicle from scratch or by making significant changes to a previously entered vehicle. If a school brings two vehicles that the design judges, in their sole opinion, find to be either identical, or to exhibit only insignificant differences, then the cars will be treated as a single entry with a duplicate car for parts. In such case only one car will be evaluated and permitted to compete in the dynamic events.

## 14. Registration

**14.1 Maximum Entries per University**

A maximum of two (2) vehicles per university will be allowed in the competition.

**14.2 Registration Deadline**

Teams must register for each Baja SAE competition they intend to enter by the specified deadline in Section 6 Appendix.

**14.3 Registration Fee**

North American Competitions – The registration fee must be paid on-line by credit card at the time of registration. Registration fees may not be paid by any other means.

Competitions outside North America – Registration fees and procedures are listed in Section 6 Appendix or will be found on the competition website.

Registration fees are NOT refundable.

**14.4 Registration Limit**

Baja SAE Tennessee is limited to 100 vehicles.
Baja SAE Illinois is limited to 115 vehicles.
Baja SAE Montreal is limited to 120 vehicles.

## SECTION 2 VEHICLE REQUIREMENTS AND RESTRICTIONS

# 20. General Design Requirements

### 20.1 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 be manufacturable using predominantly semi-skilled labor and standard machine tools. Safe operation must be an essential consideration in your design.

### 20.2 Vehicle Configuration

The vehicle must have four (4) or more wheels not in a straight line. Three (3) wheeled vehicles are prohibited from the competition. The vehicle must be capable of carrying one (1) person 190cm (6'3") tall weighing 113 kg (250lbs).

#### 20.2.1 Maximum Vehicle Dimensions

Width: 162 cm (64 in) at the widest point with the wheels pointing forward at static ride height.
Length: Unrestricted, see note below.
**NOTE:** Teams should keep in mind the Baja SAE courses are designed for vehicles with the maximum dimensions of 64 in width by 108 in length.

### 20.3 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. Vehicles competing in the Baja SAE water competition require floatation and water propulsion.

# 21. Required Engine

**Briggs & Stratton 10 hp OHV Intek Model 205432 Type 0036-el or Type 0536**

For over twenty years, the Briggs & Stratton Corporation has generously provided engines to the Baja SAE teams without charge. Teams pay only $130.00 for shipping and handling of the required engines.

### 21.1 Engine Eligibility

Teams will be eligible to receive a new Briggs & Stratton engine in every second competition season in which they participate. Engines are allocated on the basis of one engine per vehicle per two season of participation.

**Example:** Teams that received a new Briggs & Stratton engine for the 2006 competition season and competed in Baja SAE event(s) in 2006 and 2007 will be eligible to receive a new engine for the 2008 competition season.

**Example:** A team that received an engine in 2003, but did not compete in a Baja SAE event until 2004 and does not compete again until 2007, will only become eligible to receive an engine in 2008.

### 21.2 Eligible Teams – Receiving New Engines

Teams that are eligible to receive a new engine must complete the engine order form online at:
http://www.sae.org/students/students.htm

**NOTE:** The online engine order form is only accessible to registered teams.

Eligible teams will only pay the cost of shipping if the engine is shipped to a continental United States or Canada address.

#### 21.2.1 Engine Shipment outside the U.S. & Canada

Teams from countries outside of the continental United States and Canada will need to have their engines shipped:

**(A)** To the organizer of the competition they have registered for and have it held for the team's arrival.
Or
**(B)** To an address in the United States

Briggs & Stratton will not ship engines outside of the continental United States or Canada, international orders must follow one of the shipping methods listed above as exporting is not an option. For any reason the engine fails to arrive, it will not be replaced. Additionally, the team will not be permitted to order an engine next year.

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

**NOTE:** Teams requesting that engines be shipped to the organizer will be responsible for installing the engine prior to technical inspection and will need to bring the tools necessary to install the engine on-site. Teams should also get permission from the organizer.

**21.3 Purchasing of Additional Briggs & Stratton Engines**

Teams may purchase additional Briggs & Stratton Model 205432 Type 0036-el or Type 0536 engines directly through their local Briggs & Stratton dealer. There is no special discount or preset purchase price for additional engines.

**21.4 Engine Requirement and Restrictions**

To provide a uniform basis for the performance events, all vehicles must use the same engine: a stock four cycle, 7.46 kw (10 horsepower), air cooled, Briggs & Stratton OHV Intek Model 205432 Type 0036-el or Type 0536 engine. Either engine type is allowed in the Baja SAE competitions, as these engines are the same except the 0536 type number reflects a label change on the engine.

The engine MUST be a Briggs & Stratton Model 205432 Type 0036-el or Type 0536.

The required engine must remain completely stock in all ways, with the following qualifications:

**NOTE:** Blueprinting (reworking an engine to a manufacturer's exact specifications) is considered modification.

**21.4.1 Replacement Parts**

Briggs & Stratton Replacement Parts will be permitted.

**21.4.2 Piston Rings**

Piston ring end gaps may be increased if so desired. Only standard size original Briggs & Stratton piston rings may be used.

**21.4.3 Intake Ports**

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

**21.4.4 Valves**

**(A) Valve Clearance**
Any valve clearance setting between tappet and valve stem – intake and exhaust.

**(B) Valve Lapping**
Valves may be lapped to ensure proper sealing. Intake angle must remain at 45 degrees; exhaust angle must remain at 45 degrees.

**21.4.5 Shafts and Rods**

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

**21.4.6 Spark Plugs**

Must use RC12YC ONLY.

**21.4.7 Armature**

Any armature air gap setting is allowed. No slotting or elongating of armature mounting holes to increase or retard ignition timing.

**21.4.8 Flywheel Rotation**

No flywheel rotation to advance or retard timing is permissible.

**21.4.9 Carburetor**

**(A) Carburetor Re-jetting – Prohibited**
This is a fixed carburetor, re-jetting of the carburetor is prohibited.

**(B) Idle Speed**
Any idle speed adjustment, Briggs & Stratton recommends 1750 +/- 100 RPM.

**(C) Carburetor Float**
Carburetor float is non-adjustable and may not be re-adjusted.

**(D) Carburetor Venturi**
Modification of carburetor venturi is prohibited.

**21.4.10 Air Cleaner**

The air intake may be relocated, but you must use Briggs & Stratton parts to relocate the air filter: 492206 remote kits, 695329 – choke shaft and 699960 bases. The supplied air hose may be shortened to a minimum of 6.0 inches; no other type of hose will be allowed. A team may also add additional pre-filters to the top of the air intake. These parts must be included on the cost report. Any changes made to the air filter will have to pass Briggs & Stratton inspection.

**NOTE from Briggs & Stratton:** Relocation of the air cleaner may decrease engine performance.

**21.4.11 Exhaust System**

**(A) Muffler**
The original muffler must be used, but may be relocated. Tuned exhaust systems are prohibited. Briggs & Stratton is the only allowable muffler for use on the engine. All exhaust must pass through a single muffler. Multiple mufflers are not allowed.

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

**(C) Muffler Support**
Support of the exhaust pipe and muffler are strongly recommended.

**(D) Exhaust Pipe**
Exhaust pipe may not protrude inside of exhausted port, so as to alter port configuration.

**(E) Exhaust Pipe – Length**
Any exhaust pipe length is allowed, however pipe length cannot be adjustable.

**(F) Exhaust Pipe – Holes & Tubes**
No extra holes or tubes are allowed in the exhaust pipe.

Exhaust Pipe – Durability Required
The exhaust pipe and muffler must be completely intact and operational throughout the event, and shall be grounds for penalty or disqualification if not intact.

**21.4.12 Starter Rope**

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

**21.4.13 Engine Governor**

Each engine is equipped with a governor. Any attempt to defeat the engine governor so as to increase the engine speed will result in immediate disqualification. Before the performance events, each engine will be set to a maximum speed of 3800 RPM by means of the governor. Random inspection of the governor may be conducted at any time. GOVERNOR SETTING NOT TO EXCEED 3800 RPM!

**NOTE:** The governor spring must be placed in hole #6.

#### 21.4.14 Fuel System

The fuel tank supplied with the engine must be used, but may be relocated. Only one fuel tank is allowed to be mounted in the vehicle. No fuel pumps are allowed.

#### 21.4.15 Battery Requirements

The batteries must be sealed and not leak in the event of a roll over. 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.

#### 21.4.16 Onboard Instrumentation/Data Acquisition

Onboard instrumentation/data acquisition is allowed; the power for this instrumentation must be from approved batteries per 21.4.15.

**NOTE:** Ensure the above items/systems, if utilized, are included in your team's cost report.

#### 21.4.17 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 (21.4.15) if the battery is being charged by a Briggs alternator.

#### 21.4.18 Storage Energy Devices Used for Propulsion

Hydraulic accumulators are the only type of stored energy device that may be incorporated into a Baja SAE vehicle for propulsion purposes. If employed, hydraulic accumulators must be at zero energy at the start of each event. Hydraulic power systems must be properly shielded and documentation of the shielding made available for review by the National Technical Inspectors.

Hybrid electric power systems are specifically prohibited.

### 21.5 Component Failure

In the event of a major component failure, any modifications must be approved by the National Technical Inspectors prior to the vehicle returning to the competition.

### 21.6 Engine Inspection

Briggs & Stratton engine service experts will be on-site during the competition and are empowered to inspect any engine at any time.

The Briggs & Stratton staff on-site is empowered to make final decisions regarding the condition and set-up of all engines.

### 21.7 Engine Use Restriction

Briggs & Stratton generously provides engines to the teams for the exclusive purpose of use on their Baja SAE vehicle. If, for any reason, a team receives an engine and at a later date decides not to participate, it must, at its own expense, return the engine to SAE or Briggs & Stratton.

## 22. Reverse Light and Alarm

Each vehicle with reverse must have a back up light marked with an SAE "R" on the lens, be equal to, or exceed the SAE standard J759. The alarm must be rated per SAE standard J1741 or J994 that sounds when the vehicle is in reverse. An example of an acceptable backup alarm is available at www.waytekwire.com, part # 48001.

## 23. Towing Hitch Point

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.

**23.1 Front Hitch Point**

The front hitch point may be either:
A tubular front bumper strong enough to lift the weight of the car with no permanent deformation and having a maximum outside diameter of 25.4 mm (1 in) to which a clevis can be centrally attached, or
A hitch plate complying with the requirements of 23.3, which is designed to fold, or pivot, into a position where it will not affect anything during a front-end collision.

Examples of acceptable Front Hitches:

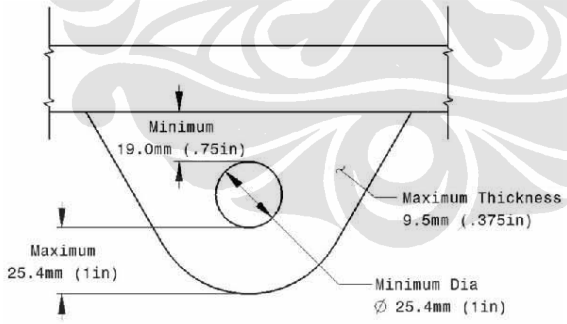
Examples of Front Hitches that are NOT acceptable


**23.2 Rear Hitch Plate**

The rear hitch point must be a plate complying with the requirements of 23.3.

**23.3 Hitch Plate Requirements – Maximum and Minimum**

Towing plate **Maximum** thickness – 9.5 mm (.375 in)
Hole diameter **Minimum** – 25.4 mm (1.0 in)
Radial clearance **Maximum** from hole – 25.4 mm (1.0 in)
Hole to tube **Minimum** clearance – 19.0 mm (.75 in)



## 24. Vehicle Identification

**24.1 Number Assignment**

North American competitions: Numbers are automatically assigned upon the completion of online registration. Assigned numbers may be found on the Baja SAE website in the "registered team list" for each competition.

Non-North American: Vehicle numbers at Non-North American competitions will be assigned by the respective organizers.

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

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

**24.2 Vehicle Number – Primary Cutout**

Each vehicle must prominently display its number as either a silhouette or stencil form cutout with a contrasting color behind. Font must be standard Arial script. Clear and easily to read numbers are essential for lap counting and vehicle identification. Cars with numbers that are hard to read, missing, damaged or obscured may not be scored and may be black flagged.

**24.2.1 Number Location**

These numbers must be affixed to the upper sides of the frame behind the rear roll hoop. The numbers must be in the vertical plane of the side of the car.

**24.2.2 Number Size**

The cutout numbers must be at least 203 mm (8 in) high.

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

**24.3 Vehicle Number – Body**

All vehicles must display their assigned number in blocker numerals on the front of the vehicle. These numbers must be at least 20.3 cm (8 inches) high, have a minimum line width of 2.54 cm (1 in) and must strongly contrast with the background vehicle color.

**24.4 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 2.5 cm (1 in) high.

Teams may also display their school name in no-roman characters provided the roman character set is highest on the car.

**24.5 Sponsor Logos**

**24.5.1 Briggs & Stratton Logos**

Briggs & Stratton logos must be displayed in a prominent space on the front and each side of the vehicle. These will be distributed during registration at the event.

**24.5.2 SAE Logo**

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

**24.5.3 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.

# 25. Transponders

**25.1 Transponders – US and Canadian Competitions**

Transponders will be used as part of the primary timing system for all closed loop dynamic events at competitions in the US and Canada.

It is the responsibility of the team to have a functional, properly mounted and fully charged transponder of the specified type on their vehicle. Vehicles without a specified transponder will **NOT** be allowed to compete in any event for which a transponder is used for timing.

The use of transponders at competitions outside of the US and Canada is the option of the organizer.

**25.2 Transponder Requirement**

All vehicles must be equipped with at least one AMB MX Rechargeable transponder. See www.amb-it.com.

The timing system is capable of recording two transponder identifications per vehicle; therefore, teams may, at their option, mount a second transponder as a backup in case the primary is damaged, knocked off the car or loses power.

**25.2.1 Transponder Purchase**

All teams are responsible for purchasing their transponder directly through AMB.
http://www.amb-it.com/-c-22_24.html

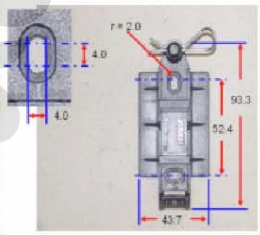
**25.3 Transponder Mounting**

Each transponder is supplied with a mounting bracket (SEE PHOTO). Teams are advised to weld a small plate to their frame to attach the bracket. The bracket can be attached with rivets, zip ties or bolts. Comment: Attaching the bracket with an M4 pan **OR** flat head bolts with lock nuts **OR** wire is strongly suggested.

The transponder mounting requirements are:
1. **Orientation** – The bracket must be mounted vertical to the frame in the orientation shown in the photograph and orientated so the transponder number can read "right-side up".
2. **Location** – The transponder must be mounted on the driver's right side forward of the seat and preferably within the lower horizontal plane of the front suspension. The transponder must be no more than 61 cm (24 in) above the track.
3. **Unobstructed** – There must be an open, unobstructed line between the antenna on the bottom of the transponder and the ground. (Do not mount the transponder inside the vehicle if sight line is obstructed.) Metal and carbon fiber may interrupt the transponder signal. The signal will normally transmit through fiberglass and plastic. If the signal will be obstructed by metal or carbon fiber, a 10.2 cm (4 in) diameter opening can be cut and the transponder mounted flush with the opening.
4. **Protection** – Mount the transponder where it will be protected from obstacles.

**Suggested Mounting Locations** (Right Front of Vehicle)

**Bracket Dimensions** (mm)




**25.4 Transponder Black Flag**

If, for any reason, a car's transponder is not being received by the timing system, the car could be black flagged for transponder repair, relocation or replacement.

## SECTION 3 ROLL CAGE, SYSTEMS & DRIVER'S EQUIPMENT

# 30. Introduction

The following design requirements apply to all Baja competitions. The design and technical rules will be strictly enforced. It is the responsibility of each team to meet all technical requirements using sound engineering principles and construction done meeting proper fabrication procedures. Failure to do so may mean disqualification from the competition; final judgment rests with the National Technical Inspectors. If you have any doubts about any technical requirement, present your questions by email to bajarules@sae.org. National Technical Inspectors will do their best to answer these questions within two weeks. Please include your name, school, contact information and the rule number in question in your email.

### 30.1 Rules Requirements and Restrictions

#### 30.1.1 Technical Inspection

All Baja 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.

#### 30.1.2 Required Modifications

All installation 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.

#### 30.1.3 Unstable Vehicles

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

# 31. Roll Cage

### 31.1 Objective

The purpose of the roll cage is to provide a minimal three-dimensional space surrounding the driver. The cage must be designed and fabricated to prevent any failure of the cage's integrity. The cage must be large enough for:
1. The driver's helmet to be 15.24 cm (6 in) away from the straightedge applied to any two points on the cockpit of the car, excluding the driver's seat and the rear driver safety supports.
2. The driver's torso, knees, shoulders, elbows, hands, and arms must have a minimum of 7.62 cm (3 in) of clearance from the envelope created by the structure of the car. (This is tested by applying a straight-edge between any two points on the outside edges of the SIM and RHO, less the roll cage padding.)

### 31.2 Roll Cage Requirements

#### 31.2.1 Elements of the Roll Cage

The elements of the roll cage that must meet the material specification per 31.5 are:

- Rear Roll Hoop (RRH) Rule 31.2.2
- Roll Hoop Overhead Members (RHO) Rule 31.2.4
- Front Bracing Members (FBM) Rule 31.2.7
- Lateral Cross Member (LC) Rules 31.2.4 and 31.2.5

Additional required members must be steel and only have a minimum thickness of .89 mm (.035 in) and a minimum outside diameter of 2.54 cm (1.0 in) and are as follows:

- Lateral Diagonal Bracing (LBD)
- Lower Frame Side (LFS)
- Side Impact Member (SIM)
- Fore/Aft Bracing (FAB)
- Front Lateral Cross Member (FLC)

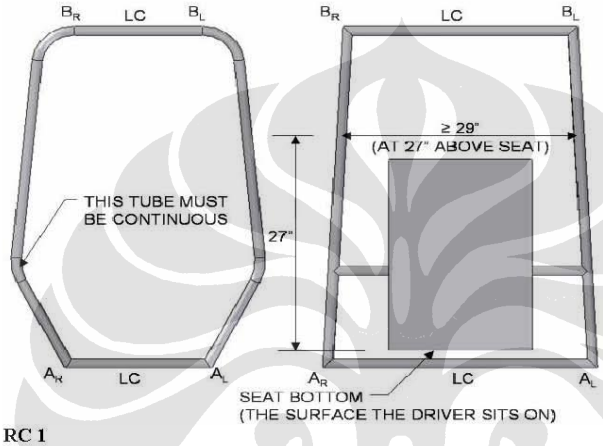
Reference points: See drawings in this section.
**NOTE:** When minimal dimensions are given that is to the centerline of the members, and when a clearance for the driver is given, it is defined by the outside edges of the roll cage members less the padding installed.

*All roll cage members having a bend radius >15.2 cm (6 in) may NOT be longer than 71.1 cm (28 in) unsupported.

**Definition** – **DRIVER** – For the purposes of this section "driver" refers to the team's largest driver and the 95 percentile male properly suited and wearing a helmet.

**31.2.2 Rear Roll Hoop (RRH)**

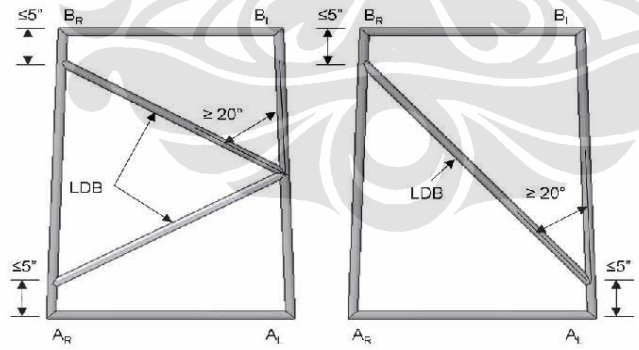
The RRH is made up of a maximum of four sections: two LC at highest and lowest points and two continuous, no break vertical members. This may be one continuous hoop/tube. The driver's seat may not intrude into the plane(s) of the RRH. The upper junctions in straight tube construction shall define points $B_R$ and $B_L$. If bent-tube construction is used, points $B_R$ and $B_L$ will occur at the upper end of each bend *(See RC1)*. The RRH shall extend upward vertically +/- 20 degrees from points A to points B. The RRH must also be a minimum of 73.6 cm (29 in) wide at 68.6 cm (27 in) above the driver's seat (checked by a template).




RC 1

**31.2.3 Rear Roll Hoop Lateral Diagonal Bracing (LBD)**

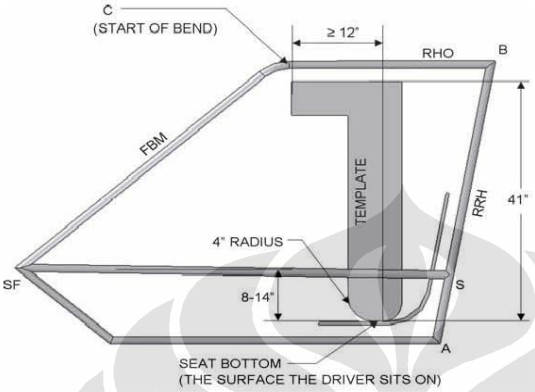
Lateral bracing for the Rear Roll Hoop will begin at a point along the vertical portion of the RRH within 12.7 cm (5 in) vertically of point $B_L$ or $B_R$ and extend diagonally to a point no farther than 12.7 cm (5 in) above point $A_R$ or $A_L$ *(See RC2)*. The vertical angle between the RRH and the LDB must be no less than 20 degrees. Lateral bracing may consist of two or more members.




RC 2

**31.2.4 Roll Hoop Overhead Members (RHO)**

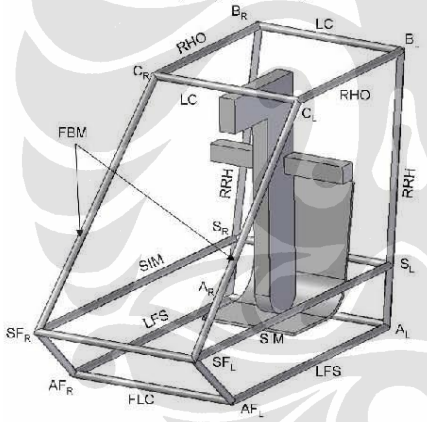
Roll Hoop Overhead members shall join the RRH within 5.1 cm (2 inches) vertically or laterally of points B and extend generally horizontal to point C. The RHO shall be located above the driver's seat by a minimum of 104.1 cm (41 inches). Points C should be located forward of the driver's seat by a minimum of 30.5 cm (12 inches) as defined in section 31.3 *(See RC3)*. Points $C_R$ and $C_L$ shall be joined by a lateral cross member (LC).




**RC 3**

**31.2.5 Lower Frame Side Members (LFS)**

Lower frame side members shall join the RRH and LC and extend to points forward of the driver's heel to a front lateral cross member (FLC) *(See RC4)*.




**RC 4**

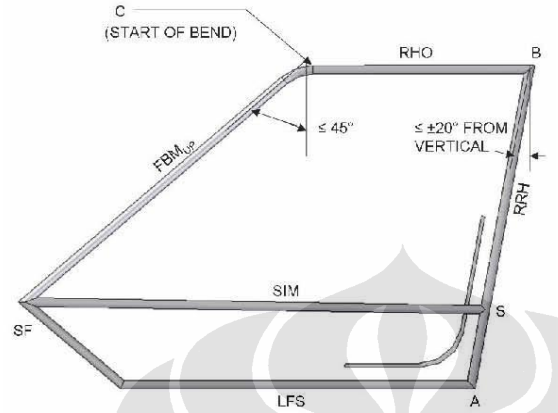
**31.2.6 Side Impact Members (SIM)**

Side impact members shall join the RRH at points S and extend horizontally to points SF forward of the driver's toes *(See RC4.)* The SIM shall be between 20.3 cm (8 inches) and 35.6 cm (14 inches) (as measured vertically) above the area of the seat in contact with the driver *(See RC3)*.

**NOTE:** The driver's feet must be behind the plane created by points $AF_{R,L}$ and $SF_{R,L}$. If the tube between $SF_{R,L}$ is below the driver's toes then an additional bar will be required above the driver's toes. (The intent of this is to protect the driver's feet from a tire intrusion).

**31.2.7 Front Bracing Members (FBM)**

Front bracing members shall join the RHO, the SIM and the LFS *(See RC5)*. The upper front bracing members ($FBM_{UP}$) should extend downward and forward and join point C on the RHO to the SIM at or behind points SF. The angle between the $FBM_{UP}$ and the vertical should be less than 45 degrees.




RC 5

**31.2.8 Roll Hoop Bracing (FAB)**

The roll hoop can be braced in the **front and/or rear.** The hoop must be braced on both right and left sides. From a side view, the bracing must be triangulated, with the maximum length of any member not to exceed 101.6 cm (40 inches) between attachment points. The angles of the triangulation must be no less than 20 degrees. A bent tube cannot exceed 81.3 cm (32 inches) between attachment points.

**31.2.8.1 Front Bracing**

If front bracing is used it must connect $FBM_{UP}$, LFS and the SIM. Front bracing must be attached as close as possible to the top of the roll cage (Point C).

**31.2.8.2 Rear Bracing**

If rear bracing is used it must be attached as close as possible to the top of the roll hoop along the outer perimeter. The bracing must be triangulated and connect back to the RRH at or below the SIM.

**31.2.9 Final Judgment**

The rules are considered a minimum, but the final judgment will rest with the National Technical Inspectors. If during the event, any frame shows signs of yield and/or failure the car will be removed from competition until the technical inspectors confirm that the frame complies with the rules again.
**Comment:** In all cases, especially bent tube construction, technical inspectors may require additional bracing if they feel the roll cage does not offer adequate protection. Any tubes showing cracks and deformation **do not** comply with the rules.

**31.3 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 (36 sq inches), and be padded with a resilient, energy absorbing material such as Ethafoam® or Ensolite®. The restraint must be a minimum thickness of 3.8 cm (1.5 inches), and be located no more than 2.5 cm (1 inch) away from the helmet in the uncompressed state. The head restraint must be securely mounted to the vehicle. The head restraint **must** meet the above requirements for all drivers.

**31.4 Driver Head Clearance**

For driver head clearance, the roll cage must extend a minimum of 104.1 cm (41 inches) above the seating surface to the bottom of the upper roll cage tubes measured vertically using the template in RC 3. The template radiused bottom should be placed in the joint of the seat base and the seat backrest and positioned vertically. The template "tee" top describes the projection of the required clearance height forward and rearward. While the template fixes the clearance height forward,

the clearance height rearward must be extended in each design over the helmet top of a seated and secured driver. Taller drivers may be accommodated by lengthening the template vertical member and raising the entire clearance height envelope above the 104.1 cm (41 inches) minimum.

#### 31.4.1 Head Clearance – Minimum

In all cases, a minimum of 15.2 cm (6 inches) vertical clearance must be provided from the helmet top of the team's tallest driver to the bottom of the roll cage top tubes or members.

### 31.5 Roll Cage & Bracing Materials

The material used for the entire required roll cage members specified in 31.2.1 must, at minimum, be:
**(A)** Circular steel tubing with an outside diameter of 2.5 cm (1 inch) and a wall thickness of 3.05 mm (.120 inch) and a carbon content of at least 0.18%.
OR
**(B)** Steel members with at least equal bending stiffness and bending strength to 1018 steel having a circular cross section with a 2.5 cm (1 inch) outer diameter and a wall thickness of 3.05 mm (.120 inch).

**NOTE:** The use of alloy steel **does not** allow the wall thickness to be thinner than 1.57 mm (.062 inch).

The bending stiffness and bending strength have to be calculated about an axis that gives the lowest value. Bending stiffness is proportional by the EI product and bending strength is given by the value of SyI/c, (for 1018 steel the values are; $S_y$ = 370 Mpa (53.7 ksi) E = 205 GPa (29,700 ksi)).
**E** = The modulus of elasticity
**I** = The second moment of area for the cross section about the axis giving the lowest value
**Sy** = The yield strength of material in units of force per unit area
**c** = The distance from the neutral axis to the extreme fiber

#### 31.5.1 Roll Cage Specification Sheet – Required

All teams must bring a copy of the Baja SAE Roll Cage Specification Sheet (See Section 6 Appendix) to the National Technical Inspectors during technical inspection. These forms must be completed for each competition. Complete roll cage specifications must be supplied with the Roll Cage Specification Sheet. Teams which do not submit a Roll Cage Specification Sheet will not be allowed to compete.

##### 31.5.1.1 Materials – Documentation

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

### 31.6 Roll Cage Padding

Any portion of the roll bar, roll bar bracing, side impact member or frame (excluding rear roll hoop) between the weld joints which would be contacted by the driver, must be covered by a resilient foam material such as Polyethylene® (pipe insulation) with a minimum thickness of 1.2 cm (.5 inch).

### 31.7 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, zip ties or other features accessible during servicing, judging or competition impact or roll over.

### 31.8 Bolted Roll Cages

Bolted Roll cages are acceptable only if the following requirements are met:
(A) Flanges or tabs must be twice (2X) the thickness of the tube structures, made of the same material type. They must be properly welded to each tubing part to be joined.
(B) Flange mounts must be twice (2X) the diameter of the attached tubing, flush mated, and with no gap between the faces greater than .07 mm (.003) inches.
(C) Tab mounts must be dual, parallel and on each side of the tubing to which they are welded, having a welded length of at least twice (2X) the diameter of the adjoined. Tubing held by bolts must be reinforced such that the area through which the bolt passes cannot be compressed from tightening or impact.

# 32. Cockpit

### 32.1 Design Objective

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

### 32.2 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, or drivers selected by the technical inspectors.

### 32.3 Firewall

A firewall between the cockpit and the engine and fuel tank compartment is mandatory. It must cover the area between the lower and upper lateral cross member. This firewall must be metal, at least .508 mm (.020 inch) thick, and must completely separate the engine compartment and fuel tank from the cockpit. Cutouts in the firewall are allowed, but they need to have grommets or boots that prevent large amounts of fuel from getting into the cockpit.

#### 32.3.1 Front or Mid-engine Cars

If the engine is not placed in the rear of the car then a firewall is not required to cover the area between the lower and upper lateral cross members. Instead the firewall must meet the following standards:
**(A)** Gas tank must be in a sealed container that prevents fuel from leaking in the event of gas tank failure.
**(B)** Splash shields must prevent fuel from being poured anywhere in the cockpit area during fueling. (See rule 35.4 "Spill Prevention")
**(C)** Engine must be completely enclosed and protect the driver in the event of an engine failure. Shielding must meet guarding requirements (See rule 38.1 "Powertrain Guards").
**(D)** Driver must be able to still egress from either side of the vehicle.
**(E)** The exhaust must not exit towards the driver and must be shielded.

### 32.4 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 inches). 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).

### 32.5 Belly Pan

The cockpit should be fitted with a belly pan over the entire length of the vehicle, so 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.

### 32.6 Leg and Foot Shielding

All steering or suspension links exposed in the cockpit must be shielded with metal. The shielding must prevent the driver's legs and feet from coming in contact, or becoming entangled during operation or a failure. No gaps can exist that are larger than 6.35 mm (0.25 inches). The driver's feet must be completely within the roll cage.

### 32.7 Kill Switches

Each vehicle must be equipped with two (2) easily accessible kill switches turning off the ignition and the entire electrical system of the car. Brake light, reverse light and reverse alarm are required not to be turned off.

#### 32.7.1 Kill Switch – Type

The kill switch 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

**Sample Mountings** (Note: The kill switches need to be mounted using the outer cases. If they are mounted using adhesive on the back cover the switch will fail. See Figure 1.)

| Note: The welded metal tabs constraining the switch. | Note: The machined block constraining the switch. |
|---|---|
|  |  |

**Figure 1**

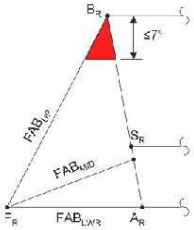



**Figure 2**

**32.7.2 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 – The external switch must be mounted on the driver's right side of the vehicle, on a panel between RRH and Rear Bracing within the red area, and behind the plane of the main roll hoop (see Figure 2). The switch cannot be more than 177.8 mm (7 inches) vertically below point Br. The switch must be within easy reach of track workers. The switch must be mounted rigidly, with no sharp edges in that area.

**32.7.3 Kill Switch – Wiring**

All wiring to kill switches 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.

**32.8 Fire Extinguisher – Size and Location**

Each vehicle must have two identical fire extinguishers with a minimum UL rating of 5 B-C. 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 fire extinguisher mount must be metal with a draw latch and must be securely fastened to the vehicle frame. Mountings must be designed to 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.

**32.9 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. Throttle cable cannot be bare from the forward mounting point to the firewall. Foot pedals must be positioned so as to avoid foot entrapment in any position.

**32.9.1 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.

## 33. Driver Restraint

**33.1 Minimum Four Strap System Required**

All drivers must use a minimum of a four (4) strap restraint harness meeting the following specifications. A four-point system consists of a 76 mm (3 inch) wide lap belt and approximately 76 mm (3 inch) wide shoulder harness straps. The restraint system installation is subject to approval of the National Technical Inspector. The restraint system must be worn as tightly as possible at all times.

**33.1.1 Release Mechanism**

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

#### 33.1.2 Safety Harness Expiration

The material of all straps must be Nylon or Dacron polyester and in new or perfect condition. All driver restraint systems must meet either SFI Specification 16.5/16.1, or FIA specification 8853/98. The belts must bear the appropriate dated labels, and on Jan 1st of the competition year be no more than three years old.

### 33.2 Harness Attachment Points

The lap belt and shoulder harness must be securely mounted to the primary structure. Shoulder belts must be looped around a frame tube or secured by other sound engineering practices. Bolts through drilled holes in tubes and tabs loaded in bending will not be accepted.

### 33.3 Lap Belt

The lap belt must pass around the pelvic area below the Anterior Superior Iliac Spines (the hip bones) (Figure 3). Under no condition may the lap belt be worn over the area of the intestines or abdomen. The lap belts should come through the seat at the bottom of the sides of the seat to maximize the wrap of the pelvic surface and continue in a straight line to the anchorage point. In side view, the lap belt must be at an angle of between 45 degrees and 65 degrees to the horizontal. This means that the centerline of the lap belt at the seat bottom should be approximately 76 mm (3 inches) forward of the seat back to seat bottom junction (see Figure 3). To fit drivers of differing statures correctly, in side view, the lap belt must be capable of pivoting freely by using either a shouldered bolt or an eye bolt attachment. Mounting lap belts by wrapping them around frame tubes is no longer acceptable. The lap belts should not be routed over the sides of the seat.

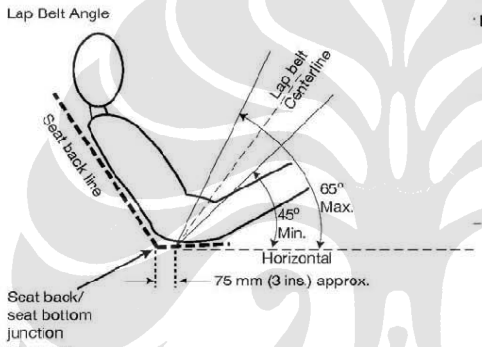



**Figure 3**

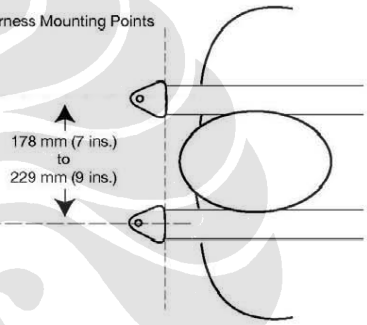



**Figure 4**

### 33.4 Shoulder Harness

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

#### 33.4.1 Vertical Location

The shoulder belts must NOT be mounted above the shoulder level, and must be mounted forward of the firewall. Shoulder belts must be no more than 102 mm (4 inches) below the perpendicular from the spine to the seat back at the shoulder level.

#### 33.4.2 Horizontal Location

The shoulder harness mounting points must be between 178 mm (7 inches) and 229 mm (9 inches) apart (see Figure 4). The straps shall not pass through anything that will cause the center distance to be less than 178 mm (7 inches) from center to center of the strap. The straps shall not pass over anything that causes them to be more than 229 mm (9 inches) apart center to center.

### 33.5 Belts

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. The lap belt must be adjustable on each half of the buckle to permit proper tightening for all drivers of the vehicle.

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

**33.6 Arm Restraints**

In the event of a rollover, the driver's arms must be kept within the limits of the cockpit. The cockpit is defined as the roll cage sides, the planes defined by the roll hoop overhead members and the side impact members. 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.

**33.6.1 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 driver must be able to reach the cockpit kill switch and steering wheel, but not allow their arms to exit the cockpit.

**33.6.2 Arm Restraint – Expiration**

The belts must bear the appropriate dated labels, and on Jan 1st of the competition year be no more than three years old.

**33.6.3 Installations – General**

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

## 34. Braking System

**34.1 Foot Brake**

The vehicle must have at least two (2) independent hydraulic braking systems that act on all wheels and is operated by a single foot. The pedal must directly actuate the master cylinder (no cables are allowed). The brake system must be capable of locking ALL FOUR wheels in a static condition and dynamically on pavement AND an unpaved surface.

**34.2 Independent Brake Circuits**

The vehicle must be 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.
**Note:** Plastic brake lines are **not** allowed.

**34.3 Brake Light**

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 lens must be marked with an SAE "S" or "U" rating (i.e.:SAE IPRSTM) or if it is not rated as per SAE J759, it must be equal to or exceed these standards. For lights with no SAE rating, teams must provide documentation to verify that the light meets or exceeds standard SAE J586. The determination of whether or not a brake light meets the required standards rests with the National Technical Inspectors.

**34.4 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.

**34.5 Cutting Brakes**

Hand or feet operated "cutting brakes" are permitted provided section 34.1 "Foot Brake" is also satisfied.

# 35. Fuel System and Fuel

### 35.1 System Location

The entire fuel system must be located within the roll cage envelope such that it is protected from impact. The tank mountings must be designed to resist shaking loose.

#### 35.1.1 Removable Fuel Tank

In an effort to minimize fuel spilling during refueling of the vehicles, removable gas tanks will be allowed. By utilizing two identical tanks, a team may pre-fill the 'spare' tank before their car pits - slowly and carefully filling it to capacity without spilling. Although the tank will already be filled, the driver must be out of the vehicle before the tanks can be switched.

The gas tank must have a quick disconnect that is in the fuel line. The tank itself will slide over two dowel pins which will tightly fit in the two cavities that are in the bottom of the tank. The design **must** also meet the following guidelines:
The gas tank must be mounted in a container that has two dowel pins located in the center that the fuel tank will securely slide onto (Figure 5).
The cover of the container when closed must contact the gas cap or tank to prevent the tank from moving vertically on the dowel pins. The container/cover must be made out of metal and mounted using sound engineer practices (Figure 6).
The following approved quick disconnect couplings which seals both sides of the gas line when disconnected must be used (Figure 7). The female fitting must be installed on the gas line connected to the gas tank.
http://www.colder.com/Downloads/IndCat_REV_FINAL.pdf
- Female coupling, Colder P/N: PLCD170-04-V (P. 20) or Briggs & Stratton P/N: 189117GS
- Male coupling, Colder P/N: PLCD220-04-V (P. 21) or Briggs & Stratton P/N: 192695GS
http://www.jiffytite.com/motorsports.cfm?sublevel=398&subpage=397 (Approved fittings but not pictured)
- Socket with Hose Barb Adapter P/N 21504
- Plug with Hose Barb Adapter P/N 22504

**Figure 5**

**Figure 6**

**Figure 7**

Note: Tanks still must meet the splash shield and spill prevention rules. The cost for two tanks, two check valves, and all couplings must be included in the engine section of the cost report.

### 35.2 Fuel Tank

Only a single fuel tank is permitted on the vehicle. Fuel tanks are restricted to the stock tank provided by Briggs & Stratton. No holes are allowed in the tank even if they have been repaired.

Teams must use a standard Briggs and Stratton gas cap with a built in check valve (Part #B4325GS). The retail price must be included in the cost report.

### 35.3 Fuel Lines

All fuel lines must be located away from sharp edges, hot engine components and be protected from chafing. Grommetting 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 and be SAE rated fuel lines. Lines must be no larger than the stock lines supplied with the engine (i.e. ½"outer diameter and ¼" inner diameter). If a fuel filter is used, it must be a Briggs and Stratton stock filter.

**35.4 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. The drip pan cannot be mounted straight to the tank around the fuel cap. The fuel must drain from the pan to the bottom of the car through a tube with a minimum inner diameter of 6.35 mm (0.25 inches). No pooling of the fuel is allowed.

**35.4.1 Splash Shields**

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

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

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

**35.5 Fuel**

The only fuel permitted is a grade of automotive gasoline consisting of hydrocarbon compounds. The gasoline may contain anti-oxidants, metal deactivators, corrosion inhibitors, or lead alkyl compounds such as tetra-ethyl lead. The addition of nitrogen bearing additives, or additives designed to liberate oxygen is strictly prohibited.
Specific gravity should not exceed 0.75 for leaded gasoline or 0.80 for unleaded gasoline when measured at 60 degrees Fahrenheit. See Section 41.4 "Competition Fuel Supply."

**35.6 Fuel Containers**

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

## 36. Steering, Suspension and Floatation Systems

**36.1 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.

**36.2 Adjustable Rod Ends**

All adjustable rod ends must be constrained with a jam nut to prevent loosening.

**36.3 Flotation Systems – Water Competitions Only**

Vehicles participating in water events must possess static stability in roll and pitch while floating.

**36.4 Inclining Test – Water Competitions Only**

Vehicles must demonstrate, in an Inclining Test, a range of static roll stability of at least 30 degrees (i.e., recover to upright from a 30 degree induced roll angle) with the team's heaviest driver seated in the normal driving position. Vehicles which may flood at any roll angle up to 90 degrees must pass the Inclining Test while in a fully flooded condition. Vehicles may not participate in water events until they have passed the Inclining Test.

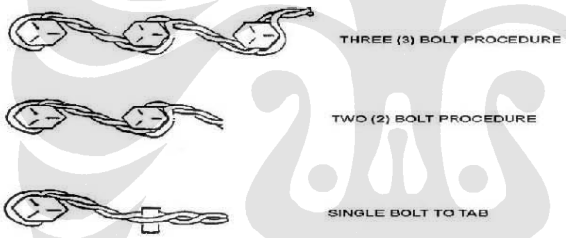
## 37. Fasteners

All threaded fasteners in the engine, steering, suspension, braking (any calipers, all master cylinder mounting, and non OEM rotors & hub systems), accelerator and driver restraint systems must meet the following guidelines.

**37.1 Fasteners**

All threaded fasteners used in the systems designated in Section 37 must be captive; defined as requiring NYLON locknuts, cottered nuts or safety wired bolts (in blind applications). Lock washers or thread sealant do not meet this requirement.

**37.1.1 Lock Wire Procedure Detail**




**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 above figure illustrates the procedure for using lock wire:

**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.

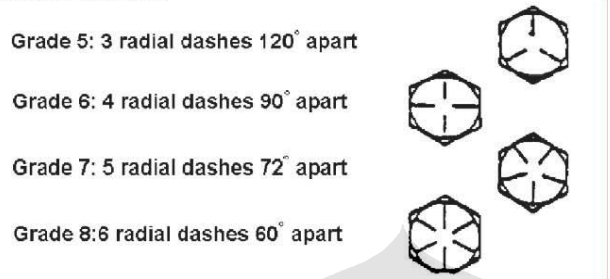
**F.** Lock wire must be aircraft quality stainless steel of .508 mm, .813mm, or 1.067mm diameter (0.020 inches, 0.032 inches, or 0.042 inches diameter). Diameter of lock wire is determined by the thread size of the fastener to be satisfied:

1. Thread sizes of ¼" and smaller use 0.020" wire.
2. Thread sized of ¼" to ½" use 0.032" wire.
3. Thread sizes > ½" 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.

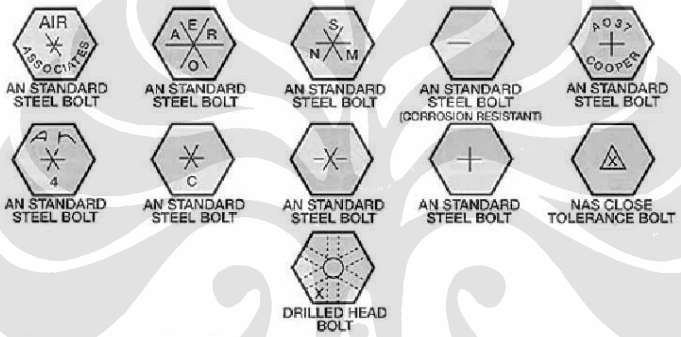
**37.2 Fastener Grade Requirements**

All bolts used in the systems designated in Section 37 must meet SAE grade 5, metric grade M8.8 or AN military specifications. See Figures below.

Acceptable SAE Bolt Grades:




Acceptable Military Specification Bolt Grades:




**37.3 Thread Exposure**

All threaded fasteners used in the systems designated in Section 37 must have at least two (2) threads showing past the nut.

**37.4 Socket Head Cap Screws**

Socket head cap screws, also known as "internal wrenching bolts" or "allen head bots", are prohibited for use in the steering, suspension, braking, driver restraint, and accelerator systems unless:

1) The bolt head is clearly marked with the letters "NAS" indicating a military / aircraft grade part. No other markings will be accepted.
2) Proper documentation is supplied, which must include a purchase receipt, and manufacturer's documentation indicating the bolt strength.

**37.5 Threaded fasteners with no markings**

Any threaded fastener (threaded rod, eye bolts, titanium bolts, etc…) must include a purchase receipt and manufacturer's documentation indicating the bolt strength. Equivalency calculations showing that the bolt exceeds the strength for a grade 5 fastener of the same size must be provided.

## 38. Guards

**38.1 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. They must be mounted with sound engineering practice, in order to resist vibration. They must be either **(a)** made of 1010 steel at least 1.524 mm (0.06 inch) thick or **(b)** a material having equivalent energy absorption at rupture per unit width of shield.

**38.1.1 Side Shields**

Side shields must prevent fingers from getting caught in any rotating part. A complete cover around the engine and drive train will be acceptable.


**38.2 Factory Stock Guards**

Factory stock guards must be demonstrated to be equal to those described in 38.1. OEM Polaris CVT covers that are not modified are allowed.

**38.3 Propeller Guards**

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

## 39. Driver Equipment Requirements

**39.1 Helmet, Neck Support/Collar & Goggles**

All drivers must wear a well-fitting Motor-Cross style helmet with an integrated (one piece composite shell) chin/face guard and a Snell M2000, SA 2000, British Standards Institution BS 6658-85 types A or A/FR. Goggles must incorporate the use of tear-offs or roll-off systems.

MOTOR-CROSS STYLE

FULL FACE HELMETS

In addition to the helmet, a neck support/collar must be worn. 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. Neck support must bear the appropriate dated labels, and on Jan 1st of the competition year be no more than three years old.


**Neck Support Permitted**

**Neck Support Not Permitted**

**WARNING:** Some Motor-Cross 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.

**39.2 Clothing**

Drivers must wear appropriate clothing, including long pants (cotton/Nomex), socks, shoes, gloves, and a long sleeved SFI rated upper garment. The upper garment must have a factory label showing it is SFI rated, FIA rated or fire resistant.

**39.3 Life Jacket Required – Water Competition Only**

For deep water events, each driver must wear a U.S. Coast Guard approved Type III life jacket.

AN EXAMPLE OF TYPE III LIFE JACKET, OTHERWISE KNOWN AS A WATERSPORT VEST

## SECTION 4 COMPETITION PROCEDURES AND REGULATIONS

# 40. Rules Clarification and Protests

### 40.1 Technical Questions

Questions about the rules requirements and restrictions must be submitted by e-mail to the National Technical Inspectors of the Baja SAE competitions. Only the National Technical Inspectors are authorized to interpret the technical sections of the rules. Technical questions are to be emailed to the National Technical Inspectors at: bajarules@sae.org. Questions and answers will be posted on the National Technical Inspectors website at: http://students.sae.org/competitions/bajasae/rules/tqa.htm.

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 National Technical Inspectors.

### 40.2 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.

### 40.3 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.

#### 40.3.1 Preliminary Review – Required

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.

#### 40.3.2 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.

#### 40.3.3 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.

#### 40.3.4 Protest Period

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

#### 40.3.5 Decision

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

# 41. Competition Procedures and Regulation – General

### 41.1 Drivers Meetings

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

### 41.2 Pre-inspection Operation Prohibited

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

**41.3 Governor Setting**

Briggs & Stratton Technical Representatives will set the governors of all vehicles. Vehicles must be presented for governor setting with (1) the drivetrain disconnected, (2) the engine shaft clear and (3) the throttle cable unhooked from the engine. Baja SAE Officials may order a recheck of the governor setting of any vehicle at any time.

**41.4 Competition Fuel Supply**

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

**41.4.1 Refueling**

All refueling of the cars done in the pit area or in the fueling area 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.

**41.5 Engine and Drivetrain Inspection**

The National Technical Inspectors reserve the right to impound and inspect any vehicle during the dynamic or endurance events. Any vehicle found to have: (1) a drivetrain configuration not matching the Drivetrain Certification Form submitted during technical inspection or (2) an engine in violation of rules sections 21.4 through 21.4.14.4, 21.5, 21.6 shall receive zero (0) for all dynamic competition events completed during the day on which the inspection was performed.

No one except technical inspectors and officials are permitted in the impound area without specific authorization from the organizers. **NO EXCEPTIONS.**

**41.6 Engine Recall Option**

The organizers and SAE may, at their sole option, recall the engine from any vehicle in the competition in exchange for a new Briggs and Stratton engine. Recalled engines will not be returned and will be inspected at Briggs and Stratton's facilities to confirm compliance with the rules.

**41.7 Pit Rules**

**41.7.1 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 move 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.

**41.7.2 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.

**41.7.3 Vehicles in the Pits**

Only the Baja SAE 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.

**41.7.4 Occupancy Restrictions**

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

**41.8 Driving Restrictions**

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

### 41.9 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.

### 41.10 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 unless there is a change by the organizer.

## 42. Rules of Conduct

### 42.1 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.

### 42.2 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.

### 42.3 Parties

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

### 42.4 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.

### 42.5 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.

## 43. Spectator Rules

### 43.1 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.

### 43.2 Alcoholic Beverages

Spectators may not drink alcoholic beverages at any event location.

### 43.3 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.

**43.4 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.

**43.5 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.

## 44. Unsafe Practices & 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.

## 45. Miscellaneous

**45.1 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.

**Water Competitions Only** – Seatbelts, helmets, goggles, wrist restraints, and the required clothing must be worn at all times a driver is operating a vehicle on land. Driver equipment rules for water events may be adjusted by the organizer and SAE depending on the characteristics of the site.

**45.2 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.

## 46. Safety – Team Responsibility

Safety is the primary consideration in the design of Baja SAE 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.

## SECTION 5 EVENT DESCRIPTION & SCORING (North American Events)

| | Tennessee | Montreal | Illinois |
|---|---|---|---|
| **STATIC EVENTS – 300 points** | | | |
| Design | | | |
| Report | 75 | 75 | 50 |
| Evaluation | 125 | 125 | 100 |
| Cost | | | |
| Report | 15 | 15 | 15 |
| Production Cost | 85 | 85 | 85 |
| Presentation | --- | --- | 50 |
| **DYNAMIC EVENTS – 700 points** | | | |
| Speed | | | |
| Acceleration | 60 | 75 | 75 |
| Traction | | | |
| Hill Climb or Pulling Event | 60 | 75 | 75 |
| Maneuverability | | | |
| Maneuverability | 60 | 75 | 75 |
| Water Maneuverability | 60 | --- | --- |
| Specialty | | | |
| Rock Crawl | -- | --- | 75 |
| Mud Bog | -- | --- | --- |
| Suspension and Traction | 60 | 75 | --- |
| Durability | | | |
| Endurance | 400 | 400 | 400 |
| **TOTAL POINTS** | 1000 | 1000 | 1000 |

## 50. Technical Inspection

**50.1 Technical Inspection – Pass/Fail – Point Deduction**

All Baja SAE vehicles must pass a technical inspection before they are permitted to operate under power. The inspection will determine if the vehicle satisfies the requirements and restrictions of the Baja SAE rules. The exact procedures and instruments used for inspection and testing are entirely at the discretion of the National Technical Inspectors. Decisions of the technical inspectors, as confirmed by the National Technical Inspectors, concerning vehicle compliance are final and may not be appealed. Vehicles are to arrive at technical inspection in ready to run condition **with all drivers present, safety equipment and documentation**. If vehicles are not ready for technical inspection when they arrive, they may receive a point deduction. Faculty advisors are not allowed to participate during technical inspection. The team captain or other designated members of the team shall do all the presenting. All vehicles that do not pass technical inspection prior to the start of the dynamic events will receive a penalty of 50 points.

Technical inspection will consist of three (3) separate parts as follows:

Part 1 – Engine inspection and governor setting
Each vehicle must arrive at Engine inspection with the output shaft bare, and working kill switches. Each vehicle engine must be inspected by Briggs and Stratton technical staff that will **(1)** confirm its compliance with the rules and **(2)** set the governor to the specified rpm.
Part 1 must be passed before a team may apply for Part 2 or Part 3 inspection.

Part 2 – Technical inspection and scrutineering
Each vehicle will be inspected to determine if it complies with the requirements and restrictions of the Baja SAE rules. This inspection will include an examination of the driver's equipment including helmet and arm restraints, a test of driver exit

time and to ensure that all drivers meet the requirements of the rules. Each team **must** bring the following items to inspection; if they do not have the items at the time of inspection they will receive a 10 point deduction for each item missing or not completely filled out:
**(a) Frame Material Documentation**: Receipts documenting the materials purchased, or otherwise acquired, and used to build the frame
**(b) Roll Cage Specification Sheet**: A completed copy of the Roll Cage Specification Sheet (See Section 6 Appendix)
**(c) Technical Inspection Sheet**: A properly completed Technical Inspection Sheet (See 50.1.2)
http://students.sae.org/competitions/bajasae/rules/
**(d) Drive Train Check Sheet**: A properly completed Drive Train Check Sheet is required at technical inspection.
**(e) Drives Present**: All drivers must be present at technical inspection
Part 2 must be passed before a team may apply for Part 3 inspection.

Part 3 – Kill switch and dynamic brake testing
Both the external and cockpit kill switches will be tested for functionality. If both switches pass the test then the vehicle will be dynamically brake tested. Each vehicle must demonstrate its ability to lock all four wheels and come to rest in an approximately straight line after an acceleration run specified by the inspectors. If a vehicle fails to pass any part of the inspection it must be corrected/modified and brought into compliance with the rules before it is permitted to operate. The inspectors and officials have the right to re-inspect any vehicle at any time during the competition and require correction of any non-compliance.

#### 50.1.1 Inspection Stickers

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

Technical inspectors and officials may remove any or all parts of the inspection sticker from any vehicle that has been damaged or which they reasonably believe may not comply with the rules.

#### 50.1.2 Technical Inspection Sheet – Pre-inspection Required

Before bringing their car to technical inspection each team **must (1)** pre-inspect the vehicle for compliance with the rules, **(2)** complete the official technical inspection sheet (available on the Baja SAE Rules and Important Documents website, http://students.sae.org/competitions/bajasae/rules/ ) , **(3)** have the completed inspection list signed by the faculty advisor and team captain. Teams must download the most current version of the technical inspection sheet within two weeks of the competition and thoroughly inspect their vehicle in accordance with the sheet. All drivers must be at technical inspection or they will be removed from the list of drivers and a 10 point penalty will be applied to the team.
**NOTE**: Teams presenting Technical Inspection Sheets that are **(1)** incomplete, **(2)** inaccurate (i.e. do not correspond to the actual condition of the car) **(3)** are found to have 4 items not in accordance with the rules, or **(4)** do not represent a serious effort at pre-inspection will be denied inspection at that time and sent back to the end of the inspection line with a 15 point deduction.

#### 50.1.3 "As-approved" Condition

Once a vehicle has passed technical inspection its configuration may not 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 adjustments permitted by the rules and normal vehicle maintenance and tuning are not considered modifications.

## 51. Static events and required reports – total 300 points

### 51.1 Engineering Design

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

#### 51.1.1 Design Report – 50 or 100 Points

The design report should clearly explain the engineering and design process that was used in developing each system of the team's Baja SAE 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.

**51.1.2 Design Report – Format**

**(a) Format** – Design reports must follow the format for SAE Technical Papers found at http://www.sae.org/products/papers/paprinfo/present.htm.
**(b) Electronic version** – The design report must be submitted electronically in Adobe Acrobat Format. The document must be a single file (text, drawings and optional content are all inclusive). The design report file must be named as follows: Car #_school name (full name) _competition.
**EXAMPLE**: Car #141_University of East Mudge_Baja Illinois.
**(c) File Size** – The maximum size for the file is **5 megabytes.**

**51.1.3 Design Report – Page Limit**

The technical paper segment of the design report is limited to ten (10) pages, excluding the cover page. Additionally the report may, at the team's option, include up to four (4) non-text pages of plans, graphics, photographs or other data for a maximum of fourteen (14) pages of information. The only text permitted on the four (4) optional pages is captions. All pages must be either 8 ½" x 11" or A4.
**NOTE**: If your paper exceeds 10 pages of technical report or 4 pages of graphics, then only the first 10 technical and 4 graphic pages will be evaluated.

**51.1.4 Design Report – Deadline and Submission**

Design reports must be received no later than the due date by the individual/address listed in the Action Deadlines page at the end of the Rules. 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.
**(a)** Electronic Report: Email the electronic version of the design report to each competition your team has entered by the submission date. Email addresses are listed in the appendix.
**COMMENT**: We recommend that you bring a printed copy of your design report to the competition and proof of submission.

**51.1.5 Design – 100 or 125 Points**

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

Design judging will involve two steps. The first step will be the initial design judging of all vehicles. After initial judging is complete and the competitors design evaluation scores recorded, the top cars (number determined by SAE and the organizers) will move onto Design Finals.

Vehicles presented in an unfinished condition may receive lower, or zero points for any incomplete area 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.

Engineering design will be evaluated, and points awarded in the following areas:

| **Design category** | **Tennessee** | **Montreal** | **Illinois** |
|---|---|---|---|
| Originality, Innovation, Craftsmanship | 31.25 | 31.25 | 25 |
| Suspension, Steering, Brakes | 31.25 | 31.25 | 25 |
| Structural Design, Operator Comfort, Mass Production | 31.25 | 31.25 | 25 |
| Powertrain, Serviceability, Flotation | 31.25 | 31.25 | 25 |
| **Total** | **125** | **125** | **100** |

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.

**51.1.6 Design Finals**

The purpose for Design Finals (DF) is to determine which car has the best design as determined by the judges.

Design judging typically is done by more than one group of judges at each event. This is due to the number of entries and the time required to properly and fairly judge each car. DF is a chance to take the top cars and determine which has the best design as determined by the team of judges at that event. The top 3-10 teams will be put in DF. This decision will be determined by the Chief Design Judge, SAE, and the Chief scoring judge and be based on initial design scores.

Scoring for DF is as follows:
After the DF cars have been determined, all initial scores will be reduced to that of the last car in DF. This score is considered "DF Initial" (DFI) score. The difference between the first car and the last car is divided by the number of cars in DF. DF Bonus (DFB) is this number or 1, whichever is greater.

Cars in DF are then judged by a single group of judges. The final rankings are given and the bonuses awarded. The car judged last in DF receives no bonus. The next car receives DF Initial plus 1X DF Bonus, the next receives DFI + 2X DFB, etc.
Example:

| | |
|---|---|
| Min in DF | 90 |
| Bonus | 1.8 |

| Car # | Initial Score | DF Initial Score | DF Rank | DF Bonus | DF Final Score |
|---|---|---|---|---|---|
| 45 | 99 | 90 | 2 | 5.4 | 95.4 |
| 23 | 97 | 90 | 3 | 3.6 | 93.6 |
| 10 | 95 | 90 | 1 | 7.2 | 97.2 |
| 5 | 93 | 90 | 4 | 1.8 | 91.8 |
| 4 | 90 | 90 | 5 | 0 | 90 |

**51.2 Cost Event**

Cost consists of two related sections: Cost Report and Prototype Cost. The cost report (See section 51.2.1) provides all the background information to verify the vehicle's actual cost. The prototype cost (See section 51.2.7) is the actual calculation of points given to each team based on the team's cost compared to the cost of other teams. Although these cost category areas are scored separately, they are closely related and are evaluated by the same judges. Cost should be treated as a single event with two parts. For example, a poorly compiled or documented cost report might not adequately support the represented cost. On the other hand, reporting a prototype cost that has been made artificially low will cause the cost report to be inaccurate and it will be downgraded accordingly.

**51.2.1 Cost Report – 15 Points**

The Cost Report should contain a maximum of three sections plus cover pages.
**Report Section 1 – Overview (Optional)** – The optional overview is intended to give each team the opportunity to point out, and briefly comment on, any design features or fabrication processes that are innovative or are expected to result in significant cost savings. Teams may also use the overview to explain items or processes that might appear to be discrepancies within the report. The overview section is limited to a maximum of four (4) pages and is entirely optional.
**Report Section 2 – Costing Sheets** – The core of the report is the series of costing sheets. This section must contain the one-page summary sheet broken up into the individual subsystem. Each subsystem needs an individual sub-assembly sheet (Form A). Please note that Vehicle Assembly Labor cost is for the labor it takes to assemble a subassembly to the frame. All fabricated parts on the sub-assemblies sheets (Form A) require a Form B. Please note that the sub-system assembly time is the time it takes to assemble all the parts in that assembly together.
**Report Section 3 – Cost Documentation** – This section includes copies of receipts, invoices, price tags, catalog pages, on-line prices, or other documentation, to substantiate the costs of the parts and materials of any item costing more than $20. Cost documentation must be at full retail US prices. The report is expected to be comprehensive, well documented, truthful and accurate.

**51.2.2 Cost Report – Electronic Format**

**Electronic version** – The cost report must be submitted electronically in two different documents, 1.) The Microsoft Excel format, using the supplied template posted on the Baja SAE important documents page, 2.) A

PDF file with all of the cost documentation described above. **The cost report file must be named as follows: car number, school name (full name), team name (if more than one vehicle is entered).** If the vehicle is participating in more than one competition use the car number of the first competition.

**51.2.3 Cost Report – File Size**

The maximum size for the Excel template is **1.0 megabytes** and **4 megabytes** for the PDF file.

**51.2.4 Multi-competition Cost Reports – North American Events Only**

Teams that are entering more than one of the North American Baja SAE competitions must submit a single multi-competition cost report.

Multi-competition cost reports must (1) Identify all the competitions to which the report applies AND the vehicle number at each event. (2) Contain a unique event form documenting all differences between competitions. If a team does not show up for the event, they will not receive a cost score and their vehicle cost will be removed from the event.

**51.2.5 Penalty for Late or Non-Submission**

Cost reports arriving after the deadline will be penalized ten (10) points per day up to a maximum of one hundred (100) points. Failure to submit a cost report will result in zero (0) points for the event.
**COMMENT**: Teams must bring a hard copy and electronic copy of the cost report and documentation showing submittal date to all competitions. Teams will be cost audited at competition. If they do not have a hard copy of their cost report, they will receive zero points for the cost of their car.

**51.2.6 Cost Judges Authority**

The judges have the authority to increase the costs and/or fabrication times if they believe that the figures submitted are below current prices for the item, source, or process involved. Prices or times that are higher than the judge would have expected will not be corrected. Mathematical errors will be penalized. Reports that are highly inaccurate, highly incomplete, or in which the costs can not be substantiated, may be rejected in their entirety and zero (0) points will be awarded for Cost.

**51.2.7 Prototype Cost – 85 points**

Prototype cost is scored on the cost, as corrected by the judges, to produce the finished vehicle brought to the competition.
Prototype cost score will be calculated as follows:
**Prototype cost score = *85* x [(Max Cost – Your Cost)/ (Max Cost – Lowest Cost)]**
Where: "Your Cost" is the cost as corrected by the cost judges. "Lowest Cost" is the corrected cost of the team producing the lowest cost vehicle. "Max Cost" is the corrected cost of the team producing the highest cost vehicle.

**51.2.8 Cost Adjustment Form**

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

**51.2.9 Cost Eligibility**

Teams that do not successfully pass technical inspection will not receive any points for prototype cost.

**51.2.10 Cost Component Categories**

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

**51.3 Presentation – Baja SAE Illinois only – 50 Points**

**51.3.1 Presentation – Objective**

The objective of the Presentation is for the team to convince the "executives" of a hypothetical manufacturing company to purchase the team's Baja SAE vehicle design and put it into production at the rate of 4000 units per year. For the purposes of the presentation assume that the judges are a mixed group of corporate executives who may have experience in marketing, production, finance as well as engineering.

**51.3.2 Presentation – Format**

One or more team members may make the presentation to the judges. The presentation itself is limited to a maximum of ten (10) minutes. Following the presentation there will be an approximately five (5) minute question period. Only the judges are permitted to ask questions. Any team member on the presentation floor/stage may answer the questions even if that member did not speak during the presentation itself.

**51.3.2.1 Projection Equipment**

Teams planning to use data projection are responsible for bringing, or otherwise arranging for their own data projectors. Some data projectors may be provided by the organizers; however, teams should not rely on either the availability or functionality of such equipment.

**51.3.3 Presentation – Scoring**

The presentation event will be scored based on such categories as **(1)** the content of the presentation, **(2)** the organization of the presentation, **(3)** the effectiveness of the visual aids, **(4)** the speaker's delivery, and **(5)** the team's responses to the judge's questions. The team's score will be the average of the individual judge's scores. The team that makes the best presentation will receive the highest score regardless of the finished quality of their actual vehicle.

## 52. Dynamic Events – Total – 700 Points

The dynamic events are intended to determine how the Baja SAE 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.

**52.1 Acceleration – 60 or 75 Points**

**52.1.1 Acceleration – Objective**

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

**52.1.2 Acceleration – Procedure**

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

**52.1.3 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<br>Second - Run disqualification |
| Leaving Course | Run disqualification |

**52.1.4 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:

**Acceleration score = *60 or 75* x [(T longest – T yours)/(T longest – T shortest)]**

Where: "T shortest" is the fastest time by any team
"T longest" is either (a)the slowest time by any team **or**
(b) 2.5x the fastest time whichever is the shorter interval
"T yours" is your team's best time

**52.2 Traction Event – 60 or 75 Points**

The traction events are designed to demonstrate the vehicle's ability to use its traction to accomplish various tasks. At the organizer's discretion, the traction event will be either the hill climb or a pulling event.

**52.2.1 Event – Objective**

These events test the vehicle's relative ability to climb an incline from a standing start or pull a designated object, e.g. "eliminator skid", vehicle, or chain, along a flat surface. The organizer will determine the hill height or object to be pulled.

**52.2.2 Event – Procedure**

Each vehicle may make two (2) attempts with the best distance counting for score. 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. During hill climb, if a vehicle stalls before reaching the top of the hill, or if its wheels are spinning without moving the vehicle forward, the attempt is scored for distance at that point.

**52.2.3 Traction Event – 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.

| | |
|---|---|
| Leaving Course | Score as maximum progress in feet at point upon exiting |
| False Start | First - Rerun at end |
| | Second - Run disqualification |

**52.2.4 Event – Scoring**

**Method A**: "Different Distances" - In the most common instance where the vehicle's climb the hill or pull the object to a variety of distances the score will be determined by the following formula:

**Event Score = *60 or 75* x [(D yours – D shortest)/(D longest – D shortest)]**

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

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

**Event Score = *60 or 75* x [(T longest – T yours)/( T longest – T shortest)]**

Where: "T longest" is either (a) the longest time through the course by any team **or**
(b) 2.5 x "T shortest" whichever is the shorter time
"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 distance and (b) at least one team climbs the hill or makes a full pull and others do not, then the vehicles going the full distance (Group I) will be scored based on time and the vehicles that fail to climb the hill or make a full pull (Group II) will be scored based on distance. Scoring will be by the following formulas:

Group I – Teams that make the full distance will be scored by the following:

**Group I Score = *60 or 75* x (T fastest/ T yours)**

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 distance will be scored by the following:

**Group II Score = (Lowest score from Group I) x (D yours/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

### 52.3 Maneuverability Events – 60 and 75 points

#### 52.3.1 Maneuverability – 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.

#### 52.3.2 Maneuverability – Procedure

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

#### 52.3.3 Maneuverability – 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<br>Second - Run disqualification |

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

#### 52.3.4 Maneuverability – Time Limit

Only vehicles that complete the maneuverability course within a time not exceeding two and half times (2.5x) 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".

#### 52.3.5 Maneuverability – Scoring

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

**Maneuverability Score = *60 or 75* x [(T longest – T yours)/(T longest – T shortest)]**

Where: "T longest" is either (a) the longest time through the course by any team **or**
(b) 2.5 x "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

### 52.4 Specialty Events – 60 or 75 points

#### 52.4.1 Specialty Events – Objective

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. Rock crawl, mud bogg and suspension and traction are examples of specialty events.

**52.4.2 Specialty Events – 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.

**52.4.3 Specialty Events – 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.

**52.4.4 Specialty Events – Penalties 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 | 5 seconds or 5 feet |
| Missed gate* | 10 seconds or 10 feet |
| False Start | First - Rerun at end |
| | Second - Run disqualification |

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

**52.4.5 Specialty Events – Scoring**

**NOTE**: For vehicles that do not complete the full course, the distance traveled is measured from the starting line to the center of the front wheels.
**Method A**: "All Vehicles Succeed" - If all vehicles complete the specialty event, scoring will be by the following formula:

**Score = *60 or 75* x [(T longest – T yours)/(T longest – T shortest)]**

Where: "T longest" is either (a) the longest time through the course by any team **or**
(b) 2.5 x "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

**Method B**: "No Vehicles Succeed" - If no vehicle completes the specialty event, scoring will be by the following formula:

**Event Score = *60 or 75* x [(D yours – D shortest)/(D longest – D shortest)]**

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

**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 specialty event will be scored by the following:

**Group I Score = 75 x (T fastest/ T yours)**

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 = (Lowest score from Group I) 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.

**52.5 Endurance – 400 Points**

**52.5.1 Endurance – Objective**

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

**52.5.2 Endurance – General Description**

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

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

Determining the winner of the endurance race:
The team that completes the distance of the competition first, or the greatest distance in the time set for the competition will be declared the winner.

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

In competitions of a timed length, the checkered flag will be given first to the leading car as it crosses the finish line at or after the expiration of the specified duration, then to the other finishers as they cross the finish line. If the leading car is not running at the expiration of the time limit, the checkered flag will be given to the next highest running car in the same manner.

**52.5.3 Endurance – Starting**

The starting grid for endurance will be based on each team's performance in a previous dynamic competition, or set of dynamic events, 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.

**52.5.4 Endurance – Command Flags**

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

**Green Flag** – (1) At a starting line or when reentering the course: Your run or session has started; enter the course under the direction of the starter. (**NOTE**: If you stall the vehicle, restart and await another green flag as the opening in traffic may have closed.)
(2) While running on the course: Course is clear, proceed.

**Yellow Flag, Steady** – Danger, SLOW DOWN, be prepared to take evasive action, something has happened beyond the flag station. NO PASSING, unless directed by the course workers.

**Yellow Flag, Waved** – Great danger, SLOW DOWN, evasive action is likely to be required, BE PREPARED TO STOP, something has happened beyond the flag station. NO PASSING, unless directed by the course workers.

**Red Flag** – Come to an immediate safe and controlled stop on the course. Pull to the side of the course as much as possible to keep the course open. Follow course worker directions. NO PASSING.

**Black Flag, Furled and Pointed** – Warning, the officials are watching this vehicle's driving – obey the event rules.

**Black Flag, Displayed** – (1) Pull into the penalty box for a discussion with the Director of Operations or other official concerning an incident. A time penalty may be assessed for the incident.
(2) Pull into the penalty box for a mechanical inspection of the car, something has been observed that needs closer inspection.

**White Flag** – In specified-distance endurance events, the white flag will be displayed to the leader as the leader begins the final lap.

**Checkered Flag** – The run or session has been completed. Exit the course at the first opportunity.

**52.5.5 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 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.

Officials and course marshals may stop any vehicle, at any time, if they believe it no longer complies with the requirements and restrictions of the rules. If a vehicle is stopped by officials for a mechanical fault, the fault must be corrected/repaired before it may reenter the event.

**52.5.6 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.

**52.5.7 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 |
| Refueling on the track | First time = Disqualification |
| Running out of fuel on the track | 20 minutes |
| Passing under a Yellow Flag | 1 lap penalty |
| Deliberate ramming | First time = 10 minutes<br>Second time = Disqualification |
| Deliberate forcing another vehicle off course | First time = 10 minutes<br>Second time = 20 minutes<br>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 | First time = 5 minutes<br>Second time = 20 minutes |

Fueling: Fueling will not be allowed 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 while fueling.

**52.5.8 Endurance – Scoring**

**(a) General**: 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 laps count, partial laps do not count for score. A vehicle must cross the counting/timing line under its own power for a lap to be counted.

"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.

"Bonus points" are additional points awarded to the first ten (10) vehicles on the leading (winning) lap, as separated by finish order as required, in part to differentiate teams finishing with the same number of scored laps. Up to 10 bonus points will be awarded in the inverse order of finish. Thus, the first vehicle to cross the finish line in the highest lap group will receive bonus points equal to the number of cars on the lead lap (max of 10); the second vehicle will receive one less bonus point etc. Example:

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

Endurance scoring is based on number of laps the vehicle completes in the allowed time:
Endurance Score = [400 x (L yours – L lowest)/(L highest – L lowest)] + bonus points
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

**(b) Endurance Heats plus a Final – Point Distribution**: When endurance is run as heats plus a final, the points for the event will be distributed between the heats and the final in proportion to the time/distance of each stage. Thus, if endurance is run as one (1) hour eliminations plus a three (3) hour final, the four hundred (400) total points will be allocated as one hundred (100) points to each elimination heat plus three hundred (300) points to the final.

**52.6 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:

Endurance score
Total dynamic events score
Total static events score

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

## Section 6 APPENDIX

### 60. Notice of possible rule changes for 2009

All drivers must wear a well-fitting Motor-Cross style helmet with an integrated (one piece composite shell) chin/face guard and a Snell M2005, SA 2005, British Standards Institution BS 6658-85 types A or A/FR or UN ECE Regulation 22.05 rating.

Each competition for 2009 will hold sales presentations.

## BAJA SAE ROLL CAGE SPECIFICATION SHEET
## 2008 BAJA SAE COMPETITIONS

**SCHOOL NAME** _____ **CAR NUMBER** _____

**Circle competition in which you are competing: Tennessee Illinois Montreal**

**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? _____

2. Material Type (ie: 4130): _____ OD: _____ Thickness: _____
_____

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

4. All welds and/or other attachment methods must be checked for integrity
Date of inspection _____

*NOTE: It is extremely important that such an inspection be made to ensure the welds have good penetration and joints are completely welded.*

**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 FOR EACH COMPETION YOUR TEAM IS ENTERING.**

**2008 BAJA SAE Tennessee Hosted by Tennessee Tech University**
**Cookeville, TN**
**May 1-3, 2008**

## ACTION DEADLINES

- **Registration – Opens OCTOBER 1, 2007 at 10:00 AM Eastern Daylight Savings Time**
  **Register online at: http://www.sae.org/students/student.htm**

- **Registration Fee - $600.00**
  **Registration Deadline – December 27, 2007**

- **Engine Orders – Available online upon completion of registration beginning 10/01/07**
  **Engine Order Deadline – December 27, 2007**

- **Design Reports**
  **See Section 51.1.1**

  **DESIGN REPORTS**
  **(1) ELECTRONIC REPORTS -must be received by 11:59 PM Eastern Standard Time on Monday, March 17, 2008:**
  **Send to: bajasae@sae.org**
  **A confirmation will be sent upon receiving your report within 48 hours. If you do not receive a confirmation it is your responsibility to follow up.**

- **Cost Reports Due**
  **See Section 51.2.1**

  **1) COST REPORT TEMPLATE (emailed) –must be received by 11:59 PM Eastern Standard Time on Monday, April 14, 2008:**
  **Send to: bajasae@sae.org**
  **A confirmation will be sent upon receiving your report within 48 hours. If you do not receive a confirmation it is your responsibility to follow up.**

- **Technical and safety inquiries must be sent via email to the National Technical Inspectors at: bajarules@sae.org**

**2008 BAJA SAE Illinois Hosted by Central Illinois Section**
**Edwards, IL**
**May 29 – 31, 2008**

## ACTION DEADLINES

- **Registration – Opens OCTOBER 1, 2007 at 10:00 AM Eastern Daylight Savings Time**
  **Register online at: http://www.sae.org/students/student.htm**

- **Registration Fee - $600.00**
  **Registration Deadline – December 27, 2007**

- **Engine Orders – Available online upon completion of registration beginning 10/01/07**
  **Engine Order Deadline – December 27, 2007**

- **Design Reports**
  **See Section 51.1.1**

  **DESIGN REPORTS**
  **(1) ELECTRONIC REPORTS -must be received by 11:59 PM Eastern Standard Time on Monday, April 7, 2008:**
  **Send to: bajasae@sae.org**
  **A confirmation will be sent upon receiving your report within 48 hours. If you do not receive a confirmation it is your responsibility to follow up.**

- **Cost Reports Due**
  **See Section 51.2.1**

  **1) COST REPORT TEMPLATE (emailed) –must be received by 11:59 PM Eastern Standard Time on Monday, April 14, 2008:**
  **Send to: bajasae@sae.org**
  **A confirmation will be sent upon receiving your report within 48 hours. If you do not receive a confirmation it is your responsibility to follow up.**

- **Technical and safety inquiries must be sent via email to the National Technical Inspectors at: bajarules@sae.org**

**2008 BAJA SAE Montreal Hosted by Ecole de Technologie Superieure**
**Montreal, Quebec, Canada**
**June 11-14, 2008**

## ACTION DEADLINES

- **Registration – Opens OCTOBER 1, 2007 at 10:00 AM Eastern Daylight Savings Time**
  **Register online at: http://www.sae.org/students/student.htm**

- **Registration Fee - $600.00**
  **Registration Deadline – December 27, 2007**

- **Engine Orders – Available online upon completion of registration beginning 10/01/07**
  **Engine Order Deadline – December 27, 2007**

- **Design Reports**
  **See Section 51.1.1**

  **DESIGN REPORTS**
  **(1) ELECTRONIC REPORTS - must be received by 11:59 PM Eastern Standard Time on Monday, April 21, 2008:**
  **Send to: bajasae@sae.org**
  **A confirmation will be sent upon receiving your report within 48 hours. If you do not receive a confirmation it is your responsibility to follow up.**

- **Cost Reports Due**
  **See Section 51.2.1**

  **1) COST REPORT TEMPLATE (emailed) –must be received by 11:59 PM Eastern Standard Time on Monday, April 14, 2008:**
  **Send to: bajasae@sae.org**
  **A confirmation will be sent upon receiving your report within 48 hours. If you do not receive a confirmation it is your responsibility to follow up.**

- **Technical and safety inquiries must be sent via email to the National Technical Inspectors at: bajarules@sae.org**

**2008 Baja SAE South Africa – Information**
**University of Pretoria, South Africa**
**October, 2008**

## ACTION DEADLINES

**Note: All Submissions Must Be RECEIVED By the Deadline-NOT POSTMARKED**

- **Registration – Opens FEBRUARY 1, 2008**
  **Register online at: www.me.up.ac.za/mini_Baja/index.htm**

- **Early Registration Fee - FREE**
  **Early Registration deadline – MARCH 3, 2008**

- **Late Registration Fee - $100.00**
  **Late Registration Deadline – SEPTEMBER 26, 2008**

- **Engine Orders – Free for local teams (contact organizer Schalk Els)**
  **Engine Order Deadline – MARCH 3, 2008**

- **DESIGN, COST AND ROLL CAGE REPORTS DUE – SEPTEMBER 26, 2008**

  **DESIGN, COST AND ROLL CAGE REPORTS ARE TO BE MAILED TO:**

  **Schalk Els**
  **University of Pretoria Main Campus**
  **Department of Mechanical and Aeronautical Engineering**
  **Engineering 1 Building**
  **Room 10-11**
  **Lynnwood Road**
  **Pretoria, 0002**
  **South Africa**

- **Rules questions and inquiries regarding the organization of the South African Baja SAE event specifically, go to Schalk Els at: schalk.els@eng.up.ac.za**

- **Go to: http://www.me.up.ac.za/mini_Baja/index.htm for official event website**


# 2006 Car Weight Data

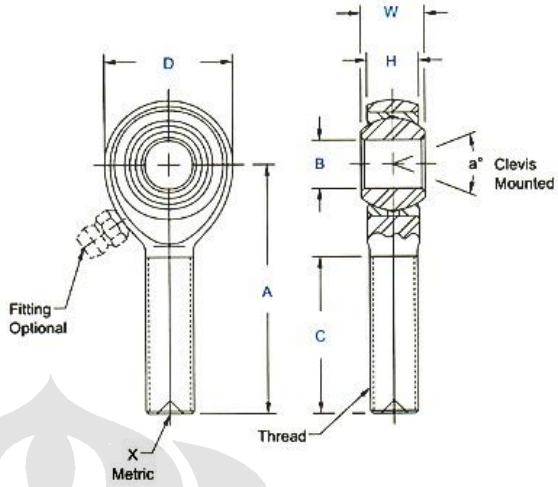
| East 2006 Car Number | weight empty, lbs. | % of weight on front | % of driver's weight on front | wheelbase, in. | front track width, in. | rear track width, in. |
|---|---|---|---|---|---|---|
| 1 | | | | | | |
| 2 | 467 | 40.7 | 43.9 | 59.0 | 48.0 | 44.5 |
| 3 | 467 | 40.0 | 39.2 | 57.0 | 62.0 | 59.0 |
| 4 | 534 | 42.1 | 44.6 | 63.5 | 53.0 | 52.0 |
| 5 | 454 | 38.5 | 42.4 | 61.0 | 49.0 | 46.0 |
| 6 | 577 | 34.1 | 38.0 | 62.5 | 51.0 | 49.5 |
| 7 | 459 | 35.3 | 40.3 | 56.0 | 51.0 | 49.0 |
| 8 | 575 | 39.7 | 42.5 | 68.0 | 43.0 | 47.0 |
| 9 | 534 | 39.0 | 42.4 | 62.0 | 46.0 | 43.0 |
| 10 | 663 | 36.5 | 37.4 | 67.0 | 49.0 | 50.0 |
| 11 | 566 | 39.0 | 44.0 | 61.5 | 47.0 | 45.5 |
| 13 | 570 | 37.5 | 40.1 | 64.0 | 48.5 | 47.0 |
| 14 | 520 | 41.7 | 0.0 | 65.0 | 47.0 | 46.0 |
| 15 | 466 | 37.8 | 40.6 | 58.0 | 48.0 | 48.0 |
| 16 | 535 | 36.8 | 39.8 | 65.5 | 53.0 | 51.5 |
| 17 | 721 | 38.6 | 41.2 | 61.0 | 56.0 | 53.0 |
| 18 | 435 | 40.2 | 43.5 | 45.5 | 52.5 | 52.0 |
| 19 | 454 | 46.0 | 49.8 | 62.5 | 47.5 | 36.5 |
| 20 | 559 | 36.7 | 41.2 | 60.0 | 42.0 | 52.0 |
| 21 | | | | | | |
| 22 | 658 | 29.8 | 34.7 | 68.5 | 47.0 | 47.5 |
| 23 | 660 | 32.3 | 34.2 | 57.5 | 55.0 | 54.5 |
| 24 | 0 | 0.0 | 0.0 | | | |
| 25 | 465 | 33.5 | 36.8 | 64.0 | 50.0 | 49.0 |
| 27 | 458 | 34.7 | 40.4 | 58.0 | 48.0 | 50.0 |
| 28 | 692 | 35.0 | 37.1 | 64.0 | 55.0 | 47.5 |
| 29 | 0 | 0.0 | 0.0 | | | |
| 30 | 452 | 35.4 | 37.9 | 69.5 | 50.0 | 48.0 |
| 31 | | | | | | |
| 32 | 594 | 39.4 | 40.7 | 57.0 | 48.0 | 46.5 |
| 33 | 585 | 42.1 | 54.7 | 59.5 | 52.0 | 49.0 |
| 34 | 686 | 38.0 | 39.4 | 68.0 | 51.0 | 50.0 |
| 35 | 570 | 44.6 | 46.1 | 60.0 | 47.5 | 42.0 |
| 36 | | | | | | |
| 37 | 478 | 42.3 | 46.3 | 60.0 | 54.5 | 52.0 |
| 39 | 557 | 41.3 | 44.6 | 64.0 | 57.0 | 55.0 |
| 40 | 508 | 35.6 | 37.2 | 61.0 | 54.0 | 49.5 |
| 41 | 492 | 33.3 | 36.5 | 72.5 | 49.0 | 48.5 |
| 42 | 701 | 39.2 | 41.0 | 58.5 | 53.0 | 51.0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 43 | | | | | | |
| 44 | 679 | 38.7 | 41.6 | 67.0 | 45.5 | 46.5 |
| 45 | 554 | 37.7 | 42.7 | 58.0 | 49.5 | 44.0 |
| 46 | 612 | 35.9 | 41.5 | 57.0 | 49.0 | 46.0 |
| 47 | | | | | | |
| 48 | | | | | | |
| 49 | 694 | 39.6 | 42.1 | 72.0 | 55.0 | 50.0 |
| 50 | | | | | | |
| 51 | | | | | | |
| 52 | | | | | | |
| 53 | 674 | 35.3 | 38.8 | 71.0 | 52.0 | 47.0 |
| 54 | | | | | | |
| 55 | 567 | 34.4 | 35.4 | 67.5 | 53.5 | 44.5 |
| 56 | 557 | 38.1 | 41.0 | 62.0 | 58.0 | 60.0 |
| 57 | 597 | 38.0 | 41.6 | 64.0 | 49.5 | 51.5 |
| 59 | 752 | 39.4 | 41.8 | 63.0 | 50.5 | 53.0 |
| 60 | 474 | 40.5 | 44.4 | 62.0 | 54.0 | 39.0 |
| 61 | 569 | 35.0 | 38.5 | 57.0 | 48.0 | 47.0 |
| 62 | 745 | 35.2 | 37.1 | 78.0 | 50.0 | 41.0 |
| 64 | 637 | 37.7 | 40.7 | 63.5 | 47.0 | 45.5 |
| 65 | | | | | | |
| 66 | 676 | 40.1 | 42.2 | 69.0 | 55.0 | 53.0 |
| 70 | 474 | 34.0 | 37.5 | 56.0 | 53.0 | 51.0 |
| 71 | 448 | 42.9 | 45.2 | 62.0 | 59.5 | 61.0 |
| 77 | 550 | 39.6 | 44.4 | 61.0 | 51.0 | 48.0 |
| 83 | | | | | | |
| 85 | 627 | 38.6 | 43.0 | 64.0 | 48.5 | 48.0 |

# LAMPIRAN 3

| Wheel travel, z (mm) | -50 | -40 | -30 | -20 | -10 | 0 |
|---|---|---|---|---|---|---|
| Camber Change (rad) | -0.000422 | -0.000762 | -0.000887 | -0.000799 | -0.000502 | 0.000000 |
| Camber change (deg) | -0.02417882 | -0.043659384 | -0.050821 | -0.045779 | -0.028762 | 0.000000 |
| Ride camber dγ/dz | -0.0000314 | 0.0000012 | 0.0000265 | 0.0000446 | 0.0000558 | 0.0000604 |
| 1/(dγ/dz) | -31880.213 | 813987.201 | 37754.372 | 22423.385 | 17919.672 | 16568.764 |
| Tread change,One wheel (mm) | 0.100226 | 0.099884 | 0.099619 | 0.099429 | 0.099312 | 0.000000 |

| Wheel travel, z (mm) | 10 | 20 | 30 | 40 | 50 |
|---|---|---|---|---|---|
| Camber Change (rad) | 0.000704 | 0.001606 | 0.002704 | 0.003994 | 0.005473 |
| Camber change (deg) | 0.040336 | 0.092017 | 0.154928 | 0.228839 | 0.313580 |
| Ride camber dγ/dz | 0.0000585 | 0.0000503 | 0.0000362 | 0.0000161 | -0.0000095 |
| 1/(dγ/dz) | 17108.143 | 19869.390 | 27662.324 | 61957.864 | -105104.199 |
| Tread change,One wheel (mm) | 0.099284 | 0.099369 | 0.099518 | 0.099728 | 0.099997 |




| Specifications | AM-M & AB-M Note |
|---|---|
| Part Number | AMF-M16 |
| Thread Type | Right Hand |
| Thread Configuration | Male |
| B - Ball Bore [mm] | 16 |
| W - Ball Width [mm] | 21 |
| H - Head Width [mm] | 14.25 |
| A - Base to Center [mm] | 66 |
| D - Head Diameter [mm] | 38.00 |
| Ball Diameter [mm] | 28.58 |
| C - Thread Length [mm] | 40 |
| Thread Size | M16 x 1.5 |
| $a_1$ - Misalignment Angle Clevis Mounted [degrees] | 23 |
| $a_3$ - Misalignment Angle Clevis Mounted [degrees] | 35 |
| $a_4$ - Misalignment Angle Clevis Mounted [degrees] | 52 |
| Ultimate Radial Static Load Capacity [Newtons] | 76,291 |
| Approximate Brg. Weight [Grams] | 173 |
| Lubrication Options ? | Zerk Fitting, Flush Fitting, or Ptfe Liner |