

## 2010 SAE SUPERMILEAGE® RULES

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## **2010 SAE SUPERMILEAGE® RULES**

### **INTRODUCTION**

This introduction is intended to highlight some aspects of the 2010 SAE Supermileage Rules that you may find of interest. The first thing you'll notice is that the 2010 Rules have been rearranged and are presented in a new format. Although certain editorial revisions and wording changes were required by the new format, there's nothing different about the technical requirements or how the competition is conducted.

The 2010 Supermileage Rules are divided into 4 parts as follows:

Part A – Administrative Requirements - Part A contains, among other items, the operating policies that govern the competition and the information on registering your team.

Part B – Technical Requirements – Part B includes all the technical regulations that govern the design and fabrication of your vehicle.

Part C – Static Event Requirements – Part C covers the written and verbal Design Reports.

Part D – Dynamic Event Requirements – Part D covers the operation and scoring of the Performance Event.  
We hope you like the new rules format and find it easy to use.

## **PART A – ADMINISTRATIVE REGULATIONS**

### **ARTICLE 1: SAE SUPERMILEAGE OVERVIEW**

#### **A1.1 Supermileage Competition Objective**

The objective of the SAE Supermileage competition is to offer undergraduate and graduate students the opportunity to enhance their engineering design and engineering project management skills in a challenging competition.

#### **A1.2 Design Goal**

The engineering design goal for SAE Supermileage is to develop a single person, extremely high mileage vehicle that complies with the Supermileage rules. The vehicles will run a specified course with the vehicle obtaining the highest combined kilometers per liter (miles per gallon) rating plus design segment points winning the event.

#### **A1.3 Good Engineering Practices**

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

### **ARTICLE 2: RULES**

#### **A2.1 Rules Authority**

The SAE Supermileage Rules are the responsibility of the SAE Supermileage Rules Committee and are issued under the authority of the SAE University Programs Committee. Official announcements from the SAE Supermileage Rules Committee, SAE or the Supermileage organizers shall be considered part of and shall have the same validity as these rules.

A2.1.1 Ambiguities or questions concerning the meaning or intent of these rules will be resolved by the SAE Supermileage Rules Committee, SAE staff or by the individual competition organizers as appropriate.

#### **A2.2 Rules Validity**

The SAE Supermileage 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.

#### **A2.3 Rules Compliance**

By entering a SAE competition the team, members of the team as individuals, 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 SAE Supermileage 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.

#### **A2.4 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 only to facilitate reading; they do not affect the paragraph contents.

### **A2.5 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.

### **A2.6 Official Communications**

All teams are required to read and follow official announcements concerning the competition and the rules that are sent from the SAE or organizers to the team captain and/or faculty advisor.

Official announcements from SAE will be posted to the SAE Supermileage Forum at [http://forums.sae.org/access/dispatch.cgi/supermileage\\_pf](http://forums.sae.org/access/dispatch.cgi/supermileage_pf). Information will also be posted on the SAE Supermileage website at <http://www.sae.org/students/supermw.htm>.

## **ARTICLE 3: INDIVIDUAL PARTICIPATION REQUIREMENTS**

### **A3.1 Eligibility Limits**

Eligibility is limited to undergraduate and graduate students to insure that this is an engineering design competition.

### **A3.2 Student Status**

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

### **A3.3 SAE Membership**

Team members must be members of SAE. Proof of SAE membership is required at the event. Information on SAE Student membership can be found on SAE’s website: [www.sae.org/students](http://www.sae.org/students)

### **A3.4 Liability Waiver and Insurance**

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

### **A3.5 Driver Requirements and Limitations**

All drivers must be at least eighteen (18) years of age and have and present proof of: (1) a valid government issued highway driver’s license and (2) medical insurance coverage.

### **A3.6 Individual Participation Requirements – Action Required**

All participating team members and faculty advisors must be sure that they are individually linked to their respective school / university on the SAE website.

If you are not an SAE member, go to [www.sae.org](http://www.sae.org) and select the “Join SAE / Membership Renewal” link under “Quick links”, then select the “Join SAE” link in the top right column. Students will need to select the “Student Membership” link and then follow the series of questions that are asked. Faculty members who wish to become an SAE member should choose the “Professional Membership” link. Please note all student participants must be SAE members in order to participate in the event; this is not mandatory for faculty advisors.

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 on the online Registration page (<http://students.sae.org/competitions/supermileage/registration.htm>). Upon completion, email the form to [CollegiateCompetitions@sae.org](mailto:CollegiateCompetitions@sae.org) indicating the event and university name in the subject line.

All student participants and faculty advisors must affiliate themselves to the appropriate team(s) online. To do this you will need to go to the SAE Supermileage homepage and select the Supermileage link to expand the menu. Next select the shaded brown “Supermileage” link and once the menu expands, click on Registration. From here you will select the “Register Your Team / Update Team Information” link in which your team links should appear on the next page. Select the team link and scroll to the bottom of the page; the “Add New Member” button will allow individuals to include themselves with the rest of the team.

Once you’ve associated yourself to your respective university team(s), 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, and phone number)

The “Add New Member” button will allow individuals to access this page and include the necessary credentials. If the individual is already affiliated to the team, simply select the Edit button next to the name.

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

All students, both domestic and international, must affiliate themselves online or submit the International Student Registration form by February 26, 2010. For additional assistance, please contact [CollegiateCompetitions@sae.org](mailto: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 26, 2010.**

## **ARTICLE 4: FACULTY ADVISOR**

### **A4.1 Status**

Each team is expected to have a Faculty Advisor appointed by the respective 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.

### **A4.2 Responsibilities**

Faculty Advisors may advise their teams on general engineering and engineering project management theory.

### **A4.3 Limitations**

The faculty advisor may not design any part of the vehicle nor directly participate in the development of

any documentation or presentation. Additionally, Faculty Advisors may neither fabricate nor assemble any components nor assist in the preparation, maintenance, testing or operation of the vehicle. In short: Faculty advisor may not design, build or maintain the vehicle.

## **ARTICLE 5: VEHICLE ELEGIBILITY**

### **A5.1 Student Developed**

The vehicle must be conceived, design and fabricated by the team members without direct involvement from professional engineers, faculty and technical staff in the college/school or professionals in the motorsports community. The team should be prepared to discuss/explain their design if asked to do so by the organizers.

### **A5.2 Professional Fabrication Limits**

Vehicles that have been professionally fabricated may be disqualified from the competition. If a team lacks access to machine shop facilities, a reasonable number of components may be professionally fabricated without penalty. The team should be prepared to document such lack of fabrication facilities.

### **A5.3 Re-entered Vehicles/Engines**

To ensure a genuine design effort, significant modifications to a previous year's entry must be made.

## **ARTICLE 6: REGISTRATION**

### **A6.1 Registration**

Registration for SAE Supermileage must be completed online.

### **A6.2 Registration Dates**

Registration opens online on Monday, October 5, 2009 at 10:00 am EDT. Registration closes on Monday, December 21, 2009 at 11:59 pm EST.

### **A6.3 Registration Fee**

The registration fee indicated in the Appendix must be paid online by credit card at the time of online registration. Registration fees may not be paid by any means.

Registration fees are NOT refundable.

### **A6.4 United States Visas**

Teams requiring visas to enter to the United States are advised to apply at least sixty (60) days prior to the competition. Although most visa applications seem to go through without an unreasonable delay, occasionally teams have had difficulties and in several instances visas were not issued before the competition.

Don't wait – apply early for your visa.

Neither SAE staff nor any competition organizers are permitted to give advice on visas, customs regulations or vehicle shipping regulations concerning the United States or any other country.

### **A6.5 U.S. Visa Letters**

International teams requiring visa letters to enter the United States must fill out the on-line form a minimum of three (3) weeks prior to the competition in which they are competing at:

<http://www.sae.org/students/student.htm>.

#### **A6.6 Vehicle Shipping**

Vehicle shipments by commercial carrier must comply with the laws and regulations of nations from which, and to which, the car is being sent. Teams are advised to consult with their shipping company or freight forwarder to be sure their shipment fully complies with all relevant, customs, import/export and aviation shipping requirements.

Shipments must be sent with the sending team or university listed as the receiving party. Neither the competition organizers nor the competition site can be listed as the receiving party.

#### **A6.7 Onsite Registration**

All team members and faculty advisors must complete the on-site registration procedures immediately after they arrive at the competition site.

On-site registration must be completed and any credentials and/or other identification issued by the organizers properly worn before the car can be unloaded, uncrated or worked upon in any manner.

### **ARTICLE 7: AWARDS**

The following awards will be made at the SAE Supermileage® Competition:

#### **A7.1 First Place Awards**

An award will be given to the team with the top overall score. This will be determined by the sum of the points earned on the Design Report added to the fuel mileage.

#### **A7.2 Additional Awards**

Awards will be given for the teams achieving the top scores. All teams will receive a financial award proportional to the individual team overall score provided a successful, positive fuel economy run is achieved.

#### **A7.3 Design Award**

An award will be given for the team with the highest Design Report score.

### **ARTICLE 8: QUESTIONS**

#### **A8.1 Rules Questions & General Comments**

Any questions or comments about the rules should be brought to the attention of the organizing committee as soon as possible to prevent misconceptions about the competition proceedings or intentions. All correspondence should be sent to the event organizers.

#### **A8.2 General Information**

General information about hotels and other attractions in the area as well as a schedule of events will be sent to the teams that return the registration form and fee.

## PART B – TECHNICAL REQUIREMENTS

### ARTICLE 1: GENERAL DESIGN REQUIREMENTS

#### B1.1 General Configuration

The vehicle must have a minimum of three wheels contacting the ground at all times. Vehicle length, width, and height are not regulated. The driver must be fully enclosed within the body of the vehicle to prevent driver contact with the pavement.

#### B1.2 Vehicle Power Limitations

The sole source of vehicle propulsion must be from the four-cycle engine. This means no human power system, no sail, etc. Any inertial system, if used, must be at rest prior to the start of the performance run.

B1.2.1 All energy used for propulsion of the vehicle must come from the fuel.

#### B1.3 Driver Position

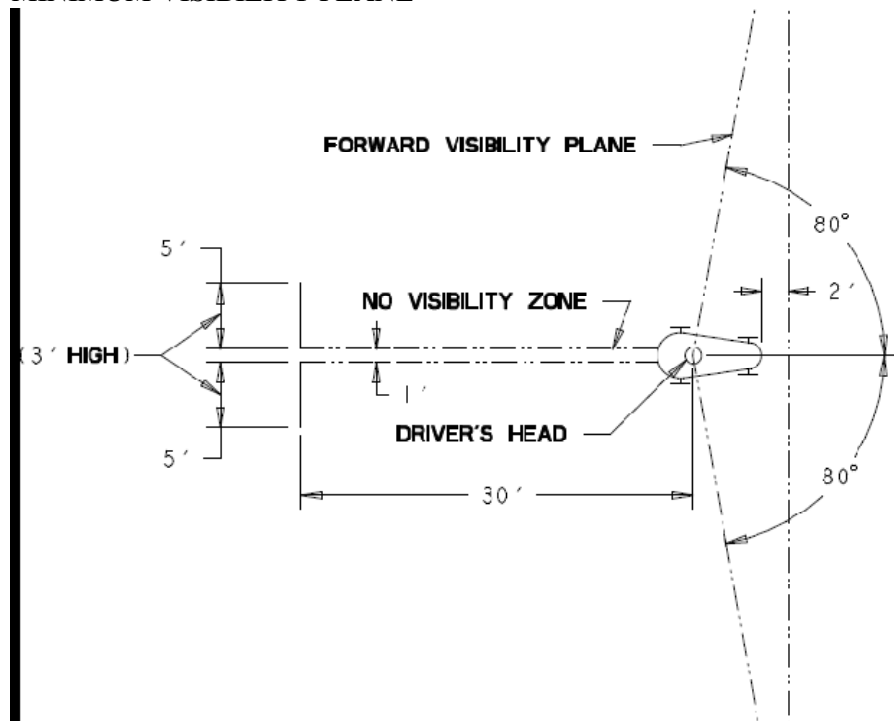
The driver must be seated in the vehicle so that his/her feet are forward in the vehicle pointing in the direction on travel. Drivers may **not** be positioned head forward in the vehicle.

#### B1.4 Forward Field of Vision

The driver must have adequate visibility to maintain control and have situational awareness. Forward field of vision not less than +/- 80° from the vehicle longitudinal axis is required.

B1.4.1 Vehicle widescreens, if so equipped, must be treated with a water beading agent on the exterior and an anti-fogging agent on the interior.

Figure 1 - MINIMUM VISIBILITY PLANE

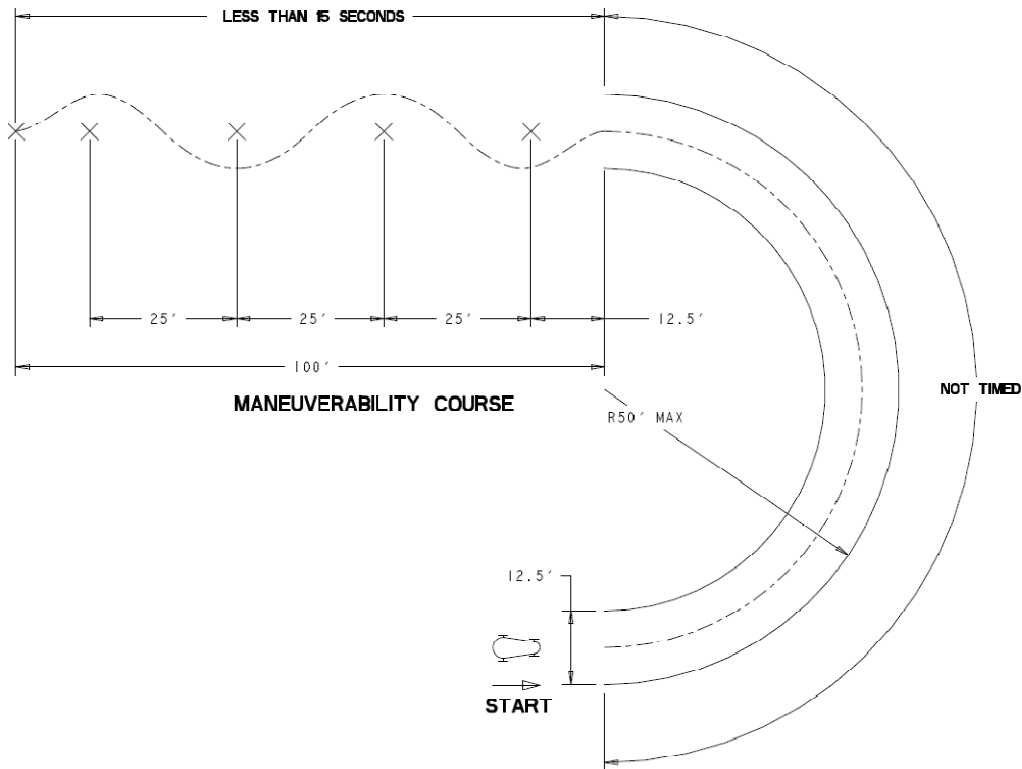




**B1.5 Maneuverability**

Each vehicle must have steering geometry capable of a 15.2 m (50 feet) maximum inside turning radius. Vehicle maneuverability will be evaluated during technical inspection using the maneuverability course described in Figure 2.

Figure 2 - Maneuverability Course



**Slalom Section:** Vehicle must traverse 30.5 meters (100 feet) slalom section in less than 15 seconds.

Pylon spacing will be 7.6 meters (25 feet)

**B1.6 Stability**

B1.6.1 Each vehicle will be required to demonstrate its lateral stability.

B1.6.2 The vehicle, with the qualified driver, must maintain full wheel contact with a ramp of **20 degrees** (measured from horizontal) when located statically on the ramp to the following configuration: one front wheel and one rear wheel of the vehicle must contact a horizontal line on the ramp with the vehicle in full right and left turn configuration. No supporting structure or wheel contact is permitted on the ramp below the horizontal line.

B1.6.3 Vehicle stability will also be evaluated during technical inspection using the slalom part of the maneuverability course described in Figure 1 above.

**B1.7 Minimum Driver Weight**

Minimum driver mass is 59kg (130 pounds) fully equipped and with a helmet. Drivers who do not meet the minimum weight requirements must provide ballast to bring their weight up to 59kg (130 pounds)

Ballast attached to the driver cannot exceed 4.5kg (10 pounds). Driver's belts or similar weights are suggested.

**ARTICLE 2: ENGINE AND POWERTRAIN****B2.1 Base Engine****BRIGGS & STRATTON 3.5 HP MODEL 091202 TYPE 1016E1A1001**

For over twenty years, the Briggs & Stratton Corporation has generously provided engines to the SAE Supermileage teams without charge.



All vehicles must use the same base engine supplied to each entrant by Briggs & Stratton Corporation (Model 091202 Type1016E1A1001 or similar). The engine is air cooled, four cycle, with a 2.61 kW (3.5 horsepower) rating at 3600 rpm. Changes to the base engine, which may be desired for improved efficiency, are acceptable but must satisfy the requirements of B2.3 "Engine Modifications".

**B2.2 Engine Eligibility**

Teams will be eligible to receive a new Briggs & Stratton engine every year. Teams **MUST** order the engines separately online once they've registered for the event. For assistance please contact [collegiatecompetitions@sae.org](mailto:collegiatecompetitions@sae.org).

**B2.3 Engine Modifications**

The base Briggs & Stratton engine may be modified in any manner that otherwise complies with these rules with the following exceptions.

**B2.3.1 Cylinder & Crankcase**

The cylinder and crankcase must be identifiable as components of the base engine supplied by Briggs &

Stratton to the entrant.

**B2.3.2 Crankshaft Support Bearings**

The crankshaft support bearings (journals) may be altered or replaced but must be retained solely by the Briggs & Stratton crankcase.

**B2.3.3 Piston Friction Surface**

The piston friction surface may be altered or replaced but must be retained solely by the Briggs & Stratton crankcase.

**NOTE:** Encapsulating another manufacturer's engine within the Briggs & Stratton cylinder/crankcase assembly is in violation of these rules.

**B2.3.4 Crankcase Ventilation**

Crankcase cannot be ventilated to engine intake air.

**B2.4 Transmission and Clutch**

Transmission and/or clutch design must be such that the engine can be disconnected from the driving wheels so as to allow the vehicle to be stationary with the engine running.

**B2.5 Exhaust System**

Engine exhaust must exit the body (if so equipped). Mufflers are not required. Exhaust pipe must be insulated or guarded to reduce the risk of burns.

The exhaust pipe must extend a minimum of 25 mm (1.0 inch) beyond the outside.

**B2.6 Guards and Shields**

B2.6.1 All moving powertrain components must be guarded to prevent damage to fuel carrying components or to the driver in the event that breakage should occur. Shielding should also protect against any potential driver body contact.

B2.6.2 If wheels are inside body shell, they must be shielded to prevent propulsion by the driver.

B2.6.3 All vehicles must have a belly pan that completely separates the driver from incidental contact with the pavement.

B2.6.4 All fuel system components must be guarded or restrained to prevent contact with moving parts.

B2.6.5 All electrical components must be guarded and/or restrained to prevent contact with moving parts and prevent abrasion of the insulation.

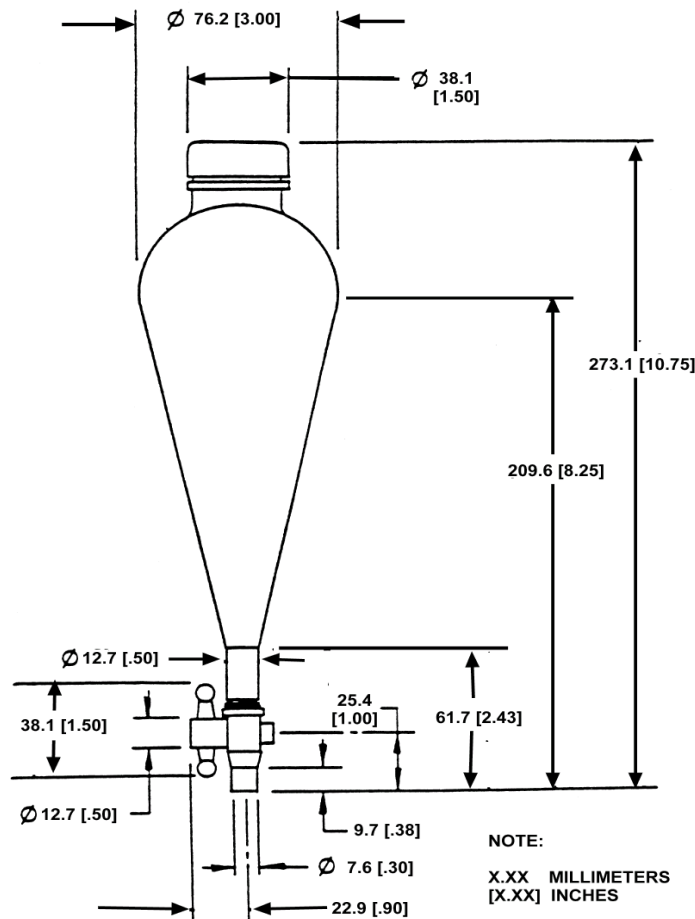
**ARTICLE 3: FUEL AND FUEL BOTTLE****B3.1 Fuel**

The fuel will be iso-octane to provide uniform fuel composition.

**B3.2 Fuel Bottle**

The fuel bottle must be mounted vertically to avoid fuel leakage from the vented cap. The bottle must be readily accessible with all body panels in place. Access doors are preferred.

Figure 3 shows the fuel bottle that will be used in the competition.



**FIGURE 3 – FUEL BOTTLE**

Separatory Funnel 250 ml

Cole-Parmer Instrument Company Catalog

Number AP-06125-20 (Teflon Fep) or Number AP-06126-20 (Polypropylene)

### B3.3 Fuel Bottle Retainment

The fuel bottle must be positively retained. The fuel bottle cannot be retained in its holder using adhesive tape. The bottle must be rigidly retained to prevent fuel spillage. Figure 3 shows the fuel bottle that will be used in the competition.

### B3.4 Access Door(s)

B3.4.1 Access door(s) for fuel bottle installation and removal must be of a sufficient size to permit easy insertion and placement of the fuel bottle.

B3.4.2 The existing fuel bottle must be able to be replaced with a new bottle within 45 seconds. The 45 seconds includes placement of the bottle, fuel line attachment, and securing of all body features to achieve a state of “ready to run.”

B3.4.3 Rear body sections of the vehicle that are hinged on the engine-side of the firewall are acceptable. Complete removal of the access door, complete removal of a body panel from the vehicle, or access panels and doors hinged on the driver-side of the firewall are unacceptable.

B3.4.4 Experience has shown that access doors in the shape of a square with a minimum side length of 20 cm (8 inches) allow sufficient access for placement of the fuel bottle.

B3.4.5 Participants will be required to demonstrate the 45 seconds compliance during Technical Inspection.

### **B3.5 Fuel System Drainage**

Fuel and lube system should be designed so that loss of fluids will not result in a fire hazard. Positive drainage away from the driver and out of the vehicle is required in all areas where fuel is present or could leak.

B3.5.1 All push-on fuel line fittings must be clamped.

## **ARTICLE 4: PRESSURIZED FUEL SYSTEM**

### **B4.1 Pressurized Fuel Tanks – Prohibited**

Pressurized fuel tanks are prohibited.

### **B4.2 Pressurized Fuel Systems**

Pressurized fuel systems are permissible. The following requirements are for pressurized fuel systems only.

### **B4.3 Hose**

Tubing pressure rating (or specification designation) must be clearly marked by the tubing manufacturer on tubing. Pressure rating must be suitable for the pressure being used.

### **B4.4 Markings**

Vehicles using pressurized fuel must mark the vehicle with the letters EFI. The lettering must be at least 25mm (1 inch) high and clearly visible on the outside of the vehicle adjacent to the fuel door.

### **B4.5 Pressure Gauge**

A pressure gauge must be provided for display of fuel pressure. The gauge must be clearly visible through the fuel access door during fuel bottle insertion and removal.

### **B4.6 Dump Valve**

A dump valve must be provided for depressurizing the fuel system before and after fuel bottle replacement. The valve must be easily accessible through the fuel access door.

B4.6.1 Dump valve must be labeled with letters at least 13mm (0.5 inches) high.

## **ARTICLE 5: ELECTRICAL SYSTEMS**

### **B5.1 Batteries**

Batteries can be carried in each vehicle but are limited to starting systems, ignitions, instrumentation, and the like. They must in no way be capable of powering the vehicle.

B5.1.1 All batteries must be securely and rigidly mounted to the vehicle.

**B5.2 Starting Systems, Lights**

Batteries used for starting systems can be of any size and voltage. They must be electrically separate from all other systems. They can only be used for starting the engine and powering lights.

**B5.3 Other Vehicle Electrical Systems**

All other electrical items (fuel pumps, injectors, ignition, instrumentation, etc) must use a 12V battery with a C20 rated capacity no larger than 1.4Ah. An engine driven generator may be required to keep the battery charged if power consumption is high.

**B5.4 Fuse Requirements**

All electrical connections to any batteries **MUST** be fused with an appropriately rated fuse.

**B5.5 Self Contained Devices**

Team communication, stopwatches, bicycle computers, or similar devices that have self-contained battery sources are permissible and are not governed by the above battery restrictions.

**B5.6 Kill Switch (es)**

B5.6.1 Three (3) kill switches grounding the engine ignition are required. One must be mounted within easy reach of the driver, and one must be mounted on each side of the vehicle.

B5.6.2 All kill switches must be of a positive action, toggle type - toggle lever arm must be a minimum 19.0 mm (0.75 inches) long. Momentary contact or rocker type switches are prohibited.

B5.6.3 The external kill switches must be securely mounted on the frame or a rigid body section. Switches must be mounted on the body between the front wheel and the rear of the vehicle at least 76.2mm (3 inches) above the ground.

B5.6.4 External kill switches may not be mounted on removable, or flexible, body panels or sections. In addition, switches must not be mounted on surfaces curving under the vehicle.

NOTE: All kill switches must also shut off any installed electric fuel pump(s).

B5.6.5 All kill switches must be clearly labeled with "run" and "kill" positions in a color which contrasts with the mounting surface. External switches must use lettering at least 38.1 mm (1.5 inches) high and internal switches must use lettering at least 12.7mm (0.5 inches) high.

**ARTICLE 6: VEHICLE STRUCTURE****B6.1 Roll Hoop**

A "roll hoop" is required and must be made of substantial material. The device must extend a minimum of 5cm (2 inches) above the tallest driver's helmet. Also in the driving position, some portion of the driver's helmet must be within 10cm (4 inches) of this device - as also shown in Figure B.

**B6.2 Roll Hoop Width**

The roll hoop must extend wider than the shoulders of any driver of the vehicle, at or above the drivers shoulders – an example of which is shown in Figure A.

**B6.3 Roll Hoop Strength**

The roll hoop must be able to withstand a 114 kg (250 lb) force applied to it. The location and direction of the 114 kg (250 lb) force may come from any of the directions shown in Figure 4C. The roll hoop

also cannot deflect so much as to cause noncompliance with the above roll protection device requirements.

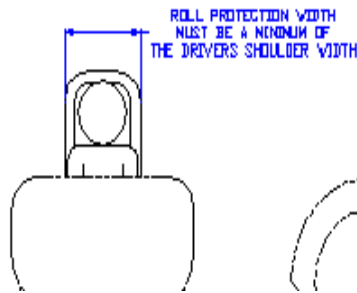


Figure 4A

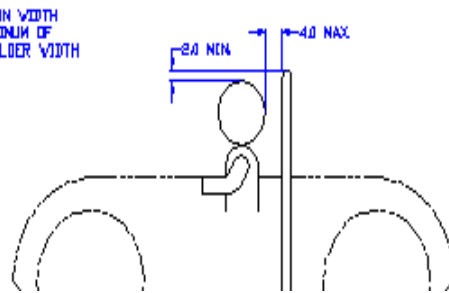


Figure 4B

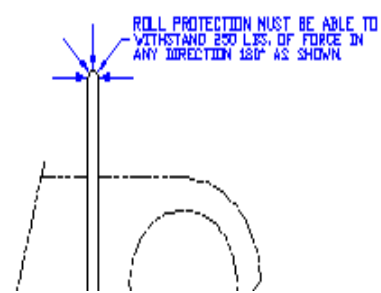


Figure 4C

#### **B6.4 Fire Wall**

- B6.4.1 A wall of steel or aluminum material of 0.813 mm (0.032 inches) minimum thickness must completely separate the operator from the engine. Furthermore, the firewall must not interfere with the operation and use of the fire extinguisher. The firewall must extend to top of driver's helmet.
- B6.4.2 No openings larger than 13 mm (0.5 inch) in diameter will be permitted in the firewall. This includes gaps between the firewall and body.
- B6.4.3 Any wires/lines passing through the firewall must be provided with effective protection against abrasion through the use of grommets, thick tape around sharp edges, etc.

#### **B6.5 Exitability**

- B6.5.1 The driver must be able to exit the vehicle within 15 seconds, unassisted, in case of an emergency. A maximum of two support personnel must also be able to quickly extract a driver from a vehicle without assistance from the driver within 20 seconds. Exitability will be tested during tech inspection.
- B6.5.2 Any latches, catches, removable parts or similar items that are used to assist driver removal by support personnel must be (1) clearly marked "Access" and (2) color coded with a minimum of 6.5 cm<sup>2</sup> (1 inch<sup>2</sup>) of fluorescent orange and be readily visible from outside the vehicle.

All loose wires/hoses/lines within the driver's compartment must be retained so as to eliminate interference with exitability or driver movement during the operation of the vehicle.

### **ARTICLE 7: BRAKE SYSTEM**

#### **B7.1 Brake Requirement**

Each vehicle must be equipped with a brake system which is capable of stopping the vehicle within 4.0 meters (13.12 feet) in a reasonably straight line when traveling at 24kph ( 15mph 22 fps).

#### **B7.2 Brake Actuator Location**

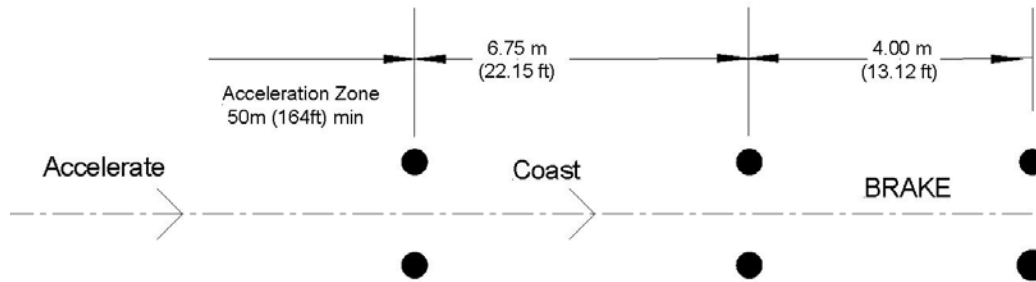
The brake actuator must be mounted to the interior of the vehicle. The brake actuator may not be mounted to any body panel. The driver must have access to the brake actuator at all times.

**B7.3 Brake Test**

The brake system will be tested to determine if it is capable of decelerating the vehicle from 24 kph (15 mph) at a rate greater than 0.25 g (gravity). Brake system performance will be evaluated at Technical Inspection using the course shown in Figure 5.

- a) Acceleration zone: There will be a minimum of 50m (164 feet) available for the vehicle to accelerate to a minimum speed of 16 kph (10mph).
- b) Coast zone: The vehicle must traverse the coast zone in less than 1.5 seconds.
- c) Brake zone: The vehicle must come to a complete stop within the brake zone.

**Figure 5 - Brake Evaluation**



**B7.4 Brake Light**

The vehicle must be equipped with a brake light that complies with SAE J586. If an LED brake light is used, it must be clearly visible in very bright sunlight. The brake light must be independent of the kill switch and remain operable at all times. The standard will be available online once individuals have registered for the competition. Only those who have their name registered to a team will have access to the standard.

**ARTICLE 8: DRIVER EQUIPMENT**

**B8.1 Driver Restraint Harness**

A minimum 3-point driver harness is required. This 3-point harness must include two lap belt points and one point connecting a belt (or two belts) supporting the upper body. The use of one upper body support would need to be a cross-belt (similar to a passenger vehicle), whereas two shoulder belts could be used attached at the uppermost point as well.

**B8.2 4, 5 or 6 Point Harnesses**

The use of a 4 point, 5 point or 6 point harnesses, or any belt system that exceeds the minimum requirement is allowed.

**B8.3 Single Release**

All driver restraint belts must use a single release common to the lap belt(s) and upper body belt or harness using a metal to metal quick release latch.

**B8.4 Belt Attachment Points**

The belt attachment points must be strong enough that the vehicle could be lifted by them.

**B8.5 Driver's Gear**

The following equipment must be worn anytime a driver is seated in the vehicle and the engine is

running or being started:

**B8.5.1 Helmet**

A well-fitting helmet with an integrated (one piece composite shell) Snell M2000, SA2000, or British Standards Institution BS 6658-85 types A or A/FR rating. Hard-shell bicycle helmets will not be allowed.

**B8.5.2 Goggles/Eye Protection**

Goggles or face shields, made of impact resistant materials, must be worn. Regular glasses or sunglasses are not acceptable.

**B8.5.3 Shoes**

Shoes or boots of durable material, free from any holes, must be worn by the driver during the competition.

**ARTICLE 9: EQUIPMENT REQUIREMENTS****B9.1 Fire Extinguisher**

B9.1.1 A multipurpose minimum 0.9 kg (2 pounds) ABC dry chemical fire extinguisher, rating no. 1A 10BC or equivalent must be provided.

B9.1.2 Extinguisher must be securely mounted such that the driver can direct the extinguishing agent on the fuel tank and engine area. If the driver has sufficient freedom of movement in the event of a fire to remove the extinguisher from its bracket and direct it on the above mentioned areas, the design will be allowed. If the driver does not have sufficient freedom of movement, some method must be provided to accomplish the desired result (i.e., a system of tubing, remote actuation, etc.)

B9.1.3 Remote actuation is preferred; if a tubing delivery system is used, 12.7 mm (0.5 inch) inside diameter tubing of no more than 1.2 meters (48 inches) length must be used. Tubing must direct extinguishing agent toward engine and fuel tank.

B9.1.4 Alternate delivery systems will be allowed only if actual test result documentation is available through the faculty advisor. Halon fire extinguishers are not allowed.

**B9.1.5 Pressure Gauge**

All fire extinguishers must be equipped with a manufacturer installed pressure/charge gauge; the gauge must be readable to the technical inspectors.

**B9.1.6 Fire Extinguisher Position**

The fire extinguisher must be mounted such that the valve is above the bottom of the canister.

**B9.2 Transponder**

B9.2.1 A transponder will be attached to the front of the vehicle for lap timing purposes. The transponder will be smaller than 13cm x 8cm x 4cm (5 inches x 3 inches x 1.5 inches) and weigh less than 230 grams (0.5 pounds).

B9.2.2 It must be mounted within 45 cm (18 inches) of the road surface, usually on the outside of the body.

B9.2.3 It can be mounted inside the body ONLY if it is not obstructed by any conductive materials such as metal or carbon fiber. It will be mounted with a piece of industrial strength, self adhesive, hook and

loop material supplied by the competition organizer at the event.

### **B9.3 Mirrors**

B9.3.1 Vehicles must be equipped with a mirror or mirrors to ensure adequate rearward visibility.

B9.3.2 The driver must be able to see a 45 cm (18 inch) square object on a vertical plane 1.52 m (5 feet) wide by 0.91 m (3 feet) high located 9.14 m (30 feet) behind and to each side of the vehicle. See illustration “Minimum Visibility Plane” in Rule B1.4 for a visual representation of this requirement.

B9.3.3 Mirrors must be securely mounted and adjustable.

## **ARTICLE 10 - NOTICE OF POSSIBLE FUTURE RULE CHANGES**

This section is intended to provide teams with advance notice of possible changes to the SAE Supermileage rules that are being considered by the Supermileage Rules Committee. Only changes that may have a significant impact on the team’s engineering design, manufacturing decisions or event preparation are listed. This section is provided only for information and is not intended to provide final text for any rules.

The following rules changes are under discussion:

- A) Driver Shielding – The driver shielding requirements may be expanded.
- B) Alternate Fuels - Use of alternative fuels for future events

## PART C – STATIC EVENTS

### ARTICLE 1: DESIGN REPORTS

**C1.1** The review of the design will require both (1) written and (2) verbal design reports.

The total design report points will be the sum of the points from the written design report and the verbal design report.

#### **C1.2 Written Design Reports – General – 250 Points Maximum**

**C1.2.1** The written design report must be submitted to the Board governing the Supermileage® Competition by the date indicated on the Action Deadline in the appendix.

**C1.2.2** The written design report serves three purposes: 1) the report is a proposal that documents the design intent and goals of the team; 2) the report serves as a record of the design; and 3) the report is an information document to show how the vehicle adheres to the rules.

**C1.2.3** The written report must be limited to a maximum of 25 pages not including supporting data in an appendix.

**C1.2.4** A maximum of 250 points will be awarded to the Written Design Report, and late reports will be assessed a penalty of 25 points per day for each business day the report is late.

**C1.2.5** NOTE: A written design report must be submitted for a vehicle to compete during the dynamic portion of the competition.

#### **C1.3 Verbal Report – 100 Points Maximum**

**C1.3.1** Each team will present a verbal design report to panel of judges

**C1.3.2** Three (3) team members and the team's vehicle must be present for the verbal design report.

Teams with less than three members are required to have the entire team participate in the verbal design report.

**C1.3.3** The verbal design report should demonstrate the team's understanding and application of the engineering principles that support their design.

**C1.3.4** The verbal design report will be presented on the first day on the competition.

**C1.3.5** Teams may schedule a time for their verbal design report after they have completed on-site registration.

**C1.3.6** Verbal design reports will be scored to a maximum of 100 points.

#### **C1.4 Design Report Contents**

**C1.4.1** The design report is intended to show the focus of the team on determining the goals for the design and the design effort to reach the established goals. The goals stated should be those of the team and hence will reflect the team members, financial resources, laboratory access, and involvement of the team.

**C1.4.2** Areas of re-design must be specifically documented. The various sections of the report should indicate

where design decisions are made, the basis for making the decisions, and the consequences of the decisions on the performance of the vehicle. Records of make/buy decisions are expected, as are decisions regarding performance parameters and compromises.

C1.4.3 The report should include drawings and written descriptions. Changes in design between submission and competition date will be allowed. Design reports will be held in strict confidence.

C1.4.4 The following topics must be covered in the design report:

a) **Basic Vehicle Configuration**  
This topic should include general arrangement, physical dimensions, location of components, etc.

b) **Engine**  
This topic must include a discussion of all modifications to the base Briggs & Stratton engine including the engineering principles that support those modifications and the team's design considerations.

The report must also include an itemized list of all engine modification. Finished, or altered, parts from some other engine, or of another manufacturers design, must be listed with the manufacturers name and part description.

c) **Powertrain Configuration**  
This topic includes a discussion of the transmission of power to the wheels.

d) **Brake System**  
This topic should present a design, which relates to the vehicle's top speed capability and should describe stopping distance and energy capacity of the system.

e) **Suspension and Running Gear**  
This topic includes the tires, axles and other associated equipment that concerns handling and steering of the vehicle.

f) **Body/Aerodynamic Shell**  
This topic includes decisions made on the basis of aerodynamic considerations as well as safety issues.

g) **Performance**  
This topic should include calculations on vehicle top speed and any calculations on mileage.

h) **Cost Estimate and Manufacturing Methods**  
The design report is to include a discussion of the manufacture and cost of the vehicle. Where parts, services, or materials are donated, a fair market-value of the donation must be included in the cost breakdown of the vehicle. Professional machine and fabrication services are to be included in the cost breakdown, including appropriate cost for work performed by university technicians even if the team budget is not charged directly.

Manufacturing methods and equipment used by the team should be discussed in the design report, generally as associated with the parts of the vehicle using that manufacturing method.

i) **Driver Safety Features**

The report is to include detail descriptions of all aspects of the design intended to protect the safety of the driver.

- j) **General Information**  
Any additional information which has not been discussed in the above items should be included here.
- k) **Re-entered Vehicles**  
Areas of redesign must be specifically documented (See Rule A5.3 “Re-Entered Vehicles/Engines”)

### **C1.5 Faculty Advisor Signature**

The design report must include the signature of the team/project faculty advisor verifying that the design report has been reviewed by the advisor and if the vehicle is being re-entered that significant redesign has been completed.

## PART D – DYNAMIC EVENT

### ARTICLE 1: PERFORMANCE RUN

**D1.1** The performance run will consist of each vehicle running six laps around a 2.6 km (1.6 mile) oval test track.

#### **D1.2 Minimum Speed**

The vehicle must achieve a minimum six lap average speed of 24 kph (15 mph). This means that each vehicle will be required to travel a total distance of 15.5 km (9.6 miles) in a maximum of 38.4 minutes.

#### **D1.3 Maximum Speed**

The vehicle must not exceed a single lap average speed of 40 kph (25 mph) (40.23km). This means a vehicle must take longer than 3 minutes 50 seconds to complete each lap.

#### **D1.4 Track Grade**

Vehicles must be capable of ascending a 1 percent grade and descending a 7 percent grade.

#### **D1.5 Slow Speed Penalty**

D1.5.1 If the minimum average speed of 24 kph (15 mph) is not maintained, a penalty will be assessed by subtracting from the km/liter (mpg) achieved.

D1.5.2 The penalty will be 4.25 km/liter (10 mpg) per second of time that the minimum average speed requirement is not met. For instance, if 39 minutes was the elapsed time for six laps, the minimum allowable time, without penalty (38 minutes 24 seconds) was exceeded by 36 seconds. The actual mileage achieved would be reduced by 153.1 km/liter (360 mpg).

#### **D1.6 Maximum Speed Penalty**

D1.6.1 If the maximum lap average speed of 40 kph (25 mph) is exceeded, a penalty will be assessed by subtracting from the km/liter (mpg) achieved.

D1.6.2 The penalty will be 4.25 km/liter (10 mpg) per second of time that the maximum average lap speed requirement is not met. For instance, if the third lap was completed in 3 minutes 12 seconds, the minimum allowable time, without penalty (3 minutes 50 seconds) was exceeded by 38 seconds. The actual mileage achieved would be reduced by km/liter (380 mpg).

#### **D1.7 Start**

D1.7.1 Prior to the performance run, an official fuel tank (supplied by the competition organizers) will be filled, weighed and installed on the vehicle.

D1.7.2 The start of the performance run will begin with the vehicle being placed on the track starting line. The vehicle engine is then started, either by the driver or his pit crew. Timing for the minimum speed requirement starts when the vehicle crosses the starting line.

D1.7.3 Vehicles cannot be push started.

#### **D1.8 Finish**

D1.8.1 Upon completion of the six lap performance run, 15.5 km (9.6 miles), the timers will record the elapsed time; the fuel tank will be removed and weighed.

- D1.8.2 The kilometer per liter (miles per gallon) calculation for the vehicle will then be computed, dividing the 15.5 km (9.6 mile) distance by the amount of fuel used.
- D1.8.3 If the maximum or minimum allowable elapsed time has been exceeded, the penalty will be computed and subtracted from the kilometer per liter (miles per gallon) calculation.

## **ARTICLE 2: GENERAL CONDUCT AND REGULATIONS**

### **D2.1 Organizer Authority**

The organizer(s) of the competition reserve the exclusive right to revise the schedule of the competition and/or to interpret the competition rules at any time and in any manner which is in their sole judgment, required for efficient operation or safety of the competition.

### **D2.2 Unsportsmanlike Conduct**

In the event of unsportsmanlike conduct, the team will receive a warning from an official. A second violation will result in expulsion of the team from the competition.

### **D2.3 Arguments with Officials**

Argument with, or disobedience to, any official may result in the team being eliminated from the competition. All members of the team may be immediately escorted from the grounds.

### **D2.4 Rule Violation**

Violation of the rules may result in the team being eliminated from the competition. All members of the team may be immediately escorted from the grounds.

### **D2.5 Alcohol and Illegal Material**

No alcohol, illegal drugs, weapons or other illegal material will be permitted on the event site during the competition. This rule will be in effect during the entire competition. Any violation of this rule by a team member will cause the expulsion of the entire team. This applies to both team members and faculty advisors. Any use of drugs, or the use of alcohol by an underage individual, will be reported to the local authorities for prosecution.

## **ARTICLE 3: COMPLAINTS AND PROTESTS**

### **D3.1 Complaints**

Contest officials, as designated by the local organizer, will be available to listen to any complaints about errors in the scores or any other aspect of the competition, except the rules.

### **D3.2 Protests**

#### **D3.2.1 Cause of Protest**

If a faculty advisor or team captain feels that a complaint was not properly addressed by the competition officials, he/she may protest.

#### **D3.2.2 Protest Format**

All protests must be filed in writing to the Chief Steward by the faculty advisor or team captain only. In order to have a protest considered, a team must be willing to put up one hundred (100) points which will be forfeited if their protest is rejected.

D3.2.3 Protest Period

Protests concerning any aspect of the competition must be filed within thirty (30) minutes of the end of the round or event to which the protest pertains to.

D3.2.4 Decision

The decision of the Chief Steward is final. Any argument with the Chief Steward or with any official after a decision is rendered may result in immediate expulsion of all team members from the competition. You and your team may be immediately escorted from the grounds.

## APPENDIX

### 2010 SAE Supermileage - Action deadlines

Eaton Corporation, Marshall, Michigan, USA

June 10-11, 2010

All submissions must be received by the deadline. Not Postmarked

#### **Registration**

Register on-line at: [www.sae.org](http://www.sae.org) on Monday, October 5, 2009 at 10:00 AM EDT.

#### **Registration fee**

Registration closes

\$600.00 USD

11:59 pm EST Monday, December 21, 2009

#### **Engine Orders**

Order engines on-line upon completion of registering

Engine order fee

\$0.00

Engine order deadline

11:59 pm EST Monday, December 21, 2009

#### **Design Report**

Due by March 31, 2010 – Not Postmarked

One (1) hardcopy of the Design Report should be sent via mail to:

Supermileage Competition  
Eaton Corporation  
13100 E. Michigan Ave  
Galesburg, MI 49053

An e-copy of the Design Report in Adobe Acrobat “pdf” file format must be sent by midnight on March 31, 2010 to: [Supermileage@eaton.com](mailto:Supermileage@eaton.com)

Subject line must read: [“School Name”] Supermileage Design Report

NOTE: Both the electronic copy and one hard copy of the design report MUST be submitted.

#### **Rules Inquiries concerning SAE Supermileage**

Any inquiries regarding rules or questions specific to SAE Supermileage 2010 should be sent via e-mail to [Supermileage@Eaton.com](mailto:Supermileage@Eaton.com)

#### **Official 2010 SAE Supermileage Website**

<http://www.sae.org/students/supermw.htm>