



2003 Supermileage®

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2003 SUPERMILEAGE®

11. OBJECTIVE

The objective of the competition is to provide SAE Student members a challenging project allowing practical experience in design and fabrication.

12. SCOPE

In an effort to increase public awareness in the area of fuel economy and student involvement, a fuel economy competition will be held. Competing teams will be required to build a one person, fuel-efficient vehicle based on a small four-cycle engine. The vehicles will run a specified course with the vehicle obtaining the highest kilometers per liter (miles per gallon) rating winning the event.

13. PARTICIPANT ELIGIBILITY

Teams formed by students at both universities and high schools are eligible to participate in Supermileage. Collegiate and High School teams will be judged in separate categories but will simultaneously participate in the competition.

13.1 Individual Participant Requirements - Collegiate Teams

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

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

(b) SAE Membership: Team members must be members of SAE. Proof of SAE membership is required at the event.

COMMENT: Information on SAE Student membership can be found at SAE's website: www.sae.org/students

(c) Liability Waiver and Insurance: All on-site participants and faculty are required to sign a liability waiver upon registration. Individual medical and accident insurance coverage is the sole responsibility of the participant.

(d) 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 and accident insurance coverage.

13.2 Individual Participant Requirements - High School Teams

(a) Student Status: Team members must be enrolled as students at the high school the team represents. Team members who have graduated within the three (3) month period

prior to the competition remain eligible to participate.

(b) **Liability Waiver:** High school students under the legal age of eighteen (18) must present a liability waiver signed by a parent or guardian and will not meet the minimum age requirement to drive. Students of legal age must sign a liability waiver on-site prior to participation. Individual medical and accident insurance coverage is the responsibility of the individual participant and/or his/her parent(s) or guardian(s).

(c) **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 and accident insurance coverage.

14. VEHICLE REQUIREMENTS AND LIMITATIONS

14.1 Student Created

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

14.1.1 Professional Fabrication Limits

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

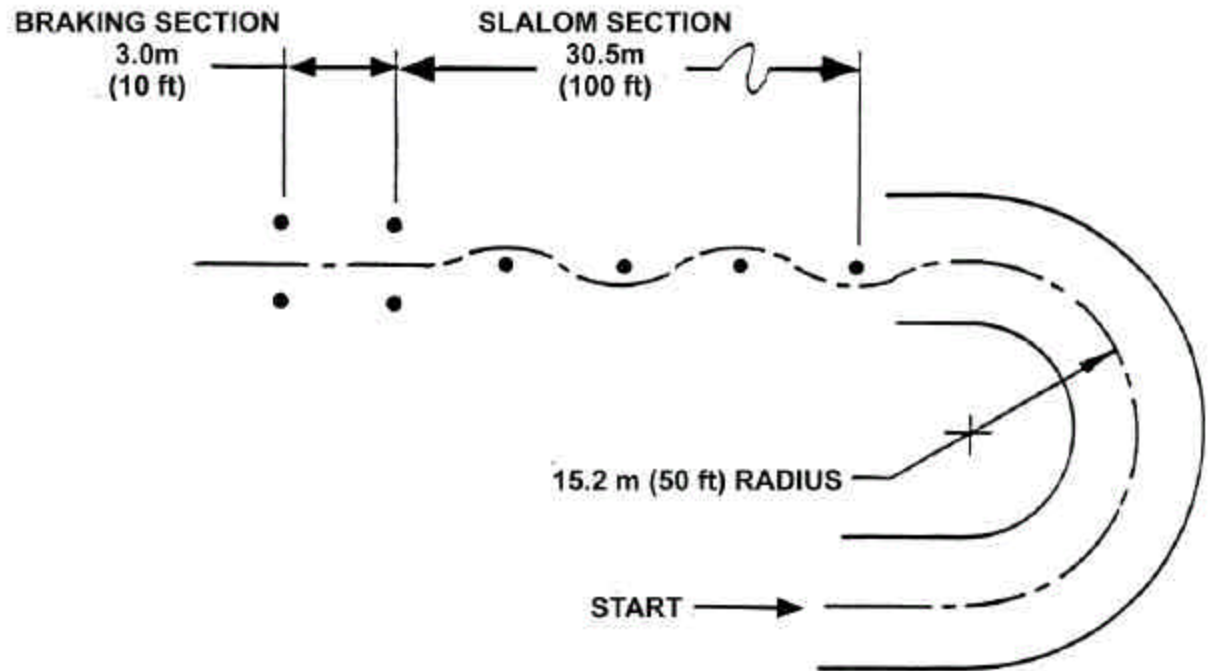
14.2 General Configuration

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

14.3 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 1.

**FIGURE 1
MANEUVERABILITY COURSE**



Braking Section: Vehicle must come to a complete stop within a 3.0 meter (10 feet) distance

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)

14.4 Stability

Each vehicle will be required to demonstrate its lateral stability. The vehicle, with the qualified driver, must maintain full wheel contact with a ramp of 15 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. Vehicle stability will also be evaluated during technical inspection using the slalom part of the maneuverability course described in Figure 1 above.

14.5 Engine

All vehicles must use the same base engine supplied to each entrant by Briggs & Stratton Corporation (Model 091202 Type1016E1A1001). 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 stated below.

14.5.1 Cylinder & Crankcase

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

14.5.2 Crankshaft Support Bearings

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

14.5.3 Piston Friction Surface

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

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

14.6 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.

14.7 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.

14.8 Fuel

The fuel used will be iso-octane so as to provide uniformity in fuel composition.

14.9 Driver Weight

Minimum driver mass is 59 kg (130 pounds) fully equipped, including helmet. Drivers who do not meet the minimum weight requirements must provide ballast to bring their weight up to 59 kg (130 pounds). Ballast must be rigidly affixed and readily removable. Ballast attached to the driver cannot exceed 4.5 kg (10 pounds). Driver's belts or similar weights are suggested.

14.10 Re-entered Vehicles/Engines

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

15. SAFETY REQUIREMENTS

The following are the minimum safety items required of all vehicles. Failure to comply with these specifications will result in disqualification until such infractions are corrected.

15.1 Kill Switch(es)

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. All kill switches must be clearly labeled with "run" and "kill" positions using lettering at least 38.1 mm (1.5 inches) high in a color which contrasts with the mounting surface. All kill switches must be of a positive action, toggle type. No momentary contact switches will be allowed.

The external kill switches must be securely mounted on the frame or a rigid body section. External kill switches may not be mounted on removable, or flexible, body panels or sections.

All kill switches must also shut off any electric fuel pump(s), if used.

15.2 Guards and Shields

All moving powertrain components must be guarded from accidental breakage or driver body contact. If wheels are inside of body shell, they must be shielded to prevent propulsion by the driver. All vehicles must have a belly pan that completely separates the driver from incidental contact with the pavement.

15.3 Helmets/Clothing

The following equipment must be worn anytime a driver is seated in the vehicle and the engine is running or being started:

15.3.1 Helmet

A well-fitting Snell M-95, SA-95, M-00, SA-00 or British Standards Institution BS 6658-85 types A or A/FR rated helmet. Hardshell bicycle helmets will not be allowed.

15.3.2 Goggles/Eye Protection

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

15.3.3 Shoes

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

15.4 Fuel and Lube System

15.4.1 System Safety

Fuel and lube system should be designed so that loss of fluids will not result in a fire hazard. Pressurized fuel tanks will not be allowed. Positive drainage away from the driver and out of the vehicle is required in all areas where fuel is present or could leak. All push-on fuel line fittings must be clamped.

15.4.2 Pressurized Fuel

If pressurized fuel is required, a separate means must be provided which derives its power from the engine which pressurizes the fuel between tank and atomization point.

15.4.3 Electric Fuel Pumps

If an electric fuel pump is used, an alternator on the engine must maintain the charge of any battery used to power the fuel pump.

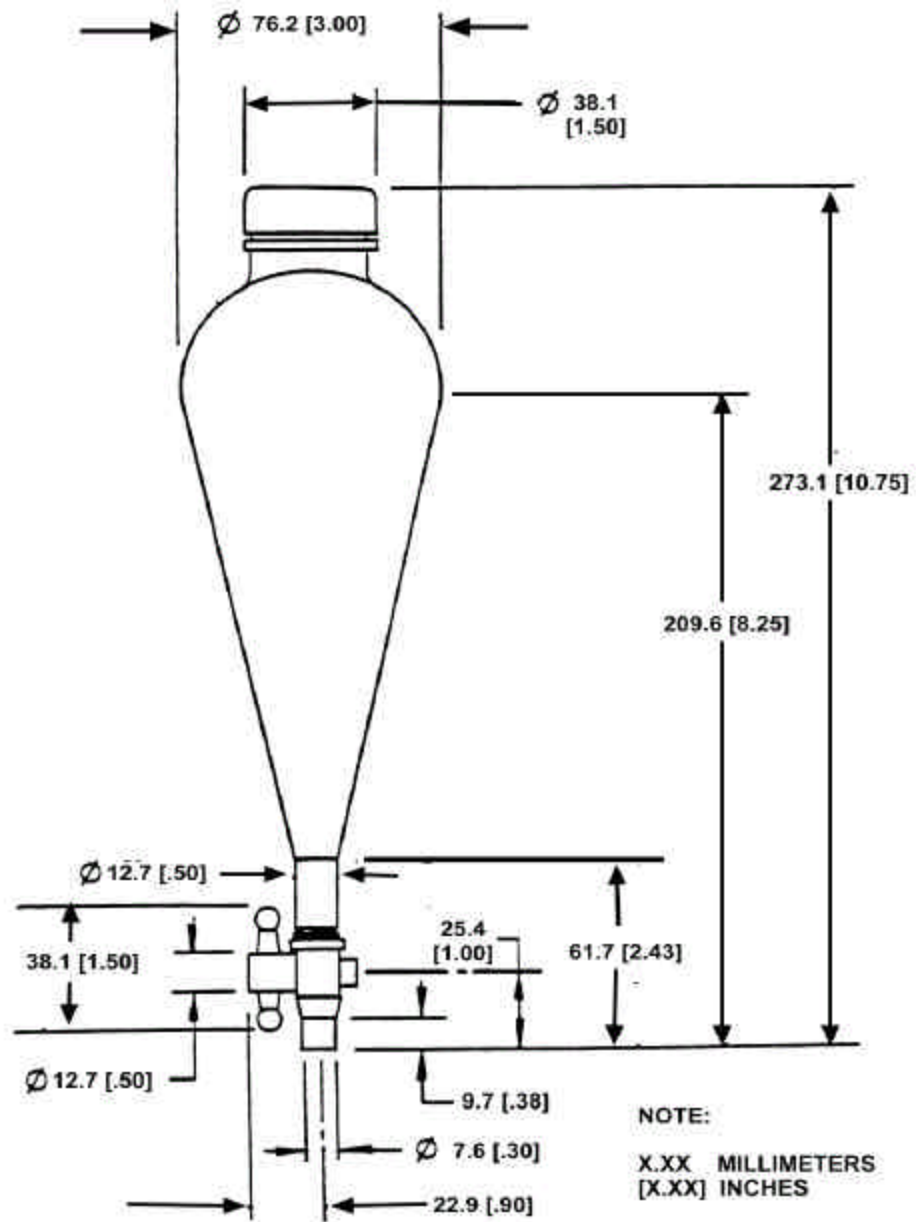
15.4.4 Fuel Bottle

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

Access doors must be of sufficient size and configuration to permit easy insertion and placement of the fuel bottle.

The fuel bottle cannot be retained in its holder using adhesive tape, a rigid clamp is preferred. Figure 2 shows the fuel bottle that will be used in the competition.

FIGURE 2
FUEL BOTTLE



Separatory Funnel 250 ml

Cole-Palmer Instrument Company Catalog

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

15.5 Brake System

Brake system must be adequate for safely stopping the vehicle in a reasonably straight line.

15.5.1 Brake System Evaluation

The performance of the braking system will be evaluated during technical inspection at the end of the maneuverability course described in Figure 1 on page 5.

15.6 Fire Extinguisher

A multipurpose minimum 0.9 kg (2 pounds) ABC dry chemical fire extinguisher, rating no. 1A 10BC or equivalent must be provided. 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.) 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. Alternate delivery systems will be allowed only if actual test result documentation is available through the faculty advisor. Halon fire extinguishers will not be allowed.

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

15.7 Exhaust System

Engine exhaust must exit the vehicle body (if so equipped). Mufflers are not required.

15.8 Fire Wall

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.

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.

15.9 Exitability

The driver must be able to quickly exit the vehicle, unassisted, in case of an emergency.

Support personnel must also be able to quickly extract a driver from a vehicle without

assistance from the driver.

15.10 Visibility

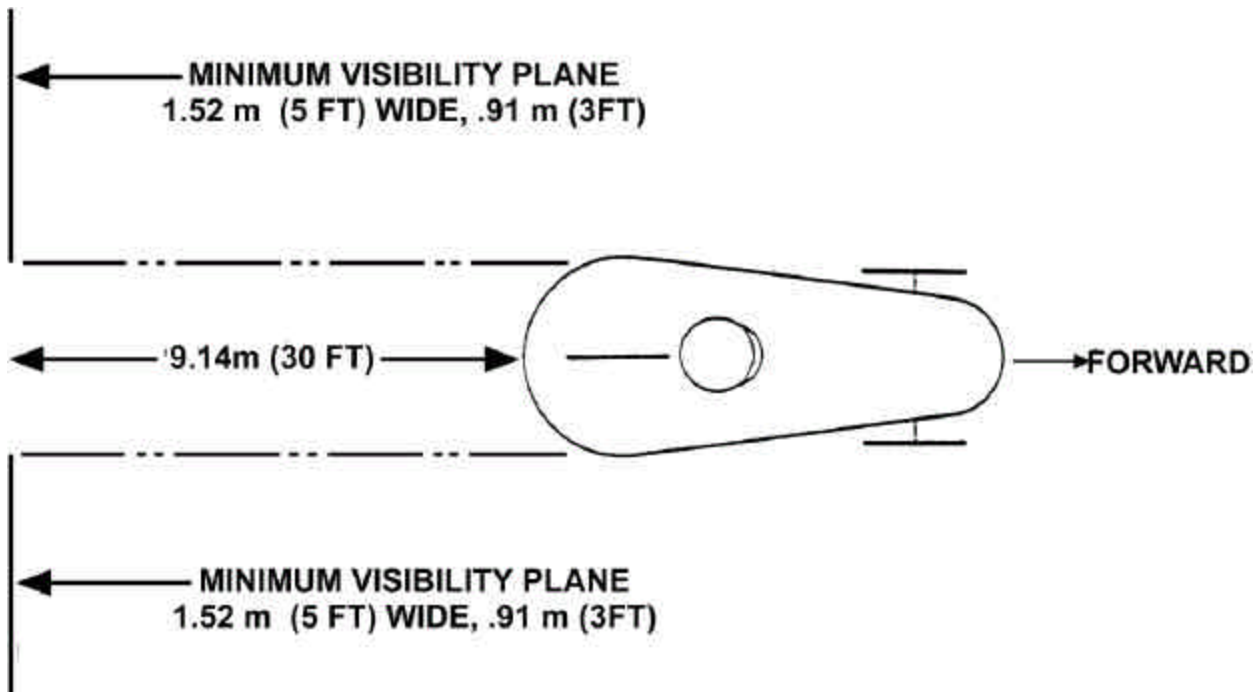
15.10.1 Forward Field of Vision

The driver must have adequate visibility to maintain control and operate in a safe manner. Forward field of vision not less than $\pm 80^\circ$ from the vehicle longitudinal axis is required.

15.10.2 Mirrors

Vehicles must be equipped with a mirror or mirrors to ensure adequate rearward visibility. The driver must be able to see a 450 mm (18 inch) square object on a vertical plane 1.52 m (5 feet) wide by .91 m (3 feet) high located 9.14 m (30 feet) behind and to each side of the vehicle. The figure below describes the minimum rearward visibility planes.

MINIMUM VISIBILITY PLANE



16. DESIGN PROPOSALS

Two design proposals must be submitted to the Board governing the Supermileage® Competition by the dates indicated on the Action Deadline on page 16. The first is the Vehicle/Powertrain Design Proposal which covers Items 16.1 through 16.7. This proposal qualifies the entrant to receive an engine from Briggs & Stratton. The second is the Engine Design Proposal which covers Item 16.8.

The design proposals serve two purposes. First, it is an information document to determine how the vehicle adheres to the rules. Second it ensures that the entry is a result of a genuine design effort.

The following subjects must be covered in the design proposal:

16.1 Basic Vehicle Configuration

This topic should show general arrangement, physical dimensions, location of components, etc.

16.2 Powertrain Configuration

This topic includes a discussion of how the engine is connected to the wheels.

16.3 Performance

This topic should include calculations on vehicle top speed and any calculations on mileage.

16.4 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.

16.5 Cost Estimate

An estimate of the cost of the vehicle is to be provided.

16.6 Safety Items

Any safety items which have not been discussed in the above items should be included here.

16.7 Re-entered Vehicles

Areas of re-design must be specifically documented (Ref. 14.8).

16.8 Engine

An engine design proposal must be submitted (see due date on the Action Deadlines on page 16). This proposal is in addition to and separate from the proposal covering Items 16.1 through 16.7. The proposal must itemize all modifications to the base Briggs and Stratton engine received by the entrant. Finished or altered parts from some other engine or another manufacturer's design (other than the Briggs & Stratton engine supplied) must be listed with the manufacturer's name and part description.

General - These proposals should be in the form of drawings and written descriptions. Changes in design between submission and competition date will be allowed, but must be

transmitted to the Design Review Committee. Design proposals will be held in strict confidence.

17. PERFORMANCE RUN

17.1 Minimum Speed Requirement

The performance run will consist of each vehicle running six laps around a 2.6 km (1.6 mile) oval test track at a minimum average speed of 24 km/hr (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. Vehicles must be capable of ascending a 1 percent grade and descending a 7 percent grade.

17.2 Slow Speed Penalty

If the minimum average speed of 24 km/hr (15 mph) is not maintained, a penalty will be assessed by subtracting from the km/liter (mpg) achieved, 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 (38.4 minutes) was exceeded by 36 seconds. The actual mileage achieved would be reduced by 153.1 km/liter (360 mpg).

17.3 Start

Prior to the performance run, an official fuel tank (supplied) will be filled, weighed and installed on the vehicle. 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. Vehicles cannot be push started. Transmission 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.

17.4 Finish

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. 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. If the maximum allowable elapsed time has been exceeded, the penalty will be computed and subtracted from the kilometer per liter (miles per gallon) calculation.

18. AWARDS

All participants will receive a financial award proportional to vehicle performance with the 1st place finisher receiving a minimum of five hundred (\$500.00) U.S. dollars.

An award will also be presented for the best Vehicle/Drivetrain Design Proposal, covering Items 16.1 through 16.7.



19. QUESTIONS

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 host.

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.

20. GENERAL CONDUCT AND SAFETY

20.1 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.

20.2 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.

20.3 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.

20.4 Safety Rule Violation

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

20.5 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.

21. COMPLAINTS, PROTESTS AND SUGGESTIONS

21.1 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.

21.2 Protests

21.2.1 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.

21.2.2 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 twenty-five (25) points which will be forfeited if their protest is rejected.

21.2.3 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.

21.2.4 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.

21.3 Suggestions

Suggestions must be made in writing. Suggestions regarding the rules will be considered for the following year. Suggestions may be sent by e-mail to: hart@sae.org or shymonik@sae.org or by mail to:

SAE Student Design Competitions
C/O: Supermileage Rules Suggestions
400 Commonwealth Drive
Warrendale, PA 15096-0001



**2003 SUPERMILEAGE - ACTION DEADLINES
EATON CORPORATION, MARSHALL, MI
MAY 30-31, 2003**

ALL SUBMISSIONS MUST BE RECEIVED BY THE DEADLINE. NOT POSTMARKED

1 Registration

Register on-line at: www.sae.org after October 1, 2002

Early registration fee	\$125.00
Early registration deadline	January 17, 2003

Late registration fee	\$175.00
Late registration deadline	February 14, 2003

2 Engine Orders

Order engines on-line upon completion of registering

Engine order fee	\$0.00
Engine order deadline	January 17, 2003

3 Vehicle/Powertrain Design Proposal

April 30, 2003

See Section 16.1-16.7

Vehicle/Powertrain Design Proposals should be sent via mail to:

Fredric Lee Kinney
Prod Engrg Truck Comp Oper NA
Eaton Corporation, Trans Div.
P.O. Box 4013
Kalamazoo, MI 49003-4013

4 Engine Design Proposal

April 30, 2003

See Section 16.8

Engine Design Proposals should be sent via mail to the address listed above.

5 Rules Inquiries concerning Supermileage

Any inquiries regarding rules or questions specific to Supermileage 2003 should be sent via e-mail to Fred Kinney at frederickinney@eaton.com

6 Official 2003 Supermileage Website

[HTTP://WWW.SAE.ORG/STUDENTS/SUPERMW.HTM](http://www.sae.org/students/supermw.htm)