

Rules for the

2004 Human Powered Vehicle Competition

Sponsored by the American Society of Mechanical Engineers

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Summary of Substantive Rules Changes for 2004

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Site Information Sheet

Host Information

Host	School hosting the competition
Contact	The name of the host school's student event director
Address	The address of the host school's student event director
Telephone	The telephone number of the host school's student event director
FAX	The fax number of the host school's student event director
E-mail	The email address of the host school's student event director

Schedules

Registration Date	Date that the competition starts; the date of on-site registration
Check-in Time	The time of on-site registration
Event Date	Dates for the competition
Preliminary Date	Date of preliminary registration
Entry Date	The date by which the host must receive the entry form and accompanying data.
Report Date	Date on which the design reports must be delivered to the judges
Year	The year of the competition.

Locations

Registration Site	The location of on-site registration Further description of location 1; i.e., a specific room
Presentation Site	The location for the design presentations.

Fees

Make Payable To	The name of the individual or group to whom the entry fee check should be payable
First Fee	The fee associated with the first entry from a competing school.
Additional Fee	The fee associated with each additional entry (past the first) from a competing school.
Dual Fee	The additional fee associated with entering a single vehicle in one or more categories (i.e., single and practical; Multi-rider and practical)

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I. General Information

Superiority of Rules

These rules have been established by the American Society of Mechanical Engineers' (ASME's) Human Powered Vehicle Competition (HPVC) Judging Team. Should any conflict arise between these rules and those of the ASME, the latter shall dominate. Should any conflict arise between these rules and other information regarding the ASME HPVC, whether generated by the ASME or any other organization, these rules shall dominate.

Location

Two competition sites are planned for the 2004 competition: Individuals wishing to participate should consult the site information sheets provided for the specific east or west coast site to determine competition date, etc.

All competitions will begin with on-site registration and check-in at the location specified by the host on the site information sheet.

Schedule Summary & Host Information

Each host site has specified all the important dates and contact information for their competition on the Site information sheet. Please review and list your specific dates and information in the table below.

Competition Summary

The Competition will include three classes of vehicles—Single Rider, Multi-rider, and Utility.

Single Rider and Multi-rider vehicles will participate in three events: Design, Sprint, and Endurance.

Utility vehicles will participate in two events: Design and Utility Endurance. Vehicles entered in dual status as described below (i.e., Utility and Single Rider or Utility and Multi-rider) will compete in all four events, with the scores for each class kept separately (i.e., Utility, Single Rider, and Multi-rider).

The four events, as they apply to the separate classes and categories of the Competition, will be fully discussed at a later point in this document.

The scores from the individual events will be summed to determine the respective orders of finish in each vehicle class. Awards will be provided for the top scorers in each class, both in the individual events and in the overall competition.

On-Site Schedule

The Design Event oral presentations will normally take place Friday afternoon and evening, followed by the Sprint and Utility Endurance Events on Saturday and the Endurance Event and award presentation on Sunday. The sequence of events will remain the same if it starts on a different day of the week. The respective sections of these rules contain specific scheduling information.

II. General Rules of Competition

Classes of Vehicles

The competition will include three vehicle classes:

- Single-rider—operated and powered by a single individual.
- Multi-rider —operated and powered by two or more individuals, each of whom contributes to powering the vehicle.
- Utility—a vehicle designed for every-day transportation for such activities as commuting to work or school, shopping trips, and general transportation.

Minimum Number of Vehicles to Constitute a Class

There is no requirement for a minimum number of vehicles. However, should the number of vehicles entered in a class be more than one but less than four, the number of awards shall be one less than the number of vehicles in the class. Further, in these special circumstances no prize money will be awarded to the winners of the category unless the vehicle completes all competitions for that category (e.g., design, sprint and endurance). Because the multi and single rider endurance race is run simultaneously and stopped when the leader crosses the finish line, judges will consider completion of the endurance race for the multi rider and single rider category to be completion of one third the required distance.

Dual Entry Status

Either Single Rider or Multi-rider vehicles may petition for dual entry status as Utility vehicles—or vice versa. These petitions will be evaluated in the context of the number of vehicles entered in each class by the Competition Director and the Chief Judge, and their decision will be final. However, all storage devices included for the Utility Vehicle events must be removed or rendered the device inoperable before the vehicle competes in events as a single-rider or multi-rider vehicle.

Teams entering one or more vehicles as dual entries will pay an additional entry fee for each such entry; this fee will be set by the Competition Director, but will not exceed \$50.00 per vehicle.

Events of the Competition

The competition will included four events:

- Design Event
- Sprint Event
- Endurance Event
- Utility Endurance Event

The Sprint Event for Single Rider vehicles will include separate categories for women and men, with the scores of each contributing equally to the team's overall standing. There will be no gender-specific categories in any other event.

Vehicle Design, Analysis, and Construction

The research, analysis, and design of all vehicles entered by a school must be performed solely by current ASME student members at that school and listed on the certified roster described earlier. Construction of the vehicle may include the assistance of outside vendors where the required capabilities exceed those available the school.

All vehicle riders must substantially participate in the design and construction of their respective team's vehicle.

Energy Storage Devices

Utility vehicles will be allowed to store regenerative energy for reuse when competing in the Utility Vehicle endurance event. Energy must be stored while the vehicle is in motion, leaving human power as the sole external source of energy. At the beginning of each event, each team must demonstrate that their storage device has no initial energy stored.

Combustion or chemical reaction engines and solar cells are excluded from the competition.

During the safety inspection each team must be prepared to discuss the safety of the storage device, especially during a high-speed incident. Teams whose vehicles present an unacceptable risk in the perception of the judges must make any necessary changes before they will be allowed to utilize the energy storage device in the competition.

No energy storage devices of any kind may be included in non-utility vehicles or in utility vehicles when competing as a single-rider or multi-rider vehicle; that is, no device—such as a spring, flywheel, compressed air container, or thermal or electrochemical storage device—specifically designed to store energy for the purpose of propelling the vehicle shall be included in its drive train. Normal operating components involved in the drive train (chain rings, chains, or other power transmission devices, wheels, etc.) are specifically permitted in as much as their design is not primarily influenced by energy storage considerations.

Aerodynamic Fairing

All vehicles in all classes of the competition shall be equipped with a full or partial aerodynamic fairing. At a minimum, this fairing must cover 1/3 of the frontal area of the vehicle, and it must extend rearward from the front of the vehicle to a point far enough along its length on both sides to provide adequate space for clearly displaying the vehicle number, ASME logo, and school identification as described below.

Note that this rule does not preclude changes in the fairing configuration from one event to another—or within a single event—to the extent that the minimum requirements are met in all configurations and that the safety of the design is not compromised. That is, a team is permitted to use a full fairing in the Sprint Event and a partial fairing in the Endurance Event as long as both configurations meet the minimum requirements.

Note, however, that the safety requirements for rollover protection and seat belts and/or harnesses remain in effect as stated in these rules for any fairing configuration.

Vehicle Number and Logos

Each school/vehicle will be assigned a number by ASME. The number "1" will be assigned to the overall winning Single-Rider vehicle from the prior year's competition. The rest of the numbers will be delegated by the host school in the order that the registration fee is obtained.

The number, school name, and ASME logo must be clearly visible from both sides of the vehicle. If these become lost or obscured, the vehicle will be removed from the competition until they are repaired. If a vehicle number is obscured during the endurance race any laps run without a number will not be counted.

Numbers - ASME will provide the actual numbers to be incorporated into the vehicle. Past competitors will have the school number sent to their department chair in September or October. New entries will be sent their numbers upon receipt of the entry fee. The vehicle color must contrast with the provided number. Teams should contact the ASME competition organizers if the vehicle numbers have not been received as indicated.

School Name – All vehicles must display their school name or initials on each side of the vehicle in characters at least 10.1 cm (4 inch) high.

ASME Logo – An ASME logo must be displayed on both sides of the vehicle. This logo will also be provided by ASME with the vehicle number. The overall vehicle color must contrast with the logo.

Fairness of Competition

All participating teams will be assured an equal opportunity and a fair competition. Any participating vehicle team that, in the reasoned opinion of the judges, seeks to exert an unfair advantage over other competitors will be subject to a penalty in performance points or disqualification from the competition.

Protests

Protests must be announced to a member of the judging staff either at the time of the incident or within a 15 minute period following the announcement of results of the event to be protested. Following the announcement of the intent to protest, a written protest must be presented within 30 minutes unless otherwise allowed by the Chief Judge. Oral protests will not be recognized.

Protests must be specific in nature and must include a factual account of the underlying event, rules infraction, or perceived error in the scoring of an event. Appendix 8 contains a format that may be used in preparing a protest, but its use is not required.

Protests will be examined and resolved by the judges at their earliest convenience during the competition. Their decision will be final and without further appeal.

III. Safety

The safety of participants, spectators, and the general public will override all other considerations during the competition. The judges will consider the safety features of the competition courses as well as that of the competing vehicles in permitting each event of the competition to begin or continue. Any event of the competition may be delayed, terminated prematurely, or canceled if the Chief Judge, in consultation with the Competition Director, the Competition Advisor, and the Judging Team, determines that such action is necessary in the interest of safety.

Safety Requirements

Each vehicle must demonstrate that it can come to a stop from a speed of approximately 15 miles per hour in a distance of 20 feet or less, can turn within a 25-foot radius and travel for 100 feet in a straight line.

All vehicles will be designed to include rollover protection for all riders and stokers. Such protection may be incorporated into the fairing, provided that the part of the fairing that contains the rollover protection will be used in all events. If the part of the fairing that contains the rollover protection is not to be used in any event, rollover protection must be incorporated into the frame. In the case of tall, slender vehicles that, by virtue of their shape, will not roll completely over, protection on the sides must be emphasized. For vehicles with rounded lateral profiles, full rollover protection must be included.

Rollover protection must be structurally attached and braced to the vehicle frame or fairing and, with the vehicle in the upright position, must extend above the riders' helmeted head (or, in the case of a multi-rider vehicle, riders' heads) such that no part of any rider will touch the ground in a rollover condition. The roll bar or other protection will be at least equivalent to chrome-molybdenum steel tubing with an outer diameter of 1.5 inches and a wall thickness of no less than 0.049 inches.

All riders must wear helmets that meet ANSI Standard Z90.4 while

- warming up or orienting themselves on any event course,
- riding in the Sprint and Endurance Events, and
- riding any competing vehicle or other human-powered vehicle in close proximity to an event course.

All riders of all vehicles in all classes and events of the competition will be secured to their vehicle by safety belts and, where feasible, shoulder harnesses at all times that the vehicle is in motion unless a specific request for waiver is presented to and approved in writing by the judges. Seat belts and shoulder harnesses shall be of automotive quality; "back pack" type belts, straps, and plastic buckles—or their equivalent or less—will not be permitted without substantial test information that substantiates their strength under crash conditions.

Any team may request an exemption from this rule (Appendix 4a). The request must be based on the safety of the rider or general public, must be stated in writing, and must be submitted to the Chief Judge no later than the due date for the Design Report. The request must successfully argue that safety is enhanced by omitting the seat belt and/or the shoulder harness. Waivers will generally not be granted for fully faired vehicles, recumbent vehicles, or vehicles with three or more wheels.

The judges will rule on any request for waiver after reviewing the configuration of the vehicle, and their decision will be final and without appeal.

The intent of the seat belt rule is to maximize safety, based primarily on the team's evaluation. It allows riders of partially faired vehicles to operate those vehicles in the Endurance Event without seat belts, but only after a waiver is requested and granted.

All surfaces of the vehicle—both on the exterior and in the interior in the region of the rider(s) and in the access area—must be free from sharp edges and protrusions.

Required Safety Test of Energy Storage Devices on Utility Vehicles

Utility vehicles will have an additional safety inspection due to their ability to use energy storing devices. In the design report, the presentation and in any safety inspection each team must discuss the safety of the storage device, especially during a high-speed incident. Teams whose vehicles present an unacceptable risk in the perception of the judges must make any necessary changes before they will be allowed to utilize the energy storage device in the competition.

Safety Certification

Participating teams must certify that (1) the design and construction of their respective vehicles have been carried out with due consideration of occupant and bystander safety, (2) the specified safety tests will have been completed before arrival at the competition, and (3) all riders and stokers will have had not less than 30 minutes of riding experience in their vehicle prior to the competition.

Appendix 4 provides the format for this certification.

Safety Inspection and Demonstration

The judges or the Competition Director will conduct tests of a vehicle's ability to meet the braking, turning and forward motion requirements the evening of the oral presentation. During this safety check the tallest rider on the team must sit in the vehicle and demonstrate the roll bar assembly extends beyond the riders helmeted head and shoulders. In addition, each vehicle will be visually inspected by the judging team to assure that all surfaces are free from sharp edges and protrusions, both on the exterior surfaces and in the interior in the region of the rider(s), and that all required safety equipment is properly installed.

NOTE: Each team must ensure that it has a sufficient number of personnel available at vehicle check-in to serve as "starters" and "catchers" for its vehicle during any required operating safety tests.

Modifications Affecting Safety

Modifications to vehicles (e.g., fairing, structure, chain rings, wheels and tires, etc.) between events of the competition will be allowed insofar as safety is not compromised. If the competition officials determine that any such modification has reduced the safety of the design to an unacceptable level, the vehicle will be disqualified from the affected event of the competition.

Disqualification of Unsafe Vehicles

The competition officials reserve the right to remove from the competition any vehicle that is judged to be unsafe. This includes consideration of a vehicle's perceived performance under prevailing weather conditions.

IV. Entry and Registration

Team Eligibility

Entry in this Competition is limited to those colleges and universities having active and current ASME student sections or mechanical engineering club chapters as listed in the "ASME Regional Supplement to AC-10."

Team Member Eligibility and Certification

All members of the respective school's team must be current student members of ASME, enrolled as full-time students in an engineering program of study at that school. Names and ASME membership numbers of all team members (Appendix 3) must accompany the final entry submission and must be received by the entry date (See site information sheet).

According to ASME rules, individuals who graduated in December (or later) and were student members of ASME immediately prior to graduation are eligible to attend ASME meetings in the spring as student members. With this as a basis, any individual who meets the requirements of having been (1) a student member of ASME (2) enrolled as a full-time student (3) in an engineering program of study, during the previous semester or quarter but who (4) graduated no earlier than the previous December is eligible to fully participate in the ASME HPV Competition.

The team roster must clearly identify all designated riders. Only those individuals thus identified and certified will be allowed to participate in the Sprint and Endurance Events.

Rider Requirements and Exceptions

Separate competition categories will be held for men and women in the Sprint Event; their scores will be averaged to determine the team's Sprint Event score for inclusion in the overall competition score. In the Endurance Events, female riders must start the event for their team and must complete a specified number of laps.

An exception to the eligibility rule **may** be allowed in the Sprint and Endurance Events to allow female riders to compete for a school other than that in which they are enrolled, as described below. No other exceptions will be allowed.

If the minimum number of both female and male participants can not be listed on a participating school's roster, that school (the "requester") may request the voluntary participation of one or more female/male riders from other participating schools (the "respondent"), provided that any such volunteer is included on the respondent's roster, will not participate in the same event for the respondent, and meets all of the eligibility requirements. The requester must submit a written request for a waiver of the rules for this purpose to the Chief Judge for approval prior to the start of the Endurance Event. Any score derived in this manner will be credited to the requester.

A team that does not include the minimum number of either female and male riders, and cannot enlist them from another team, may still compete in all of the events, but with the following consequences:

- In the Sprint Event score teams without female riders will be scored as if the team finished last in the female class. Teams without male riders will be scored as if the team finished last in the male class.
- Teams lacking the minimum number of female riders will start the Single-Rider and Multi-rider classes of the Endurance Event at the time that the last female rider (of all of the teams with female riders) completes the required number of laps. Should the last female rider not complete the required number of laps and incur a lap penalty, all teams without female riders will receive an equivalent lap penalty.
- Vehicles lacking the minimum number of male riders will start the Single-Rider and Multi-rider classes of the Endurance Event at the time that the last female rider (of all of the teams with female riders) completes the required number of laps. Should the last female rider not complete the required number of laps and incur a lap penalty, all teams without female riders will receive an equivalent lap penalty.

Verification of Team Rosters

Each team roster must be signed by the respective school's current ASME faculty advisor. Copies must be submitted concurrently to the Host Organization and to the ASME Regional Office for the competition for verification of ASME membership (the regional office address will be provided by the host school); the host school may, at its option, submit a copy of the team rosters to the respective school registrar's office for verification.

Submittal of Preliminary Entries

Preliminary entries, which indicate an intent to participate in the competition, must be received by the host organization not later than **preliminary date set by the host institution** (See site information sheet) in order to be considered. The preliminary entry (Appendix 2) must include the following:

- A completed copy of the preliminary entry form;
- a non-refundable deposit of \$50.00 per vehicle;
- identification and contact information for the single-point of contact for the entry;
- an indication of the type of vehicle (i.e., Single Rider, Multi-rider, Utility); and
- a certification of organizational eligibility.

In addition, each entering team is urged to submit a vehicle or team photo for use in the competition program and publicity information.

Submittal of Final Entries

Final entries must be received by the **entry date** (see site information sheet) and must include the following:

- A copy of the preliminary entry form, updated as necessary (if no preliminary entry was completed, a copy of the Appendix 2 entry form, indicating that this is a final entry);
- the balance of the registration fee;
- identification and certification of eligibility of team members (Appendix 3);

- a signed certification of vehicle safety (Appendix 4);
- a description of the vehicle (Appendix 5); and
- an acknowledgment of understanding of the rules or requests for clarification or variance. (Appendix 6)

Late Entries

At its sole discretion, the host school may allow consideration of entries received after the preliminary entry date; however, no entries will be accepted after the final entry date.

Entry fees

The entry fees for the competition may differ depending on site (especially for the international sites). The specific fees are all listed on the Site information Sheet.

Below the fees are described for clarity.

- First vehicle entered by a school: **First Fee** (including deposit)
- Additional entries by a school: **Additional Fee** (including deposit)
- Dual entry of a single vehicle **Dual Fee** (including deposit)

Limitation of Entries

Safety will be the primary determinant in establishing the maximum number of vehicles accepted into the competition. The host organization and the competition judges will make this determination prior to the entry date; however, in any case the total number of vehicles entered will usually be limited to 40, and the number of single rider vehicles will usually be limited to no more than 34. Dual entries will be counted as a single vehicle.

Entries will be considered from qualified schools in the order received and according to the following criteria: (1) the first entry from a school, (2) additional entries from schools already entered as necessary to assure a competition class (e.g., Single Rider, Utility, or Multi-rider vehicles), and (3) other additional entries from schools already entered. All entries must be received prior to the final entry date.

Appeal of Declined Entries

Appeals of declined entries must be submitted in writing to the Competition Director, who may, at his or her discretion, request the consultation of the others in reviewing the limitation decision.

Refund of Entry Fees

If an entry is not accepted by the host school, all fees, including the deposit, will be returned.

If a school requests a cancellation of an entry and refund of the entry fee and the request is received by the host school before the entry deadline, a full refund, less the non-refundable deposit, will normally be made. No refunds of registration fees will normally be made after the entry deadline.

At its own option, the host school may decline to refund entry fees or may make partial refunds in the case of (1) cancellation of the Competition for reasons beyond its own control, (2) non-receipt of the full entry fee by the final entry deadline, or (3) submittal of an entry by an ineligible school.

Notification of Acceptance

Notification of acceptance of the first entry in each vehicle class will be sent not more than one week after receipt of the preliminary entry. Notification of acceptance of additional entries from the same school will be sent not more than one week after the final entry deadline.

The host organization will provide specific information concerning the competition to each approved entrant at the time of notification of acceptance. This information will include

- a vehicle number, as described below;
- the final rules for the competition;
- a course map for the Sprint Event;
- a course map for the Endurance Event;
- a course map for the Utility Endurance Event;
- lap requirements for the single-rider and Multi-rider vehicle classes in the Endurance Event (Male/female, maximum/minimum per rider, total);
- a map showing the location of the various events; and
- a schedule of events.

On-Site Registration

All competitors must register with the **host school** competition committee before participating in the competition. Registration will begin at 2:00 PM and continue until 8:00 PM on the date and location specified by the site host (See site information sheet).

Upon arrival at the competition site, competitors must complete the on-site registration process, during which they will

- request changes in the list of participants for verification;
- present photo identification for verification and receive identification for each participant (arm stamp, wrist bracelet, etc.);
- receive confirmation of the schedule for the oral presentation of the vehicle design;
- confirm their assigned vehicle numbers; and
- receive a final schedule, including times, locations and any other appropriate event information.

In addition, the event officials may inspect any or all vehicles to assure that the safety conditions described in Section III have been met and that all safety equipment has been properly installed.

Late registration will be possible at the Sprint and Endurance Event sites, contingent on a reasonable explanation of the conditions making late registration necessary and the circumstances at the time. Late entrants must present their vehicle(s) and certifications to the Competition Director and judges for verification prior to entering any event.

V. Design Event

Goal

The goal of the Design Event is to present an opportunity for engineering students to develop an innovative human-powered vehicle design, document that design in a formal

report, present an oral summation of the design, and have their design efforts evaluated by a panel of practicing engineers.

Description

The Design Event includes two parts: the written design report and the oral design presentation. **If no design report is submitted, no oral presentation will be scheduled and the vehicle will be judged as a non-participant in the design event.** Similarly, a vehicle will also be judged as a non-participant in the design event if a design report is submitted within the required schedule but the design is not presented orally. Neither of these conditions will affect the vehicle's participation in the other events, provided that the vehicle is presented to the judges and the Competition Director for inspection and safety verification.

Design Report

The report should concisely describe the vehicle design and document the design, analysis, and testing processes and results. The report should have the character of a professional engineering report and should be organized as described below. Report writers should note that bulk is not necessarily a desirable feature; rather, the report should emphasize clarity both in presentation and in the statement of results and conclusions, therefore reports have a **30 page maximum limit** (including text, figures, tables, references and appendices).

A copy of the 2001 judges score sheet has been included in appendix 13 in order for teams to optimize their design score.

Photographs and drawings are encouraged where beneficial in documenting unique features of the design.

The design report must clearly and plainly display the assigned vehicle number in the upper right corner of the cover.

The design report should include the following sections:

- **Abstract** summarizes the design features and supporting work; its length should be approximately 1 page.
- **Description** includes appropriate background information, design criteria, descriptions of supporting research, and other information concerning the development and construction of the vehicle. It should clearly identify *design innovations* and new approaches and technologies incorporated in the design or construction of the vehicle.
- **Analysis** summarizes the engineering evaluation of the vehicle's performance and structural viability as related to the design criteria outlined in the description. This section should include a discussion of computer analyses and the results thereof, the design optimization processes undertaken to improve existing or new components or designs, and a discussion of the use of the analytical results in the final vehicle design. Note that raw data or uninterpreted computer printout is of little value to the judges in evaluating the design.

The design analysis shall address the provision for rollover protection and shall indicate how it is incorporated in any operating configuration.

This section should include a production cost estimate for the vehicle (1) as presented for the competition and (2) as estimated for a production run based on 10 vehicles per month. The estimate should contain detail to the major component and fabrication process level.

- **Testing** includes a discussion of any physical tests conducted to develop the design or to verify it. It should include a description of test objectives, methods, and results; where appropriate, it should compare test results with design calculations.
- **Safety** considers the potential hazards to both occupants and observers inherent in operating vehicles of this type in a general competition and describes the features incorporated in the vehicle to mitigate those hazards.
- **Utility** applies to Utility Vehicles only and addresses the overall usefulness of the vehicle in routine tasks, such as shopping; commuting, either to work or to school; or recreation. Design judging considerations for Utility Vehicles are included in Appendix 8.

Previous Work

Design scoring will emphasize work done in the current year. In the event that the design is not a completely new design, the report must clearly identify which features of the design are new and what new analyses, tests, etc., were performed to verify the design changes. As necessary for clarity, extracts or sections of previous design reports may be included, but such material must be clearly identified and referenced as having been done outside of the current year's effort. *Design scoring will focus on the current year's work.*

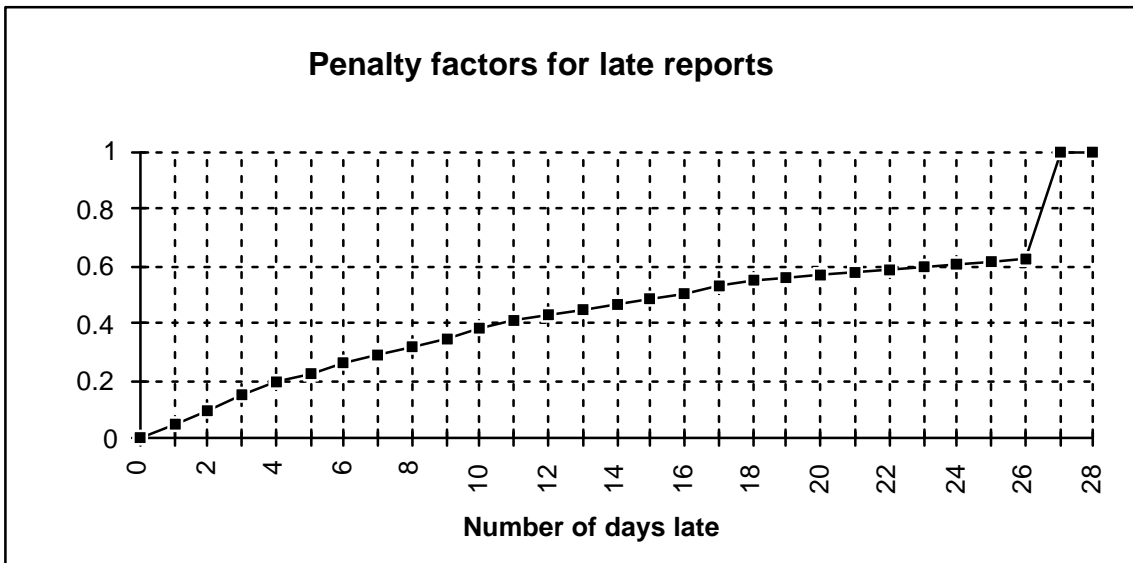
Design Report Submittal

One copy of the design report must be received by each of the judges and by the appropriate ASME Regional Office at least 32 days prior to the competition (i.e., Monday, **Report Date**). In all, eight copies will be required. Addresses to which the reports must be sent will be provided well in advance of the report due date.

Late Reports

Late reports will be accepted until 1 week before the competition check in date, but a penalty will be applied according to the following schedule and figure. The on time arrival of reports to the judges is a priority so reports will be considered on time if all the judges receive the reports prior to the deadline. However, the official receipt date for late reports will be determined by the stamp in date recorded by the ASME regional office.

<u>Number of days that report is late</u>	<u>Penalty</u>
1 through 4 days	5% per day
5 through 11 days	20% plus 3% per day over 4
12 through 18 days	41% plus 2% per day over 11
19 through 27 days	55% plus 1% per day over 18
More than 27 days	Report will not be accepted.



Oral Design Presentation

The oral presentation provides an opportunity for the participating school's team to discuss the design development process and to highlight the special features of its vehicle. The presentation should include a general description of the vehicle and those special features that set it apart from other designs. It might include such topics as chassis and fairing development, aerodynamics, ergonomics, testing, safety, and design optimization. It should include a discussion of any work that was accomplished after the design report was submitted.

The presenting team should have its vehicle present during the presentation.

Visual aids (overhead projector transparencies, videotapes, and computer-generated graphics) are encouraged to the extent that the presenters wish to use them. The Host Organization will provide an overhead projector and projection screen for use by all competitors. *Upon prior request*, it will also provide a VCR and monitor. Needs for specialized computers and related projection equipment should be communicated to the host organization, but their availability is not certain.

Oral Presentation Duration

Five minutes will be allotted for the oral presentation; at the end of this period, no further presentation will be allowed. Immediately following the presentation, the judging panel will have 3 minutes to question the speaker(s). This period may include a brief inspection of the vehicle. Only the judges will be allowed to present questions.

Presentation Schedule

The oral presentation part of the Design Event will begin at 3:00 PM at the site specified by the host (See site information sheet). With the exception of a scheduled 30-minute dinner break, presentations will be scheduled at 10-minute intervals. Specific times for individual presentations will be assigned within one week of receipt of the Design Report and scheduling request (Appendix 7) and reconfirmed during the on-site

registration process. Competitors and competition officials are expected to adhere to the established schedule; a penalty will be assessed if a team is not present and ready to begin its presentation at the appointed time.

Any team may appeal its time assignment, but this must be done prior to the on-site registration process.

Vehicle Display

An area adjacent to the **presentation site** (See site information sheet) will be designated for static display of the vehicles from 5:30 PM until 9:30 PM on Friday evening. All teams will have their vehicles on display during this period—except when either making their oral presentations to the judges or waiting in line to do so. At least one team member must be present with the vehicle during this period, and it is highly recommended that one or more posters that explain the vehicle's design and construction be prepared for display with it.

During the evening, it should be expected that the general public, as well as other participants and the competition judges will tour the display area. During this time, the judges will review the display and inspect and query the design features of any vehicles for which a formal design report was not received.

Design Scoring: Single and Multi-rider Vehicles

Design scoring will be based on the overall competency of the design and the effectiveness of the written and oral presentations. Design teams must address each of the specified topics in order to receive a score for that topic.

Scoring of the Single and Multi-rider Vehicle Design Event will be executed by the judging panel as follows:

<u>Subject Area</u>	<u>Percent of Score</u> <u>Single/Multi-rider</u>
Design Innovation	25%
Analysis	25%
Testing	20%
Safety	20%
Aesthetics	10%

Design Scoring: Utility Vehicles

As with the Single and Multi-rider Vehicles, Utility Vehicle design scoring will be based on the overall competency of the design and the effectiveness of the written and oral presentations, and design teams must address each of the topics in order to receive a score for the topic.

Scoring in the Utility Vehicle Class differs significantly from that of the Single and Multi-rider Vehicle Classes. In this class, the scoring will consist of two parts: Basic Vehicle Design and Design for Utility. Although the final scoring will be based on the Design for Utility score, all vehicles will be judged in both areas. Those vehicles whose "Basic Vehicle Design" scores equal or exceed 70 percent will be designated as "Tier 1," with

those scoring below this level designated as "Tier 2." The "Tier 1" designs will be ranked above those in Tier 2.

<u>Subject Area</u>	<u>Percent of Score Basic Vehicle Design</u>	<u>Percent of Score Design for Utility</u>
Design Innovation	30%	-
Analysis	30%	-
Testing	20%	-
Safety	20%	20%
Utility	-	70%
Aesthetics	-	10%

Design Score Penalties

The Judging Team may impose penalties for failures to comply with the rules of the Design Event. Penalties will be assessed according to the following table in those cases where an unfair advantage might have been gained or where the Judges' ability to evaluate a design has been compromised. Penalty factors will not be applied against the aesthetics score.

<u>Rules Infraction</u>	<u>Maximum Penalty</u>
• No design report submitted	Event "non-participant"
• Late report:	See "Late Reports" above
• Report content largely non-original (e.g., substantially copied or extracted from either an earlier report or a contemporary report for a separate vehicle)	25%
• Failure to provide specified number of copies of report	10%
• Late for presentation	5%
• No design report	Event "non-participant"
• No oral presentation	Event "non-participant"

Overall Design Scoring

The judges will compile the design scores as described above, factor in any penalties, and rank order the results. Each team will receive points corresponding its place in the event, determined as follows:

P = points earned by the vehicle
 n = number of vehicles entered into the event
 p = place in the event by the vehicle
 M = maximum possible points
 = 40 for Single Rider and Multi-rider Vehicles
 = 60 for Utility Vehicles

$$P = \{(n+1) - p\} * (M / n)$$

Teams not competing in this event will receive zero points.

VI. Sprint Event

Goal

The goals of the Sprint Event are to provide an opportunity for engineering students to demonstrate the speed capability of their human-powered vehicles in a balanced competition, free from serious accidents, and to accurately record and promptly report the results in accord with the rules of the competition.

Time and Place

The Sprint Event, a "flying start speed trial," will be held on Saturday morning, beginning at approximately 8:00 AM at a location specified by the host organization and identified at on-site registration. The exact starting time may vary due to weather conditions or equipment readiness.

Duration

The Sprint Competition will normally continue for 4 hours. However, this time may be either extended or curtailed as necessary and allowable to meet externally-imposed requirements or weather conditions.

Sprint Course Description

The host organization will be responsible for selecting the course and securing approval by ASME prior to the event. The course will consist of a straight, smooth, and level paved surface of suitable width and clear of obstacles, pits, cracks, or potholes. The timed portion of the course shall be 100 meters in length, preceded by a 300 to 400 meter "run-up" section and followed by a "run-down" section at least 200 meters in length. The course will include a separate route for returning vehicles from the "run down" end of the course to the starting area.

While the course should be designed to completely avoid collision hazards, this may not be possible in all cases. Hay bales or equivalent cushioning material will be used to protect vehicles and riders from collision with any fixed obstacles located adjacent to the course. Such cushioning shall reflect proper safety design with due consideration to the estimated speed of passing vehicles and their direction along the course.

The course shall be clearly marked to indicate the following points:

- 300 meters to time trap
- 200 meters to time trap
- 100 meters to time trap
- 50 meters to time trap
- beginning of time trap
- end of time trap
- end of course

Timing Area

The timing and scoring area, which will be located at the end of the speed trap, will be off limits to spectators and all others except the officials of the competition and the event timing staff.

Tally Board

The Host Organization will provide and staff a "tally board" on which the speeds and standings of the respective vehicles can be posted. This "tally board" should be separated from the timing and scoring area.

Drivers Meeting

All drivers who will participate in the Sprint Event must attend a *mandatory* Drivers Meeting at approximately 7:30 AM on Saturday morning at the Sprint Event starting area. The meeting will clarify operating procedures and signals and will identify course features, hazards, and landmarks.

Any team that is not represented at this meeting will not normally be permitted to participate in the event; in cases of unavoidable absence, the team may file an appeal with the Judging Team, whose decision regarding participation will be final and without consideration of fees paid.

Starting Order

The first round of sprint attempts will be in the numerical order of the vehicles to the extent possible. Subsequent starts during the first two hours of the competition (Part I) will be on a "first ready, first started" order. Teams will be notified of their staging order three-deep in line.

Line Position Forfeiture

Each successive vehicle will have 15 seconds to begin a sprint attempt after the Chief Official has determined that the course is ready and safe for the event to proceed. If a vehicle is not ready within the 15-second period, the vehicle must stand aside for others that are ready to proceed. In extreme cases, the vehicle will forfeit the run and the vehicle must reenter at the end of the line.

Start Assistance

Start assistance will be limited to holding the competing vehicle upright and stabilizing it as it begins its run (during no more than a 10 meter distance); pushing the vehicle is only permitted as required to keep the vehicle stabilized and upright. No more than four individuals may assist in the starting process.

Number of Attempts

During the Sprint Event each vehicle will be allowed to make as many runs as time and prevailing conditions permit, and all vehicles will be provided an equal opportunity to compete.

Although all competitors will have an equal opportunity to compete, there will be no assurance of an equal number of runs for all vehicles. Teams may structure their own competitive strategy, either taking advantage of every opportunity to maximize their number of runs or passing opportunities as they choose. Such strategies should consider that there will be no assurance that foregone opportunities will be regained and that the maximum number of runs will be made by those vehicles that are ready to compete and regularly take their places in the line.

Under normal conditions, all present and competing teams will be notified before the final run is begun, and all teams will be allowed an opportunity to make a final attempt.

Interruption and Termination

The Sprint Event will normally run continuously. However, circumstances such as equipment failures, an emergency, or hazardous weather or wind conditions may require a delay or premature termination of the event. The need for—and extent of—any such delay or termination will be evaluated by the Judging Team and the Competition Director, with the Chief Judge making the final determination.

Scoring

The judges will determine the overall placements in the Sprint Events by the speeds attained. Each team will receive a number of points corresponding to its overall place in each category and class in the Sprint Event (male single rider, female single rider, and Multi-rider).

In the case of the Single-Rider class, the places in the male and female categories will be averaged to provide a single placement for each team. Single-rider vehicle entrants without either a male or a female rider will be judged as non-competitors in that category, placing last, and that placement will be averaged with the female or male rider's placement as just described.

The judges will compile the placements and rank order the results. Each team will receive points for its place, determined as follows:

P = points earned by the vehicle

n= number of vehicles entered into the event

p = place in the event by the vehicle

M = maximum possible points (30 for both Single Rider and Multi-rider Vehicles)

$$P = \{(n+1) - p\} * (M / n)$$

Teams entered into the competition but not competing in this event will receive zero points. In the event of a tie score, the female rider's placement will be used as the tie-breaker.

VII. Endurance Event

Goal:

The goal of the Endurance Event is to provide an opportunity for engineering students to demonstrate the speed, agility, and durability capabilities of their human-powered vehicles on a road course—without serious accidents—and to accurately record and promptly report the results in accord with the rules of the competition.

Time and Place

The Endurance Event will take place on Sunday, beginning at approximately 8:30 AM at a location specified by the host organization and identified at on-site registration.

The Endurance Event will begin with the Single Rider Class, followed by the Multi-rider Class.

Course

The competition will take place over a continuously paved course that includes turns in both directions and straight sections designed to demonstrate the advantage of the vehicles' aerodynamic fairings. The overall distances for the classes (Multi-rider, and Single-rider) shall be as shown below, to the extent allowed without partial laps. Individual laps should be approximately 2 kilometers in length, again to the extent that the event site permits; in no case, however, may the lap length be less than 1.0 kilometer.

Single-rider vehicles	65	kilometers (40.4 miles), timed
Multi-rider vehicles	65	kilometers (40.4 miles), timed

The exact number of laps corresponding to the distance requirements will be provided by the host organization.

The course layout must reflect the needs for pit work areas, including safe entry and exit; room for the starting line-up; and a straight run of at least 100 meters between the starting line and the first turn. The pit area shall be located in an area adjacent to the course and shall begin not less than 30 meters and not more than 50 meters after the start/finish line.

The host organization will design the course and secure its approval by the ASME competition judges prior to the competition. The host organization will provide a detailed map of the course to each competing team and to the judges; the map will show the location of the course as well as its layout and overall length and the number of laps required for the Single-rider and Multi-rider classes. It will also identify any special features or course hazards of which the competitors should be aware.

Hay bales or equivalent cushioning material will be used to protect vehicles and riders from collision with any fixed obstacles located adjacent to the course. Any counter-flowing traffic lanes will be separated by a minimum of two rows of bales or equivalent padding material. Such cushioning shall reflect proper safety design with due consideration to the estimated speed of passing vehicles and their direction along the course.

Assistant Lap Counters

Each competing team must provide one Assistant Lap Counter as a scoring assistant to count and record laps in the judging area for the Multi-rider and Single-rider Endurance Events. No score will be tabulated for any school that does not provide an Assistant Lap Counter. Lap counters should have in their possession a digital watch from which to obtain the time of day, a pen or pencil, and a hard surface to use as a "writing desk".

Lap Counting Process

The Judging Team will provide lap-counting forms to the Assistant Lap Counters. The forms include spaces to log the event start time (time of day) and the time at the completion of each lap (time of day—*not* elapsed time), the identity of the rider(s), and other substantive information. Counters should obtain the timing data from their own watches; times need not be synchronized between counters.

Pit Crews:

Due to space limitations, no more than eight crew members (excluding drivers) will be allowed in the pit area for each team. Crew members may not be in another team's pit area without permission.

Right of Way in the Pit Area

Competing vehicles have the right of way on the course and in the pit areas at all times during an event. Vehicles entering the pit area from the course shall have the right-of-way over those returning from the pits to the course. Interfering with a competing vehicle *in any way* may result in a penalty assessment against the responsible team.

Rider Requirements

1. **Minimum distance for any rider:** the number of laps nearest 5 km
2. **Maximum distant for any rider:** the number of laps nearest 20 km
3. **The minimum number of either male or female riders:** equal to the rider capacity of the vehicle. That is, each team must have at least the number of both male and female riders equal to the capacity of the vehicle such that, during the Endurance Event, the vehicle will be completely occupied and operated at a time specified by riders of the same gender.
4. A team may include any number of riders, above the minimum, of either gender as long as the minimum rider requirements and the distance-per-rider requirements are met.
5. All endurance events will begin with one or more female riders, depending on the capacity of the vehicle. In multi-rider vehicles, all of the riders at any time will be of the same gender.
6. All laps by an individual rider must be continuous – that is, all riders must complete their laps in sequence and uninterrupted by any other rider.
7. All endurance events will end when the lead vehicle completes the required distance. All other vehicles will complete the lap concurrent with the finish of the lead vehicle. Thus, the actual number of riders will be less for all the but the lead vehicle.

Female/Male Rider Exception

Vehicles lacking either a female rider or a male rider will start the Single-Rider and Multi-rider classes of the Endurance Event at the time that the last female rider (of all of the teams with female riders) completes the required number of laps. Should the last female rider not complete the required number of laps—or should any other female rider not complete the required number of laps but who would have finished last had she done so—and incur a lap penalty, all teams without female riders will receive an equivalent lap penalty.

Judging Area

The lap counting and judging area will be adjacent to the start/finish area. It will be off limits to everyone except the officials of the competition and the assistant lap counters.

Drivers' Meeting

All drivers who will participate in the Endurance Event must attend a *mandatory* Drivers Meeting at approximately 8:00 AM on Sunday morning at the Endurance Event starting

area. The meeting will clarify operating procedures and signals and will identify course features, hazards, and landmarks.

Course Practice

The road course will be opened by the Chief Official for practice and will remain open at his/her sole discretion.

All vehicles practicing on the course must be operated in a safe manner and with extreme caution, particularly when entering the pit area or any other areas congested with participants, officials, or spectators.

All riders operating a vehicle on or adjacent to the course, whether on conventional bicycles or competing vehicles, must wear helmets meeting the approved standards for the competition.

Starting Order

Vehicles will start the Endurance Event in the order of finish in the Sprint Event. For the Single Rider Vehicles, the order will be that of the finish of the female rider. To maintain equity between the multi rider entries, all multi rider vehicles will be placed behind the single rider entries and placed in the order of their sprint times. Vehicles for which there were no female qualifiers in the Sprint Event will start in their order of finish in the Sprint Event at the very end of the endurance starting line up.

Vehicles will be arranged in the specified starting order in two columns with the lead vehicle in the inside position.

Start Assistance

A standing start will be used in all classes of the Endurance Event. Two team members will be allowed to assist each vehicle in the starting process.

The standing start requires that the assisting personnel exercise extreme caution in avoiding contact with vehicles starting from line positions behind them. Assistants at the outside of the two starting columns should take positions to the outside of the course after their vehicle has started, while the "inside" assistants move to the center of the course. Assistants should concentrate on the approaching vehicles once their vehicle has started.

Any vehicle that requires mechanical assistance at the time of the start must forfeit its starting position and safely exit to the side of the course; it may rejoin the event at the rear of the field of competitors when ready. Repair work that interferes with the smooth and orderly start of an event may result in the assessment of a penalty against the responsible team.

Signals

Flags will be provided by the host team for use by competition officials as follows:

<u>Flag Color</u>	<u>Usage</u>
Green	Start event
Red	Stop event
Yellow	Proceed with caution, beware of hazards, no passing

Black	Proceed directly to pits: problem with vehicle, rule infringement, or penalty assessment
White	One lap remaining
Black/white	Event completed, proceed to pit area

Each Course Marshal will be supplied with a yellow flag with which to signal caution in the event of an accident. All other flags will be held in the judging area.

As described, a green flag will signal that the event is underway. A red flag will indicate that a restart is necessary, and all vehicles should proceed by their most direct path to the starting area. A red flag at any other time during the event requires that all vehicles stop at the earliest safe opportunity.

Disabled Vehicles

The first concern following any accident must be the safety of the rider. Once the Course Marshals or other personnel have determined that the driver is not injured, any disabled vehicle must be removed from the course as soon as possible. In the event of an injury, no person should take any action that might increase the risk associated with the injury.

Disabled vehicles must be removed from the course at the nearest safe exit; drivers may not move disabled vehicles along the course other than to reach a point of removal. Disabled vehicles may be returned to the pit area by the driver and/or team members by safely removing the vehicle from the course and wheeling or carrying it back to the pit area.

Course workers will assist with the removal of vehicles from the course, as necessary in the interest of safety. Primary responsibility, however, remains with the respective team.

Non-emergency blockage of the course by a disabled vehicle may result in the assessment of a penalty.

Traffic will be controlled in the area of a disabled vehicle by the Course Marshals or by other competition officials, who will oversee the clearing of the course and signal the resumption of normal competition.

Disabled vehicles that have been removed from the course and repaired must reenter the course either at the point of removal or at some point that it had passed between that point and the starting line on that same lap. That is, no vehicle will be allowed to advance its position on the course as the result of a disablement. Reentering vehicles must yield the right-of-way to vehicles on the course.

Fouls and Penalties

The Chief Judge or the Judging Team will determine whether a foul has occurred and will determine the extent of any assessed penalty (which may include disqualification from the event or from the competition). The responsible team will be notified immediately of an infraction and any resultant penalty by the Judging team.

Fouls will include—but will not be limited to—the following:

- failure to meet equipment requirements, including the proper display of vehicle numbers;
- safety violations, such as entering the course without a proper helmet or seat belt;
- obstruction of a vehicle by a competing team or by a spectator;
- foul driving, whether intentional or unintentional;
- poor sportsmanship or an activity that fosters unfair competition; and
- failure to meet driver lap requirements or limitations.

Drafting is expressly permitted as long as there is no interference with other vehicles.

Penalties will be assessed as follows:

- **Equipment violations**, such as failure to display the vehicle number as required, will require a pit stop to remedy the violation.
- **Safety violations:** Depending on the seriousness of the violation, subtraction of one or more laps from the team's total lap count.
- **Conduct violations:**
 - > First violation: A minimum of a 15-second delay in the pit area. The driver will be signaled into the team pit area. No work may be performed and no rider changes may be made during this stop.
 - > Second violation: A minimum of a 60-second delay, with the same stipulations as above,
 - > Third violation: Disqualification
- **Lap requirement violations:** deduction of one lap for each improper lap.

Note that the recording of a violation and the assessment of penalties will be at the sole discretion of the Chief Judge and the Judging Team. Penalty appeals may be filed in accordance with specified protest procedures.

Interruption

The Endurance Event will normally run continuously. However, circumstances—such as obstruction of the course, an emergency, or hazardous weather or wind conditions—may require a delay or premature termination of the event. The need for—and extent of—any such delay or termination will be evaluated by the Judging Team, the Chief Official, and the Competition Director with the Chief Judge making the final determination.

If the event is interrupted and a restart is required, the restart order will recreate, as nearly as possible, the order of vehicles at the time of the interruption.

Termination

The Endurance Event will continue until the leading vehicle completes the required number of laps. At that time, a "sweep" vehicle will enter the course and complete one lap. The sweep vehicle will not pass any operable competing vehicles on the course, nor will any competing vehicles pass the sweep vehicle. At the completion of the lap by the sweep vehicle, the event will be declared complete.

Note that the competition staff may terminate the event if weather or other conditions threaten the safety of the participants.

Scoring

The order of finish will be determined by the number of laps completed by each vehicle at such time that the lead vehicle has completed the event. Vehicles in the same lap will be scored by their relative position when crossing the finish line at the end of that lap.

Final scoring of the event will incorporate any penalty laps assessed during its course.

The judges will compile the placements and rank order the results. Each team will receive a number of points corresponding to its overall place in its class (single rider, and Multi-rider), determined as follows:

P = points earned by the vehicle

n = number of vehicles entered into the event

p = place in the event by the vehicle

M = maximum possible points (30 for both Single Rider and Multi-rider Vehicles)

$$P = \{(n+1) - p\} * (M / n)$$

Teams entered in the Single Rider or Multi-rider classes but not competing in this event will receive zero points.

VIII. Utility Endurance Event

Goal:

The goal of the Utility Endurance Event is to provide an opportunity for engineering students to demonstrate the combined speed, agility, utility, and endurance of their human-powered vehicles, developed specifically for this competition, on a road-type course, without serious accidents, and to accurately record and promptly report the results in accord with the rules of the competition.

Time and Place

The Utility Endurance Event will take place on Saturday, either in conjunction with or following the Sprint Event at the location specified by the host organization and identified at on-site registration.

Course

The host organization will design the course and secure its approval by the ASME competition judges prior to the competition. The host organization will also provide a detailed map of the course to each competing team and to the judges; the map will show the location of the course and will identify any special features or course hazards, including those described below.

The course will include

- a distance of approximately 10 km over a paved, closed-loop course, with each lap between 1 to 2 kilometers in length. (Lap length and total distance will be subject to local limitations; also short lengths are better to increase obstacle encounters.)
- a driveway entry ramp, typical of city or campus ramps;
- a speed bump, typical of those found on roadways on campuses, shopping areas, or residential areas;

- a simulated "stop" sign, requiring a vehicle to come to a complete stop and to hold that stop for as much as 30 seconds; and
- a "head-in" parking and parcel pickup area, of such size that the vehicle cannot be turned around within the area.

The minimum (unless otherwise noted) specification for the speed bumps and driveway ramps are as follows:

<u>Obstacle</u>	<u>Height (Minimum)</u>	<u>Length (Minimum)</u>	<u>Width (minimum)</u>
Ramp			
Up ramp	10 in.	8 ft.	8 ft.
Top of ramp	10 in.	4 ft.	8 ft.
Down ramp	10 in.	8 ft.	8 ft.
Speed bump	2.5 in. (max)	2 ft.	10 ft.

As with the Single Rider and Multi-rider vehicle Endurance Events, hay bales or equivalent cushioning material will be used to protect vehicles and riders from collision with any fixed obstacles located adjacent to the course. Counter-flowing traffic lanes will be separated by a minimum of two rows of bales or equivalent padding material. Such cushioning shall reflect proper safety design with due consideration to the estimated speed of passing vehicles and their direction along the course.

Description of the Utility Endurance Event

Riders will move their vehicles to the starting area at the starter's signal. Individual vehicles will begin the event at approximate 30 second intervals or as specified by the starter. During the course of the event, at least one rider change will be made. Rider changes will be made in the start/finish area at the end of a lap; the individual team may develop its own strategy for changing riders.

Vehicles will proceed on the course for the specified number of laps. During the course of the event,

- one stop at the end of a high speed section or down hill will be required (this can not coincide with a pit or rider changing area);
- one or more speed bumps will be encountered;
- one driveway ramps must be negotiated;
- one parcel stop with parking slot requiring reverse exiting must be made;
- a slalom section is desirable but not mandatory; and
- a very tight turn (hair pin) should also be encountered.

The speed bumps and driveway ramps will be located such that they do not present a complex road hazard—that is, they will not be located on a curve or corner. At the parcel stop, all riders will dismount their vehicles and pick up or drop off parcels equivalent to a 12-can pack of soft drink or a soft bundle the size of a large bag of groceries (approximately 30 cm x 20 cm x 40 cm). These parcels must be carried for a full lap and dropped off at the end of the lap. While the vehicle is in motion parcels are to be carried in a designated trunk-like structure and not by any person in the vehicle. All parcels will be the same for all riders but may vary from lap to lap. No assistance will be provided to the rider in dismounting the vehicle, loading or unloading the parcel, or remounting the vehicle and entering the course. In the event the parcel is separated from

the vehicle during the process of a lap, riders can receive assistance to clear hazards from the course, but the rider(s) must reload the parcel with out assistance.

The event is a timed event, and the total time will include the start, all intermediate stops, parcel handling, rider changes, and vehicle repairs as required. Time penalties will be assessed for failure to complete any part of the event successfully.

Judging Assistants

Each team that competes in the Utility Endurance Event must provide one Judging Assistant to time and record laps for the event. No score will be tabulated for any school that does not provide a Judging Assistant . Judging Assistants should have in their possession a digital watch from which to obtain the time of day, a pen or pencil, and a hard surface to use as a "writing desk".

General Operating Rules

The operating rules of the Endurance Event concerning the number of team members and the driver right-of-way in the pit area, as described above, remain the same for the Utility Endurance Event.

Rider/Stoker Requirements

All teams must begin the event with a female rider, who must complete at least one lap of the course. If the vehicle is "Multi-rider," all initial riders must be females.

There must be at least one complete rider change during the Utility Endurance Event. In the case of a Multi-rider Utility Vehicle, all riders must change at the same time. The team and rider eligibility rules cited earlier apply.

No individual may compete in the vehicle for more than the number of laps equivalent to 6 kilometers, and all laps by any single individual must be consecutive. (That is, once a rider has dismounted the vehicle to allow another to ride, he/she may not remount the vehicle for additional laps.)

The exact number of laps corresponding to the distance requirements will be provided by the host organization.

Judging Area

The lap counting and judging area will be adjacent to the start/finish area and will be off limits to everyone except the officials of the competition and the assistant lap counters.

Drivers' Meeting

All drivers who will participate in the Utility Endurance Event must attend a Drivers Meeting just before the start of the event at the starting area. The meeting will clarify operating procedures and signals and will identify course features, hazards, and landmarks.

Course Practice

The Utility Endurance course may be opened by the Chief Official for practice and will remain open at his/her sole discretion. Any period of course orientation will be brief.

All vehicles practicing on the course must be operated in a safe manner and with extreme caution, particularly when entering the pit area or any other areas congested with participants, officials, or spectators.

All riders operating a vehicle on or adjacent to the course, whether on conventional bicycles or competing vehicles, must wear helmets meeting the approved standards for the competition.

Start Assistance

There will be no assistance in the starting of any vehicle in the Utility Endurance Event, either at the start of the event or during its course.

Signals

Flags will be provided by the host team for use by competition officials as follows:

<u>Flag Color</u>	<u>Usage</u>
Green	Start event
Red	Stop event
Yellow	Proceed with caution, beware of hazards, no passing
Black	Proceed directly to pits: problem with vehicle, rule infringement, or penalty assessment
White	One lap remaining
Black/white	Event completed, proceed to pit area

A green flag will signal that the event is underway. A red flag will indicate that a restart is necessary; a red flag at any other time during the event requires that all vehicles stop at the earliest safe opportunity.

Disabled Vehicles

The instructions regarding disabled vehicles, as provided for the Endurance Event, apply to the Utility Endurance Event. Safety and fairness of competition will be emphasized.

Fouls and Penalties

The instructions regarding fouls and penalties, as provided for the Endurance Event, apply to the Utility Endurance Event.

Interruption

The Utility Endurance Event will normally be run continuously. However, circumstances—such as obstruction of the course, an emergency, or hazardous weather or wind conditions—may require a delay or premature termination of the event. The need for—and extent of—any such delay or termination will be evaluated by the Judging Team, the Chief Official, and the Competition Director with the Chief Judge making the final determination.

If the event is interrupted and a restart is required, the restart order will recreate, as nearly as possible, the order of vehicles at the time of the interruption.

Termination

The Utility Endurance Event will continue until all vehicles have completed the course. In the event that a vehicle becomes disabled and cannot complete the course in a within a

reasonable time period, the number of laps or partial laps completed will be used to establish its place in the event. The Competition Judges will, if necessary, determine the time at which the event will be terminated under this circumstance.

Note that the competition staff may terminate the event if weather or other conditions threaten the safety of the participants.

Scoring

The order of finish will be determined by the elapsed time in completing the required number of laps in the event. Vehicles that do not complete the course will have their finish determine by the number of laps or partial laps completed, as noted above.

Final scoring of the event will include any penalty laps or times assessed during its course.

The judges will compile the placements and rank order the results. Each team will receive a number of points corresponding to its overall place in the event, determined as follows:

- P = points earned by the vehicle
- n= number of vehicles entered into the event
- p = place in the event by the vehicle
- M = maximum possible points (40)

$$P = \{(n+1) - p\} * (M / n)$$

Teams entered in the Utility Class but not competing in this event will receive zero points.

IX. Faculty Competition

A faculty endurance event may be held at the discretion of the host organization after completion of the Multi-rider Vehicle Endurance Event. Each vehicle will complete 5 laps, which will not be timed or scored. Any class of vehicle may compete, and there are no minimum or maximum rider lap requirements. Except as noted herein, the normal Endurance Event rules will apply. This event will be administered by the Host Organization, and it will not be included in the overall competition scoring.

X. Overall Scoring

The Design Event, Sprint Events, and Endurance Event scores will be combined to determine the overall standings in each of the three classes of the Competition. The team with the greatest number of points in each class of the Competition will be declared as the overall champion of the class.

Competition Event	-----Maximum Scores-----		
	<u>Single Rider</u>	<u>Multi-rider</u>	<u>Utility</u>
Design Event	40	40	60
Sprint Event	30	30	N/A
Endurance Event	30	30	N/A

Utility Endurance Event	N/A	N/A	40
Total Score	100	100	100

In the case of a tie in the overall point count, the order of finish in the Design Event will determine the overall finish for all vehicle classes.

XI. Announcement of Results and Awards

Announcement of Results

The judges will post the results of each event of the competition as soon as possible after the completion of the respective event and validation of the collected data.

Presentation of Awards

The awards presentation will be held at the completion of the competition's final event. If the Competition Judges are to present special recognition awards (see "Other Awards" below), one of the judging team will make those awards prior to the competition awards. The host student organization's team leader or his/her designee will present the competition awards as designated below.

Competition Awards

Competition placing will be awarded as follows:

- Single-rider Vehicle Class
 - First Place: Design Event (trophy)
 - First Place: Sprint Event, Men's Category (trophy)
 - First Place: Sprint Event, Women's Category (trophy)
 - First Place: Endurance Event (trophy)
 - First Place: Overall (trophy, \$500 to team)
 - Second Place: Overall (trophy, \$200 to team)
 - Third Place: Overall (trophy, \$100 to team)
- Multi-rider Vehicle Class
 - First Place: Design Event (trophy)
 - First Place: Sprint Event (trophy)
 - First Place: Endurance Event (trophy)
 - First Place: Overall (trophy, \$500 to team)
 - Second Place: Overall (trophy, \$200 to team)
 - Third Place: Overall (trophy, \$100 to team)
- Utility Vehicle
 - First Place: Design Event (trophy)
 - First Place: Utility Endurance Event (trophy)
 - First Place: Overall (trophy, \$500 to team)
 - Second Place: Overall (trophy, \$200 to team)
 - Third Place: Overall (trophy, \$100 to team)
- Host Organization (School) (plaque, \$1,000)

As noted earlier, if more than 1 but less than 4 vehicles enter any class of the competition, the number of awards will be one less than the number of entries into that class. In addition, No monetary award will be given to an overall winner in a class, if the winner does not compete in and complete the minimum requirements in all of that class' events. Minimum requirements include submission of a design report, design presentation, at least one sprint time (not applicable for the utility class) and 1/2 the laps of the endurance event.

Other Awards

From time to time, the Judges may recognize significant achievements by one or more teams during the course of the Competition. Judges awards may include—but are not limited to the following:

- Sportsmanship
- Team Spirit
- Support of the Competition
- Design Research
- Reliability and crash worthiness
- Special Achievement

Additional awards may be suggested or provided by the host, the teams involved, or others. Such awards are encouraged in the spirit of the competition; however all such awards must be approved by the ASME judging team prior to the event. In any case, there shall be no awards or other mementos presented to the judges as a part of this competition.

XII. Clarification and Modification of Rules

These rules will be modified by the Competition Judges as necessary to maintain the competition as a challenging and rewarding experience for engineering students. No changes by any party shall be made without the written consent of the Chief Judge. Questions or recommended changes should be referred to the Chief Judge.

The current Chief Judge of the ASME Human Powered Vehicle Competition is

Dr. Corinne Lengsfeld
E-mail: clengsfe@du.edu

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Appendix 1: Registration and Documentation Submittal

The following documentation is required for registration and participation in the ASME Human Powered Vehicle Competition. The required materials should be submitted to the parties indicated in accordance with the schedule as noted.

For reference, the following lead times establish the deadlines:

Preliminary Date	11 weeks before Registration Date
Entry Date	8 weeks before Registration Date
Report Date	32 days before Registration Date
Registration Date	0

Document	Submitted by	Primary Recipient	Date Required
Preliminary entry (App. 2: Entry Registration Form)	Competing Team	Host School Chief Judge ASME Regional Office	Preliminary Date
Prelim. entry fee	Competing Team	Host School	Preliminary Date
Team photo	Competing Team	Host School	Preliminary Date
Entry Confirmation (First vehicle)	Host School	Competing Team	1 week after Preliminary Date *
Final entry (Rev. App. 2: Entry Registration Form))	Competing Team	Host School Chief Judge ASME WRO	Entry Date
Appendix 3: Certification of Eligibility	Competing Team	Host School	Entry Date
Appendix 4: Safety Certification	Competing Team	Host School Chief Judge	Entry Date
Appendix 4a (if req'd)	Competing Team	Host School Chief Judge	Entry Date
Appendix 5: Vehicle Description	Competing Team	Host School	Entry Date
Appendix 6: Acknowledgment of Rules	Competing Team	Host School Chief Judge	Entry Date
Vehicle photo	Competing Team	Host School	Entry Date
Final entry fee	Competing Team	Host School	Entry Date
Entry Confirmation (Additional veh.)	Host School	Competing Team	1 week after Entry Date *

Design Reports	Competing Team	Chief Judge Individual Judges ASME WRO	Report Date
Appendix 5: Vehicle Description	Competing Team	Chief Judge Individual Judges	Report Date
Appendix 7: Presentation Scheduling Request	Competing Team	Chief Judge	Entry date
Response to App. 4a	Chief Judge	Competing Team	1 week after Report Date *
Response to App. 6 (if required)	Chief Judge	Competing Team Host School	1 week after Report Date *
Response to App. 7	Chief Judge	Competing Team Host School	1 week after Report Date *
Final Presentation Schedule	Chief Judge	Host School Competing Teams	Registration Date
Protests (if req'd) (Appendix 8: Protests)	Competing Team	Chief Judge	At the competition
Protest Response	Chief Judge	Competing Team	At the competition
HPV Evaluation (App. 9: Evaluation and Comment)	Competing Team	Chief Judge Host School ASME WRO	Either during or after the competition Either during or after the competition Either during or after the competition

* Or 1 week after receipt of document(s), whichever is later.

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**Appendix 4: Safety Certification
Due Entry Date**

As the team leader for the following Human Powered Vehicle entry in the ASME «year» Human Powered Vehicle Competition,

School: _____

Vehicle Name: _____

Vehicle Number: _____

I certify that, except as noted in Appendix 4a,

- (1) the design and construction of the vehicle has been carried out with due consideration of occupant and bystander safety;
- (2) the design of the vehicle has incorporated
 - a. a braking system that can bring the vehicle to a stop from a speed of approximately 15 miles per hour in a distance of 20 feet or less,
 - b. a steering system that will allow the vehicle to turn within a 25-foot radius,
 - c. rollover protection for riders and stokers, and
 - d. safety belts, and, where feasible, shoulder harnesses;
- (3) the vehicle will have successfully completed tests of items 2a and 2b above before its arrival for the competition;
- (4) the vehicle has been inspected to assure that all surfaces are free from sharp edges and protrusions or that such edges and protrusions have been adequately covered with padding material;
- (5) all riders and stokers associated with this vehicle will wear helmets that meet ANSI Standard Z90.4 while operating the above Human Powered Vehicle or any other human-powered vehicle either on or in close proximity to any event course;
- (6) all riders and stokers will wear belts (and harnesses, as appropriate) at all times when the vehicle is in motion; and
- (7) all riders and stokers will have had not less than 30 minutes of riding experience in their vehicle prior to the competition.

Finally, I understand that our vehicle is subject to on-site inspection and testing and that any modification to the vehicle that reduces the safety of the design to an unacceptable level in the view of the Competition Officials may result in the disqualification of the vehicle from the competition.

Printed Name

Signature

ASME Student Member Number

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**Appendix 6: Acknowledgment of Rules
*Due Entry Date***

School: _____

Vehicle Name: _____

Vehicle Number: _____

I certify that our team has read the HPV Competition Rules.

___ **We need no further clarification and have no request for variation.**

___ **We request further clarification or variance as follows.**

Pending receipt of rules clarification or a ruling on a variance as indicated above, we agree to abide by the HPV Competition rules as stated.

Printed Name

Signature

ASME Student Member Number

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**Appendix 7: Presentation Scheduling Request
*Due Report Date***

Competition Location: _____
Vehicle Number _____
School: _____
Vehicle Name _____

Design Presentations will take place between 3:00 and 9:30 PM on **Presentation Date** at the **Presentation Site** (See site information sheet). Teams must request a range of times or a specific time for their presentation. Although every effort will be made to satisfy these requests, there is no assurance that this will be possible. If no request is made, the judges will assign a time to meet the needs of the competition.

Presentations will be scheduled on an interim basis, based on the judges' best ability to satisfy the requests (1) in the order received and (2) to meet the needs of the largest number of teams, the judges, and the overall competition, within the time constraints of the schedule.

The judges will provide an interim schedule within one week of the receipt of your request, which must be submitted with your Design Report. If a team has an unavoidable conflict with the time assigned in the interim schedule, the team should contact the Chief Judge immediately to present its case and request a rescheduling.

The final schedule will be distributed approximately one week before the Competition and posted at design presentation area. Teams must be present and ready for their presentation at the time assigned.

With this understanding, we request that our design presentation be scheduled as follows:

Within the period of _____ to _____ PM.

and preferably at _____ PM (scheduled at 10 minute intervals)

Team Leader e-mail address

Telephone: Day: _____ Night: _____

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Appendix 9: Evaluation and Comment
(Please return to the Chief Judge of the Competition)

- | | Yes | No |
|---|-------|-------|
| • Should the display of vehicles be continued during the design presentations? | _____ | _____ |
| • Was e-mail used to keep in contact with the host school ? | _____ | _____ |
| • If so, was this an effective way to get information or clarification? | _____ | _____ |
| • Was the layout of the Endurance course satisfactory | _____ | _____ |
| • Was the Sprint course (600-800/100/200 m) (a) too short __; about right __; or too long __? | | |
| • Was the Endurance event course length (a) too short __; about right __; or too long __? | | |
| • Was the Utility Endurance event course length (a) too short __; about right __; or too long __? | | |

Free Form Evaluation

What did you think worked well this year and should be continued in future ASME HPV competitions?

What would you like to see improved in future ASME HPV competitions?

What changes to the ASME HPV rules would you recommend?

Please add any other comments—either general or specific that would help us improve this competition or make it more challenging.

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Appendix 10: Utility Vehicle Design Judging Considerations

- Is the vehicle designed for everyday use?
- Does the vehicle's design allow for unassisted ingress/egress?
- Is it comfortable?
- Can it accommodate persons of varying size?
- Is it fast/efficient enough that someone would actually use the vehicle for commuting instead of driving their car?
- Can it accommodate shopping bags and parcels?
- Can it carry heavy loads—perhaps as much as 100 pounds—in addition to the rider?
- Can the vehicle operate on less-than-perfect streets or dirt roads?
- Does it have adequate ground clearance to pass over speed bumps and driveway entrances?
- Does it offer any protection from inclement weather to passengers and/or cargo?
- Are its gear ratios consistent with an ability to climb roadway grades?
- Is it visible in traffic?
- Does it have lights and/or reflectors for safe operation in low-light conditions?
- Can on-the-road repairs be accomplished with tools that you would carry with you?
- Is the design viable for mass production?

In addition, the vehicle designers should note the course description and requirements for the Utility Endurance Event, as included in Section VIII of the rules.

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Appendix 11: Roles and Responsibilities of Competition Hosts and Officials

A. Competition Officials

The Competition Officials include the following:

- Competition Director
- Competition Advisor
- Chief Timer
- Course Marshals
- Staff Assistants
- Chief Judge
- Judging Team
- Chief Official
- Chief Lap Counter
- Assistant Lap Counters
- Judging Assistants

B. Roles and Responsibilities

Host Organization

- establishes and maintains an Internet site and provides communications with potential participants, participants, ASME staff, competition officials, and the general public;
- designs the competition courses and secures the ASME judges' approval for same;
- makes all arrangements for use of courses and other facilities, including refreshments and restroom facilities at the various venues;
- makes all arrangements and supplies all materials and equipment for the competition, including communications, shelter for the judges' and timers' enclosures, flags as specified in the rules, communications equipment, boards for posting interim results, Endurance course barriers, and equipment for the Utility Endurance event;
- provides means for ready identification of competition participants, officials, and staff;
- verifies eligibility of all teams and certifications of all team members and vehicles;
- verifies all vehicle safety certifications;
- provides all awards, except for the overall championship "traveling trophy;" and presents all such awards; and
- provides staffing as required to carry out all events within the competition.

Competition Director (provided by the Host Organization)

- designs, schedules, budgets and coordinates the competition;
- secures ASME approval for the venues of the competition;
- maintains overall responsibility for all events of the competition;
- arranges for on-site facilities, staff, and equipment for all events of the competition;
- provides and certifies the testing of all timing and recording devices; and
- conducts required drivers' meetings.

Competition Advisor (provided by the Host Organization)

- represents the host school and its mechanical engineering program and
- advises the Competition Director and the Director's staff.

Chief Timer (provided by the Host Organization)

- assures the availability and proper functioning of the timing mechanism for the Sprint Event;

- records the times for the Sprint Event; and
- provides timing data to the Judging Team.

Course Marshals (provided by Host Organization)

- monitor the courses for the Sprint and Endurance Events for conditions or circumstances that have the potential for compromising the safety of participants or spectators;
- act to protect the safety of participants or spectators in the event of an accident or near accident;
- maintain control of the Sprint Event lineup;
- control access to or across the courses by participants or spectators;
- direct vehicular traffic into and out of the Endurance Event pit area;
- assist in removing disabled vehicles from the courses and obtaining assistance; and
- observe the conduct of the competition and record and report any rules infractions to the Chief Official or to any member of the Judging Team.

Staff Assistants (provided by the Host Organization)

- assist the Competition Director in all aspects of the competition and
- respond to the instructions of the Competition Director and the Judging Team.

Judging Team (provided by ASME)

- assures a fair competition throughout all events;
- provides formats for recording times, lap counts, and other data;
- times, scores, and compiles the results of the Design Event;
- scores and compiles the results of the Sprint Event;
- scores and compiles the results of the Endurance Event;
- scores and compiles the results of the Utility Endurance Event;
- determines the need for penalties and assesses same if so determined;
- examines and resolves all protests (beyond which action there shall be no appeal); and
- compiles the individual event scores into an overall score for each vehicle class.

Chief Official (provided by the Judging Team)

- maintains control of the Sprint, Endurance, and Utility Endurance Event courses;
- determines actual starting times for the Sprint, Endurance, and Utility Endurance Events;
- manages the starting process for the Sprint, Endurance, and Utility Endurance Events; and
- determines the need to interrupt or terminate any part of the competition in the interest of safety.

Chief Lap Counter (provided by the Judging Team)

- establishes procedures for lap counting during the Endurance Event;
- instructs assistant lap counters and manages the counting process;
- maintains independent lap count records;
- makes final determination of timing and lap count; and
- provides verified lap count data to the Judging Team.

Assistant Lap Counters (provided by the Competing Teams)

- assist the Chief Lap Counter during the Endurance Event;

- record lap count, clock time, driver identity and other pertinent data on a standard format for his/her assigned vehicle; and
- provide lap count records to the Chief Lap Counter immediately following the completion of the Endurance Event.

Judging Assistants (provided by the Competing Teams)

- assist the Chief Lap Counter during the Utility Endurance Event and
- record events (stops, rider changes, and package handling) during the Utility Endurance Event.

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Appendix 12: Judges' General Comment on the Competition The Rules of the Competition

A brief and simple comment on the rules: we'd like you to read them and follow them in your participation. If you think that they are not fair in any way, please give us your comments for consideration. All of us—the hosts, participants, and judges—have invested a considerable effort over the years to make this competition interesting, challenging, and fair, and we do our best to convey this to you through the rules. They describe a common basis for an impartial competition, and we have an obligation to assure that they are applied evenly and fairly.

A second comment: *read* the rules! If you don't understand them, ask the judges—preferably before you arrive at the competition site. We're prepared to answer questions, clarify, and explain. We expect you to have knowledge of the rules and to comply with them.

As an example of the consequences of not reading, not understanding, or not clarifying the rules, the rule concerning rider changes in the road event has not changed since at least 1989. In spite of that, in 1995 one team developed and implemented a rider change strategy that lay outside the rules. Other teams observed the change, and some questioned the judges immediately to confirm the rule. Other teams realized that the strategy might give them an advantage as well and followed suit. The net result was that *all* of the teams that broke the rule lost the laps that were completed in violation of the rule. First place was lost, as were other places by other teams. It was an unfortunate ending to an otherwise superb event.

Insights Into the Design Competition

Design Reports Scoring—General

The reports are due four weeks and four days before the race and almost everyone meets the deadline. Each of the judges reads each report and gives it a preliminary score in four of the five design categories (Innovation, Analysis, Test, and Safety) prior to the presentations; in the case of Utility vehicles, we also score it in that category. We usually average from one-half to one hour scoring each report. At the presentation, we consider any new information that you offer, adjust our preliminary scores, and score Aesthetics. See appendix 13 for detailed information on how the judges specifically score each section.

After all of the presentations have been completed, we meet to review each of our scores in each category for each vehicle to assure that there is consensus among the judges. If there is more than a 20% difference between the highest and the lowest scores, we discuss the reasons for the differences—just to assure that we all are on the same course. This process usually requires two to three hours to complete.

This system has been refined over many years and we think it's extremely fair. It assures that each design has been thoroughly reviewed and that—to the best of our collective ability—nothing has been overlooked.

The Competition In Context

Keep the objective of this competition in mind: to provide you with a practical engineering experience in the context of competition. Simply put, you are given the requirements for a project and you must meet them. Emphasize this practical, hands-on experience when you seek that first engineering job. It will be invaluable.

The Role of the ASME HPV Judges

In contrast with the popular image of judges, we hope that you will find us approachable during the competition. If you have questions, please ask; we'll try to answer directly. If the response is not clear, please pursue the inquiry until the answer is clear. We may want to check among ourselves to be sure of the point—particularly if it is a hard one—but we will give you a definitive answer—and one that is based on the *written* rules.

Our objectives are to assure that the competition is carried out as safely as possible; that all of the competitors have an equal opportunity; that no unfair advantage is gained by actions outside the rules; that the environment is one of good sportsmanship; and that the experience is a positive one for the competitors, spectators, hosts, and judges.

We look forward to all aspects of the competition at least as much as you do—meeting you, the engineers of the future, learning from your work, and enjoying your company. That's why most of us have been involved with it for most of its history.

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Appendix 13: Sample Judges Design Report Score Sheet¹

Score Sheet Instructions:

The following scoring sheet is to help provide a degree of uniformity in technical judging, and for students to gauge the judges expectations. Traditionally, we give each entry a score out of 20pts in each of the following categories: Innovation & design, Analysis, Testing, Safety, Practicality (only for Utility entries) and Aesthetics. Below is an explanation of the general evaluation method, however some flexibility exists to enable judges to differentiate one team from another as effective engineering does not always fit nicely into one of the individual items listed.

Innovation and design

- If the team was able to design a new vehicle from scratch they should receive 6pts. If the vehicle is a second generation one must determine to what extent they changed, extended or refined the design by adjusting the points accordingly.
- Teams must demonstrate that proper design methodology was followed listing design criteria, their objective, provide some supporting research and discuss alternatives that were considered. (6pts)
- Finally, teams that step out on the limb and provide significant innovation in design, testing, analysis etc must be appropriately rewarded for thinking outside the box. (6pts)
- Judges discretion: can be used to grade the quality of the writing and organization of the report. (2pts)

Analysis

- Each team must prove that the roll over protection they installed on their vehicle was equivalent to 1.5 inch diameter, 0.049 inch thick chrome-molybdenum steel. Most teams do not use this exact material and therefore should have presented a calculation demonstrating the equivalence. (5pts)
 - Modern students all have access to computational engineering tools such as Fluent or various FEA applications. Therefore we should now expect teams to have included some sort of computational analysis of their vehicle this may include a Fluent calculation (computational fluid mechanics) to determine best fairing shape, or FEA analysis for the frame structure or axle. (5pts)
 - An additional calculation considering biomechanics, the steering mechanism (especially three wheel bikes), vibration modes, suspension, or etc should also be included. (5pts)
 - Finally were the findings of these analyses used within the design process or done post design. True engineering use analysis up front to make design decisions, not as a back end tool. (5pts)
- ***NOTE: To obtain all 5pts in each of the first three bullets remember the analysis must be sound.

¹ This score sheet is based on the one used in 2001 and may change slightly from year to year

| Indicates changes for 2004

Testing

- Not all design decisions can be made using the analysis tools students have available. Some design decisions must be made using information collected from their own testing systems. Here we want to see if the students can develop a sound testing procedure to collect quantitative data and analyze the data effectively to make good design decisions. Or several assumptions will be required to simplify their design problems sufficiently to conduct the analysis in the above section. However, subsequent testing would be required to determine the validity of the analysis. Here we want to see if the students took the time to verify their analysis with quantitative data. Did it agree, why or why not? (10pts)
- Testing of the bike after fabrication to optimize performance is an essential step in the engineering design process. Again did students develop a sound testing procedure to collect quantitative data and analyze this data effectively to optimize the design after fabrication. (10pts)

Safety

The safety section can not always be determined up front, this score will likely be modified the night of the presentation.

- There are 6 obvious safety considerations (3pts each): shell, frame, seat belt, side protection, roll over protection, and visibility. The score card asks what type of material was used for each of these safety features. Obviously a steel frame is extremely safe unless the welds are so poor that the vehicle appears to be on the brink of falling apart. In this case the team would likely not get much of the 3 points available for that safety item.
- Judges discretion (2pts)

Practicality (Utility only)

Again over time, 7 essential traits have appeared in practical vehicles. What makes a vehicle practical? The question one might ask is would (not could) grandma drive this vehicle to the grocery store and back for her weekly needs.

- Weight - if the vehicle is extremely heavy grandma will not be able to drive up hill (3pts)
- Storage capacity – does it fit grandma’s groceries, can grandma get items in and out easily (3pts)
- # of wheels – will grandma be able to manage the vehicle at a stop light easily (3pts)
- Clearance – will the vehicle high center on a speed bump, can she get in and out easily (2pts)
- Visibility - is the vehicle visible to other motor vehicle drivers (3pts)
- Lights, mirrors and other accessories - does the vehicle provide other amenities, such as those need to drive in adverse weather or at night (3pts)
- Speed – if the vehicle is not able to sustain speeds of residential street traffic, grandma will get run over by other vehicles and annoy neighbors (3pts)

Aesthetics

This category is truly up to the individual judges and will only be assessed during the presentations

Vehicle # _____	Location: _____
Vehicle name _____	Report mailed: _____
School _____	Report arrived: _____

Innovation and design	Score =
<u>Innovation (6 pts max)</u> New design or recycled <u>Design methodology (6 pts max)</u> design criteria objective supporting research alternatives discussed <u>Significant Innovation (6 pts max)</u> "Great Leap Forward" <u>Discretionary Points (2 pts max)</u>	

Analysis	Score =																				
<table border="1"> <thead> <tr> <th>Type</th> <th>Soundness</th> <th>*Post/Pre</th> <th>Resulting decision</th> </tr> </thead> <tbody> <tr> <td>Roll over protection (5 pts max)</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Use of computational tools (5 pts max) FEA, Fluent, etc</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Additional Calculations (5 pts max) biomech, steering, vibr, susp.</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Use of calcs in decision process*</td> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p>*Post/Pre asks whether analysis was done before or after design decision was made.</p>		Type	Soundness	*Post/Pre	Resulting decision	Roll over protection (5 pts max)				Use of computational tools (5 pts max) FEA, Fluent, etc				Additional Calculations (5 pts max) biomech, steering, vibr, susp.				Use of calcs in decision process*			
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Testing	Score =																
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Indicates changes for 2004