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RULES FOR THE

2010 HUMAN POWERED VEHICLE CHALLENGE

Sponsored by

ASME

SETTING THE STANDARD

Rules for the
2010 Human Powered Vehicle Challenge
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I General Information

A) *Objective* To provide an opportunity for engineering students to demonstrate application of sound engineering design principles toward the development of efficient, sustainable, and practical human-powered vehicles.

B) *Superiority of Rules* These rules have been established by the ASME's Human Powered Vehicle Challenge (HPVC) Committee. 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.

C) *Location* Three competition sites are planned for 2010 – HPVC East, HPVC West, and HPVC Latin America. Teams wishing to participate should consult the HPVC website or the ASME HPVC Community on ASME's Peerlink pages.

HPVC:
http://www.asme.org/Events/Contests/HPV/Human_Powered_Vehicle.cfm

HPVC Community:
http://peerlink.asme.org/COP/ASMEHumanPoweredVehicleChallenge

D) *Schedule Summary & Host Information* The ASME HPVC web site and each host web site shall specify all the important dates and contact information for the relevant competition.

E) *Competition Summary* The competition shall include four events: a design event, a sprint or drag race event, a utility endurance event, and a speed endurance event. Scores from each event are totaled to obtain the overall score for each vehicle class. The overall competition winner must compete in all four events. Speed class winners compete in all events except the utility endurance event.

F) *On-Site Schedule* On-site registration begins on Friday morning of the competition. All teams must register in person before the end of the registration period. The registration times shall be posted on the ASME HPVC web sites.

Design presentations and safety checks shall take place throughout the day on Friday. Each team will be provided with a presentation/safety check time block. It is the responsibility of each team to be ready at the start of their assigned time block.

The sprint or drag race will take place on Saturday morning, followed by the Utility Endurance Event Saturday Afternoon. The Speed Endurance event shall take place on Sunday Morning.

II General Rules of Competition

A) *Classes of Vehicles* For scoring purposes, vehicles compete only against vehicles in the same class. The competition shall recognize the following vehicle classes:

- Unrestricted: The vehicle competes in all events with no restrictions.
- Speed: The vehicle is designed for non-utilitarian speed events only. It shall not participate in the utility endurance event and shall not receive a design score for practicality.

> *Chief Judge's Note:* For 2010 there will be no distinction between multi-rider and single-rider vehicles in either class. Multi-rider vehicles are still legal, but will compete in the same class as single-rider vehicles.

B) *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 granted for overall placement in that event shall be one less than the number of vehicles in the class.

Further, no prizes or prize money will be awarded to the winner of a class unless the vehicle completes all competitions for that category. In the endurance events, a vehicle must complete at least 10 kilometers in order to meet this requirement.

C) *Events of the Competition*

- Design Event: Teams are scored on their application of sound engineering principles and practices toward a vehicle design.
- Men's and Women's Sprint or Drag Event: Teams are scored on the speed of their vehicles, either in a 100 meter sprint with flying start or a head-to-head drag race from a standing start. The ASME HPVC Committee will announce which event will be held well in advance of the competition. Separate scores for male and female riders are recorded for this event.
- Utility Endurance Event: Teams are scored on the practicality, performance and reliability of their vehicles in a typical urban transportation role.
- Speed Endurance: Teams are scored on the speed and reliability of their vehicles.

D) *Energy Storage Devices* Unrestricted-class vehicles are encouraged to use regenerative energy storage devices when competing in the Utility Endurance event. Energy must be stored while the vehicle is in motion, with human power as the sole external source of energy. Prior to 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 will not be allowed to utilize the energy storage device in the competition.

No energy storage devices of any kind may be included in speed-class vehicles. No device—such as a spring, compressed air container, or thermal or electrochemical storage device—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 permitted, provided that their design is not primarily influenced by energy storage considerations.

E) *Modification of Vehicles* To be considered for an overall prize in any class, a vehicle must complete all events in the vehicle class for which it is entered. Modifications to the vehicle are allowed between events, as long as safety is not compromised. Vehicles must retain at least 60% of their features between events. Any vehicle deemed to have undergone changes in excess of this allowance will be allowed to compete if it does not present a safety risk; however, any scores achieved will not be credited to the original entry.

F) *Aerodynamic Devices* Each vehicle shall include components, devices, or systems engineered specifically to reduce aerodynamic drag. Front fairings, tailboxes, and full fairings are allowed. Other devices may be permitted providing they clearly demonstrate that the device or system significantly reduces aerodynamic drag. The effectiveness of such devices must be justified in the design report.

Fairing configurations may be changed between events in accordance with **Section II.E** provided that all safety requirements, including the seat belt and RPS rules, are met.

G) *Vehicle Number and Logos* ASME shall assign each vehicle a number. The number "1" will be assigned to the overall unrestricted-class winning vehicle from the prior year's competition. All other numbers will be assigned by ASME based on the order of completion of final registration (including fee). At its discretion, ASME may consider requests for specific vehicle numbers, but no zero or triple digit numbers will be allowed.

The vehicle number, school name, and ASME logo must be clearly visible from both sides of the vehicle. Each vehicle shall provide space sufficient to display this information on each side of the vehicle. This space may include fairings, cargo containers, or surfaces especially designed for this purpose.

If the vehicle number, school name, and ASME logo become lost, obscured, or difficult to see from either side of the vehicle, the vehicle shall be removed from

the competition until they are restored. If a vehicle number is obscured during an endurance race, any laps run without a number will not be counted.

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.

ASME shall provide stickers with numbers and the ASME logo that meet the requirements of this part. The stickers will be given to the team during the on-site registration process.

H) *Team Website* All participating teams are encouraged to create a website including basic information about the team and its entry. Each team's website should include, but is not limited to, the following information:

- School Name
- Team Name/Vehicle Name
- Team/Vehicle History (if any)
- Plans for Competition
- Design Innovations (optional)
- Team members and biographies (optional)

Please note that any conduct in violation of ASME's Code of Ethics will not be permitted, and will result in the offending team being scored as a non-competitor in all affected events.

I) *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.

J) *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. 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 event being protested and the specific rules infraction, or the perceived error in the scoring of an event. ASME HPVC Form 7 may be used to file a protest. This form is available on the HPVC website or from HPVC officials.
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.

K) *Event Scoring* The rank of each team is determined according to the rules of each specific event. Points for each event are awarded based on rank according to the following formula:

$$\text{Points} = \{(n+1) - r\} \times \frac{M}{n} \qquad (1.1)$$

1) n= number of vehicles entered into the event
2) r = rank in the event by the vehicle
3) M = maximum possible points for the event

III Safety

A) *General* 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 those 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 ASME and the Judging Team, determines that such action is necessary in the interest of safety.

B) *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.

C) *Rollover Protection System* All vehicles must include a rollover protection system (RPS) that protects all riders in the vehicle in the event of an accident. Functionally, the RPS must 1) absorb sufficient energy in a severe accident to minimize risk of injury, 2) prevent significant body contact with the ground in the event of a fall (vehicle resting on its side) or rollover (vehicle inverted), and 3) provide adequate abrasion resistance to protect against sliding across the ground. In addition, the RPS shall meet the top and side load requirements described below.

1) <u>RPS Load Cases:</u> The RPS system shall be evaluated based on two specific load cases – a top load representing an accident involving an inverted vehicle and a side load representing a vehicle fallen on its side. In all cases the applied load shall be reacted by constraints on the vehicle chassis in locations that represent the actual chassis loading in an inverted or side position with riders strapped in and clipped in to the pedals.

(a) Top Load: A load of 600 lb shall be applied to the top of the roll bar, directed downward and aft (towards the rear of the vehicle) at an angle of 12° from the vertical.

The roll bar is acceptable if 1) there is no indication of permanent deformation, fracture, or delamination on either the roll bar or the vehicle frame, 2) the maximum elastic deformation is less than 2.0 inches and shall not deform such that contact with the rider's helmet, head or body will occur.

(b) Side Load: A load of 300 lb shall be applied horizontally to the side of the roll bar at shoulder height.

The roll bar is acceptable if 1) there is no indication of permanent deformation, fracture or delamination on either the roll bar or the vehicle frame, 2) the maximum elastic deformation is less than 1.5 inches and shall not deform such that contact with rider's helmet, head occurs.

2) RPS Attachment The RPS must be structurally attached and braced to the vehicle frame or fairing and, with the vehicle in the upright position, must extend above the helmeted head(s) of the rider(s) such that no part of any rider will touch the ground in a rollover or fall over condition. The RPS may be incorporated into the fairing, providing that that part of the fairing is used in all events. Teams must demonstrate that the RPS meets both functional requirements and loading requirements.

D) *Safety Harness* All riders of all vehicles in all classes and events will be secured to their vehicle by safety belts and, where feasible, shoulder harnesses at all times that the vehicle is in motion. Commercially available seat belts and harnesses designed for automotive, aviation or racing applications will generally be accepted without test data for the straps and buckles. Test data for attachment points may still be required.

1) Custom Fabricated Harnesses If the harness is custom fabricated by the team or a commercial entity not in the business of producing harnesses or webbing products designed for use in life supporting application (ie. climbing, racing, automotive) Significant test data will be required as defined below.
   - Hand stitching of webbing is not acceptable under any situation. Machine stitching will be acceptable with supporting test data.
   - Webbing connections secured with a properly tied water knot will be accepted without test data.
   - The minimum acceptable width for harness webbing is 1" (25mm).

2) Testing requirements for non-commercially produced harnesses
   - Tensile test samples of a stitched joint must be prepared in an identical manner to the intended production method including: Base webbing material, thread, stitching pattern and quantity.
   - Tensile tests performed on a minimum of 5 samples must show a 95% statistical confidence of an ultimate strength in excess of 750lb.

3) Testing requirements for off application buckles
   - Off application is defined as a buckle designed for anything other then a life supporting applications (automotive, aviation, climbing, etc.). Other buckles designed for life supporting applications will be accepted without testing documentation.
   - Plastic buckles of any type are not permitted.
   - Tensile tests performed on a minimum of 5 samples must show a 95% statistical confidence of an ultimate strength in excess of 750lb.

E) *Exemptions* Any team may request an exemption from rule **Section III.C** or **Section III.D** (HPVC Form 4). The request must be based on the safety of the rider or general public, and must be submitted in writing to the Chief Judge no later than the Entry Registration Date. The request must convincingly argue that safety is enhanced by omitting the safety harness and/or the RPS. Waivers will generally not be granted for fully faired vehicles, recumbent vehicles, or vehicles with three wheels. Requests for waivers will be granted or denied by the judging committee, 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 without safety harnesses and rollover protection, but only after a waiver is requested and granted.

F) *Vehicle Hazards:* 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.

G) *Clothing and Protective Equipment* All participants must wear appropriate clothing and helmets that meet CPSC Safety Standard for bicycle helmets (16 CFR Part 1203) while:
   - warming up or orienting themselves on any event course,
   - riding in the Sprint, drag race, Endurance Events, and safety check, and
   - riding any competing vehicle or other human-powered vehicle on or in close proximity to an event course.

   Note that this requirement applies to all participants riding any HPV or bicycle, including personal vehicles.

H) *Required Safety Test of Energy Storage Devices* Unrestricted-class vehicles that utilize energy storage devices shall specifically address the safety of the device or system in the design report and during the safety inspection. In particular, safety in the event of a high-speed accident shall be addressed. Teams whose vehicles present an unacceptable risk in the perception of the judges will not be allowed to utilize the energy storage device in the competition.

I) *Safety Certification* Participating teams must certify (HPVC Form 3) 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. Each team shall present a ride log at registration that clearly indicates the operator's name, date, duration in hours and minutes, and location for each ride or vehicle test used to satisfy the safety certification requirement.

J) *Safety Inspection and Demonstration* The judging team shall oversee tests of each vehicle's ability to meet the braking, turning and forward motion requirements. Each vehicle shall be visually inspected by the judges to ensure that no hazards exist that are likely to cause harm to the driver, passengers, competitors or pedestrians. Potential hazards include but are not limited to defects or play in the steering system, sharp edges, open tube ends, and pinch points. In addition, the vehicle must provide the rider with a field of view of at least 90° to right and left of vehicle front and center. During the safety check, teams are responsible for providing start and catch assistants if they are required.

The rollover protection system, if required, must appear substantial and correctly installed. The tallest rider on the team must sit in the vehicle and demonstrate the roll bar assembly extends beyond the rider's helmeted head and shoulders.

The safety check will take place during the scheduled safety inspection time block (within one hour of the end of the presentation time block.) No vehicle will be allowed to participate in any race unless it has successfully completed the safety check. Any team that fails the safety inspection may petition the safety judge for a re-inspection at a later time. Such re-inspection will be granted at the sole discretion of the safety judge based on available time. If the re-inspection occurs after the designated inspection time block for that team, the team shall be assessed a 10% design score penalty. In no event shall safety re-inspections take place after the end of the final safety inspection time block.

K) *Modifications Affecting Safety* Modifications to vehicles between events of the competition must not compromise the safety of the vehicle. If the competition officials determine that any modification has reduced the safety of the design to an unacceptable level, the vehicle will be disqualified from the affected event of the competition.

L) *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

A) *Team Eligibility* Entry in the Human Powered Vehicle Challenge is limited to colleges and universities having active and current student sections of ASME.

B) *Team Member Eligibility and Certification* All members of the respective school's team must be current student members of ASME and enrolled as full-time students in an engineering program of study at that school. Any individual that has been enrolled as a full-time student in an engineering program of study during the previous semester or quarter, but who graduated no earlier than six months prior to the competition date, is eligible to fully participate in the ASME HPVC.

Names, ASME membership numbers, and academic majors of all team members must accompany the final entry submission and must be received by the entry date using HPVC Form 2. In addition, all competitors must bring photo identification and current ASME membership cards to the competition.

The team roster must clearly identify all designated riders. Only those individuals thus identified and certified will be allowed to participate as vehicle drivers at any time during the competition.

C) *Verification of Team Rosters* Each team roster must be signed by the respective school's current ASME student section advisor. Copies must be submitted to ASME for verification of ASME membership. ASME may, at its discretion, submit a copy of any team's roster to the respective school's registrar's office for verification of enrollment and academic major.

D) *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. All student team members shall be listed on the team's certified roster. Construction of the vehicle may include the assistance of outside vendors where the required capabilities exceed those available at the school.

E) *Rider Requirement Exceptions* All events except the design event require that teams have at least one complete crew of each gender. Significant penalties are incurred for teams that do not meet this requirement, as described in the rules for each event. An exception to the eligibility rule may be granted to allow riders to compete for a school other than that in which they are enrolled, as described below. No other exceptions will be allowed.

If a participating school's roster can not support at least one complete crew of each gender, that school may request the voluntary participation of one or more riders from other participating schools, provided that the volunteer 1) is included on the respondent's roster, 2) will not participate in the same event for the respondent, and 3) 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 applicable event. Scores derived in this manner will be credited to the requester.

F) *Submittal of Final Entries* Final entries must be received by the published entry date and must include the following:
- A completed entry form (HPVC Form 1)
- The registration fees
- Identification and certification of eligibility of team members (HPVC Form 2)
- A signed certification of vehicle safety (HPVC Form 3)
- If required, a Safety Exemption Request (HPVC Form 4)
- An acknowledgment of understanding of the rules, or requests for clarification or variance (HPVC Form 5)
- A description of the vehicle (HPVC Form 6)

G) *Late Entries* At its sole discretion, ASME may consider entries received after the entry date.

H) *Entry fees* The entry fees for the competition may differ depending on site (especially for the international sites). The specific fees will be specified on the competition website.
- First vehicle entered by a school: First Fee (including deposit)
- Additional entries by a school: Additional Fee (including deposit)

I) *Limitation of Entries* The total number of vehicles entered shall be limited to 40.

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, and (3) other additional entries from schools already entered.

J) *Appeal of Declined Entries* Appeals of declined entries must be submitted in writing to the HPVC Committee Chair. He or she may request the consultation of the others in reviewing the decision.

K) *Refund of Entry Fees* If an entry is not accepted, all fees, including the deposit, will be returned. If a school requests a cancellation of an entry and refund of the entry fee 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.

ASME may decline to refund any or all entry fees 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.

L) *Notification of Acceptance* Notification of acceptance of the first entry in each vehicle class will be sent within one week of receipt of the Entry Registration Form. Notification of acceptance of additional entries from the same school will be sent not more than one week after the entry registration deadline.

M) *Competition Information* The following information, or a URL for a website that contains this information, shall be provided to each approved entrant at the time of notification of acceptance:
- A vehicle number
- On-site registration location and time
- The final rules for the competition
- A course map for the Sprint Event or the Drag Race Event, as appropriate
- A course map for the Utility Endurance Event
- A course map for the Speed Endurance Event
- Lap lengths for the endurance event courses
- A map showing the location of the various events
- A schedule of events

N) *On-Site Registration* All competitors must register on-site with the host school competition committee before participating in the competition. Registration location and time shall be provided to teams at the time of acceptance. All competitors are expected to bring, and present if requested, photo identification and their ASME membership cards.

During the on-site registration process teams may:
- Request changes in the team roster for verification
- Present photo identification and ASME membership card for verification
- Receive identification for each participant (arm stamp, wrist bracelet, etc.)
- Confirm their assigned vehicle numbers
- Receive a final schedule, including times, locations and other event information.

O) *Late registration* Late registration will only be possible if prior arrangements have been made with ASME.

V. Design Event

A) *Objective* To provide teams the opportunity to demonstrate the effective application of established principles and practices of design engineering to the development of their vehicle.

B) *Description* The Design Event includes two parts: the written design report and the oral design presentation. Failure to submit a design report will result in a team not being scheduled for a presentation. If a team fails to complete either part of the design event, their vehicle will be judged as a non-participant. This condition will not affect the vehicle's participation in the other events, provided that the vehicle successfully completes the safety inspection.

C) *Design Report T*he 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. The design report must clearly display the vehicle number in the upper right corner of the cover page.

Reports should emphasize clarity both in presentation and in the statement of results and conclusions. Report writers should note that bulk is not a desirable feature; therefore, reports have a 30 page maximum limit (including text, figures, tables, references and appendices). Photographs and drawings are encouraged where beneficial in documenting unique features of the design.

Teams are expected to comply with ASME's Code of Ethics in the creation of their reports. A copy of the current judges score sheet shall be placed on the HPVC website in order for teams to optimize their design score.

The report style, including citations and references, shall comply with ASME Journals Digital Submission Tool Guidelines and Information: Writing a Technical Paper or Brief. These guidelines can be found on-line at:

http://journaltool.asme.org/Help/AuthorHelp/WebHelp/JournalsHelp.htm#Guidelines/Getting_Started.htm

D) *Design Report Organization* The design report shall be organized in accordance with the design report score sheet (see the HPVC website). It shall include the following sections:

1) Abstract The abstract summarizes the design features and supporting work; its length should be no more than 1 page.

2) Design Description The design description section includes appropriate background information, design objectives, design criteria, and design alternatives that were considered. It should clearly demonstrate that established design methodologies, including structured design methods, were effectively used during the vehicle design process. Established Design for X (DFX) procedures and methods should be documented, where X could be manufacturability, environment, cost, etc. Any innovation that contributes to the art of HPV design or manufacture should be clearly identified.

3) Analysis The analysis section summarizes the engineering evaluation of the vehicle's performance and structural viability as related to the design criteria outlined in the description. For each analysis documented, the objective, modeling method and assumptions, results, and conclusions should be clearly indicated. Conclusions should describe how the results were used to improve the vehicle, i.e. what changes were made as a result of the analysis. This section should include a structural analysis of the rollover and side protection system, and analyses demonstrating theoretical effectiveness of aerodynamic devices. It should also contain examples of computer-aided analyses such as FEA, CFD, etc., and examples of additional calculations and analyses used in

the design process. In all cases, sufficient examples should be included to indicate the extent to which analyses were used in the design process.

This section should also 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 production run cost estimate should include capital investment, parts and materials, labor, and overhead for a 6 year production run.

4) Testing The testing section includes a discussion of any physical tests conducted to develop the design or to verify it. For each test, the objectives, methods, and results should be clearly described. Test results should be compared with design specifications and analytical predictions. Sufficient examples should be included to demonstrate the extent to which physical testing was used during the design process. This section should include a structural test of the rollover and side protection system, developmental testing to develop or verify the design, and performance testing (post prototype) to evaluate and optimize vehicle performance.

5) Safety The safety section includes an analysis of potential hazards to 1) vehicle occupants, and 2) bystanders. Features, components, and systems designed to mitigate hazards should be described. Of particular interest is how established engineering principles were used to design safety systems.

6) Practicality The practicality section applies to Unrestricted vehicles only and addresses the overall usefulness of the vehicle in routine tasks, such as shopping and commuting. Because human-powered vehicles are used for many diverse utilitarian tasks, this section should clearly show:

   - Objectives: Objectives of vehicle with respect to practicality should be clearly stated. Utilitarian functionality should be clearly defined.
   - Environment: The region of the country, type of operating environment, design conditions (weather, salt, dust, etc.) and maintenance schedules should be clearly defined. Teams must choose between the host school region and their home school region.
   - Design Solutions: Clearly show vehicle components and systems selected or designed to achieve the utility objectives and meet environmental requirements. Show how engineering principles were used to develop these solutions.
   - Effectiveness: Demonstrate the effectiveness of the design solutions and describe assessment methods used for the evaluation of utilitarian components and systems.

E) *Previous Work* The report should only include work done during the current academic year. The report should clearly indicate if the documented design work is for a new vehicle design or improvements to a previous design. To be considered a new design, the vehicle must be substantially different from previous entries by that team. A substantially different vehicle has a significantly different objective, or is registered in a different (not additional) class, or has a significantly different design solution. 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. Extracts from previous design reports may be included, but such material must be clearly identified and referenced as having been done prior to the current year's effort. Scoring is based solely on the current year's work.

F) *Design Report Submittal* The design report must be submitted electronically to ASME no later than the Report Date. The Report Date is normally 32 days prior to the competition, but may be changed at the discretion of ASME. See competition website for dates specific to each competition.

G) *Late Reports* Design reports will be accepted up to 25 days past the published Report Date, subject to a 4% penalty per day the report is late. Teams that do not submit reports within 25 days after the Report Date will not be eligible for participation in the design event.

H) *Oral Design Presentation* The oral presentation provides an opportunity for teams to discuss the design process and to highlight the special features of its vehicle. The presentation should emphasize design activity that has taken place since the report was submitted. Vehicle testing is often of particular interest to the judges.

The outline of the presentation should follow that described for the design reports. Brief summaries of work contained in the report are appropriate, however, emphasis should be place on analyses, and testing completed since the report was submitted. Teams should ensure that all applicable points in the Judges' Score Sheet are addressed either in the report or in the presentation.

Visual aids are encouraged to the extent that the presenters wish to use them. The host organization will provide a projector and screen for use by all competitors. Due to time constraints, teams are encouraged to limit the number of presentation slides to five (excluding the title slide.)

I) *Oral Presentation Duration* Oral presentations shall last no longer than five minutes; at the end of this period, no further presentation will be allowed. Immediately following the presentation, the judging panel will have three minutes to question the speaker(s). Only the judges will be allowed to ask questions.

J) *Vehicle Display* An area adjacent to the presentation site (see competition website) will be designated for static display of the vehicles. Teams must have the vehicle in the static display area during their entire scheduled presentation time block. At least one team member must be present with the vehicle during this period, and it is recommended that each team display at least one poster that explains the vehicle's design and construction.

During the static display time, it is expected that other participants and the competition judges will tour the display area. The judges may also review the display and inspect the design features of any vehicles for which a design report was not received.

K) *Design Scoring* Design scoring is based on the extent to which established engineering design principles were applied in the design process and effectiveness of those design practices used. Scores should also reflect the effectiveness of the report and presentation in communicating the design process and solution. Design teams must address each of the specified topics in order to receive a score for that topic. Design scoring for all vehicles shall be as follows:

Subject Area	**Percent of Score**
Design Innovation	25%
Analysis	15%
Testing	15%
Safety	15%
Practicality	20%
Aesthetics	10%

Report Section	Points	Fraction	Weight
Innovation & Design	20	0.25	1.25
Analysis	30	0.15	0.83
Testing	35	0.15	0.57
Safety	20	0.15	1.00
Practicality	45	0.20	0.00
Aesthetics	10	0.10	1.00

L) *Design Score Penalties* In addition to those previously described, penalties may be imposed by the judging team for failures to comply with the rules of the Design Event. Penalties will be assessed according to the following table in cases where an unfair advantage might have been gained or the Judges' ability to evaluate a design has been compromised.

Rules Infraction	**Maximum Penalty**
Report content largely non-original	Event “non-participant”
Late for presentation	5%

M) *Overall Design Scoring* The judges will compile the design scores including any penalties, and rank order the results. Each team will receive points based on its rank, determined using Equation (1.1).

VI. Sprint Event

A) *Objective* To provide teams the opportunity to demonstrate the speed of their vehicles.

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

C) *Duration* The Sprint Competition will normally continue for four hours. However, this time may be either extended or curtailed as deemed necessary by the Chief Judge.

D) *Sprint Course Description* The host organization will be responsible for selecting the course and securing approval from 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 400 to 600 meter "run-up" section and followed by a "run-down" section at least 200 meters in length. Where possible, the length of the “run-up” should be maximized.

The beginning of the run-up shall be marked by a starting line. All vehicles in line for a run shall remain in a marked staging area until directed by the Chief Official to move to the starting line. 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:

- Staging area
- Starting line
- Release line
- 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

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

F) *Tally Board T*he Host Organization will provide and staff a "tally board" on which vehicle speeds and standings can be posted. The "tally board" will be separated from the timing area.

G) *Drivers Meeting* All drivers who will participate in the Sprint Event must attend the 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.

H) *Starting Order* The first round of sprint attempts will be in the numerical order of the vehicles to the extent possible. Subsequent starts will be on a "first ready, first started" basis. Teams will be notified of their staging order three-deep in line.

I) *Line Position Forfeiture* Each successive vehicle will have 15 seconds to begin a sprint attempt after the Chief Judge 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 must reenter at the end of the line.

J) *Start Assistance* Start assistance will be limited to holding the competing vehicle upright and stabilizing it as it begins its run; 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, and all assistance must end within the first 10m, which will be marked.

If the starting official determines that a vehicle has received start assistance in excess of that allowed by these rules, a mis-start may be declared. The mis-start shall be made known by a single blast of a horn or whistle, or as announced at the Driver's Meeting. This will occur before the vehicle reaches the "300 meters to time trap" marker.

K) *Number of Attempts* During the Sprint Event each vehicle will be allowed to make as many runs as time and 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 take advantage of every opportunity to maximize their number of runs, or selectively pass opportunities. Such strategies should consider that foregone opportunities may not be regained.

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.

L) *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. Delays or terminations will be determined by the Chief Judge with the help of the Judging Team and the Competition Director.

M) *Scoring* The Sprint Event is scored separately for each gender. Thus each vehicle will have two sprint scores, one for male riders and one for female riders. The vehicle rank (for each gender's event) is determined solely by the highest speed attained for a vehicle in any single run. The male sprint and female sprint events shall be run concurrently.

VII. Endurance Events – Rules Common to Both Events

A) *Objective* To provide teams the ability to demonstrate the functionality, agility, and durability of their vehicles.

B) *Description* The endurance races are lengthy, timed races with multiple laps around a closed course. Each team shall include multiple riders of both genders. The races are run for a pre-determined time, with all classes competing simultaneously.

C) *Assistant Lap Counters* Each competing team must provide one assistant lap counter as a scoring assistant to count and record laps in each endurance event. No score will be tabulated for any school that does not provide an assistant lap counter. Lap counters will be provided with a lap counting sheet on which to mark the time each lap is completed, the driver's gender, and the times of rider changes. Assistant lap counters shall have a watch with time of day and an operable pen.

D) *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.

E) *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.

F) *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.

G) Rider/Stoker Requirements

- Minimum distance for any rider: the number of laps nearest 5 km
- Maximum distance for any rider: the number of laps nearest 20 km
- For multi-rider vehicles, the minimum distance also applies to same-gender crews, i.e. at least one male-only crew and one female-only crew must complete the minimum distance. Otherwise, mixed-gender crews are permitted.
- A team may include any number of riders as long as the distance-per-rider requirements are met.
- All laps by an individual rider must be continuous – that is, all riders must complete their laps in sequence, uninterrupted by any other rider, and may not ride in that event further.

H) *Single-Gender Teams* Vehicles without riders of both genders shall be held at the start line for 15 minutes, after which they may proceed with the competition as usual.

I) J*udging 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.

J) *Drivers' Meeting* All drivers who will participate in either Endurance Event must attend the mandatory Drivers Meeting for that event. Drivers meetings will take place approximately 45 minutes prior to the scheduled start of the race. The meeting will clarify operating procedures and signals and will identify course features, hazards, and landmarks.

K) *Course Practice* The road course will be opened by the Chief Judge 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, on competing vehicles or otherwise, must wear helmets meeting the approved standards for the competition.

L) *Starting Order* Vehicles shall start each endurance race in the order of finish for the female sprint or female drag race. Vehicles with no female sprint or drag race score shall be placed at the end of the starting line up.

M) *Mechanical Malfunctions at Start* 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 safe and orderly start of an event may result in a penalty against the responsible team.

N) *Signals* Flags will be provided by the officials for use by competition officials as follows:

Flag Color	**Usage**
▪ 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	Less than 10 minutes remaining in the race
▪ 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.

O) *Disabled Vehicles* The first concern following any accident must be the safety of the rider. Once it has been determined that the driver is not injured, disabled vehicles 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 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 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.

P) *Fouls and Penalties* The Chief Judge or the Judging Team will determine whether a foul has occurred and 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: Require a pit stop to remedy the violation.
- Safety violations: Subtraction of one or more laps from the team's total lap count.
- Lap requirement violations: deduction of one lap for each improper lap.
- Conduct violations:
    - First violation: A minimum of a 15-second delay in the 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;
    - Third violation: Disqualification

Violations and 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.

Q) *Interruption* The Endurance Events will normally run continuously. However, obstruction of the course, an emergency, hazardous weather, or other 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.

R) *Termination* The endurance events shall be run for 2.5 hours. At that time, all vehicles still in the competition will be permitted to finish the lap they are currently on. A "sweep" vehicle will enter the course and complete one lap. The sweep vehicle shall not pass any operable competing vehicles on the course, nor shall any competing vehicles pass the sweep vehicle. At the completion of the lap by the sweep vehicle, the event will be declared complete.

When the official race clock reads 2:20, the white flag shall be placed on prominent display near the judge's area, and will remain there until a race time of 2:30. At that time, the white flag shall be replaced with the black and white checkered flag.

S) *Scoring* Vehicle rank in the endurance event is based on average speed. Average speed is computed as

$$V_{AVG} = \frac{\text{Number of Laps Completed} \times \text{Lap Length}}{\text{Actual Finish Time}}$$

Average speeds for vehicles that do not complete the race will be calculated using the time corresponding to course closure (the end of the race.)

VIII. Utility Endurance Event

A) *Time and Place* The Utility Event will take place on Saturday following the Sprint Event at the location specified by the host organization.

B) *Utility Endurance Course* The Utility Event shall take place on a closed-loop course 1 to 2 km in length. The start area shall accommodate a LeMans-style start, including a broad, straight section immediately preceding the start line. This area shall be broad enough to ensure a safe start. The start area will include a designated driver start area at least 10 meters from the locked vehicles parked in preparation for the start. The pit area should be located after, but in relatively

close proximity to the start line. Obstacles designed to demonstrate the utilitarian nature of the vehicles shall be provided on the course, as described below.

C) *Obstacles* Obstacles shall include:
- A driveway entry ramp, typical of city or campus ramps;
- A speed bump per specifications below
- A stop sign, requiring a vehicle to come to a complete stop and to hold that stop for as much as 5 seconds; and
- A "head-in" parking and parcel pickup area, of such size that the vehicle cannot be turned around within the area.
- A simulated rain shower (water hose sprayed on vehicles as they pass.)
- Up/down grades (hills) (if local terrain permits.)
- A tight hairpin turn of approximately 180 degrees.
- A slalom section consisting of a series of tight turns.
- A section of rough pavement or gravel surface is encouraged for this event, but should not occur in the same location as other obstacles.

The specifications for the speed bumps and driveway ramps are summarized as follows:

Obstacle	**Height (Minimum)**	**Length (Minimum)**	**Width (minimum)**
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.

D) *Start of Utility Endurance Event* Female riders shall begin the Utility Endurance Event. The Utility Endurance Event shall begin with a LeMans style start. All vehicles shall be locked and parked diagonally on one side of the race course. Drivers will be positioned across the track at least 10 meters from their vehicle. At the start signal, all drivers shall run to their vehicles, unlock the vehicle, properly buckle all driver restraint devices, and then start the race.

Vehicles without an anti-theft device shall be held in a designated area for 5 minutes after the race start. Drivers shall be positioned at least 10 meters from their vehicle, but on the same side of the course.

Start assistance is not permitted for the Utility Endurance Event.

IX. Speed Endurance Event

A) *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.

B) *Speed Endurance Course* The Speed Endurance event shall 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. Up and down grades are permitted. 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.

The course layout must include 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.

C) *Start of Speed Endurance Event* Female riders shall begin the Speed Endurance Event. The Speed Endurance Event shall begin with a standing start. Vehicles will be arranged in the specified starting order in two columns with the lead vehicle in the inside position. At the start signal, all vehicles will proceed across the start line and commence the race. Drivers shall use caution during the start to avoid accidents.

No more than two team members are allowed to assist each vehicle in the starting process. Assisting personnel must exercise extreme caution in avoiding contact with vehicles starting from line positions behind them. Assistants at the outside of the two starting columns should move 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 safe and orderly start of an event may result in a penalty against the responsible team.

X. Drag Event

A) *Objective* To provide teams the opportunity to demonstrate the speed and reliability of their vehicles.

B) *Time and Place* The Drag Race Event shall be held on Saturday morning at approximately 8:00 AM at a location specified by the host organization. The exact starting time may vary due to weather conditions or equipment readiness.

C) *Drag Course Description* The drag race course shall consist of a paved level course 0.6 to 0.8 km in length. The course shall be at least 6 meters wide at all locations. The surface shall be free of potholes, cracks, and debris. Curves are

permitted on the course, which may be a closed loop (although a closed loop is not required). The course immediately following the start and immediately preceding the finish line shall be straight, unless separate and equal length lanes are provided for each vehicle.

D) *Timing Area* The timing and scoring area shall be off limits to competitors, spectators, and all others except competition officials and the event timing staff.

E) *Tally Board* Race results shall be posted on a tally board or computer monitor throughout the race. Results should be updated after each individual race, and should indicate the winners' and losers' brackets and race times.

F) *Drivers Meeting* All drivers who will participate in the Drag Race Event must attend the mandatory drivers meeting for that event. The drivers meeting shall take place approximately 45 minutes prior to the scheduled start of the race. The meeting will clarify operating procedures and signals and will identify course features, hazards, and landmarks.

G) *Race Description* The Drag Race Event is gender specific. Each rider shall compete against riders of the same gender. Separate scores shall be kept for male and female riders.

The drag race consists of two phases: a single-elimination qualifying race and a double-elimination tournament drag race. All vehicles shall compete in the qualifying race. The sixteen vehicles with the fastest qualifying times shall compete in the double-elimination drag tournament.

H) *Qualifying Race* The event shall begin with the female driver qualifying race. After all female drivers have competed the qualifying race, the male qualifying race shall commence. In both male and female races, vehicles shall start in the order of vehicle number. The maximum number of vehicles racing in each heat shall be at the discretion of the chief judge, and will depend on the nature of the course and the available timing equipment. Each vehicle shall be timed separately. Qualifying race place is based on finish times.

I) *Drag Race* The top sixteen female and top sixteen male vehicles from the qualifying race shall advance to the double-elimination drag races. All races in the drag tournament shall be between two vehicles. Seeding for both events shall be based on qualifying times. That is, the first race shall take place between the vehicles with the first and sixteenth qualifying times, the second race between the second and fifteenth qualifying places, and so on. After the first round, the event is split into two brackets: the winner's bracket and the loser's bracket. At the end of each round, the losers in the winner's bracket move into the loser's bracket. The losers of the loser's bracket are eliminated from the competition. The championship race determines the winner of the event. In the event that neither

championship contestant has two losses after the round, an extra race will determine the winner.

Men's and Women's Rounds The event shall begin with the women's first round, followed by the men's first round. These are followed by the women's loser's first round and then the men's loser's first round. The tournament then proceeds by alternating women's and men's rounds and alternating from the loser's bracket and winner's bracket until the championship round. In the event that neither championship contestant has two losses after the round, an extra race will determine the winner.

J) *Vehicle Classes* The tournament for each class shall be completed prior to starting the tournament for any other class. Generally the unrestricted class shall compete first. If there are less than 16 vehicles in a class, the qualifying and tournament rules above will apply with the exception that the tournament shall include the number of vehicles equal to the largest power of two less than the total number of vehicles in that class. In the event that the number of entries in a class is exactly equal to a power of two (16, 8, 4) there will be no qualification round.

Vehicles shall only compete against other vehicles in the same class. In the event a class is represented by only one vehicle, that vehicle must make an exhibition run or be deemed a non-participant. The exhibition run may be made alone or against a vehicle of any other class if a team is so willing. The outcome of an exhibition run shall not affect the standing of the other vehicle.

K) *Race Forfeiture* Vehicles must be in line and ready to start in turn. If a vehicle is not ready to start at their turn, they forfeit the race and either move to the loser's bracket or are eliminated from the race. If a vehicle is unable to start within 20 seconds of the start signal it must forfeit the race. Forfeiture in the qualifying race makes the vehicle ineligible to compete in the drag tournament.

Disabled vehicles at the start or during the race will have no more than 20 seconds to make repairs or they will forfeit the race. Disabled vehicles must clear the course as rapidly as possible.

L) *Start Assistance* Start assistance is permitted only for Speed-Class vehicles. Unrestricted class vehicles shall not use start assistance.

Start assistance will be limited to holding the competing vehicle upright and stabilizing it as it begins its run; pushing the vehicle is only permitted as required to keep the vehicle stabilized and upright. No more than two individuals may assist in the starting process, and all assistance must end within the first 10m, which will be marked.

M) *Interruption and Termination* The Drag Race Event will normally run continuously. However, circumstances such as equipment failures, an emergency,

hazardous weather or wind conditions may require a delay. Delays will be determined by the Chief Judge with the help of the Judging Team and the Competition Director.

The Drag Race Event will end with the completion of the championship rounds for all classes and both genders.

N) *Scoring* All races from both the qualifying race and the drag tournament shall be timed. Vehicle place for the first four places shall be determined by the round in which the vehicle was eliminated.

The place order for all remaining vehicles shall be determined first by the round in which the vehicle was eliminated and then by the maximum speed of that vehicle. All vehicles eliminated in loser's round 1 shall be ranked lower than all other vehicles, vehicles eliminated in loser's round 1 and 2 shall be ranked lower than all other vehicles, etc. Within each loser's round, the rank of each vehicle shall be determined by the maximum speed that vehicle has obtained during any race in the tournament. Vehicles that did not qualify for the drag tournament will be ranked but below than all qualifying vehicles in order of their qualifying race time.

Separate scores shall be maintained for each gender and each class of vehicle.

XI. Overall Scoring

A) *Overall Score* Scores from Design Event, Sprint or Drag Race Events, and Endurance Events scores will be combined to determine the overall standings in each of the 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 by Class**	
	Unrestricted	Speed
Design Event	40	40
Male Sprint or Drag Event	10	15
Female Sprint or Drag Event	10	15
Utility Endurance Event	20	N/A
Speed Endurance Event	20	30
Total Score	**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.

XII. Announcement of Results and Awards

A) *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.

B) *Presentation of Awards* The awards presentation will be held after 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.

C) *Competition Awards* Competition awards shall be given as follows:

Unrestricted Class

Design Event	1st, 2nd, and 3rd place trophies
Men's Sprint or Drag Event	1st, 2nd, and 3rd place trophies
Women's Sprint or Drag Event	1st, 2nd, and 3rd place trophies
Utility Endurance Event	1st, 2nd, and 3rd place trophies
Speed Endurance Event	1st, 2nd, and 3rd place trophies
Overall 1st Place:	Trophy and $800 to team
Overall 2nd Place:	Trophy and $325 to team
Overall 3rd Place:	Trophy and $175 to team

Speed Class

Design Event	1st, 2nd, and 3rd place trophies
Men's Sprint or Drag Event	1st, 2nd, and 3rd place trophies
Women's Sprint or Drag Event	1st, 2nd, and 3rd place trophies
Speed Endurance Event	1st, 2nd, and 3rd place trophies
Overall 1st Place:	Trophy and $650 to team
Overall 2nd Place:	Trophy and $300 to team
Overall 3rd Place:	Trophy and $150 to team

Host Organization (School)	Plaque and $1,000 scholarship

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 for speed-class vehicles include valid non-zero scores in the design event, male sprint or drag event, female sprint or drag event, and the speed endurance event. Minimum requirements for unrestricted-class vehicles include valid non-zero scores in the design event, male sprint or drag event, female sprint or drag event, the utility endurance event and the speed endurance event.

D) *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	Design Research

Team Spirit	Reliability and crash worthiness
Support of the Competition	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.

XIII. Clarification and Modification of Rules

A) *Clarification and Modification of the 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.

B) *Current Chief Judge* The current Chief Judge of the ASME Human Powered Vehicle Challenge is

Dr. Mark Archibald
E-mail: cmarchibald@gcc.edu

Appendix
Registration and Documentation Submittal

The following documentation is required for registration and participation in the ASME Human Powered Vehicle Challenge. 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:

Entry Date	8 weeks before Registration Date
Report Date	32 days before Registration Date
Registration Date	The initial day of competition

Document	HPVC Form	Notes	Date Due
Entry Registration	Form 1		Entry Date
Certification of Eligibility	Form 2		Entry Date
Safety Certification	Form 3		Entry Date
Safety Ride Log	Form 3a		Registration Date
Safety Exemption Request	Form 4	▪ Submit only if a exemption is requested ▪ Submit to Chief Judge	Entry Date
Acknowledgment of Rules	Form 5		Entry date
Design Reports		ASME electronic submission	Report Date
Vehicle Description	Form 6		Entry Date
Protests	Form 7	Submit to Chief Judge only if required	In accordance with II.J
Evaluation	Form 8	Form provided by ASME at the end of the competition	End of competition

Please refer to the ASME HPVC website for dates, registrations fees, and registration instructions.

http://www.asme.org/Events/Contests/HPV/Human_Powered_Vehicle.cfm