AMERICAN SOLAR CHALLENGE™

2005 REGULATIONS

NOVEMBER 2003.

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1. PURPOSE

1.1. The fundamental missions of the American Solar Challenge™ are to promote and celebrate educational excellence and engineering creativity. Fuelled by the spirit of friendly competition and teamwork, the American Solar Challenge (ASC) champions the creative integration of technical and scientific expertise across a range of exciting disciplines.

1.2. Our mission includes:

1.2.1. The support and encouragement of bright young minds to succeed in the fields of engineering, sciences, mathematics, in multi-disciplined learning, and in subsequent careers.

1.2.2. The creation of public awareness and enthusiasm, both for education excellence itself, and for the technologies that emerge from that excellence.

2. ADMINISTRATION

2.1. Application of Regulations - These Regulations will apply to the American Solar Challenge (the "Event"), which includes the selection of teams, registration of teams, the inspection of solar cars ("Scrutineering"), the qualification of solar cars (the "Qualifier"), and the cross-country competition (the "Rayce").

2.2. Supplemental Documents - Additional documents may be distributed to all teams entered in the Event to supplement these Regulations. These documents will clearly state that they are a supplement to the Regulations and they will have the same force and effect as these Regulations. If there is a conflict between a supplemental document and these Regulations, the document having the later date shall take precedence. Supplemental documents specifically referenced in these Regulations include the American Solar Challenge newsletter, Official Interpretations and Instructions for Scrutineering. The organizers reserve the right to revise these Regulations at any time.

2.3. Acceptances of Regulations - All persons or groups selected to participate in the Event are assumed to know these Regulations. Their participation in the Event will constitute acceptance of them.

2.4. Interpretation of Regulations – Prior to Scrutineering all interpretations must be published in the American Solar Challenge newsletter or posted to the Internet under “Official Interpretations” on the ASC page in order to become official. During and after Scrutineering, all official interpretations will be announced at Briefings and posted at Headquarters and on the Internet. The only group authorized to interpret the regulations is the Regulations Committee.

2.5. Advertising, Promotion, and Publicity - All advertising, sales promotion, and publicity material produced by the teams or their sponsors concerning or referring to the Event will refer prominently to the Event as "*The American Solar Challenge*". (It may be, that the Name will be appended with a naming sponsor i.e. "*The Acme - American Solar Challenge",* in which case teams will need to display the entire name.) All teams, by entering the Event, specifically agree to abide by this regulation. By entering the Event, all teams and team members agree to the use of their names and their likenesses in any publicity materials (brochures, magazines, videos, photographs, etc.) that may be issued by the Event's sponsors or organizers.

2.6. Headquarters - During Scrutineering, the Qualifier, and the Rayce, a Headquarters will be established at the site of each function and will assume the management functions for the Event.

2.7. Officials - A team of Officials to conduct Registration, Scrutineering, the Qualifier, and the Event will be selected by American Solar Challenge Organizers. Officials having specific duties shall be announced to the teams through the American Solar Challenge newsletter and briefings.

2.8. Jury - A Jury will be formed to evaluate protests on conformity with these Regulations, to resolve team disputes, and assign penalties. In addition, the Jury is empowered to decide cases not specifically covered by these Regulations. The jury will be available to teams during the Rayce.

3. ENTRIES

3.1. Entry Registration - The Event is open to all to participate. Each team wishing to participate in the Event must submit an entry package consisting of a Team Entry Form and a signed Participation Agreement. No team will be officially registered until the Entry Form, Participation Agreement, and Entry Fee are submitted to Headquarters. The Fee Schedule is as follows:

3.1.1. Open Class - $2000 US

3.1.2. Stock Class - $1000 US

3.1.3. The entry fee will be waived for teams placing first overall in any ISF event after January 1, 2002, provided that the team submits an intent to register by January 1, 2005 and the entry field has not been filled.

3.2. Registration Deadlines - Registration opens January 1, 2004, and closes June 1, 2005.

3.3. Number of Entries - In the interest of safety, the number of solar cars entered in the Rayce will be limited to 60 (sixty), and will be registered on a first come, first served basis.

3.4. Faculty Advisor – Teams representing an educational institution must have at least one faculty advisor who will provide guidance as needed throughout the solar car design, building and testing process. The faculty advisor will be the official contact between the Event and institution.

3.5. Technical Documents - Technical documents describing the solar car's structure, batteries, and solar cells must be submitted to ASC Headquarters for approval. Early submissions will receive prompt review by Headquarters. The technical information provided in these documents will not be made public prior to the end of the Event. The information contained in each team's final submission must match the solar car presented at Scrutineering.

Safety should be the primary concern with regard to the structural development and fabrication of the solar cars.

3.5.1. Preliminary Roll Cage/Suspension/Steering Report – Particular attention should be given to the roll over and impact protection systems for the driver/passenger. A preliminary sketch and description of the roll cage must be submitted to ASC Headquarters by September 1, 2004. Additional instructions will be provided.

3.5.2. Structural Report - The Structural Report must present and address the design issues involved in impact, roll over and suspension scenarios. It must also address vehicle stability, including center of gravity and relative weights on each wheel. Document this with calculations and or testing. Photos, drawings and anecdotal references are acceptable. The entire document including appendices shall not exceed fifty (50) pages (not sheets) in length. Additional instructions will be provided. The report must be submitted to ASC Headquarters by March 1, 2005.

3.5.3. Battery Approval - All storage batteries used in the solar car must be approved by ASC Headquarters. Each team must provide a copy of the manufacturer's battery specification sheet, the Material Safety Data Sheet (MSDS) obtained from the battery manufacturer, and a battery approval form with the following battery information:

- Manufacturer's name, and contact information
- Stock number, type, or description
- Cell & Module voltage (e.g., 1.2, 4, 6, 12, or 24 V)
- Buss voltage
- Number of modules to be used in the solar car
- Manufacturer's specifications, including capacity (kWh), weight (kg), and cost (US$).
- Spill/damage protocols and procedures (if these are not provided in the MSDS then the team must obtain this information from the manufacturer and submit it to Headquarters with the MSDS).
- Description of protective system

Battery forms must be submitted to ASC Headquarters by March 15, 2005. (see 5.8.1 for additional information) If an intermediate supplier is used, submit the cell manufacturer's data required on the Battery Approval Form. Please note the definitions included in 5.8.3.1

3.5.4. Solar Cell Approval - All solar cells must be approved by ASC Headquarters. Each team must provide a copy of the manufacturer's solar cell specification sheet, and a solar cell approval form with the following solar cell information:

- Manufacturer's name and contact information
- Stock number, type, or description
- Manufacturer's quote for cell area (cm^2)
- Manufacturer's quote for performance
- Cost (US$) per cell
- Cell area (cm^2) after trimming or cutting or placement on the solar car

Solar cell forms must be submitted to ASC Headquarters by April 1, 2005.

3.6. Team Data - Each team must submit a team photo and data sheet to American Solar Challenge Headquarters by May 1, 2005. The photo and data will be publicly released and used in event brochures. Late submissions will be omitted. Early submissions will not be made public prior to June 15, 2005 without permission of the team representative.

3.6.1. Team Photo - The team photo must clearly show the solar car and team members. Team members in the photo must be identified by name and by their company or institution when there is more than one company or institutional sponsor. The photos will be used in ASC programs and other publications. Additional instructions will be provided.

3.6.2. Data Sheets - The data sheet must include solar car weight (with battery but no driver/passenger), solar car dimensions, motor type and rating, solar cell type and manufacturer, estimated peak solar array power in both Raycing and charging configuration (overhead sun, clear sky), battery weight and estimated capacity, chassis description, braking system, and wheel type and size. All specifications must be provided in metric units (SI). The team leader, crewmembers, designated driver/passengers, and faculty advisor(s) must also be listed.

3.6.3. Team Data Changes - Teams may change specifications of the solar car and crew up to the scheduled time of Scrutineering, with the exception that solar cell specifications may not change after April 1, 2005 and battery specifications may not change after March 15, 2005 without specific approval from ASC Headquarters. Any changes submitted after June 1, 2005 may not appear in print.

3.7. Registration - All participants in the Event must be registered with Headquarters. This includes team members, sponsors, officials, guests, and the media. All participants must present themselves at Registration to complete all required forms. Badges will be issued and used to obtain access to restricted areas. These badges must be visible at all times.

3.8. Driver/Passenger Requirements - Only registered solar car drivers and passengers will be allowed to drive/ride in solar cars during the Event. A team shall have a minimum of two drivers and (if a two passenger vehicle) two passengers available at all times. In addition to meeting the crew requirements, solar car drivers and passengers must be 18 years old or older and must supply their own ballast material (metal shot only). Solar car drivers must present a valid driver's license. The official weight of each driver/passenger, including driving clothes, helmet, and shoes, will be 80 kg. If a driver/passenger weighs less than 80 kg, ballast will be added to make up the difference. If a driver/passenger weighs more than 80 kg, no credit will be given.

3.9. Insurance – All teams must show a certificate of insurance or self-insurance commensurate with what is detailed in the participation agreement or participate in the purchase of the event insurance provided by the organizers. The former is preferred.

4. EVENT COMPONENTS

4.1. Scrutineering- Each team registered for the Event must submit their entry for inspection prior to the Qualifier to verify compliance with these Regulations. All North American (Canada, USA, Mexico) based teams are required to attend a preliminary scrutineering. In addition, spot checks for regulation compliance may take place during and immediately after the Qualifier and Rayce. The top five overall finishing cars will be impounded immediately following the Rayce for a final inspection.

4.1.1. Scrutineering Time and Location – The date and location of Scrutineering for American Solar Challenge will be announced in the ASC newsletter and on the ASC website. Order of inspection will be determined by drawing. Teams that fail to present their solar car at their designated time will drop to the back of the queue and risk not having enough time to complete the Scrutineering process. Additionally, teams failing to participate in mandatory team meetings may be given last priority for Scrutineering and risk not having enough time to complete the process.

4.1.2. Scrutineering Format - Scrutineering will involve inspection stations for sizing, body, electrical, mechanical, dynamic tests to verify handling and braking performance, and support vehicles. Instructions for Scrutineering and a detailed description of the Scrutineering tests will be distributed in advance to all registered teams.

4.1.3. Configuration and Drivers for Scrutineering – All Drivers must be present for designated scrutineering inspection stations. The driver selection and car configuration are at the discretion of the scrutineers for each station and teams may be required to repeat tests with different drivers and or configurations.

4.2. Qualifier - Each team must successfully participate in a Qualifier, a two-day track rally for solar cars, before they will be allowed to compete in the Rayce. The date and location of the Qualifier(s) for American Solar Challenge is yet to be determined. A maximum of 60 (sixty) qualified teams will be permitted to participate in the Qualifier(s). The team with the most Officially Logged Miles will be declared the winner and will gain pole position for the Rayce.

4.3. The Rayce - A maximum of 60 (sixty) qualified teams will be permitted to participate in the Rayce, a cross-country rally for solar cars. Solar cars must rayce in the same configuration used at the Qualifier. The team with the shortest Official Elapsed Time will be declared the winner of the Rayce or class thereof.

4.4. Safety - Each team is responsible for the road-worthiness of its solar car. Passing Scrutineering or implementing changes suggested in comments on the team's Structural Report does not relieve the team of any liability. All solar cars and support vehicles must be maintained in a safe, road-worthy condition and be operated safely at all times. A team may be disqualified and withdrawn from the Event at any time if it is judged to be operating in an unsafe manner.

4.4.1. Team Safety – Each team is required to have at least one member trained in basic First Aid, including CPR. Proof of training will be required.

4.5. Withdrawals - Any team wishing to withdraw must notify American Solar Challenge Headquarters in writing. All written withdrawals signed by the team representative are final. American Solar Challenge Headquarters may withdraw teams that do not meet the technical document deadlines or fail to present a solar car at Scrutineering or the Qualifier.

5. SOLAR CAR REGULATIONS - ELECTRICAL

5.1. Power - Global solar radiation received by the solar car without artificial external augmentation is the only source of energy that can be used for propulsion, except for energy stored in the solar car's battery system at the beginning of the first day of Raycing. Wind energy as well as direct and diffuse radiation are considered forms of global solar radiation. With the exception of the effects of wind on the basic shape of the car, all components used to convert global solar radiation for propulsion shall be considered part of the solar array described below.

5.2. Solar Array - At any given moment, the solar array comprises all components that are involved in the conversion of the above-defined solar energy for use by the vehicle. In addition to direct energy conversion components (such as photovoltaic cells, Stirling engines or wind generators), the solar array includes any reflective surfaces, refractive lenses, or thermal-cooling systems employed to increase power output. Components that carry or process the energy after conversion are not considered part of the solar array, nor are structural members whose sole function is to support the solar array. The entire solar array must fit within an imaginary right rectangular parallelepiped ("box") of limited size whenever the solar array is connected to the solar car's motor or battery. The "box" may not exceed:

5.2.1. Dimensions

5.2.1.1. For ISF 5000 Solar cars - up to 5 meters in length, 1.8 meters in width, 1.6 meters in height.

5.2.1.2. For ISF 6000 (2 Person Solar Cars) – up to 6 meters in length, 2 meters in width, and 1.6 meters in height.

5.3. Raycing Configuration - Whenever the solar car is moving under its own power, the solar array must be in its Raycing configuration. In Raycing configuration, the "box" must be defined such that the length and width lie parallel to the ground. Furthermore, All portions of the solar array must be carried by the solar car and must remain fixed with respect to the car chassis, in the same orientation and configuration used when the solar car was inspected during Scrutineering.

5.4. Charging Orientation - Whenever the solar car is stationary, the solar array may be reoriented to maximize solar exposure for charging. In charging orientation, the "box" can have any orientation relative to the ground. Charging configuration will be demonstrated as part of Scrutineering.

5.5. Electrical Connection - All connections between the solar array and the solar car must be carried by the solar car.

5.6. Water Spray - Ambient-temperature water from an external source may be applied to the solar array using hand-pumped sprayers if the water is applied while the solar car is stationary and the application does not present a shock hazard. This is a unique exception to the general requirement that cooling systems must be considered part of the solar array.

5.7. Solar Cell Technology Limitation

5.7.1. Stock Class - If photovoltaic technology is used, only solar cells that are listed on the ASC2005 Approved list will be allowed. These will have been determined to be available to all registered teams at a price not exceeding US$10/watt for bare cells; teams may pay extra for cutting, tabbing, or lamination of the cells. Substantial modification of the crystal structure, junction, or metallization constitutes manufacture of a new cell. Teams or suppliers wishing to make an addition to the list must submit all appropriate data to ASC Headquarters by December 1, 2004.

5.7.2. Open Class – There are no limitations on cells that may be used. Solar cell information listed in 3.5.4 must be provided to Headquarters.

5.8. Storage Batteries – All solar cars are allowed to store solar-generated energy in a battery system composed of individual modules having a weight determined by the technology used. Adherence to weight limitations does not imply automatic battery approval. Battery approval forms must be submitted to Headquarters before official approval may be issued. ASC Officials reserve the right to refuse approval of modules.

5.8.1. Weight Limits – ISF 5000 (Single Seater) cars may use up to:

- 165kg of sealed Pb-acid battery
- 100kg of NiCd battery
- 60kg of NiMH battery
- 25kg of Li-ion battery
- Other energy storage methods (such as other battery technologies or fuel cells) will need to be evaluated by ASC Headquarters. Samples and details of proposed systems must be submitted before October 1, 2004.

5.8.2. Weight Limits – ISF 6000 (Two Seater) cars may use up to:

- 198kg of sealed Pb-acid battery
- 120kg of NiCd battery
- 72kg of NiMH battery
- 30kg of Li-ion battery
- Other energy storage methods (such as other battery technologies or fuel cells) will need to be evaluated by ASC Headquarters. Samples and details of proposed systems must be submitted before October 1, 2004.

5.8.3. Protection Circuitry – Batteries must have protection circuitry appropriate for the battery technology. Proof is required at scrutineering that the protection system is adequate. Protection circuitry should be primarily for the purpose of protection.

5.8.3.1. Definitions - Please use these definitions when describing your pack in the Battery Approval Form

- **Cell -** The smallest available source of energy in your battery pack that you purchase from a manufacturer. a single electrochemical cell.
- **Module -** The smallest easily removable group in your battery.
- **String -** The series group of cells needed in your battery pack that provide the required voltage.
- **Protection Limit-** The measured level that your team decides is adequate to protect from an event.
- **Active -** Active means constantly monitored measurements where action can be taken immediately without operator intervention.

5.8.3.2. Li-ion - All lithium based battery packs must have active protection such that over voltage, over temperature, over current and under voltage cause the pack to electrically isolate the source or sink from the battery pack. The level of protection detection is required down to the module level at a minimum and may be required at a cell level depending on the cell manufacturer.

5.8.3.3. NiMH / NiCd - All nickel based battery packs must be protected from over temperature and over voltage. Isolation is not required but recommended if active measurement is unavailable.

5.8.3.4 Pb-Acid - All lead based battery packs must be protected from over voltage. Isolation is not required but recommended if active measurement is unavailable.

5.8.4. Hybrid Battery Packs – Allowances for hybrid packs will be based on percentages of the weight allowances for the types of modules used, i.e. If a NiMH/Lead acid hybrid pack is comprised of 50% of the allowable weight for NiMH, then the lead acid allowance for that pack will be 50% of the allowance for lead acids. The total of the percentages used in the pack may not exceed 100%.

5.8.5. Supplemental Batteries - Supplemental, replaceable batteries carried in the solar car may be used to power only the following accessories: radios, electronic panel meters, driver ventilation fans (if solely for driver ventilation), main disconnect relay, horn, and data telemetry.

5.8.6. Other storage techniques - If any other storage techniques are used, they must be shown to be storing no energy before the start of each day of the Rayce. For example, if power condenser is used, the electric charge must be proved to be zero before the start of each day of the Rayce. If a flywheel is used, it must be proved not to be rotating before the start of each day of the Rayce.

5.9. Battery Enclosures - All battery modules must be fully contained in enclosures that are electrically isolated from the solar car. The enclosures must be constructed from non-conductive, electrolyte - resistant material. The battery enclosure covers must be constructed from the same material used in the fabrication of the rest of the enclosure. The cover must be firmly secured. The resistance measured between the battery terminals and any portion of the solar car chassis shall be greater than 1 mega ohm for applied potentials up to 500 V. The battery enclosures must be secured to the solar car chassis so as to prevent them or the modules within from coming loose in the event of an accident or rollover. Velcro fasteners/straps will not be approved. All sides of each battery enclosure, including top, must be marked using 10-mm-high letters with "Caution: Chemical Hazard" and "High Voltage" and any other standard hazard markings specific to the type of battery enclosed.

5.9.1. Battery Removal - Battery enclosures must be designed such that the entire set may be removed and placed in impound (see 7.23.). Teams must remove their entire battery nightly and place it in a single, solid, box/container, securable with a standard padlock. This box constitutes the impound space and as such must be situated per observer request. Cell/module level removal is allowed but discouraged.

5.9.2. Battery Stacking - Stacking the batteries is discouraged. If it is necessary to stack the batteries, a battery rack must be used. The rack must be made of non-conductive, electrolyte - resistant material that is strong enough to support the weight of the entire battery system. The rack shall meet the same electrical isolation requirements as the battery enclosures.

5.9.3. Battery Ventilation - Battery enclosures must be equipped with a forced ventilation system rated at a minimum of 280 liters per minute. It must operate whenever the battery system is electrically connected to the solar car or to the solar array. Such ventilation systems must exhaust to the exterior of the solar car and must be powered by the battery system.

5.10. Main Fuse - A separate fuse (not a circuit breaker) must be placed in series with the battery system and the rating must not exceed 200% of the maximum expected current draw. All low-voltage taps from the battery system must be separately fused. All fuses must be placed first in series with the battery starting at the positive connection.

5.11. Power Switch - The solar car must be equipped with a single throw manually operated, high current multiple pole switch to quickly isolate the battery, motor, and array from each other and the electrical system of the vehicle. This switch must be capable of interrupting the voltage and the full load current. The switch must be located within easy reach of the driver.

The switch must be plainly marked in letters at least 10-mm high as the "Power Switch" with "ON" and "OFF" designations. These markings must be clearly visible to the driver inside the solar car and to rescue personnel outside the solar car; use two sets of markings if necessary. Relays for this purpose must be normally open, and power for the relay may be supplied by auxiliary batteries.

5.12. Cable Sizing - All electrical cables must be properly sized to expected system currents.

5.13. Electrical Shock Hazards - All exposed or easily exposed conductors, junction boxes, solar cells, etc., operating at greater than 36 volts must be protected from inadvertent human contact and must be marked "High Voltage" in letters at least 10 mm high.

5.14. Lighting - Solar cars must have amber front indicators, red or amber rear turn indicators and red brake lights which must all be clearly visible from 30 meters in full sunlight. Turn signals must be located at the front extremity of the vehicle with a 1.5-meter minimum left to right separation. Turn signals and brake lights must be located at the rear extremity of the vehicle with a 1.5-meter minimum left to right separation. The geometric visibility of each light shall be 30 degrees from center and 15 degrees up and down. Additional brake lights may be centrally located if desired.

5.15. Horn - Solar cars must be equipped with a horn that can be heard at a sound power level between 75 and 102 dBA at a distance of 15 meters in front of the solar car. The horn must be permanently mounted.

5.16. Accelerator - Accelerator mechanisms on solar cars must be free moving, and when released, must return to the zero current position. If the solar car is equipped with cruise control, it must be designed with an automatic shut-off when the brake is activated.

5.17. Control - Acceleration, braking, and steering must be under the sole control of the driver.

6. SOLAR CAR REGULATIONS - MECHANICAL

6.1. Solar Car Dimensions - The solar car (including solar array) may not exceed the following maximum dimensions when moving under its own power. These define both Open and Stock Classes (see 5.2 for array dimensions):

> **6.1.1. For ISF 5000 (Single Person Solar Car)** – length=5 meters, height=1.6 meters, width=1.8 meters. When turning corners, wheels and wheel fairings may exceed these dimensions.
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> **6.1.2. For ISF 6000 (Two Person Solar Cars)** – length=6 meters, height=1.6 meters, width=2 meters. When turning corners, wheels and wheel fairings may exceed these dimensions.

6.2. Tire and Wheel Requirements - The solar car shall have a minimum of three tires in contact with the ground at all times. The wheels and tires shall be designed for the intended application.

6.3. Tire ratings - Tires in contact with the ground shall be loaded and inflated within the manufacturer's rating at all times during vehicle operation. Each wheel and tire on a single axle must be rated for the full weight applied to that axle.

6.4. Dynamic Stability - All wheels and their suspensions, steering linkages and geometries will be inspected for safe operation in normal and adverse conditions.

6.5. Driver/passenger Cockpit - The driver/passenger's cockpit may not subject the driver/passenger to excessive strain during normal operation, and must be designed to protect the driver/passenger from injury in the event of an accident. The driver/passenger must be clear of moving parts and linkages, so as to provide adequate space for safe operation of the vehicle.

> **6.5.1. Seating Position** - The normal driving/riding position must place the driver/passenger's entire head higher than the highest point of his or her legs and feet. No headfirst positioning is allowed for the driver. If a passenger is seated headfirst, she/he must be located such that her/his head is located rearward of the driver's.

6.5.2. Belly Pan - The cockpit must be equipped with a full belly pan to isolate the driver/passenger from the road. The belly pan must be strong enough to support the full weight of an 80 kg driver/passenger.

6.5.3. Roll Cage - All solar cars must be equipped with a roll cage that encompasses the entire driver/passenger in all directions. (The roll cage must encompass the driver well enough that a cloth stretched around the roll cage is clear of the driver.) The roll cage shall be a fixed, integral part of the solar car structure. The protection provided for the driver/passenger in a collision must be documented in the team's Structural Report. In addition to providing collision and rollover protection, the roll cage must be designed so as to deflect body/array panels of the car away from the driver/passenger in the event of an accident. There must be 5 cm of clearance in all directions between the roll cage and the helmet of the driver/passenger seated in the normal driving position. The roll cage must be of steel tubing having a minimum carbon content of 0.18 percent. The roll cage tubing must have a minimum outside diameter of 2.5 cm and minimum wall thickness of 2 mm. Alternate materials which afford equivalent protection for the driver/passenger are permitted, provided they are fully documented in the team's Structural Report. A preliminary sketch and description of the roll cage must be submitted to ASC Headquarters by September 1, 2004 (see 3.5.1.). Materials and details should then be more fully documented in the team's Structural Report.

6.5.4. Padding - The roll cage must be padded with energy-absorbing material wherever it may come into contact with the driver/passenger's helmet. This energy-absorbing material may be included within the required 5 cm of clearance. In addition, a headrest of at least 2 cm thick resilient material must be mounted behind the driver/passenger's head.

6.5.5. Crush Space - The driver/passenger, when seated, must have a minimum of 15 cm of horizontal distance between his or her shoulders, hips, and feet and the car's outer body surface.

6.5.6. Safety Belts - All solar cars must be equipped with a minimum of a five-point lap and shoulder belt (harness system) for each driver/passenger. The use of safety belts is mandatory. The safety belts must be attached securely, as recommended by the manufacturer, to a strong component connected to a main frame member, or to a main frame member itself in the solar car. The harness must be attached with bolts and nuts; bolts threaded into a structural member or "insert" are not allowed. If a hammock-type seat is used, the safety belts must remain functional in the event of a structural failure in the driver/passenger's seat. Only commercially manufactured safety belt systems are allowed, and any modifications must be approved by the manufacturer.

6.5.7. Outside Air Circulation – Outside air from intake vents or wheel openings must be provided for the solar car's driver/passenger.

6.5.8. Egress - The driver/passenger's cockpit must provide for the driver's unassisted exit, standing clear of the car, within 10 seconds. Driver/passenger's doors and/or canopies may not be taped shut at any time.

6.6. Visibility

6.6.1. Eye Height - In the normal driving position with ballast on board, the driver's eyes must be at least 70 cm above the ground.

6.6.2. Windshield - All solar cars must have a windshield made of shatter-resistant material. The windshield must be free of excessive distortion. This will be tested by having the driver identify 4 cm high letters at a distance of 3 meters through any of the required viewing angles referenced below. Solar cars must have a method to clear at least 0.1 m^2 of the windshield of rain. The clearing method must be operable at all times and must be in use when it becomes necessary to use the windshield wipers on the team's support vehicles.

6.6.3. Forward Vision - From the normal driving position, the driver must be able to see at all times without artificial assistance: 1) a point on the ground 8 meters in front of the solar car, 2) a minimum of 17 degrees above the horizon on level ground, and 3) a full 100 degrees to either side of center. To provide an "encompassing" roll cage, some elements of the roll cage may obstruct a portion of the forward vision. However, this view must be essentially unobstructed by the solar car structure so the driver can easily see the road and traffic.

6.6.4. Rear Vision - All solar cars must be equipped with a rear view system that at all times will allow the driver to see a vehicle 15 meters directly behind the solar car and up to 30 degrees off center. The system must provide the driver with a single reflex type image and must operate without driver input. The driver must identify the direction of an arrow, of 30cm brush strokes, on a $1m^2$ board held at about 1m off the ground.

6.7. Fasteners - All fasteners must be of suitable type, strength, and durability for their application, with the following minimum requirements:

6.7.1. Bolts - Bolts used in the steering, braking, suspension, seat mounts, safety harness, drive train, and battery box systems must at minimum meet SAE grade 5, metric grade M 8.8 and/or AN/MS specifications. Bolts must be of the correct length, and extend at least two threads beyond the nut. Bolts in tension must not have shaved or cut heads.

6.7.2. Securing of Bolts - The bolts described above must be secured from unintentional loosening by safety wire, cotter pins, and nylon lock nuts. In difficult areas only, Inspectors may allow Loctite, or other means deemed appropriate. Lockwashers may not be used.

6.7.3. Hose Clamps - Hose clamps must not be used to secure any structural or critical members of the car. Their use to secure ducting or wire cables is allowable.

6.7.4. Body Panels and Array – All moving or removable body panels and the array must be securely fastened to prevent unintended movement.

6.8. Covers and Shields - All moving parts must be suitably covered to prevent accidental human contact when the solar car is fully assembled. The driver/passenger must be shielded from contact with all steering linkage and other moving parts.

6.9. Steering Stops - The steering system must include steering stops to prevent dangerous or damaging steering travel.

6.10. Clearance - Interference or rubbing of the wheels with the solar car's body, wheel well, or structure at full steering lock or suspension travel is not permitted. Movement of rod-end bearings may not be obstructed in any axis throughout the full travel of suspension and steering. Other moving parts, such as the motor shaft, must not contact stationary parts except through properly designed bearings.

6.11. Drag Reducing Devices – Devices, such as actuated fins, which improve the aerodynamics of the car, are permitted. They must not be able to move the car by themselves,

and may not compromise the on road stability of the vehicle. (Note 4.1.3 allows the car to be scrutinized in any, or multiple, configuration(s) of the scrutineers' selection.)

6.12. Ballast – Any solar car driver/passengers weighing less than 80 kg will require ballast to bring his or her weight to 80 kg. Ballast weight will be measured into containers provided by Headquarters.

> **6.12.1. Ballast Carrier** – Each solar car must have a single box or other suitable carrier for carrying ballast container(s). The carrier must be securely fastened to a structural member of the solar car and/or be demonstrated to hold the ballast container(s) fixed in the event of an impact. (2 person vehicles may have two carrier locations.)
>
> **6.12.2. Ballast Access** - The ballast container and its identification and security markings must be visually accessible during driver/passenger changes.

6.13. Brakes - Solar cars must have a balanced, co-reactive, dual braking system so that if one system should fail, the solar car can still be stopped. The two systems must be operationally independent and may be either front/rear or redundant front or rear (one-sided systems, left or right, are not permitted). Hydraulic systems must have separate master cylinders. Regenerative brakes may not be considered as one of the braking systems.

> **6.13.1. Braking Performance** - Solar cars must be able to repeatedly stop from speeds of 50 kph or greater with an average deceleration on level WETTED pavement exceeding 17 kph per second. The time interval over which the deceleration is averaged shall be from the first indication that the driver should stop until the solar car comes to a complete halt. When braking, the solar car must not veer excessively to the left or right, or exhibit structural instability. The tire pressure and mechanical systems settings used in this test will be considered Raycing configuration.

6.14. Handling Performance – Solar cars will be tested for handling performance. A combination of the following tests may be conducted:

> **6.14.1. Figure-8 -** Solar cars must be able to negotiate a figure-8 course (of which the center circle of each half of the figure-8 has a radius of 6 meters) with a 5-meter-wide-lane, without knocking over any of the cones or exhibiting signs of structural instability in less than 9 seconds per side.
>
> **6.14.2. Stability at Speed** - Solar cars must be able to stay within a 4 meter lane while traveling at 65mph.
>
> **6.14.3. Slalom Test** - Solar cars must be able to negotiate a slalom course TBD.

6.15. Turning Radius - Solar cars must be able to make a U-turn in either direction, without backing up, such that all wheels remain within a 16-meter-wide lane.

6.16. Data Logger – Solar cars may be required to carry a self-powered data logger provided by rayce officials. The data from the logger will be used to help resolve conflicting reports of vehicle location or speed. The unit weighs approximately 1kg and has an antenna of approximately 6x6cm that requires exposure to the sky (can be through a transparent medium). Additional details will be provided by ASC Headquarters.

6.17. Graphics - Solar cars must prominently display their assigned number, Institution name, and the Event logo such that they are clearly visible from a roadside vantage point. Additional graphics related to the team's Institution(s) or sponsors are permitted, provided they are neither offensive nor disruptive.

6.18. Solar Car Numbers - Each team registered for the Event will have a unique number approved by American Solar Challenge Headquarters (positive integer, 3 digits maximum). This number must be clearly displayed on both sides of the solar car. Each number must have a minimum of 5 cm of unobstructed background color on all sides. These colors can be black on white, white on black, or another high-contrast color approved by American Solar Challenge Headquarters. The numerals themselves must be a minimum of 25 cm high, 12 cm wide (except the numeral one), and have a minimum brush stroke of 4 cm. Numbers containing more than one digit must have a minimum of 2.5 cm spacing between them.

> **6.18.1. Number Assignment -** Teams that participated in ASC2003 may have priority for retaining their 2003 car number if they contact ASC Headquarters prior to the ASC2005 Kick-off Conference. A car number event will be held during the conference for the remaining numbers. Teams not able to attend may contact HQ but priority may be given to teams at the conference.
>
> **6.18.2. Number Conflict -** If a car number conflict arises, American Solar Challenge Headquarters will determine the numbers assigned.

6.19. Institution/Company Name - The name of the Institution(s) or organization sponsoring the team must be displayed on the solar car. American Solar Challenge Headquarters must approve the use of abbreviations or initials. The Institution's name shall be larger and more prominent than any team sponsor's logo or name.

6.20. Event Logo - The Event logo must be applied on both sides of the solar car. The logo will be provided by American Solar Challenge Headquarters and will measure no more than 20 cm in height by 30 cm in width.

7. RAYCING REGULATIONS

Any location where all of the competitors are released from the same point is termed a "Staged Start".

The distance between two Staging Areas is such that it is unlikely that any vehicle, falling within these regulations, will complete that distance in one Raycing Day. At the end of any Raycing Day during which an entry has not reached the next planned Staging Area (and does not trailer to the Staging Area), the team will stop where they are. They will begin the next morning at the same point, following regulations established for non-staged starts.

7.1. Traffic Laws - During the course of the Rayce, all state and local traffic laws must be obeyed. Solar cars must observe a maximum speed limit of 65 mph (Note: while event organizers may or may not be aware of or enforce specific local regulations, under no circumstances does this imply that jurisdictions will not enforce local ordinances, laws, or regulations).

7.2. Team Uniforms - On Rayce Days from 6:30 a.m. to 8:30p.m. team members shall wear uniforms representing their Institution(s)/Company(s). The uniforms are required to have the Institution/Company name, car number, and ASC logo.

If team sponsors are displayed, the event sponsor must also appear in a similar manner on the team uniform. Artwork for ASC logo and for the event sponsors may be obtained from ASC Headquarters.

7.3. Rayce Time - Official clock time for each team each day of the Rayce will be based on the local time at that day's start line, as displayed by the Officials. The same official time ("Rayce Time") will remain in effect for each team for the entire day (until midnight), even though that day's route may cross into a different time zone.

7.4. Drivers/Passengers - Only one person, the authorized driver, may ride in the solar car at any time with the exception of an authorized passenger in a two person vehicle.

7.4.1. Driver/Passenger Helmets – Driver/passengers must wear a helmet while operating/riding in the solar car. The helmet must meet or exceed the Snell M95 or DOT motorcycle standard. Bicycle helmets will not be allowed.

7.4.2. Driver/Passenger Shoes – Driver/passenger must wear closed-toed shoes in the solar car. Sandals are not permitted.

7.4.3. Driver/Passenger Ballast – Drivers/Passengers and ballasts will be identified with unique identification tags. The tags on the ballasts carried by the solar car must match the tags on the solar car driver/passenger at all times.

7.4.4. Driving/Riding Time – Drivers/Passengers may not drive/ride more than a total of six hours in a given Rayce Day.

7.4.5. Water/Fluids – Each driver/passenger must have sufficient quantities of water/fluids in the cockpit/passenger area to stay properly hydrated. *(Minimum one liter for each driver/passenger switch).*

7.5. Briefings - A Briefing will be held each Staged location and in the case of emergency. Attendance at this meeting by a team representative and driver(s) is required. Briefing notes and other daily updates will be available at Checkpoints, posted to the Internet, broadcast by e-mail and available by phone. All official statements, rule interpretations, and special instructions will be contained in these postings.

7.5.1. Official Statements, including rule interpretations and special instructions are announced at Briefings.

7.5.2. On Non-Staged Days it will be the responsibility of the team to check available outlets for updates and instructions.

7.6. Starting Line

7.6.1. Staged - Each team will be assigned a start time, which will be distributed to the teams at the Briefing. If the start of the Rayce is delayed, then all assigned start times for that day will be adjusted accordingly. If the team leaves the starting line at their assigned time, then that becomes their Official Start Time for that day. If the team leaves before their assigned time because they were moved forward in the queue by the Start Line Officials, then the team's Official Start Time is their actual start time. If the team leaves after their assigned time because they weren't ready, then the team's Official Start Time will remain their assigned time. The solar cars will be released from the Official Starting line at 60 second intervals beginning at 9:00 a.m. All solar cars must report to their starting position by 8:45 a.m. Each team's lead and chase vehicles must merge with their solar car after it leaves the starting line. The movement of all vehicles in the Start Line area is under the control of the Start Line Officials.

7.6.2. Non-Staged - Solar cars will be released from their start point at 8:00 a.m.

7.7. Starting Order - The starting order for the first day of the Rayce will be determined at the Qualifier. On all other staged days, the order is based on the solar cars' Official Total Elapsed Time available at 7:00 a.m. of that morning, from shortest to longest. In case of a tie on any day, the first of the tying teams to cross the previous stage's finish line will precede the others in the starting line-up and so on.

7.7.1. Teams Not Ready - If a team's solar car, lead, and chase vehicles are not in their assigned starting positions at 8:45 a.m., the Start-Line Officials may, at their discretion, move all of the following cars up one slot, and the tardy team must move to the end of the starting queue.

7.8. Delayed Start - The start of the Rayce, at any stage, may be delayed if inclement weather or other hazardous conditions appear likely to pose a threat to the solar cars or their driver/passengers.

7.9. Rayce Route - An American Solar Challenge Route Book will be distributed to each team that qualifies for the Rayce. The Route Book will contain information to direct the team along the official route. It will specify days, distances, directions, route numbers, maps, and points of reference. For a team to receive official time, they must follow the official Rayce Route.

7.9.1. Route Revisions - Due to unforeseen events, it may be necessary to detour. When advance warning is available, Rayce Headquarters will correct the official route accordingly and provide revisions to the Route Book to all Rayce teams, or provide written revisions at the Briefing, at Checkpoints, by e-mail, and on the Internet.

7.9.2. Teams Departing from the Rayce Route - Any team leaving the Rayce Route must rejoin the route at the same intersection where they left the route, or they will receive no credit for distance driven beyond that point.

7.9.3. Checkpoints *("Media Stops")* - A Checkpoint, otherwise referred to as a Media Stop, is a mandatory stop. Checkpoints will be established along the Rayce Route. Checkpoints will remain "active" for a specified number of days (or portions of days) and "open" from 7:45 a.m. to 6:30p.m. within those days (by each team's daily start-time clock). After the specified number of active days (or portions of days), Checkpoints will be permanently shut down and will be referred to as "Closed". Failure to stop at an active Checkpoint will result in no credit for distance driven beyond that point. The distance between consecutive Checkpoints will be referred to as an "interval".

Checkpoint stops are mandatory for all solar cars. The length of the Checkpoint stop time will be specified by Rayce Officials (typically this will be 30 minutes). Checkpoints may be added or subtracted as needed by Rayce Officials. Within the Checkpoint area, the movement of all team vehicles shall be under the control of Checkpoint Officials.

Solar charging of solar car batteries and solar car maintenance are allowed during the mandatory Checkpoint time. However, teams must not interfere with or block any other team's passage through the Checkpoint. Teams unable to leave the Checkpoint area after the mandatory time must move their solar car elsewhere. Mandatory time spent in an active/open Checkpoint will not be factored into a team's "Interval Time".

7.9.3.1. Late Arrival at Active Checkpoints – If a team fails to arrive at an active Checkpoint during open hours, they must remain at the checkpoint until open hours to officially check-in at that stop.

7.9.3.2. Arrival at Closed Checkpoints (Missed Checkpoints) - Teams that arrive at a Checkpoint after it has closed (i.e., a missed Checkpoint), must reach the next Checkpoint while it is active and check-in during open hours.

If a team misses one Checkpoint and has not trailered any section of that interval, the team may drive without trailering to the next checkpoint while it is active. They will then receive credit for the entire distance driven to that active Checkpoint.

Teams that miss two consecutive Checkpoints must arrive at the next Checkpoint while it is active and check-in during open hours. Teams must then trailer directly to the end of that stage and will receive no credit for the distance to the end of that stage, or for the distance driven past the first missed Checkpoint.

Teams that miss three consecutive Checkpoints will be disqualified from the Rayce and their observer will be withdrawn.

7.10. Trailering – Should it become necessary to load the solar car onto a trailer for transport, it may be pushed onto the trailer. Battery charging from the solar array while trailering is allowed during non-impound hours.

Once a team has decided to trailer, they must trailer to and check in at the next active Checkpoint. Teams may only resume driving their solar vehicles for credit at an active Checkpoint or Stage location.

See Regulation 8.14 for Trailering Penalties

7.11. Support Vehicles - All vehicles and trailers associated with a team other than the solar car itself are support vehicles. These vehicles must be registered with ASC Headquarters.

7.11.1. Support Vehicle Graphics - All support vehicles, including trailers, must be marked with the team's solar car number (at least 25 cm tall with a 4 cm brush stroke) on both sides and the rear. The name of the team's sponsoring Institution(s)/Company must also be displayed prominently on each vehicle. Additional graphics are permitted provided they are neither offensive nor disruptive.

7.11.1.1. Event Logo - ASC Headquarters will provide 10 Event Logos to be placed on the sides of support vehicles. These logos will not be larger than 30 cm in height by 45 cm in width.

7.11.1.2. CB Channel – All support vehicles on the route must be labeled with the "official event" CB Channel sign on the rear of the vehicle. The sign will be provided by ASC Headquarters and will be no larger than 20 cm by 20 cm.

7.11.1.3. Slow Moving Caravan – A sign provided by ASC Headquarters must appear on the rear of the chase vehicle to warn overtaking traffic of the solar car caravan. The sign will be provided by ASC Headquarters and will be no larger than 50 cm by 50 cm.

7.11.2. Scout Vehicle – Each team will be permitted to include a “scout vehicle” in their convoy for the purpose of investigating road and traffic conditions ahead of the solar car. The scout vehicle must meet US Federal Motor Vehicle Safety Standards. The scout vehicle must display the team's solar car number on its front windshield (at least 15 cm tall), in addition to both sides and the rear. The scout vehicle shall not be larger in height or length than a standard 15-passenger, full-size van. The scout vehicle must maintain at least a 500 meter separation from the solar car caravan. The scout vehicle must not obstruct traffic or other solar car convoys.

7.11.3. Lead Vehicle - Each team must provide a support vehicle meeting US Federal Motor Vehicle Safety Standards to alert oncoming traffic to the presence of the solar car. This "lead" vehicle must travel within 500 meters ahead of the solar car, with its headlights on and with roof-mounted flashing amber lights. The lead vehicle may not tow a trailer. The lead vehicle must display the team's solar car number on its front windshield (at least 15 cm tall), in addition to both sides and the rear. The lead vehicle shall not be larger in height or length than a standard 15-passenger, full-size van.

7.11.4. Chase Vehicle - Each team must provide a support vehicle meeting US Federal Motor Vehicle Safety Standards to protect the solar car from the rear. This "chase" vehicle must follow directly behind the solar car, with roof-mounted, flashing amber lights. The chase vehicle may not tow a trailer. The chase vehicle must display the team's solar car number on its front windshield (at least 15 cm tall), in addition to both sides and the rear. The chase vehicle shall not be larger in height or length than a standard 15-passenger, full-size van.

7.12. Other Support Vehicles - Other support vehicles may travel on the Rayce Route, but must maintain at least a 500 meter separation from the solar car caravan. *(The intent of this rule is to allow support vehicles to be close but they must not obstruct other traffic.)*

7.13. Radios/Communication - The chase vehicle must be in two-way radio communication with the solar car driver/passenger at all times. Additionally, a solar car passenger must be in direct audio or radio contact with the solar car driver. All two-way radio channels must be registered with ASC Headquarters. All teams must also have a separately monitored CB radio in every support vehicle on the route tuned to an "official event" CB channel to communicate with other nearby teams and officials.

7.14. Passing Traffic - When six or more vehicles are lined up behind a team's chase vehicle, the team must pull over as soon as safely possible to allow the traffic to pass.

7.14.1. In Traffic - Teams need not disrupt their own progress to permit other vehicles to pass when they themselves are traveling at the posted speed limit or trapped behind other traffic.

7.15. Passing Teams - In the event that one team is overtaken by another, the overtaking team can signal their intention to pass by flashing the headlights of their lead vehicle between high and low beam. The overtaking team must also attempt to make CB radio contact with the team being passed to coordinate the pass. Once the overtaking team has signalled their intention to pass, the team being passed must facilitate the pass at the first available safe opportunity, either by slowing down by at least 8 kph (5 mph) in a zone where passing is permitted and feasible, or by pulling completely out of the traffic lane.

7.16. Drafting - Drafting by a solar car is prohibited. A solar car will be considered to be drafting if it continuously follows behind another vehicle at less than a three-second interval. The only exception to this is in congested traffic at speeds of 40 k/hr (25 mph) or less.

7.17. Pushing - Except for the following situations, solar cars may not be pushed or pulled from the time they are moved into their starting position for the Daily Start until they reach the finish line later that day. In no case shall regenerative braking be engaged while pushing or pulling the solar car.

7.17.1. Checkpoint - Solar cars may be pushed within the confined area of the Checkpoint.

7.17.2. Emergency - In an emergency or breakdown situation, the solar car must be removed from the road. In this circumstance, the car may be pushed or lifted off the roadway. The solar car may then be pushed or lifted back onto the roadway at the same location where it left the roadway.

7.17.3. Weather - The solar car may be pushed onto and off of a trailer to protect it from the weather, provided the solar car is moved back to its original location after it is unloaded from the trailer.

7.18. Accidents and Reinspection - All accidents involving either solar cars or support vehicles must be reported immediately to ASC Headquarters. In the case of an accident involving personal injury, notification of the appropriate emergency medical services and public safety officials shall take priority. If a solar car is involved in an accident it must:

7.18.1. Stop and be visually inspected by team members and the Observer.

7.18.2. Be re-inspected by an Inspector at or before the next Checkpoint. The Inspector may require repairs prior to resuming the Rayce.

7.19. Timing - Timing and distance determinations for the Event will be the responsibility of ASC Timing Officials. ASC Headquarters will recognize no other timing or distance information.

7.20. Raycing Hours

7.20.1. Staged Start Days are nine hours in length with the start and finish times depending on each vehicle's Official Start Time. For example: an entry with an Official Start Time of 9:00 a.m. may officially Rayce until 6:00 p.m. and an entry with an Official Start Time of 9:32 a.m. may officially Rayce until 6:32 p.m. (See 7.22.2. for allowable stop time window.)

7.20.2. Non-Staged Start Days are 8:00 a.m. to 6:00 p.m. (See 7.22.2. for allowable stop time window).

7.21. Elapsed Time

7.21.1. Interval Time will be based on the actual Rayce Time that elapsed during the interval. Rayce Time will begin from the Official Start Time or the end of the last Checkpoint Time (the time after serving the mandatory checkpoint stop time) and will continue until the team enters the Checkpoint at the end of the interval.

7.21.2. Teams Off Course – If a team departs from the Rayce Route but then returns properly to the route and continues, their Interval Time will be determined in the normal manner; no credit will be given for the time the team was off-course.

7.21.3. Official Interval Time – Official Interval Time will be the Team's Interval Time plus any penalties and any protest filing fees. Note that protest filing fees are counted against the interval on which the protest is filed, whereas penalties are counted against the interval in which the infraction occurred. Thus, the Official Interval Time is not final until after the end of the Rayce.

Official Interval Time = Interval Time + Penalties + Protest Filing Fees

7.21.4. Official Elapsed Time - Each team's Official Elapsed Time for the Rayce will be the sum of the team's Official Interval Time for all of the intervals of the Rayce.

7.22. Overnight Stops

7.22.1. Finishes in a Staged Area - Once a team's solar car crosses the finish line of each stage, the movement of that team's vehicles shall be under the control of Finish Line Officials. Specific areas will be designated for solar charging, Impound, support vehicle parking, Rayce Headquarters. These areas, or others as designated, will become the Staging Area for the start of Raycing for the next stage. Solar cars may be pushed within and between these areas, but regenerative braking may not be used during such times.

7.22.2. Finishes in a Non-Staged Area - Official Rayce Time ends at 6:00 p.m. each day. In the interest of safe bivouac, teams may stop as much as fifteen minutes before or as late as thirty minutes after their Official Stop Time without penalty. The following day they must start as much early or late as they ended the night before. Example: Team A elects to drive 17 minutes late to find an appropriate over night venue. The following morning they may not begin raycing until 8:17 a.m. when their Rayce Time begins. Conversely: Team B elects to stop raycing 7 minutes early. The next morning their Rayce Time begins 7:53 a.m. Teams that elect to stop Raycing more than 15 minutes early will gain no additional credit. Teams that Rayce beyond 30 minutes past their Official Stop Time will be penalized two minutes for every minute beyond that limit. These time adjustments do not apply to staged starts.

7.23. Impound - All registered and sealed batteries must be removed from the solar car and kept overnight in battery boxes/containers (see 5.9.1) that will be secured by the Observer. Headquarters should be appraised of special issues for impound.

7.23.1. Impound Times - Batteries must be impounded by 8:30 p.m. each evening and will be released from Impound at 6:30 a.m. the following morning.

7.24. Accommodations and Lodging - All teams are responsible for team accommodations and food during the Rayce. Teams are responsible for their own reservations.

7.25. Charging Area

7.25.1. Staged - A charging area will be provided for the teams. Internal combustion generators will not be permitted within the charging area. Solar car charging may only occur within this designated area.

7.25.2. Non-Staged - Teams may choose appropriate charging areas.

7.26. Observers - Trained Observers, selected and sponsored by ASC Headquarters, will travel with each team to alert the Inspectors to possible infractions of these Regulations, and to help teams deal with unforeseen events. The Observer has the authority to warn teams when they believe that a rule infraction is imminent. Observers will determine official start times for non-staged starts. Observers may not interpret these Regulations or give advice on Rayce strategy. Observers will be rotated in their team assignments at Checkpoints.

7.26.1. Observer Access for Inspection - Observers will be assigned to keep each solar car in sight from the release from impound to the time of impound each day. The Observers shall witness any and all work done on the solar cars during this period. The Observers must be allowed access to the solar cars for inspection of ballast during all driver/passenger changes.

7.26.2. Observer Record of Performance - The details of the activities of a team will be recorded in a logbook carried by the Observer. The team leader will be permitted to review the book each day; however, failure to do so does not make any record invalid. The records kept by the Observer include the Official Start Time, stopping times (including Checkpoint), the distances traveled, and any apparent rule infractions either by their assigned team or by any other team.

7.26.3. Observer Accommodations

7.26.3.1. During Raycing Hours - Teams must allow the Observer the seat of his or her choice behind the driver in the chase vehicle. The Observer must be able to see the solar car and read the chase vehicle's speedometer from this location, and must also be able to determine, at least periodically, how many vehicles are following behind the team.

7.26.3.2. Before and After Raycing Hours - Teams must provide a secure shelter for the observer and the battery impound box.

7.26.3.3. Meals and Lodging - Observers should be considered another team member for whom the team will supply adequate food, drink, shelter, and amenities.

8. PENALTIES

Any team failing to comply with these Regulations during Scrutineering, the Qualifier, or the Rayce will be penalized. Penalties range from official warnings to disqualification from the Event. It is the responsibility of the Chief Inspector, with input from the other Inspectors and the Observers, to determine whether an infraction occurred, the severity of the incident, and the appropriate penalty. All time penalties will be submitted by the Chief Inspector to Rayce Headquarters for subsequent posting. Disqualification of a team from the Event requires concurrence of the Director. Penalties will generally be applied to Total Elapsed Time on the Official Elapsed Time Sheet (posted by 7 a.m.) on staged days, at the start of non-staged days, or at Checkpoints.

8.1. Posting of Penalties - Except for the last day, all compiled time penalties will be posted and broadcast by Rayce Headquarters by 8 a.m. each morning. On the last day of Raycing, time penalties will be posted no later than 30 minutes after the finish of the Rayce.

8.2. Conduct - Penalties, including disqualification from the Event, may be imposed for improper conduct or the use of alcohol or illegal substances. Improper conduct may include, but is not limited to, improper language, unsportsmanlike conduct, unsafe behavior, or cheating. Teams are responsible for the conduct of all persons associated with the team, whether or not they are officially registered.

8.3. Non-Solar Charging of Batteries - After the start of the Rayce until the official finish, teams will be disqualified from the Event for charging their solar car's storage batteries from any source of energy other than the solar car's solar array, without specific written instruction from Rayce Officials. Such charging of a solar car’s storage battery will constitute replacement and is subject to Regulation 8.4.

8.4. Replacement of Batteries - Decisions to exchange (or externally recharge- see 8.3) all or part of a battery must be communicated formally to the team's Observer or an Inspector. The penalty will be computed as follows:
Time penalty (minutes) = 480 * (n+S)/N, where:
n = number of replacement modules
S = sum of all modules previously replaced
N = total number of modules in solar car battery pack

8.5. Disturbing Official Battery Seals – Solar car batteries will be marked with an official seal. Disturbing these seals in a manner that prevents proper identification by Inspectors may be penalized as though all of the battery modules affected had been replaced.

8.6. Traffic Violations - Any solar car committing a traffic violation may be penalized. Any solar car driver who commits three traffic violations over the course of the Rayce may be individually disqualified from the Event.

8.7. Failure to Allow Other Traffic to Pass - Any team failing to properly facilitate passing by traffic or other teams may be penalized.

8.8. Drafting - A penalty may be assessed for any time a solar car drafts behind another vehicle.

8.9. Pushing - A penalty may be assessed each time a team to pushes or pulls their solar car in order to advance along the Rayce Route. (Except in an emergency as in 7.17.2)

8.10. Improper Ballast - A penalty may be assessed each time a team operates their solar car with ballast that does not match the solar car driver/passenger.

8.11. Unauthorized or Missing Drivers/Passengers - Any solar car that is rayced with an unauthorized or missing driver/passenger, may receive a time penalty. Additionally, the vehicle may be required to return to the starting point of the infraction and drive with an authorized driver/passenger in order to receive credit for driving beyond that point.

8.12. Failure to Impound - A penalty may be assessed for every minute between 8:30 p.m. and 6:30 a.m. that a solar car's Raycing batteries are not in Impound.

8.13. Exceeding Size Specifications - Oversized solar arrays will be penalized up to 10 minutes per Rayce day per excess centimeter in each dimension beyond the allowed size specification. Oversized solar cars will be penalized up to 5 minutes per Rayce Day per excess centimeter in each dimension. If both the array and car are oversized, both penalties will be applied.

8.14. Trailering Penalties - Teams electing to trailer their solar vehicles will be assessed ALL of the pre-published driving time for the intervals of the current stage from the beginning of the stage through the one in which trailering ended, plus a penalty per uncompleted (not driven by solar car) mile of the interval(s) trailered of 1.5 minutes per mile. Teams trailering multiple times in the same stage will not be assessed a specific interval's time more than once.

For example (cities will be updated for the 2005 route asap): if Team ABC trailers the last 20 miles of the interval into Edmond, ABC's time for Rolla through Edmond will be the pre-published driving time for Rolla to Joplin, plus the pre-published driving time for Joplin to Edmond, plus a 30 minute trailering penalty (20 miles x 1.5 minutes per mile). If ABC also trailers the last 50 miles into Albuquerque, ABC's time from Rolla to Albuquerque will be the pre-published time for each interval in the stage, plus a 30 minute trailering penalty (for the miles trailered into Edmond), plus a 75 minute trailering penalty (for the miles trailered into Albuquerque). The interval times for Rolla to Joplin and Joplin to Edmond will not be assessed twice.

8.15. Protests - Any team desiring to file a protest must do so by submitting an official protest (signed by the team leader) to Rayce Headquarters. Protests may be filed for any reason, including disputing a penalty levied against any team, correcting timing errors, or protesting the actions of another team. A "filing fee" of 10 minutes will be assessed against the team's Official Elapsed Time for the day on which the protest is filed. The Jury will hear all protests.

8.16. Protest Judgments - The decision of the Jury is final and no further appeals are allowed. The Jury will notify Rayce Headquarters of their decision, and Rayce Headquarters will then inform the affected teams. The Jury may refund some or the entire filing fee, which will be credited to the day the filing fee was assessed.

8.17. Opportunity to Be Heard - Protests will normally be heard by the jury at the earliest possible jury sitting. It may be necessary in some instances for the jury to postpone the hearing on a protest.

8.18. Time Limit - Except for the last day, all protests against penalties must be filed by 8:30 p.m. the day the penalty is posted. Protests that do not directly relate to a penalty must be filed by 8:30 p.m. on the day after the offence occurred. On the last day of Raycing, protests for any purpose must be filed within 60 minutes after the finish of the Rayce.

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Thanks to all those who contributed to these regulations - the attendees of the 2003 debrief, the Solar Raycing and ASC Tech list members, and the regulations committee.