



North American Solar Challenge 2008

Regulations

Rev B - June 2007

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1. Purpose

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

1.2 Our Mission includes:

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

1.2.B The creation of public awareness and enthusiasm, both for education excellence and engineering creativity itself, and for the technologies and practices that emerge from that excellence.

2. Administration

2.1 Application of Regulations These Regulations will apply to the North 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 North American Solar Challenge newsletter, Official Interpretations and Instructions for Scrutineering. The organizers reserve the right to revise these Regulations at any time.

2.3 Acceptance 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 North American Solar Challenge newsletter or posted to the Internet under “Official Interpretations” on the NASC page in order to become official. During and after Scrutineering, all official interpretations will be announced at Briefings, 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 North American Solar Challenge”. (It may be, that the Name will be appended with a naming sponsor i.e. “The Acme - North 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 a site appropriate to 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 North American Solar Challenge Organizers. Officials having specific duties shall be announced to the teams through the North 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 rule on penalty appeals. 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. Jury meetings will be held in private. A representative of the team(s) involved may attend the deliberations, but not the vote. The Jury will consist of:

2.8.A The event organizer, who will chair the jury and only vote in the case of a tie

2.8.B The chief inspector, or his designate. All inspectors may attend the meeting, but only the chief inspector may vote.

2.8.C Selected members of the NASC advisory board

3. Entries

3.1 Entry Registration The Event is open to all to participate. Registration and payment of the Entry Fee, \$5000 USD, will occur in two parts as described below.

3.1.A Registration Part 1 Each team wishing to participate in the Event must submit an entry package consisting of a Team Entry Form, a signed participation agreement, and the first part of the entry fee, \$1000 USD. This portion of the entry fee is non-refundable. No team will be considered registered until the Entry Form, Participation Agreement, and first part of the Entry Fee are received by NASC Headquarters.

3.1.B Registration Part 2 When the team submits their Mechanical Report (as described in section 3.5.2), the second part of the entry fee, \$4000 USD, must be paid. This portion of the entry fee is also non-refundable. The registration process is not complete until NASC Headquarters has received all documentation and the entire Entry Fee for both steps of the registration process.

3.1.C Grants Teams with demonstrated financial need, and technical potential, may apply for a grant from the event organizers to cover all or part of the part 2 entry fee.

3.2 Registration Deadlines Registration opens January 1, 2007 and closes March 1, 2008.

3.3 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.

3.4 Technical Documents Technical documents describing the solar car's structure, batteries, and solar cells must be submitted to NASC 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.

3.4.A Document Format All technical reports will be submitted in PDF format.

3.4.B Preliminary Mechanical Report A preliminary mechanical design must be submitted to NASC Headquarters by September 1, 2007. Particular attention should be given to the roll over and impact protection systems for the driver. Additional instructions will be provided.

3.4.C Mechanical Report The Mechanical Report must present the as-built design; addressing 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 NASC Headquarters by March 1, 2008.

3.4.D Battery Approval All storage batteries used in the solar car must be approved by NASC Headquarters. Battery forms must be submitted to NASC Headquarters by March 1, 2008. (see 5.7.B for additional information) Mass and cost will be based on manufacturer's data. If an intermediate supplier is used, submit the cell manufacturer's data required on the Battery Approval Form. Please note the definitions included in 5.7.B.1. 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:

3.4.D.1 Manufacturer's name, and contact information

3.4.D.2 Stock number, type, or description

3.4.D.3 Cell & Module voltage (e.g., 1.2, 4, 6, 12, or 24 V)

3.4.D.4 Buss voltage

3.4.D.5 Number of modules to be used in the solar car

3.4.D.6 Manufacturer's specifications, including capacity (kWh), weight (kg), and cost (US\$).

3.4.D.7 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).

3.4.D.8 A description of the battery box(es) and their mounting. Include the chemical compatibility of the box material and the electrolyte in case of leakage.

3.4.D.9 Description of protective system

3.4.E Solar Cell Approval All solar cells must be approved by NASC Headquarters. Solar cell forms must be submitted to NASC Headquarters by March 1, 2008. 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:

3.4.E.1 Manufacturer's name and contact information

3.4.E.2 Stock number, type, or description

3.4.E.3 Manufacturer's quote for cell area (cm²)

3.4.E.4 Manufacturer's quote for performance

3.4.E.5 Cost (US\$) per cell

3.4.E.6 Cell area (cm²) after trimming or cutting or placement on the solar car

3.4.E.7 A layout map of the cells and calculations of total area.

3.5 Team Data Each team must submit a team photo and data sheet to NASC Headquarters by May 1, 2008. 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, 2008 without permission of the team representative.

3.5.A 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 NASC programs and other publications. Additional instructions will be provided.

3.5.B Data Sheets The data sheet must include solar car weight (with battery but no driver), 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, crew members, designated drivers, and faculty advisor(s) must also be listed.

3.5.C 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, 2008 and battery specifications may not change after March 15, 2008 without specific approval from NASC Headquarters. Any changes submitted after June 1, 2008 may not appear in print.

3.6 Participant 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.

3.7 Driver Requirements Only registered solar car drivers will be allowed to drive in solar cars during the Event. A team shall have a minimum of two drivers available at all times. Each team may register at most 4 drivers. In addition to meeting the crew requirements, solar car drivers must be 18 years old or older and must supply their own ballast material (metal shot or coins only). Solar car drivers must present a valid driver's license. The official weight of each driver, including driving clothes, helmet, and shoes, will be 80 kg. If a driver weighs less than 80 kg, ballast will be added to make up the difference. If a driver weighs more than 80 kg, no credit will be given.

3.7.A Driver Information All Drivers will submit an informational form and a copy of their drivers license before scrutineering.

3.8 Insurance All teams must purchase the liability insurance provided by the Organizers or show a certificate of commensurate purchased insurance or self-insurance.

3.9 Graphics Solar cars must prominently display their assigned number, institution(s) 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.

3.10 Solar Car Numbers Each team registered for the Event will have a unique number approved by NASC 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 NASC 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 the digits.

3.10.A Number Assignment Teams which participated in NASC 2005 may have priority for retaining their 2005 car number. Car numbers will be assigned at the Kick-off Conference. Teams not able to attend may contact HQ, but priority may be given to teams at the conference.

3.10.B Number Conflict If a car number conflict arises, NASC Headquarters will determine the numbers assigned.

3.11 Institution Name(s) The name of the Institution(s) or organization sponsoring the team must be displayed on the solar car. NASC Headquarters must approve the use of abbreviations or initials. The Institutions name shall be larger and more prominent than any team sponsors logo or name.

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

3.13 Demonstration Class Vehicles that do not meet these regulations (ie fuel cell, older solar cars) will not be allowed to compete in the Event; but may be allowed to participate as demonstration vehicles, with the permission of the organizers. Teams wishing to participate in Demonstration Class must submit a proposal by January 1, 2008. Demonstration Class cars may be held back by event officials to ensure competing vehicles are ahead. Demonstration class vehicles do not have to meet regulations marked with a •, but must meet all others.

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.A Scrutineering Time and Location The date and location of Scrutineering for North American Solar Challenge is yet to be determined. 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.B Scrutineering Format Scrutineering will involve inspection stations for sizing, driver, 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.C 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 inspectors for each station. Teams may be required to repeat tests with different drivers and/or configurations as directed by the inspectors.

4.2 Qualifier Each team must successfully participate in a Qualifier, a track rally for solar cars, before they will be allowed to compete in the Rayce. The date and location of the Qualifier(s) for North American Solar Challenge is yet to be determined. 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 Solar cars must rayce in the same configuration as approved during Scrutineering and used at the Qualifier. The team with the shortest Official Total 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 technical documents 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.A 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 North American Solar Challenge Headquarters in writing. All written withdrawals signed by the team representative are final. North 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. 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.

5.2.A Solar Arrays • can be either:

5.2.A.1 • 6m^2 of any solar cells, measured by adding the total area of the solar cells from the manufacturers data sheets, validated through measurements. Teams may use no more than 6 types / sizes of solar cells. Teams will provide a detailed map of the car cell types, showing every cell, copies of manufacturers data sheets, and calculations showing the array area of the car with the mechanical report as in Reg. 3.4.C. Sample cells and data sheets must be provided at scrutineering for validation.

5.2.A.2 • Fit into a box of dimensions, not exceeding 5m length and 1.8m width, 1.6m height, in racing configuration, of solar cells that are listed on the NASC2008 Approved list or of other non-photovoltaic cell technology. 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 metalization constitutes manufacture of a new cell. Teams or suppliers wishing to make an addition to the list must submit all appropriate data to NASC Headquarters by January 1, 2008.

5.2.B • All portions of the solar array must be carried by the solar car.

5.3 Raycing Configuration • Whenever the solar car is moving under its own power, the solar array must be in its Raycing configuration. 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. For vehicles with arrays defined in 5.2.A.2, the "box" must be defined such that the length and width lie parallel to the ground in Raycing configuration.

5.4 Charging Orientation • Whenever the solar car is stationary, the photovoltaic cell array may be reoriented to maximize solar exposure for charging. The photovoltaic cell array cannot be reconfigured, only reoriented.

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 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. NASC Officials reserve the right to refuse approval of modules.

5.7.A Weight Limits • cars may use up to:

5.7.A.1 125kg of sealed Pb-acid battery

5.7.A.2 100kg of NiCd battery

5.7.A.3 70kg of NiMH battery

5.7.A.4 30kg of Li-ion or Li-Polymer battery

5.7.A.5 Other energy storage methods (such as other battery technologies or fuel cells) will need to be evaluated by NASC Headquarters. Samples and details of proposed systems must be submitted before October 1, 2007.

5.7.B Protection Circuitry Batteries must have protection circuitry appropriate for the battery technology. Proof is required at scrutineering that the protection system is adequate. Testing procedures will be provided, and the protection system design should allow for testing. Protection circuitry should be primarily for the purpose of protection.

5.7.B.1 Definitions Please use these definitions when describing your pack in the Battery Approval Form

5.7.B.1.a Cell The smallest available source of energy in your battery pack that you purchase from a manufacturer. A single electrochemical cell.

5.7.B.1.b Module The smallest easily removable group in your battery.

5.7.B.1.c String The series group of cells needed in your battery pack that provide the required voltage.

5.7.B.1.d Protection Limit The measured level that your team decides is adequate to protect from an event

5.7.B.1.e Active Active means constantly monitored measurements where action can be taken immediately without operator intervention.

5.7.B.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. Fuses are not acceptable for over-current protection, but are required as in 5.9.

5.7.B.2.a Isolation MOSFETs or other solid state switches are not acceptable for isolating Li-Ion Packs.

5.7.B.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.

5.7.B.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.

5.7.C 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%.

5.7.D 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, and horn.

5.7.E 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.

5.8 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. The type (ie Li-ion, Pd-Acid) of the battery must be marked on the top of the battery enclosure(s) in 10-mm-high letters. No more than two separate enclosures may be used for batteries in 5.7.A.4 (Li-ion/Polymer); other battery types may use up to four separate enclosures.

5.8.A Battery Removal • Battery enclosures must be designed such that the entire set may be removed and placed in impound (see 7.22). 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.

5.8.B 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.

5.8.C Battery Ventilation Battery enclosures must be equipped with a forced ventilation system rated at a minimum of 280 liters per minute exhaust flow. 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.

5.9 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.

5.10 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 in normal driving configuration and the labels visible to 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.

5.10.A External Power Cut Off Switch The solar car must be equipped with an externally activated electrical cutoff switch. This switch must meet the electrical requirements of Regulation 5.10. The switch can be the same as in 5.10, provided it can meet all the requirements for both sections. The switch may be actuated remotely using a mechanical linkage. The switch actuator must be located on the exterior of the car, on an upper surface of the car, near the cockpit on the driver's left hand side of the car.

This external switch actuator must be clearly marked by the international marking of a red spark within a white-edged blue triangle, with the smallest dimension of the triangle being at least 25 mm, and the longest being at least 50 mm. Along with the triangle, a clear direction how to open the switch must be displayed using letters (10 mm minimum height). Non-limiting examples of such directions would include PUSH, PULL, or OFF with another arrow pointing in the correct direction of actuation.

The cover must be labeled in such a manner (10 mm minimum letter height) as to simply direct the user as to how either remove the cover or how the switch can be activated through the cover. The blue triangle marking may be located on the cover, but must not obstruct the view of the switch or actuator.

The switch may be covered with a colorless, transparent cover. Such a cover must be demonstrated that either:

5.10.A.1 the cover is quickly removable without tools, excessive force or damaging the switch mechanism *OR*

5.10.A.2 the switch may be activated normally, without tools, without excessive force, through the cover.

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

5.12 Electrical Shock Hazards All exposed or easily exposed conductors, junction boxes, solar cells, etc., operating at greater than 32 volts must be protected from inadvertent human contact and must be marked

“High Voltage” in letters at least 10 mm high.

5.13 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.

5.14 Strobe An amber strobe light must be mounted near the top of the car, must be powered off the main batteries, and run whenever the car motor switch is on. It must be visible from 315 degrees; it should be blacked out for 45 degrees facing backwards to reduce strain on the chase vehicle crew. It should be clearly visible from at least 30m in full sunlight and flash at least once every 3 seconds.

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. 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 (see 5.2 for array dimensions) length=5 meters, height=1.6 meters, width=1.8 meters. When turning corners, wheels and wheel fairing 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.

6.3.A Tire sets Only 4 tire type configurations will be allowed. (ie Configuration 1: Tire Brand A on all wheels; Configuration 2: Tire Brand A in front and Tire Brand B on rear) Tire ratings must meet worst case tire loading in all configurations.

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 Cockpit The driver's cockpit may not subject the driver to excessive strain during normal operation, and must be designed to protect the driver from injury in the event of an accident. The driver must be provided adequate space for safe operation of the vehicle, and clear of any moving parts or linkages.

6.5.A Seating Position • The normal driving/riding position must place the driver's entire head higher than the highest point of his or her legs and feet. No head-first positioning is allowed for the driver. The driver must be seated at less than or at a 27 degree angle, as measured in Appendix A. The seat must be appropriately constructed with a solid base and back rest.

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

6.5.C Roll Cage All solar cars must be equipped with a roll cage that encompasses the entire driver 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 in a collision must be documented in the team's Mechanical 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 in the event of an accident. There must be 5cm of clearance in all directions

between the roll cage and the helmet of the driver seated in the normal driving position. There must be at least 3cm of clearance between the driver's head and the padding. 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 are permitted, provided they are fully documented in the team's Mechanical Report. A preliminary sketch and description of the roll cage must be submitted to NASC Headquarters by September 1, 2007 (see 3.4.B).

6.5.D Padding The roll cage must be padded with energy-absorbing material, meeting SFI-45.1 or better, wherever it may come into contact with the driver's helmet. In addition, a headrest of at least 2 cm thick resilient material must be mounted behind the driver's head.

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

6.5.F Safety Belts All solar cars must be equipped with a minimum of a five-point lap and shoulder belt (harness system) for each driver. 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. Bolts threaded into a structural member or "insert" are not allowed. Only commercially manufactured safety belt systems are allowed, and any modifications must be approved by the manufacturer.

6.5.G Outside Air Circulation Outside air, directed towards the driver's face, from intake vents or wheel openings must be provided.

6.5.H Egress The driver's cockpit must provide for the driver's unassisted exit, standing clear of the car, within 10 seconds. Driver's doors and/or canopy may not be taped shut at any time. Wheel chocks are not permitted.

6.6 Visibility

6.6.A 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.B 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 m² 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.C Forward Vision 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. From the normal driving position, the driver must be able to see at all times without artificial assistance:

- 6.6.C.1** a point on the ground 8 meters in front of the solar car,
- 6.6.C.2** a minimum of 17 degrees above the horizon on level ground, and
- 6.6.C.3** a full 100 degrees to either side of center.

6.6.D 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. Having the driver identify the direction of an arrow on a 1m² 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.A 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.B Securing of Bolts The bolts described above 6.7.A must be secured from unintentional loosening by safety wire or cotter pins. In other areas, Inspectors may allow Loctite, nylon lock nuts, or other means deemed appropriate. Lockwashers may not be used.

6.7.C 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.D 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 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 Ballast Any solar car drivers 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.

6.11.A 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.)

6.11.B Ballast Access The ballast container and its identification and security markings must be visually accessible during driver changes.

6.12 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.

6.12.A 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.

6.13 Parking Brake Solar cars must be equipped with a parking brake which:

6.13.A operates completely independently from the main brake system.

6.13.B can be locked in the 'ON' position, so the driver does not need to hold it

6.13.C can hold the car in place without wheel chocks on a 10% grade

6.13.D is independent of the brakes in 6.12 and not used in performance tests for 6.12.A

6.14 Steering Wheel • All cars steering must be controlled by a steering wheel with a continuous perimeter as in B

6.15 Steering Static Test • All drivers must be able to turn the car steering lock to lock with the car static, in race configuration (with driver and ballast).

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

6.16.A 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, as illustrated in Figure 6.1) 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.

6.16.B Stability at Speed Solar cars must be able to stay within a 4 meter lane for at least 250m. If a car cannot do this at 65mph, the car speed will be limited to where it can stay within a 4m lane for the entire event.

6.16.C Slalom Test Solar cars must be able to negotiate a slalom course 126m long, with cones every 18m as in 6.2 in 11.5 seconds.

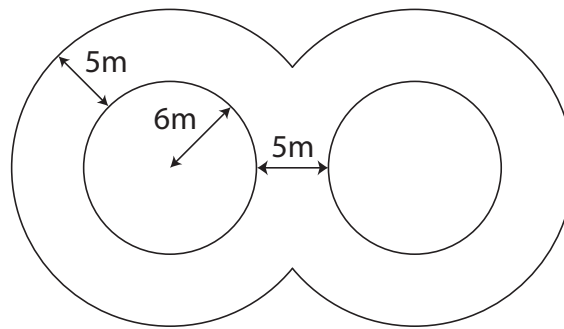


Figure 6.1: Figure-8 Test

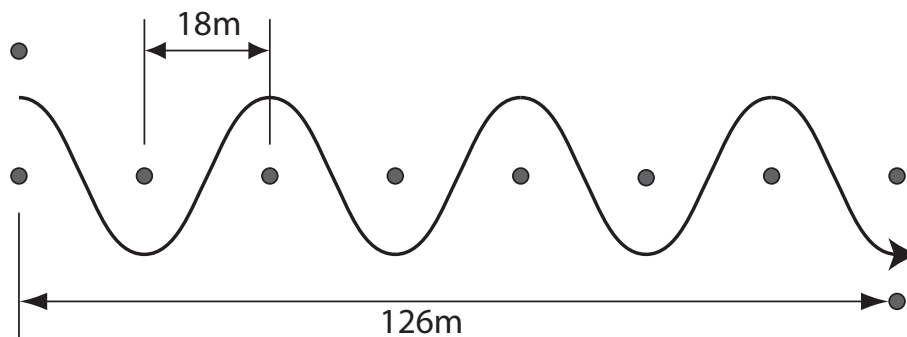


Figure 6.2: Slalom Course

6.16.D 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.

6.17 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 two pounds and has an antenna of approximately two square inches that requires exposure to the sky (can be through a transparent medium). Additional details will be provided by NASC Headquarters.

6.18 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.C allows the car to be scrutinized in any, or multiple, configuration(s) of the inspector's selection.)

6.19 Towing Hardpoint • Solar cars must be equipped with a hardpoint where an appropriate rope or strap may be attached in order to tow the car for recovery purposes. The hardpoint must be either securely attached to, or part of, a non-moving structural component. The hardpoint may be covered while not in use. The hardpoint must allow the car to be pulled with the body installed on the car, however the canopy may be removed.

7. Raycing

7.1 Rayce Format The Rayce is comprised of a series of stages between predetermined locations (Stage Points) following a specific Rayce Route. Each stage will begin with a Staged Start, where all solar cars are released from the same point. The distance between two Stage Points (with the exception of the last stage) 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 Stage Point (and does not trailer to the Stage Point), the team will stop where they are located along the Rayce Route. The team will begin the

next morning at the same point, following regulations established for Non-Staged Starts. Stages may also have mandatory Checkpoints. Interval time will be calculated from each stage/checkpoint to the next stage/checkpoint, including any penalties and posting fees incurred in the interval. The summation of these interval times will yield an Official Total Elapsed Time for the entry. Overall placing will be determined based on the lowest Official Total Elapsed Time.

7.2 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, unless set lower as in 6.16.B. (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).

7.3 Team Uniforms On Rayce Days from 6:30 a.m. to 8:30 p.m., team members shall wear uniforms representing their Institution(s). The uniforms are required to have the Institution name, car number, and NASC logo. If team sponsors are displayed, the event sponsor(s) must also appear in a similar manner on the team uniform. Artwork for the NASC logo and for the event sponsor(s) may be obtained from NASC Headquarters.

7.4 Drivers Only one person, the authorized driver, may ride in the solar car at any time.

7.4.A Driver Helmets Driver must wear a helmet while operating the solar car. The helmet must meet or exceed the Snell M95 or DOT motorcycle standard. Bicycle helmets will not be allowed.

7.4.B Driver Shoes Driver must wear closed-toed shoes in the solar car. Sandals are not permitted.

7.4.C Driver Ballast Drivers and corresponding 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 at all times.

7.4.D Driving Time Each individual Driver may not drive more than a total of six hours in a given Rayce Day.

7.4.E Water/Fluids Each driver must have sufficient quantities of water/fluids in the cockpit area to stay properly hydrated. (A minimum of one liter for each driver must be provided).

7.5 Support Vehicles All vehicles and trailers associated with a team other than the solar car itself are support vehicles and must be registered with NASC headquarters. All vehicles must meet US/Canada Federal Motor Vehicle Safety Standards.

7.5.A 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) must also be displayed prominently on each vehicle. In addition, the scout, lead, and chase vehicles must also display the team's solar car number on the top passenger side of the front windshield (at least 15 cm tall). Additional graphics are permitted, provided they are neither offensive nor disruptive.

7.5.A.1 Event Logo NASC Headquarters will provide 4 Event Logos to be placed on the sides of the Lead and Chase vehicles. These logos will not be larger than 20 cm in height by 30 cm in width.

7.5.A.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 NASC Headquarters and will be no larger than 20 cm by 20 cm.

7.5.A.3 Slow Moving Caravan A sign provided by NASC Headquarters must appear on the rear of the chase vehicle to warn overtaking traffic of the solar car caravan. The sign will be no larger than 50 cm by 50 cm.

7.5.B Scout Vehicle Each team is 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 shall not be larger in height or length than a standard 15-passenger, full-size van. The scout vehicle must maintain at least a 1km separation from all solar car caravans. The scout vehicle must not obstruct traffic or other solar car convoys.

7.5.C Lead Vehicle Each team must provide a "lead vehicle" to alert oncoming traffic to the presence of the solar car. The lead vehicle must travel within 500 meters ahead of the solar car, with its headlights on and with roof-mounted flashing amber lights visible from ahead. The lead vehicle may not tow a trailer. The lead vehicle shall not be larger in height or length than a standard 15-passenger, full-size van.

7.5.D Chase Vehicle Each team must provide a "chase vehicle" to protect the solar car from the rear. The chase vehicle must follow directly behind the solar car, with roof-mounted, flashing amber lights visible from the rear. The chase vehicle may not tow a trailer. The chase vehicle shall not be larger in height or length than a standard 15-passenger, full-size van.

7.5.E Other Support Vehicles Additional support vehicles, including truck/trailer units, may travel on the Rayce Route, but must maintain at least a 1km separation from the solar car caravan. (The intent of this rule is to allow other support vehicles to be close but they must not obstruct other traffic or other solar car convoys.)

7.6 Radios/Communication The chase vehicle must be in two-way radio communication with the solar car driver at all times. All two-way radio channels must be registered with NASC 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.

7.6.A Observer Monitoring All communications between the solar car driver and support vehicles must be audible (for voice communications), or visible (for text messaging), to the observer at all times. Any communications in languages other than english, in code, or via text messaging, must be explained to the observer if the observer requests it.

7.7 Briefings A Briefing will be held at 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.

7.7.A Official Statements, including rule interpretations and special instructions shall be announced at Briefings.

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

7.8 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 Rayce Officials. The same official clock 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.

7.9 Starting Order The starting order for the first day of the Rayce will be determined based on performance during 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 stages finish line will precede the others in the starting line-up.

7.9.A 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.

7.10 Starting Line

7.10.A Staged Starts Each team will be assigned a start time, which will be distributed to the teams at the Briefing. 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 were not 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. 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.

7.10.A.1 Delayed Start The start of the Rayce, at any stage start, may be delayed if inclement weather or other hazardous conditions appear likely to pose a threat to the solar cars or their driver. If the start of the Rayce is delayed, then all assigned start times for that day will be adjusted accordingly.

7.10.B Non-Staged Starts Solar cars will be released from their start point at 8:00 a.m. (See 7.21.B for adjusted non-staged start times based on the allowable stopping window from the previous day)

7.11 Rayce Route A North 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.

7.11.A Route Revisions Due to unforeseen events, it may be necessary to detour from the official route. 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/or on the Internet.

7.11.B 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.

7.11.C Checkpoints ("Media Stops") A Checkpoint, otherwise referred to as a Media Stop, is a mandatory stop in a predetermined location 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 (according to 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".

7.11.C.1 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, or they will be required to trailer the remainder of the stage. Teams do not stop at closed checkpoints.

7.11.C.2 Array Stands Array stands are not permitted at checkpoints.

7.12 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 8.17 for Trailering Penalties)

7.13 Passing Traffic When six or more vehicles are lined up behind a team's chase vehicle, (including other teams solar car caravan wishing to pass) the team must pull over as soon as safely possible to allow the traffic to pass.

7.13.A 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.

7.14 Passing Teams In the event that one team is overtaken by another, the overtaking team signals 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 signaled 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.

7.15 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.

7.16 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. In no case shall regenerative braking be engaged while pushing or pulling the solar car.

7.16.A Checkpoint Solar cars may be pushed within the confined area of the Checkpoint.

7.16.B 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.

7.16.C 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.

7.17 Accidents and Reinspection All accidents involving either solar cars or support vehicles must be reported immediately to NASC 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:

7.17.A Stop and be visually inspected by team members and the Observer.

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

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

7.19 Raycing Hours

7.19.A 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 7.21.B for allowable stop time window.)

7.19.B Non-Staged Start Days are 8:00 a.m. to 6:00 p.m. (See 7.21.B for allowable stop time window and adjusted non-staged start time).

7.20 Elapsed Time

7.20.A Interval Time will be based on the actual Rayce Time that elapsed during the interval. Rayce Time will begin from the Official Start Time (at a Stage Point) 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 next Stage/Checkpoint.

7.20.B 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.

7.20.C 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

7.20.D 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.

7.21 Overnight Stops

7.21.A Finishes at a Stage Point 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, and 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.

7.21.B Finishes Not at a Stage Point 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.

7.22 Impound All registered and sealed batteries must be removed from the solar car and kept overnight in battery boxes/containers (see 5.8) that will be secured by the Observer. Headquarters should be appraised of

special issues for impound.

7.22.A 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.

7.22.B Impound Rules at Stage Locations After crossing the finish line at the end of a stage, each team will be given 30 minutes to impound their batteries. This time includes moving the solar car to an area designated by the Finish Line Officials, removing the battery pack, placing the batteries in the approved impound box, and delivering to the designated impound area. At 6:00 p.m. that evening, the batteries will be released from impound, and the team may charge from then until the regular night impound time, as described in 7.22.A.

7.23 Charging Area

7.23.A 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.

7.23.B Non-Staged Teams are responsible for choosing appropriate charging areas.

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 Observers Trained Observers, selected and sponsored by NASC Headquarters, will travel with each team to alert the Inspectors to possible infractions of these Regulations, and to help teams deal with unforeseen events. 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 and Stage Locations.

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

7.25.B 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 Checkpoints), the distances traveled, and any apparent rule infractions either by their assigned team or by any other team.

7.25.C Observer Accommodations

7.25.C.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. The Observer must also be able to determine, at least periodically, how many vehicles are following behind the team.

7.25.C.2 Before and After Raycing Hours Teams must provide a secure shelter for the observer and the battery impound box.

7.25.C.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 on staged days, at the start of non-staged days, or at Checkpoints.

8.1 Penalty Times All penalty times listed are suggested minimums. Driving conduct penalties (8.4-8.9) may double with each subsequent infraction. Mathematical penalties (8.12-8.17) will normally be the same each infraction. If inspectors believe the teams are deliberately violating traffic or driving regulations for strategic advantage,

they may impose more severe penalties.

8.2 Posting of Penalties Penalties will be publicly posted by 7:30pm the night before the start of the next stage. All teams must provide a cell phone number and alternate to NASC headquarters, with functioning voice mail, which is checked regularly, where penalties can be officially delivered to the team. On the last day of Raycing, time penalties will be posted no later than 30 minutes after the finish of the Rayce.

8.3 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.

8.4 Speeding Any solar car speeding may be penalized 5min. Speeding penalties may be assessed based on the speed of either the solar car itself or the chase vehicle.

8.5 Traffic Violations Any solar car committing a traffic violation may be penalized, up to disqualification. Any solar car driver who commits three traffic violations (including speeding) over the course of the Rayce may be individually disqualified from the Event.

8.6 Failure to Allow Other Traffic to Pass Any team failing to properly facilitate passing by traffic or other teams may be penalized 5min.

8.7 Support Vehicles Impeding Rayce Any support vehicles too close to solar car caravans (7.5.E, 7.5.B) or impeding another teams solar car caravan will be penalized 10min.

8.8 Drafting A 5min penalty may be assessed for any time a solar car drafts behind another vehicle.

8.9 Pushing A 2min penalty may be assessed each time a team pushes or pulls their solar car in order to advance along the Rayce Route. (Except in an emergency as in 7.16)

8.10 Improper Ballast A 30min penalty may be assessed each time a team operates their solar car with ballast that does not match the solar car driver.

8.11 Unauthorized Drivers Any solar car that is rayced with an unauthorized driver may receive a time penalty. The vehicle will be required to return to the starting point of the infraction and drive with an authorized driver in order to receive credit for driving beyond that point.

8.12 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 cars storage battery will constitute replacement and is subject to Regulation 8.14.

8.13 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 as in 8.14.

8.14 Replacement of Batteries Decisions to exchange (or externally recharge - see 8.12) 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) = $480 \times \frac{n+S}{N}$, where:

n = number of replacement modules

S = sum of all modules previously replaced

N = total number of modules in solar car battery pack

8.15 Failure to Impound A 2min penalty may be assessed for every minute between 8:30 p.m. and 6:30 a.m., or any time between the 30min after finishing allowed at the end of a stage and 6pm, that a solar car's Raycing batteries are not in Impound.

8.16 Exceeding Size Specifications Oversized solar arrays will be penalized 10 minutes per Rayce day per excess centimeter in each dimension beyond the allowed size specification. Oversized solar cars will

be penalized 5 minutes per Rayce Day per excess centimeter in each dimension. If both the array and car are oversized, both penalties will be applied.

8.17 Trailing 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 trailing ended, plus a penalty per uncompleted (not driven by solar car) mile of the interval(s) trailed of 1.5 minutes per mile. Teams trailing multiple times in the same stage will not be assessed a specific interval's time more than once.

For Example:

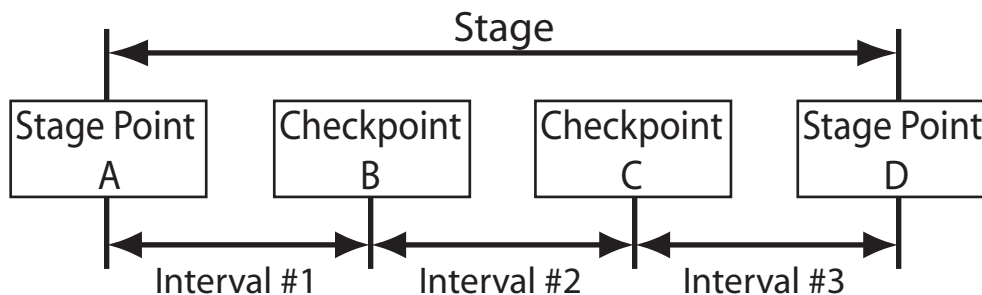


Figure 8.1: Stages, Checkpoints and Intervals

If Team XYZ trailers the last 20 miles of Interval #2, XYZ's time for Stage Point A through Checkpoint C will be the pre-published driving time for Interval #1, plus the pre-published driving time for Interval #2, plus a 30 minute trailing penalty (20 miles \times 1.5 minutes per mile). If XYZ also trailers the last 50 miles into Stage Point D, XYZ's time from Stage Point A to Stage Point D will be the pre-published time for each interval in the stage (Intervals #1, #2, and #3), plus a 30 minute trailing penalty (for the miles trailed into Checkpoint C), plus a 75 minute trailing penalty (for the miles trailed into Stage Point B). The interval times for Interval #1 and #2 will not be assessed twice.

8.18 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.

8.19 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.

8.20 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.

8.21 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 6:30 p.m. on the last day of the stage when the offense occurred. On the last day of Raycing, protests for any purpose must be filed within 60 minutes after the finish of the Rayce.

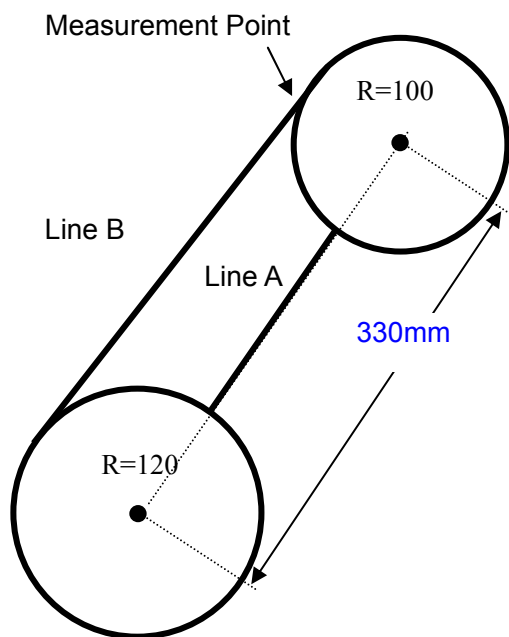
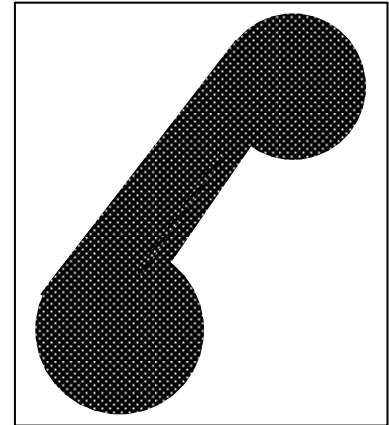
A. ISF Standard Measurement of Seating Angle

International Solarcar Federation Standard Measurement of Seating Angle

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The seating angle must not exceed 27 degrees

For ISF scrutineering purposes, measurement is effected by using a template based on the hip and shoulders of a two-dimensional form.



Making a Template

- Draw a circle with a radius of 120mm.
- At a point 330mm from the centre of the circle, draw another circle with a radius of 100mm
- Draw a line connecting the centre of the two circles (Line A).
- Draw a tangent to connect the circumferences of two circles (Line B)
- Cut the shape using suitable material
- Attach a plumb line to the measurement point
- The angle is measured between line A and the perpendicular.

B. ISF Standard Steering Wheel Specification

Refer to Panasonic World Solar Challenge Regulations Appendix 1. Available at:
<http://www.wsc.org.au/2007>

C. Recommendations

These are not binding parts of the regulations, as they are impractical to enforce fairly, but the NASC officials believe they are essential to creating a good, safe solar car. All teams should meet these recommendations on their own.

C.1 Driver Training Driver Training is essential to ensuring your car can be driven safely. Solar vehicles have substantially different controls, field of vision, and feedback from regular vehicles. We recommend that every team trains all drivers in a gradual and controlled manner. This means that a driver will begin learning to handle the vehicle in a very controlled setting (such as a large closed parking lot or track) and progress to more challenging situations as he/she gains experience. Prior to any driving, the vehicle should always be given a safety check and the driver should have properly functioning safety equipment. As training progresses, the driver (and all team members in the caravan) should practice handling the following situations:

1. Blow-outs and run flats, especially of the single rear wheel on a three wheel vehicle
2. Loss of power
3. Primary brake partial and complete failure
4. Passing protocols
5. Merging protocols
6. Road hazard avoidance
7. Moving to shoulder from operational speed
8. Caravan communication and protocols for possible emergencies
9. Emergency stop and egress

C.2 Vehicle Stability and CG CG location has an important influence on vehicle stability. Your CG location should be a **design requirement**, not something you find after you build the car. Information about recommended CG location, and its influence, will be posted on the NASC website.

D. Revision Table

Rev	Description	Date
Draft	Major New / Changed Regulations from 2005: 2.8 2.8.A 2.8.B 2.8.C 3.4.A 3.4.B 3.4.E.7 3.7 3.7.A 5.2.A.1 5.2.A.2 5.4 5.7.A.1 5.7.A.2 5.7.A.3 5.7.A.4 5.7.B.2 5.7.B.2.a 5.8 5.10.A 5.10.A.1 5.10.A.2 5.14 6.3.A 6.5.A 6.5.D 6.5.F 6.5.G 6.5.H 6.7.B 6.13 6.14 6.15 6.16.B 6.16.C 7.2 7.6.A 7.11.C.1 7.11.C.2 7.22.B 8.1 8.2 8.4 8.7 8.17 8.21	Jan 2007
Release	1. Edits: 3.13 5.2.A.2 5.3 5.4 5.7.A.4 5.8 5.10.A 5.10.A.2 5.14 6.5.E 6.13.D 7.22.B 8.15 2. 5.7.D Telemetry system cannot be run on Supplementary Pack.	Feb. 2007
Rev B	Changed 3.13 and marked related regulations	June 2007