

# MICROFILM DIVIDER

OMB/RECORDS MANAGEMENT DIVISION

SFN 2053 (2/85) 5M



ROLL NUMBER

DESCRIPTION

1452

2001 HOUSE TRANSPORTATION

HB 1452

2001 HOUSE STANDING COMMITTEE MINUTES

BILL/RESOLUTION NO. HB 1452

House Transportation Committee

Conference Committee

Hearing Date February 2, 2001

Tape Number	Side A	Side B	Meter #
1	8		4,031
Committee Clerk Signature <i>Laurence B. Zink</i>			

Minutes: Rep. Weisz - Chairman opened the hearing on HB 1452; A BILL for an Act to create and enact a new section to chapter 39-21 of the North Dakota Century Code, relating to experimental vehicles.

Rep. Grosz: For the record I represent District 42, Grand Forks. The University of North Dakota engineering students for several years and this NDSU engineering students are entering their designed and built solar powered cars in national competition. The cross country race will be this summer from Chicago to California. The cars are need to be road tested and driver to prove their road worthiness. Usually the highway patrol has the duty of certifying home build vehicles and experimental vehicles but the way our statutes read they can not begin to certify our solar cars. The reason being some of the details included in the statutes address hood latches ( a safety concern ) and of course solar cars do not have combustion engines therefore no hoods. The hoods are the solar cell panels. The are many others examples of things like that. Yet there are no safety short cuts on brakes, controls, lights, turn signals and the like. The purpose of this bill is to

provide for exceptions limited specifically to solar vehicles so that we can actually road test them. We have 25 students members of the race team here from UND. They have drawings, rendering, and specifications with them for you to look at and to ask questions. Most of them are engineering students in the various fields of engineering. I believe that they will be able to answer your technical questions. We also have members of the NDSU engineering team here. They will also address their progress and participation. The drawings and renderings were taken back with the teams; however, the competition contest rules specifying the structural, safety, and other features of the of the solar vehicles is attached.

Committee members showed a great interest in the vehicles and the competition asking questions regarding blinkers, rear view mirrors, highway speeds, economies, chemical versus electrical power efficiencies, lead and chase vehicles, etc.

At the recommendation of Rep. Grosz, the committee amended HB 1452 to provide for an emergency clause. The basis for the emergency clause was to allow both schools to road test their vehicles currently under construction; to provide for High Patrol inspection and to allow time for modifications prior to these summers race competition.

There was no opposition testimony.

Rep. Carlson: ( 5746 ) I move the amendment to HB 1452.

Rep. Kelsch: I second the motion for the amendment.

On a voice vote the amendment was approved.

Rep. Carlson: ( 5818 ) I move a 'Do Pass as amended' for HB 1452.

Rep. Kelsch: I second that motion.

On a roll call vote the motion carried unanimously: 12 yeas 0 nays 2 absent.

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House Transportation Committee

Bill/Resolution Number HB 1452

Hearing Date February 2, 2001

Rep. Ruby was designated the carry HB 1452 on the floor. ( 5764 )

**FISCAL NOTE**  
 Requested by Legislative Council  
 03/12/2001

Bill/Resolution No.:

Amendment to:           Engrossed  
                                   HB 1452

**1A. State fiscal effect:** *Identify the state fiscal effect and the fiscal effect on agency appropriations compared to funding levels and appropriations anticipated under current law.*

	1999-2001 Biennium		2001-2003 Biennium		2003-2005 Biennium	
	General Fund	Other Funds	General Fund	Other Funds	General Fund	Other Funds
Revenues						
Expenditures						
Appropriations						

**1B. County, city, and school district fiscal effect:** *Identify the fiscal effect on the appropriate political subdivision.*

1999-2001 Biennium			2001-2003 Biennium			2003-2005 Biennium		
Counties	Cities	School Districts	Counties	Cities	School Districts	Counties	Cities	School Districts

**2. Narrative:** *Identify the aspects of the measure which cause fiscal impact and include any comments relevant to your analysis.*

The fiscal impact of this bill would be less than \$5,000 per biennium.

**3. State fiscal effect detail:** *For information shown under state fiscal effect in 1A, please:*

**A. Revenues:** *Explain the revenue amounts. Provide detail, when appropriate, for each revenue type and fund affected and any amounts included in the executive budget.*

**B. Expenditures:** *Explain the expenditure amounts. Provide detail, when appropriate, for each agency, line item, and fund affected and the number of FTE positions affected.*

**C. Appropriations:** *Explain the appropriation amounts. Provide detail, when appropriate, of the effect on the biennial appropriation for each agency and fund affected and any amounts included in the executive budget. Indicate the relationship between the amounts shown for expenditures and appropriations.*

<b>Name:</b>	Keith Kiser	<b>Agency:</b>	NDDOT
<b>Phone Number:</b>	328-2725	<b>Date Prepared:</b>	03/12/2001

10624.0101  
Title.0200

Prepared by the Legislative Council staff for <sup>VR</sup> 2/7/01  
Representative Grosz  
January 23, 2001

House Amendments To HB 1452 House Trn 2-07-01

Page 1, line 2, after "vehicles" insert "; and to declare an emergency"

Page 1, after line 14, insert:

"SECTION 2. EMERGENCY. This Act is declared to be an emergency measure."

Renumber accordingly

Date: 2/02/01  
 Roll Call Vote #:

2001 HOUSE STANDING COMMITTEE ROLL CALL VOTES  
 BILL/RESOLUTION NO. HB 1452

House Transportation Committee

Subcommittee on \_\_\_\_\_  
 or  
 Conference Committee

Legislative Council Amendment Number \_\_\_\_\_

Action Taken Do Pass as Amended

Motion Made By Rep. Carlson Seconded By Rep. Kelsch

Representatives	Yes	No	Representatives	Yes	No
Robin Weisz - Chairman	✓		Howard Grumbo	✓	
Chet Pollert - Vice Chairman	✓		John Mahoney	✓	
Al Carlson	✓		Arlo E. Schmidt	✓	
Mark A. Dosch	✓		Elwood Thorpe	A	
Kathy Hawken	✓				
Roxanne Jensen	✓				
RaeAnn G. Kelsch	✓				
Clara Sue Price	✓				
Dan Ruby	✓				
Laurel Thoreson	A				

Total (Yes) 12 No 0

Absent 2

Floor Assignment Rep. ~~Ruby~~ Ruby

If the vote is on an amendment, briefly indicate intent:



REPORT OF STANDING COMMITTEE (410)  
February 7, 2001 10:17 a.m.

Module No: HR-22-2562  
Carrier: Ruby  
Insert LC: 10624.0101 Title: .0200

**REPORT OF STANDING COMMITTEE**

HB 1452: Transportation Committee (Rep. Welsz, Chairman) recommends  
**AMENDMENTS AS FOLLOWS** and when so amended, recommends **DO PASS**  
(12 YEAS, 0 NAYS, 2 ABSENT AND NOT VOTING). HB 1452 was placed on the  
Sixth order on the calendar.

Page 1, line 2, after "vehicles" insert "; and to declare an emergency"

Page 1, after line 14, insert:

**"SECTION 2. EMERGENCY.** This Act is declared to be an emergency  
measure."

Renumber accordingly

2001 SENATE TRANSPORTATION

HB 1452

2001 SENATE STANDING COMMITTEE MINUTES

BILL/RESOLUTION NO. HB 1452

Senate Transportation Committee

Conference Committee

Hearing Date 3-1-013-8-01

Tape Number	Side A	Side B	Meter #
1	x		29,4-30,7
2	x		1,6-5,6
Committee Clerk Signature <i>Suzette Schief</i>			

Minutes: **HB 1452** relates to experimental vehicles.

**Rep. Michael Grosz:** (District 42; Supports) See attached handouts. Solar cars do not meet criteria to become a registered vehicle. If it can't be a registered vehicle, then it can not get insurance or practice on our roadways. I'd like to see exceptions made for experimental vehicles.

**Senator Trenbeath:** The last sentence in the bill is unconstitutional. That needs to be looked at.

**Keith Magnusson:** ( Director of Driver Vehicle Services; Neutral) What we do before we register a vehicle is refer them to the Highway Patrol to see if vehicle meets safety standards and therefore be able to drive on the road. We will not register them until this happens.

**Senator Espegard:** What is the real intent of this bill?

**Rep. Grosz:** Currently, solar cars can not drive on ND roads and they are not able to test or practice. We are planning not to drive on the highways, but rather less traveled county roads.

**Senator Trenbeath:** How do other states test their solar cars?

Page 2  
Senate Transportation Committee  
Bill/Resolution Number HB 1452  
Hearing Date 3-1-01;3-8-01

**Rep. Grosz:** They take it to a testing site. Last year ND took their solar car to Nevada a week before the races to test on a site there.

**Senator O'Connell:** What would be wrong with giving the Highway Patrol authority to issue a permit for these vehicles?

**Senator Stenehjem:** The permit could place restrictions where they need to be placed. For example, they can't drive on highways and only on certain roads.

**Col. Jim Hughes:**(Superintendent of Highway Patrol; Neutral) HB 1452 is so broad. We can work it out and compromise. A permit could be worked in. We could eliminate the licensing part and possibly put in fees, etc. We will look at this and come back with something everyone will be happy with.

**Senator O'Connell:** This takes care of the safety issue then too.

Hearing closed.

Committee reopened on 3-8-01.

Rep. Grosz hands out proposed amendments and see attached testimony.

Mark Betke states that he has viewed these amendments and is happy with them.

Senator Espeguard motions to adopt the amendments. Seconded by Senator Trenbeath. Roll call taken. 6-0-0. Senator Espeguard motions to Do Pass as amended. Seconded by Senator Trenbeath.

Roll Call taken. 6-0-0. Floor carrier is Senator Espeguard.

Committee closed.

PROPOSED AMENDMENTS TO ENGROSSED HOUSE BILL NO. 1452

Page 1, line 1, remove "section to" and replace "39-21" with "to title 39"

Page 1, line 2, after the semicolon insert "to provide a penalty;"

Page 1, line 4, remove "section to" and replace "39-21" with "to title 39"

Page 1, replace lines 6 through 14 with:

**Definitions.** As used in this chapter, unless the context otherwise requires:

1. "Chase vehicle" means a motor vehicle that accompanies an experimental vehicle while operating on a highway.
2. "Experimental vehicle" means a vehicle with an unladen weight of six thousand pounds [2721.55 kilograms] or less which may be equipped with any configuration of axles and wheels and which is primarily powered by some source other than a combustion engine, muscle, or an animal.

**Applicability.** An experimental vehicle is a motor vehicle under this title, except:

1. Chapter 39-22 does not apply to experimental vehicles.
2. Registration of an experimental vehicle is governed by this chapter.
3. The governing body of a political subdivision may regulate, restrict, or prohibit the use of an experimental vehicle operating within the political subdivision's corporate limits in areas under the jurisdiction of the political subdivision.

**Experimental vehicle registration - Application - Issuance - Fees - Renewal.**

1. An individual may not operate an experimental vehicle unless the vehicle has been registered in accordance with this chapter.
2. The department shall design and furnish an application that must be used to register an experimental vehicle. The registration must state the name and address of every owner of the experimental vehicle and must be signed by at least one owner. A copy of the application is evidence of registration for the first thirty days after the date of application.
3. On receipt of an application and the appropriate fee, the department shall register the experimental vehicle and assign a registration number and a certificate of registration. The certificate of registration must include information regarding name and address of the owner.
4. The fee for registration of an experimental vehicle is fifty dollars for each registration cycle of one year ending on March thirty-first. The department may prorate the initial registration fee. For a duplicate or replacement registration number or registration card that is lost, mutilated, or becomes illegible, the department may charge a fee of not more than five dollars.

5. To renew a registration, the owner of an experimental vehicle shall follow the procedure adopted by the department and pay the registration fee.
6. The department may adopt rules for the registration of experimental vehicles and the display of registration numbers.

**Exemption from fees.** Payment of fees is not required of an experimental vehicle owned and used by the United States, a state or any of its agencies, institutions, or political subdivisions; an experimental vehicle registered in a foreign country and temporarily used in this state; or an experimental vehicle validly licensed in another state and which has not been in this state for more than thirty consecutive days.

**Transfer or termination of experimental vehicle ownership - Change of address of owner.** Within fifteen days of a transfer of any ownership interest in an experimental vehicle, other than a security interest, the destruction or abandonment of any experimental vehicle, or a change of address of the owner as listed with the application for registration, written notice of the fact must be given by the last registered owner to the director in the form the director requires.

**Rules of operation.** A person may not operate an experimental vehicle on a highway without being accompanied by a chase vehicle. The chase vehicle must follow the experimental vehicle at a safe-driving distance.

**Equipment.** An experimental vehicle must be equipped with a horn, front and rear turn signal lamps, stop lamps, a balanced and coreactive dual-braking system, a windshield, a safety belt installed at each seating position, an exterior mirror mounted on the operator's side of the vehicle, a roll cage that encompasses the entire driver, fresh air intake vents or wheel openings, and either an exterior mirror mounted on the passenger's side of the vehicle or an interior rearview mirror.

**Penalty.** A violation of this chapter for which there is no penalty in this title is a class B misdemeanor."

Renumber accordingly



Date: 3-8  
 Roll Call Vote #: 2

2001 SENATE STANDING COMMITTEE ROLL CALL VOTES  
 BILL/RESOLUTION NO. 1452

Senate Transportation Committee

- Subcommittee on \_\_\_\_\_  
 or  
 Conference Committee

Legislative Council Amendment Number 10624.0201

Action Taken Motion to Do Pass As Amended

Motion Made By Espgaard Seconded By Trenbeath

Senators	Yes	No	Senators	Yes	No
Senator Stenejem, Chairman	X		Senator O'Connell	X	
Senator Trenbeath, Vice-Chair	X		Senator Bereler	X	
Senator Mutch	X				
Senator Espgaard	X				

Total (Yes) 6 No 0

Absent 0

Floor Assignment Espgaard

If the vote is on an amendment, briefly indicate intent:



**REPORT OF STANDING COMMITTEE**

HB 1452, as engrossed: Transportation Committee (Sen. Stenehjem, Chairman) recommends **AMENDMENTS AS FOLLOWS** and when so amended, recommends **DO PASS** (6 YEAS, 0 NAYS, 0 ABSENT AND NOT VOTING). Engrossed HB 1452 was placed on the Sixth order on the calendar.

Page 1, line 1, remove "section to" and replace "39-21" with "to title 39"

Page 1, line 2, after the semicolon insert "to provide a penalty;"

Page 1, line 4, remove "section to" and replace "39-21" with "to title 39"

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**Penalty.** A violation of this chapter for which there is no penalty in this title is a class B misdemeanor."

Renumber accordingly

2001 TESTIMONY

HB 1452

**AMERICAN SOLAR CHALLENGE™ REGULATIONS**

**OFFICIAL VERSION AUGUST 24, 2000.**

# AMERICAN SOLAR CHALLENGE REGULATIONS

## 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 Formula Sun-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 Formula Sun newsletter, Official Interpretations and Instructions for Scrutineering.

**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 Formula Sun 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 Formula Sun-American Solar Challenge. 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 Formula Sun 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 Rayco.

### **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 Information Sheet and a signed Participation Agreement. No team will be officially registered until the Team Information Sheet 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

**3.2. Registration Deadlines** - Registration opens May 1, 2000 and closes June 1, 2001

**3.3. Number of Entries** - In the interest of safety, the number of solar cars entered in the Rayco will be limited to 60 (sixty), and (with the exception of seeded teams -see 3.4) will be registered on a first come, first served basis.

**3.4. Seeded Entries** - The top two finishing vehicles in any International Solar Racing Federation (ISF) sanctioned event worldwide since 1996 will be awarded seeded status in American Solar Challenge provided they submit an intent to register before January 1, 2001 and complete their entry for American Solar Challenge before the registration cut-off date of June 1, 2001. These "seeded" teams must still comply with the requirements of these regulations to ensure their entry in the Rayco.

**3.5. 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 advisor will be responsible for signing documents representing the school.

**3.6. Technical Documents** - Technical documents describing the solar car's structure, batteries, and solar cells must be submitted to ASC Headquarters by April 1, 2001 for approval. Early submissions will receive prompt review by Headquarters. The technical information provided in these documents will not be made public. The information contained in each team's final submission must match the solar car presented at Scrutineering.

**3.6.1. Structural Report** - Safety should be the primary concern with regard to the structural development and fabrication of the solar cars. The Structural Report must present and address the design issues involved in impact, roll over and suspension scenarios. Particular attention should be paid to the roll over and impact protection systems for the driver. Document 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.

**3.6.2. 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 MSDS (Material Safety Data Sheet) obtained from the battery manufacturer, and the following battery information:

- Manufacturer's name, and contact information
- Stock number, type, or description
- Module voltage (e.g., 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).

**3.6.3. 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 the following solar cell information:

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

**3.7. Team Data** - Each team must submit team photos and data sheets to American Solar Challenge Headquarters by May 1, 2001. 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, 2001 without permission of the team representative.

**3.7.1. Team Photo** - The team photo shall be submitted as a color print measuring approximately 20 by 25 cm. The 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.

**3.7.2. 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 Racing 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 drivers, and faculty advisor(s) must also be listed.

**3.7.3. 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 and battery specifications may not change after April 1, 2001 without specific approval from ASC Headquarters. Any changes submitted after June 1, 2001 may not appear in print.

**3.8. Registration** - All people taking part in the Event must be registered with Headquarters. This includes team members, sponsors, officials, guests, and the media. Badges will be issued and used to obtain access to restricted areas. These badges must be visible at all times.

**3.9. Crew Requirements** - All team members involved in the ("crew") must present themselves at Registration to complete all required forms. Team members will be required to complete and sign liability waivers and emergency medical information forms.

**3.10. Driver Requirements** - Only registered solar car drivers will be allowed to drive solar cars during the Event. A team shall have a minimum of two (2) drivers available at all times. In addition to meeting the crew requirements, solar car drivers must be 18 years old or older, present a valid driver's license and must supply their own ballast container and ballast (sand or metal shot only). The official weight of each driver, including driving clothes, helmet, and shoes, will be 80 kg. If the driver weighs less than 80 kg, ballast will be added to make up the difference. If the driver weighs more than 80 kg, no credit will be given.

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

## **4. EVENT COMPONENTS**

**4.1. Scrutineering**- Each team registered for the Event must submit their solar car for inspection prior to the Qualifier to verify compliance with these Regulations. In addition, spot checks for regulation compliance may take place during and immediately after the Qualifier and Rayce, and 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 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 will risk not having enough time to complete the Scrutineering process.

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

**4.2. Qualifier** - Each team must successfully participate in the 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 for American Solar Challenge is yet to be determined. A maximum of 60 (sixty) qualified teams will be permitted to participate in the Qualifier. The team with the most Officially Logged Laps 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 their solar car 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 Racing. 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 solar energy for use by the vehicle. In addition to direct energy conversion components (such as photovoltaic cells), 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. Stock**

**5.2.1.1. For Classic Dimension Solar Cars** - up to 5 meters in length, 2 meters in width, 1.6 meters in height. Furthermore, the product of the length and width, less any single rectangular region not occupied by solar array components, may not exceed 8 m<sup>2</sup>.

**5.2.1.2. For New International Standard (NIS) Solar cars** - up to 5 meters in length, 1.8 meters in width, 1.6 meters in height

### **5.2.2. Open**

**5.2.2.1. For Classic Dimension Solar Cars** - up to 5 meters in length, 2 meters in width, 1.6 meters in height. Furthermore, the product of the length and width may not exceed 8m<sup>2</sup>. Furthermore, the product of the length and width, less any single rectangular region not occupied by solar array components, may not exceed 8 m<sup>2</sup>.

**5.2.2.2. For New International Standard (NIS) Solar cars** - up to 5 meters in length, 1.8 meters in width, 1.6 meters in height. (The reason for the two sets of dimensions is to allow bodies & arrays built for previous ISF events to compete. It is the intent of the organizers of ASC and other solar car organizers to phase out the "Classics" over a period of three or four years.)

**5.3. Racing Configuration** - Whenever the solar car is moving under its own power, the solar array must be in its Racing configuration. In Racing 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 remain fixed with respect to the solar 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. Reconfiguration of the array is NOT allowed. 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 ASC Suppliers 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 January 15, 2001.

**5.7.2. Open Class** - There are no limitations on cells that may be used.

**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 (see 5.8.2).

For both Stock and Open Class entrants, the battery weights will include all charge control devices that were packaged with the batteries. The actual pack to be used during the race must be weighed. Sample batteries may not be used for weighing.

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. Stock Class** - May use up to 165kg of sealed (non-spill) lead-acid battery. Battery size shall be based on the manufacturer's published specifications submitted by the team. The solar car storage battery may be composed only of rechargeable, commercially produced lead-acid modules. Batteries must be available in sufficient quantities to be accessible to all participating teams. The battery modules may not be modified in any manner, including the addition of electrolyte additives; case modification; or plate addition, removal, or modification.

**5.8.2. Open Class** - May use up to:

- 165kg of sealed Pb-acid battery
- 60 kg of NiMH battery (see 5.8.2.1 for exception)
- 100 kg of NiCad battery
- 30 kg of Li Ion battery
- 30 kg of Li Ion Polymer /Li Ion Alloy (polymer) battery

(This weight will be determined using scales provided by the organizers).

**5.8.2.1 Grandfathering of Ovonics NiMH** - Open Class entrants may use the Ovonics NiMH battery that was approved for Sunrayce 99 only if the batteries were purchased prior to January 1, 2000. Teams must submit the model number and proof of purchase date to Headquarters for approval. ASC Officials reserve the right to refuse approval of modules considered under this category.

**5.8.2.2 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 165kg allowance for lead acids. The total of the percentages used in the pack may not exceed 100%.

**5.8.3. 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.

**5.8.4. Other storage techniques** - If a 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. Fuel cells may not be used.

**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** - Batteries enclosures must be designed such that the entire set may be removed and placed in impound overnight. 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. Battery Switch** - The battery system must be equipped with a manually operated, high-current switch to quickly disconnect the battery from the electrical system. This switch must be capable of interrupting 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 "Battery 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 (canopy removed); 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. Motor Switch** - All solar cars must have a motor switch wired to disconnect all power to the motor from either the battery or the solar array. The switch must be able to interrupt full load current, and it must be separate from the battery switch. It must be within easy reach from the driver's position and clearly marked in letters at least 10-mm high as the "Motor 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 (canopy removed); use two sets of markings if necessary.

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

**5.14. 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.

**5.15. 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.

**5.16. 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 and must be acoustically coupled to the air outside the solar car.

**5.17. 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.

**5.18. 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) will have 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. Classic** - length = 6 meters, height = 1.6 meters, width = 2 meters. When turning corners, wheels and wheel fairings may exceed these dimensions.

**6.1.2. NIS** - length = 6 meters, height = 1.6 meters, width = 1.8 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, and steering linkage and geometry 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 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 position must place the driver's entire head higher than the highest point of his or her legs. No headfirst positioning is allowed for the driver.

**6.5.2. 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.

**6.5.3. Roll Cage** - All solar cars must be equipped with a roll cage that encompasses the entire 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 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 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 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 are permitted, provided they are 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'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's head.

**6.5.5. 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 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 bolt (harness system). 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's seat. Only commercially manufactured safety belts are allowed. They must bear the manufacturer's emblem, and they must not be modified in any way from the condition in which they were received from the manufacturer.

**6.5.7. Fresh Air Circulation** - Fresh intake air from vents or wheel openings must be provided for the solar car's driver.

**6.5.8. Egress** - The driver's cockpit must provide for the driver's unassisted exit within 10 seconds. Driver'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 2-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<sup>2</sup> 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 will allow the driver to at all times 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. Having the driver identify 20-cm high letters at a distance of 15 meters will test this.

**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.

**6.8. 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 80kg will require ballast to bring his or her weight to 80kg.

**6.11.1. Ballast Carrier** - Teams must supply a single sealable container for the purpose of ballasting each driver. The container itself will be loaded to the weight required for the driver. This container must be shown to securely fasten to a structural member of the solar car and/or be demonstrated to remain fixed in the event of an impact.

**6.11.2. 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. All wheels must have at least one component of this dual system. The two systems must be operationally independent and may be either front/rear or redundant front and rear (one-sided systems, left or right, a.e not permitted). Hydraulic systems must have separate master cylinders. Regenerative brakes may not be considered as one of the braking systems.

**6.12.1. Braking Performance** - Solar cars must be able to repeatedly stop from speeds of 50kph or greater with an average deceleration on level WETTED pavement exceeding 17kph 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 Racing configuration.

**6.13. Handling Performance** - 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 4 meters) with a 5-meter-wide-lane without knocking over any of the cones or exhibiting signs of structural instability in less than 11 seconds per side.

**6.14. 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.

**6.15. 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.

**6.16. 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. Those 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.

**6.16.1.** Teams fielding a vehicle that has participated in previous ISF events and registering on time for the by American Solar Challenge have the right to retain the number they used formerly.

**6.16.2.** If a conflict arises American Solar Challenge Headquarters will determine the numbers assigned.

**6.17. 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.

**6.18. 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. The logo must be mounted with 5 cm of unobstructed background color on all sides.

## **7. RAYCING REGULATIONS**

The Rayce is planned to start in Chicago, IL on July 15, 2001 and is intended to end in Southern California on July 25, 2001. Any location where all of the competitors are released from the same point is termed a "Staged Start".

The first stage of the Rayce is planned to run from Chicago, IL to Rolla, MO, where all the vehicles will stage again according to rank at the time of staging. At this writing, there is at least one other planned Staged Start in Barstow, CA.

The distance between Staging Areas is such that it is unlikely 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. Although these Raycing regulations are intended to be very close to the final draft it is likely that some details will change.

**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 Rayco days from 6:00 a.m. to 9:00 p.m. team members shall wear uniforms representing their Institution(s)/Company(s). The only information or graphics approved to appear on the front of the team uniform (jacket, shirt, hat, or other wearable) shall be the Institution/Company name/logo, Team name/logo, Car name/number, and ASC logo.

Team sponsors may also be displayed, but only on the back of the team uniform shirt or jacket. If team sponsors are displayed, the event sponsor must also appear in a similar manner on the back of the team uniform. Artwork for ASC logo and for the event sponsors may be obtained from ASC Headquarters.

**7.3. Rayco Time** - Official clock time for each team each day of the Rayco will be based on the local time at that day's start line, as displayed by the Officials. The same official time ("Rayco 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** - Only one person, the authorized driver, may ride in the solar car at any time.

**7.4.1. Driver Helmets** - Drivers 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.

**7.4.2. Driver Shoes** - Drivers must wear closed-toed shoes in the solar car. Sandals are not permitted.

**7.4.3. Driver Ballast** - Drivers and ballast will be identified with unique identification tags. The tags on the ballast carried by the solar car must match the tags on the solar car driver at all times.

**7.4.4. Driving Time** - Drivers may not drive more than a total of six hours in a given Rayco day.

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

**7.5. Briefings** - A Briefing will be held each Staged morning 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 starting order official statements, 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 each day, 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 two teams to cross the previous stage's finish line will precede the other in the starting line-up.

**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 drivers.

**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 am to 6:00 pm within those days. 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 for 30 minutes and are mandatory for all solar cars. 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 30-minute Checkpoint. However, teams must not interfere with or block any other team's passage through the Checkpoint. Teams unable to leave the Checkpoint area after 30 minutes must move their solar car and support vehicles elsewhere. Time spent in an active/open Checkpoint will not be factored into a team's "Total Elapsed 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 miss a Checkpoint must reach the next Checkpoint while it is active and check-in during open hours.

If a team arrives at one Checkpoint after it has Closed (i.e., a missed 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. They will not receive the 30-minute time credit for the missed 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 Race 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.

**7.10.1 Trailering Penalties** - Teams will be assessed a pre-published driving time for each interval trailered, plus a penalty per uncompleted (driven by solar car) mile of the interval trailered. Once a team has decided to trailer they must trailer to the next active checkpoint before they can drive again.

If a team trailers any section of an interval, they must check-in at the next active checkpoint. The team will receive a trailering penalty for the portion of the interval trailered. Credit will then be given for distance driven after the team has checked-in at an open Checkpoint.

If a team drives through an interval but misses the checkpoint, and trailers for any portion of the interval to the next active checkpoint, they will receive a trailering penalty for that entire second interval.

**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 15-cm tall) 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.

**7.11.2. 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 may not tow a trailer, and must maintain at least a 500 meter separation from the solar car caravan. The scout vehicle should 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. 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 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 not to obstruct other traffic.)*

**7.13. Radios** - The chase vehicle must be in two-way radio communication with the solar car at all times. All two-way radio channels must be registered with ASC Headquarters. All teams must also have a separately monitored CB radio in the chase vehicle tuned to a designated 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 kmph (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 40k/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 Race.

**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. Racing Hours**

**7.20.1. Staged Start Days** are 9:00 am to 6:00-6:30 pm (depending on Official Start Time - i.e. an entry with an Official Start Time of 9:00 am may officially Race until 6:00 pm where an entry with an Official Start Time of 9:32 am may officially Race until 6:32 pm.)

**7.20.2. Non-Staged Start Days** are 8:00 am to 6:00 pm.(see 7.22.2 for allowable stop time window)

#### **7.21. Elapsed Time**

**7.21.1. Teams Completing the Staged Route** within the time allotted will have their Daily Elapsed Time based on the actual Race time that elapsed from their Official Start Time until the team's solar car crosses the Official Finish line for that Stage.

**7.21.2. Teams Not Completing the Staged Route** - Teams that do not complete the stage's entire route within the allotted time will have their Elapsed Time calculated based on their distance traveled along the route. After noting and recording the time and route distance covered, the team may load their solar car onto a trailer for transport to the finish

line. Battery charging from the solar array while trailering is allowed. Teams not completing the stage's route will have their Elapsed Time calculated as the allowed driving time for the leg plus .93 minutes/kilometer of distance not covered on that stage's official route (.93 minutes/kilometer = 1.5 minutes/mile).

Example (based on 30-hour stage and 300 kilometers not completed):  
Stage Elapsed Time = 30 hours + (.93 minutes/kilometer \* 300 kilometers) = 34.65 hours

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

**7.21.4. Checkpoint Assessment**- Teams not reaching Checkpoints before their official closing will be assessed the 30 minute Checkpoint time per Checkpoint not reached in a given stage.

**7.21.5. Official Elapsed Time** - Each team's Official Elapsed Time for each stage will be that team's Computed Elapsed Time plus their Checkpoint Assessment, plus any penalties for that stage, plus any protest filing fees. Note that protest-filing fees are counted against the stage on which the protest is filed, whereas penalties are counted against the stage in which the infraction occurred. Thus, the Official Elapsed Time for a given day is not final until after the end of the Rayce.

Official Elapsed Time = Elapsed Time + Checkpoint Assessment + Penalties + Protest Filing Fees

## 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, and food service. These areas will become the Staging Area for the start of Raycing the following morning. 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 6:00p.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 minutes. Conversely: Team B elects to stop Raycing 7 minutes early. The next morning they may start as early as 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 storehouses or under the direct supervision of the Observer. Headquarters should be appraised of special issues for impound (i.e. other than ambient temperature, super ventilation needs, propensity to explode, etc.)

**7.23.1. Impound Times**- Batteries must be impounded by 9 p.m. each evening and will be released from impound at 6 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 cars must be charged 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 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.

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

**7.27.3.3. 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.

**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 will be penalized as though all of the battery modules affected had been replaced.

**8.6. Traffic Violations** - Any solar car committing a traffic violation will be penalized up to 15 minutes for each violation. Any solar car driver who commits three traffic violations over the course of the Rayce will 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 will be penalized up to 15 minutes for each offense.

**8.8. Drafting** - A penalty of up to 1 minute will be assessed for each minute that a solar car drafts behind another vehicle.

**8.9. Pushing** - A penalty of up to 30 minutes will be assessed each time it is necessary for a team to push or pull their solar car in order to advance along the Rayce Route. Teams pushing or pulling their solar car along the Rayce Route for more than 15 seconds (except as in 6.11.2) will be assessed a time penalty. The penalty as may be great as if the team had made no further progress beyond that point on that day.

**8.10. Improper Ballast** - A penalty of up to 60 minutes will be assessed each time a team operates their solar car with ballast that does not match the solar car driver.

**8.11. Failure to Impound** - A penalty of up to 3 minutes will be assessed for every minute between 9 p.m. and 6 a.m. that a solar car's Raycing batteries are not in Impound.

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



**8.13. 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.

**8.14. 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.

**8.15. 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.

**8.16. 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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## **HB 1452 Amendment Narrative**

Thank you Mister Chairman. Members of the Senate Transportation Committee. For the record my name is Michael Grosz, representative from District 42 in Grand Forks. House Bill 1452 is the bill that deals with allowing experimental vehicles to drive on North Dakota highways.

With help from the North Dakota Highway Patrol, I have drafted an amendment to this bill that basically hog houses the bill. The title is changed to reflect that the bill would now create a new chapter to title 39. Lines 6 through 14 are removed from the bill, and replaced with a new chapter to title 39. I based this new chapter on the low speed vehicle chapter of the Century Code which was created in the 1999 legislative session. The provisions in the amendment outline a method where an experimental vehicle can be registered along with rules of operations and necessary equipment.

It states that the department shall design and furnish an application that must be used to register an experimental vehicle. An experimental vehicle can be registered for a registration cycle of one year at a registration fee of \$50. Certain organizations are exempt from the registration fees, including institutions of higher education.

I included in "Rules of Operation," that a chase vehicle must accompany an experimental vehicle. This is the current practice for testing these vehicles, and it provides a warning for any other traffic as well as a safety measure.

I have also outlined certain pieces of equipment that experimental vehicles must have.

The one item that survived from the original bill is the emergency clause. This is needed as the current teams from the University of North Dakota and North Dakota State University will want to test their vehicles by late April or early May.

Thank you Mister Chairman for accepting my testimony on the amendment, and I would be happy to answer any questions.