

HANDOUT 13 STRUCTURAL REPORT REQUIREMENTS

North American Solar Challenge 2005

Instructions for Structural Reports

It is the intent of American Solar Challenge to maintain the safest entries possible while encouraging a wide variety of designs and materials for solar-powered vehicles. The purpose of the structural report is to require each team to document, by calculation or testing, the structural integrity of their vehicle and the protection provided to their drivers.

The structural report shall be presented in the format described in this document. Reports that do not meet this format will not be read and could jeopardize a team's chances for competing in NASC2005. The report should be written to be as concise as possible and should only present information relevant to the requirements of the report. The report is limited to a total of 50 pages, including appendices. These instructions outline the minimum criteria for critical systems of the solar car. **However, each team is responsible for the safety of its members, and these minimum criteria should not be construed as design specifications for the construction of a "safe" solar vehicle.**

Structural reports may be submitted as one printed copy and two CD-ROM copies (one copy per CD). The CD-ROM copies must be in either Word or PDF files and they need to be identical to the printed version. We encourage teams to submit reports in this format because it will help with distribution and long-term storage.

The other option for submitting structural reports is to submit three printed copies.

All structural reports, whether printed or on CD, must be submitted by postal mail to:

ASC Team Registration
PO Box 164
Ellensburg, WA 98926
USA

The deadline for submission to ASC is March 1, 2005.

Structural reports WILL NOT BE ACCEPTED if they are sent by email, fax, or on disk other than a CD. We appreciate your assistance with this!

You do not have to wait for the deadline! Teams are strongly encouraged to turn in reports early (in whole or in part), particularly if there is a section that you are concerned about.

Section 1: Introduction

A brief summary of your project and the design of your vehicle.

Section 2: Mechanical Systems Analysis

The mechanical systems analysis section must include the following six sub-sections:

- **Front suspension**
- **Rear suspension**
- **Brakes**
- **Steering**
- **Wheels & Tires**
- **Battery Enclosure**

Each sub-section must contain all of the following information:

Material Specifications

Describe the materials utilized, their important dimensions (e.g., tubing diameter and thickness), material properties (in the "as welded" or "as fabricated" condition).

Loading Conditions

Describe the specific loading conditions used in the analysis of the component. Teams should consider road and traffic conditions when determining loading criteria and potential failure modes. For suspension and steering systems, analysis needs to include a 1 g turn, a 2 g bump, and 0.5 g braking.

Assumptions

Include any assumptions that played a factor in the design and analysis of the mechanical system.

Drawings

Include component drawings or photographs and mechanical system assembly drawings or photographs. All drawings must be identified by number and must include a description.

System Analysis

Mechanical components and systems must be analyzed to show that they will not fail due to fatigue and possess a reasonable factor of safety for strength and stress. Provide a summary of the methods used and the results of the analysis for each mechanical component or system. Analyses may be in the form of either calculations, computer modeling (such as finite-element analysis) or empirical testing of the actual vehicle or its components. If testing is not completed at the time the report is submitted, detailed plans of the scheduled testing must be included in the report. The results from the described tests must be submitted once they have been completed.

Teams that choose to use NGM wheels and Bridgestone tires are not required to include the analysis for those wheels and tires, but they must still address all other areas of the report.

All teams must include the expected weight on each tire.

Teams must show how they intend to build and secure battery enclosures to meet the requirements of Regulation 5.9. Include a description of how the enclosure will be ventilated and how the cells will be secured in the battery enclosure.

Conclusions

Provide a discussion of your findings and how the results impacted your design.

Section 3: Vehicle Impact Analysis

The vehicle impact analysis section must include the following topics.

Specifications

The report must describe the vehicle frame and construction techniques (aluminum space frame, composite monocoque, etc.), including the materials utilized, their important dimensions (e.g., tubing diameters and thicknesses, number of plies in composite constructions), and their properties (in the "as welded" or "as fabricated" condition). The report must also list the specific impact criteria that are assumed for each case, as well as sample calculations and computer output as applicable.

Drawings

The report must include structural drawings of the vehicle from five viewpoints: top, front, side, rear, and isometric. These drawings must illustrate the following:

- Driver location
- All members considered "structural"
- Locations of ballast and batteries
- Locations of chassis hard points (points of attachment)
- Calculated center of mass

The report must contain structural drawings of the driver's compartment from three viewpoints: top, front, and side. These drawings must illustrate the following:

- Driver location
- "Crush" space between the driver and the outer perimeter of the vehicle
- Roll cage design and location
- Location of structural members
- Driver's harness attachment points

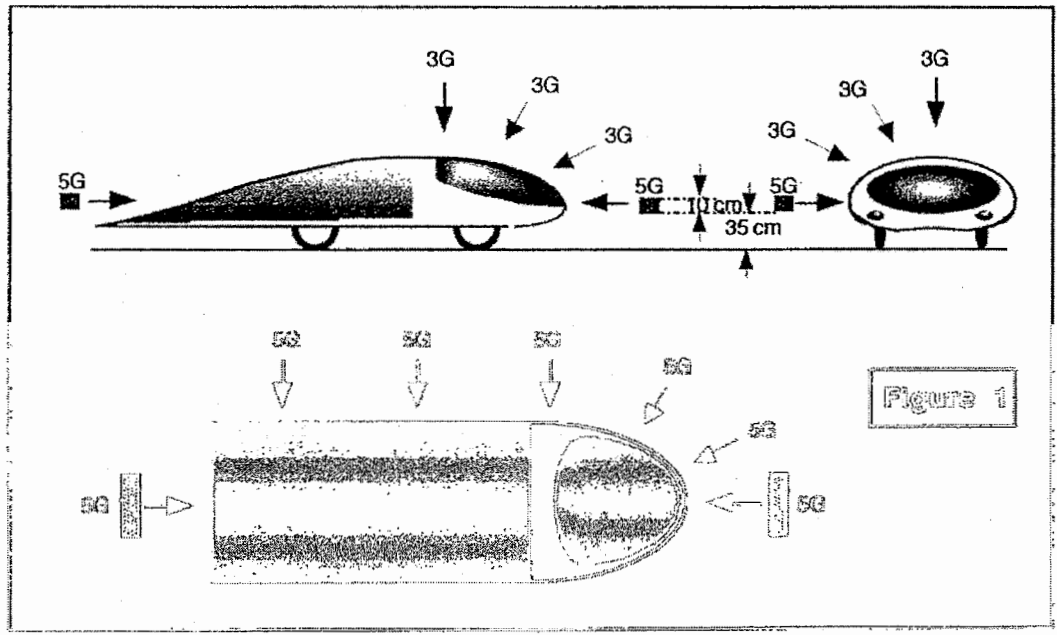
The report must contain an isometric drawing of the body and solar array.

All drawings must be identified by number and must include a description.

Analysis

Analyses may be in the form of computer modeling (such as a finite-element analysis) or empirical testing of the actual vehicle or its components.

The report must document performance of the vehicle regarding front, rear, side, and rollover impact. Front, rear, and side impact with another vehicle assumes a bumper height of 10 cm and elevation of 35 cm as shown in Figure 1. Rollover analysis must address loads at a minimum of two increments between horizontal and vertical.



The minimum criteria for these impacts are loads of 3-5 G, where the G is the total gross weight of the vehicle (including driver and ballast) as illustrated in Figure 1. Emphasis should be placed on how protection is provided for the driver under these conditions. All impact scenarios must take into account movement of body panels and the vehicle's solar array to ensure that these members do not penetrate the space occupied by the driver during the impact.

Conclusions

The report should contain a summary of the findings for each impact case and a brief discussion of the results. Raw data should be attached as an appendix to the report.

Section 4: Appendix

The appendix should only include relevant information that is referenced from the main body of the report. Items that might be found in the appendix are calculations that support the results describe in the main body of the report. Appendix items should be organized into two categories.

Appendix A
Mechanical Systems Analysis Supporting Documentation

Appendix B
Vehicle Impact Analysis Supporting Documentation