

## 2011 Formula SAE -- Design Judging Score Sheet

Team Name \_\_\_\_\_

Car # \_\_\_\_\_

Category	Areas Covered	Score
<b>Suspension</b> <input type="radio"/> Design <input type="radio"/> Build <input type="radio"/> Refinement/Validation <input type="radio"/> Understanding	Tires, wheels, hubs, uprights, control arms, steering linkage, springs, dampers, anti-roll bars, geometry, kinematics, vehicle dynamics. Selection and use of materials.	____/25
<b>Frame/Body/Aero</b> <input type="radio"/> Design <input type="radio"/> Build <input type="radio"/> Refinement/Validation <input type="radio"/> Understanding	Primary structure/tub/tubing, body, and aerodynamic/ ductwork systems. Rigidity and stress-relief methods. Load analyses. Fasteners. Selection and use of materials.	____/25
<b>Powertrain</b> <input type="radio"/> Design <input type="radio"/> Build <input type="radio"/> Refinement/Validation <input type="radio"/> Understanding	Engine, transmission, clutch, final drive, differential, half-shafts, tripods, etc. Also peripherals, such as cooling, oiling, electronic engine controls. Fuels/lubricants selection. Selection and use of materials.	____/25
<b>Cockpit/Controls/ Brakes/Safety</b> <input type="radio"/> Design <input type="radio"/> Build <input type="radio"/> Refinement/Validation <input type="radio"/> Understanding	Driver interfaces, seat, belts, steering wheel, steering column, control panel/dash, cockpit sizing & protection, driver comfort/ease of control, shifter, pedals, braking system. Is this car as safe as it can be? Selection and use of materials.	____/25
<b>Systems Management/ Integration</b> <input type="radio"/> Packaging <input type="radio"/> Electronics/pwr mgmt <input type="radio"/> Team Organization <input type="radio"/> Analysis methods/tools	Design integration, plumbing/wiring, power management, schematics. Are sensitive items protected? Proper use of Data? Do systems compliment another? Progressive project management/ organization methods evident? Special communication tools utilized? What testing/development tools have been used or created?	____/20
<b>Manufacturability/ Serviceability</b>	Ease of repair? Sub-systems accessibility, parts interchangeability, manufacturing complexity? Have fasteners been standardized? Are special tools required to diagnose/service vehicle?	____/15
<b>Aesthetics/Style</b>	Attractive overall appearance? Is car clean, reflective of professional work? Does car instill pride in team, or apologies?	____/ 5
<b>Creativity</b>	Will this car cause a rules change? Have the judges learned something new? On rare occasions, creative or innovative design may merit special points.	____/10

**OVERALL DESIGN SCORE: \_\_\_\_\_/150**

# FSAE Design Event Scoring (Some Insight into the Process)

The design and developmental process of a FSAE car is a complex process. So is judging! Though many metrics and details are reviewed during judging, it is easy to overlook various features which are critical to a given team's efforts. It is important for team members to be pro-active in communicating these special details which separate their design from their competition. Do not force the judges to hunt for such areas!

Judges and teams should be familiar with the scoring categories. A more detailed break-down of each category can be found in the following pages. The judging criteria, which follows, are not simply check-lists to be blindly followed, but instead lists *some* of the key attributes every team should be able to demonstrate. Consider *why* the team may include or omit items in their design. The scope of judging is certainly not limited to these items exclusively.

Space for comments has been provided, so judges' observations may be shared with students. **Judges: Please provide as many detailed comments as time permits, for the benefit of students!**

REMEMBER: Judges are not just scoring your vehicle. They are scoring *your knowledge and understanding* of vehicle development and performance. Reflective of this, for each physical design category (**Suspension, Frame/Body/Aero, Powertrain, and Cockpit/Controls/Brakes/Safety**) judges evaluate the team's development process. Generally, each category is judged with the following emphasis:

**Design (~25%):** Assessment of design process used by team. Is this a new design, evolution, or complete carryover? Were different design options considered? Were appropriate pre-build analyses performed?

**Build (~25%):** Does physical specimen presented reflect the early design work? Is it reflected in design report? If not, why not? What special manufacturing considerations were encountered?

**Refinement/Validation (~25%):** How thorough and honest has the team been about testing? Was a test plan developed and executed? Were discrepancies between predicted and tested results documented and acted upon to improve final build?

**Understanding (~25%):** Is the team that presents the car at competition truly intimate with the design? Can they quickly give detailed answers about any sub-system? Or do they have to "go ask someone else"?

## About your score...

The Design Event Score Sheet totals 150pts. At the end of competition, you will most certainly find that your assigned final points do not match the score listed here. **Do not panic!**

The score listed on this sheet is reflective of your assigned judges' assessment, relative to other teams in your queue. Typically, judges score slightly differently from queue to queue. Hence, judges compare notes about cars from different queues, with the assistance of specialty and floating judges, to ensure minimal bias. This is accomplished after the initial score sheet has been submitted.

After scores have been submitted, multi-tier rankings of teams is created. Score sheets and written judge's comments are not shared with other teams. Thus, consider your "score" (on this sheet) as a first cut review, subject to discussion among judges prior to design finals selection. Do not attempt to compare your (score sheet) score to that of another team!

# Design Scoring Assessment Areas & Judging Comments

The Design score sheet is designed for both judges and students. The following topical area breakdown offers some suggested items which should be addressed. It is not a check-off list, as each vehicle may have unique properties which should be covered. If you have further design questions (as a judge) or offerings (as a team) not included here, be sure to raise them during your evaluation.

## SUSPENSION (0-25pts)

Score: \_\_\_\_\_

### Will the tires stay in appropriate contact with the road under all conditions?

This category focuses primarily on the unsprung masses of the vehicle, particularly those related to road holding and directional control. In addition, steering geometry downstream of steering column/shaft is assessed. Where appropriate, understanding of failure modes and critical limp-home requirements should be addressed as well. This is known as *robustness*. Teams should demonstrate analysis methods, appropriate execution, and validation within their design. Sample areas include, but are not limited to:

- Does the team understand vehicle dynamics fundamentals?
- What methods were used for selecting tires and sizes?
- How was the handling, response and tractive capability of the tires considered in the design of the suspension?
- What analysis methods were used in the development of wheel base, weight distribution, c.g. height, front and rear track widths, roll axis location (static and dynamic), camber gain curves, link lengths, Ackerman, anti-squat/dive, king pin inclination scrub radius, bump steer, and other geometry/kinematics?
- Have peak loads been determined and designed for?
- Have appropriate materials and heat treatments/coatings been selected for their function?
- Have attachments been properly analyzed and implemented? (e.g., no rods-ends in bending, double shear joints, etc)
- How were dampers selected and how are they valved?
- How were wheel rates and roll resistance values developed/determined?
- Has every effort been used to reduce unsprung mass?
- Have adjustments been provided for different competition environments?
- Has system friction, hysteresis and bearing lubrication been addressed?
- Do suspension/steering links and hardware have excessive compliance?
- Have predicted handling characteristics been validated? If so, How?
- Other \_\_\_\_\_
- Other \_\_\_\_\_
- Other \_\_\_\_\_

Comments: \_\_\_\_\_

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**SYSTEMS MANAGEMENT/INTEGRATION (0-20pts)**

**Score:** \_\_\_\_\_

**Is team progressive, well-balanced and capable of repeating their effort?**

This category considers the packaging, instrumentation, team development methods, and team management / organization. It is crucially important for team performance, though not always directly applicable to the performance of the car in a given session.

- Are accessory devices (ECU, Data, Comm. Equip., Control system components) placed in protected areas?
- Do test equipment / data systems complement the development of the vehicle (or just there to show off?)
- Is data utilized during the competition to improve performance?
- Has wiring been safely routed, color coded, and marked for function?
- Can the team produce wiring, plumbing, and sub-system schematics for the vehicle?
- Has plumbing (fuel/oil/water/brakes/etc) been sized and routed safely and with serviceability / inspection in mind?
- Has the team proven its fluency with simulation and advanced analysis techniques?
- Has Project Management been a priority for the team?
- Have the organizational skills of the team been well demonstrated?
- Has the team really read the rulebook?
- Other \_\_\_\_\_
- Other \_\_\_\_\_

Comments: \_\_\_\_\_  
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**MANUFACTURABILITY / FIELD SERVICEABILITY (0-15pts) Score:** \_\_\_\_\_

**Can they efficiently build more than one? Can it be fixed it in the field?**

This category addresses the ability of a reasonable manufacturing facility to construct the *vehicle as presented* and for teams campaigning the vehicle to perform maintenance and repairs. Considerations may include:

- Are unusual, or specialized, machining operations required? Exotic / expensive materials?
- Are fasteners standardized (SAE or Metric?) throughout vehicle?
- Have the number of fastener sizes been minimized?
- Are components from various corners of the car interchangeable?
- Can all areas of vehicle be accessed without major component (engine) removal?
- Can components be substituted in field with conventionally available items?
- Is special training or equipment required to service subsystems? Will this prove unreasonable as the car is campaigned outside the university environment?
- Other \_\_\_\_\_
- Other \_\_\_\_\_

Comments: \_\_\_\_\_  
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**AESTHETICS/STYLE (0-5pts)**

**Score:** \_\_\_\_\_

**Is the car appealing?**

This category may not seem engineering / design oriented, but is an important reflection of the professionalism and seriousness of the team. It is the first impression of the vehicle, and often influences the ability of the team to diagnosis emerging problems (leaks, cracks, etc.) before they become catastrophic.

- Is the overall appearance attractive?
- Does the car look fast?
- Does the car exhibit high levels of fit and finish?
- Is the car clean (washed, free of oil, grease, debris, etc.)?
- Does the car instill pride in driver/owner/team/sponsors? Or apologies...?
- Other \_\_\_\_\_
- Other \_\_\_\_\_

Comments: \_\_\_\_\_  
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**CREATIVITY (0-10pts)**

**Score:** \_\_\_\_\_

**Is the design and execution of this car going to cause a rule change?**

Strictly speaking, innovation is extremely rare in FSAE. It implies a marketing success coupled to a new paradigm. Creative interpretation or adoption of ideas in new ways is certainly encouraged in this competition, however: If it makes us go redress the rule-book, then perhaps it is even better!

- Are any components or systems unique or unusual, due to special analytical finding?
- Has there been creative use of materials, manufacturing processes, or test procedures?
- If so, do the creations contribute to the potential performance of the vehicle or to its overall effectiveness? (Creativity that does not have a function is “art”.)
- Do the students understand why and how their idea is better than the classic method?
- Other \_\_\_\_\_
- Other \_\_\_\_\_

Comments: \_\_\_\_\_  
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