principia solar car

THE SOLAR FLARE

May 2008

Principia to Host NASC Pre-scrutineering May 17th-18th

by Sten Palmer

Traditionally, the May before a North American Solar Challenge, the race sponsors organize a weekend of pre-scrutineering. This is an opportunity for teams across the continent to have their cars inspected prior to the weeklong inspection required for teams to race in July. This year, the race participants are taking this task on their own shoulders, and Principia College will be hosting the only pre-scrutineering event in the United States! Along with schools in Ontario and Alberta, Canada, we will be opening our campus to other college solar car teams to have their cars' mechanical and electrical components inspected.

Top: *Part of the bustling scrutineering track as Ra 4 undergoes the driver handling test.* ***Middle:*** *An official times RA 6 as she manuevers through a figure 8 test.* ***Bottom:*** *RA 4 completeing a driver handling test at a previous scrutineering event.*

Two or three NASC inspectors will be spending the weekend in the campus guesthouse while the teams are invited to camp out in our new Coach Crafton Athletic Complex. The solar cars and their trailers will be set up in the Crafton parking lot near the mechanical and electrical stations and amid a plethora of shelter tents. Skipping across campus, we plan to set up the figure eight test in the newly extended staff parking lot behind the Science Center.

At this point, you may be wondering why the only liberal arts college participating in NASC is hosing this event. Southern Illinois University Edwardsville had initially volunteered to take on the venture, but found that they needed to withdraw their offer. Principia was then approached by NASC organizers (hey, we're central) and the rest has been unfolding harmoniously ever since. The support from our Legal, Athletic and Facilities departments has been tremendous. It is just a matter of time before the rest of the community is buzzing with excitement.

This is a great opportunity for Principia to give back to NASC and its participating schools. We can't wait to utilize our wonderful new

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facilities in this unprecedented role. The positive publicity that goes hand-in-hand with selfless service, such as this, won't hurt Principia's greening image, either. (At the end of last quarter, we erected a test wind tower across from the Gatehouse to verify the feasibility of constructing a wind turbine in the future). It is easy to see that what blesses one, blesses all.

On a personal note, I am incredibly grateful to be involved in planning this event. Over spring break I found out that my schedule could allow me to join the solar car team for my final quarter of college. Not only was I able to fulfill a science/math requirement with something I have always wanted to do, but the team also gained a team member who wanted to organize scruitineering! I am thoroughly impressed with the entire team's commitment, work ethic and dynamics. Naturally, I am also enjoying getting dirty in the solar car shop as we focus on the completion of the car before May 17th.

Thanks for your ongoing metaphysical support of right ideas! You are welcome to come and check out the activity 8am-6pm Saturday May 17th. Parking at Crafton will be needed for the teams, so our apologies for a potential trek in advance. Coincidentally, the annual alumni baseball game is the same day from 12-2pm. The weekend is bound to be a blast for all. Look for a rundown of our scrutineering event in our next newsletter.

Profile: Laura Warsinskey

by Melissa O'Connor

Laura Warsinskey is a senior Physics major from Lakewood, Ohio and has been a dedicated member of the solar car team for her entire four years. As a freshman, she immediately became an active member of both the body and mechanical teams. This quarter, she is also filling in as team metaphysician while our resident meta-head is on an abroad in China.

Laura joined the team because she prefers a hands-on approach to learning. "I love working with my friends on a project that is intriguing. I have had so many great experiences and chances to grow while being on the team." Though Laura has not yet had the chance to be a part of a race team, she hopes to be one of the four drivers for the car this summer. She has high expectations for this year's team: "I want to see the team do its best and work on a project that is done well."

After graduating this spring, Laura will pursue a degree in engineering and hopes that she will one day be able to design roller coasters.

A closer look at the "solar" part of a solar car

An inside look at how a solar cell works and the materials used to make the car run

by Laura Warsinskey

As petroleum prices skyrockets, many people are beginning to wonder how exactly our car makes it down the road without having to stop for gas. The sun provides a source of energy that is always reliable and will not run out anytime in the near future. But how does the energy from the sun get converted into electrical and mechanical energy, the kind that is needed to make the car move?

A simple explanation says that the photons from sunlight strike the solar array and are then absorbed by the semiconducting material on the surface. A semiconductor is a material that acts as a conductor at high temperatures or when struck by light, and acts as an insulator at low temperatures. In a solar cell the semiconductor is "doped," meaning that chemical impurities are intentionally added to gain an excess of positive or negative charge carriers. When these two layers are put together it is referred to as the pn-junction. The pn-junction allows electrons to move through the material; this movement creates a direct current.

The solar array is made up of many individual solar cells. These solar cells are wired together to form strings, and these strings are laid out to gain the maximum amount of power efficiency. The materials used in a solar cell may vary depending on the use of the cell. For our particular purpose, we chose to use gallium arsenide which is a compound made up of gallium and arsenic. This type of solar cell has many advantages over the typical silicon cell. Mainly it can function at higher power levels making it more efficient for this sort of application.

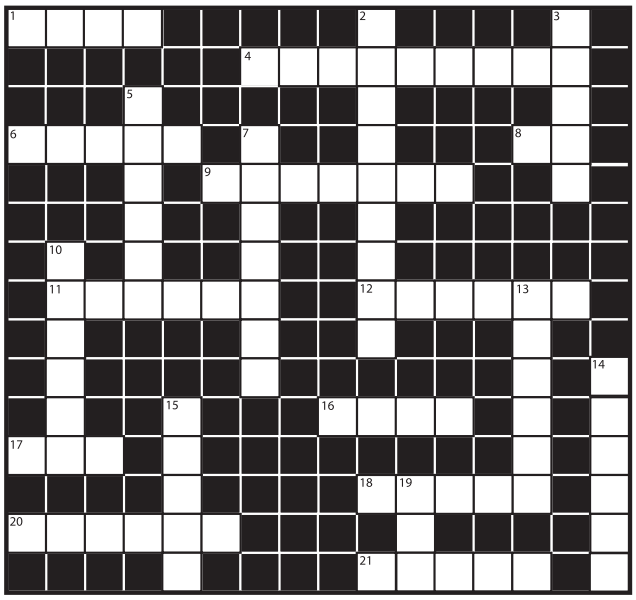
In the coming weeks, we will receive our solar cells and begin to wire the car. This is one of the more tangible aspects of moving towards the actual race. With solar cells, we will finally be able to generate power to actually move us down the road.

Our previous solar array on Ra 6.

The more power we generate, the greater potential we have to go farther and faster. And that, after all, is half the fun of solar racing!

The Solar Crossword

by Brian Kamusinga



Solution page 5

1. ***ACROSS*** Number of passengers allowed in a solar car. Also "dividing by this number allows you to prove, mathematically, anything in the universe. You can prove that 1+1=42, and from there you can prove that J. Edgar Hoover is a space alien, that William Shakespeare came from Uzbekistan, or even that the sky is polka-dotted." Charles Seife, from: *Zero: The Biography of a Dangerous Idea*.

2. ***DOWN*** The cost of one solar car. Also a long running and successful advertising campaign of MasterCard.

3. ***DOWN*** The type of energy that the car runs on. Also a jazz composition attributed to Miles Davis.

4. ***ACROSS*** The Principia College solar car number. Also the winning car number of Ray Harroun in the inaugural Indianapolis 500 in 1911.

5. ***DOWN*** What the battery box in the car is made from. Bullet proof jackets are also made from the same stuff.

6. ***ACROSS*** The number of wheels on a solar car. Also the number of strikes before the batter is out and the number of outs per side per inning.

7. ***DOWN*** The finish line of the 2008 race. Also is the largest city in the province of Alberta, Canada.

8. ***ACROSS*** The name of the solar car. Also the Egyptian sun god.

9. A***CROSS*** What stores the energy that drives the car. In baseball jargon, this refers collectively to the pitcher and catcher.

10. ***DOWN*** Fibers made from this element are used to make the body of the car. Also a filler often used to improve the properties of rubber or plastic compounds.

11. ***ACROSS*** Where the race will be in 2009. Also the second largest continent.

12. ***ACROSS*** What season during which the race will take place. In most countries children are out of school during this time of year.

13. ***DOWN*** Speeds of previous solar cars. Also, according to Exodus 7:7, Moses was this many years old when he initially spoke to Pharaoh on behalf of his people.

14. ***DOWN*** The number of years that solar car has had a program. Also popular jersey number of American football quarterbacks, like Roger Staubach, Chris Chandler, Randall Cunningham, Rich Gannon, Ken Stabler, Bob Griese, Jim Kelly, Joe Namath, Terry Bradshaw, and Tom Brady. It's also the number worn by hockey players Sid Abel and Ryan Malone.

15. ***DOWN*** Devise which collects the energy that powers the car. Also arrangement in line or ranks.

16. ***ACROSS*** Used to make the mold of the car. Also a family of fishing lures.

17. ***ACROSS*** Atomic number of hydrogen.

18. ***ACROSS*** The major resin/adhesive used in the construction of the body. Also widely used as primers to improve the adhesion of automotive and marine paints.

19. ***DOWN*** What drivers of the solar car are fed every now and then. Also rhymes with 3.14159265.....

20. ***ACROSS*** The starting point of the 2008 race. Also considered the fifteenth-tallest city on earth.

21. ***ACROSS*** Our newest car will be named Ra _. This also happens to be the number of spots on a common ladybug.

Why We Race

by Tom Brownell

With a small student population, no engineering department, and a chemical engineer as a faculty adviser, many may wonder why Principia is in the business of building and racing solar cars; for that, our long-standing history of participation and success in the solar racing community helps explain why we do it, and publications such as Steve Warren's 2005 film Racing With The Sun and Dr. David Cornell's (faculty who helped start Principia's team) book of the same title help explain how we do it. Given the appropriate support, resources, and teamwork, this project is a testament to the mantra claiming that "where there's a will, there's a way."

But the more important question at hand is why solar racing exists at all. Supporters and others interested in the project often ask when they should expect to see solar cars on the consumer market, to which our answer is consistently "never." With a six-digit price tag, vulnerability to any weather worse than a light rain, no room for passengers or groceries, and no sound system whatsoever, I can't think of any market where a solar car would be practical at all. That being said, I believe there to be two main purposes for solar car racing.

The first is that it is a great "brain-sport." It poses an engineering problem, and asks participants to solve it with few limits other than the technology available and their own creativity. After the car is built, teams must work to understand how it performs, what its limits are, and how to maximize its potential, so that they can strategically decide how exactly to race the car while considering energy available, weather, terrain, distance, and power consumption. For example, during the 2005 NASC race, Principia's team was able to pass many of the leading cars one day when a delayed start helped to keep the car out of bad weather that was slowing other teams down.

The second purpose of solar car racing is the awareness it raises of alternative and cleaner sources of energy. Regardless of how practical a solar car is, the fact that we can drive one for 2,400 miles at highway speed on the same amount of energy that a hair dryer uses is a noteworthy accomplishment worth considering. And while solar panels are not practical on a car, they can be when installed on roofs and in large arrays. Other energy sources such as wind, solar thermal, geothermal, nuclear, and biomass can help to reduce dependency on petroleum and reduce pollution. Nuclear energy, for example, creates one million times less waste per unit of energy than coal, and all but 4% of that waste can be safely recycled and reused.

My suggestion for driving a near-carbon-neutral car? Wait for a pure electric vehicle that meets your normal commuting needs and install solar panels on the roof of your home to generate the energy needed to charge the car. This, I think, is one of the most direct ways that individuals can make a difference for the environment and society, and I anticipate that electric vehicles will be the next significant change in automobile manufacturing in the next five to ten years. In the meantime, we'll stick with our solar car.

www.principiasolarcar.com

Our web designers assure us the new site will be up by the time you receive this newsletter. Check out the countdown to NASC 2008

Solar Crossword Solution — *from page 4*

ACROSS	*DOWN*
1. ZERO	2. PRICELESS
4. THIRTYTWO	3. SOLAR
6. THREE	5. KEVLAR
8. RA	7. CALGARY
9. BATTERY	10. CARBON
11. AFRICA	13. EIGHTY
12. SUMMER	14. TWELVE
16. PLUG	15. ARRAY
17. ONE	19. PIE
18. EPOXY	
20. DALLAS	
21. SEVEN	

Electrical Update

by Matt Shaw

Before the electrical team can actually begin the fun job of physically wiring Ra 7, we have some homework to do! The past few quarters, we have been hunched over the drawing board, determined to make the wiring job quicker and more organized. Inspiration arrived in the form of a new idea for a PCB (printed circuit board) to organize the wiring as well as a new system for our pesky turn signals that have been a source of creative wiring in the past.

A PCB is a series of copper traces that are printed onto a thin non-conductive material, typically an epoxy fiber glass laminate (see fig.1). The idea, in our case, is to simplify a mess of wire by designing a board that will be more compact, cleaner, and more efficient (see fig.2). All of the control switches in the steering wheel, the brake switch, and accelerator will be plugged into this junction box with a small, light weight connector. From there the wires will run to their desired ending locations, which could be the motor controller, the radio, or the turn signals and brake lights. This PCB is being designed with a computer program called ExpressPCB (see fig.3). With this program, we can design and order the finalized boards.

The turn signal, a simple system, has always managed to cause the electrical team some problems. This time, we are starting work on the turn signal circuitry early. Ra7's turn signals will use the same lights that the brakes use. For instance, when the driver is stopping and turning right, the left brake light will be solid while the right brake light will be flashing. This increases efficiency by using fewer LEDs (light emitting diodes), thereby consuming less power. We have created a circuit diagram for the turn signals and are currently in the testing phase.

As the electrical team waits for the completion of the rolling chassis to begin the overall wiring of the car, we will continue to work on projects that will make the assembly of the electrical systems simpler and faster when the time comes.

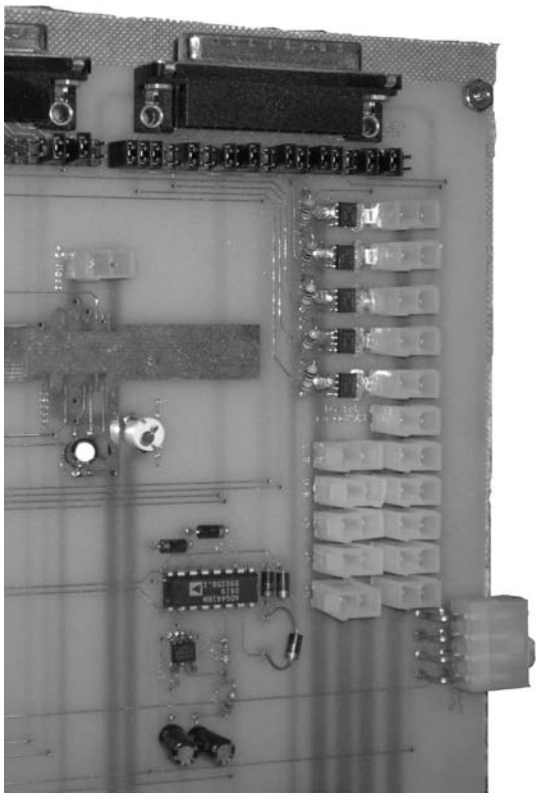


Figure 1

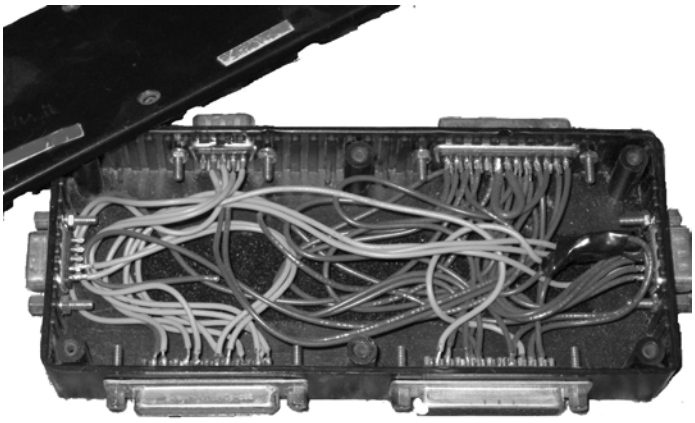


Figure 2

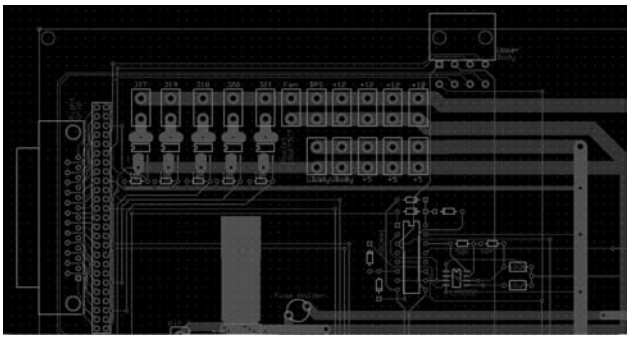


Figure 3

RA 7 Machining

by Pathik Bollaidlaw

While Ra 7 body construction has taken over the solar car shop, mechanical team members have been hard at work in the machine shop trying to finish components for our frame. We send the larger parts, such as the foam blocks for the fabrication of the upper and lower body, to local shops to be milled with large CNC gantry mills. Meanwhile, we enjoy working on many of the smaller components ourselves. We machine many of the smaller parts in our machine shop right here on campus.

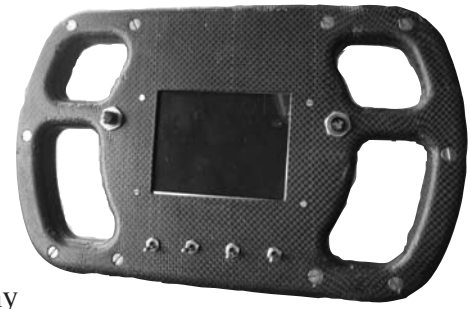
Right now, our new acceleration pedal gleams proudly from its post in the machine shop as the most recently completed part. It sports a new design where the springs work in compression instead of tension, reducing the wear on the acceleration assembly and the track to which the pedal is mounted.

All objects are designed around the criteria of safety, weight and punctuality. To save on weight with the acceleration pedal and track along with the break pedal, none of our objects are solid blocks of aluminum. Instead the pedals are milled using 6061 grade aluminum milled between 1/2" to 1/8" thickness with holes drilled in locations where the slight loss of strength is not of significant importance.

Still hard at work in the machine shop, several of our team members are currently constructing the motor support brackets. Due to the need for a close fit with the wheel bracket ball-bearings, we are milling our chrome steel spindles on the lathe down to an accuracy of ±0.001". These parts are small enough to never been seen by the average bystander, yet you can be sure that they are an absolutely critical part to creating a functioning car!

Reinventing the Wheel!

by Justin Sinichko



Over the years Principia has had a fun run with different steering devices. We've used everything from tillers to fighter jet controllers. Nothing was too regulated about the steering method. With dramatic new race regulations taking effect this year though, it's no surprise new rules have been created. These regulations require not only a minimum seating angle, but also a traditional enclosed steering wheel. Principia, not one to simplify things too much, decided to include all of the driver interface devices within the wheel alone.

This project took the form of a Formula 1 race wheel. It's carbon fiber artwork, custom designed and manufactured within the shop. Electronics riddle the outside – push buttons and toggles control just about every feature on the car. It also includes a display screen, used to display the image from our rear view camera as well as real-time data about the car.

Another interesting feature is the quick release and multi pole connector used on the back. We'll need to remove the wheel in order to climb in and out of the car (yes, it's that snug). These features not only provide a 'wireless' connection, but allow for quick and safe egress from the car in case the driver needs to climb out…*bathroom break anyone!?*

In any case, what really makes this wheel unique was the design process. This wheel was first designed in Unigraphics, the same software suite used to design the car. Just like the body, we milled a mold from REM 4-40 using the UG CAD file. We then used this mold to create a carbon fiber part. After cleaning the part and drilling the holes, we attached all the components. Because the part was built in 2 halves, screws tighten each half together; this provides quick access to the inside components and wiring.

Even with a "traditional" steering wheel, we have found our own way to make it unique. The design process has certainly paid off in the long run. Like many things in solar car, teaching ourselves is a luxury we count ourselves fortunate to afford. It's the hands-on experience from the formulation of an idea, through the design process, and finally the fabrication of a part that provides such satisfaction. Sometimes new regulations lead to wonderful innovation!

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