



February 2015

### Special points of interest:

- REV is participating in a WeRGold project in order to gain funding for members to attend the Electrathon competition.
- Finishing touches are being added to Testa 3.0 as testing dates and competition approach
- Some preliminary tests have already been done to test the compatibility of key systems like the motor controller and new motor

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## REV: Rensselaer Electric Vehicle

### WeRGold: The Competition Mission

Since 2011 when REV competed for the very first time, our flagship competition has always been the Shell Eco Marathon (a vehicle efficiency competition for high school and university level teams). This year, REV is branching into new territory and has enlisted in the help of our supporters to make it happen. In addition to attending SEM with our current vehicle (previously we have taken two), we also aim to attend Electrathon Americas, a more local competition in Connecticut.

This competition, strictly for battery electric vehicles and based on travel range rather than efficiency, will allow the team to expand our engineering goals. Furthermore, given that the competition is much closer than SEM, we will be able to give more members (especially underclassmen and newer members) the chance to experience a competition environment. REV has been working with RPI's WeRGold initiative in order to gain funding to cover the

costs of travel and entry fees, as well as to gain awareness for the project. If you are interested in donating, a donation page for REV will soon be featured at <https://impact.rpi.edu/g/wergold>. All of your help and support is appreciated!



REV members prepare for racing at 2015 SEM competition.

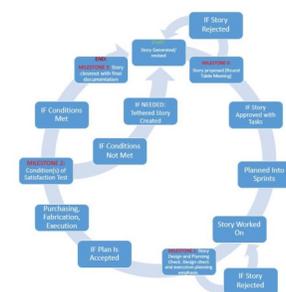
### MAPS: Management and Project System

Based on the feedback received from the first semester of utilizing this unprecedented system, the team has implemented several additional changes to MAPS. One of the major aspects of MAPS is documentation aspect. To create more flexible templates, and work spaces for REV members using MAPS, the team has made two changes. To address the first objective of having more flexible templates for the various Milestones, the team has made a permanent open discussion for all REV members to express feedback. Some templates have evolved since the start of the semester which have aided in simplifying and making the milestone documents easy and accessible to all. To meet the second objective of the team in creating more flexible workspaces, the team has separated documents into two online document drives, one for living documents and one for final documents. This was found to be the easiest solution to new

members not knowing how to utilize document clouds such as Sharepoint. System usage of Google Drive also proved to be the most practical for managing living documents, in particular among new members on the electronics team. Using Sharepoint for only final documents has reduced confusion as to which documents are still being worked on. One final aspect of Google Drive that makes revisions and reviews easier is the ability to highlight certain aspects of a design review, comment on specific sections, and allow them to be addressed in real time.

Within MAPS itself, it was also found that a number of members did not fully understand the MAPS system. To address this, several steps have been taken to increase member knowledge of the system. The first step has been to create a wiki page on the club's Sharepoint page. This goes into detail about the different aspects of MAPS including definitions, descriptions, and simplified

tables. Additionally a formal report has been assembled for MAPS describing its background for a complete in depth discussion as to the objectives and formulation of MAPS which had not existed in the past. MAPS will also continue to be heavily advertised at general body meetings for the spring semester. Already this semester a general MAPS tutorial and example Milestone tutorial have been done with the team to increase understanding and involvement in the new process.





A REV member tests the new seat design.

“Though many members are new to the club, everyone has shown great initiative in addressing the system’s various projects.”



Motor shaft geometry.

## Body/Chassis Team

The Body Chassis team has been working tirelessly to complete their projects. The rear hatch and the replacement lower body mounts of Testa 3.0 that were designed last semester were completed and passed testing easily. Their other projects are well under way as the entire team works toward completing the functional tests to be able to go to competition. One of these is bulkhead of the car, which is to separate the driver from the operational parts of the vehicle, like the motor and the electronics. This crucial element has been fabricated and installed, with sealing of the bulkhead to prevent

## Drivetrain Team

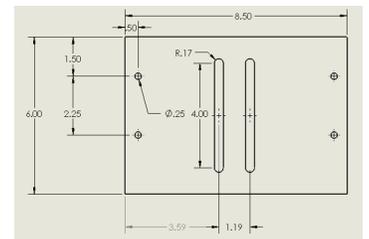
The Drivetrain system members have been hard at work over the course of the Fall semester. Though many members are new to the club, everyone has shown great initiative in addressing the system’s various projects. In terms of the new rear wheel for Testa, the team has obtained the required parts – namely the wheel, axle and sprocket – and is ready to assemble and install it to the chassis. The rear wheel project also involved the fabrication of a sprocket adapter piece, intended to allow the motor to accept an appropriate 9 tooth sprocket necessary to provide sufficient torque to the wheel.

However, after obtaining the motor, it was clear that the actual geometry of the motor shaft differed greatly with what was assumed. This is due to communication errors with the supplier. A new sprocket adapter design was created to fit this

air travel between the two spaces coming in the next few weeks. The new seat design has had some issues, but are being resolved to create a more robust design to support the driver. In addition to these projects, they are also working on selecting and installing gas springs to hold up the door, and replacing the remainder of the mounts between the body pieces and the chassis using the same system of butterfly latches that was used for the hatch. Once these projects are completed, the vehicle will be race ready!



Butterfly latches on back access hatch of Tetsta 3.0



Motor mount design.

shaft, and has been manufactured.

Several manufacturing issues presented themselves over the course of this project. Firstly, the threaded portion of the sprocket adapter required a left-handed tap in order to mesh with the motor shaft, which required special parts to be acquired. The team also inadvertently broke one of its taps attempting to tap the steel piece. Finally, the team made some mistakes in several of its measurements, leading to several manufacturing delays. At this point, the piece is nearly complete, and requires only the drilling of two clearance holes to allow set screws to pass through the sprocket and adapter and butt against the motor shaft.

Once this is completed, Testa’s improved rear brake mount will be installed, which has been machined and is ready to be fit

onto the rear wheel brake rotor.

Drivetrain has finished designing a motor mount for the new motor, and has nearly completed manufacturing. The design for this piece can be seen above. Rather than using water jet cutting to create the central slots, a simple milling operation was performed instead. All that is left to complete is to bolt the piece onto the chassis and attach the motor to it.

The Drivetrain team was also assigned to standardize the parts and tools used on REV’s cars and to make manufacturing faster and easier.

In order to do so, the other subsystems have been surveyed so that a consensus can be made on the dimensions of parts used, such as the grade of bolts. Bulk orders are at this point prepared to be made, so that obtaining these common parts is also easier. In addition, organizational tools such as drill charts will be made more readily visible.

Finally, the Drivetrain team has taken it upon themselves to revitalize the machine tools left in the shop, such as the drill press and defunct band saw. A diagnostic investigation was performed to determine the state of both pieces of equipment and the fixes necessary to bring them back into working order.

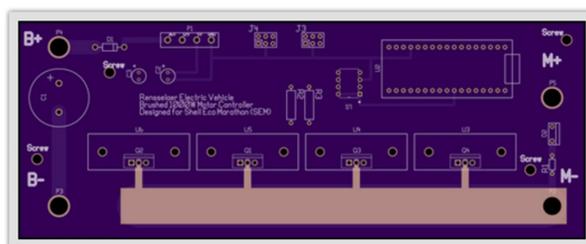
## Electronics Team

The end of the 2015 Fall semester involved much work on the new motor controller design. This is one of the most critical parts which will allow the driver to vary the speed of the vehicle. The motor controller design has been under development since the middle of the Fall semester to ensure its accuracy and probability of succeeding under the strenuous conditions put on it by the motor. One of the first things to keep in mind was the trace widths of the paths on the PCB. Previous versions of motor controllers had burnt-out traces since they were not ready to handle the inrush current of the motor. Additionally, the MOSFETs used to turn the motor on and off were not cooled in any way. Thus the new motor controller has large trace widths which will be widened by applying a layer of solder and plenty of room for heat sinks to cool off the MOSFETs. While part of the electronics team

Luckily, aside from large amounts of internal and external cleaning to remove blockages and residue, both machines required only some replacement parts. The team has designated the parts necessary to be ordered and is communication with Bill Mielke to ensure that proper protocol is enacted to operate the machines safely.



New potential battery.



Motor Controller PCB.

dealt with that issue, some of the others looked into the digital logic of the design. To simplify things, an ATmega328 processor was chosen to take the inputs of the driver and output a variable speed to the motor by turning the MOSFETs on and off. While this was already the plan, a new addition by the team was to add a MOSFET driver to increase the switching speed of the MOSFETs. This reduces the wasted heat dissipation and ensures the MOSFET does not fail from harmful overheating. The team hopes to receive, assemble, and test the motor controller by the end of February. While manufacturing occurs, the case that will keep debris from damaging the circuitry is under experiment as the team practices different techniques for making a clear, strong, and lightweight design.

The second big project starting the end of Fall 2015 and con-

tinuing into early 2016 is the addition of temperature sensors to the battery as required by race officials. The battery must be able to sense dangerous conditions like over-voltage and over-current. While most of those parameters are commonly looked after by most battery management systems (BMS), no current batteries owned by REV have temperature sensors. After asking race officials, it was determined that the team could either find a new battery that also senses temperature or add temperature sensors to an existing battery. Currently the team is exploring both options as it would allow the team to have a good main battery and a back-up battery. Adding temperature sensors would require a logical placement of the sensors on the battery and a logic circuit that would interpret data from the sensors but would be significantly cheaper than buying a new one.

**“...projects are well under way as the entire team works toward completing the functional tests to be able to go to competition.”**

However, a new purchase would mean additional features compared to the old battery like a longer run-time and no need to add temperature sensors. Both designs will be reviewed further before ultimately making the decision to choose one method or do both. Before the end of February the installation of the motor, motor controller, and battery into the vehicle will be completed, at which point the system can be tested to accurately and safely move the car forward at variable speeds.

## **Rensselaer Electric Vehicle**

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### **Useful Links:**

Shell Eco Marathon:

<http://www.shell.com/global/environment-society/ecomarathon/events/americas.html>

Electrathon Americas:

[http://www.electrathonamerica.org/Welcome\\_to\\_Electrathon\\_America.html](http://www.electrathonamerica.org/Welcome_to_Electrathon_America.html)

Our WeRGold Video!

<https://www.youtube.com/watch?v=2TDCZGky3ul>

Rensselaer Electric Vehicle is an RPI student organization that works together to design, build, optimize, and compete electric vehicles. Our mission is to educate our members on the principles of the engineering design process and professional development through hands on experience and involvement. Drawing from our diverse talents, skill levels, and majors, we aim to create the most efficient vehicle possible.

All students are welcome to join at any time. Shoot us an email and check out our website below for more information!

Find us online!

<http://rev.union.rpi.edu/>