October 2022

October was an exciting month for Penn State Formula Racing with events like the Homecoming Parade and, of course, more progress on the EV car. Keep reading to hear from our team captain and see what our subsystems have been up to.
Captain's Note

Friends of Penn State Formula Racing,

I’m Nate, PSFR’s Team Captain for this inaugural battery-electric vehicle project, and in this new segment I hope to add a little personal touch to the team’s progress since our last updates. I would like to first and foremost thank each and every one of you – our valued sponsors, stakeholders, alumni, and friends – for your support of this team. Since we began the journey of creating this year’s challenger, PSR23, your help has been vitally important.

Over the last two months, we’ve brought in an incredibly dedicated group of new members who have thoroughly impressed me and all of the Leads with their willingness to learn and take on responsibility. The quality of their work is impeccable, and periodic design reviews with other members, project groups and subsystems has been invaluable in forming a strong, systems-level overview of PSR23’s creation.

It’s nearing the end of October, which means each day is more exciting than the last in our bustling workshop. In the next month, we anticipate significant progress over some of the vehicle’s largest project, including the composite rear monocoque and aerodynamics package. I look forward to updating you with our progress next month. Once again, thank you for your support and encouragement.

Best wishes,
Nate Dreyer, Team Captain
Events Recap

SCCA Autocross

October 9

Our team had the opportunity to join the Central PA Region Sports Car Club of America chapter for one of their autocross events. It was super fun to test the car out in a new environment. Huge thank you to everyone who was involved and interested in learning more about our team!

Homecoming Parade

October 21

Walking in the Penn State Homecoming Parade with the car was a blast! The entire crowd was excited to see us and hear the car running. This is definitely a tradition that we want to keep going in the future!
Subsystem Updates

Aerodynamics

Aero has been hard at work running Simulations on the Rear Wing and side tunnels on the car. Due to changes from suspension we are able to run a larger Rear Wing. Rear wing downforce is looking great at 40lbs. With the increases in downforce we have been looking into Rear wing mounting using topology optimization to attain the best strength to weight ratio. The front wing has been completely redesigned and now fits underneath the nosecone. Finally, we are looking into two different designs for the tunnels which we will compare later for performance and ease of manufacturing. Overall, the Aero package as a whole is looking really strong and we plan on hitting our goal of 70lbs of downforce at 25mph.

Chassis

The Chassis subsystem is reaching the tail-end of our design phase. We sent out orders for manufacturing materials and are eagerly awaiting their arrival so we can start building! This month we met with our Tech Inspection judge from our competition in May and learned a lot about what we need to consider when designing a chassis for EV. There is a long wait time for our monocoque molds, so we are starting this year's nosecone in the meantime! We've spent a lot of time planning, so now it is time to see the Chassis subsystem in action!

Controls, Brakes, and Safety

Over the past month, the Controls, Brakes, and Safety subsystem has been working hard to finalize our designs. This past week, a design review was held to review what we have so far and to find out what needs to change. The pedal tray design for this year's electric car is coming along well and is nearing completion. The accelerator pedal design will be using linear potentiometers for the accelerator pedal position sensor as well as rotary return springs for simplicity and neat packaging. The pedal face has been designed using a curved profile for increased driver comfort. With the center of gravity yet to be determined for the electric car, which the brake pedal geometry will rely on, it will be a little longer before we have the brake pedal design complete. This is because the master cylinders we decide to use will be heavily reliant on the weight transfer of the car under heavy braking.
The steering system design is delayed due to a recent decision to move our suspension back to decrease the wheelbase of the car, resulting in an improved turning radius. This change requires the steering rack to sit farther back on the car, increasing the CV joint angle on the steering column. The feasibility of continuing to use the CV joints is being evaluated, as their maximum usage angle cannot be passed. The fourth iteration of the steering wheel itself is currently in progress. Drivers of the car recommended a slightly wider profile as well as a more comfortable feel where the thumbs curl over the grips. As mentioned in the previous newsletter, these iterations will continue until we design the steering wheel with all positive feedback.

The braking system design has been undergoing simulations and validation to ensure that continuing to use the existing system is the right decision and can be backed by the data we collect. One of the considerations we have had is a possible reduction in rotor width to improve cooling performance. After many simulations, we have determined that the existing width is here to stay, with the rotors being made of gray cast iron due to its heat dissipation capabilities. Another project we have been working on is the addition of wheel speed sensors to the front wheels. This addition will require a hall effect gear to be added to the front spindle. Luckily, these sensors already exist on the rear wheels of the IC car so we can base our design off of that.
Drivetrain

At the halfway point of the semester, Drivetrain has greatly advanced on designs and validation. The final drive ratio, chain selection, sprocket selection, and differential selection has been made. Coupling this information with the full car CAD has allowed our subsystem to advance greatly with designs for the motor and differential mounts. Furthermore, the cooling system is making great progress choosing a water pump and radiator sizing. Overall, we hope to have all designs finalized and ready for manufacturing by the end of the semester.

Finance

Finance has had a busy month. Although we did not welcome any new sponsors to the team, we have begun purchasing major components for PSR23. New projects for the subsystem include working alongside High Voltage Electronics to source our accumulator, as well as Chassis to source molds for PSR23. Behind the scenes we have been working with new companies to negotiate possible sponsorships that we hope to announce within the coming weeks!

High and Low Voltage Electronics

This month High and Low Voltage Electronics focused mainly on vehicle communications. We have successfully created a CAN communication network made of two TEENSY 4.1 microcontrollers. Additionally, we are beginning to implement traction control with CAN Bus throttle control. We are going to be able to limit motor torque if our rear wheels are spinning which enables better rear wheel grip. For the high voltage side of things, we have ordered our charger and are working on prototypes for our battery transport cart. We are finalizing and ordering many in-house circuits and are looking at testing and manufacturing over the next few weeks. This includes major projects such as the Precharge/Discharge, BSPD, and many more!
Outreach

October was a more behind-the-scenes month for Outreach, with focuses on creating a stronger team environment. So far, this has taken the form of the creation of a diversity, equity, and inclusion workshop specifically for the team with the help of Steve White and Dr. Jessica Menold from the Learning Factory. We are hoping to do one workshop this semester in December and continue with more in the spring semester. Additionally, we have been focusing on other fun outreach events such as the Homecoming Parade! Outside of events, we have coordinated with other student organizations such as Engineers for a Sustainable World to further recruiting. Be sure to check out our Instagram and our new TikTok to see our homecoming parade video and keep further up to date with us!

Suspension

This month we have made a lot of progress with the design of our new car. We have finished the overall design of the rear suspension geometry with only slight changes being made in the future. We are also close to finishing the design of the rear upright. A MATLAB code was created to calculate the forces in the suspension links to determine the loads experienced under different conditions. This code will be validated with strain gauges once the car is complete. We also took our air shocks to get compression tested to find out the spring rate at different pressures.

On track, we have continued testing the 2022 car in order to hone in the perfect setup. This year we are taking a more methodical approach to track testing in order to better replicate the events we will see at competition.
Sponsorships

Thank you to our sponsors for the year thus far:
- Altair, Altium, Braid, Calspan Tire Research Facility, Fibre Glast Development, Flex Seal, Gorilla Car Care, Institutes of Energy and the Environment, IZZE Sensors, Joe’s Racing Products, MasterCAM, Plascore, Prowire USA, Rapid Harness, Rock West Composites, Rod End Supply, SimScale, Stackpole Engineering, TeXtreme, Timet, Titanium Joe, Uline, and VI-Grade

We are looking forward to your continued support.

Acknowledgements

We would like to take the time to acknowledge the following individuals on the team:
- All of our Aerodynamics subsystem!

And thank you to all others who have provided us with constant support throughout our switch to electric.

Contact Us

Interested in joining or sponsorship opportunities?
Please contact our team administration below or keep updated with our social media.

Nate Dreyer, Team Captain: ngd109@psu.edu

Lauren Waer, Outreach Lead: lmw5895@psu.edu

Joel VanSkiver, Finance Lead: jpv5295@psu.edu

Instagram & TikTok: @pennstate.fsae
Website: https://sites.psu.edu/pennstateracing/