

UP RACING

UPR-09

Silverstone Review

James Tatham

Version 1.0 (2017)



Introduction:

This review is an account of what happened during Formula Student UK 2017 held at the Silverstone motor circuit. It highlights areas we succeeded on and areas of focus for the next year.

Thank You:

The UPR-09 was only possible to be manufactured with the help of the University of Portsmouth and the UPRacing team sponsors. We are extremely grateful to be given the opportunity to manufacture the car we designed during our 2016/17 term, then race it against teams from all over the world. Thank you to all of our sponsors for the 2017 year.



Arrival:

Due to some complications assembling the dry sump system for the first time, there was a delay to getting the car ready for testing before the event. Therefore it was decided to send a split team up on the Wednesday to set up the campsite and prepare the pits for the arrival of the car on Thursday.

This allowed the team to spend more time to prepare the dry sump system, allowing us to run the engine without restriction back at the University. As soon as we arrive at Silverstone we would not be able to start the engine until we had passed several stages of scrutineering. This allowed us to ensure the engine was running okay before the car arrived. Unfortunately we spotted an issue with our ECU, luckily Sussex University were kind enough to drive back down to their base to give us a spare ECU. We spent the evening fixing the issue with the help of Sussex.

The car arrived as expected on Thursday and prepared for scrutineering, due to the size of the queue we unfortunately couldn't start the scrutineering process until 17:50, and it closed at 18:00, unfortunately we did not get in to get the car checked, however were first in line for the Friday morning.

Due to the unfortunate timing of the Engineering graduation ceremonies many team members had to miss the Thursday at Silverstone, creating a logistical puzzle, however with good planning and organisation several team members arrived on the Thursday evening and Friday morning after their award ceremonies, without affecting the team at Silverstone.

Scrutineering:

Thursday evening the team double checked everything to ensure we could get through all scrutineering checks as smoothly as possible.

The scrutineering process is split up into 6 categories:

- 1) Technical inspection – ensuring the car complies by the rules, this process can take up to 2 hours. Every rule is checked to ensure a fair competition. If a car fails on 3 items then it will be sent away to get the issues amended. The drivers are also checked for egress [evacuating the vehicle in less than 5 seconds from the driving position].
- 2) Chassis – The chassis is checked to comply with all safety regulations, cockpit templates are used to ensure there is enough space for drivers.

- 3) Safety – All safety equipment is checked, the welds are inspected and any play in systems analysed.
- 4) Tilt – The car is fully fuelled, and all fluids topped up. The car is put on a tilt table, initially to 45° to check fluid leaks, then 60° to check the car is stable with no wheels lifting [simulating a 1.3g turn]
- 5) Noise – The sound of the exhaust is checked not to exceed 109dB at 1100rpm, idle is checked and all kill switches.
- 6) Brake test – The first time the car is allowed to move under its own power. The car must accelerate and brake, showing it can lock all 4 wheels at the same time.

The car can only progress to the next stage once the previous is complete. The whole process is very time consuming, especially considering there are around 100 cars to go through this process, all with their own unique design.

We managed to get through stages 1,2 and 3 with only a few minor problems to resolve. These were quickly amended, so we never had to leave our station during the process. Many top teams got caught out by major issues. Passing these stages quickly (within 3 hours) was critical to succeeding and showed good preparation.



Figure 1 During Scrutineering

We fuelled the car and attempted the tilt test table. We found a really small fuel leak that was intermittent. We had to take the car back to the pits to fix it and prepare for the static events.

After the static events we only had enough time to do 1 more tilt test before the end of the day. Unfortunately the fuel leak re-appeared. We did however pass the 60° tilt criteria of no wheels lifting. We spent the evening rectifying the problem so that we could pass tilt first thing in the morning.



Figure 2 tilt test at 45°

We arrived at tilt test as soon as it opened on Saturday morning, with the fix in place we passed with ease. Allowing us to go onto noise.

This is the stage where the car can be started for the first time at the event. We started the engine without any problems, thankfully after the ECU issues, although spotted a few issues with a minor oil leak, and a coolant pipe had slipped, clashing with the exhaust. These were minor issues and quickly fixed. We managed to complete noise test without issue.



Figure 3 Final preparations for noise test



Figure 4 Starting the car for the noise test

Our attention turned to the brake test, without being able to run the car prior to the event, we hadn't been able to bed in the brakes. This meant we were going to spend a few attempts to pass. During the brake test the chain was beginning to stretch (being a new chain this is common) meaning we also had to tension the chain.

It took longer than we would have liked to pass the brake test, although we managed to pass it in time to compete in the sprint event in the afternoon.

Static Events:

The static events are split into 3 sections:

1) Business

Business event is to show how our design and car can be marketed and sold to the public as a weekend single seater racer. The business event is held away from the car in a boardroom type setting.

2) Cost

The cost event uses a standardised cost template to cost the car as though a batch of 1000 were being made. It uses the standardised costing template to enable everyone to be on a level base to compare the costs of the car. It must be costed in absolute detail, down to how many turns of a screw to assemble it. Consideration must be taken place for design for cost effective manufacture, and environmental processes and materials. The event takes place in the pits around the car where the team of judges compare the cost report submitted with the car in front of them. There is also a special cost event where we had to design and cost a bike rack for a current production car.

3) Design

The design event is run with a team of 6 judges analysing the design and decisions made to achieve the design. Understanding the teams goals and methods to attain how good the design is. The design event happens in the pits around the car.

Business

The business event was completed by 2 of our newest team members, both being 1st year business students. They took the challenge really well, however being business students didn't have enough technical knowledge. We have learned to have an engineer in the room to answer any technical questions regarding the car. All things considered the business team did a great job, especially with their lack of experience. They have learned an awful lot and took notes on the business final so that they can come back next year even stronger.

Final Result: 38/75 46.5 Points

Cost

The team approached the cost report in a different way to previous years, having just a small team completing the cost report for the car. Previously the designers would then cost their parts once they were designed. We realised at the event that this method was not the best and resulted in too much work for the small team completing the cost report resulting in several missed out components. However we have learnt to cost as we design, this will help the team members understand the importance of cost, to design something to be manufactured cost efficiently and sustainably. The special cost was an improvement on previous years. However there was not enough focus on the cost, most of the focus went to the design of the bike rack. These lessons are important and help us develop as young engineers. We will make sure we pass this knowledge on to next years team.

Final Result: 45/75 27.72 Points

Design

The design event was the most prepared we have ever been, with over 13 supporting documents along with the design reports from each section (Powertrain, Chassis, Suspension and Electronics). These documents were used to show our design decisions, and our logic behind the decisions. They complimented us on our use of decision matrix to define our choices. They were impressed by our knowledge transfer and highlighted how we are doing the right thing by training our new team members. We also had all of our technical drawings on display, where we were praised for our excellent drawing quality. The judges however commented on how we should use more simulation to improve our designs and further justify our design. They would also like to see more revolutionary technology being used. With the University completing its new Future of Technology centre, which houses a metal laser sintering machine we can provide more cutting edge initiatives on the car next year. We have great ideas for next year and will be in a much stronger position to improve our score.

Final Result: 45/75 70 Points

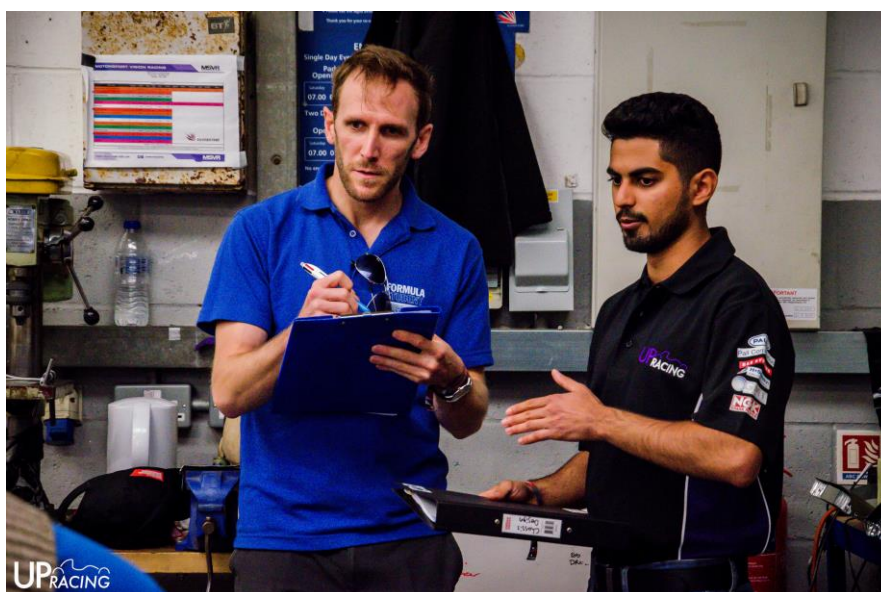


Figure 5 Design judging

Dynamics:

The dynamic events are split into 4 events:

- 1) Acceleration – 75m Drag style event. The driver does not have to go off a start light, however so it does not test reaction time, purely the cars acceleration.
- 2) Skid Pad – Timed loop around a left hand circle, then right hand circle. The average of these are taken. This tests the cars lateral grip, and ability for fluids to be forced to one side during a constant turn.
- 3) Sprint – Single 1km autocross style lap, constructed with a coned layout with the track width only being around 3 metres. This tests the cars full potential in accelerating, braking and cornering. The track features tight hairpins, slaloms and fast sweeping corners.
- 4) Endurance – 22 laps of the sprint track. With a driver change half way through (11 laps per driver). During the driver change only the drivers can touch the car and cannot carry out any work other than adjusting seat and belts. The engine must be switched off and restart under its own power. The driver swap must happen within 3 minutes and engine restart within 2 minutes. The car is inspected during this period for any fluid leaks. If at any point during the endurance some bodywork falls off or the car fails, there is no opportunity to fix it. As soon as you start you have that one attempt.

Unfortunately due to Acceleration and Skid pad being conducted on Saturday morning, we were unable to compete in these due to not completing scrutineering until Saturday afternoon.

However we were able to compete in Sprint and the Endurance event.

Sprint

The sprint allows 2 drivers to set 2 timed laps each. The weather was very bad, with heavy rain for the both drivers. However considering the rain the first driver set 2 good lap times, being fastest driver on track at the time. The second driver set an even faster first lap, however collected some cones, thus losing time. During the second attempt the chain was slipping on the sprocket due to it stretching. The driver aborted the lap to preserve the car, ready for the endurance.

Final Result: 26/75 10.91 Points



Figure 6 Rain soaked sprint

Endurance

The car was prepped overnight, adjusting the chain tension and ensuring everything was okay. We made our start slot and started off easy and built up the pace. The first driver was doing well maintaining the chain which was still stretching. After 11 laps with no major issues the car came into the driver change area. Unfortunately the marshals spotted an oil leak. We later discovered that there was a leak coming from the flanges on the scavenge pump for the dry sump. This was unfortunate as it had not been seen previously, and was an easy fix. However this meant we could not complete the endurance. Not many teams even made it to the driver change, so we were very happy to have shown what we can do. Not being able to finish it due to a minor issue is something good to take on board. With some testing prior to the event we would have been able to iron out all of the issues. However due to designing a completely new car this year we made the manufacture period too short and did not have enough time to test.

Final Result: 26/75 11 Points



Figure 7 During the endurance



Figure 8 Endurance

Summary:

Overall Final Result: 43/75 166.1 Points

The team had worked extremely hard from September 2016 to Silverstone in July 2017 to design and build an entirely new car. Taking on over 20 new team members and training them up so that they are competent on CAD, understand the design process, materials and science behind the design. Then learn technical drawings, contacting our sponsors, meeting with them to organise manufacture of the components. Bearing in mind every team member is studying a full time degree, including coursework and exams. After their exams, coming back to University when everyone has left for summer to build the car. It was an incredible feat to be able to do this as a team of mainly engineering students, who would give up any spare time to help each other learn and progress.

We spoke to James Allen, patron of Formula Student, head of Mercedes HPP. He said it was amazing that we could even get a car built and ready for the event. He spent a lot of time looking at the car and was impressed by what we achieved and our attitude to engineering.

Although we are competing, the scores aren't the most important thing. The real result is what the students are taking from the experience, the lessons, skills, teamwork, comradery and knowledge. It can be seen that alumni from UPRacing will go into better engineering firms, they get placements quicker and get a job faster than those who don't do formula student.

With the sponsors help we are able to give the team members a much better experience in their education so that they are far more prepared for industry. They learn many of the key skills that are needed. Thank you all as this means so much to us.



THANKS TO OUR SPONSORS

