

Rotary Racer – Greenpower – 2011

The year of the tail



What a year for the Rotary Racer team. 3rd at the Corporate Challenge and 1st at all of the F24 races as well as winning the National Greenpower Final. This write up is based on the teams Todo list and describes the main activities of the team this year. We hope it gives ideas for other teams taking part in this excellent engineering challenge.

The Early Winter Months

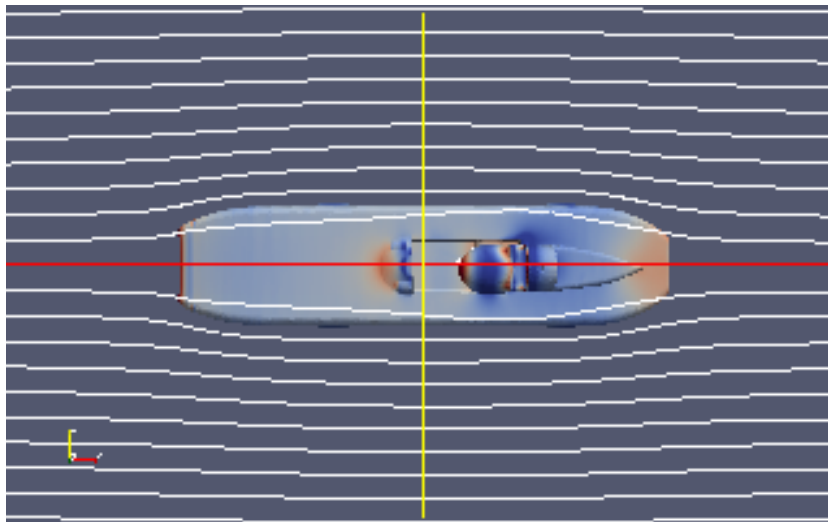
We had an excellent year in 2010 getting podium finishes at most of our races and coming 3rd in the National final. We did have the roll incident at Castle Coombe, but this did provide another learning and minor re-design opportunity and the throttle linkage failure at the final.

2011 was the year of the battery change. Finance was going to be a issue, so a new car was out of the question. Two of the older members had left the team and we had three new members who needed driving training and engineering experience with the car. The older pupils were also coming up for their GSE exams this year and so we wanted to restrict the work they had to do. The parents also had little time due to work commitments. We had a few team meetings at the start to discuss our plans for the following year. This led to the following actions:

Look for Sponsorship. (TA,KA,BM,IM,others)

Various letters were sent out to companies and organisations. Chipping Sodbury School was very fortunate in that the Rotary Club decided to provide enough money to purchase about 2/3rds of the batteries for the teams as well as finance the building of a Wind Tunnel. Half of the money would be held back until the Wind Tunnel was built. We also obtained some funding from the Townsland Trust and the Royal Air Force, discounts or materials from Schwalbe, CTEK and others. Chipping Sodbury Greenpower teams were also very fortunate this year as the building firm Wates, who were building a new school sports hall, built a new Greenpower garage for the school teams alongside the DT department for free. This meant we could have more room and keep the cars inside rather than in the leaky and damp metal lock-up units we were using.

Check rules for next year. (BM)



Apart from the minor changes needed, the rules allowed the car to be 300mm longer. So we set GB,DD the task to see how best to use this with 3D CAD and VWT experiments.

Purchase 2 new batteries.

We had some money left over from the previous year and so purchased two of the new batteries for testing.

Check size of rear view mirrors. (TA)

All Ok.

Build new car support trestles. (DB,SD,LB)

It was always hard working on the car. Martin noticed, as he does, some cheap trestles in Lidl's and the new team members were set to working building them and later reducing their height.

Clear out old storage containers. (GB,DD,BM)

As we were moving into the new Wates Greenpower garage it was time to clean out the junk from the lock-ups.



Offer Brendan ideas for new Greenpower room. (LB,TA,KA)

Working out how best to use the new space provided.

Build battery test rig and test new batteries. (DD,TA,TB)

A major effort would be testing the new batteries and seeing what current we could get out of them in a race. We modified the battery test rig for the new batteries (removed some of the halogen bulbs for reduced current) and added connectors to easily connect the new batteries and then performed multiple discharge tests at different temperatures. This gave us the average current we could use at a race.

Design full size wind tunnel. (GB,DD,BM).

With the Rotary Club's money, the older lads were set the task to design and build a full sized wind tunnel to fit in the new Wates Greenpower garage.

The Later Winter months and Race Season work

After some battery testing and experimentation with the VWT on variations of the cars shape we had other meetings to decide what next to do. These came up with the following higher priority items (plus others as well):

Look at improving cars performance.

Various ideas were put forward and investigated. (All)

Modifying rear end for new shape

This will change the rear end to have a more "pointy" shape as per GB's VWT simulation designs. It needed to be easy to remove/hinge for battery changing etc. (GB,DD,MD). GB had played with the cars shape using 3D CAD and the VWT to see what could be gained with the extra 300mm length. Various ideas were tried including making the nose more pointy, making both the front and the rear more pointy and then just the rear. After quite a bit of work and fine tuning, a new rear end



shape was designed that, according to the VWT, offered around 12% improvement in aerodynamic drag. The basic shape was printed out onto paper and the new team members(SD,LB) and TA, with MD's help, glued and shaped some foam to match. The cars rear end was cut off and a method of fastening the new rear end that still allowed quick battery changes was devised.



Improve seat arrangements for new shorter drivers with better antisubmarine support. (LB,DB,TB).

The joy stick had been shortened at various times to suit the growing lads (approaching 6 foot). The new members were much shorter and could not reach the joystick. We played with foam behind the driver and head but this did not work so well. Eventually we decided to make an adjustable joystick offering about 300mm of travel. With this the drivers would all be located at the back of the seat and against the same head rest. As the drivers crutch would be further back with



the smaller drivers, we had to find a better antisubmarine system for safety than the foam block we were using. We decided on using a 5/6 point harness. The lads vetoed a 5 point one (:) and so were given the task of sourcing a 6 point one. The seatbelt mountings were moved and strengthened for this. The plans for the adjustable joystick were done on paper by the new team members and made out of aluminium tube and bar. A keyway was milled in the bar and it was turned



in a lathe to fit inside the tube. (DB,LB).

The pupils decided on a cycle seat clamp type adjuster and TA with KA made a tight fitting plastic block for this. MD “found” someone (as he does) to weld the aluminium steering arm and handle to the outside and we had an adjustable steering column. The car could now safely fit pupils from about 1.3 to 2 metres tall.

Fitting new batteries

Method to fit the new batteries, new connectors and hole for scrutineering. (BM,IM). As the new batteries were smaller the battery holder was modified to make the new ones a snug fit. This was done with foam and thin plywood to improve heat insulation while doing so. We also had to modify the plugs and sockets to the batteries as only one battery at a time could be fitted according to the new rules. IM managed to obtain some battery connectors (0 pounds :)) and the main battery wiring was cut, crimped and fitted. (BM,DB,SD,LB,TA,KA,IM,TB)

Based on new battery sizes, make new battery box/boxes, trolley etc as needed.

(Smaller battery boxes ? Wheels on battery boxes ?) (BM,IM,TA,KA). An extra insulated battery box was needed, so a smaller one (actually two) were made. The battery trolleys wheels were a bit small on the rough ground and so BM found some larger ones from a go-cart and fitted these.

Replace throttle mechanism.

Either new electrical throttle mechanism or repair old one). (TA,KA). After the failure in the 2010 final a new throttle mechanism was called for. After searching the Internet, 4QD's electrical throttle was purchased and fitted.



Modify rollbar rear strut for better forward/backward strength. (LB,MD)

Following the roll last year and the new rule changes we modified the rear roll-bar strut to provide forwards as well as backwards support.

Modify cockpit opening to remove flaps

Probably replace with fixed solid foam bits reducing area. Maybe look at rounding front bar to allow drivers knees to come up for easier entry/exit. We cut some of the flaps away so drivers could exit without the foam bending and then screwed down the flaps so they could not open. (SD,DB,LB,TB)

New gearing

Our Greensim simulator was used to estimate the gearing we would need based on the VWT improvements, batteries energy and weight. It was determined that we could obtain the required gearing by just changing the motor drive sprocket and we had the necessary gears for this. The simulator suggested > 110 miles was easily possible.

Improve Laptop display. (DD,TB)

The Laptop's telemetry display was a bit “techy” and so difficult for the pupils to use easily. So we devised and implemented a new, simple, bar-graph display, that shows the main data and allowed easy changing of the cars power level. This allowed the pupils to completely take over this aspect of the racing this year.

Wind Tunnel

The older lads were during this time designing and building a full sized wind tunnel with a fold-away design. They researched and purchased 4 24inch fans and the wood to build it. Some of the new experiences included finding the new Screwfix shop and purchasing the nuts and bolts there. The wind tunnel was finished just before the final and will start to be used next year.



The Racing Year

The first outing of the season was the test day at Goodwood. We had three new team members, (DB,SD,LB). So it was decided to make this a driver test day and pitstop practice day for just the new members with the older TA to provide direction. The older pupils were left at school with GCSE's approaching, much to their disgust. We didn't have the new adjustable joystick available yet, so used foam packing, but did have the new rear end for testing. This proved to be an excellent day. The new members had the time to get used to driving and managing the car in a relaxed environment and had a lot of fun. Us oldies had fun as well as we were allowed to race the car around Goodwood :). This was an great experience and was a great way to check how the car behaves.

The first race was the Corporate challenge at Silverstone. We knew from the speed of Simple Trug at the test day, it would be hard to beat and so it proved. Silesian Greenpower were also excellent on the day narrowly missing out on winning. For us it was a see how the batteries would actually do race. So we played relatively safe keeping energy in reserve. DD mainly managed the cars power from the laptop with others helping. The drivers chose to use 4 drivers so everyone eligible could have a race on this circuit. The race went very well for us, managing third, and surprisingly well ahead of the other school competitors.



The Goodwood race was a very wet race, the wettest we have been in. There were a few problems with wet getting into the car, but it held together and the drivers both new an old drove excellently in this race to take the win. They choose to use 7 drivers to give everyone experience of driving. This was the first race with the new Joystick/harness and it worked well, although pit-stops took quite a time as we had had little practice with the new arrangement. The team always look at the opposition at the races and saw that Fireblade were going exceptionally well and were close to matching us until they had some problem and were out of the race for a bit. No room for complacency ...



The Dunsfold race had superb weather, light winds and hot, probably to hot. Again an excellent race for us managing first but with Fireblade in a strong second place and the new BY-pod car from stable-mates The Pod Movement doing very well on their first outing. This is quite a tight circuit with quite a few entrants and so the track is quite crowded. Staying out of trouble is the order of the day and quite difficult when driving one of the faster cars. It was estimated that RR overtook over

650 cars in the race about one every 22 seconds and we had three new drivers learning to do this. They did very well, keeping to the outside most of the time. With the excellent conditions we managed, along with other teams, to break the distance record for this circuit and with the smaller batteries.

The car was going so well, and so little work was needed the summer holidays was a quiet time for us away from Greenpower. Merryfield was soon after the holidays and there was some time for some pit-stop practice and car maintenance prior to the race. Again we managed to win the race and again we managed to break the circuit record for a Greenpower car at this circuit.



Castle Coombe was looming and we wanted to get the Renishaw Shield back from The Pod Movement after last years race. Also we wanted to reduce the likelihood of Gremlins at the final after last years throttle problem. So we stripped the sides and top off the car and cleaned and checked things over.



We checked the chassis for cracks, the steering and subframe nuts/bolts, cleaned the chain and check the electronics over. We also had a ripped seat that had to be repaired. As a few cars were close to us on performance, we looked at fairing behind the brake light. GB's VWT work showed that we could obtain about 4% improvement by doing this. So SD, LB and MD made up and fitted this prior to the race. The race was again excellent with superb weather especially for October. The drivers again choose

to use 6 drivers to give most members a go with DD on the laptop. We managed to again win the race with an excellent 113 miles and won the Renishaw Shield back :)

So it was onto the final. All the work we had planned to do on the car had been done and now was not the time for changes. The better battery sets were selected, topped up with charge and warmed. The new tyres had been run-in at Castle Coombe. The cars tracking was checked for the umpteenth time. The electronics was checked, new batteries put in the telemetry receiver. The car horns new sounds/music had been added. There was time for pit-stop practice, checking a few things over and a strategy meeting amongst the drivers. Although we had been quite well ahead at the races this year, this was not a time for complacency. We had obtained the high first place position at a race with excellent weather and without our main competitors attending or if there having problems on the day. We also had the gremlins to deal with having the number "1".

The national final is always an excellent affair with all of the finals regalia and this year was especially good with the excellent weather. As has been the norm this year, us adults had little to do and had the chance to wander around looking at the various designs and teams in action and take photo's. The race went exceptionally well for us.

The car was on song and flying around although being kept on its leash by DD to keep energy in reserve. We did have the laptop's disk drive fail in the second half of the race, but we did have a backup laptop that went in relatively smoothly. The drivers had chosen to be competitive and go for 5 drivers although they used the 3 heaviest, older drivers as this would be their last race. They made up for this a bit by using the fastest of the lighter new drivers to drive the longest last stint. We were just ahead of the opposition at half time, but with energy, and the lightest driver in reserve. As the last



driver started her run, KA had calculated we were on the edge of doing 117 miles so DD increased the power levels a bit as we had energy to spare. As the time progressed and the batteries were looking good, DD decided on full power. This with DB's weight and fast driving got our mileage even beyond the 117 and up to 120 miles.

An excellent year for the Rotary Racer team even more so as the adults involved did less of the work than ever. The car certainly went exceptionally well with the new batteries. The team managed to do the same mileage as we did at our Final win in 2009 but with 34% less energy. This was probably mainly down to: The longer aerodynamic tail, the lighter and more stable batteries, the superb conditions and lack of the chicane on the day, the excellent driving and pit stops.

Thanks to Brendan who puts in so much work for the Greepower teams at Chipping Sodbury and all of our Sponsors who all helped with our success this year.

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