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**Innovation drives Renishaw Greenpower team to success**

Greenpower races require teams to design, build and race fully functioning electric vehicles. Greenpower aims to introduce children and young people aged between nine and 25 to an engineering environment, encouraging participation from schools, universities and companies. Since its first event in 1999, the Greenpower initiative has grown significantly and now works with over 8,000 students across the country.

Here, Stephen Hunter, a Technical Manager at [global engineering company Renishaw](http://www.renishaw.com/en/renishaw-enhancing-efficiency-in-manufacturing-and-healthcare--1030), explains how Renishaw’s team of apprentices and graduates designed, built and raced electric cars straight to the top of the podium.

In the F24+ category (ages 16-25), teams race their electric cars with the aim to complete as many laps of the track as possible within an hour. The cars use standard twelve volt batteries and a standard motor according to the Greenpower rules. The aim is to use the batteries as efficiently as possible so that the car travels the furthest distance in the allocated time.

In the 2016 Greenpower finals held at Rockingham Motor Speedway, the Renishaw team of graduates and apprentices achieved both first and second place in the Silverline Corporate Challenge. This success comes down to the team’s creativity and innovative thinking when designing the cars because the team works to a small budget – each Renishaw car was originally built for less than £750

The final results were a culmination of a season that saw the Renishaw team enter several races and make numerous modifications to its three cars. The innovative effort did not go unrecognised as Renishaw was awarded the Siemens PLM Engineering and Design Award for the cars’ innovative designs and the Siemens Digital Award for its telemetry and phone app.

**Design**

The starting point for this year’s entry were the cars from the previous season – a good benchmark based on a positive double first place finish in the 2015 F24+ final and the Silverline Corporate Challenge.

The team used Siemens NX software throughout the design stage for its race cars, particularly for performing aerodynamic analysis and part simulations. The software enabled the team to use computer aided design (CAD) models, test the aerodynamics of the car virtually and ensure there were no mechanical design incompatibilities.

**Aerodynamics**

An important design focus was the aerodynamics of the car. Siemens NX software allowed the team to create various iterations of bodywork that team members could access and contribute to. The software could also be used to test the aerodynamics of the designs in a virtual wind tunnel and refine the design accordingly.

To improve the aerodynamic performance of the car, the team reduced turbulence behind the driver’s head by using helmet fairings. Another design improvement was using a round nose cone on the front of the vehicle for better aerodynamics with cross winds.

The cars were designed with the smallest wheels possible and these were canted at a ten-degree camber. The wheels were enclosed by the body of the car, with the body tightly wrapped around them. The small wheels and camber decreased the cars cross sectional area to give an aerodynamic advantage.

**Rolling resistance**

As well as aerodynamics, the team focussed on rolling resistance, the force resisting the motion of the wheel rolling on the track, which leads to wasted energy. To reduce the rolling resistance, the team inflated tyres to over 100psi and reduced weight wherever possible in the cars.

**Gear choices**

As well as aerodynamics and rolling resistance, the team also prioritised gearing. Using a gearing system allows drivers to adjust current usage during the race in reaction to changes in conditions. This means that the current usage can be fine tuned to the track and conditions of each individual race, thus improving the performance of the car.

The cars designed by Renishaw operate using derailleur gears similar to those on a push bike. This is a more technical approach than a number of competitors who operate cars with a single gear on a sprocket or fixed gear ratios. The bonus of the design of Renishaw’s cars is that the gear can be adjusted to go up and down hills more efficiently, a great advantage on circuits with large elevation changes. The driver is also able to adapt to the conditions during the race, such as a change in wind speed or direction.

**Electronics**

Early designs of the cars were simple systems consisting of a relay and a switch; the team then looked to more advanced control systems. For example using metal–oxide–semiconductor field-effect transistors (MOSFETs) to control the motor instead of a relay to increase efficiency and decrease power use. These could be controlled by a proprietary microcontroller board, such as an Arduino, allowing interaction between the car and the driver.

One of the team’s main electronic innovations was the creation of a smartphone display function which allowed the driver to make appropriate gear choices. The display showed the voltage and current draw during the race. Information could be relayed from the Arduino through a Bluetooth module to the android smartphone.

This meant the driver was able to adjust to use more or less power as appropriate by changing gear to suit the immediate conditions. This was an innovative choice of display function rather than a custom display or control unit and meant that none of the power was wasted on display – only wirelessly transmitted to a smartphone. The android phone in the car then relayed this to a web page that could in turn, then be accessed by any of the pit crew during the race.

**Build**

The team built the cars and made the majority of components themselves in a development workshop using a mixture of manual machines as well as more complex CNC mills and lathes. This is not only in the spirit of Greenpower, but also the quick nature of the manual building meant that if tweaks were required between races in the season, parts could be produced quickly.

The cars were built using predominantly steel and plywood according to the designs produced in Siemens NX. The body work of the cars is an effective and lightweight structure, made from horizontal stringers running over vertical bulk heads covered by an extremely thin shrink wrap film.

The successes of Renishaw’s Greenpower cars came from the team’s creative design and skilled hands combined with its use of software and electronics to optimise the car performance.

Ends 1,053

Notes to editors

UK-based Renishaw is a world leading engineering technologies company, supplying products used for applications as diverse as jet engine and wind turbine manufacture, through to dentistry and brain surgery. It has over 4,000 employees located in the 35 countries where it has wholly owned subsidiary operations.

For the year ended June 2016 Renishaw recorded sales of £436.6 million of which 95% was due to exports. The company’s largest markets are China, the USA, Japan and Germany.

Throughout its history Renishaw has made a significant commitment to research and development, with historically between 14 and 18% of annual sales invested in R&D and engineering. The majority of this R&D and manufacturing of the company’s products is carried out in the UK.

The Company’s success has been recognised with numerous international awards, including eighteen Queen’s Awards recognising achievements in technology, export and innovation.

Renishaw is listed on the London Stock Exchange (LSE:RSW) where it is a constituent of the FTSE 250, with a current valuation of around £1.8 billion.

Further information at [www.renishaw.com](http://www.renishaw.com)