Facts

Challenge

Build in the shortest possible time a, lightweight, compact, battery housing with integrated cable ducts and cooling channels for an electric-powered race car.

Solution

Production of the battery housing from fire-resistant PA12 material, using Additive Manufacturing.

Results

- Optimised: lightweight and compact for weight and volume savings
- Construction freedom: integrated cooling channels and cable ducts
- Safe: fire-resistant material

International cooperation: The race car from the team Global Formula Racing is the first and only electric vehicle that was designed and produced by students from a German and American university (Source: Global Formula Racing).

Electro Racer Made Easy: The Young Engineers of Formula Student Racing are Powering Ahead, Thanks to EOS Technology

e-Manufacturing Solutions

Additive Manufacturing and its freedom of design helps students to racing success

Short profile

Global Formula Racing is the first innovative international cooperation of its type in the history of the US and European Formula Student competition. The ex-BA Racing Team of the Baden-Württemberg Cooperative State University (DHBW-R) in Ravensburg, Germany, and the Beaver Racing Team, from Oregon State University (OSU) in the USA, have pooled their resources to form a single team.

Address

Global Formula Racing e.V.
Fallenbrunnen 2
88045 Friedrichshafen
(Germany)
www.global-formula-racing.com

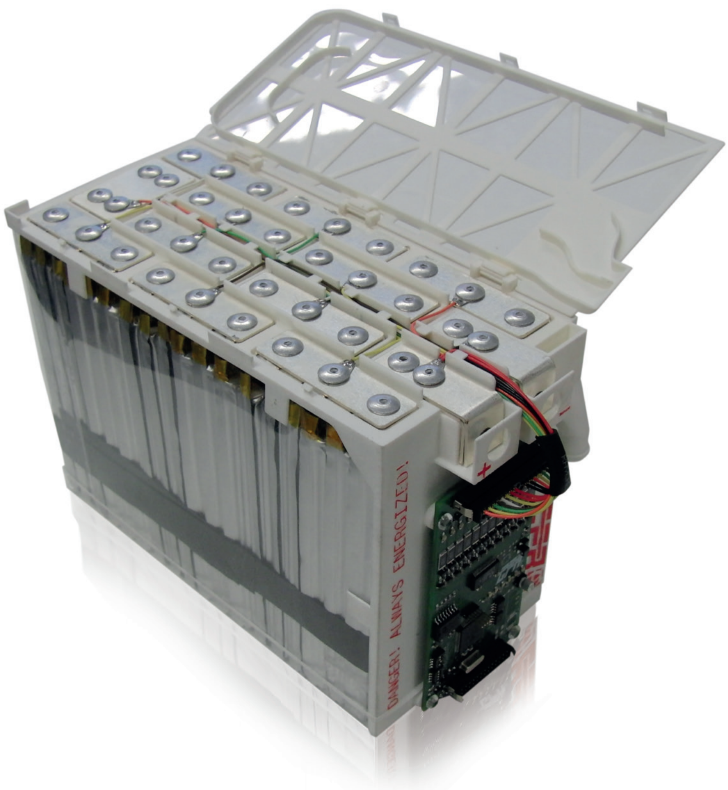
"If the race begins at three, you'd better be ready at three. They won't wait for you." So spoke the legendary Ferry Porsche. It's a sentence that the Global Formula Racing Team has taken to heart. They have built an electric vehicle for the Formula Student – the racing series for universities and higher education institutes that's honing the skills of the next generation of engineers. Global Formula Racing is the first, and, until now, the only Formula Student team, formed from students from two different international universities – Oregon State University in the US, and the Baden-Württemberg Cooperative State University (DHBW-R) in Ravensburg, Germany. The international team utilises EOS technology in the manufacture and assembly of a safe and extremely compact container for the required battery pack of its racing car.

Challenge

The Formula Student began in the USA as an international construction competition for institutions of higher education. Students are given the opportunity to develop a racing car from a blueprint to the racetrack, and have the chance to compete against their peers from around the globe. The series now has two classes, one for combustion engines, and the second for vehicles powered by electricity. And, it's no longer enough to just build a fast car. Entrants must adhere to cost and safety considerations, as well as factoring in numerous other requirements that need to be set out in a comprehensive and transparent plan.

On the racetrack itself what counts towards a podium finish includes acceleration, time on the circuit, and fuel efficiency – all placing high demands on the technologies in play. The Global Formula Racing Team has set itself the target of optimising performance by taking a closer look at the challenges faced in the previous season. As with all electrically powered motor vehicles, it was the battery – and more specifically, the storage capacity – that came under particular scrutiny.

Of course, the most critical consideration is safety. But, beyond that, there are a number of other important factors: The total weight of the construction – and therefore all of the component parts – should be kept to a minimum. Correspondingly, size



Using the EOS technology, the volume of the battery housing was reduced by half, and the weight by 40 % (Source: Global Formula Racing).

must remain a consideration. "In 2011, more than anything it was the battery housing that gave us headaches," explains Salvatore Decker of Global Formula Racing. "The system of the previous season still comprised a loose battery assembly that only fitted into the two casings with some effort. The housings were really big and heavy, and the heat dissipation wasn't optimal. Also, the configuration of cables for each battery stack was particularly complex."

Solution

The Additive Manufacturing process opened up new design possibilities for the construction of the complete energy storage system. The race team's constructors were then able to plan from the outset for an optimised overall system solution. Because of the creative freedom offered by the housing, the complete battery pack could be compacted. The actual design process proved to be relatively simple, thanks to CAD software – and the usual steps could be followed right up to production.

"In these times of skilled labour shortages, young engineers are becoming more important than ever for maintaining Germany's position as a center of industry. Because of this, we put our support behind the Formula Student: young technicians can experiment here and explore unchartered territories. Our technology fits perfectly with these aims," explains Nikolai Zaepernick, Business Development Manager Automotive at EOS. "Laser sintering opens up new opportunities to manufacturers in the design and construction of their products. Incremental production processes allow engineers to create totally new designs and to construct them within a matter of hours."

In this specific case, Salvatore Decker's team used the EOS technology with a synthetic granule known as PA12. After the race team has transferred the prepared CAD data to the machine, the production began, layer by layer. For the creation of the CAD template, the engineers made use of their standard programme. The part was constructed from initial drafts to a finished component in just a few days. Because of the accuracy of the layered manufacturing process, the battery housing fit perfectly in place on the first try.

Results

In this way, the team was able to decrease the volume of the battery housing by half, and to reduce the weight by 40 %, in comparison to 2011. As a result, the dimensions of the housing were just 20 x 14 x 9 cm, which was enough to accommodate the 36 battery cells. The modular battery assembly in the 2012 car contained eight battery packs, a fact that made servicing the system far simpler.

Also, constructors were able to integrate the cable ducts and the cooling system directly into the housing during production. A complex reworking of the housing was thereby avoided, and the channeling for the cooling ducts could take place unrestricted. This, in turn, made the designing of the team's cabling easier, and, as planned, the heat dissipation was improved.

In line with safety considerations, the utilised material is fire-resistant, important due to the proximity to the energy storage. Owing to the thankfully infrequent, though nonetheless very real, possibility of a crash, and to the chance of a defective battery overheating, all materials and component parts must be resistant to fire.

"The high degree of design flexibility of the additive production process has really helped us a lot. It allowed us to match the design to our requirements and to reach an optimum compatibility with our proprietary system for battery management – and all of that within the shortest time frames, at a low cost, and critically, as an ultra-lightweight construction. This technology is absolutely perfect for our line of work," enthused a very satisfied Salvatore Decker.

Ferry Porsche would certainly have appreciated the passion of the young engineers and their electric racing car. And, you can be sure that in the coming season, thanks to the technologies at their fingertips, they'll be at the track well in time for the green light.

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Salvatore Decker,
Global Formula Racing

EOS GmbH
Electro Optical Systems
Corporate Headquarters
Robert-Stirling-Ring 1
82152 Krailling/Munich
Germany
Phone +49 89 893 36-0
Fax +49 89 893 36-285

Further EOS Offices

EOS France
Phone +33 437 49 76 76

EOS India
Phone +91 44 28 15 87 94

EOS Italy
Phone +39 0233 40 16 59

EOS Korea
Phone +82 32 552 82 31

EOS Nordic & Baltic
Phone +46 31 760 46 40

EOS of North America
Phone +1 248 306 01 43

EOS Singapore
Phone +65 6430 05 50

EOS Taiwan
Phone +886 3 657 63 51

EOS UK
Phone +44 1926 62 31 07

www.eos.info • info@eos.info

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