

Case Study

Motor Housing for an Electric Race Car



**3D-Printing in Motor Sports by
Lions Racing Team**

3D-Printing Success Story

ROBUST ALUMINIUM CONSTRUCTION
improving connection strength and cooling capacity



INCREASED PERFORMANCE

7% gain in cooling capacity through additive design

Part Data

Designation:	Motor Housing
Industry:	Automotive Industry / Racing
Material:	AlSi10Mg
Layer Thickness:	30 µm
Build Time:	20h 1min (4 pieces)
Machine:	SLM®280 Twin



SLM®280

Current Situation

Motor cooling for wheel hub electric motors

The Lions Racing Team competes in Formula Student and is represented in the start class for electric motors. Their student developed vehicle includes four wheel hub electric motors to power the tires through an integrated wheel carrier gearbox. To limit the heat build-up from these motors, and to use the motors at a higher performance, they are locally cooled. To achieve the desired temperature control, a water cooling system is integrated into the vehicle, where coolant is spiraled down into each motor housing, taking the heat from the electric motors and

dissipating it into a passing flow of air in the radiators. The standard design featured a plastic motor housing.



Innovations with Selective Laser Melting

Additively manufacturing design optimized for improved performance

The motor housings for their LR17 race car model were manufactured in aluminum using the selective laser melting process. The design is the result of the systematic development of the plastic motor cooling housings from previous years. Development focused primarily on an improved and simplified sealing, stable connection pipes for the cooling hoses and an increase in heat dissipation from the electric motor and the water system.

To achieve the first goal of improved seals, O-ring grooves and a narrow gap between the motor and the motor housing were required. To achieve this, the motor housing was manufactured with excess material in the geometry during the SLM® process, accounting for internal material to be CNC machined after the additive build. The O-ring grooves were also post-processed for their tight tolerances.

Since the motor housing is produced in aluminum, it has a very similar thermal expansion and the gap between the motor and the motor house stays consistently narrow, allowing the O-rings to function optimally, a great advantage of the aluminum design.



Despite the thicker walls in the former plastic motor housing, the connection pipes for the tubes could break under light overload. This, however, was eliminated in the robust aluminum design. The wall thickness of the connection pipes was reduced through the improved mechanical properties of aluminum and, consequently, the inside diameter was increased. This reduced the resistance in the water cooling system, which increased the mass flux, and thus increased the cooling capacity of the entire system.

Since the four wheel hub electric motors and the corresponding motor housings of the formula vehicle are directly exposed to airflow, an additional cooling effect is generated. Thus, hybrid cooling was utilized where water cooling primarily cools the motor, and cooling fins help the main radiator to maintain a low water temperature. Depending on the operating location and the surrounding conditions, an additional 250-500 watts of cooling capacity can be produced

via the motor housings. This corresponds to a 7.5 kW main cooling capacity across 2 large radiators and a gain of approximately 7%. Thus, the increased thermal conductivity of aluminum is advantageous in comparison to plastic, which appears more insulating.

Thanks to the SLM® method, great developmental progress could be made in sealing, connection stability and improved heat dissipation, all at an identical weight to the previous design.



Additional SLM® parts for LR17

Together with the motor housings, SLM Solutions manufactured additional components for the Lions Racing car:



Summary

Motor housing optimized for cooling race car electric wheel hub motors

- Robust aluminum design to meet performance and weight requirements
- Additional 250-500 W of cooling capacity produced due to motor housing design
- Increased strength of hose connections while improving flow through decreased wall thickness compared to former plastic component
- International design competition for students



Lions Racing Team – TU Braunschweig

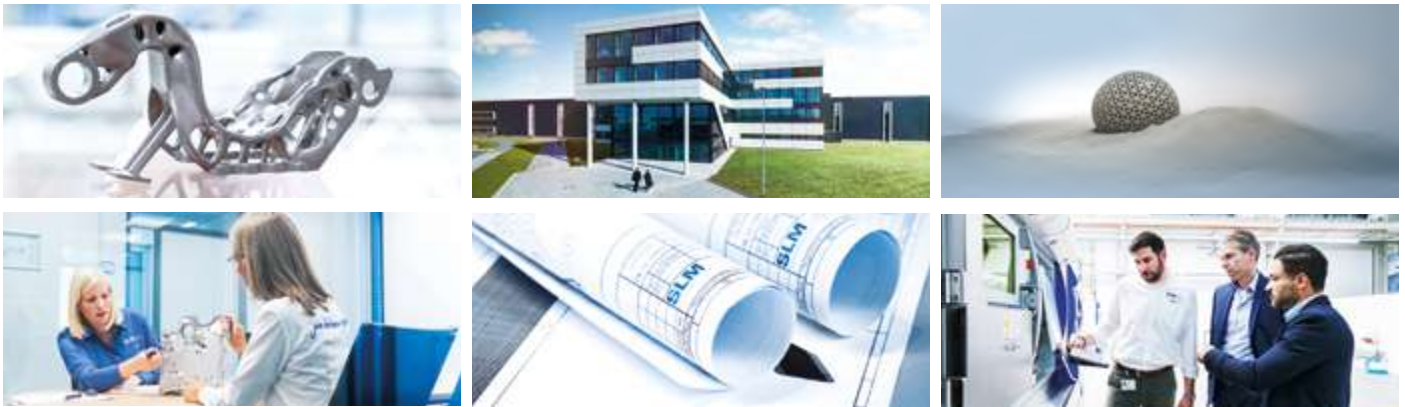
The Lions Racing Team from the Braunschweig University of Technology is a student association that annually builds and develops electronic racing cars to compete in Formula Student.

Formula Student is an international design competition where students from all over the world go head to head in a variety of events, showcasing race cars they have designed and built themselves.

SLM Solutions - Technology Pioneers, Innovation Leaders

SLM Solutions helped invent the laser powder bed fusion process, was the first to offer multi-laser systems and all selective laser melting machines offer patented quality, safety and productivity features. Taking a vested interest in customers' long-term success in metal additive manufacturing, SLM Solutions' experts work with customers at each stage of the process to provide support and knowledge-sharing that elevate use of the technology and ensure customers' return on investment is maximized. Optimal paired with SLM Solutions' software, powder and quality assurance products, the SLM® technology opens new geometric freedoms that can enable lightweight construction, integrate internal cooling channels or decrease time to market.

A publicly traded company, SLM Solutions Group AG focuses exclusively on metal additive manufacturing and is headquartered in Germany with offices in China, France, India, Italy, Russia, Singapore and the United States and a network of global sales partners.



SLM Solutions Group AG | Estlandring 4 | 23560 Lübeck | Germany
 +49 451 4060 - 3000 | info@slm-solutions.com | slm-solutions.com

SLM® is a registered trademark by SLM Solutions Group AG, Germany.

