CASE STUDY

LIONS RACING TEAM AND NIKON SLM SOLUTIONS

HOW A MOTOR HOUSING FOR AN ELECTRIC RACE CAR WAS 3D PRINTED

LIONS RACING TEAM

Nikon SLM SOLUTIONS

A Nikon Company

Nikon

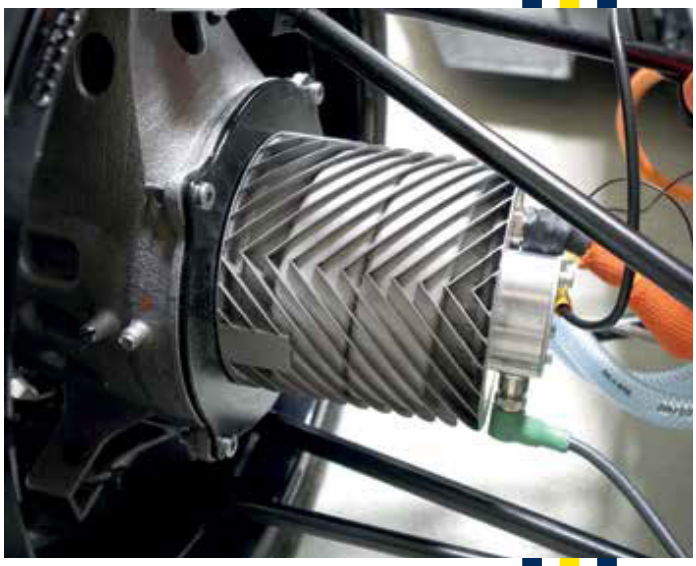
LIONS RACING TEAM TU BRAUNSCHWEIG

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.

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.



AM DESIGN OPTOMIZED 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 Nikon 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.

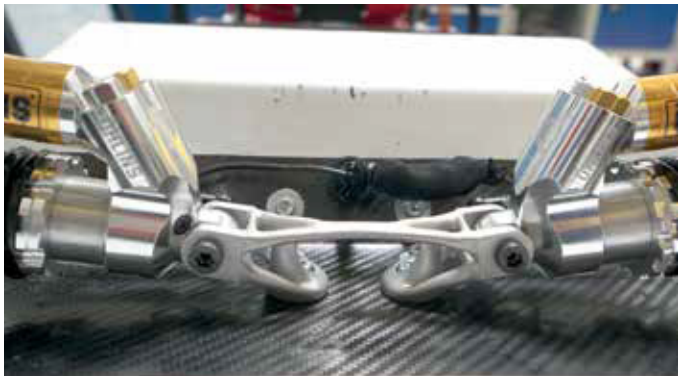
Since the motor housing is produced in aluminum, it has a very similar thermal expansion and the gap between the motor and the motor house stays consistently narrow, allowing the O-rings to function optimally, a great advantage of the aluminum design.

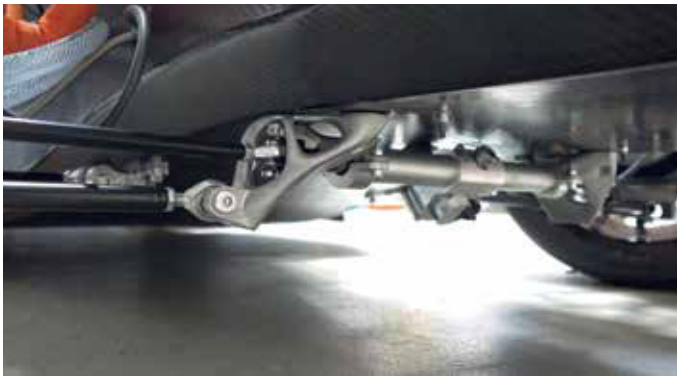
Despite the thicker walls in the former plastic motor housing, the connection pipes for the tubes could break under light overload.

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.

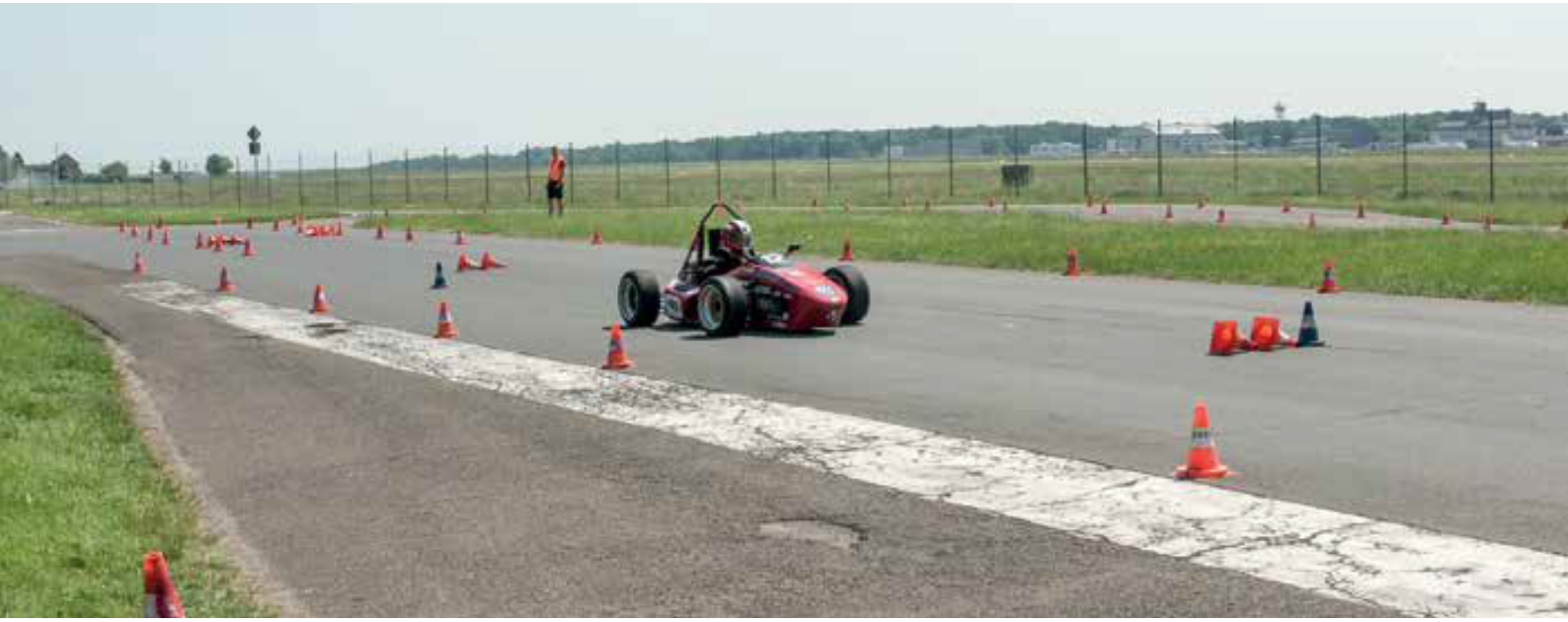
Together with the motor housings, Nikon SLM Solutions manufactured additional components for the Lions Racing car





MOTOR HOUSING OPTOMIZED FOR **COOLING RACE CARE ELECTRIC WHEEL HUB MOTORS**

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



NIKON SLM SOLUTIONS

Nikon SLM Solutions is a global provider of integrated metal additive manufacturing solutions. Leading the industry since its inception, it continues to drive the future of metal AM in every major industry with its customers' long-term success at its core. Nikon SLM Solutions is home to the world's fastest metal additive manufacturing machines boasting up to 12 lasers and enabling build rates of <1000ccm/h. With a portfolio of systems to suit every customer's needs, along with its team of experts closely collaborating at every stage of the process, Nikon SLM Solutions leads the way on return on investment with maximum efficiency, productivity, and profitability. Nikon SLM Solutions believes that additive manufacturing is the future of manufacturing and has the desire and capability to take its customers there right now.

Nikon SLM Solutions is a publicly-tradedcompany headquartered in Germany, with offices in Canada, China, France, India, Italy, Japan, Singapore, South Korea, and the United States.

Further information is available on **www.nikon-slm-solutions.com**