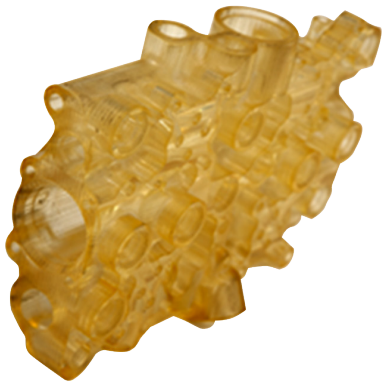
Lotus F1 Team and 3D Systems move together towards race-ready mass production of parts

Formula 1 is a sport revolving around engineering innovation where teams work relentlessly to reach and maintain a competitive advantage. The research and development machine never stops and at Lotus F1 Team the contributions of Technical Partners plays a crucial role in helping a lean and efficient organisation reach its targets.



"Race after race, new components made of complex composites and aerospace alloys see the light after surviving a harsh selection in the R/D and simulation labs," Technical Director Nick Chester explains.

IMG.1 (SLA prototype of 1999 gearbox hydraulic manifold)

"At the end of a racing season, we expect our race car to be in excess of a second per lap quicker than when we started and Technical Partners have to survive the same ruthless selection. We are not interested in relationships that are not capable of bringing value to this quest for performance."

The history of Rapid Manufacturing in Enstone began in 1998, when the first 3D Systems SLA® 5000 was deployed to do what it said on the tin: rapid prototyping. This is a useful discipline in a sport where aerodynamic surfacing constrains internal race-car components under a tightly packaged set of curvy panels. If function/fit tests were the main application for this new machine, the potential of the technology could not pass unobserved as aerodynamicists of the then Benetton Formula One team saw the complexity of the components coming out of the SLA® 5000.

Nicolas Hennel, Lotus F1 Team Head of Aerodynamics, explains: "Once the team got their 3D Systems machine, they began using it to develop component prototypes with a size-fit function. The use of solid imaging technology then gradually expanded from rapid prototyping to wind tunnel model manufacturing, allowing our Aero Department to grow from 11 to 80 employees. In Wind Tunnel testing, aerodynamics is an empirical science. We design and compare new ideas and choose directions to follow. The more ideas we can compare and evaluate, the more successful we will be on the track." Nicolas continues: "The car model in the wind tunnel features a complex network of pressure sensors. These were positioned by drilling pressure tappings into metal and carbon fiber components before SLA technologies became available. The ability to produce complex solids with intricate internal channels has revolutionized our ability to place these sensors and increase their numbers. It's a dream come true for aerodynamicists!"

IMG.2 (Wind Tunnel model SLA Air-box)

Lotus F1 Team now has nine of these centers and houses five SLA® iPro 8000 Systems, one SLA® 7000, one Sinterstation® Pro 140 SLS® System and two Sinterstation® HiQ™ SLS® Systems, which today allow direct manufacture of production parts our race cars.

Thomas Mayer, COO at Lotus F1 Team, is in no doubt of the added efficiency these technologies have brought to the team: "The first SLA® System parts were installed in a racecar in 2001 and following their success, we have continued to explore the boundaries of these materials. Since the launch of our Advanced Digital Manufacturing (ADM) Centre in 2002, 3D Systems' technologies have become an effective new manufacturing process that enabled us to reduce both cycle times and cost, and has added invaluable benefit to the team. On one hand, we enjoy the ability to manufacture multiple iterations of the same part for Wind Tunnel testing while on the other we see the number of sintered components in the actual car grow every year."

In practical terms, Lotus F1 Team can not only test hundreds of components per month in the Wind Tunnel, but also build some race-car parts directly from digital data using CAD and SLS® technology. Designers electronically flag a design as complete and send it, along with the material selection, to the ADM Department. Using SLS, complex car components are produced in hours rather than weeks, and in some cases the part is ready for inspection before the drawing has even passed through the system.

IMG.3 (SLS electronic box cooling duct)

Lotus F1 Team also produces gearbox and suspension components via accurate casting patterns, and can be more creative with their part design now that restrictions on permissible complexities have been removed. The SLA® process follows the exact blueprint of their CAD designs, and because the process is so accurate, time is saved on proof machining for the finished casting.

To reduce cycle time and cost, Lotus F1 Team ultimate goal is to use Advanced Digital Manufacturing as a fully industrialized technology to deliver race-ready car parts in volume. Lotus is especially looking forward to 3D Systems' development of materials that can withstand the punishing environment presented by an F1 car. The intense temperatures (the average temperature of a Formula One car is 250°C) and vibrations present a high hurdle but, like F1, 3D Systems' technologies are ever-evolving.

IMG. 4 Gearbox casting pattern