

CONCEPT TO PRODUCTION IN UNDER 3 DAYS

FDM Prototyping & Production Eliminates Tire Blowouts in Time For Next Race

"We're making FDM parts that gain us seconds on the track -- the difference between winning the race and finishing last."

- Nelson Cosgrove, Joe Gibbs Racing

After each race Joe Gibbs Racing (JGR) engineers have just three days to diagnose a problem, find a solution, and implement it before the car ships to the next race. FDM additive fabrication technology makes it possible for engineers to perform this feat by creating concept models, functional prototypes, manufacturing tools, and end-use parts in a matter of hours.

It's JGR's ability to speed from concept model to production part that has helped lead it to three championships and position it as one of the most competitive teams on the NASCAR circuit.

Real Challenge

One Sunday a tire blew out on a JGR car, causing it to crash, damage the car, and leave the race. It was later determined that extreme heat from a brake rotor overheated the tire, causing the blowout. A duct outlet supplying air to the tire was not adequately doing the job.

In the past, it would have taken at least several weeks to: Develop a concept design, Build a prototype using CNC machines, Evaluate the prototype's performance, Update the design, Build a new prototype, Build a mold via CNC to make a composite part, Make the part, And finally install it on the car. By this time, the team would have run the risk of losing several races.

"Our 37 engineers generate a lot of great ideas," says JGR Engineering Director Nelson Cosgrove. "Our challenge is getting those ideas onto the cars fast enough to win next Sunday's race."

Real Solution

On Monday morning following the race, after determining the problem, JGR Mechanical Engineer Scott Temple designed a new duct outlet that followed the contour of the wheel. He designed it to deliver air over the tire bead exactly as needed to keep it cool. Then, using a Fortus 3D Production System, he built a concept model from ABS-M30 plastic in just four hours. "It's impossible to evaluate fitment in a CAD program because the CAD geometry does not always exactly match the geometry of the car," Temple says.

How Did FDM Compare to Traditional Manufacturing Methods for JGR?

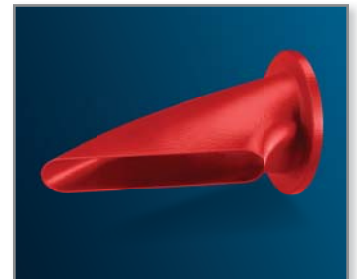
Method	Cost	Production Time
Traditional manufacturing methods	\$1175	33 days
Prototyping & manufacturing with FDM	\$ 47	3 days
SAVINGS	\$1128 (96%)	30 days (91%)



For Joe Gibbs Racing, a Sunday blowout revealed a brake rotor overheating.



Engineers had only three days to design and manufacture a new air-duct outlet.



Monday: First iteration of air-duct outlet concept model is produced.



Tuesday: Functional prototype is used in bench testing and then bolted to car for fitment evaluation.

Temple chose red ABS-M30 because JGR uses red to indicate concept models and other colors for the various other stages in the component's development.

After completing a couple iterations of the concept on Monday, Temple was ready to move on to a functional prototype. He chose PC-ABS, to create one with good impact strength. He used the Fortus machine to build the prototype overnight. On Tuesday morning, he performed bench testing on it and determined that the airflow could be improved with minor changes to the design. After evaluating the prototype's fitment on the car, Temple discovered it interfered with the brake caliper, so he created another iteration in CAD, making a number of small but significant changes to the geometry. Then he used the Fortus machine to create the new part late Tuesday morning. "More iterations equal better designs," says Cosgrove. "Having the ability to make multiple versions allows our engineers to optimize the part for functionality, fitment, and manufacturability."

Tuesday afternoon, Temple confirmed that the fourth design iteration's prototype fit perfectly, and the airflow was now optimized over the tire bead to keep it at the proper temperature. Using the Fortus 3D Production System, he then produced the part again -- this time using high-temp PPSF plastic -- to be used as a tooling buck to create a fiberglass mold. On Wednesday the mold was used to create the final duct outlet part from carbon fiber. JGR often creates an FDM part from PPSF for this application because the material can handle either the 100+°F (38+°C) temperatures of the wet layup process or the 350+°F (177+°C) temperatures of the "pre-preg" layup process. The carbon fiber part cured over the morning and early afternoon. Wednesday late afternoon the part was bolted on the car before it was loaded to the hauler and transported to the next race.

Real Benefits

"We designed, validated, and manufactured a problem-solving duct outlet in only 56 hours with the help of FDM technology," says Cosgrove. "Conventional manufacturing methods would have taken several weeks." An analysis of time to perform concept modeling, functional prototyping, and mold-core production via CNC milling and other conventional methods showed it would have taken JGR 33 days without FDM.

"Back when we evaluated the leading additive fabrication systems, we selected Fortus because it produces thermoplastic parts durable enough for functional testing and sometimes even use on the race car," says Cosgrove. "Having access to a range of materials on one system lets us pick the best material for the application. It's important to us to have a system versatile enough to handle both design and production stages. It's an important part of our edge. We're making similar FDM parts on a weekly basis that gain us seconds on the track -- the difference between winning the race and finishing last."



Wednesday: Final air-duct outlet is produced from carbon fiber composite.



The new outlet was bolted onto the car in time for the next race -- only three days after the overheating problem.

For more information about Fortus systems, materials and applications, call **888.480.3548** or visit www.fortus.com

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