



Trimming Time

ONE DAY AND ONE LABOR-HOUR IS ALL THAT'S NEEDED FOR WATERJET CUTTING FIXTURE.

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– Mark Bringle, Joe Gibbs Racing

CASE STUDY



Borrowed from the aerospace industry, NACA ducts draw in air with no appreciable drag. Ducts are shown mounted in the rear window of JGR's #18 M&M car.

REAL CHALLENGE

Joe Gibbs Racing (JGR), one of NASCAR's most powerful teams, is constantly searching for ways to make things faster. Like other race teams, it uses NACA ducts to keep temperatures steady and drag forces low. Borrowed from the aerospace industry, these oddly-shaped, bottle-like parts draw in air with little change to the car's resistance. NACA ducts are common in NASCAR, but JGR finds an edge in making the ducts a little better and a whole lot faster.

Each NACA duct is custom made to JGR specifications through a vacuum-forming process. The clear plastic parts are then trimmed to size with a waterjet cutting machine. To restrain the NACA duct while in the waterjet, it is nested in a custom fixture produced with a Fortus additive fabrication machine, using the FDM process.

Real Solution

When the NACA ducts were first shifted to the waterjet, the JGR team reviewed its fixture-making alternatives, but it did not take long to pick the FDM process. “We didn’t even give CNC machining a second thought. It was obvious that FDM was our best option,” says Mark Bringle, JGR’s technical manager. “Just one look at the fixture and we knew that it would be too much work and take too much time to get it milled on one of our CNCs.”

The day after process selection, JGR had two custom fixtures in service, Bringle says. “After the meeting, we had our designer draw it up, and we popped two out the next morning. We pulled the fixtures off the Fortus machine, mounted them on a surface plate and started trimming our NACA ducts. Right off of the machine, the FDM fixtures worked fantastic.”

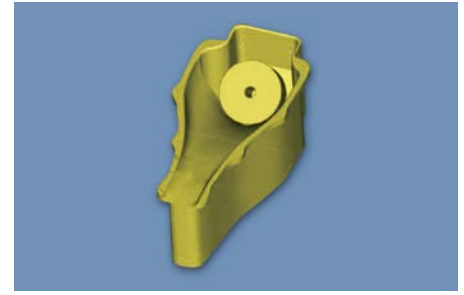
To make two FDM fixtures, the total lead time was less than one day, and the cost was only \$525. JGR also noted that the entire process was completed with only one hour of direct labor, which would not have been possible with machining.

Bringle estimated that if JGR had no other option than to machine the fixtures it would have required more labor and taken much longer, he says. “It would take a week to build them that way, and it would have tied a machinist up for a couple of days.” The estimated cost to machine two fixtures was \$2,550 — more than four times that of the FDM solution. Bringle attributed much of the expense to the fixture’s deep pockets, which would force the fixture to be split into halves, machined separately, and then assembled.

The estimate for machined parts also included time and labor to fine-tune the fixtures to match the contours of the NACA duct. “There is no way of knowing if the fixture is good or not until both halves are done, assembled and test fitted to the NACA Duct,” says Bringle. If machined and the fit was poor, the fixtures would be disassembled and re-machined, which is actually what would have been expected. Considering the added tolerance for the assembly and the loose tolerance of the vacuum formed NACA ducts, JGR machinists would have intentionally left extra material stock on the fixtures. “We call it sneaking up on a dimension. If we machined them to the nominal dimensions, there is the risk of being undersized and ruining the fixture,” says Bringle.

Overall, Bringle feels that the single-piece construction used to make the FDM fixture offers better accuracy. With FDM, the fixtures are made directly from the CAD design data that is an exact mirror of the NACA duct’s contours. “You get exactly what was in the design.” And these fixtures proved him right since they had a perfect fit the first time around.

It has been nearly three years since JGR put the two fixtures into service, and they are still going strong. From the very first NACA duct trimming operation on the waterjet cutter to the latest duct mounted to a JGR race car, these fixtures have been the first and only solution used on the shop floor. But if one were to be lost or damaged, Bringle would not be overly concerned, he says. “If we ever needed a replacement, we’d just load the file and spit out another one. We would be up and running again in less than a day.”



JGR produced this fixture with FDM direct digital manufacturing. The fixture was designed to secure air ducts while they’re being trimmed via water-jet.



A clear “NACA duct” nests in the pocket of the fixture on the right. The fixture was designed and manufactured in a single day.



The fixture’s deep pocket would have been difficult to machine, but it was no problem for direct digital manufacturing.

How Did FDM Compare to Traditional Fabrication Methods for JGR?

METHOD	COST	LEAD TIME
Traditional Fabrication	\$2,550	7 days
Direct Digital Mfg. with FDM	\$525	1 day
Savings	\$2,025 (79%)	6 days (86%)

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