

Don Schumacher Racing pushes the limits of machining



A funny car on display at Don Schumacher Racing. One of the biggest challenges faced by the machine shop team is manufacturing parts that are both light weight and durable enough to withstand the rigors of high-speed racing, including engine heat and crashes. (Images provided by CNC Software Inc.)

Lapping the Competition

Don Schumacher has never been a stranger to success. During his career as a race car driver and crew chief, and marketer of Funny Car drag racing, Schumacher personally won five National Hot Rod Association (NHRA) title events. His reign continued when he returned to the sport as a team owner in 1998. Don Schumacher Racing (DSR) in Brownsburg, Ind., now fields seven professional teams and is the winningest group in NHRA Drag Racing history, with over 325 national event titles and 17 world championships.

The secret to DSR's victories lies in its high performance automotive manufacturing shop. DSR has the real world

knowledge of the specific problems NHRA racers experience and all the capabilities of a top of the line machine shop; there's no need to trust another manufacturer to make the durable, precise parts their cars need. "We manufacture engine components, chassis components, exhaust widgets, everything down to nuts and bolts," said Scott Cutler, senior manufacturing engineer at DSM/DSR.

Cutler has been with DSR for two years but has worked in five-axis machining for more than 20. His experience is crucial to keeping the well-equipped shop running smoothly. Currently, the DSR shop houses 22 CNC machines, 15 of which are Okuma. These include horizontal four-axis milling

centers, five-axis milling centers, seven-axis mill turn machines, three-axis lathes, vertical milling centers, and a Swiss screw machine. Including Cutler, there are seven machinists and four programmers at DSR, all dedicated to producing the highest quality automotive parts possible.

Make the Parts Light

Cutler said there are certain challenges to manufacturing these parts. “We need to make the parts light, but at the same time we need to make the parts strong and durable. Cosmetically, they have to be nice looking. We have to ensure that all the machine features are to tolerance because we always have to take into account not just the fitment, but safety as well,” he explained. “You know, these cars are going at high rates of speed and a lot of things are happening, so safety’s a big concern. In top-fuel racing, we’re in the most extreme conditions. We make the most horsepower in any form of racing, we run for the shortest amount of time; we’re basically building a controlled bomb.”



Operator Frank Cervelli is machining the engine block on an Okuma MU6300V. Here he mounts the Hemi heads into the machine.

The general shop floor tolerance is plus or minus two and a half thousandths, and many parts require even tighter tolerances. DSR relies on Mastercam CAD/CAM software from CNC Software, Inc., Tolland, Conn., to meet its standards for precision and safety.

Of all the issues to be considered, that of weight versus durability causes some of the most strife. “Mass will always

help you in durability but it doesn’t help you in increasing speed or reducing overall weight. It’s one of the hardest things to do because we can’t use heavy metals like we should, so we have to use a weaker metal but somehow we have to make it hang on to the most power,” Cutler said.

DSR primarily uses aluminum, 6000 and 7000 series aluminum, Grade 5 titanium, magnesium, and mild steel. To balance out the weakness of these metals while maximizing lightness and durability, DSR takes a targeted approach to machining each part, Cutler said. “We don’t make any flat parts. All our parts have to be contoured so we can add ribbing in critical places and then thin material out in others.”

The shop manufactures parts anywhere from 0.25-140 lb (0.11-63.5 kg). Sometimes the process includes shaping a part from 800 lb (362.9 kg) of raw stock material, and removing material quickly and safely is paramount. “In order to remove that much material on a part at a good rate, we take advantage of the software’s Dynamic Motion OptiRoughing,” said Cutler.

“With the combination of the software and our range of Sandvik Coromant tools, combined with our Okuma machining centers, we’re able to remove material at feed rates of 300 ipm (7.62 m/min) with full depths of cut at about 3/8" (9.5 mm) on average.”

Proprietary Algorithms for Results

Dynamic Motion technology uses proprietary algorithms to calculate the optimum feed rates and toolpath motions required to machine safely, ensuring that there are no air cuts, prolonging tool life, and minimizing cycle times. Cutler said: “That’s really the big advantage. Dynamic Motion and the high quality and bold cutting angles allow us to remove material at that rate without worrying.” The OptiRough toolpath within

Dynamic Milling uses deep, aggressive cuts followed by small up-cuts to remove material at heightened rates. The result of this bi-directional cutting strategy is a quality surface finish in record time.

Before Cutler and his team even start cutting, though, they use some of the software’s other features. “We have a tool library created for basically each category of machine.



We constantly import Sandvik's tooling models. It helps us in simulation, and we can look at the actual tool holder, look for interference there and not just on the cutter." Cutler then turns to the Compare feature within the Simulation tool to compare solid models, visualize the accuracy of the cuts, and check for any collisions. "It's given us a lot more flexibility in working with solids when we get into a lot of our complex parts, because everything is 3D. We can now go and write in through the software and manipulate it to get us the result we need."

ShopWare Inc., Elgin, Illinois, its Mastercam Reseller, keeps DSR up to date with new features and helps its programmers through any problems that arise with its seven seats of the software. "They're a major asset," said Cutler. "They don't just supply us with a product, it's the people behind the product that really make the difference." The ShopWare team is just a call or email away, and they're always ready to help. Cutler also works with machinists and engineers at CNC Software, Inc. "Chris Kozell and Chad Chmura, they're great. Chris has helped us with post issues and with working through the bugs of a new option on one of our machines. Chad helps us with training, shows us how to properly use them, and physically helps us choose between the many different toolpaths that Mastercam offers—sometimes super-fast and super-aggressive is not the right path. It's a huge help."

Support a Key Value Proposition

The support from both Mastercam reseller and developer is invaluable to DSR as it plans to stay current and relevant in an evolving industry. "Without the support that we get, so much of this would be hard," Cutler said. "If we have a really tough, complex part here that maybe nobody in the world's ever made before, if we get stumped, we

have numerous people we can reach out to and get support and move forward."

What sets DSR apart from its competition is its dedication not only to deliver parts on time, but to push the boundaries of what's possible in automotive machining. "Sometimes we'll get an emergency order or an order to update a part, and we've got to get it to the track by the next weekend.



An engine block made in the manufacturing operations of Don Schumacher Racing. It started out as an 800 lb of aluminum and was machined down to 140 lb using high-speed Dynamic Motion and Opti-Rough Toolpaths to rough out complex geometries.

There's many all-nighters," Cutler said. "But we don't sacrifice quality. We have to know that we'd want to put that part on our car, not just sell it." His team works whatever hours necessary to meet their deadlines and provide the highest quality parts, but somehow they also find time to explore their abilities.

Cutler said that the true strength of DSR lies in its research and development. "We do pride ourselves on having our stuff together and really pursuing that 'we really want to try this' idea. We're not just fixing failures, we're looking for improvements." DSR's reputation—on and off the track—is one of innovation and trailblazing. And, this racing company isn't slowing down anytime soon. 🏁

Edited from information supplied by CNC Software Inc.