

FDM Technology Speeds Automobile Restoration, Customization and Production

Restoring and customizing vehicles is a laborious process that demands skill and attention to detail, making the process ideal for FDM (fused deposition modeling) technology. The Pit Viper (figure 1), a GT500E - inspired Mustang, started life as a 1968 Fastback. In late 2005, Brook Phillips and his team at TPI Performance began the restoration and customization process.

Seeking perfection in fit, finish and symmetry, they elected to use 3D scanning and FDM for nine components: two pair of side scoops, two hood scoops, front grill, rear bumper and center console. Phillips not only achieved his goals of symmetry and fit, but he also saved hundreds of hours and thousands of dollars.

To achieve the 1/16th inch precision, perfect symmetry and consistent flush and gap that Phillips wanted, he turned to Realadi, Inc. for TPI reverse engineering and 3D scanning tools, and to Stratasys, Inc. for rapid prototyping and direct digital manufacturing. Through its RedEye On Demand service group, Stratasys built one-quarter scale and full-size models, and also manufactured the finished parts for the Pit Viper on display at the SEMA 2006 trade show.

THE PROCESS

A 3D scan of the 1968 Mustang led to a model that could be produced with rapid prototyping. TPI's crew then handcrafted the nine components on the scale model, making design iterations, as needed. TPI used direct digital manufacturing to produce full-scale parts used as patterns for splash molds. From a sketch to the finished product, there were eight steps.

Step One: 3D Scanning

The first step in the day-and-a-half scanning process was a photogrammetry shoot (figure 2). Realadi used an ATOS 3D scanning system from GOM to create 105 scans for a complete digital representation of the Mustang.

Step Two: Data Processing

Software processing of the data took two weeks and became an STL file for the rapid prototyping process (figure 3).

Step Three: Rapid Prototyping

RedEye teams at Stratasys created a quarter scale model of the Mustang in 10 days. Because the model exceeded the 24 x 20 x 24 inch capacity of Stratasys' FDM Maxum, TM technicians sectioned the model into two halves. Running around the clock without an operator, the FDM Maxum created the scale model in a durable ABS plastic with overall accuracy greater than 1/32nd of an inch. By sending the digital file online, Phillips and his team were able to keep the Mustang at TPI's shop. Thus, the crew could continue working on body restoration while the prototyping was in progress.

Step Four: Designing

Phillips joined the two halves together and began the design process. Working on a smaller scale and modeling only half the parts saved TPI more than six weeks in the design process. In addition, the Mustang would have perfect symmetry because of the FDM technology's ability to create a mirror image of each part.



Figure 1: Pit Viper



Figure 2: Photogrammetry

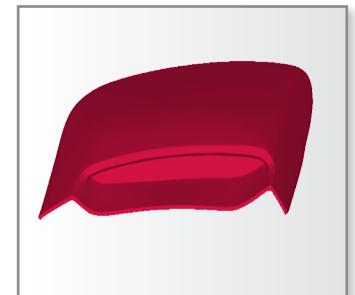


Figure 3: STL of side scoop



Figure 4: Side scoop

Step Five: Scanning & Processing

Realadi repeated the 3D scanning and data processing of the custom parts that TPI had handcrafted. This step in the process took only three weeks. After scanning and processing, Realadi mirrored the files to create a digital representation of the parts.

Step Six: Rapid Prototyping

From receipt of the files, it took the RedEye team just one week to deliver the nine prototype parts.

Step Seven: Reviewing and Refining

Review and refinement of the parts took just a few days. To capture any subtle changes, Realadi repeated the 3D scanning process. This data, when enlarged to full scale, became the digital definition of the parts that would define the Pit Viper.

Step Eight: Creating Full Scale Parts

With design work complete, Stratasys began manufacturing the nine full-scale custom parts in ABS plastic. All were delivered over a two-week period. When placed on the car (figures 4 and 5), all parts exceeded Phillips' demands for 1/16th inch precision and were flush with a consistent gap. TPI finished, primed and painted the custom parts before installing them on the car.

LIMITED PRODUCTION & LATE MODEL VEHICLES BROUGHT BACK TO LIFE

The SEMA Pit Viper is the first in a limited production series of 25 cars. Should the need arise for a replacement part, TPI will simply pull the CAD data from its files to remanufacture the plastic part using FDM technology.

Using tools applied to the Pit Viper, aftermarket companies also can have access to prototype or production vehicles well before a product launch. This means that accessories and customization products can be ready for sale the day the vehicle becomes available, as illustrated by the 2006 Jeep Grand Cherokee SRT8. In January 2006, the new Jeep was 3D scanned by Realadi at the OEM's facility (figure 6). The STL file was used to create a rapid prototype of a one-quarter scale model of the SUV (figure 11). Both the CAD data and prototype model were completed six months before the introduction of the vehicle (figure 7).

Restoring vehicles no longer needs to be a laborious process. Phillips and his team found that the procedure can be accelerated by FDM technology, saving both time and money, while achieving precise symmetry and fit objectives. As a result, the 1968 Mustang that became a Pit Viper, complete with nine new, handcrafted components, won the hearts of those attending SEMA 2006.



Figure 5: Console

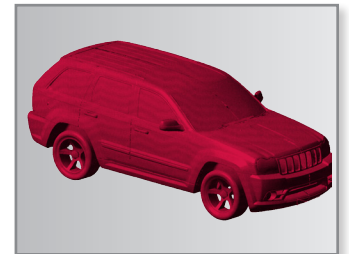


Figure 6: Scan of Jeep



Figure 7: 1/4 scale model of a Jeep Cherokee built on FDM Maxum

For more information about RedEye On Demand, call **866-882-6934** or visit www.redeyeondemand.com

Worldwide Headquarters

RedEye On Demand

8081 Wallace Road
Eden Prairie, MN 55344
+1 866-882-6934 (US Toll Free)
+1 952-906-2725 (Int'l)
+1 952-906-2765 (Fax)

GoDigital@redeyeondemand.com

European Headquarters

Materialise

Technologielaan 15
3001 Leuven
Belgium
+32 16 39.67.60
+32 16 39.62.75 (Fax)

GoDigitalEU@redeyeondemand.com

Australasia Headquarters

RapidPro

3/17 Diane Street, Mornington, 3931
Victoria, Australia
+ 61 1300 559 454 (Local)
+61 3 5976 3603 (Int'l)
+61 3 5973 6001 (Fax)

enquiries@redeyeondemand.com.au

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