

3-d Printing Uses for Restoring Classic Cars

By Craig DeVine



As so many of our PNR members say, our cars should be driven! The sound, the sights, and the feeling of driving these well engineered “rolling sculptures” adds dimension to the experience of owning a Classic. But driving them does cause wear and tear, which means that many of our cars will at some point need maintenance, repairs and even new parts. And many of us enjoy the challenge of finding a car that needs restoration... and again, new parts may be required to restore a car to its former visual and mechanical glory.

So... owning and restoring Classic cars means that sometimes we will have to get new parts... some parts being acquired more easily than others! If you're fortunate, perhaps you'll find the parts you need from a local or national supplier, or, you may need to search for suppliers in other parts of the world. If the part you need can't be found, then you face the task of making new parts from scratch... a process that requires recreating the part design and specifications, and then having it carefully manufactured by a skilled craftsman and high precision machines.

Decades ago, manufacturing was almost always done using a material removal process... starting with a block of metal and using precision mills, lathes and other tools to remove material carefully and precisely from the original block until all the attributes of the needed part are recreated... often to a precision of thousandths or even ten-thousandths of an inch. A carefully measured part would be depicted on a paper drawing with many views and dimensions that would allow a skilled machinist to make the part...

using the material removal process.

In more recent years, the real power is in the form of a digital file. The digital file includes all the part attributes and dimensions.

In the last few decades, these digital part files could be downloaded to CNC machines... “Computer Numerical Controlled” mills and lathes, and with a high degree of automation, create the part using the material removal process. But these machines (and their machinists/operators) are expensive, and parts created this way can be costly.

Today, parts can be created another way... the additive process. As before, it's necessary for a designer to carefully define the attributes and dimensions of the needed part, which typically requires great precision. The measurements are often still shown on printed paper, but, more importantly, the information is now maintained in the digital part file. The additive process uses the information in the digital file to create the part “from the ground up”... adding material in all the right places to create an accurate part... rather than removing material as was done in the past. Today's additive process is accomplished by 3-dimensional printers.

How does a 3-d printer work? As an analogy, think of how a workman creates a brick wall. Layer after layer of bricks are laid down in the right place, at the right height, and at the right thickness depending on the design of the building. And in some places, bricks are not laid, leaving space for doors and windows. To enable spaces and openings in a structure, temporary supports are

built while the bricks are laid around an opening for a door or window, then the supports are removed later when the mortar is strong, and the open space remains. If the workers do the job right, the newly constructed walls, doors, and windows will exactly match the specifications and dimensions created by the designer. This is precisely how 3-d printing works. Layer after layer of material is laid down by the 3-d printer, building the part up to its completed form. It's can be a slow process... each layer is of material laid down by a 3-d printer is typically on the order of 0.015 thick. It can take from 1 hour for a small part (~1 in³) to 24 hours for a larger part (maybe 1 ft³.)

CAD Files and Drawings

A designer creates the design and specifications of a part including all its attributes and dimensions. High precision parts are very carefully dimensioned, sometimes to the thousandth or ten-thousandth of an inch, depending on the function of the part. Accurate dimensions/specifications of the part are critical. If the specifications and measurements are off, even just a little bit, then the part produced won't fit or operate correctly. When the designer has completed the design, all these accurate dimensions and specifications are contained in the digital part file.

The digital files are then down-loaded to 3-d printers that create the parts



Examples of 3-d printed plastic parts

from the ground up. The 3-d printer puts the part material down in layers (often in thicknesses of only 0.005" to 0.010"). Layer after layer is laid down in accordance with the specifications and dimensions in the digital file. And where openings are required for holes and other part features, support material is laid down instead of the normal part material. The part material is then laid on top of the support material, which will be removed later. Since the layers are so small (0.005" to .010" per layer) you can understand that making a completed part takes time!

3-d Printing with Plastic

Most 3-d printing today uses ABS plastic as the model material. The tolerance of the finished printed parts can be on the order of +/- 0.020 to

0.030 for smaller parts, or more for larger printed parts. These plastic parts are strong... but of course, not as strong as metal. The plastic parts often have some texture on the surface too... related to the layering during printing. And the surface texture can vary from one axis/ plane to another, so the orientation of the part is important in the printing process. The surface finish of many parts for Classic cars is very important, so the surface texture creates some issues that will be discussed later.

The ABS plastic raw material used by 3-d printers is in the form of string or line wound up on spools. The ABS plastic line is guided into a high temperature head that forces out controlled amounts of melted plastic as the head moves back and forth. The head moves back and forth, placing layer after layer down in well-controlled manner. After hours of work... from perhaps 1 hour for a small 1 in³ part, to 24 or more hours for a part that might use 1 ft³ of material.

Typical 3-d printers used in schools and homes today can print parts up to 10"x10"x10".

Making Metal Parts from the 3-d Printed Plastic Prototypes

Sometimes, a plastic part can suffice, but more often, a metal part is required, and with some type of metal finishing like chrome, zinc or cadmium. Since metal parts are usually required, one approach is to use the printed plastic part to create a mold for a metal casting. While this process can be successful, it requires significant expertise in mold making and the casting process.

Coming Up Next -- 3-d Printing in Metal



The Rest of the Story

By Barrie Hutchinson

Recently, I had the opportunity to experiment with Craig Devine to reproduce a broken visor bracket for my 1948 Jaguar using 3d printer technology. The goal was to produce, in bronze, smooth parts suitable for plating.



Craig, then a teacher in the STEM program at Mountlake Terrace High School, worked with one of his students to produce CAD and electronic print files based on existing sample parts. They then employed a 3d printer to execute the print files in plastic. The results were exactly as Craig describes in his article. That is, the plastic parts exhibited an undulating "grid" pattern varying with the contours of the plastic parts. For our purpose the surface texture on the plastic parts posed insurmountable problems creating sufficiently smooth surfaces in bronze using the lost-wax casting process.

While our experiments with 3d printing didn't provide the hoped-for results, the experience was educational, enlightening and extraordinary. A big "thank you" to Craig, his students and his co-worker caster all for their efforts with the files, the printer and the castings. (At the end of this experience I learned that the parts I was seeking had been used on some pre-war GM cars, and I was able to source reproductions.)