<u>Northrop Grumman Gets Rapid Results</u>

Aircraft Maker Masters SLA, Saves Time and Money in the Process

Aircraft maintenance and repair personnel have a tough job—for a number of reasons. First, they must ensure that every part on the aircraft they service can withstand the rigors of flight, guaranteeing the safety of the crew and any passengers that might be on board. They also must minimize aircraft downtime while making sure that repair costs don't spiral out of control.

The Air Combat Systems Group of Northrop Grumman Corp., El Segundo, Calif., has mastered this balancing act, largely due to the efforts of its Rapid Prototyping and Manufacturing (RP&M) team.

Northrop Grumman's RP&M team has a remarkable propensity for creating the perfect tool for the task at hand. It also has discovered a surefire method for reducing to an absolute minimum both the time and cost associated with building those tools.

Stereolithography is the method that Northrop Grumman's RP&M team uses to create tools. Commonly known as SLA, stereolithography was invented by a company called 3D Systems, which is based in Valencia, Calif., and that is the company that Grumman's RP&M team relies on for the technology it uses to build its tools.

When first introduced in the early 1990s, SLA was referred to as rapid prototyping because it was a quick method of building products used to test the functionality and marketability of new designs. In the SLA process, a laser hits a vat of photosensitive liquid polymer, causing it to form the shape of a part created in a 3D CAD model.

Rapid manufacturing

This is the same process that was used at the outset of the rapid prototyping movement, when the parts that were created were used primarily to test the form or function of a design. Before SLA, companies relied exclusively on conventional prototyping methods, which required stamping or cutting sample parts on regular production machines. More often than not, these samples would have to be discarded and several more created before a working prototype was produced.

With SLA, these iterations are not necessary because the parts are being created directly from the CAD model. Over time, however, as the materials used to create rapid prototypes—which are essentially plastic resins—improved, some companies were able to create end-use parts. That was the beginning of what is now known as rapid manufacturing, a technique that Northrop Grumman has perfected.

“We have more than 700 SLA-generated tools operating in our production and maintenance facilities,” says Chris Farren, manager of technology applications for Northrop Grumman’s Air Combat Systems Group. “I’m not talking about molds or prototypes. We are using SLA to create tools that are immediately used to build or modify our products.”

In essence, Northrop Grumman has fulfilled the vision that the founders of 3D Systems had when they developed the first SLA machine, which was to make the creation of parts as simple as sending documents from a word processor to a laser printer.

It’s like orthoscopic surgery

Of the 700-plus tools that Northup Grumman has created with SLA, none is more impressive than its aircraft repair kit. This kit, which is used to modify aircraft in the field, allows Northrop Grumman technicians to perform what traditionally would have been major teardown-and-rebuild operations with almost no manual labor. “I liken it to orthoscopic surgery,” Farren says of performing repairs with the kit. “We don’t have to disassemble nearly as much of the aircraft as we typically would.”

The Northrop Grumman RP&M team initially developed the kit for a specific task, which it performed flawlessly the first time out. That result can be attributed to the intense preparation on the part of the RP&M team, a process that also was enhanced by the 3D Systems SLA technology.

The initial repair task was to reshape a component located in a hard-to-reach section of an aircraft. Doing that without tearing down an entire section of the aircraft—and spending millions of dollars in the process—required a tool that would allow a technician to reach inside the aircraft and reconfigure the component without having to see it.

This delicate operation had to be done right the first time, because even a single mistake could have caused additional damage to the component and added millions more to the ultimate repair cost. Fortunately, the Northrop Grumman team had 3D Systems SLA technology at its disposal.

A flawless procedure

In addition to using SLA to create the repair kit, the team also built a full-scale SLA model of the aircraft section in which the damaged component was located. That allowed technicians to conduct several dry runs of the repair procedure before taking the finished kit into the field.

The kit, which fits in a standard-size suitcase, consists of a set of tools for shaping metal into a particular profile, along with a number of rings and gauges for ensuring that any cuts in the metal are set at the proper angle and depth. There also is a port for cooling metal after it has been heated for shaping or cutting and a second port for extracting debris.

In its initial project, the kit was programmed to form a complex 3D shape in titanium bulkheads on the left and right side of the aircraft. “We entered the aircraft through a small access panel that has an opening of about 12 inches by 18,” Farren recalls. “The technician performed a one-handed operation that consisted of heating and reshaping a portion of the aircraft’s titanium bulkheads.”

Because the technician could not see inside the aircraft, he had to rely on the tool, which employed its depth gauges and other sensors, to first find the right location and then create the proper shape. “The operation worked flawlessly the first time, on both the left-hand and right-hand sides of the aircraft,” Farren exclaims. “This process was anywhere from 10 to 100 times less expensive than conventional methods, primarily because we were able to build this tool, test it, and use it without having to go through an iterative development process."

Farren says that the repair kit represents the ultimate step in Northrop Grumman's use of SLA. "We bought our first SLA machine [from 3D Systems] roughly 10 years ago as a prototype development tool," he explains. "We used it to build wind tunnel models and for other projects, but it spent most of its life in the engineering department." About three years ago, Farren adds, the production department acquired an SLA machine, also from 3D Systems, and the use of the technology has since spread across the Combat Systems Group.

"There is not a department that has responsibilities related to our products that is not using SLA in some manner," Ferren says. Because of the success of its repair kit, Farren's team is looking to expand the use of SLA tools to additional field service operations. The team also is recommending the use of SLA throughout Northrop Grumman Corp.

"We are proposing the use of SLA for our next generation of aircraft," Ferren says. "This is a reliable and cost-effective method for making the exact tool that you need for a given job. We have shattered the notion that only metallic tools are durable. With the current state of SLA technology, including the plastic resins on the market today, you can take tools directly out of an SLA machine and use them in the field."

In effect, rapid manufacturing is now a viable, multibeneficial reality.

###