Final flight-certified 3D printed ducting for air conditioners, 3D printed with Stratasys ULTEM™ 9085 resin on the Fortus 450mc.

Marshall Aerospace and Defence Group Soars With 3DP

A Need for Quick, Complex Prototyping

Headquartered in the UK, Marshall Aerospace and Defence Group is one of the largest, privately-owned aerospace and defense companies that delivers innovative solutions in the air, on land and at sea. Marshall specializes in the conversion and modification of military, civil and business aircraft alongside defense vehicle engineering and shelter manufacturing.

> “ULTEM™ 9085 resin is aerospace-grade and possesses documented traceability, which enabled us to certify these parts for flight.”

Chris Botting

Materials, Processes and Additive Manufacturing Engineer, Marshall Aerospace and Defence Group

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Case Study

To increase responsiveness, reduce production time and cost, and remain innovative, Marshall decided to look at advanced additive manufacturing as a possible solution. The group now uses the Stratasys® FDM®-based Fortus 450mc™ and F370™ 3D Printers for prototyping, advanced tooling and final part production.

Additionally, Land Systems — part of Marshall Aerospace and Defence Group — uses the 3D printers to seamlessly and cost-effectively provide proof of concept to customers within a day.

“In Land Systems, we need to create prototypes of extremely complex parts, without having to resort to a complex machine,” explains Stuart Dean, Design Manager at Marshall Land Systems. “By having a F370 in-house, we have an easy-to-use system that provides dependable results throughout the prototyping process. Previously, we had to outsource our prototyping requirements, which caused a bottleneck in productivity.”

Finding Efficiencies with 3D Printing

Any halt in production presents difficult and often costly challenges. However, through the use of in-house additive manufacturing Marshall Aerospace has been able to minimize tool replacement, improve responsiveness to engineers’ manufacturing needs and create more innovative tooling solutions.

In another part of the business, it has been used for limited-production runs. Traditionally, tools would be manufactured in aluminum, which was often expensive and time consuming and left little room for design flexibility. Now, the team is seeing efficiencies in tool production using 3D printing.

“We now regularly produce customized, low-volume tools within 24 hours of an engineer’s request, and at a fraction of the cost of an aluminum tool,” says Chris Botting, Materials, Processes and Additive Manufacturing Engineer, Marshall Aerospace and Defence Group. “Using high-performance, engineering-grade thermoplastics, we can produce tools tailored to specific jobs with repeatable, predictable quality.”

Other Marshall tooling applications that use Stratasys additive manufacturing include drill jigs, masking templates, bonded fixtures and composite-mold tooling.

“All of the tooling we create has different and often unique requirements. We usually favor ASA or Nylon 12. That said, the 3D printers offer us the flexibility to choose from a wide variety of materials based on application demands,” adds Botting.

3D Printing
Flight-ready Parts

When tasked with creating a prototype ducting adapter — which is essential for providing fresh air to cool the aircraft's avionics while it is on the ground — the team turned to 3D printing.

"Before committing to expensive aluminum machining, we used the Fortus 450mc to 3D print a prototype in ASA material. It enabled us to create an accurate working prototype of the complex component that we were then able to demonstrate," says Botting. "The 3D printed duct led to a significant cost reduction compared to machining the part out of aluminum, as well as a 63 percent reduction in overall weight."

It was not just functionality that impressed the team. Overall, producing this part in Nylon 12 was only a fraction of the total material and machining cost compared to using aluminum.

However, it was not just for ground equipment that the team used 3D printing. Today, the Aerospace team has several pieces of 3D printed ducting flying on various aircraft thanks to the ability to create accurate, repeatable and reliable parts through 3D printing.

"When manufacturing for one of our most sophisticated engineering projects, we need a method that can create a complex, functional and lightweight duct efficiently — this is where 3D printing fits perfectly. But we also need to ensure that the ducting produced will be approved by the EASA for flight," explains Botting. "As a result, we're using ULTEM™ 9085 resin thermoplastic — a tough, yet lightweight 3D printing material with high thermal and chemical resistance. This has been crucial to overcoming the challenge of certification, as we can now 3D print parts with the desired flame, smoke and toxicity requirements for use on aircraft."

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Materials, Processes and Additive Manufacturing Engineer, Marshall Aerospace and Defence Group

3D printed forming tool in Stratasys Nylon 12.

Flying Into the Future

Each arm of the business has now set its sights on increasing the use of additive manufacturing for final parts across all the projects they undertake.

"FDM Technology™ has altered the way we work, and the aerospace-grade 3D printers and materials enable us to meet all our manufacturing requirements. Today, we have successfully identified areas of the aircraft in which we can optimize the use of certified 3D printed parts to great benefit. In the future, there is no doubt that 3D printing will continue to have a significant impact in the way we design and manufacture our aircraft," says Botting.

Final, 3D printed ECS duct adapter designed to cool aircraft while on the ground. 3D printed in Stratasys FDM Nylon 12 on the Fortus 450mc.

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