

# Emirates Uses SLS Printing For Better Fuel Economy and Supply Chain Efficiency

Flame retardant nylon material and 3D Systems SLS printing help airline lower weight of in-cabin parts for significant operational cost savings opportunity

Everything matters in the aviation industry, and anything that can be improved, should be improved. Emirates airline has taken this approach from day one and uses innovative new technologies to change the landscape of aviation. As a company in constant search of leading methodologies to deliver better products, better experiences, and better cost-value benefit, Emirates began exploring 3D technology in 2014, and identified interior cabin parts as a fertile testing ground for bringing 3D plastic production on board. Of particular interest was a new and improved solution for high volume, high turnover complex components such as its seatback video monitor shrouds, which must periodically be replaced to restore the aircraft cabin appeal and image.

According to Ahmed Safa, Senior Vice President, Engineering Support Services at Emirates, "At Emirates there is a strong focus on operational efficiency. Even a small reduction in weight of a single cabin component can have a significant impact when compounded over our fleet of over 265 aircraft, and can lead to reduced fuel emissions and associated costs. The opportunities and potential for lighter weight parts are staggering." By taking advantage of the unique optimization capabilities of additive manufacturing to deliver ubiquitous in-cabin parts, Emirates seeks to realize savings through lighter weight parts, reduced inventory, and a more efficient supply chain.



*The SLS printed video monitor shrouds are between 9 and 13% lighter than their conventionally manufactured counterparts.*

#### **CHALLENGE:**

Reduce part weight for high volume, high turnover parts to improve operating efficiency and cost savings using materials that comply with stringent aviation standards.

#### **SOLUTION:**

Fit-for-purpose parts delivered using reverse engineering and 3D Systems' selective laser sintering (SLS) with certified DuraForm<sup>®</sup> ProX<sup>®</sup> FR1200 flame retardant nylon material.

#### **RESULTS:**

- 9–13% weight reduction in SLS printed parts as compared to conventionally produced ones
- Significant cost savings introduced with every weight saving measure
- Potential for significant reductions in fuel emissions
- Flame retardant nylon passes certification for civil aviation
- SLS printing offers faster, cheaper alternative for delivering bespoke cabin parts with potential to reduce inventory for increased supply chain efficiency



*A scan-based design workflow enabled a more efficient and accurate design process, adding agility to Emirates' process.*



*Emirates airline uses innovative new technologies to change the landscape of global airlines.*

### **Safety first: materials matter**

It should come as no surprise and great comfort that rigorous certification protocols are the gatekeepers to new innovation in aviation. Although Emirates was extremely interested in taking advantage of 3D printing for all the benefits additive technology offers in terms of weight reduction, lower operating costs, and supply chain efficiency, these pragmatic interests always come second to safety. Therefore, after selecting to work with 3D Systems due to the company's leading expertise in additive manufacturing and dedicated aerospace department, Emirates laid out the material and certification requirements that needed to be met for final 3D printed parts to pass inspection and be incorporated in the aircraft cabin.

The result of this collaboration is DuraForm® ProX® FR1200, a FAR 25.853 compliant, flame retardant nylon material that is 10% lighter than the average aviation plastic. Designed for use with selective laser sintering (SLS) 3D printing, this powdered material is fused together layer by layer according to the requirements of the design file. By using SLS printing, Emirates is no longer bound by injection molding design rules and is able to optimize its designs to create fit-for-purpose parts with an optimized strength-to-weight ratio. DuraForm ProX FR1200 also passes AITM smoke density and toxicity requirements and has a UL certification for consumer goods. Furthermore, Emirates is in the process of securing Form 1 certification to validate the SLS printed video shroud part design as approved for aircraft use, which it plans to bring into flight once fully certified.

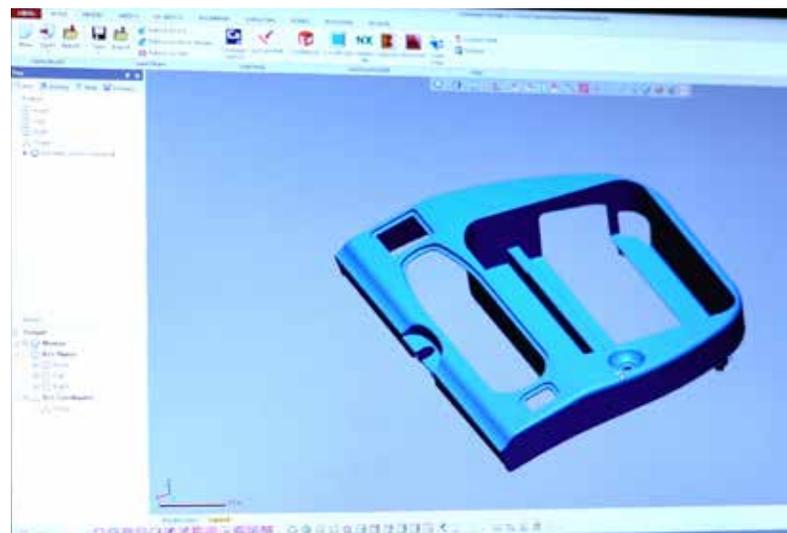
### **Designing fit-for-purpose parts**

In addition to a 3D printing production process and certified SLS material for aviation, Emirates needed a 3D design file to launch the manufacturing process. Without preexisting CAD data on hand for video monitor shroud production, Emirates enlisted help from FARO Technologies using the FARO® Design ScanArm to collect point cloud data, and 3D Systems

Geomagic Design X™ reverse engineering software to turn that data into a parametric CAD file ready for 3D printing. This scan-based design workflow enabled a more efficient and accurate design process that added agility to Emirates' process.

3D Systems' aerospace applications team designed key engineering improvements to update the new CAD data to address areas of stress where the video monitor shroud most often failed, as well as to introduce additional opportunities to reduce part weight. Because the final part would be 3D printed, the design was no longer constrained by the need to adhere to draft angles and consistent thicknesses, which enabled a number of design improvements over the original part.

Once the video monitor shroud design was complete, 3D Systems' technology continued to deliver productivity through a faster production 3D printing process with SLS.



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*— Ahmed Safa, Senior Vice President, Engineering Support Services at Emirates*

“We wanted to print as many parts as possible in the fastest possible timeframe,” said Safa. 3D Systems SLS printing technology offered Emirates lighter components, faster manufacturing, and the ability to produce multiple parts at the same time through printer nesting algorithms that allow for smaller parts to print within the voids of larger parts.

Taking a step back to view the broader supply chain, Safa says the potential and cost advantages are enormous: “Consider the traditional supply chain and all its different elements. Now you can cut that supply chain into a software file that’s hosted in a virtual warehouse.” The potential impact of this capability is more far reaching than accelerated print speeds and faster part delivery, and hints at a future where savings come from reduced inventory costs as well. In environments like the airline industry where maintaining large volumes of stock for every individual cabin component is part of standard operating procedure and cost, relocating warehouse aisles to file names is an incredible opportunity.

### **SLS printing and On Demand Manufacturing**

Using SLS printing, 3D Systems’ On Demand Manufacturing team produced the video monitor shrouds, which are

between 9 and 13% lighter than their conventionally manufactured counterparts, and then used Geomagic® Control X™ 3D inspection and metrology software to verify part accuracy by comparing the final printed geometry to the original digital file. The new printed parts were then sent for manufacturing certification by UUDS, a European aviation engineering and certification office and services provider based in France. UUDS put the 3D printed parts through a broad range of structural, durability, flammability and chemical testing.

Satisfied with the properties and performance of the DuraForm material, Emirates will soon transition the new 3D printed components to onboard trials and full certification. According to Safa, this is a standard practice for any new part: “Once we perfect the manufacturing of the component, we need to monitor to see how durable the parts are during normal passenger operation.”

In the meantime, Emirates will continue to innovate. “We are in a very special and unique position to leverage the extreme and staggering potential of opportunities presented by these emerging technologies,” says Safa. “They are helping us shape our vision and make it a reality.”



*Geomagic Design X™ reverse engineering software transforms 3D scan data into parametric CAD files ready for 3D printing.*



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