



Facts

Challenge

Design and production of flight-certified components.

Solution

Efficient and resource-conserving production of components for commercial aircrafts using Additive Manufacturing.

Results

- Optimized: part-integrating capability eliminates assembly costs
- Efficient: tool-less production saves time and money
- Fast: clean surface of components reduces post-processing costs and shortens lead times
- Economical: plastic powder can be recycled



The Bell 429: Parts of the Environmental Control System (ECS) of this commercial helicopter were produced by using EOS technology (courtesy of Bell Helicopter).

Making Production-Grade, Flight-Certified Hardware Using Industrial 3D Printing



Bell Helicopter and Harvest Technologies Utilize Design-Driven Manufacturing with EOS Technology

Short Profile

Founded in 1935 as Bell Aircraft Corporation and headquartered in Fort Worth/Texas (USA) Bell Helicopter Textron Inc. continues to set the pace for the industry and expand the scope of vertical lift.

Headquartered in Belton/Texas (USA) Harvest Technologies has almost 20 years of experience in the Additive Manufacturing industry. The company has over 40 AM systems, many of them used to create end-use components and assemblies.

Further Information

www.bellhelicopter.com
www.harvest-tech.com

Sometimes, a company's entire manufacturing history begins with prototyping. In 1941, Arthur M. Young demonstrated an ingeniously engineered model helicopter flying on a tether while working for Bell Aircraft Corporation. Just five years later, Bell Helicopter received the first-ever certification for a commercial helicopter. Today, Bell Helicopter Textron Inc. has made and sold more than 35,000 helicopters worldwide.

The engineering-driven company already produced prototypes for different components of their aircraft using Additive Manufacturing (AM) and now wanted to use the technology for functional parts. Harvest Technologies, one of the world's largest suppliers of AM technologies, provided the deep knowledge of the technology Bell Helicopter was looking for.

Challenge

However, before production could begin, Bell Helicopter and Harvest needed to prove out the EOSINT P 730 and its processing capabilities in order to certify this platform for use. The technological advances and sheer platform size would certainly provide greater efficiencies, but Bell Helicopter and Harvest needed to ensure this was not at the cost of part integrity. Furthermore, heat distribution, powder degradation, dimensional accuracy, repeatability, part quality and performance,

and the economics of the platform were examined. "We characterized the mechanical properties of each additively manufactured build so that we could confirm that the EOS system met our specification requirements and produced the same quality product each time," said Elliott Schulte, Engineer III at Bell Helicopter. This systematic testing was done with a number of different materials lots and a series of individual builds to establish that EOS' technology was robust and highly repeatable with identical results.

Solution

Now, Bell Helicopter and Harvest could begin the meticulous sequence of manufacturing aerospace hardware. First, the engineering team would call up the same database used to qualify the EOSINT P 730. Based on the mechanical properties specified, engineers would then design the part. "Material characterization is a critical consideration for us during design," said Christopher Gravelle, Bell Helicopter's Rapid Prototyping Lab lead. "For instance, if you're creating bosses for attachment points in additively manufactured nylon, it's a new material and process – you can't just use the exact configuration you would for a metal part."

After a final review of design for system producibility, Bell Helicopter would send a 3D CAD model along with a request for



EOS technology is capable of creating complex shapes such as the ductwork above (courtesy of Bell Helicopter and Harvest Technologies).

quote (RFQ) to Harvest for review and for development of a build strategy. Once Bell Helicopter accepted the quote, production would begin in earnest at Harvest. Before each batch, there was a rigorous checklist of pre-production inspections – developed by Harvest – for instance, a nitrogen leak rate check – that reduces waste and ensures part quality. "After every build, we test for tensile and flexural properties," said Caleb Ferrell, Quality Manager at Harvest Technologies. This is a requirement established for process assurance that Harvest continuously monitors.

Results

At present, the helicopter company mostly produces parts for the Environmental Control System (ECS) by using EOS technology. And AM production is expanding: Bell Helicopter is interested in employing additively manufactured components throughout the aircraft systems of their commercial helicopters. "Now the ECS engineers who've gained experience with the material and the process are communicating to teams with other functions, and those teams are starting to incorporate additive manufactured hardware into their assemblies," said Schulte. Bell Helicopter will also be evaluating

AM of high-temperature plastics intended for use in more demanding roles and environments.

Ferrell added: "In addition to the design advantages, there are significant manufacturing benefits to EOS technology. Tool-less manufacturing means you don't face certain limitations and up-front costs. And if you need to change something, you can build new revisions simply by changing the CAD file – no moulds, no new machining tool paths, and very little wasted time or money."

"Because of the larger EOS build platform, we could build bigger components in one piece rather than in sections," said Lewis Simms, Marketing Director at Harvest. Engineers are now learning to take greater advantage of the freedom of design that comes with applying EOS technology. "Our engineers are using the part-integrating capability to eliminate assembly costs," Gravelle said.

Another advantage of the EOS system was the clean surface it produces. "We were able to achieve the desired quality with the other AM system," said Ron Clemons, Director of Business Development at Harvest, "but there was a lot more finishing

labour associated with it than on the EOS platform." The EOSINT P 730 incorporated a software fix that provided crisper detail and smoother surfaces. As a result, there was relatively little peripheral powder melting and adhesion. Switching to the EOS system offered significant post-processing cost savings and shorter lead times for Bell Helicopter.

An important secondary benefit of EOS' technology was increased recyclability of the plastic powder. Other AM processes left behind a significant amount of partially melted and therefore unusable powder. The reduction of this waste in the EOSINT P 730 made much of the leftover powder more recyclable.

Harvest has acquired a second EOSINT P 730 system, and an EOSINT P 760 system, from EOS and is currently working with Bell Helicopter to implement the manufacture of one-off or two-off orders of spares, nested in with their existing batch production. "We have a strong legacy of using 3D-printed thermoplastic parts," Schulte says. "We definitely want to stay at the forefront of new EOS materials and processes, so we'll continue our IRAD (Independent Research and Development), supply chain integration, and our

industry involvement with Additive Manufacturing."

"The EOS technology gives us a great deal of flexibility and freedom. The parts that we get have very good feature definition and the mechanical properties have been good as well. We're especially happy with the larger platform size and the nestability we've been able to achieve."

Caleb Ferrell, Quality Manager at Harvest Technologies

"The EOS technology produces a robust and highly repeatable process. We have done a number of conversions of aircraft parts from previous processes to Additive Manufacturing. With the EOSINT P 730, we often discovered that the production cost per piece is substantially reduced compared to conventional manufacturing methods. The system complies with our specification."

Elliott Schulte, Engineer III at Bell Helicopter

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