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CASE STUDY
FDM

From Idea to Standard Practice

Parker Hannifin's Additive Investment Pays Continuous Dividends

Parker

Every worthwhile achievement, big or small, begins with an idea. When Parker Hannifin tooling engineer Dave Howe was asked by his manager what would help the company move forward, Howe's reply was "additive manufacturing" (AM). What he probably didn't realize at the time was that his vision for how AM technology might help would change how they do business, and they'd never look back.

Making the Idea A Reality

Parker Hannifin is a name synonymous with motion control, and its Aerospace Group's flight control components are renowned internationally. A high percentage of commercial or private aircraft that take flight every day has an actuator or control device with the Parker name on it. Dave Howe is part of the Parker Hannifin additive manufacturing team at the company's Ogden, Utah, Commercial Flight Controls division. It's here that Howe and the rest of the AM team have transformed 3D printing from a calculated risk to business as usual.

The journey started with the idea that additive manufacturing might help with the company's tooling needs. With the assistance of PADT, an advanced 3D printing product development and services provider, Howe and Dan Zumbo, Parker's additive manufacturing manager, started small with a loaner 3D printer.

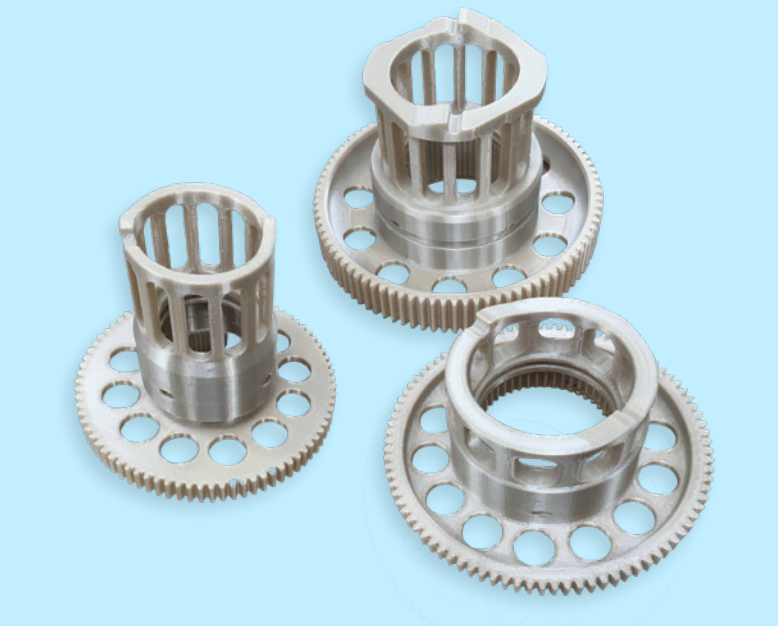
The pair quickly saw the value in the technology, using it to make caps and protective covers for the numerous types of control devices the company produced. Others within the organization were noticing the value, too, which created an increasing demand for 3D printing services. "As we were printing things and showing engineers throughout the facility what could be possible with additive, the 3D printed projects started coming out of the woodwork," says Howe.

The time came to return the loaner printer to PADT, but the Parker team knew additive technology was an investment that would pay long-term dividends. The question was how to justify the purchase of a new 3D printer. The Parker team approached this by substantiating the printer's cost on the savings it would generate.

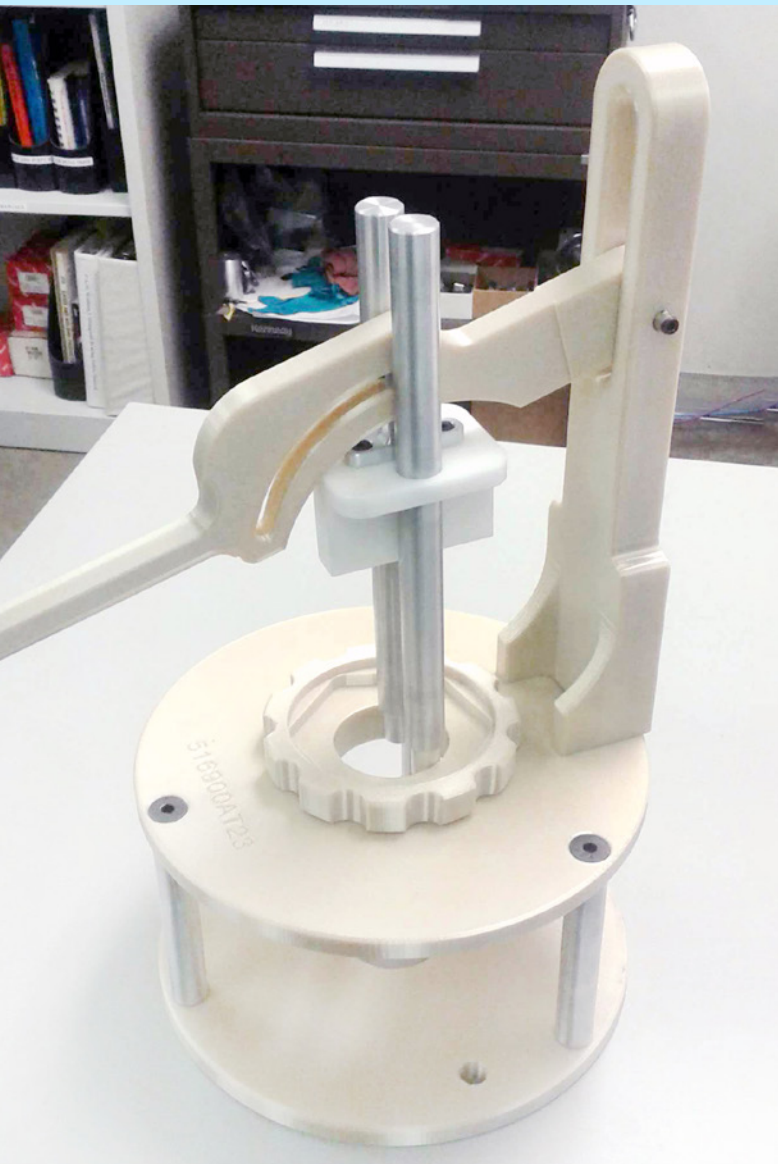
"You have to show your justification in dollars, so we did that. We kept track of what we were printing and did a simple comparison to a conventionally machined part," says Zumbo. "When we made our first printer purchase, it didn't take long to be able to pay for it because the savings are great when you compare a printed part to something that you'd have to design and machine out of metal," he adds.

An FDM actuation component safety cover.

An FDM 3D printed protective cover.



These mockup gears were printed using ULTEM™ 9085 resin.



This pressing tool incorporates ULTEM™ 9085 resin material.

Expanding the Additive Applications

Rarely does a company adopt AM and stay within a limited range of uses. Most often, the creativity of the engineers using it has the effect of "letting the genie out of the bottle," and the applications grow. Howe notes that they've printed engineering models, prototypes, gauge holders, potting tools, masking templates, and even obsolete parts that are no longer available for older machines. However, protective components for the flight hardware have arguably netted the most significant impact, considering the wide variety of controls and actuators the company produces. "There are a lot of moving parts, a lot of articulating links and levers, and when they're putting these things together or taking them apart or shipping them, they need to be protected," Howe says. "It really saves from us having to do rework or scrapping parts out or making late deliveries to customers," he adds.

Zumbo echoes this sentiment but adds that beyond the quantifiable savings, there are significant "soft savings" too. It's not as easy to put into dollars and cents, but very real nonetheless. For example, if an actuator component is damaged, there's a quality fallout, which could result in rework and a missed customer delivery. This is where the 3D printed components pay dividends. Another example of soft savings is lead time. Having the ability to internally produce parts versus the logistics of sourcing from the supply chain can result in a much shorter timeframe. It's more difficult to determine monetary savings for this but compressing what might take weeks or months into days is a very convincing metric.

The same could be said for 3D printed tooling, which provides better worker ergonomics. "We create additive parts and solutions for ergonomics, whether it be for reaching or for lifting or comfort at a workstation. It's more difficult to dollarize the savings you get from ergonomics but there is definitely value that should be realized," Zumbo says.

One of the most dramatic examples of AM's impact involved turning what could have been a significant operational event for one of its customers into a much more short-lived problem. The report of a possible misaligned component on an actuator required fast action to provide a method to verify the proper positioning of the component. The traditional approach would have been to develop a custom gauge to verify the component's position. However, designing and machining a bespoke tool could take days, so the Parker team used a 3D printed gauge instead. Howe relates the story, "We designed it, printed it overnight, and had it shipped to the customer the next day to verify whether the alignment was correct. The customer was blown away because things don't happen overnight in the aerospace world. So this was a huge win for us, and we really made one of our important customers very happy."

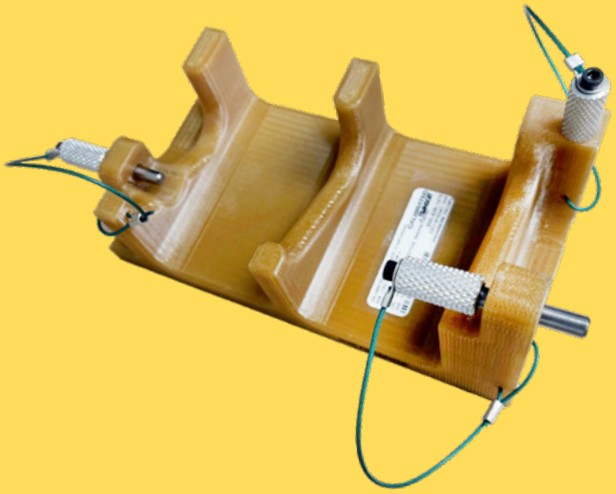
This inspection fixture was printed with ULTEM™ 1010 resin material

Breaking the Mold of How Things Are Done

It's not uncommon for organizations to experience challenges when a new technology like AM is introduced since it may require adapting to changes in long-standing methods and processes. Changing people's hearts and minds takes time. However, the proof, particularly concerning AM's capabilities, is pretty convincing, and the Parker additive team made it their mission to preach AM's broad benefits.

Although Howe is clear that AM has really changed how they approach tooling design and fabrication, effort was needed to cement the change. "When we first adopted this technology, it was a bit of a challenge to get people to accept what was possible. There were some naysayers at first as well as some apprehension on whether we could use AM for various applications. We really had to go forth and prove out different materials and things that could add value," Howe says.

To that end, Howe and Zumbo went on a virtual road show within the company, connecting with groups in their shop and other Parker divisions. They explained the AM process and the materials used, ultimately winning converts to a new way of doing things. Now, as needs arise, Howe and the team show them what AM is capable of. "Every time you have that interaction, you're kind of breaking that mold, just by educating people of what you can do with 3D printing," says Howe. "It's changed the way most people perceive us in tooling now. We have requests all the time for things that normally could not have been made before, and so we've really worked hard to put that message out," he adds.



A component holding fixture with integral locating pins.

Puller tools incorporating integral identification labels

Generating Bottom-Line Benefits

Parker's Commercial Flight Control Division's additive journey has come full circle from its early loaner-printer beginnings. The division's two Stratasys polymer 3D printers include a Fortus 400mc and a Fortus 450mc™. "Both printers have been workhorses, and our success rate on prints is 99.9%," says Howe. Their real benefit, however, lies with the time- and cost-savings these printers produce and the positive impact they've had on the business.

"3D printing has really helped promote innovation and collaboration within different groups," says Parker additive manufacturing chief engineer Brian Suisse. "This technology allows us to quickly turn ideas into functioning hardware, and it promotes creativity and resourcefulness. In general, we can service all of our internal and external customers quickly. We've recognized that additive manufacturing really helps us save money, and it also protects our reputation," Suisse says.

Suisse notes that because AM lets them rapidly produce assembly tooling, shipping devices, quality assurance gauges, and replacement parts, the entire operation is streamlined. "We're able to reduce scrap, improve quality, and reduce our lead time. Overall, it really enhances our bottom line," says Suisse.

Parker's results aren't unique, however. It's an AM story that's been achieved by other manufacturers, too. But the Parker team's recipe for success bears noting: it started with a vision of what AM could do. That was followed by demonstrating how it could pay for itself and evangelizing its benefits throughout the organization. For Suisse, who works with AM daily, the benefits of 3D printing are clearly apparent. "This kind of technology has allowed us to change how we tackle our challenges, and it drives better efficiency in our workflow. The machines, we feel, pay for themselves time and time again," Suisse says.

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> **Brian Suisse**
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