

special focus: making aerospace parts

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An airplane sees maintenance at American's maintenance and engineering base in Tulsa, Okla.



All images: American Airlines

D.I.Y. for the SKY

Airlines are manufacturing more of their own replacement parts.

Airlines have been manufacturing replacement parts for their airplanes almost since the dawn of commercial aviation. By doing so, an airline can save 35 to 55 percent or more on the cost of replacing parts, compared to purchasing them from the original equipment manufacturers.

This practice has increased considerably since the events of Sept. 11, 2001, exacerbated financial problems in the already struggling U.S. airline industry.

“Profitability started tanking in 2001, even before 9/11,” said Kevin Michaels, principal and co-founder of AeroStrategy LLC, Ann Arbor, Mich., a management consulting firm devoted to aviation and aerospace. “So interest [in alternative

sources for airplane parts] has really mushroomed in the last 5 years, because airlines have got to look for savings everywhere.”

Part prices have been rising for some time, and this steady increase, as well as the heavy markup on airplane replacement parts, is often arbitrarily fixed by the OEM.

“What you find with the cost of spare parts is that it’s not directly related to the manufacturing cost of the part, it’s related to the amount of money that the OEM wants to make,” said David Doll, a partner in AMMA LLC, Woodland Park, Colo., an aviation and aerospace consulting firm. According to Doll, OEMs have raised the price of parts 4 or 5 percent every year regardless of the economic situation. This has caused resentment to build among airlines.

Doll, a former manager of manufacturing engineering for United Airlines, noted that it’s typically the “legacy carriers”—airlines that have been in business for decades—putting the strongest resources toward manufacturing their own replacement parts. Perhaps the best example is American Airlines.

Leaving on Tulsa Time

American Airlines’ 630,000-sq.-ft. maintenance and engineering base in Tulsa, Okla., has had a machine shop in operation since opening in 1959. Today, the 22-employee shop has 26 machines, including a lathe, drill press, wire EDM and a range of Bridgeport and CNC mills.

The shop machines replacement parts for American’s fleet of Boeing 737s, 757s, MD80s and A300s, running roughly 600 to 800 parts a month. It produces both structural parts for the airplanes’ framework, cabin and landing gear, and engine parts, such as bushings, liners and bearing retainers. These are generally machined out of stainless steel or aluminum to a tolerance of ± 0.0002 .

The shop has considerable latitude in machining replacement parts because American holds Federal Aviation Administration Part 121 air carrier certification, which permits an airline to manufacture parts for its own internal consumption. It also holds FAA Part 145 repair station certification, which states that an airline has the required

quality system in place and the means to do maintenance and repairs.

It’s more difficult for a parts-manufacturing authority (PMA)—an independent supplier of airplane parts acting as an alternative to an OEM—to gain the authority to manufacture parts. For each part it seeks to manufacture, a PMA has to first get design approval and then approval for its entire manufacturing process directly from the FAA.

The requirements are less stringent for an airline seeking such approvals. “Basically, the requirements are that the airlines have the proper data that defines the design of the aircraft; they have to use FAA-approved data,” said Ronald Wojnar, senior advisor to the FAA’s aircraft maintenance division in Washington, formerly deputy director of aircraft certification. “So they either have some arrangement to get the OEM’s data and use that to build the part exactly to that data, or they develop their own data and have it FAA-approved as a substitute for the original [design].”

When the team at American’s shop in Tulsa cites the need for a replacement part, it usually gets the OEM’s original blueprint for the part and, based on that print, proceeds with machining.

If a blueprint is not available, American’s mechanics remove the original part from the plane and send it to the shop, which reverse-engineers it. “We can digitize it and have the print drawn up off the [digital scanner] or we can trace it off the mill,” said Jim Robinson, the shop’s supervisor of machine processes.

In this circumstance, the shop would need FAA approval before proceeding. Or, it could obtain approval from a designated engineering representative or designated airworthiness representative. These are individuals hired by airlines who are authorized by the FAA to approve a replacement part on-site.

Production Particulars

Because it doesn’t compete for customers, the shop generally is unconcerned with productivity metrics such as cycle time, cutting speeds and feeds. “We’re not worried about that,” Robinson said. “We’re just worried about getting the part back to the aircraft as soon as we can.” He added that “very

seldom do we get repeat parts on structure pieces. They will be damaged in a different area or have corrosion in a different area. So, cycle time is not that important.”

The shop does see repeat parts for engines, however. According to John Eberstein, the shop’s managing director of auxiliary power unit and landing gear maintenance, one part that the shop machines regularly—roughly 200 a year—is a gearbox liner for the Pratt & Whitney JT8 engine.

“If you can’t put a new liner in this gearbox, you have to buy another gearbox housing and that’s \$30,000,” Eberstein said. “So, for the price of a 2024 aluminum liner—probably a couple hundred bucks—we save a \$30,000 part from being replaced, and it’s as good as a new box once the liner is in there.”



An American mechanic at the Tulsa base in front of an airplane’s engine.

The liner is an example of “manufacture for a known need,” referred to as manufacture for stock, one of two major classes of work done in the shop. The second major class is “manufacture for an immediate need.” This is AOG, or aircraft on the ground, which is high-priority work. Eberstein recalled one AOG job where the shop machined a replacement spar cap, which is an aluminum structural support for a wing, on a Bridgeport CNC mill.

This was for an American Eagle plane that was damaged on the airfield. “We spent that whole weekend cutting,

heat-treating and painting parts for an airplane that somebody ran into and sliced the rear spar,” Eberstein said. “Eagle had it in their hands in about 4 days. I’m not too sure that the OEM could have come up with the part in 4 weeks. They probably would have had to go to a machine outfit and have the part made.”

This, according to Steve Carroll, manager of team processes in the shop, is the fundamental value of the shop, something that makes it more important than its benefit to the airline’s bottom line. “One of the most impressive things is that these guys are making things you can’t buy. Almost every week something comes in here that [mechanics] have taken off the airplane that they’ve tried to buy and found it’s either not available for any price or not available in the time frame they need it in,” Carroll said. “It’s beyond saving money. It’s about getting the airplane out on time. You couldn’t get a part from Boeing and have it fit [in the plane] and fly away in the time frame that we work on it.”

Risky Business

Are there any economic risks that an airline contends with when manufacturing its own replacement parts? AMMA’s Doll suggested there may be some difficulty associated with returning an airplane containing internally manufactured parts to its OEM or selling it to another airline.

“Every airplane is a collection of spare parts flying in close formation,” Doll said. “Each one of those parts has to have a pedigree: where it came from, who manufactured it and what repairs were done to it. There’s a tremendous paper trail that is associated with any aircraft, and when you go to sell that plane, some people may not be willing to accept that [replacement parts were manufactured by the airline].”

The American shop’s staff countered that it’s disposed of a lot of airplanes, and has never had to remove any replacement parts due to complications associated with documentation.

The FAA’s Wojnar confirmed that these parts can be considered legitimate. “Airline-manufactured parts,

The following companies contributed to this report:

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manufactured to the true design data, are considered to meet all FAA regulations,” Wojnar said. “So there are no issues as far as their interchangeability or the sale of the aircraft.”

Another economic risk involved is that an airline manufacturing replacement parts might require capital investment that could eventually outstrip the profits associated with making its own parts.

“I think some of these airlines are being pennywise and pound foolish,” Aerostrategy’s Michaels said. “Should an airline like American be building up their engineering staffs and buying big capital equipment, in light of the fact that their competitors are outsourcing most of that heavy maintenance activity—taking all that capital

equipment off the balance sheet—and focusing on their core transportation business?”

Not surprisingly, the American shop’s staff believes the answer is yes. “It’s very important to finding a competitive advantage to exploit the core competency that we have in this building, which is cutting things out of metal,” said Eberstein, who added that American will be manufacturing its own replacement parts indefinitely, and the amount it machines will probably increase over time.

“Our machines are in good shape. Our workforce is in good shape. And [American is] eager to save more money,” Carroll said. “So we’re looking forward to expanding on this, rather than pulling back.” Δ



American mechanics at the Tulsa base inspect an airplane’s landing gear.