Metalworking

5 Challenges for Sheet Metal Fabricators in the Aerospace Industry

Kip Hanson | Nov 14, 2023

One of the reasons that statistics continually show commercial airline travel is safer than driving a car is strict regulation—of everything from pilot training to the production of airplane components.

Before planes manufactured by companies from Boeing to Gulfstream—not to mention defense contractors such as Lockheed and BAE—can even leave the ground, they must adhere to some of the ***most stringent quality standards*** ever devised.

Luke Adair, senior national account manager at JPW Industries, has worked with all of them. So has his colleague, product training manager Chuck Holcomb.

They and the team at JPW represent a wide range of machine tool brands, including Jet, Wilton, Edwards and Baileigh, the latter of which enjoys broad use in sheet metal fabrication throughout the aerospace and defense industries.

“We’ve worked on projects with each of these companies, whether it’s bending parts on a CNC press brake or cutting sheet and plate stock on a laser or plasma table cutter,” Adair says.

Aerospace fabrication is demanding, close-tolerance work, they agree. Many of the parts are made of difficult metals like titanium, not to mention newer composite materials that are both abrasive and prone to delamination.

“We also see a fair amount of plate-rolling work, where it can be challenging to meet radius requirements,” Holcomb adds. “Whatever the application, however, customers in this industry demand high-quality equipment at a competitive price.”

A Demanding Industry

It’s not surprising that airplane and spacecraft manufacturers, not to mention those responsible for maintenance and repair operations, would be finicky in their equipment selection.

After all, each must not only adhere to various Federal Aviation Administration and other industry-specific requirements but also overcome challenges that go well beyond bending parts and drilling

holes. These include:

1. Compliance

Shops providing parts for the aerospace industry are (or should be) well-acquainted with AS9100. According to its publisher, SAE International, the worldwide standard is supported by the International Aerospace Quality Group and "specifies the QMS [quality management system] requirements to be documented and implemented by organizations designing, developing, and manufacturing aerospace products."

As with the more general ISO 9001 certification, the requirements are stringent, and compliance can be both tedious and demanding. Still, it's a small price to pay for participation in this industry, as it provides clear-cut guidelines for manufacturers and their suppliers and helps both to improve process control.

To comply with AS9100, companies must meet multiple criteria. Regular employee training, supplier monitoring, management review, adherence to ethics standards and numerous other requirements must all be evaluated, documented and routinely audited for compliance.

Bringing in a consultant early in the process might be a good investment. The same can be said for software tools or platforms that help monitor and ensure adherence to these requirements.

2. Cost Control

Along with rigorous quality requirements, aerospace manufacturing is highly competitive. One strategy for coping is using a cost control tower, which assigns ratings to affordability initiatives based on their odds of success and consolidates data across departments and companies.

According to the consulting firm *McKinsey & Co.*, cost control towers help companies in many industries—aerospace and defense among them—stay within budget and reduce costs.

With high-value contracts common, cost overruns can be a significant concern. But by prioritizing manufacturing projects and continuous improvement initiatives, companies can determine which ones to implement first, as well as which ones to forgo.

The term "control tower" in this context is relatively new, however. Initially an *SCM (supply chain management) tool*, it provides a host of capabilities that companies can use to capture data in real time, analyze and predict trends, model alternative scenarios and offer collaborative responses to potential problems.

Although a company's *ERP (enterprise resource planning)* software may support some of these functions, it's likely that a more comprehensive solution will be needed, one that gathers and shares information across multiple platforms. Regardless, control towers are a valuable tool for managing supply chains, project costs and much more.

3. Tricky Materials

The aerospace industry uses many *materials* that are challenging to process.

While they often fall into the *heat-resistant superalloy (HRSA*) category, which includes nickel- and cobalt-based alloys, there are also many grades of titanium.

Thanks to their light weight, superior strength and corrosion resistance, alloys like Ti-6Al4V titanium are commonly bent and formed into an assortment of aircraft components.

Parts like fairings and covers, exhaust ductwork and high-performance control surfaces might all be made of titanium and formed on fabrication equipment like that offered by JPW Industries.

Composite materials also play a prominent role in newer aircraft designs, thanks to their high strength-to-weight ratio. Carbon fiber reinforced plastic (CFRP) and metal matrix composites (MMC) are among the most common, although many other types exist.

The Boeing 787 Dreamliner and Airbus A350 are two examples, each using significant amounts of these advanced materials.

Due to their abrasive nature and tendency to delaminate, however, special cutting tools—often made of polycrystalline diamond (PCD)—are required to drill holes and trim edges of fuselage parts produced through the automated fiber placement (AFP) process.

Similarly, titanium can be prone to cracking, which is why special care and precise process control must be used when forming or bending parts from sheet stock.

4. Design Complexity

The designs of parts, meanwhile, offer their own challenges, with complex shapes and tight tolerances that allow little room for deviation.

The turbine blades found in jet aircraft engines are one example. Here, the raw material—almost always made of heat-resistant superalloys—is typically cast into a near net shape (one close to its final form) and then machined to size.

On the fabricating side of an aerospace shop floor, sheet metal is often stamped, rolled, bent and formed into a plethora of curved, usually complex shapes for use in the fuselage, frame and control surfaces.

Capital equipment from JPW Industries can provide the muscle needed to perform these tasks, although high-precision punches and dies are used too.

Laser machines are a common sight in a sheet metal shop, which are used to cut workpiece blanks to size before they are bent on a press brake or placed into a stamping and forming machine.

5. Integration and Collaboration

Modern software platforms are a valuable tool in the aerospace manufacturing toolbox. The days of a shop relying solely on its ERP software for the front office and CAD/CAM for the production floor are long gone.

For instance, advanced engineering and simulation software like that provided by Siemens Digital Industries and Dassault Systèmes reduces the need for—and sometimes eliminates—costly wind tunnel testing.

And smart shops, especially those doing demanding aerospace work, use manufacturing execution systems (MES), quality management systems (QMS), product lifecycle management (PLM) and other systems to manage each aspect of the manufacturing process.

Since each of these systems needs and generates data, integration between them and external

software systems is no longer just a nice-to-have. That's because robust integration eliminates the siloing of information and potential errors that would otherwise occur.

Given all this complexity, further exacerbated by the huge numbers of parts, suppliers and specifications, aerospace firms must also maintain open doors of communication with other manufacturers and suppliers to avoid supply-chain disruptions.

This leads us to one more critical ingredient for aerospace manufacturers and their suppliers: collaboration.

That means collaboration between internal and external project teams, collaboration between engineering and purchasing and finance, collaboration between the production floor and everyone else.

Again, each of these is no longer a nice-to-have, but rather an essential component for success in the aerospace and defense industry, whether your parts are made of sheet metal or billet, composite or titanium.

In summary, while the challenges for sheet metal fabricators in the aerospace industry are numerous, a combination of technology, training, collaboration and proactive management can help in navigating them effectively.

What are the biggest challenges your shop faces in aerospace machining? Tell us in the comments below.