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➤ BY ALAN RICHTER, EDITOR

THE Sky's THE Limit

Making aerospace parts can be lucrative, especially while the industry is experiencing record-setting growth, but manufacturers need to be prepared before quoting those jobs.

The aerospace industry is flying high, with all thrusters in the forward position. "In my entire 20-something-year career in the aerospace industry, I haven't seen a simultaneous civil and military upturn like this one," said Richard Aboulafia, aviation analyst for Teal Group Corp., Fairfax, Va. "All the market segments are enjoying growth that ought to continue for at least a couple of years."

The aerospace industry's sales figures back that claim. The Aerospace Industries Association reported that total U.S. aerospace sales increased by $14 billion in 2006, or 8.4 percent over 2005's total, reaching $184.4 billion—a record level for the third consecutive year.

That's good news for manufacturers making aerospace parts. But what about manufacturers that aren't producing those parts but are looking to diversify and target aerospace? There are opportunities to enter the market, but companies will need to have the appropriate quality system certification, tools and equipment, skills, financial resources and patience to make those opportunities pan out.

"The bad news is [entering the industry] is getting more difficult than ever in terms of upfront costs and long-term payoff," Aboulafia said. He added that manufacturers of aerospace parts should be prepared for greater upfront investment than ever before, helping the prime aircraft makers with the burden of development costs. In a report on the Boeing 787 Dreamliner, for example, Aboulafia stated that development of the twin-engine, wide-body

commercial transport is expected to cost from $7 billion to $10 billion, about half of which will come from the supplier/partner base. Seventy percent of the jet's parts come from outside suppliers, the *Chicago Tribune* reported, noting that the first delivery will be in May 2008.

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To begin courting aerospace business, Aboulafia recommends against approaching the prime aircraft manufacturers and suggests going to the next tier down. "The major airframe integrators have a larger-than-ever role and that role is only going to grow," he said.

Peter Boucher, president of 3V Precision Machining Inc., a Lakewood, Wash., job shop that produces parts for the aerospace and medical industries, disagreed with this advice. "You want to go straight to the man and deal directly with Boeing," he said, explaining that lower tier manufacturers generate lower profits. However, the machine tools needed to produce large aerospace parts can be prohibitively expensive for smaller shops. When that's the case, "small shops should target large shops that have too much aerospace work and are desperate to farm out [the smaller parts]," Boucher said.

Not Your Father's Aircraft

To increase fuel efficiency while maintaining aircraft integrity, more titanium and composite components are being used in new generation aircraft, such as the Boeing 787 and the Airbus A350. In a report about machining aerospace and defense parts, Francois Gau, global segment manager, aerospace and defense industry, Kennametal Inc., Latrobe, Pa., noted that, by weight, the use of composites is growing eightfold, titanium is doubling and aluminum, once the dominant material, has decreased to about 20 percent of the total.

Machining aerospace parts often requires removing a large percentage of material from a solid workpiece.

Titanium is generally considered a difficult-to-machine material, but machining it efficiently doesn't necessarily require applying the most advanced cutting tools. "Going low tech with cobalt-HSS roughers is about the most efficient way to remove titanium stock," said Paul Hartz, vice president of engineering and finance for Mack Tool & Engineering, a South Bend, Ind., job shop that specializes in medical and aerospace parts. Not only is a cobalt-HSS' tool life predictable, he noted that it's also significantly longer than that of a carbide tool when hogging titanium. "I get a bit faster speeds and feeds out of the carbide," Hartz said, "but because I have to change [the carbide tool] that much more, the cobalt rougher ends up being the way to go."

Gau explained that an "alpha crust" of varying thickness is formed during the titanium forging process, most notably on the newer titanium alloys, and P/M HSS endmills are particularly well suited and economical when roughing this crust. "That doesn't mean it is the only solution," he said, "but it's one of many and one that's very efficient in many instances."

High-temperature alloys, such as Inconel 625 and 718, are also used to make aerospace parts because, as the name implies, the metals are able to withstand the heat that aircraft parts are exposed to. "A high-temp alloy is not going to melt when it gets over 2,000° F," said Boucher of 3V Precision.

Cobalt-HSS tools can be effective for roughing Inconel as well. "I've found that 5-flute, M42 hog mills with a fine pitch work the best," Boucher said. "It's kind of old school, but it works better than any carbide I've found so far. Carbide is only good for finishing Inconel."

The extended life of HSS tools when cutting some aerospace-grade materials plays a significant role in being able to machine them efficiently and profitably. For example, Boucher described one aerospace part that starts as a ⅝"-thick plate of Inconel and is machined to a 0.040" thickness in cavities with ±0.005" tolerances, and the final part has no straight surfaces. "It's a fairly complex process that takes a long time to develop so that the cutter doesn't give out before it finishes machining the part," he said.

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"If your endmill gives out and digs into the part enough, you're going to have scrap on your hands." A scrapped part can be an expensive proposition, especially near the end of the job, because the workpiece material costs $500 and the part takes about 16 hours to process.

Having skilled workers is also critical when making aerospace parts. "You can't put Doogie Howser on the job. You have to have an experienced machinist just to run a job like that," Boucher said in reference to the Inconel part. "If you got the skills, you can get the thrills."

Profit through Productivity

As in the automotive industry, manufacturers of aerospace parts may be contractually obligated to sell parts at a lower cost per unit each successive year. This requires increasing productivity so the shop can maintain or increase its profit. "I've achieved my productivity pretty easily over the last 4 to 5 years just by purchasing better machines and equipment," Mack's Hartz said. That equipment includes the Integrex 200-IIISY multitask machine, the 5-axis Variaxis 630/5X vertical machining center and the 4-axis PFH4800 horizontal machining center from Mazak Corp. In addition, a couple of palleting systems each tie several machines together into a manufacturing cell for increased spindle utilization.

Whether an industry novice or veteran, if a shop is unable to invest in new machine tools, productivity gains can be realized through advanced cutting tools. "[Toolmakers] bring thousands of new products to the market each year with the objective of improving the performance of an application," Gau said. "If you've been machining a 737 part for the past 10 years using the same techniques, it's likely you'll find pockets of optimization available."

Although it's unique to see simultaneous growth in all segments of the aerospace industry, the boom won't last forever. Still, market conditions should be favorable for at least a couple of years. Shops looking to target aerospace should begin by "getting your feet wet with little projects," Hartz recommends.

Because the primary aircraft manufacturers are currently placing orders for new projects, shops are "coming to the game a little late if they're just starting to look. They better act quickly because the only opportunity they'll have after that is if they're going to be cheaper than somebody else," Hartz said. △