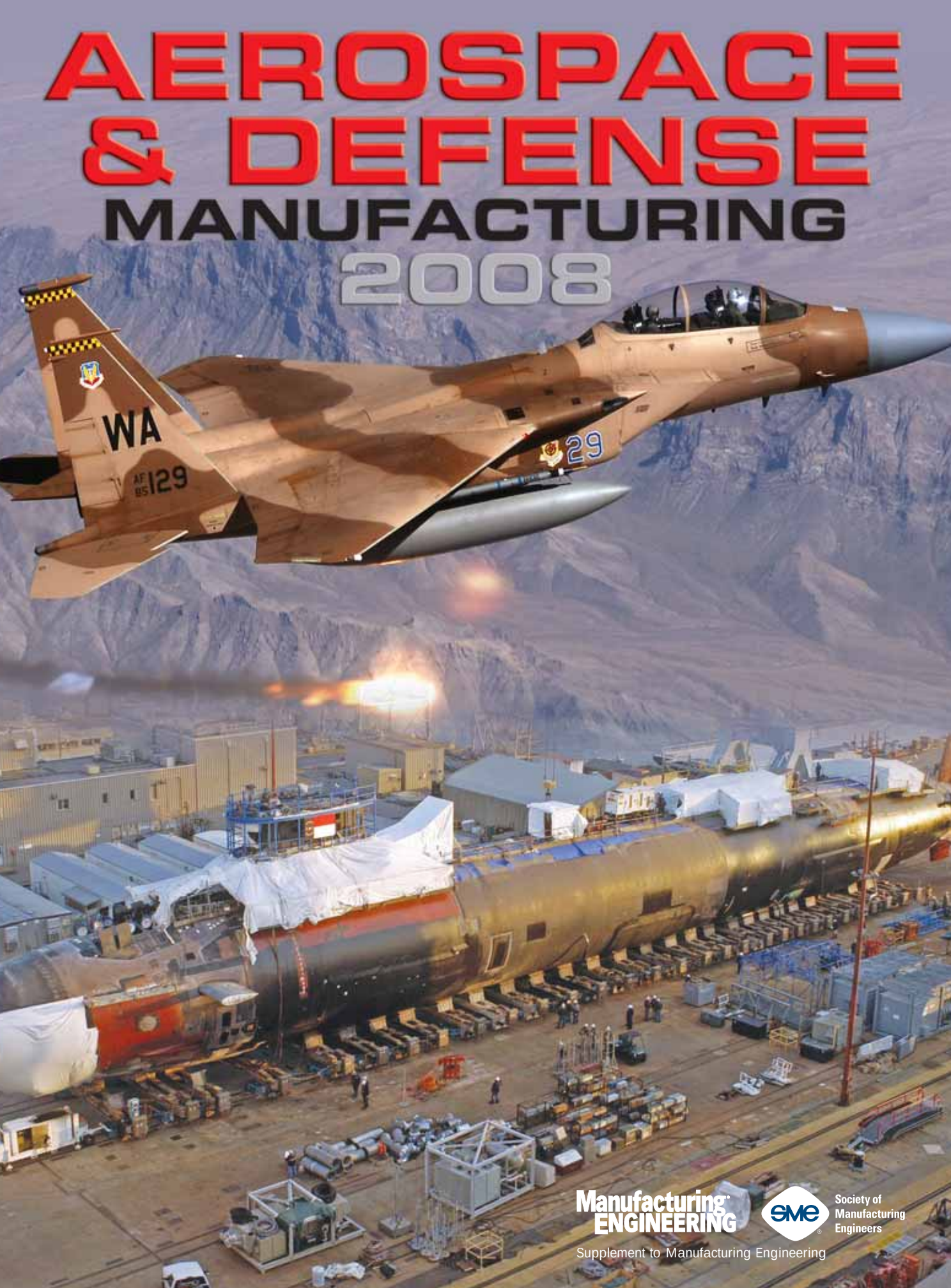
AEROSPACE & DEFENSE MANUFACTURING 2008



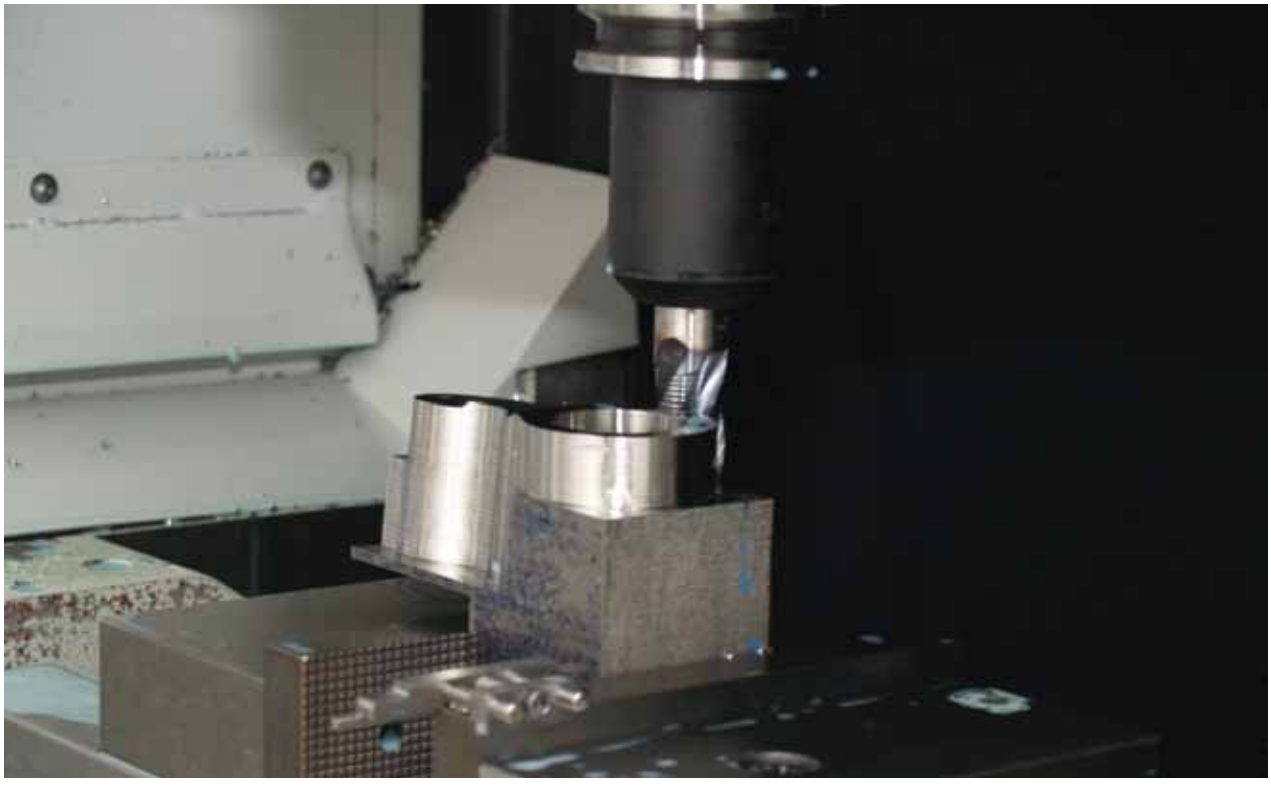
Manufacturing ENGINEERING
Supplement to Manufacturing Engineering
SME Society of Manufacturing Engineers

Lessons in MULTITASKING

Precision manufacturer learns to value new technology.

Who better to get things done right the right way than a teacher? Owner and CEO Pam Rubenstein admits it was "quite an adjustment and very challenging" to give up her career as a teacher to go into the precision-machining business at Allied Specialty Precision Inc. (ASPI—Mishawka, IN). Rubenstein arrived at ASPI in 1989 after a successful career teaching at the high school and college levels, and began to work her way through various positions in the office and factory. In 2005, she purchased the company.

At first look, Allied Specialty Precision Inc. appears to be simply another good-quality provider of components and subassemblies for aerospace applications, but it's much more. The company began in 1954, largely for the purpose of supplying precision parts to local powerhouse Bendix Aerospace, now part of Honeywell. Today, customers all over North America use ASPI parts for hydraulic and fuel control as well as braking systems. Flying on every civilian and military plane in the US, applications range from B-52 and KC135 brakes to hydraulic pumps for the Boeing 787 Dreamliner, and even tiny fuses to relieve excess pressure in overheated airplane tires.



Complex lever is machined from titanium in three setups on a Mazak Variaxis 500 five-axis VMC allowing a single vise setup for this sculptured lever, versus nine setups using traditional processes.

Michael C. Anderson
Yearbook Editor

ASPI's pedigree includes certification under ISO 9001:2000 and the extended AS9100:01 standard for aerospace quality and reliability. In addition, it has achieved accreditation under NADCAP standards AS7110 and AS7116, which are sponsored and maintained by The Society of Automotive Engineers (SAE) specifically for aircraft and aero-engine manufacturing.

Many families of round parts requiring secondary milling, drilling, and tapping operations are completely processed in a Mazak Integrex Multitasking center.

Not only are ASPI's quality certifications up-to-date, but the company is a Certified Woman-Owned Small Business, making it quite unusual among contract manufacturers serving industry. Pam Rubenstein, owner and CEO, takes this certification as seriously as all the others, because it helps open doors for her company in both the corporate and government sectors.

It is not a simple thing to achieve Woman Business Enterprise (WBE) certified status, as Rubenstein and her core management group learned from full immersion three years ago. The process involves an extensive questionnaire about financial control, and, more important, the operational control of the enterprise. After reporting volumes of numbers, the certifying organization visits for one-on-one interviews with all levels of personnel to ensure that the owner is in full control of the day-to-day business, not just its shares. Financial control alone does not qualify for WBE status. And the certification must be confirmed annually.

Rubenstein sees her role at ASPI as avoiding the status quo. Her favorite question is a simple "why?" to enhance her own understanding of the issue and to encourage new thought processes about problem solving among her associates. True to her commitment to learning, ASPI proudly sponsors an apprenticeship program that is certified by the US Department of Labor Office of Apprenticeship Training. She is also an active member of the National Tooling & Machining Association (NTMA), where she serves as the team leader for its educational programs.

"We're doing well," observes Rubenstein about her company. "We've doubled sales over the last three years, increased our employment as best we could, and invested about $2 million in advanced technology for the manufacturing floor. Unfortunately, our issue remains skilled people." The aerospace industry is booming, and ASPI could add another shift if only they could find qualified operators and programmers. "The combination of an aging workforce and fewer young people choosing to enter manufacturing hasn't completely stifled our growth, but it will definitely affect how we continue to grow."

Cutting Processes and Costs

Well-executed implementation of technology for machining allows ASPI to be a front-runner with the same head count, only smarter. Rubenstein credits a visit to Yamazaki Mazak's World Technology Center and factories in Japan during a technology exchange session in 2005. There she learned about a variety of Mazak multitasking technologies used extensively in its own factories, and came home a true believer in multitasking. Multitasking machine tools that combine a variety of operations onto one machine proved to be a significant part of the answer to the skilled-labor shortage ASPI faces. Non-value-added functions like part and tool setup, designing and building multiple fixtures, part handling and queue time, WIP inventory, and more are cut to the minimum because the entire part can be machined in only one or two setups. She embraced the "done-in-one" philosophy.

ASPI's first Mazak Variaxis 500 five-axis VMC with two-pallet changer was installed in early 2006. Its configuration consists of a 30-hp (22.4-kW), 12,000-rpm vertical spindle moving in three linear axes—*X*, *Y* = 20" (508 mm); *Z* = 18" (457 mm)—combined with a trunnion-style rotary axis (*A* axis) and an NC rotary table mounted on the trunnion (*C* axis). The *A*-axis tilt travel is +30/-120º, and *C*-axis rotary table motion is ±360º. An 80-tool magazine switches cutting tools in 4.5 sec, chip-to-chip.

The first part chosen for the Variaxis was a highly detailed lever that ASPI had been machining in quantity for some time. Machined from Ti-6AI-4V, it was formerly cut from a rough forging. Since ASPI was completely reprocessing the part for five-axis cutting, it determined that a more efficient way of obtaining blanks was to simply buy 2" (51-mm) thick titanium plate and wire-EDM the blank to as close to net

shape as possible. This new process saved lead time, eased workholding, and reduced metal removal significantly.

The L-shaped lever is approximately 4" (102-mm) long on both legs. The toolroom at ASPI designed and built a two-position fixture, one for the turn/milled shaft end and the other for machining the multifaced, multiangled portion, which will connect with its mating part. The part program is designed to machine parts in both fixture positions, so a finished part is obtained at each machine cycle, with the exception of a final grinding operation on the shaft.

The lever-end of the part may appear straightforward, but multiple features on compound angles required nine setups and discrete operations. On the Variaxis, all angled cuts are achieved by the *A*-axis and *C*-axis rotary positioning, as opposed to being built into a fixture. This reduces the number of discrete operations from nine to three, and eliminates six tools. ASPI had a lot of experience with this lever and recorded that the total cycle time was reduced by 44%. Part quality improved because of less handling and the tooling savings.

Another example of improvements in costs and throughput is found in an intricate gear-type actuator machined from 17-4 stainless. It contains a lever arm, hub, face coupling, and approximately 100º of a gear form on the OD. The original process required six operations, while only one is needed on the Variaxis—with a 41% reduction in cycle time.

All angled cuts are achieved by *A*-axis and *C*-axis rotary positioning, as opposed to being built into a fixture. **This reduces the number of discreet operations from nine to three, and eliminates six complete tools.**

Multitasking as strategy

A year and a half later, another Variaxis 500-5X was churning out parts. As the number of discrete part numbers grew, so had the need for more tools and more tool storage—up to 120. Plus Mazak and ASPI were finishing up installation of a new Integrex 200-IV ST multitasking center equipped with a part load/unload material-handling robot. The difference, however, is that this investment was made without a specific contract in hand.

The Integrex configuration allows the completion of a finished part to be accomplished in a single setup. This multitasking center offers done-in-one machining of turned and machined features, with two opposed turning spindles that also have *C*-axis positioning and contouring control. Above the workpiece is a rotating *B* axis, 30-hp (22.4-kW), 12,000-rpm milling spindle, with a toolchanger and 80-tool storage that manage fixed turning/boring tools plus mills, drills, and taps. In addition, a nine-position lower tool turret allows for simultaneous turning/facing/boring operations to increase productivity where the part configuration allows. With robotic material handling and in-machine part orientation, a cut blank is unloaded from a storage pallet and a finished part put in its place every machine cycle with no operator intervention.

Pam Rubenstein says she has come to understand the benefits of multiprocessing. This Integrex was brought in to address the many parts that were basically round in shape but with flats, cross-bores, drilled, and tapped features that inevitably require additional handling and setup. All were reprocessed into one cycle, using standard top jaws machined to hold the part. Tooling cost was reduced from thousands of dollars to hundreds, and changeover time is counted in minutes.

A number of caps, plugs, spindles, and spools already in-house were reprocessed for multitasking, leading to cycle time reductions of 26–45%. In addition, ASPI could offer new capacity and new technology to help expand its business, whether within or outside the aerospace market.

But Rubenstein is most excited about the robotic automation on the Integrex machine. “Can you imagine?” she exclaims. “A small company like ours being at the forefront of automation—it’s absolutely amazing. But it’s a place that we need to be, to grow and succeed for our employees, families. and community.”✈

The Language of Manufacturing

The lure of spending more time with her young son, and “an overall love of learning” brought Pam Rubenstein out of the teaching profession and into Allied Specialty Precision Inc. in 1989.

“Learning a new business was fun,” says Rubenstein of the time between 1989 and 2005 when she was absorbing her new environment as an employee, and eventually the owner and CEO. Rubenstein, however, says her degrees in linguistics prepared her well to be a business owner. “Linguistics is the puzzle of language, of how words or parts of words work together,” she says. “Parts are puzzles and shops are puzzles—just different kinds of puzzles.”

Rubenstein is concerned about the much-discussed impending shortage of workers who understand—and care about—manufacturing processes. Finding and retaining qualified machinists are her most immediate concerns: “That’s the biggest challenge right now.” It’s this challenge that drives her in her involvement as leader of the National Tooling and Machining Association’s Education Team, and her support of the Apprentice Academy, a new local effort to train people in manufacturing skills. Once a teacher, always a teacher.