Hi-Tek’s Laserdyne 795XL fiber laser has capability to maintain ±2% airflow variation on a new generation of aerospace engine components, where ±10% had been the norm.

High-Tech Lasers at Hi-Tek Manufacturing

"Constantly improving," is a term Cletis Jackson, president, and Gary Griessmann, vice president and engineering manager, might refer to when they talk about the future of Hi-Tek Manufacturing Co. (Mason OH). Founded in 1980, successful and rapidly growing Hi-Tek Manufacturing has invested consistently and heavily in the latest and best capabilities to address the complex and changing needs of their customers in the aerospace and gas turbine industries.

Hi-Tek is a highly regarded manufacturer of products for the hot gas paths of turbines—everything from HPT blades and vanes to combustion liners, structural fairing components and complete assemblies. To improve its processing of these parts, Hi-Tek recently implemented fiber laser to its broad fabricating capabilities with a new Prima Power Laserdyne 795XL fiber laser system.

When asked about how the new system makes Hi-Tek more competitive, Scott Stang, manufacturing technology manager for Hi-Tek said, “Our new fiber laser system produces better beam quality, with more consistent power, considerably lower maintenance and the power consumption is much less than earlier systems.”

While YAG and CO₂ lasers continue as important manufacturing systems at Hi-Tek, (they operate a Laserdyne 780 JK704 purchased in 1996 and a Laserdyne 890 PRC 3500..."
Hi-Tek's Scott Stang holds an aerospace engine component processed on the company's Laserdyne 795XL Beam Director with fiber laser.

A CO₂ laser purchased in 1995, the Laserdyne fiber-equipped laser system presents new manufacturing opportunities for Hi-Tek and its demanding customers.

According to Stang, those customers have a very broad range of requirements, from a single complex part to an entire program of parts needed with short lead time, manufactured over many months with multiple releases. To handle these needs efficiently, Hi-Tek's services encompass a full spectrum of manufacturing capabilities including fabricating, machining, assembly and testing operations delivering "engine ready" assemblies. This includes managing a particular assembly's exacting purchasing and production requirements from beginning to end.

To achieve this level of customer performance, Hi-Tek Manufacturing is a PRI registered ISO 9001:2008, AS91000 and Nadcap AS7003 and AC7114 certified with AC7116 Non-conventional machining certification.

**The Fiber Laser's Contributions**

"We're using the new fiber laser to percussion drill, trepan, cut and weld," said Stang. "Products range in size from small military aircraft engine applications to large distributed energy turbines and all applications in between. Many of the components require a combination of cooling hole drilling and complete assembly including the fitting and laser welding of sheetmetal components. Increasingly, these parts may have a thermal barrier coating applied before cooling holes are drilled with the fiber laser. Many components require assembly, including vacuum brazing, along with heat treatment before they are shipped to customers."

"We deal with many different material specifications," reported Stang. "Almost all are high-temperature nickel or cobalt-based alloys. Many parts are precision castings, some forgings and some sheetmetal parts ranging from 0.002" up to 0.5" (0.05–12.7-mm) thick. Many parts are TBC coated.

"Part runs are all across the map—from a one-piece lot size up to production runs that last as long as six months, never shutting down. What is typical of most of our customers is their needs change rapidly and we have to change with them."

The high-temperature materials Hi-Tek processes is especially challenging and includes Haynes 625m 188, 230 and 718. Material thickness ranges from 0.127 to 12.7 mm and are processed readily on the new fiber laser. In addition to drilling these materials, Hi-Tek's new six-axis fiber laser system cuts and welds medium-to-large 3D parts with combined high velocity and acceleration. The system accomplishes a high level of quality with features that include the Laserdyne third-generation Beam Director. It provides C (rotary) axis motion of 900°, and D (tilt) axis motion of 300°. This latest Beam Director laser beam positioning capability combined with high-accuracy rotary table motion provides a five-axis system enabling new manufacturing processes while improving existing ones.

**Accurate Processing**

For Hi-Tek, achieving a high level of accuracy from prototype to production stages and from one job to another is possible because Laserdyne designs and integrates all of its system features. Everything works together in a coordinated manner—the controller, software, motion system, laser and process sensors.

Of particular importance Stang pointed out, are "Laserdyne's software and hardware for part mapping and focus control that enhance both the quality and cycle times compared to traditional methods of production."
Among these are the SP94P control, which includes as a standard feature a full complement of dedicated hardware and software features. These include Automatic Focus Control for capacitive part sensing, patented Optical Focus Control (OFC) for sensing of thermal barrier coated surfaces, Shape-Soft software for programming shaped holes, Break Through Detection for drilling clean, consistent holes with the minimum number of pulses, and multibuffer capable mapping.

The Optical Focus Control (OFC)/Automatic Focus Control (AFC) feature is particularly important to Hi-Tek’s work. Continuously refined so that both hardware and software is leading edge, OFC/AFC precisely guides the motion system, maintaining critical focus position and following the contour of the part regardless of slight surface irregularities. With all machine axes reacting to sensing of the part surface, this creates unlimited R-axis correction with high speed and sensitivity. OFC/AFC allows top machine speeds so productivity is maximized without downtime or scrapped parts. The SP94P control also allows Hi-Tek to use programs created for its other Laserdyne systems with little or no modification.

As for speed, the new Laserdyne fiber laser system operates at up to 800 ipm in all axes (0–20 m/min) with bidirectional accuracy of 0.0005” (12.7 μm). This accuracy is throughout the system’s 80 x 40 x 40” (2 x 1 x 1-m) work envelope, making it ideal for demanding process validation and reliability requirements. Accuracy of the new system is certified to ISO 230-1:1996 and 230-2:2006 in accordance with Prima Power Laserdyne’s standard accuracy and repeatability test procedures.

“We feel strongly that the addition of the 795XL with all of its latest control features along with new fiber laser allows us to improve our throughput and quality while providing a platform for both larger and more complex components requiring drilling, welding and cutting,” reported Stang.

With only a few months of use, Stang’s overall appraisal of the new Laserdyne 795XL fiber laser quality is quite high stating that “the trepan quality is excellent with very little exit burr. Maintenance of the new fiber laser system hasn’t been an issue. Our operators like operating the system. All of our folks here have enjoyed a good relationship with Laserdyne ever since we bought our first system in 1995.”

This feature was edited by Senior Editor Michael Anderson from information provided by Prima Power Laserdyne.