

## Case Study

### Fabricating challenges using multi-axis laser machining

LAI International is a supplier of precision components and sub-assemblies for original equipment manufacturers, operating from several facilities across the USA. For more than three decades, Eric Nelson, vice president and chief technology officer, LAI international, has stayed committed to Laserdyne laser systems.

Rich Technology International is a diversified contract manufacturer and one of the five LAI International, Inc. manufacturing facilities dedicated to supplying of precision engineered components and assemblies for the aircraft, power generation and defence industries.

A typical job – spacer bands for land-based turbines – requires laser cutting a series of accurately spaced complex profiles along the part contour. Part runs for this job average 40 to 50 sets a week using one of the refurbished Laserdyne 890 BeamDirector systems equipped with a 3 kW CO<sub>2</sub> laser, see figure 1. The material is 440 stainless steel with a chrome additive – a very hard material that processes efficiently on the system with consistently smooth, burr-free edges. Accuracies are a tight 100 µm true position total tolerance for the special airfoil shape and speeds are relatively fast considering the geometry of the part features, reports Mr. Nelson.

“Achieving this level of productivity and accuracies from one job to another is possible because of how Laserdyne designs and integrates its system features,” reports Mr. Nelson. “Everything works perfectly together – the controller, software, motors, laser – because everything is Laserdyne designed and manufactured.”

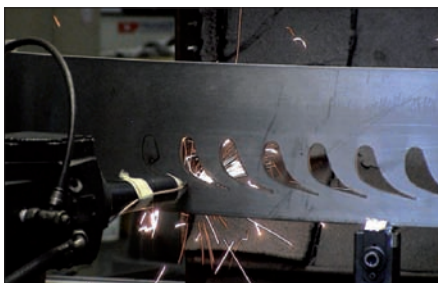


Figure 1. Complex hole shapes are laser cut with 100 µm accuracy and high repeatability.

A perfect example is Laserdyne’s Automatic Focus Control (AFC™). It’s a feature Mr. Nelson swears by and one with which he provided Laserdyne feedback and saw refined through the years. AFC guides the motion system, maintaining focus position and following the part contour regardless of surface irregularities. With AFC, all machine axes react to sensing of the part surface, creating unlimited R-axis correction with high speed and unmatched sensitivity. AFC allows top machine speeds so productivity is maximized without downtime or scrapped parts.

LAI International uses trepanning, percussion drilling, and drill on the fly laser processing techniques in which the AFC feature is extremely important. For trepanning, Laserdyne’s laser positioning systems allows for unique and tight tolerance trepanned features such as those shown in figure 2.



Figure 2. LAI International uses trepanning laser drilling process to produce hundreds of precision shaped cooling holes in aerospace combustor components.

A variation of percussion drilling is “drill-on-the-fly” where pulses are delivered to the part by the stationary laser while the part is rotated. The hole placement is a function of rotational speed and laser pulse frequency. If multiple pulses are required, “drill-on-the-fly”, software developed by Laserdyne engineers, is utilized to synchronize the movement of the part to the laser pulses, ensuring that multiple pulses are delivered to the exact location required. By changing the laser pulse energy, pulse count or lens focal length, the characteristics of the drilled hole size and taper can be controlled to meet the requirements of the part. Drill-on-the-fly software also allows changes of the pulse shape during the process to improve hole geometry.

“System repeatability ( $\pm 2.5$  µm) of the machine really comes into play on our jobs,” Mr. Nelson reports. Our Laserdyne 890 and 780 BeamDirectors with their Automatic Focus Control features are designed so we maintain

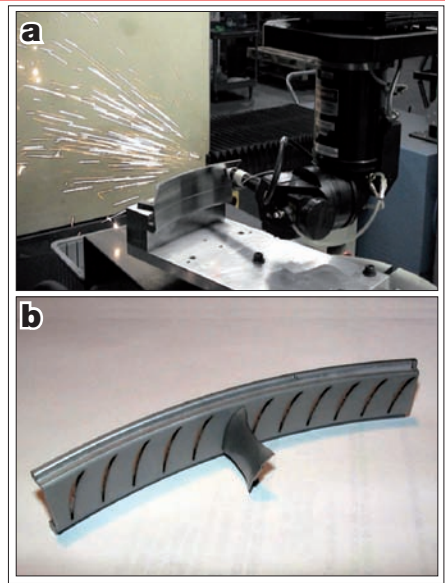


Figure 3 (a) Laser drilling of an Inconel aircraft vane component; (b) the finished part. Part features are accurate to 100 µm true position

extremely good accuracy with consistency through the entire work envelope.”

With equipment options that include waterjet and EDM, Mr. Nelson’s equipment preference for laser drilling aircraft vane sector components is a Laserdyne system with a BeamDirector because it provides higher feed rates and is more accurate, he reports.

In the job shown in figures 3, the Inconel part sets up quickly. Multi-axis laser machining is essentially a non-contact process so only minimal clamping is required. Using an updated Laserdyne 780 BeamDirector equipped with a 1500 Watt CO<sub>2</sub> laser, 1500 to 2000 of these parts are laser processed at LAI, week after week, with only minimal operator adjustments.

“The multi-axis laser stands out as a very unique manufacturing system in today’s broad array of fabricating systems,” reports Mr. Nelson. “Getting the most out of a machine is one thing. Getting the most out of an entire manufacturing technology is something else. And it is much more challenging today because part features, hole configuration and size, material difficulty, speed and quality required have exceeded anything thought possible even just a few years ago, let alone when this all began in the mid-1980’s. With Laserdyne, we’re meeting those challenges and more.”

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