

## TL Precision Welding, Inc. develops new methods for refurbishing turbine engine components

Turbine engine repair and refurbishing is a rapidly growing business requiring specialized equipment and experience. Leading engine manufacturers are more frequently outsourcing this activity, demanding the highest quality work from their suppliers. This requires a dedication to continually improving the laser processes and quality while providing fast turnaround time.

TL Precision Welding, Inc. of Houston, Texas is a 12 person laser contract shop started in 1997 that serves this important and growing area of the turbine engine industry. The success of their early engine refurbishing work has led to new opportunities in laser processing, company growth and a broadening of TL Precision's laser capabilities. In an era of general economic decline, this is an industry niche with promising growth simply because of the sheer number of turbine engines, both land based and aero engines in operation and the constant need for engine maintenance. One leading turbine engine manufacturer for aircraft alone reports 25,000 engines in active service, all of which are continuously monitored for periodic maintenance. The high value engine components, such as turbo combustors, nozzle guide vanes, blades and other transition parts, for both land and aerospace engines, are regularly refurbished and put back into service. To keep maintenance costs as low as possible and to extend time between overhaul, engine manufacturers are requiring suppliers like TL Precision to improve their processes.

TL Precision has met this challenge by becoming an expert at refurbishing these components but also positioning itself with new equipment and skills to handle new laser machining work as well. In 2008, TL Precision purchased their second system from Laserdyne Systems, maintaining a tradition commonplace for Laserdyne System users. TL Precision uses these systems for drilling difficult to machine materials such as Inconel 617, Titanium and Hastelloy X. These are the base materials used to make land based gas turbine engines. The result -- the company is attracting substantial new laser processing work.

### Recreating Turbine Engine Holes

A significant amount of engine overhaul calls for the repair and refurbishing of engine components' air flow

holes. Large combustor components have thousands of these small airflow holes of various sizes and shapes. The holes are designed to maximize engine thrust by selectively cooling critical components, and are precision drilled using laser processes in carefully plotted, complex patterns over the part's contoured surfaces. These holes are contoured and angled to the part surface to maximize air flow, reduce engine noise and minimize fuel requirements. Hole angles vary from 90° to just 20° to the surface and require a high degree of complex and agile positioning and dimensional precision.

The challenge with refurbishing air flow holes in these complex parts is that they must be "re-created" in the same position and with the identical size of the original part as when new, according to Quang Tran, president of TL Precision.

"Recreating precision holes in a used part is often more difficult than generating precision holes in a new part," reports Mr. Tran. "In recreating the hole, there's no margin for error because most of the holes are positioned closely together and have diameters as small as .5 mm and a tolerance as tight as  $\pm .05$  mm."

"Our Laserdyne 790 BeamDirector systems are the keys to doing this work successfully," reports Mr. Tran. "These systems are often the same models used by OEM's to make the parts originally so there are both hardware and software compatibility which helps facilitate the refurbishing process. Using the same programming coordinates as when the part was processed new, our operators employ Laserdyne's "through-the-lens" viewing feature to re-establish the hole location and align the laser beam to it."

TL Precision utilizes percussion drilling to cleanly and accurately remove from existing holes the exhaust refuse and other foreign material that has built up during engine operation. Trepan drilling is less frequently used in engine refurbishing.

"With our new Laserdyne 790 system we have current technology in our laser systems and trained operators that can easily process new parts when we get this kind of order. We are using all of Laserdyne's automatic and quality features that are designed into their systems," reports Mr. Tran.



**Recreating cooling holes in the same position and with the same specification as the original**

### New laser processing work

Mr. Tran and his laser system operators make full use of the Laserdyne multi-axis laser technology. Take for example, Laserdyne's Automatic Focus Control (AFC™) feature. "What we often must do manually to recreate a hole, we can do automatically to make new holes in new parts with AFC," reports Mr. Tran.

AFC guides the motion system, maintaining critical focus position and following the contour of the part regardless of slight 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 also allows top machine speeds so productivity is maximized without downtime or scrapped parts.

Another important capability with Mr. Tran's laser systems is percussion "drill-on-the-fly". The hole placement is a function of rotational speed and laser pulse frequency. If multiple pulses are required, "drill-on-the-fly" software synchronizes the part movement to the laser pulses, ensuring that multiple pulses are delivered to the same location. 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.

"We continue to build on our laser processing knowledge with these Laserdyne systems," reports Mr. Tran. "Laserdyne engineers are always available for consultation and additional training if we need it. Our systems have tremendous capabilities and we continue to have nothing but positive results as we acquire more varied and difficult part projects."

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