

Laser

Hardening

Technology



Fraunhofer USA

Center for Coatings and Laser Applications

### Laser Beam Hardening

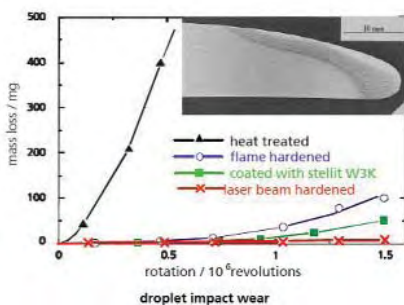
A laser beam can be used for transformation hardening of ferrous materials such as hardenable steels and cast irons. Laser hardening improves the wear resistance of surfaces and increases the service life of parts. The technology is especially suitable for selective hardening of complex shaped parts, bores or edges, and parts where low distortion is critical.

#### Process Advantages

- Outstanding wear properties
- Self quenching process
- Low loss of part ductility
- No need for post-process machining

### Laser Hardening of Turbine Blades

Laser hardening can be used to minimize erosive wear on the leading edges of turbine blades used in power generation applications. The laser process minimizes heat induced distortion, eliminating the need for straightening. Martensitic and precipitation hardening steels can be hardened with the process. Laser hardened blades have improved fatigue strength and a low loss of ductility compared to conventional flame hardened blades.



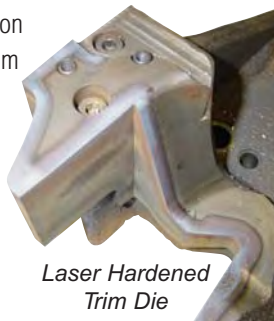
Laser Hardened Turbine Blade Performance Enhancement



Laser Hardening of Machine Component

### Laser Hardening of Metal Forming Tools

Wear surfaces on forming and trim dies can be hardened with robotic laser hardening systems. The low heat input of the process



Laser Hardened Trim Die

leads to minimal part distortion, and the process can be controlled with coaxial temperature monitoring to prevent melting of edges.

### Laser Hardening of Machine Components

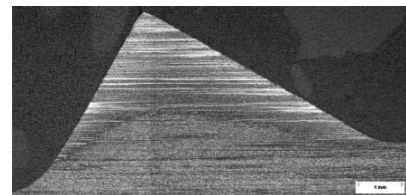
The laser is an ideal tool for hardening of challenging geometries on machine components, such as edges, corners, or recessed features like grooves or bores.



### Fraunhofer Services

- Feasibility Studies, Process Development
- Metallurgical Analysis
- Prototype Production
- System Integration

Laser Hardening of grooves

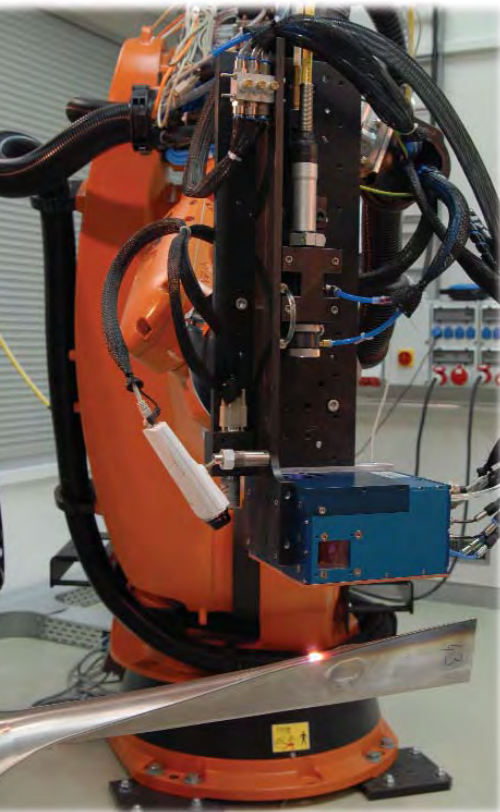


Laser Hardening of edges / teeth

Making innovation a reality

### Robotic Laser Hardening

The advent of lower cost, reliable lasers with fiber beam delivery enables robotic laser applications. Robotic systems offer low cost system technology and high flexibility. Fraunhofer offers integration of robotic systems for laser hardening, together with process control tools to make processing easier and more reliable.



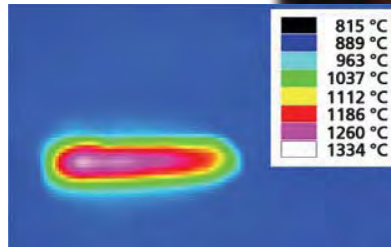
Robotic Laser Hardening System

### Surface Temperature Measurement System E-Maqs & Control Software Lompoc Pro

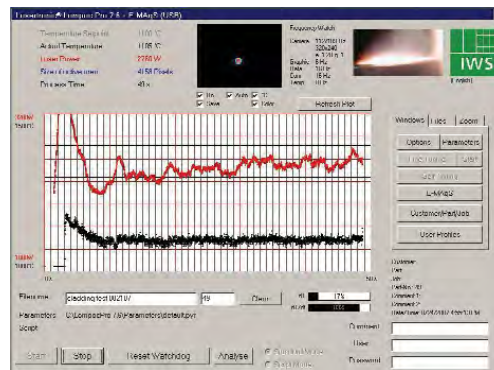
A pyrometer is typically used for non-contact surface temperature measurement for hardening processes. Pyrometers have the disadvantage that they measure the average temperature in a field, which can result in melting of surfaces in an inhomogeneous temperature field. Fraunhofer has developed the E-Maqs CCD camera system, which can resolve the surface temperature over an area with a resolution of 0.1mm. The information from the camera is fed to the Lompoc Pro control software, which creates a closed loop control of the laser power to regulate the surface temperature during hardening.



E-Maqs Camera on Diode Laser



Laser Beam During Hardening Process (Track width = 20mm)



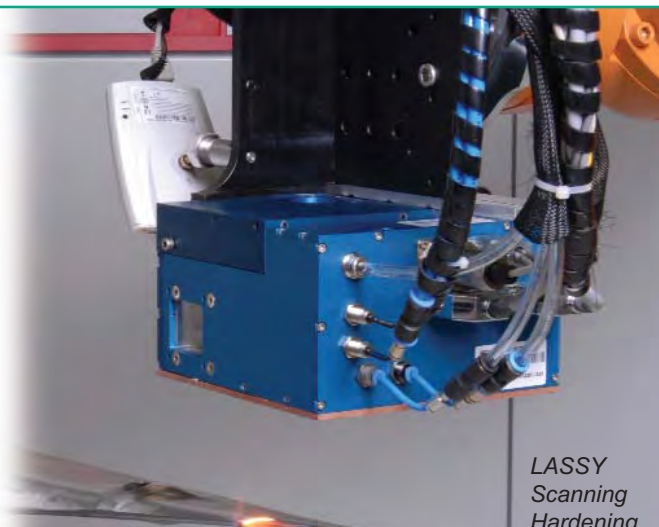
Control Screen, Lompoc Pro

### LASSY Beam Scanning System

The width of the track produced by laser hardening can be controlled with the use of a beam scanning system. Fraunhofer offers the LASSY beam scanning system, which enables the user to adjust the track width to the application without having to switch optics. Track widths of up to 60mm can be achieved, with up to 4kW of laser power.



Laser Hardening with Variable Track Width



LASSY Scanning Hardening System