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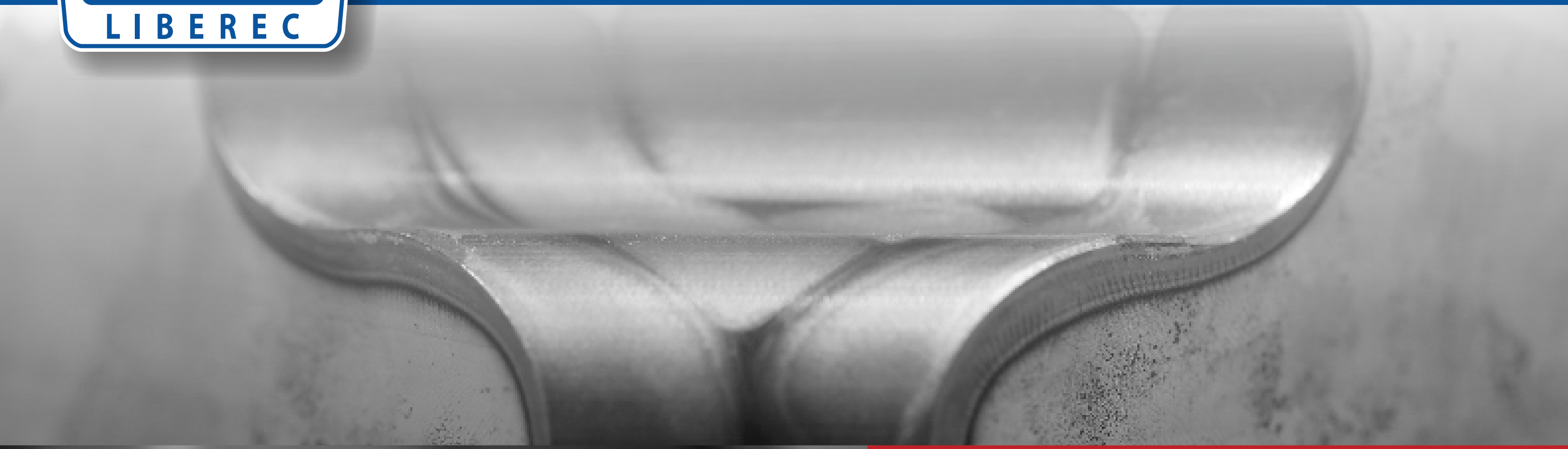
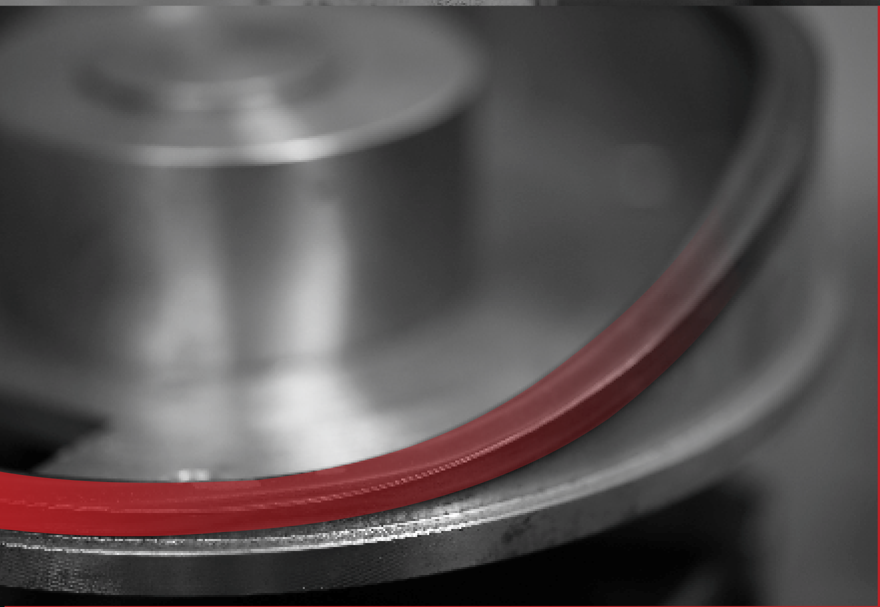
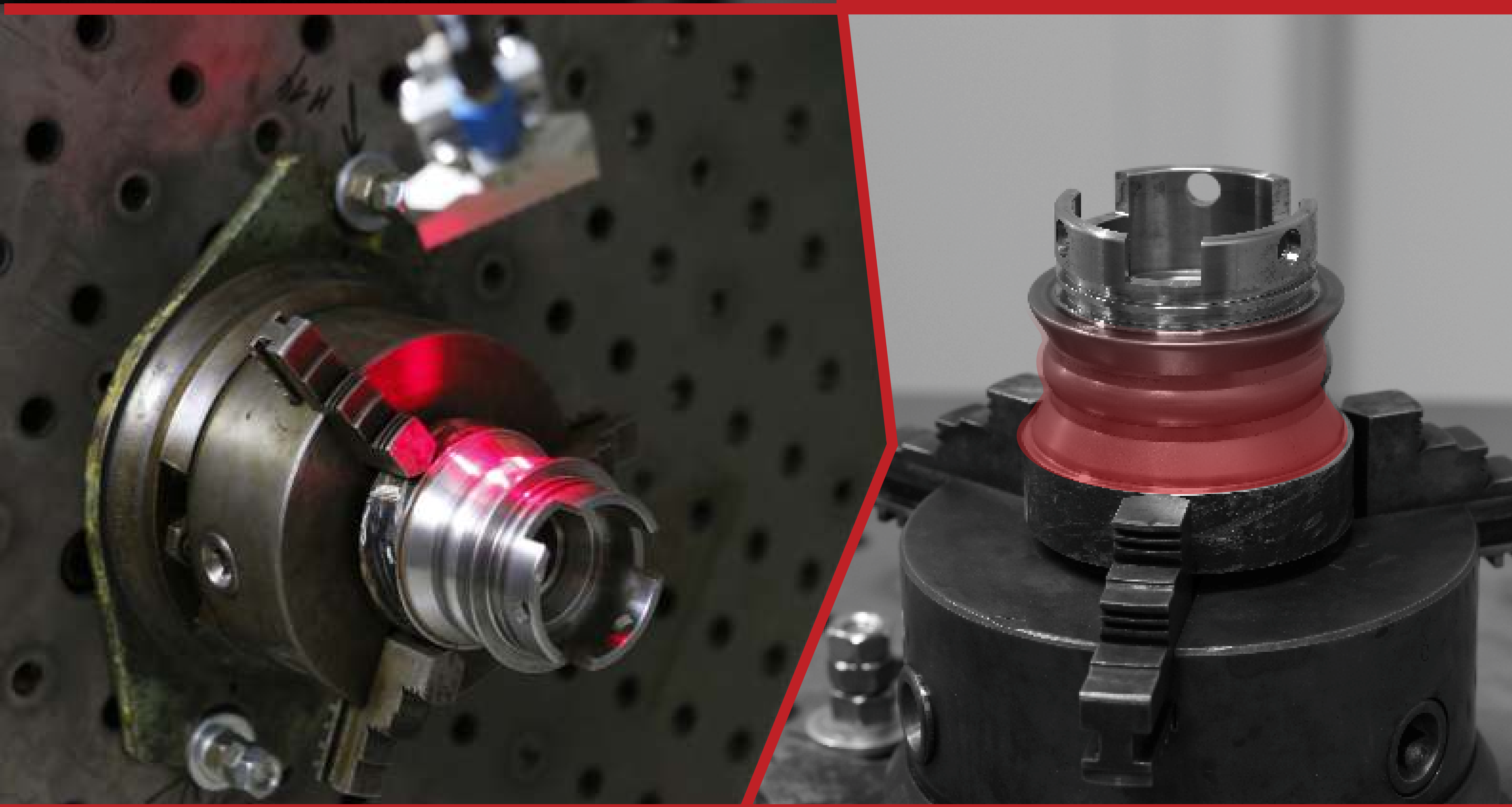
Laser Application Center LAC





LASER HARDENING



Vision unlimited

LASER HARDENING

During laser hardening, in comparison with conventional methods, the laser beam intensively heats up only surface layers under melting temperature, while surrounding material is maintained at ambient temperature. Using a laser beam can be quickly and properly heat treated material surface to a depth of 2.5 mm. For laser hardening are used CO_2, Nd:YAG, fiber and high-power diode laser sources. High-power diode lasers operate with relatively short wavelengths. Absorption received energy in the workpiece material is significantly higher in comparison with other laser types and the efficiency of these lasers is about 35 % - therefore their operation is more economical. This technology is mainly used in the field of materials processing. Laser hardening is used for simple and complex shapes, difficult to reach areas, various holes or grooves, where the focus is on maximum accuracy and minimum deformation. Therefore laser hardening is carried out using modern robotic systems that are accurate and reliable as well.

PRINCIPLE OF LASER HARDENING

Laser hardening is called a heat treatment, where is rapid heating followed by holding time and rapid cooling. The structure of the processed material is affected by several parameters, such as laser beam power and its properties, ability to absorb laser radiation, specific material properties and its microstructure. The holding time is about 10^{-3} to 10s during hardening process by high-power diode lasers. For steels, the material undergoes austenization in the heating phase and desirable fine-grained martensitic structure is formed during subsequent cooling. Heat dissipation, i.e. material cooling, happens directly in the workpiece material. The hardening is done largely without coolant, i.e. directly at ambient atmospheric conditions. The hardening can be carried out under a protective atmosphere of assistance gas to prevent oxidation of the surface.

ADVANTAGES OF LASER HARDENING

- Local surface hardening in exactly required locations with maintained unaffected material tenacity
- Low temperature deformation
- On-line process temperature control
- High process speed and efficiency
- No or minimum need for further processing
- No surface cracks
- Low surface oxidization
- Environmentally friendly process
- Energy efficiency
- Easy process automation

POSSIBILITIES

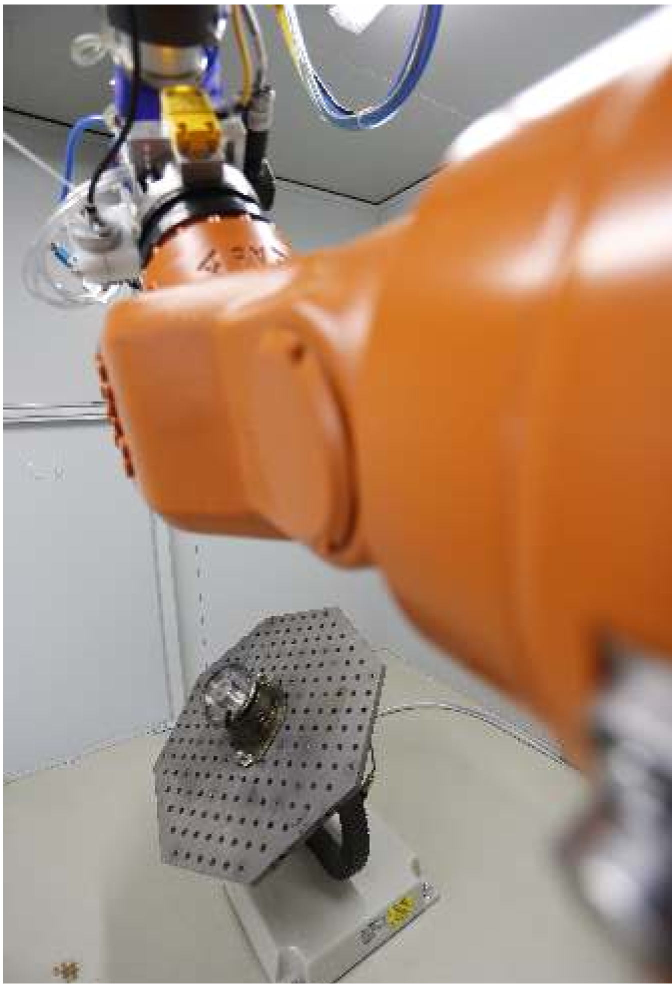
Laser hardening can be applied for surfaces of common structural and tool steels, cast iron, and cast iron with lamellar or spheroidal graphite. Condition for hardenability material is the carbon content. Hardened material must have at least 0.22% carbon. Furthermore, the high-power diode lasers can be used also for hardening of steels with surface pre-treated by carbonization or nitration. The heating rate is more than 1000 [$K \cdot s^{-1}$] in laser hardening. The heating temperature is adjustable and can be monitored by a pyrometer of infrared camera.

MOST COMMON USE OF LASER HARDENING

- Complex shape casting and dies
- Shearing and bending tools
- Bearing housing
- Gear wheels
- Turbine blades
- Piston rings

LASER APPLICATION CENTER EQUIPMENT

- 6 axis robot KUKA KR60 HA
- Positioner KUKA DKP-400
- Table 1000 x 1500 mm with 3D clamping system
- Diode laser source Laserline LDF 4000-100
- Laser hardening optics Laserline
- IR Pyrometer
- Connecting the working gases - CO_2, O_2, N_2, Ar, He
- CAM KUKA.Sim Pro



TECHNICAL PARAMETERS

Robot KUKA KR60 HA

Max. reach	2033 mm
Number of axes	6
Repeatability	<±0.05 mm
Control system	KR C4

Positioner KUKA DKP400

Number of axes	2
Repeatability	±0.1 mm
Payload	400 kg

Laser source Laserline LDF 4000

Max. power	4 kW cw
Expandability	10 kW
Wavelength	1030-1060 nm

Process optics Laserline LLK-B

Beam quality		20-150 mm.mrad
Focal length		250 mm
Spot	●	Ø 0.2-30 mm
	■	4x4 mm
	▬	4x8 mm
	▬▬	4x16mm

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