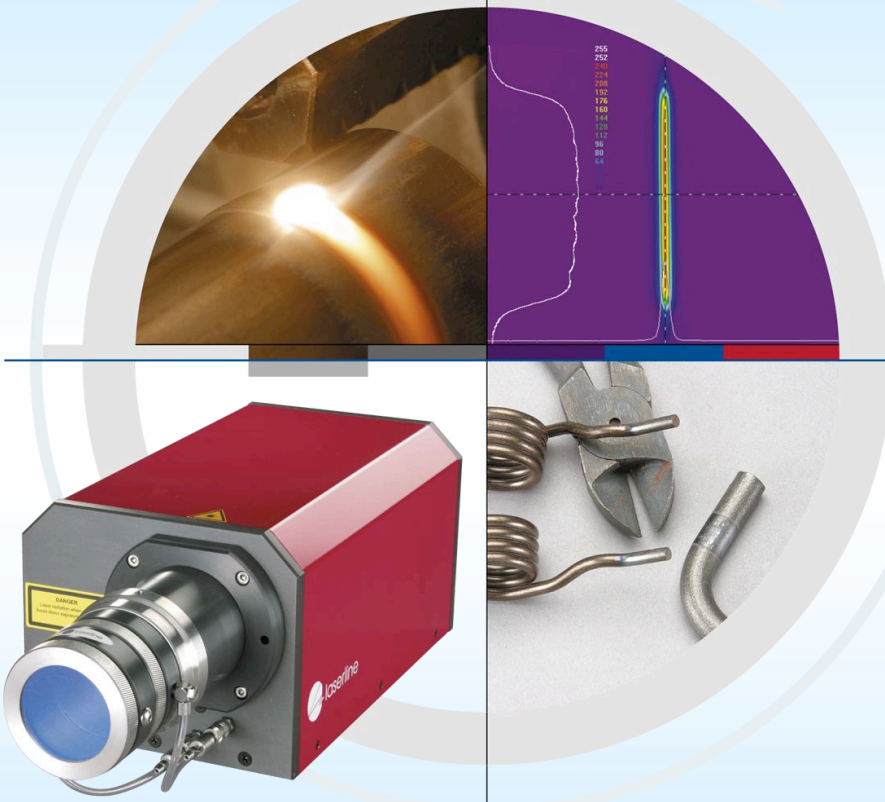
Hardening

with Diode Lasers

June 2005



Laserline GmbH ◆ Mülheim-Kärlich ◆
Germany
www.laserline.de

Hardening with Diode Laser

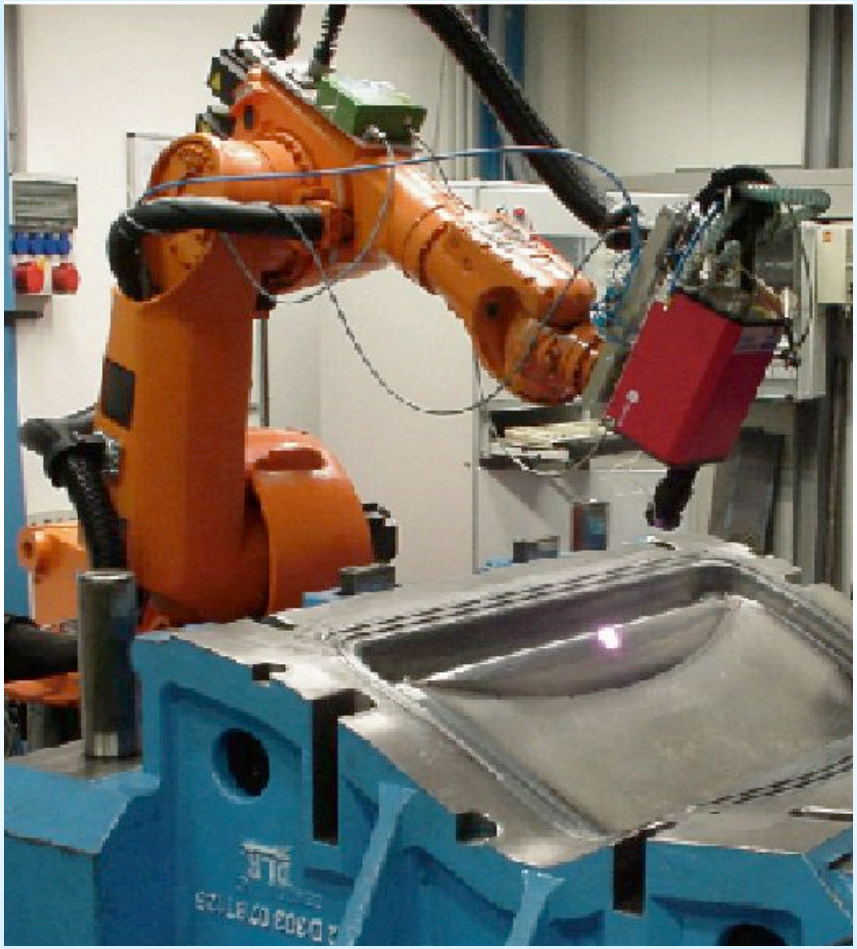


Photo: Erlas

Hardening of forming tools with direct diode laser.

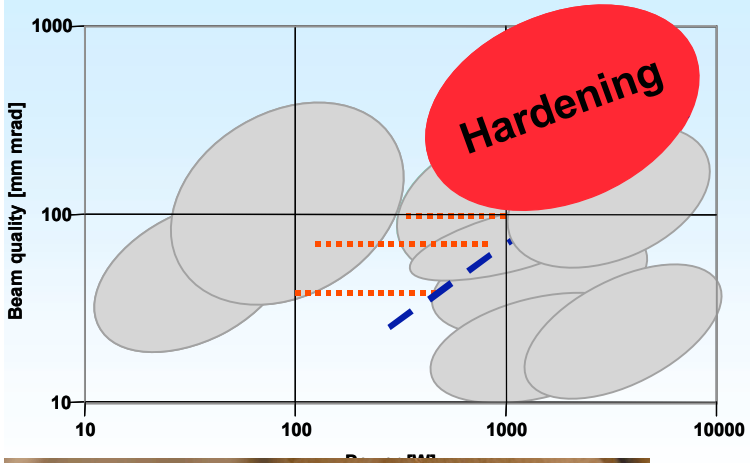
Advantages of Diode Lasers

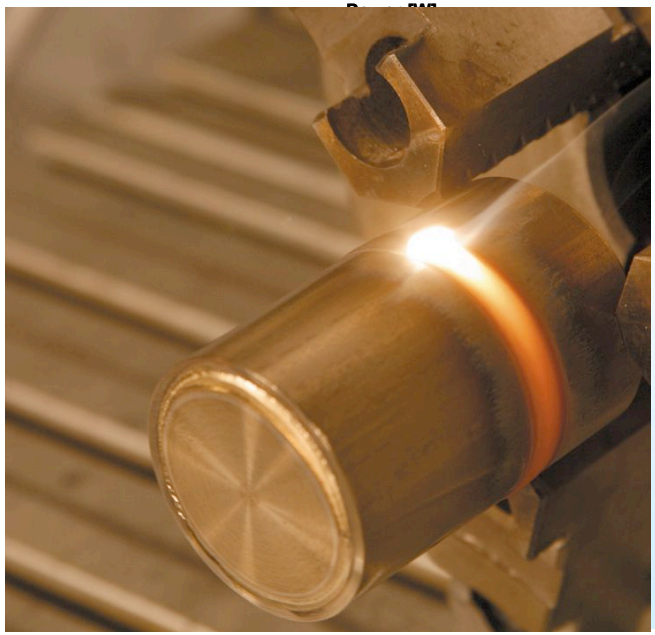
- Spot dimensions adapted to parts
- Local hardening only where required
- Adaptive temperature control
- High processing speed, very high productivity
- Low heat input and thus low distortion
- Short wavelength, therefore very good absorption

Applications

- Work pieces of batch size 1 (local hardening of injection moulding and forming tools), series production of components

Hardening: Typical Data





Hardening of cylindrical component

Laser

- Direct diode laser, Twin- or Multi lasers

Power

- 1000 W to 6000 W

Beam quality

- 85 - 400 mm mrad

Spot dimensions

- 3 x 3 mm² to 15 x 15 mm², 19 x 9 mm² or up to 40 mm length, adapted to specific part to be hardened

Material

- steel and cast iron

Diode Laser Types for Hardening

Direct diode laser on robot.

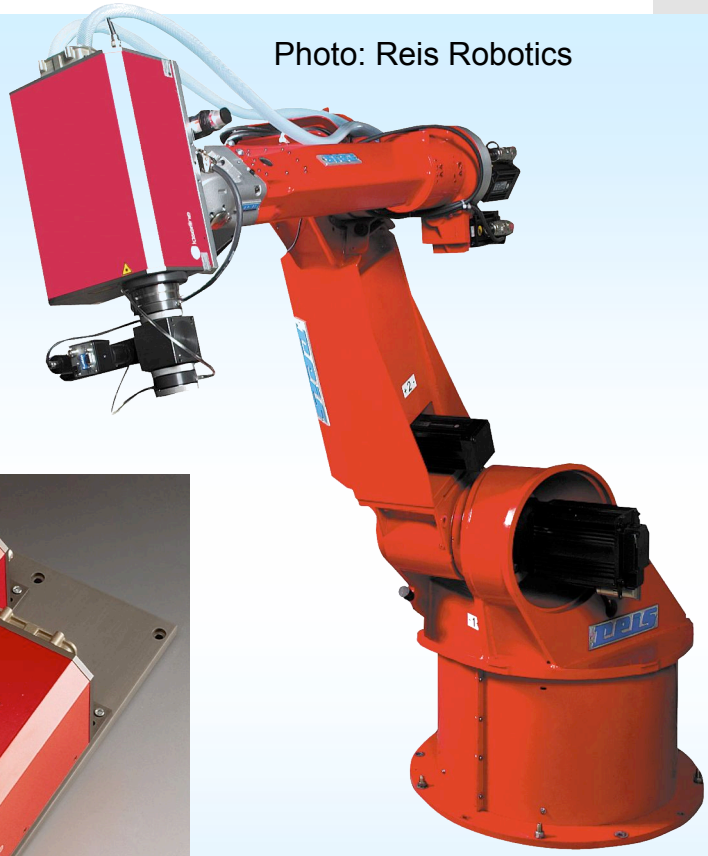
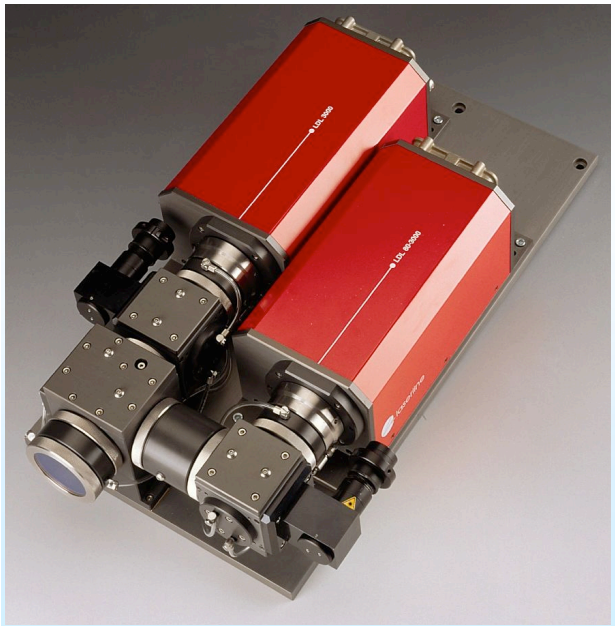
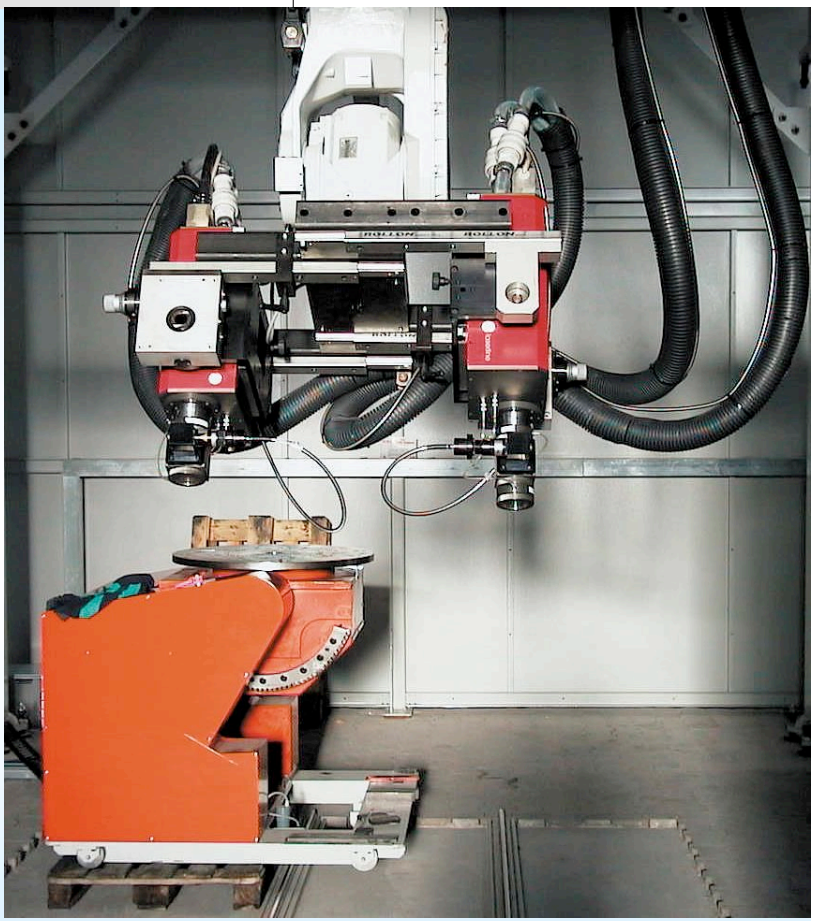


Photo: Reis Robotics

Twin spot diode laser

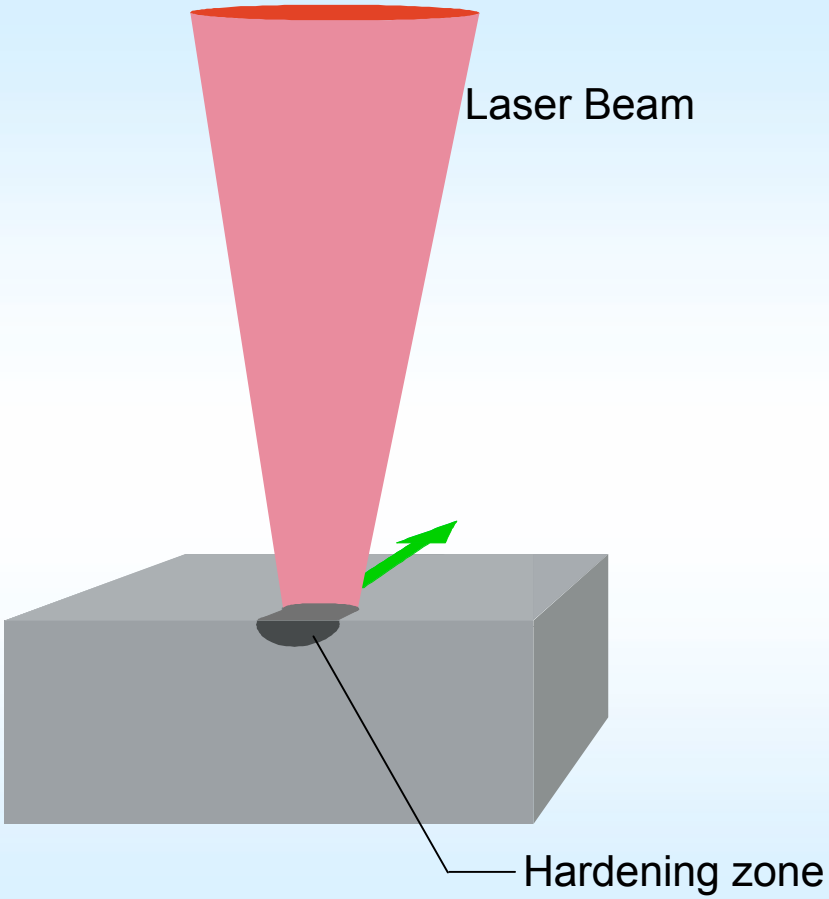




Multi kW twin diode laser on 7 axis gantry system.

Photo: Stiefelmayer

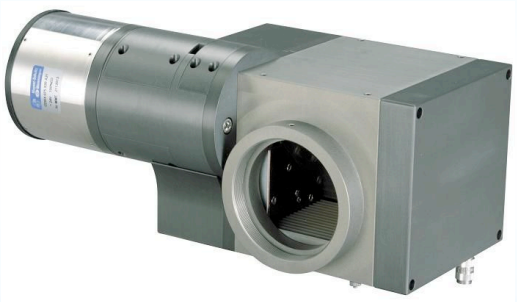
Hardening: Principle

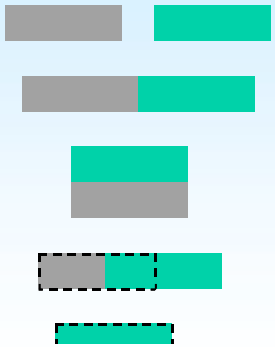


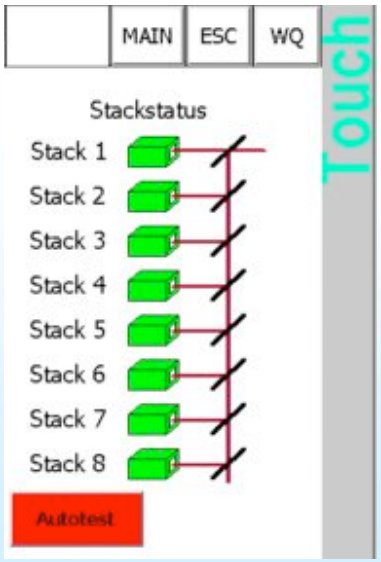
- Local heating of zone to be hardened
- Pyrometer control to avoid melting
- Self-quenching because of cold bulk material
- Formation of fine-grained microstructure of great hardness
- Low overall heat input, low distortion

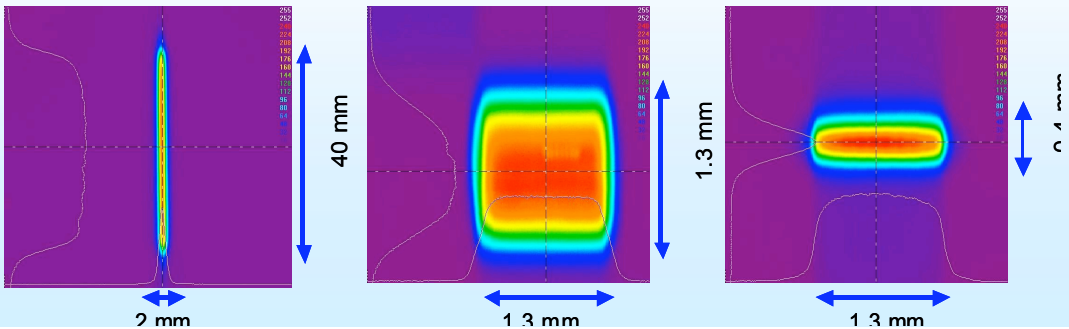
Hardening: Options

- Optimized beam geometry for every application
  e.g. 40 x 8 mm², 30 x 10 mm², 15 x 15 mm²
- Integrated pyrometer for temperature control
- Mechanical shutter, stack management
- Interfaces: Profibus-DP, Interbus,
  Ethernet, PC-based control
- Vario optics
- Twin-laser or twin-spot solutions



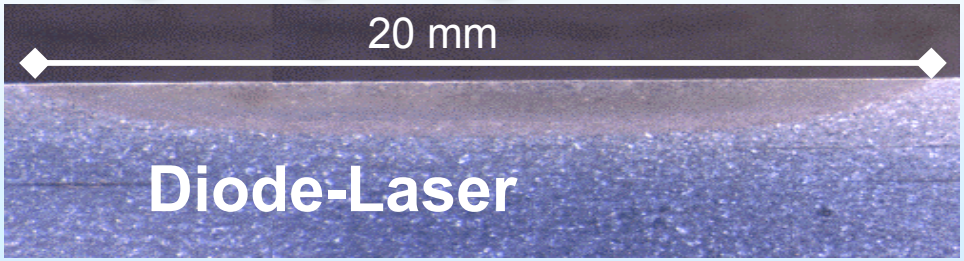




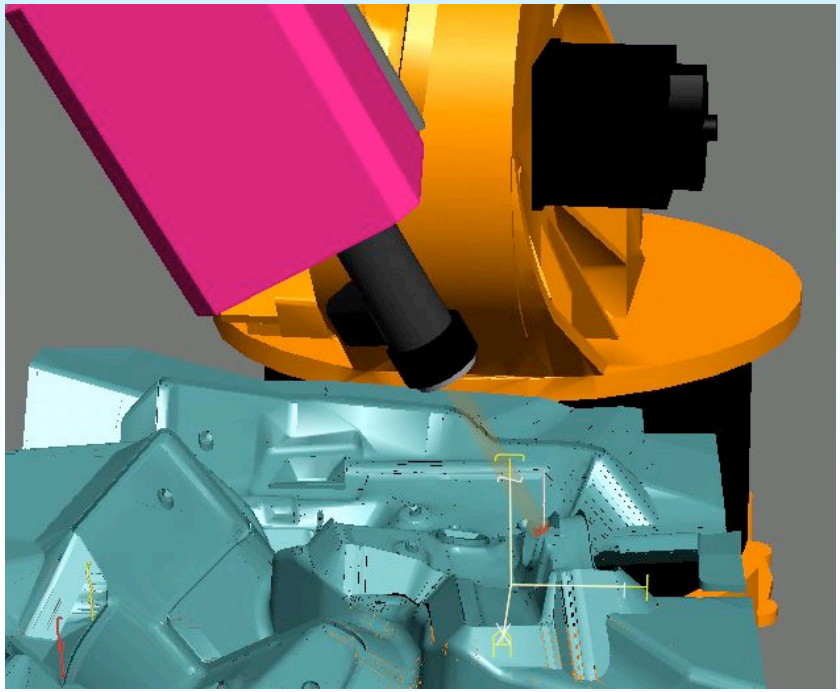


Hardening: Comparison of Lasers

Hardening: Comparison of Results

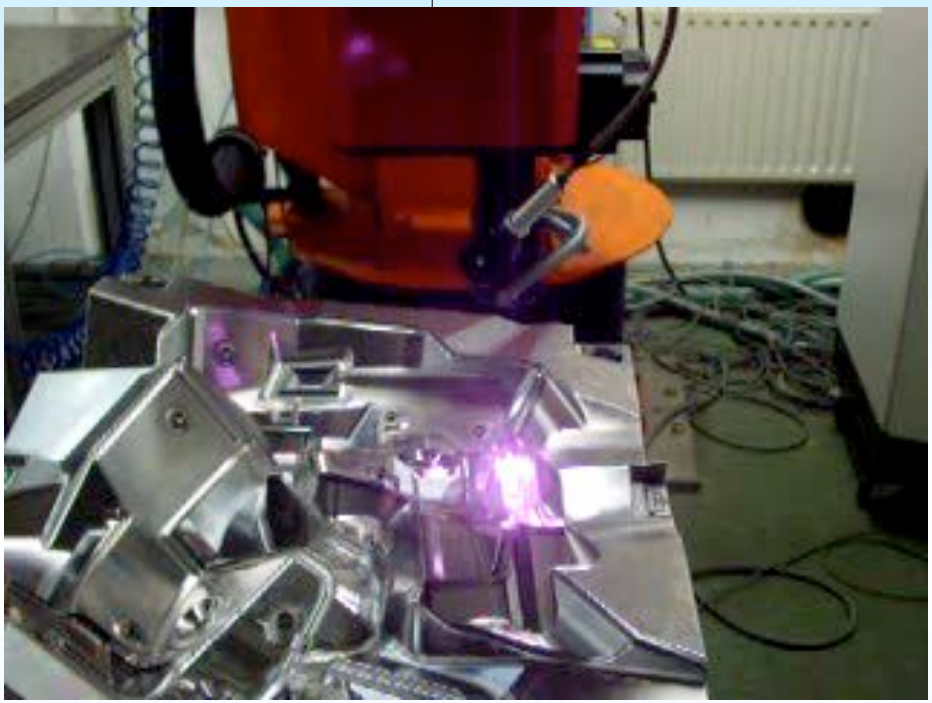


Hardening: Simulation and Reality



Offline-Programming with TopLas3D® of forming tool

- Simulation of process
- Generation of robot NC programm
- Collision control



Hardening of the same forming tool

weight:	1,5 tons
material:	1.2738
$T_{Hardening}$:	1100 °C
speed:	5 mm/s

Hardening of Forming Tools

- Here: deep drawing tool for back door of VW Passat
- Material: GGG 70 (0.7070)
- $T_{Hardness}$: 1000°C
- Length: 35 m
- Width: 20 mm (single track)

Hardening of Forming Tools

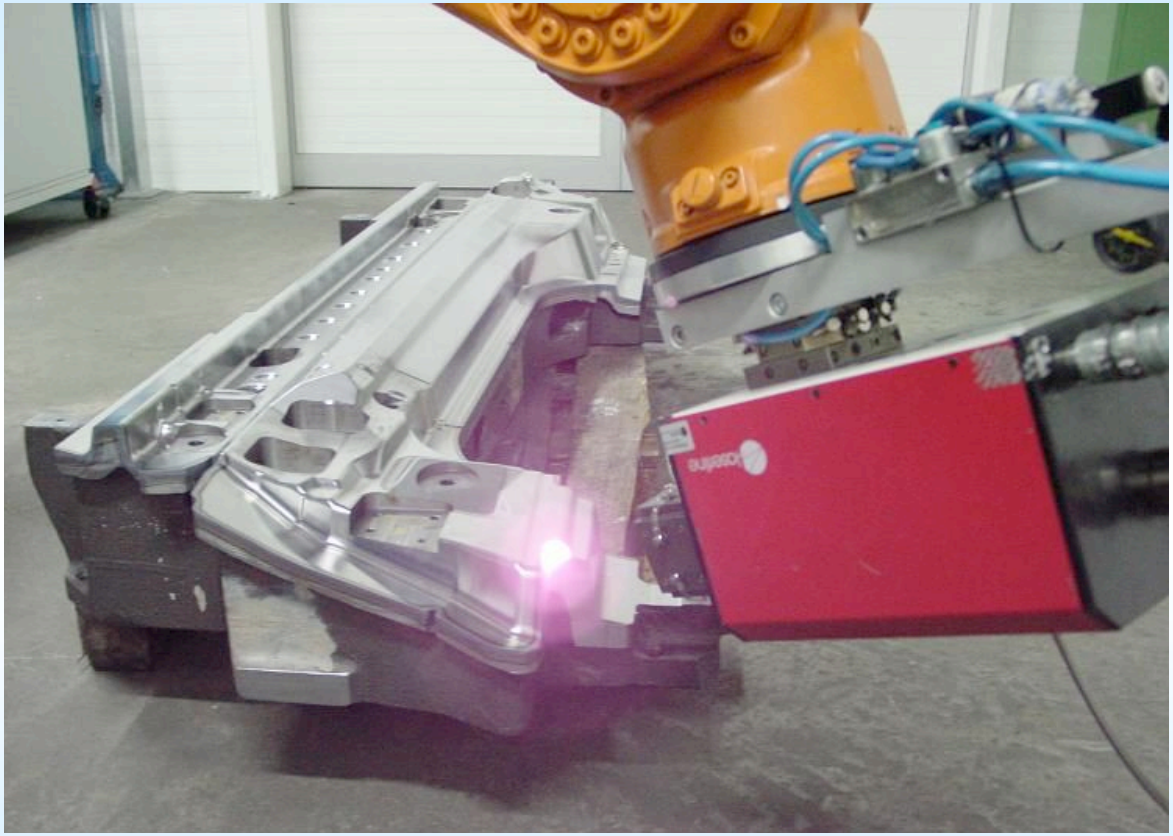
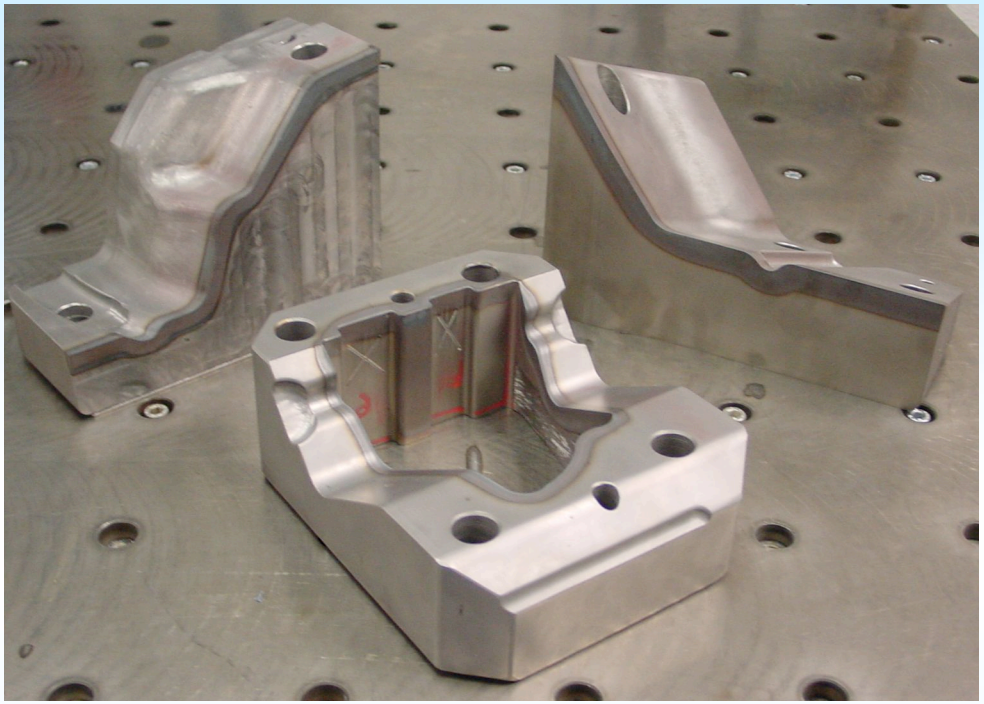


Foto: Erlas

- Automotive industry
- Tools for body-in-white sheets

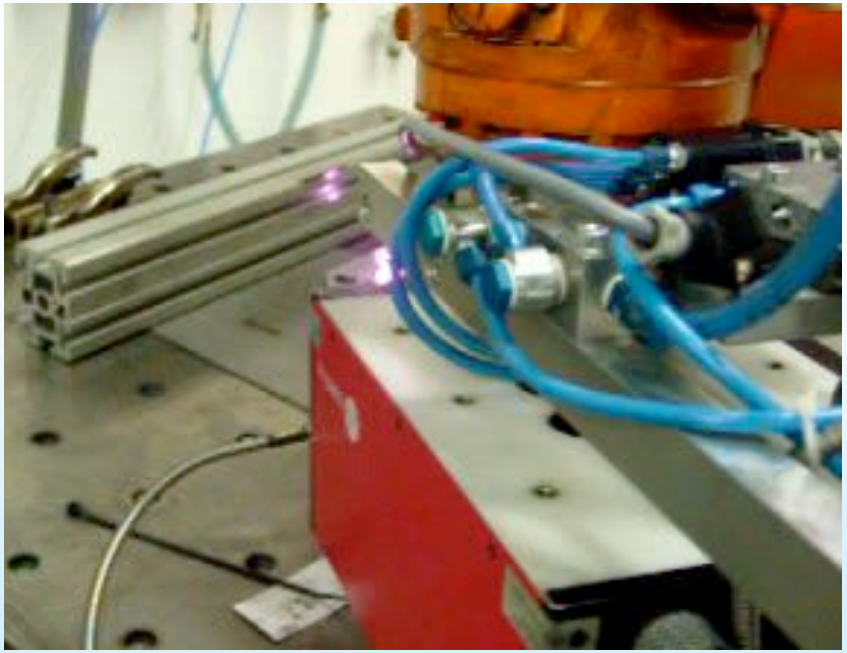
Hardening of Cutting Tools



Material: 1.2379

$T_{Hardening}$: 1100 °C

Speed: 5 mm/s



Laser system: ERLASER® 4000 TCH

$P_{Laser,max.}$: 4000 W

Wavelength: 808 + 940 nm

Hardening of Bending Tools

Photo: ERLAS

LDL 160-4000

- Optical power: 4000 W
- Temperature controlled spot: 17 x 17 mm^2

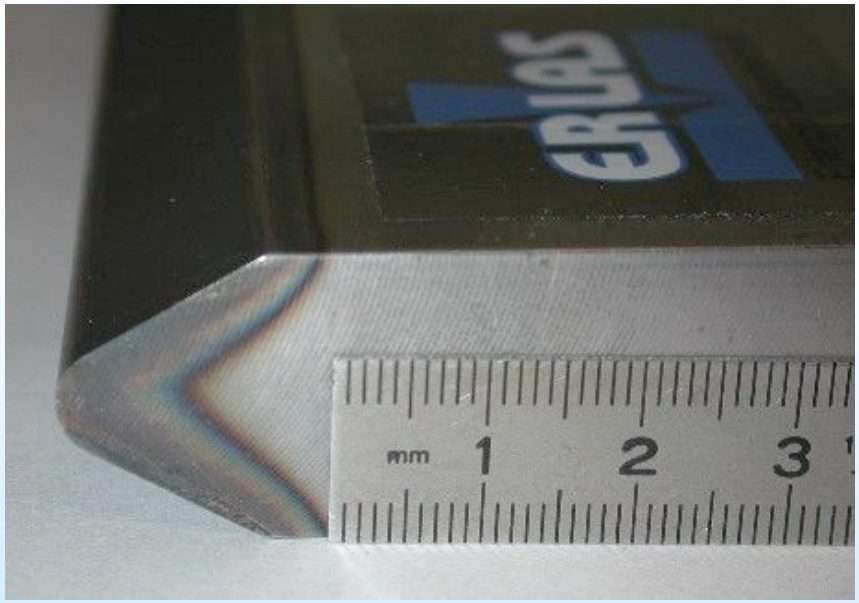


Photo: ERLAS

Hardening of Cutting Tools

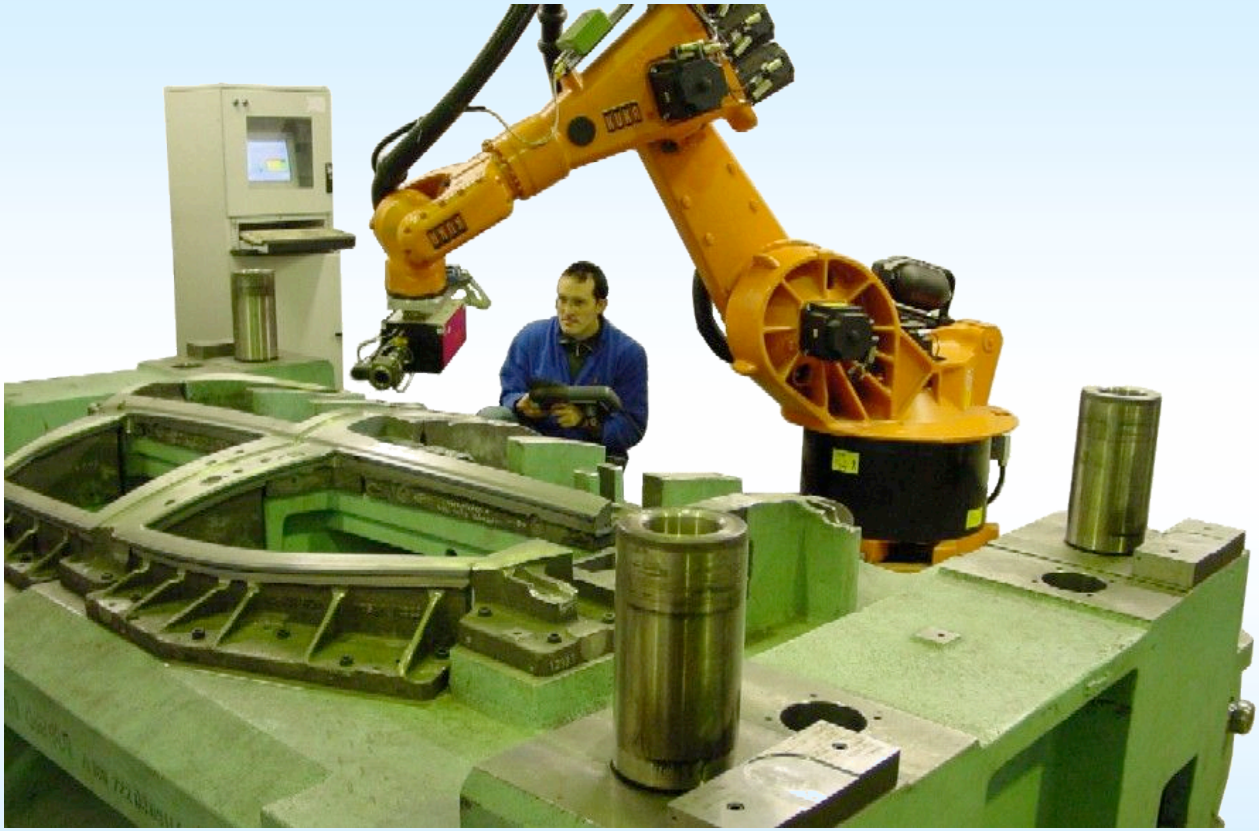
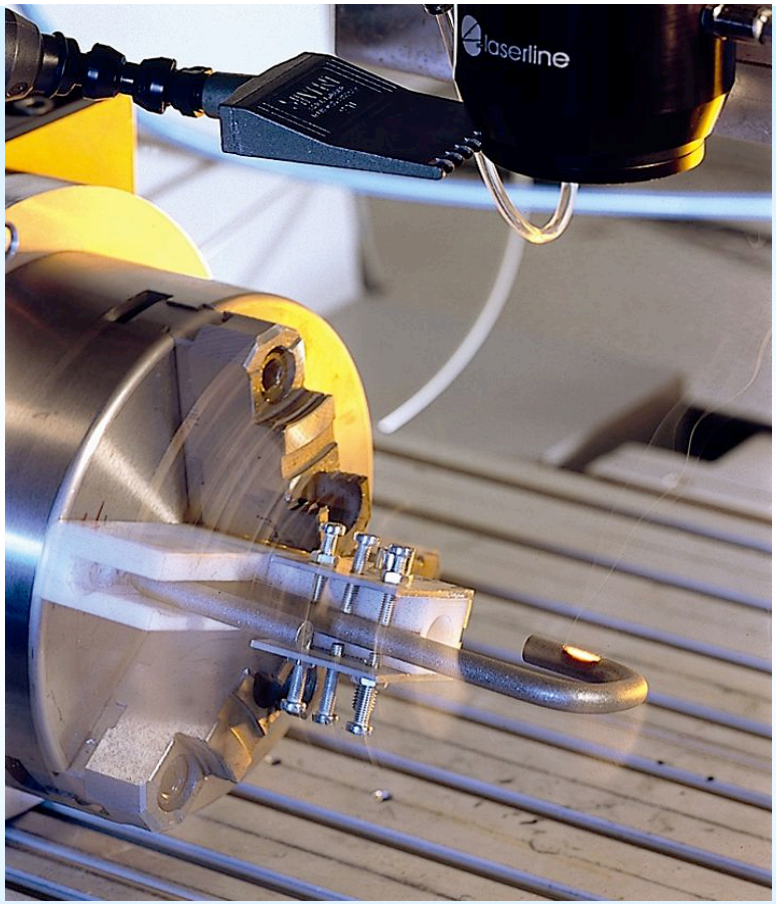


Photo: Erlas

- Automotive industry
- Cutting tools for body in white sheets

Hardening: Industrial Applications

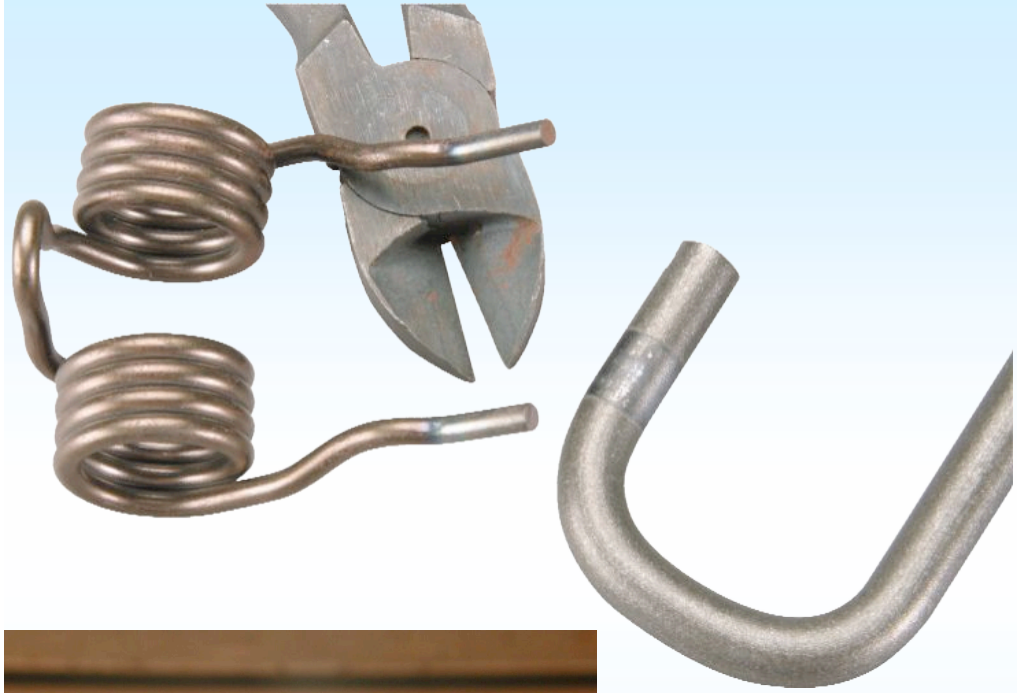


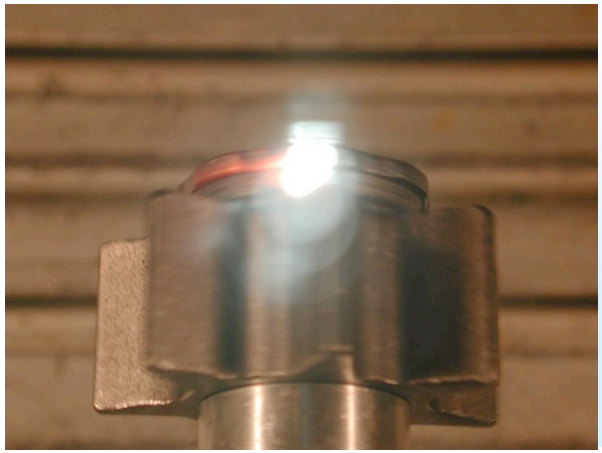
Spring from automotive door

Photo ERLAS

Hardening System: Robot and Diode Laser

Hardening of Mass Production Parts





- Local hardening of
  - Cutting edges
  - Car door spring
  - Springs
  - Saw blades
- Laser power approx. 1.000 W
- Spot geometry adapted to hardening zone

Hardening with Diode Laser

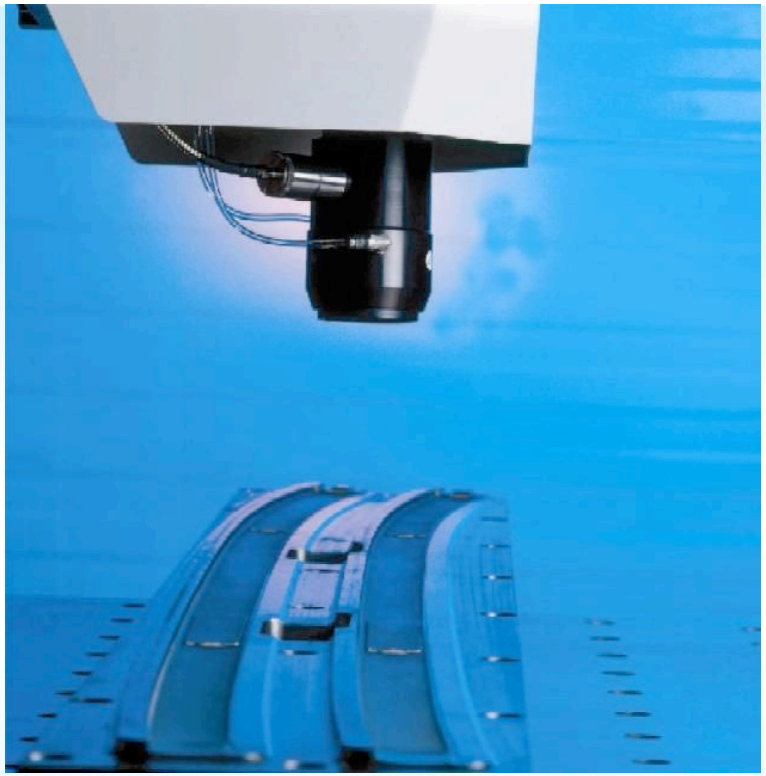
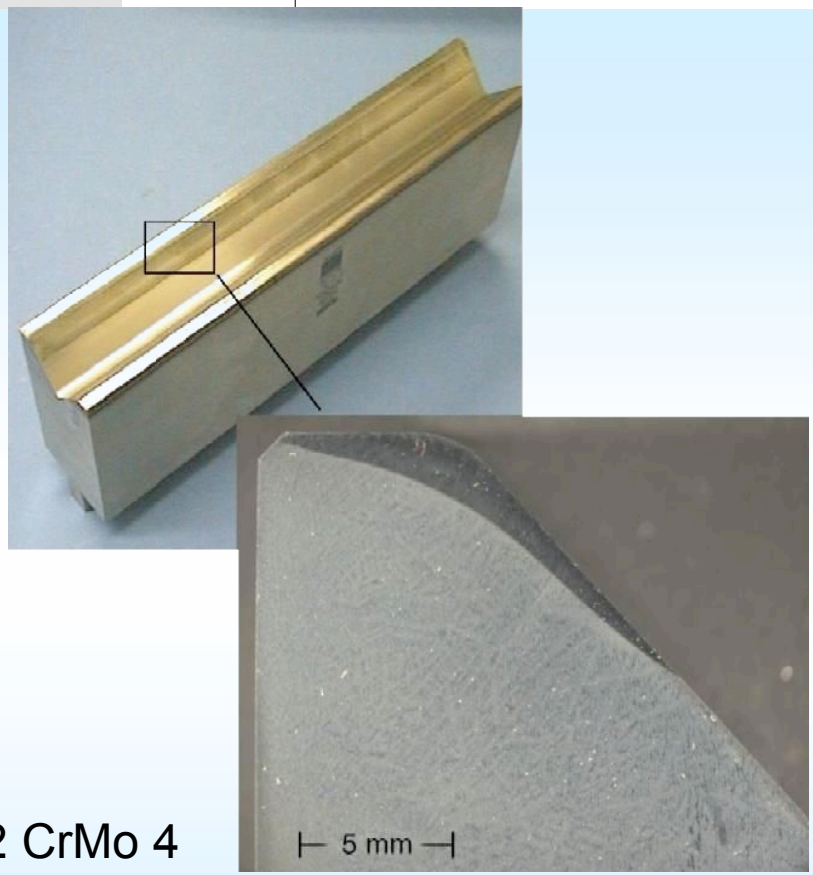


Photo: ERLAS

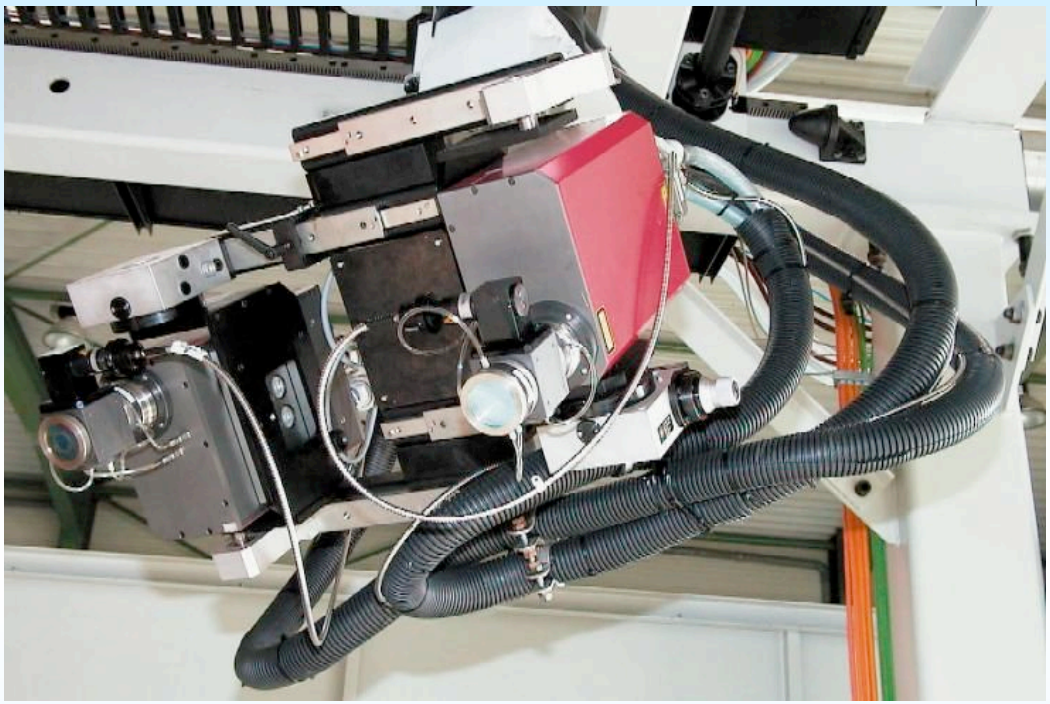
- Material: 40 CrMnMo 7
- Temperature: 1050 °C
- Spot: 17 x 17 mm²
- Power: 2500 W
- Speed: 5 mm/s



- Material: 42 CrMo 4
- Temperature: 1050 °C
- Spot: 25 x 8 mm²
- Power: 2500 W
- Speed 5 mm/s

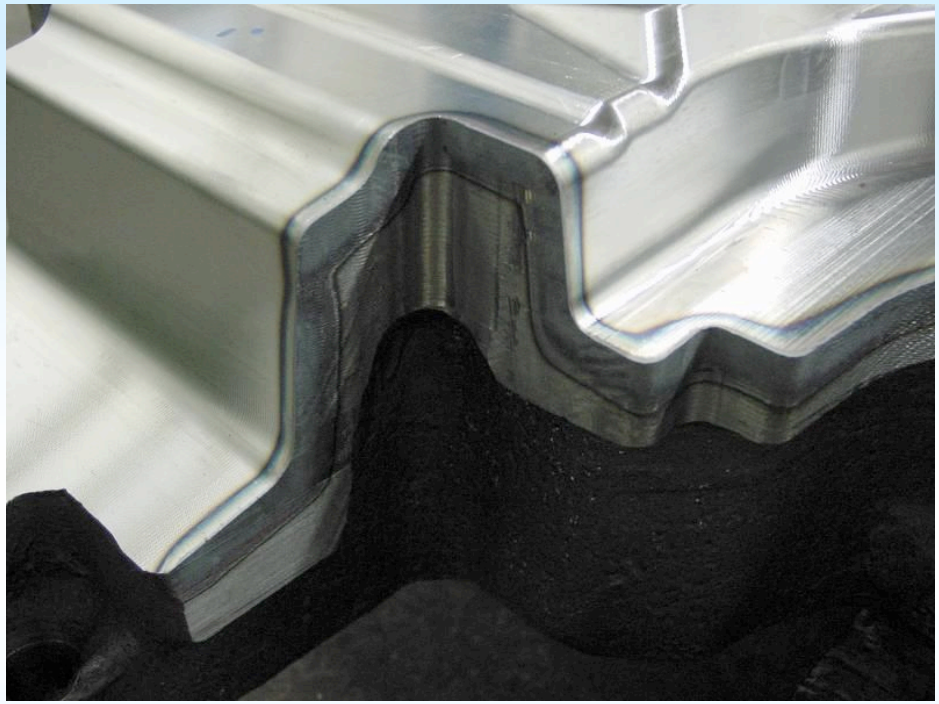
Photo: Trumpf Grüsch AG

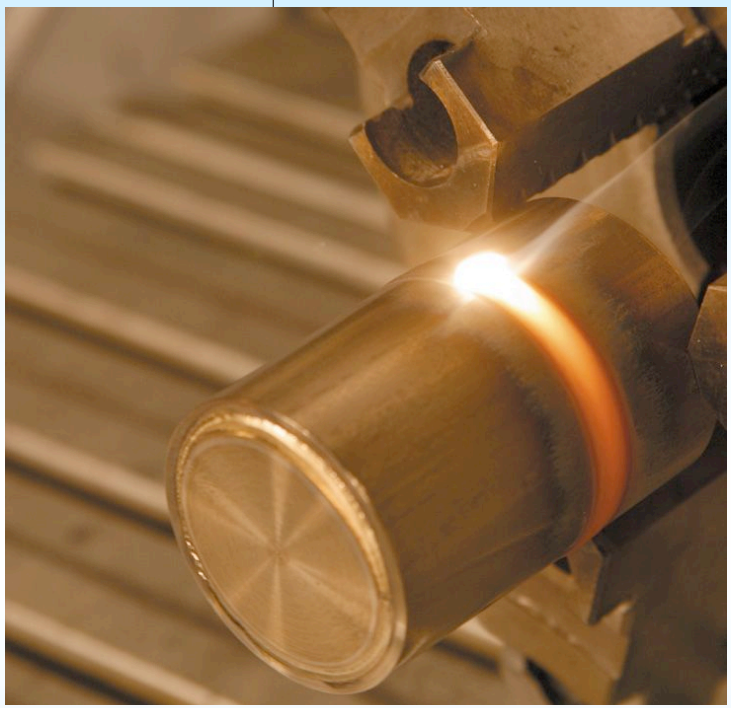
Hardening with TWIN- Diode Laser



- Two multi-kW diode lasers combined
- 7 axis handling station
- Operation from both sides possible for reduction of heat induced bending

Hardening with Diode Laser





- Hardening of different geometries
- Hardening in edges
- Temperature controlled hardening