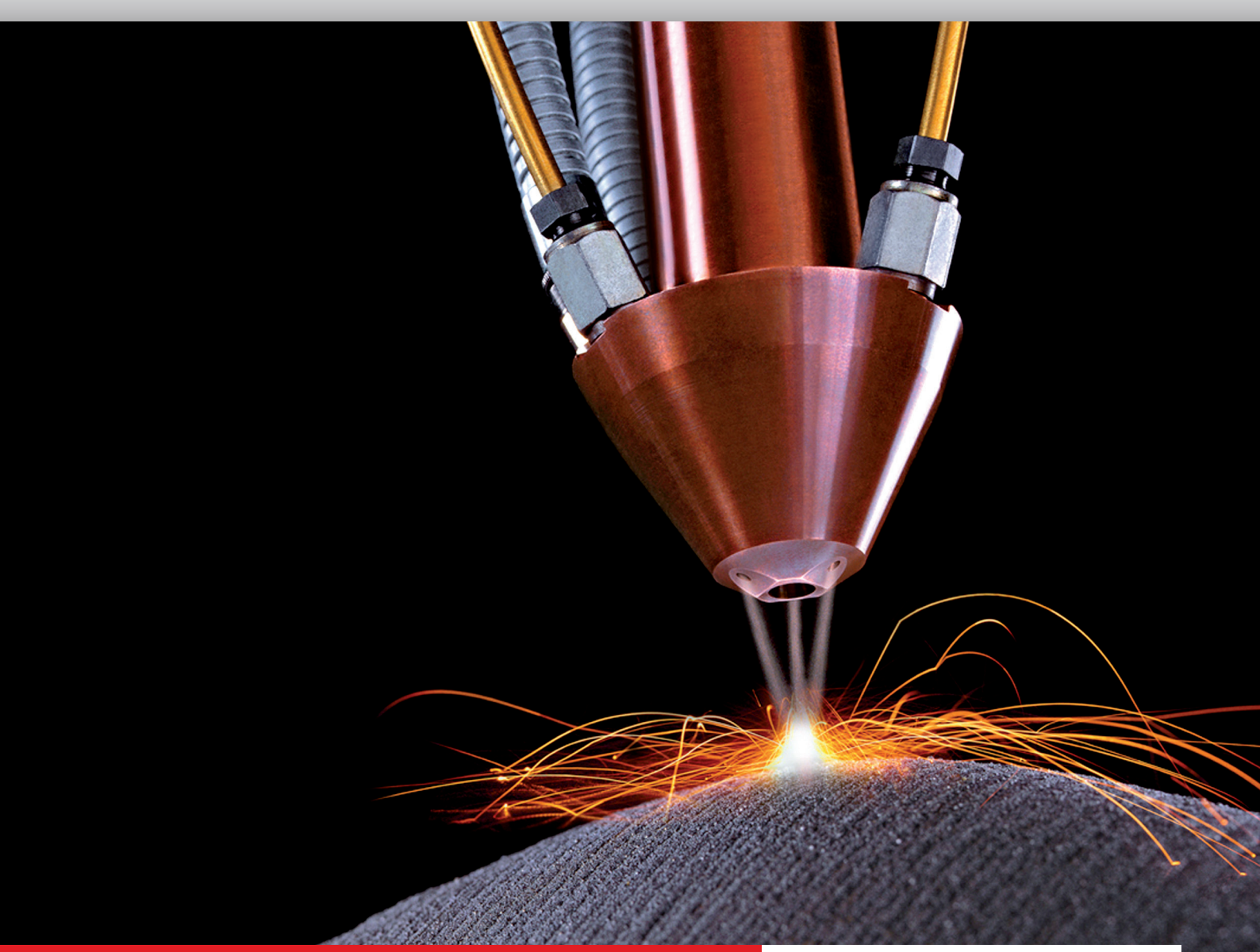
HIGH PERFORMANCE LASER AUTOMATED WORKPLACE



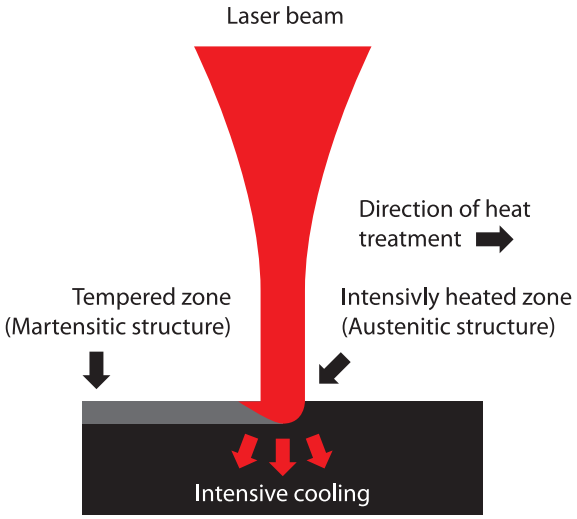
KSK Precise Motion, a.s.
„We always have a solution!“

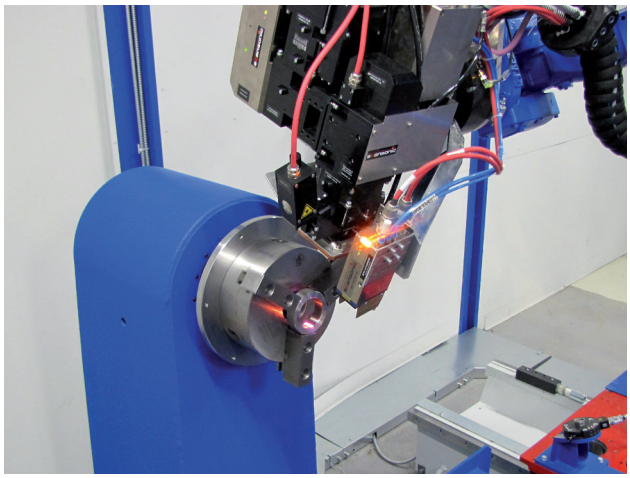
KSK PRECISE MOTION

Courtesy of Trumpf

Tempering

Using a laser beam it is possible to heat polish material surfaces quickly and to a high quality to depths of single millimetres.





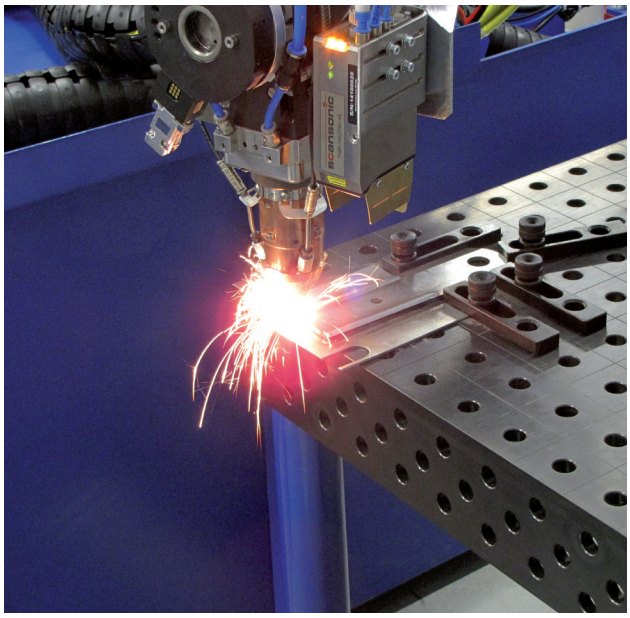
Laser tempering uses the self-cooling effect of the material to create the tempered layers.

The advantages of laser tempering:

- Low energy demands (its tempers only the required area)
- Thanks to automation it can process any geometry
- Low heat load on the surrounding material, which means the elimination of cracks and deformation
- Management of the process according to actual temperatures, which means the possibility to control the depth of the tempering and its resulting hardness (commonly 60 HRC)
- Low oxidation of the surface
- No or minimal necessity for further working

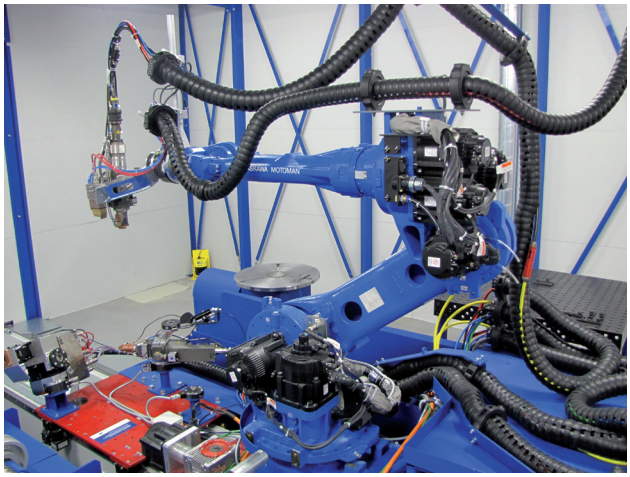
Building up

- Building up using powder is a method which allows not only the repair of existing damaged surfaces, but also the creation of a functioning coating (better rubbing, anti-corrosion and oxidation etc.) on machine parts.
- Building up is optimal for repairs to tools and instruments, forms and adhesively loaded parts.
- We build up with powders based on iron, nickel, cobalt and other materials. Because of the fact that we have the possibility to precisely mix the powder we are able to add different components such as wolfram carbide and other ceramics, oxides and polymers, etc. to the applied base material, which improves the quality of the built-up surface.



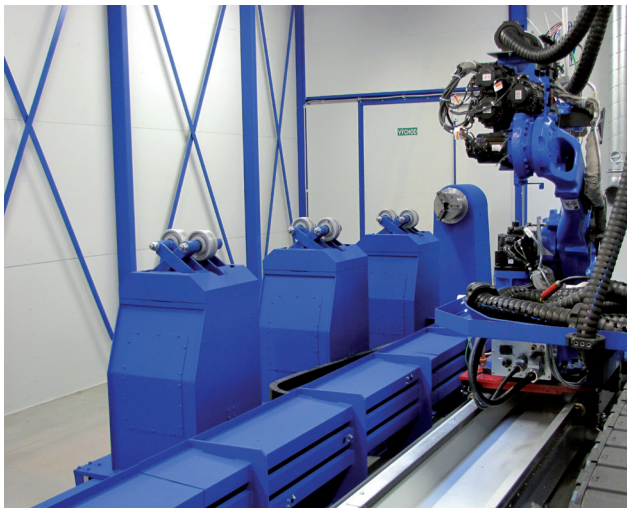
Welding

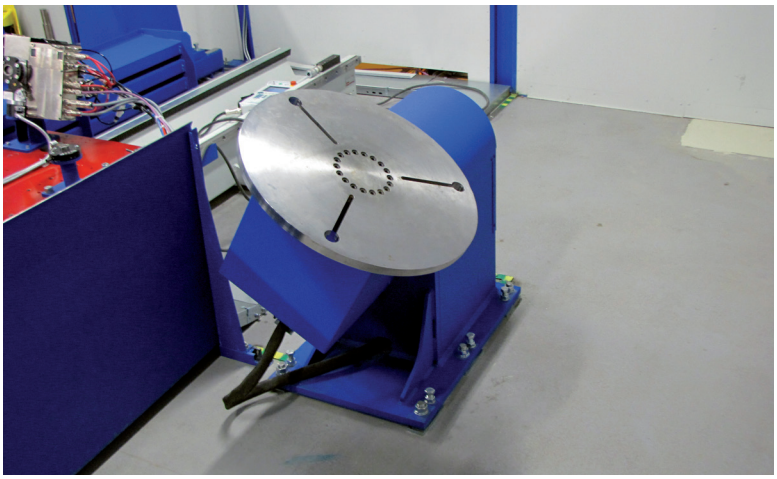
- Laser welding allows us to join both thin and also massive components.
- The high stability of the process while welding at high speeds is ensured by introducing a small amount of heat which results in minimal effects on the base material and minimal deformation.
- The energy introduced is controlled depending on the welded material which ensures a smooth symmetrical welded joint without pores.
- A high quality weld with no or a minimal need for further working.

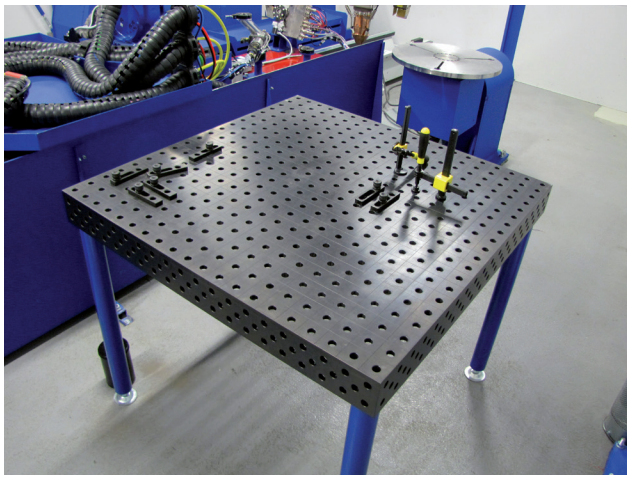


Workplace equipment

- A six axial Motoman robot with a work range of 2,000 x 7,000 mm
- A single axial positioning device with a load capacity of 1,000 kg, a clamping diameter of 200 mm, spinning diameter of 800 mm, and maximum clamped component length of 6,000 mm.
- A double axis positioning device with a load capacity of 250 kg, and work piece diameter of 1,200 mm
- Fixed preparation table – dimensions 1,000 x 1,000 mm

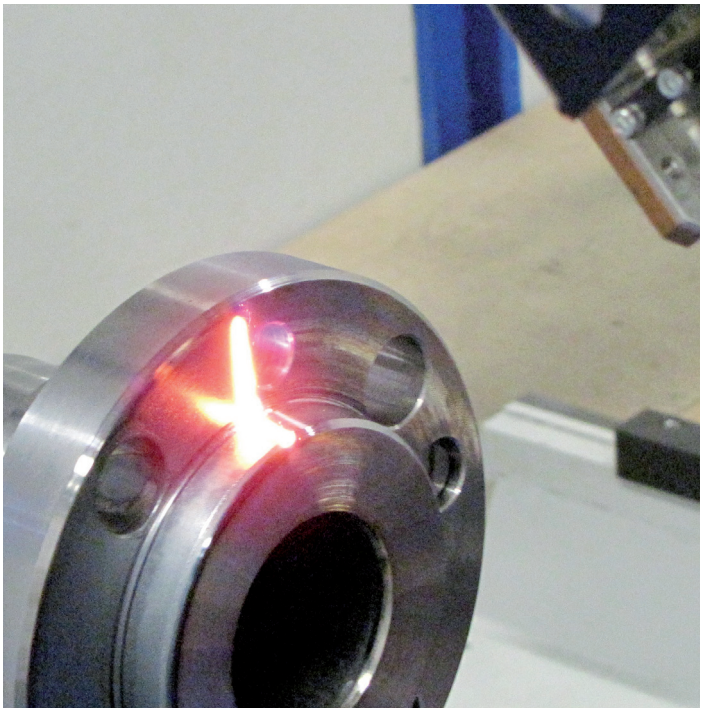




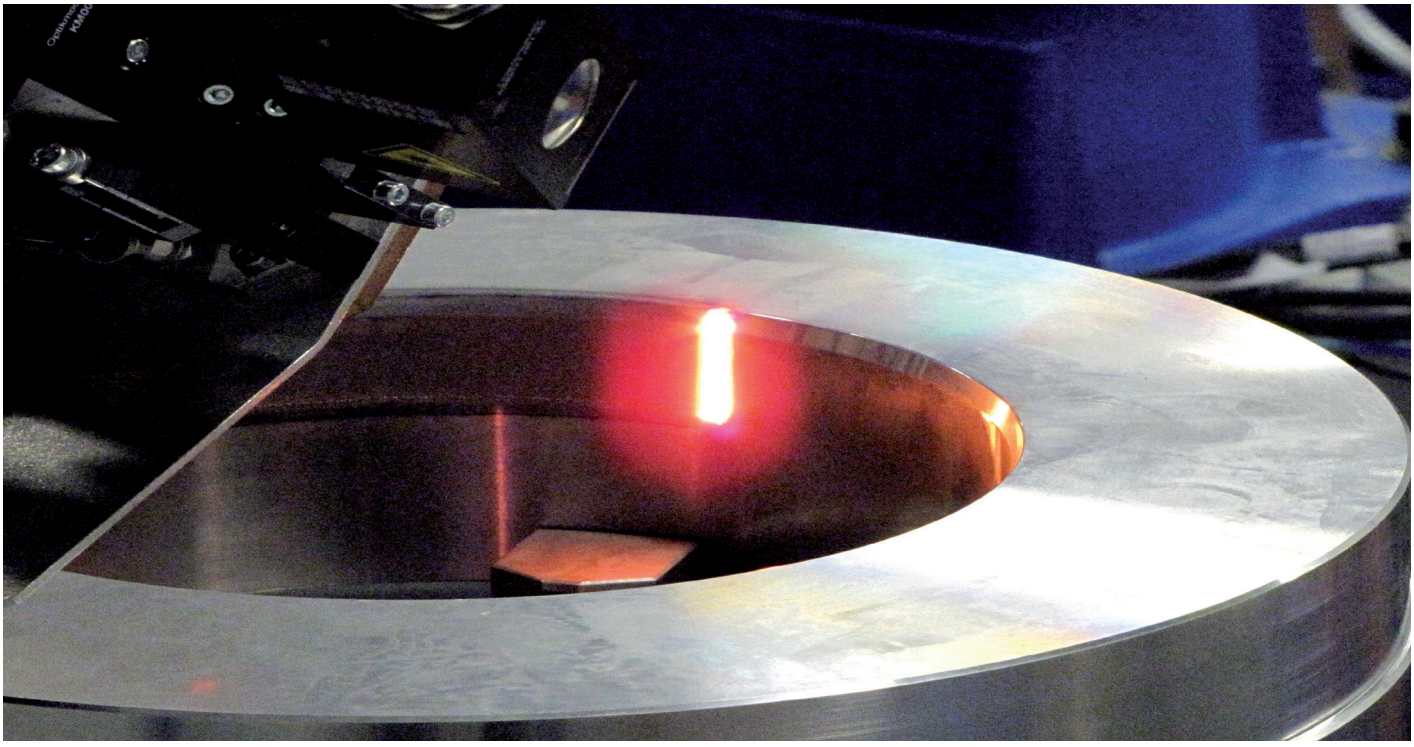


Laser

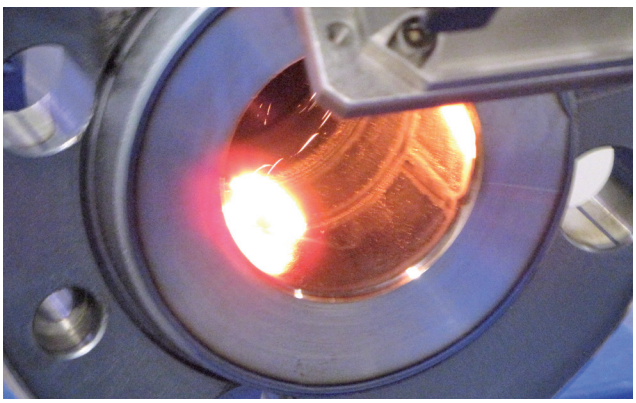
Maximum 6 kW laser beam performance. Laser beam diameter of 600 micro-millimetres. Wavelength 1,030 nm.

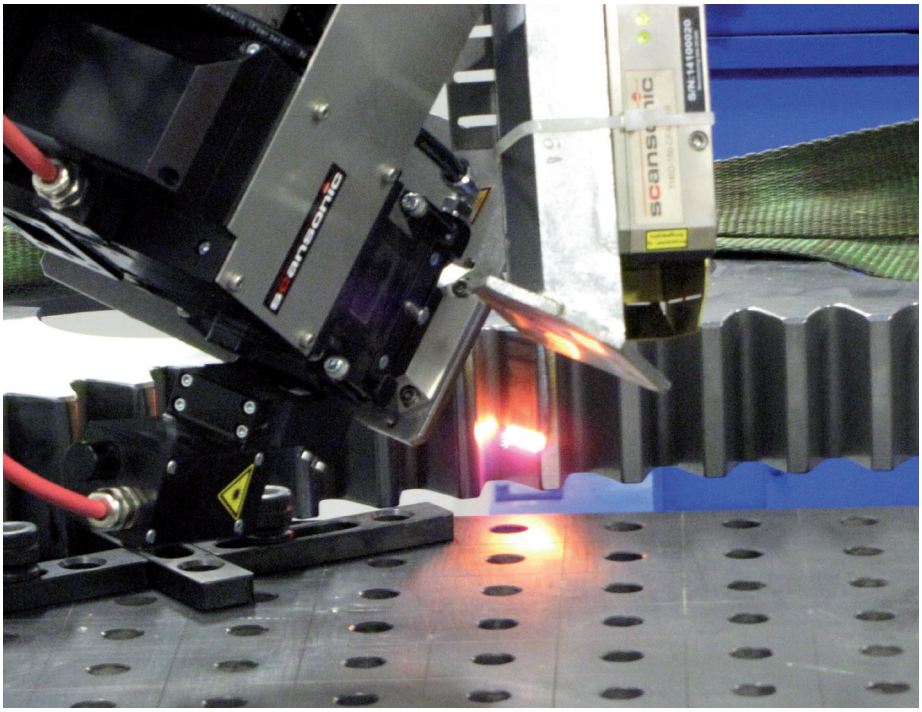


Due to thee scanning technology is the temperature controlled locally, which ensures optimal hardening temperature and prevents partial melting of edges.

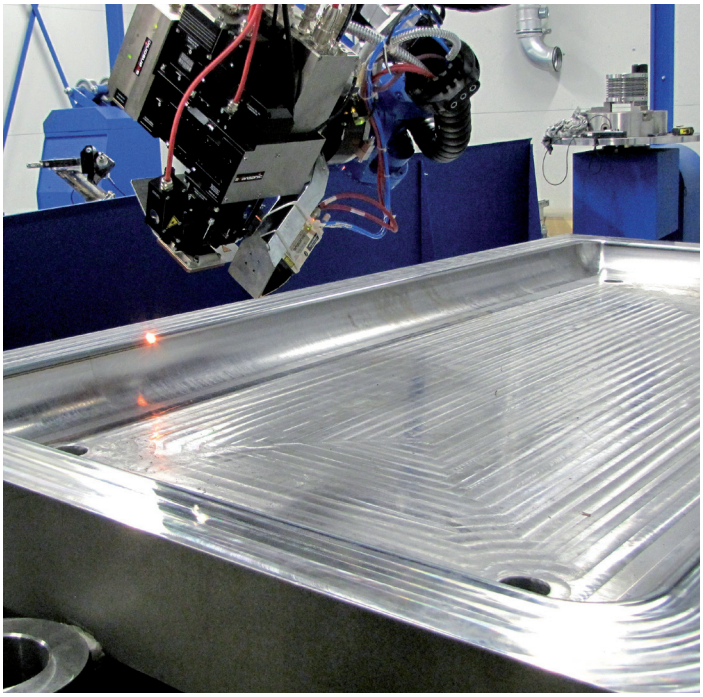


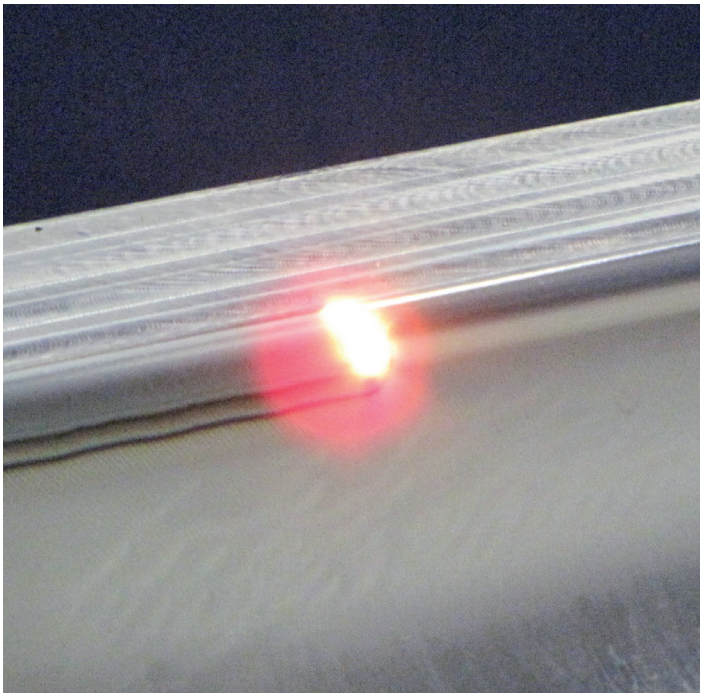
With scanning and focusing of the beam at a distance of 170 mm from the front of the head, we are able to harden cavities with the depth distance of up to 140 mm.





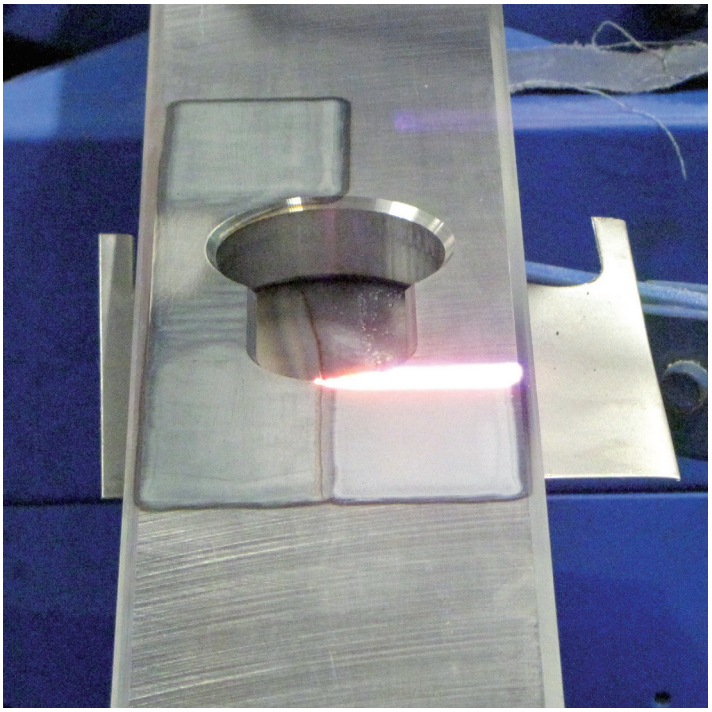
We can harden sides of toothing from a module of 4 mm.

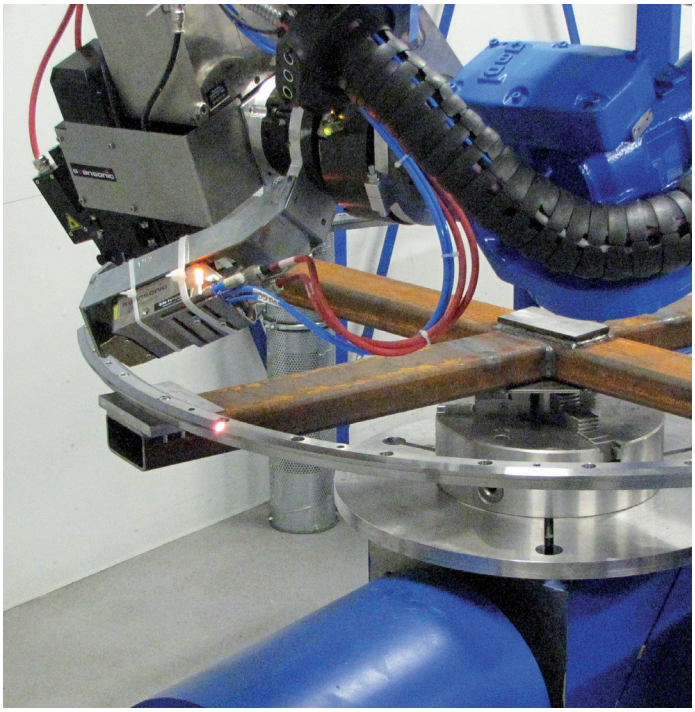




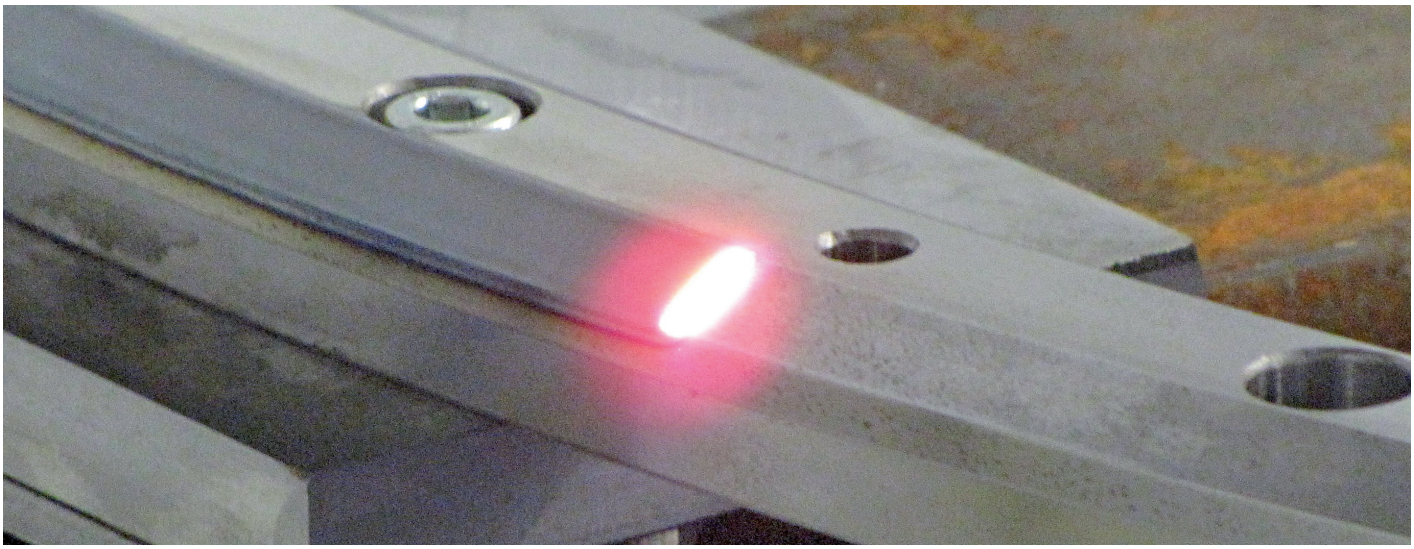
With a large working range of the robotized workplace, can be harden functional surfaces of large parts up to weight of 5 tons.

In case of hardening of large surfaces, the hardening strips are placed side by side.

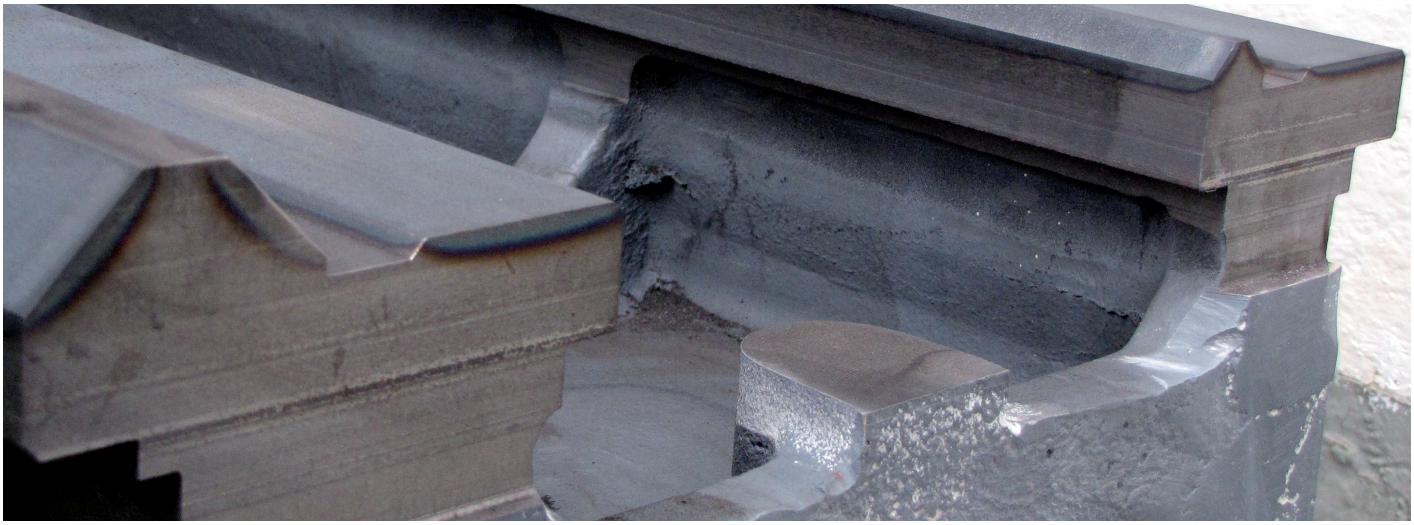


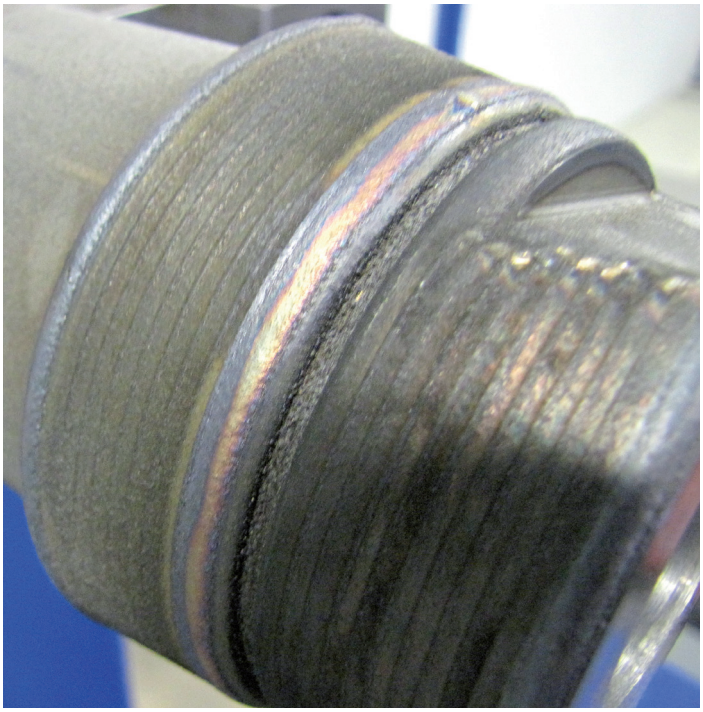


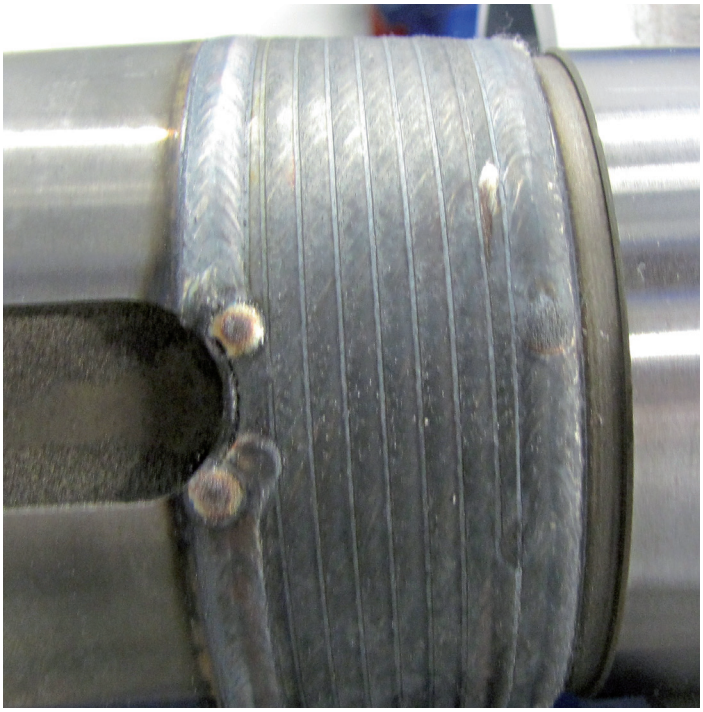
We are able to harden rotary parts of large diameters.



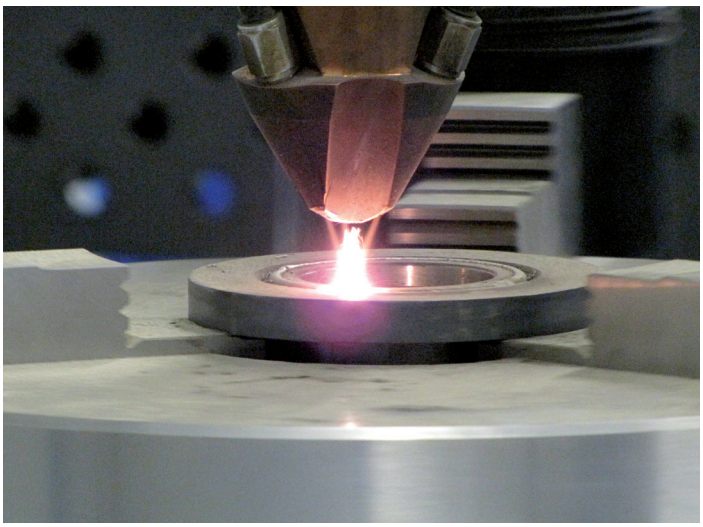
We can make laser hardenning on supporting elements of machine tools.



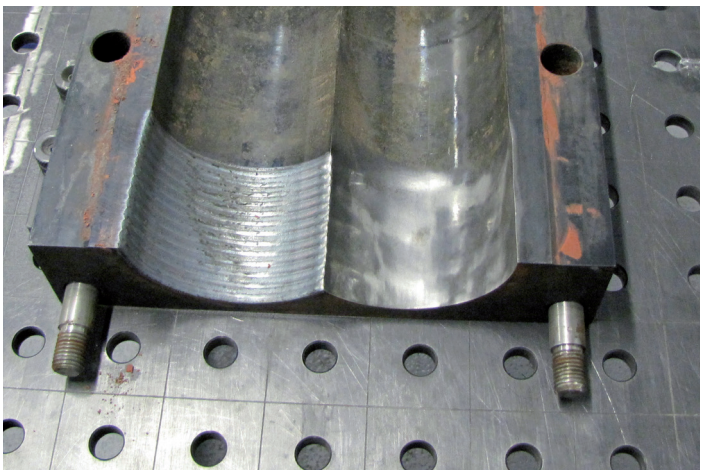


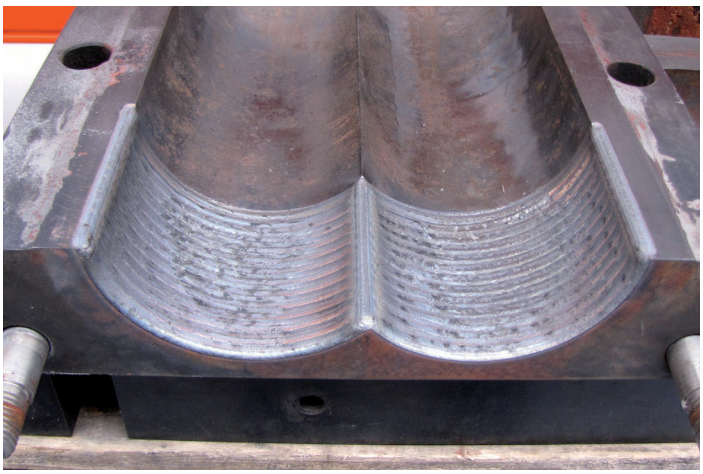


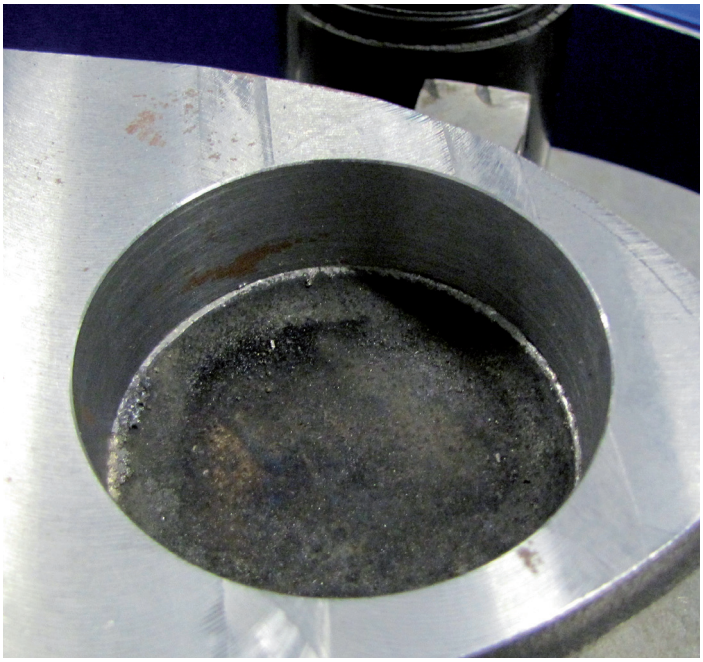
The technology of alloy cladding is suitable for repair of surfaces as well as enhancing of properties of surface layers in terms of increased lubricity, hardness, abrasion-resistance, improved cavitation, corrosion resistance, resistance at high temperatures and pressures, etc.



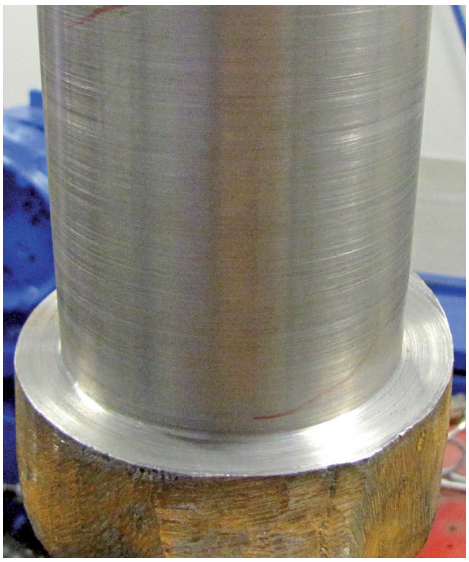
The six-axis robotic arm allows us to process components of complex shapes.
The technology of alloy cladding is used to repair worn parts of moulds and various other parts.

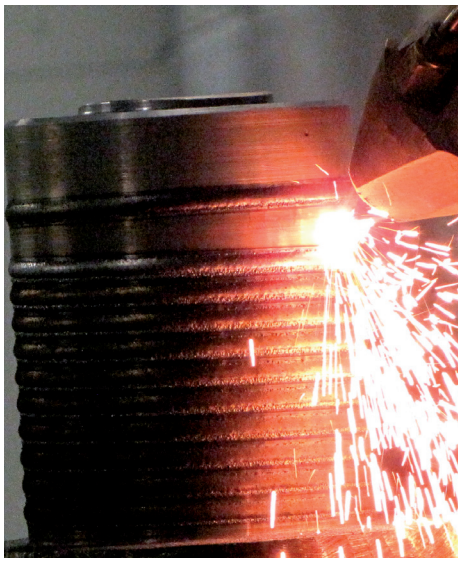






Surface cladding can be carried out on outer and inner diameters.





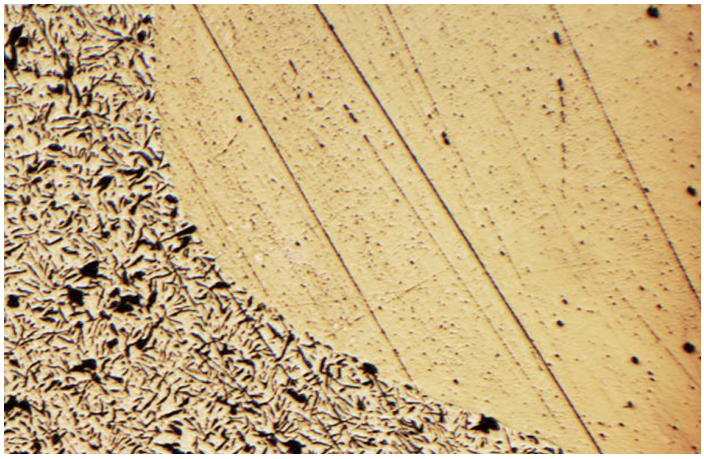
Welding of surface defects of grey and ductile cast iron using laser technology

Within the casting production in the foundries, some castings are rejected due to surface pores, sand holes, non-metal inclusion, etc. Annually, these rejects represent economic loss and decrease in profitability. Because of these reasons the foundries are looking for suitable repair methods. Many customers are concerned that the material properties of the casting will be affected by conventional welding and therefore, in their acceptance conditions, they do not allow that manufacturer repairs the castings. **The laser technology addresses effectively this major drawback of conventional welding methods.**

General description of laser beam welding technology

Additional material in the form of metal powder is fed via inert gas through three nozzles of the welding head into the space of the laser beam, which is also surrounded by inert gas (argon). The entire welding process takes place in a protective atmosphere of inert gas and due to the extremely high energy density of the laser beam the welding process is very fast and prevents the diffusion processes necessary for changing the structure of casting metal matrix. In comparison to the conventional welding method, the material of the welded component is not heated, so there are avoided internal stresses, which are causing cracks. In laser welding, no fluxes are used; the weld is perfectly metal clean due to the inert atmosphere. The robotic automatic arm provides excellent repeatability of the process. The arm range allows gradual welding of casting batch, which increases efficiency of the process.

Arc welding using E-S716 electrode (50%Ni), 4 layers, calking and brushing of each layer; waiting for the cooling of each layer – about 40 min.



Weld of laser technology without a transition region, time and course of the weld, see our video on YouTube – the link is below.

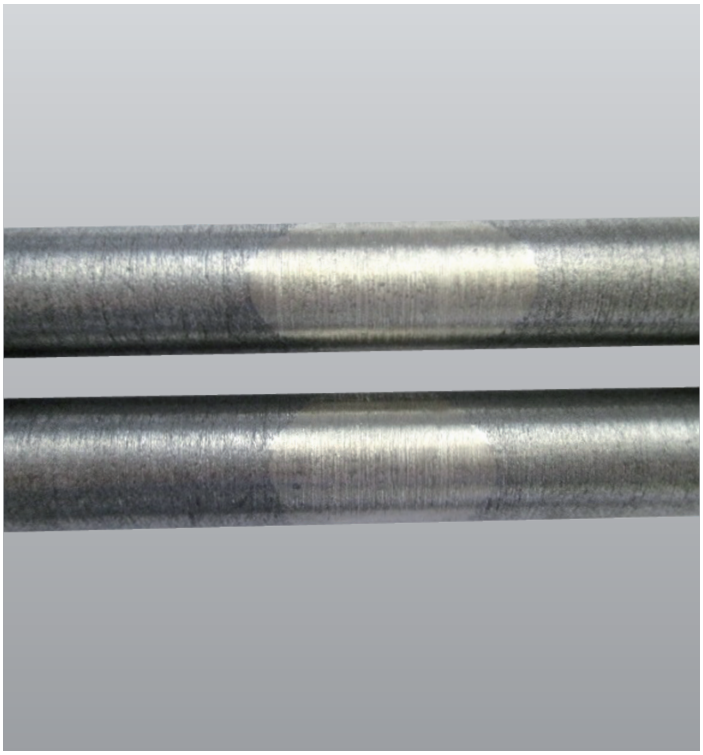
Mechanical properties of a weld formed by the laser technology

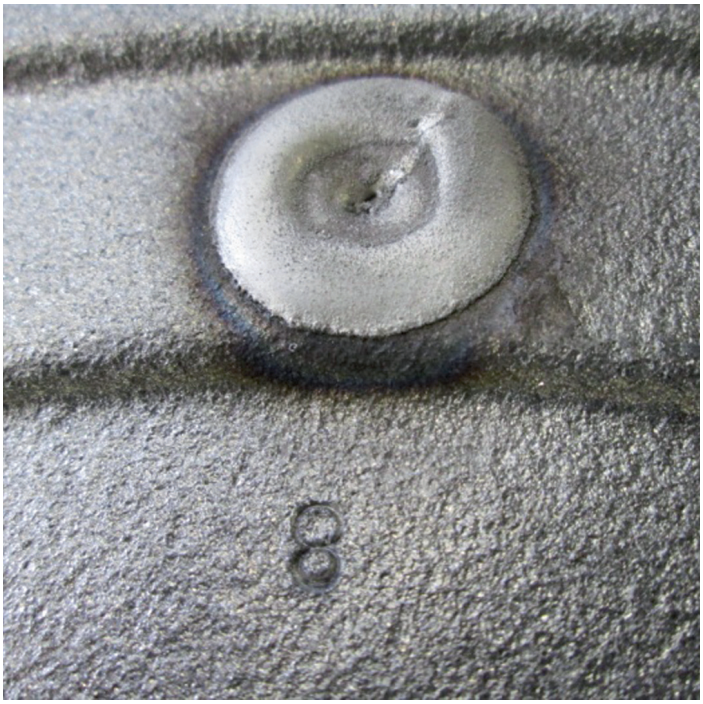
Mechanical properties of the weld and hardness of the additional material depends on used metal powder. Many types of metal powders from different manufacturers are available in the market, making it easy to select and test the metal powder according to specific requirements. We have verified the bond strength of the additional material with the casting, so that the conditions match the reality of the welding surface defect on the casting. A hole was drilled into the test block Y III made of the GGG40 material; the hole was then welded using the laser technology. A Ø 10 mm test specimen for the tensile test was designed so that additional material covers the fracture area.

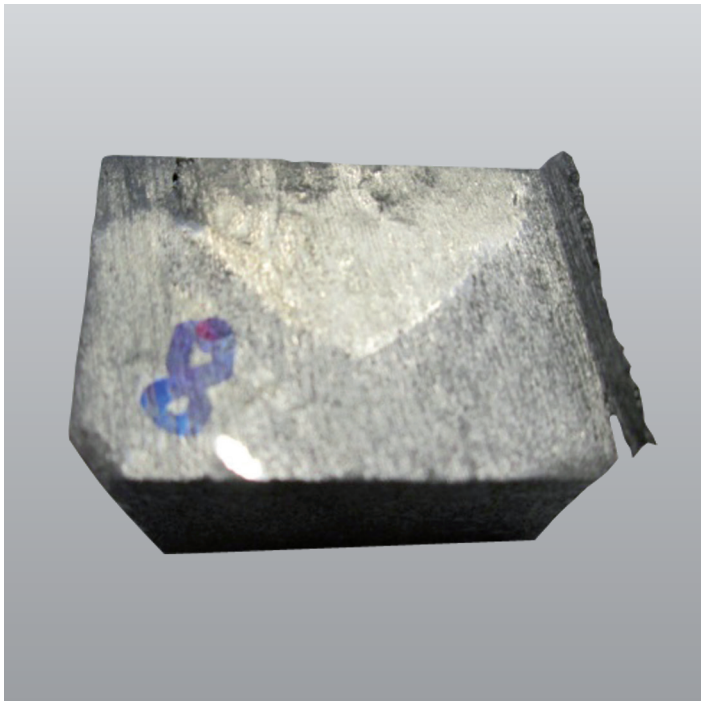
Measured values were:

Bar 1	Rm = 330 MPa	A = 3,0%	Rp = 285 MPa
Bar 2	Rm = 385 MPa	A = 4,5%	Rp = 260 MPa

Hardness measurements:	basic block from GGG40 HB 145	additional material HB 275, 229, 217
Machinability:	very good	





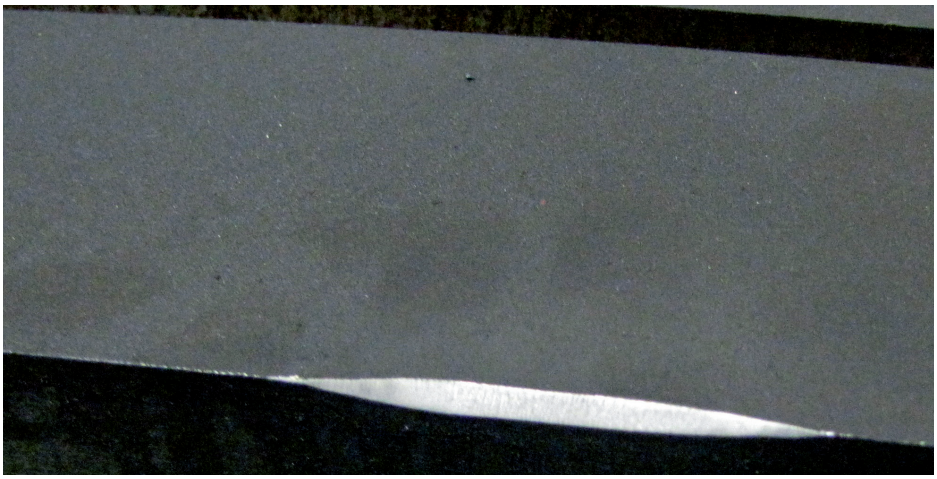


Conclusion:

Welding of the surface defects of grey and ductile iron castings using laser technology is a very effective process, allowing repair of extremely high quality without fear of thermal effects on the casting material and fear of internal stresses and related cracks in the weld vicinity. Achievement of specific mechanical properties may be controlled by suitable choice of additional metal powder. Due to high productivity, low energy consumption and high efficiency of additional metal powder, this progressive laser welding technology is easily affordable in relation to the price of defective casting.

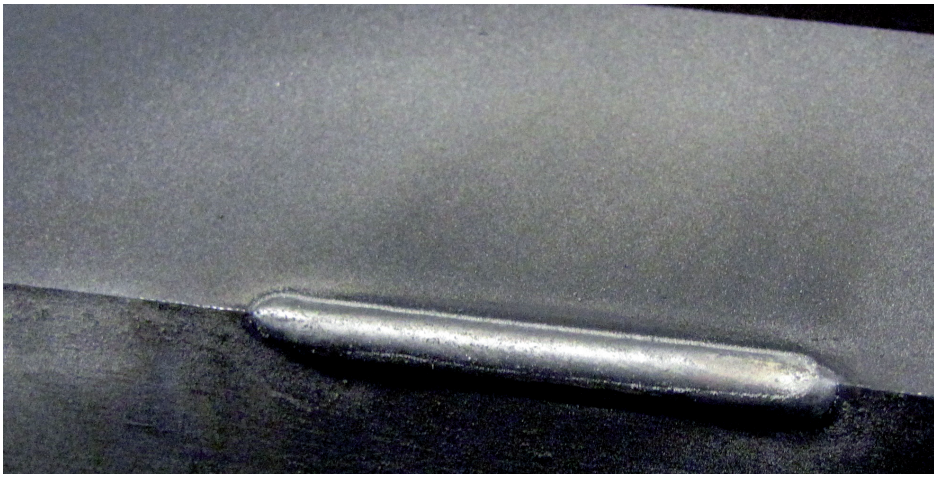
Presentation of laser welding technology can be found at: http://youtu.be/660_52Nxzz0

Repair of surface defects of iron in practice:

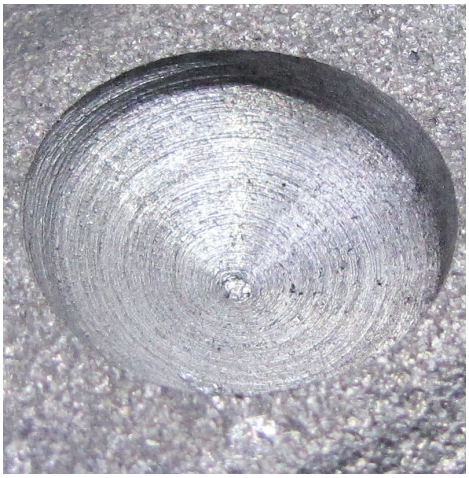


Before welding

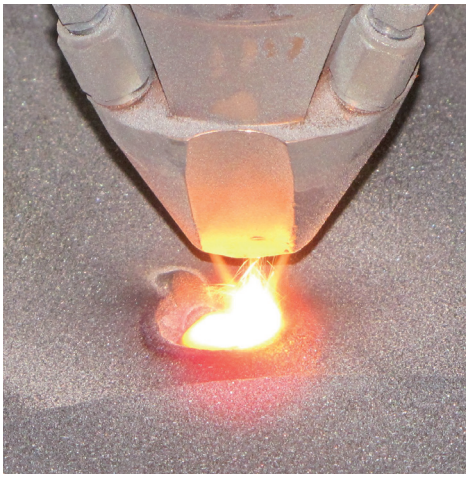
Preparing for weld by drilling



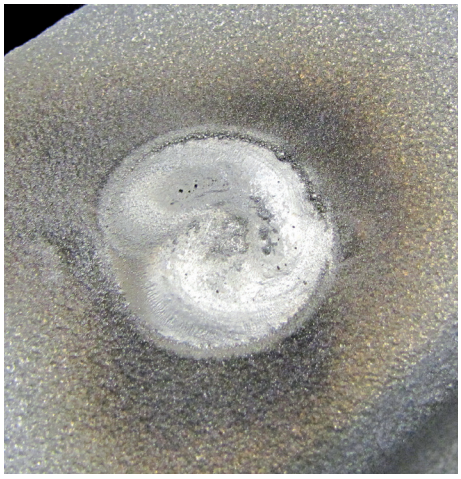
After welding



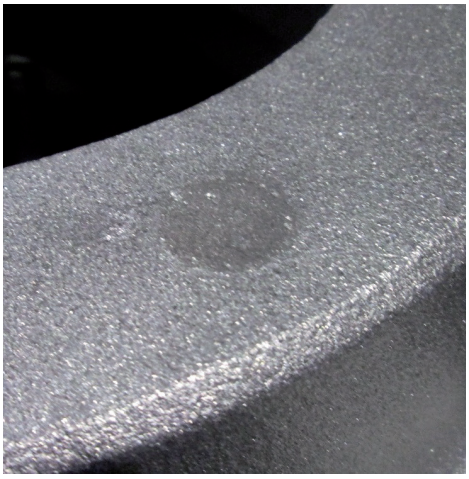
Surface before welding



Welding



Welded defect



Final appearance after repair

Video-presentation of iron casting repair using laser welding technology can be found at: http://youtu.be/ify2WgctZig

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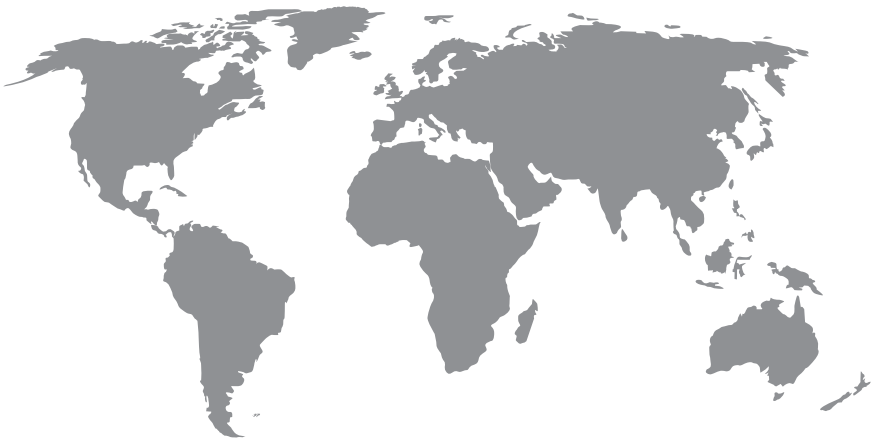

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