Longer lifetime for parts and tools?

Shorter manufacturing time?

The solution is LASER.

Our defect analyses of breakdowns of machine parts clearly show that in almost every case the initial deterioration in material properties – such as cracks, abbrasive wear, fatigue from repeated plastic deformation or repeated temperature alteration, cavitations from chemical dissolution etc. - appears on the surface first.

So the material properties on the surfaces have a greater infuence for the structure of the whole part then those inside the material have.

It is very likely that the reinforcement methods of surfices, enhancing their material properties, will gain priority over methods improving material properties both inside and outside the material, like volume heat treating or the manufacturing of the parts from great amount of more and more expensive matrials.

These days, one of the most modern method of surface hardening is the laser heat treatment. With this laser hardening process we can make the useful lifetime of machine parts – for example active and passive elements, rolling, sliding, pressing, cutting etc.components - with great friction, pressure, fatigue explosure lasting longer.

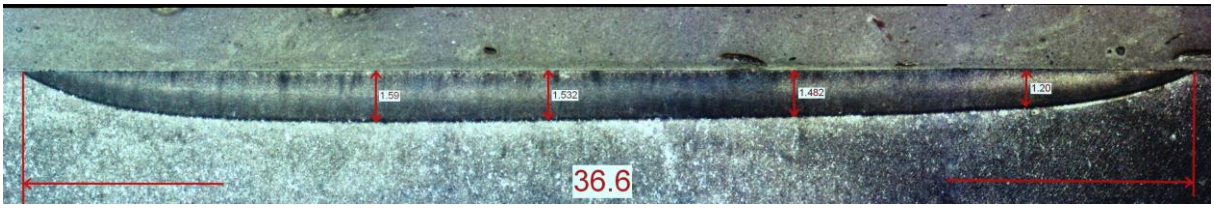
Advantages of laser hardening

- applicable for all hardenable materials
- hardened track width from 5 mm up to 70 mm, depth of hardened layer app. 0.8 – 1.5 mm, depending on material
- low distortion through very selective, high energy input during extremely short time
- after grinding or machining is not necessary
- temperature measurement and accurate process regulation possible
- fully repeatability, hardening temperature on the work piece surface is adjustable within + / - 10 °C
- quality control during the process of hardening with data storage
- selective hardening of work piece surfaces lead to hard surface with tough core and unaffected areas in the immediate vicinity
- oxidation free hardening without annealing colors is possible by using protection gas
- low modification of surface roughness

Costs and environmental sustainability

- low energy consumption due to short heating times and high efficiency
- very low power need of whole installation compared to induction or volume hardening
- self-quenching process by heat conduction in the material, so no additional media like water or gas are required

Robotic arm holds the laser source with heat camera and optics. The shield gas protects agains oxidation. The working stretch of the robotic arm is 3800 mm x 3800 mm.

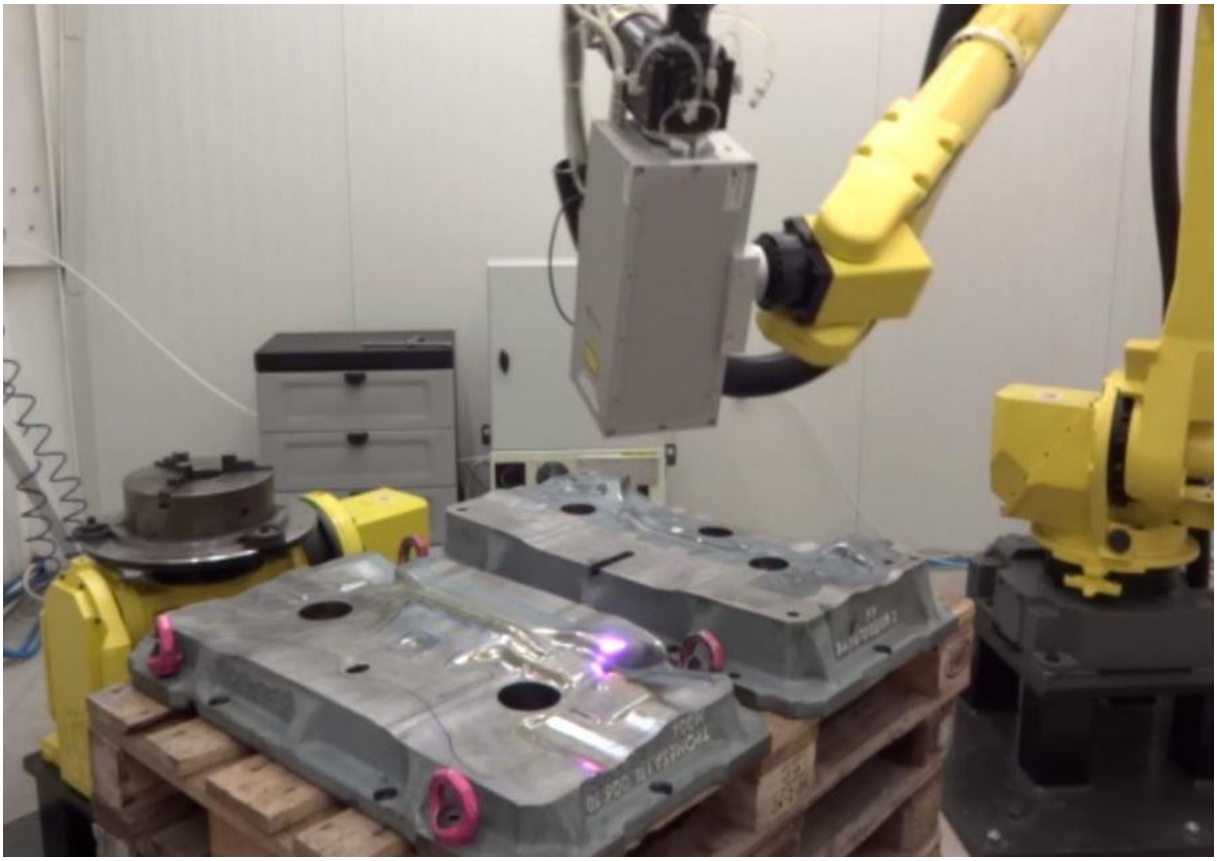


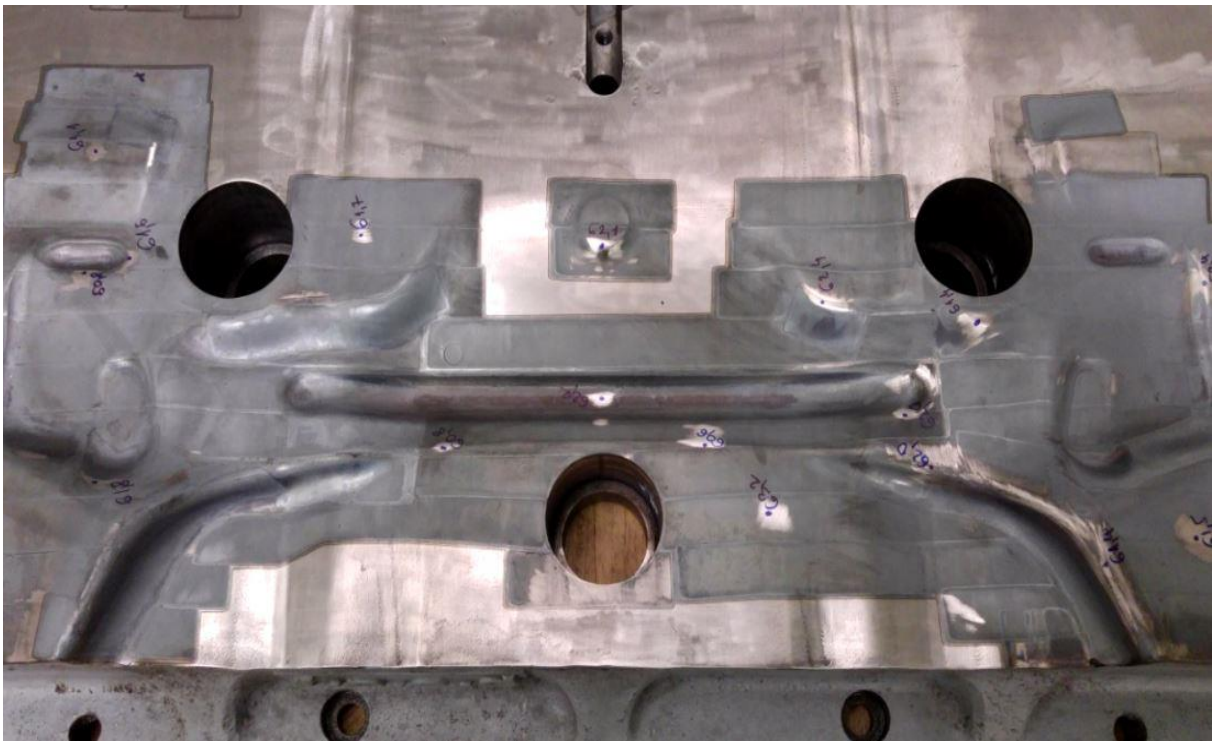
The geometry of heat treated zone. The track width of hardened zone can be from 5 mm up to 70 mm, depth of hardened layer app. 0.8 – 1.5 mm, depending on material

To mention some application examples, in the cases of large series automotive steel plate cutting and forming tools it is basic requirement for the tools to be resistant against the wearing effects of steel plates and not chipping at the cutting edges while int he case of turbine blades the most important is to be resistive for the high temperature change and not to respond to the erosive effect of high pressure steam by forming cavitations.

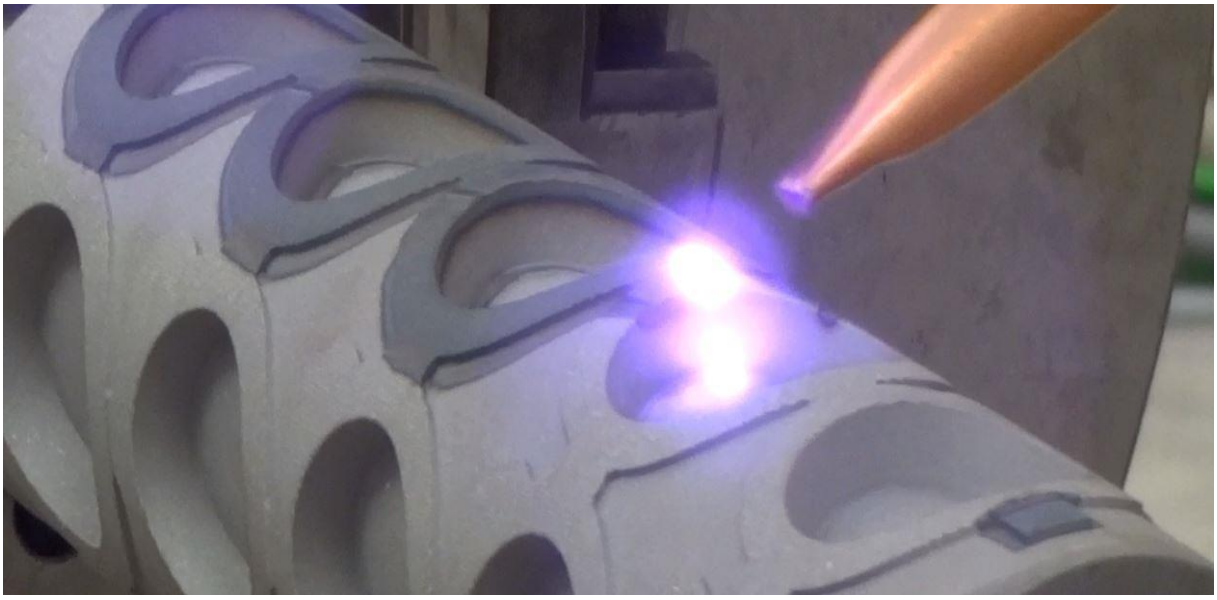
Heat treatment of radiuses of deep drawing tols for automotive applications

The surfice hardness and resistance against wearing and chipping can be improved by laser surface heat treatment. If the material properties will be improved where it has to be improved only, the manufacturing cost can be lessen signficantly.

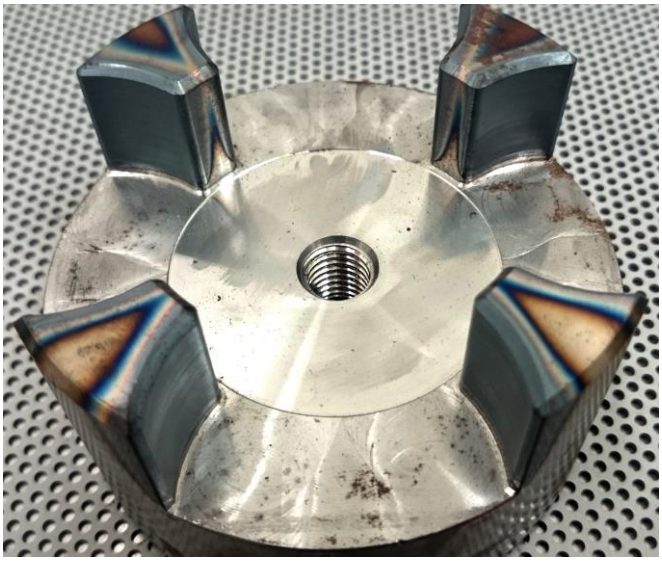




Heat treatment of large working surface of deep drawing tool for automotive industry



Hardening of working surfaces of a sealing roller for herbal tea bag packaging machine

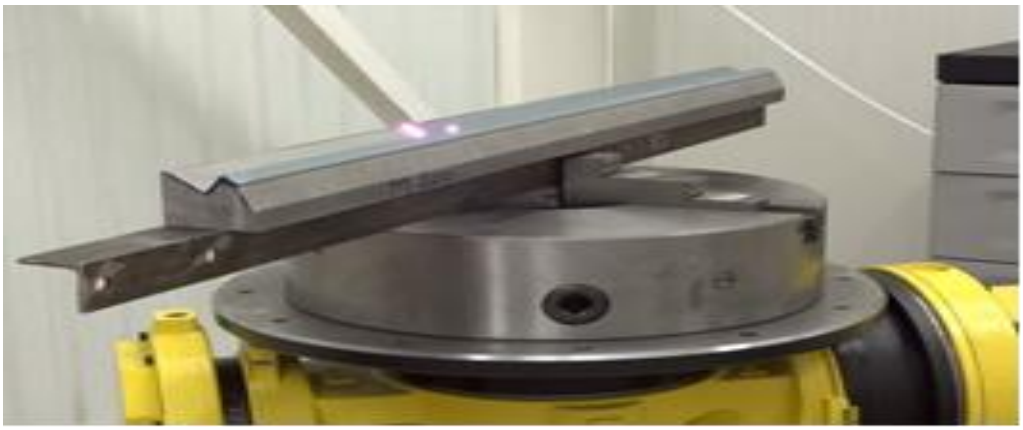


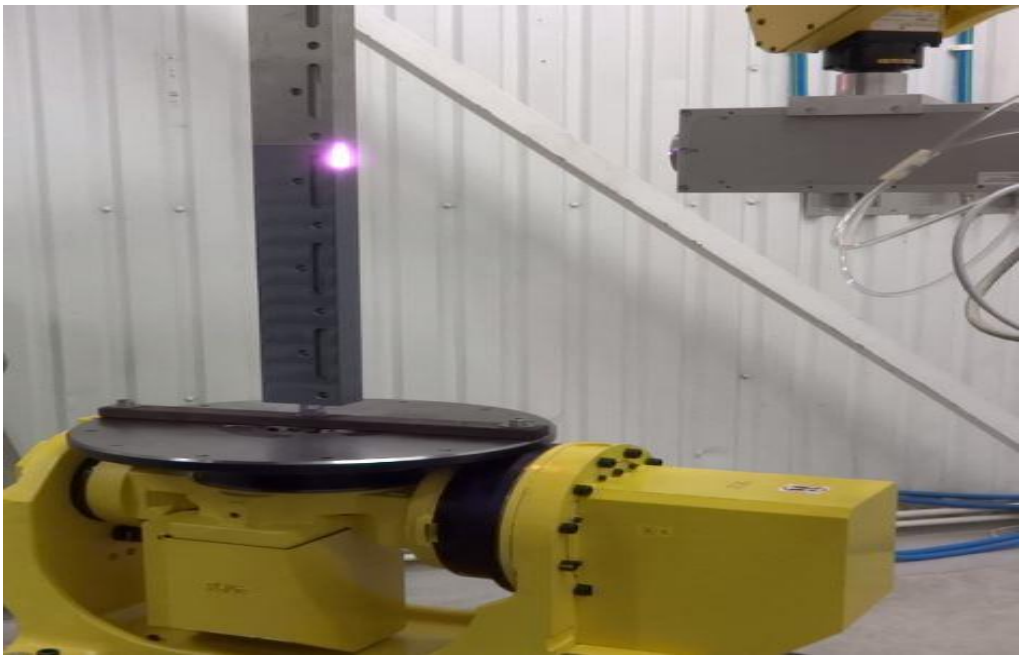
Heat treatment of teeth of a coupling part

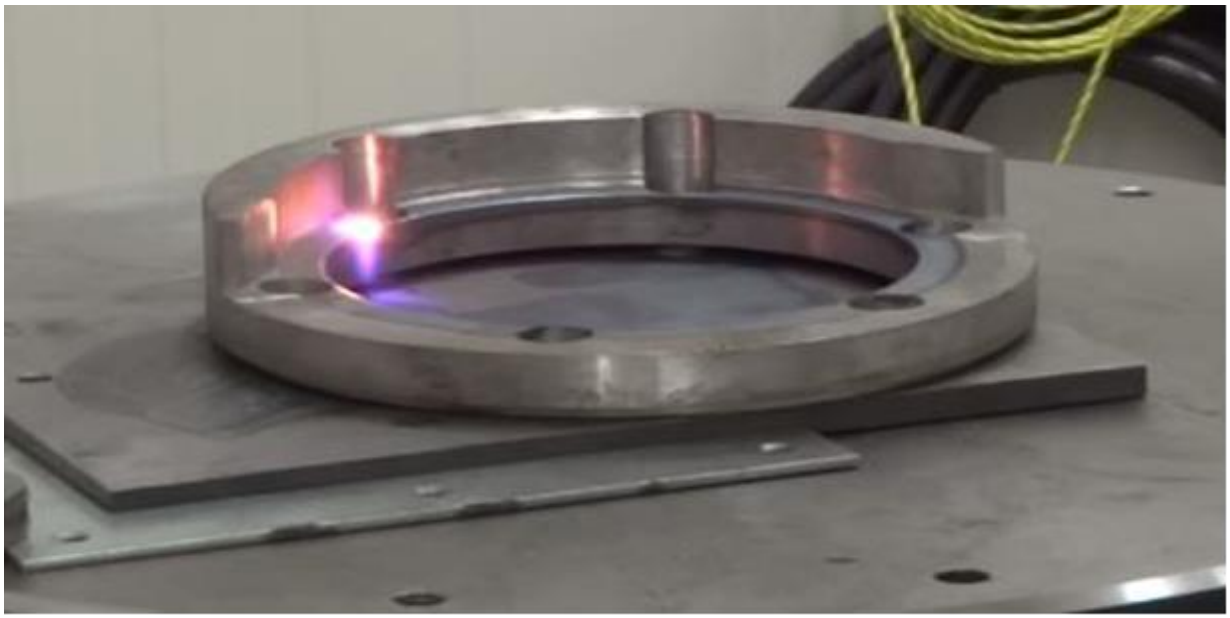
About the laser technology in manufacturing of parts and tools in general

The main methods of material processing can be reproduced by using laser technogy.
But in practice it has only advantage to use laser technology when it comes about the need of extremely high power density and very short working time and very selective power deployment and the usual technology is not suitable or not effective enough.
Just imagine that it is possible to heat material within a couple of tenth of seconds or even in milliseconds from room temperature to melting point of metals.

So it can be uncomparably useful when it comes to a special need for extremly high concentration of high power within extremely short time.







Heat treatment of mixed parts

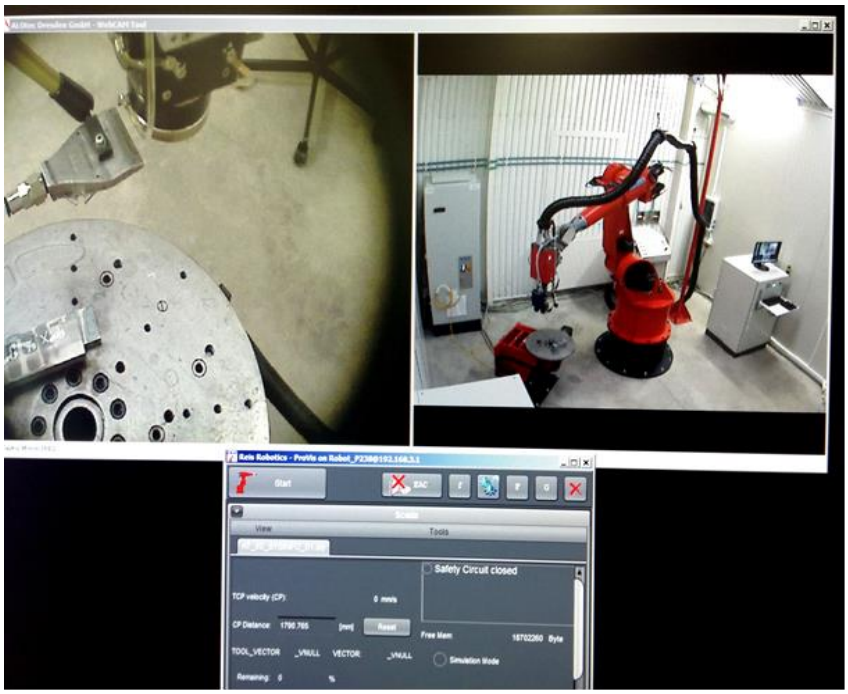
The principle of laser heat treatment

The Laser heat treatment process means that heating power is applied to the surface by a specially designed apparatus which comprises a laser source, connections and optics, a robotic arm and controlling elements, to produce, place and control high power energy to the working place. The goal of every kind of hardening of hardenable steels is to reach the necessary cooling speed to cool the heated steel down so fast that the martensitic material structure will form.
In normal way at the quenching process the cooling media makes the material cool down. But in the case of laser hardening there is no quenching media applied other than the core material behind the heated outer layer itself and the cooling will be done actually by the mean of heat transfer into the core of the material.
Through this very fast and concentrated way of heating and cooling of the outer layer of the material, any distorsion and deformation of the working part can be fully avoided, so it is highly advisable to apply this Laser hardening process strictly to fully finshed parts.

It comes from the above mentioned that after the Laser hardening process there is no need for maching, after grinding or any usual finishing rather then removing a very thin –thickness of some microns –layer by polishing if polished surface is needed forming because of minor oxidation during the process. This oxidation can be minimalised by the use of protective gas but cannot be totally eliminated.

The process of the laser hardening can be repeated many times on the same part with the remainig effect of the last process.

The process also can be reproduced be recorded parameters and every parameter during the process will be stored.



The control display

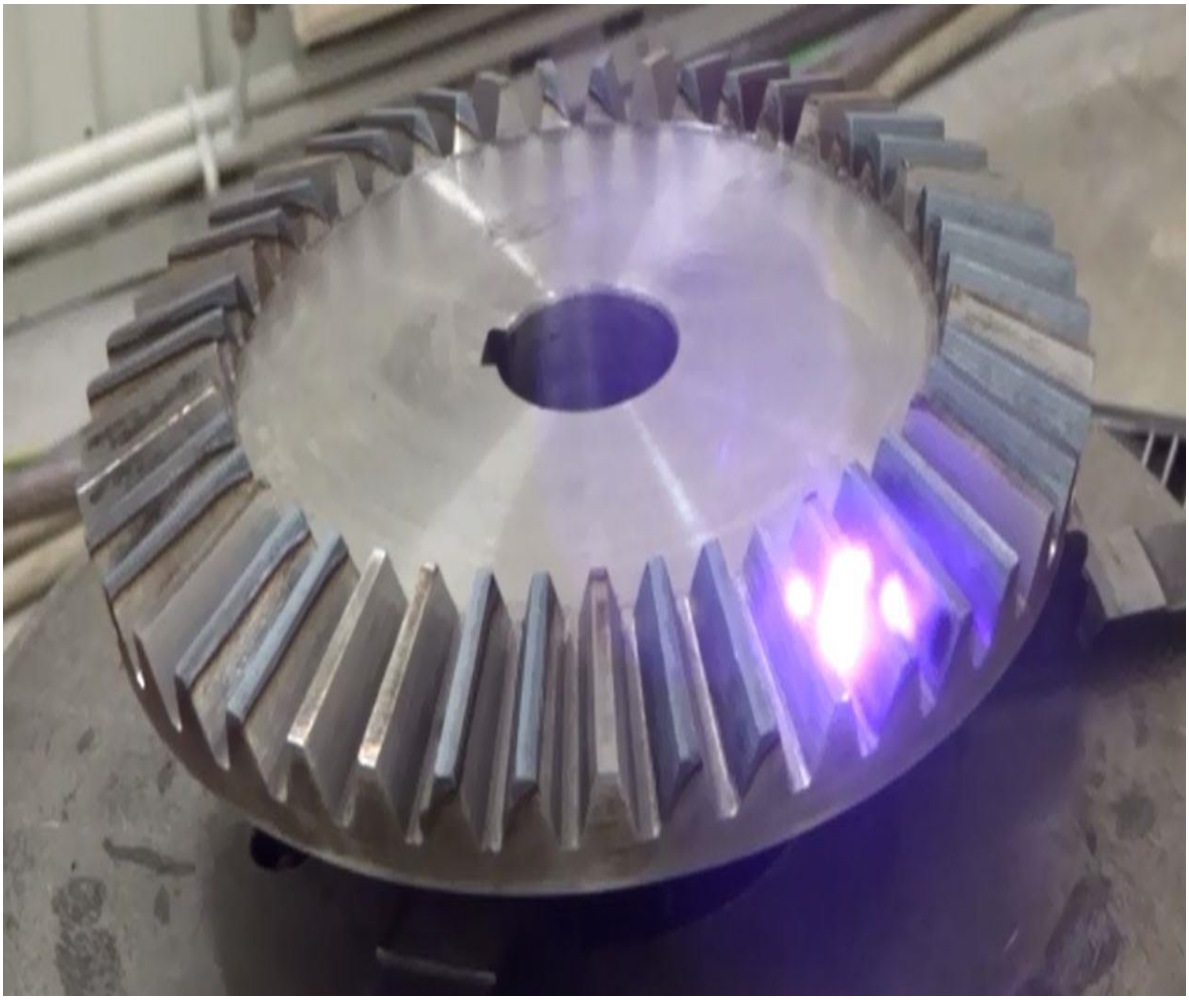
Hardness values

In the case of laser hardening the goal of the process is the attainment of the highest possible hardness with the exeption of a very few cases when a special – not the maximum - hardness is needed

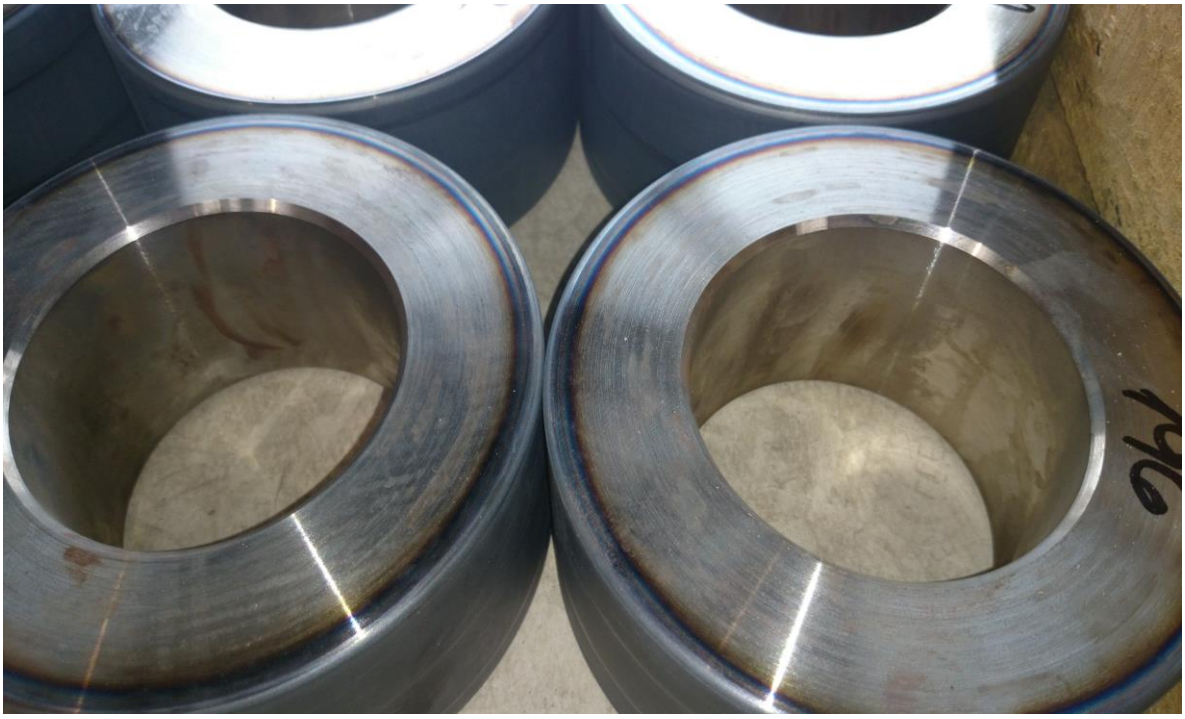
The depth of the hardened layer is between 0.6 and 2 mm depending on material and geometry, but in most cases between 0.8 – 1.5

Usual hardness for some common material:

Cast iron	66-67 HRC
C45, K110	60-64 HRC
S235, BC3, Stainless Steel	46-50 HRC



Hardening of a cogwheel



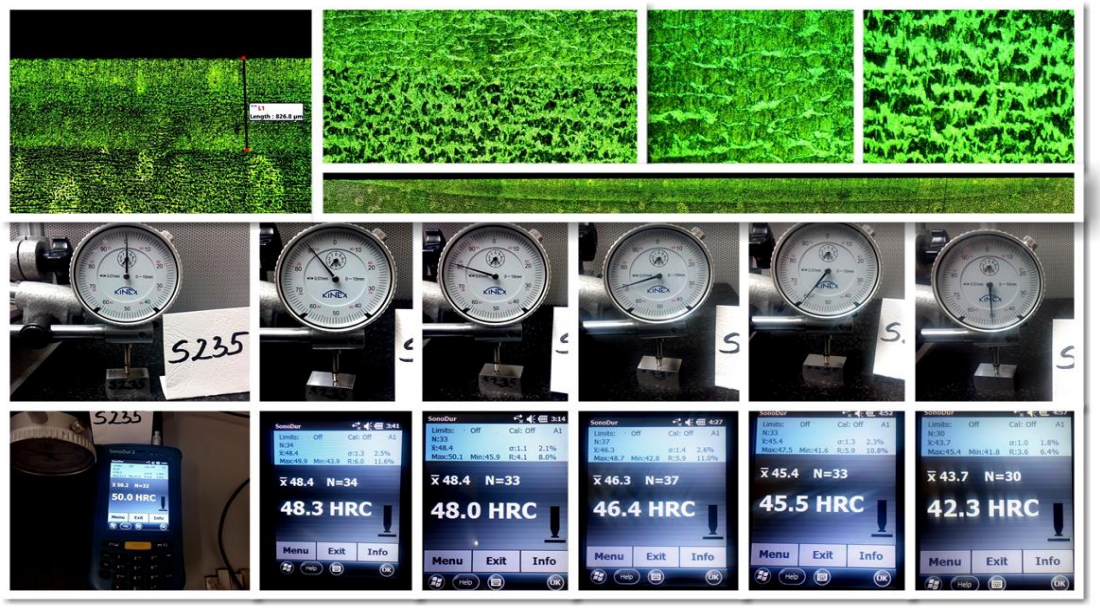
Hardening of rings

Hardening of cutting edges of an automotive tool

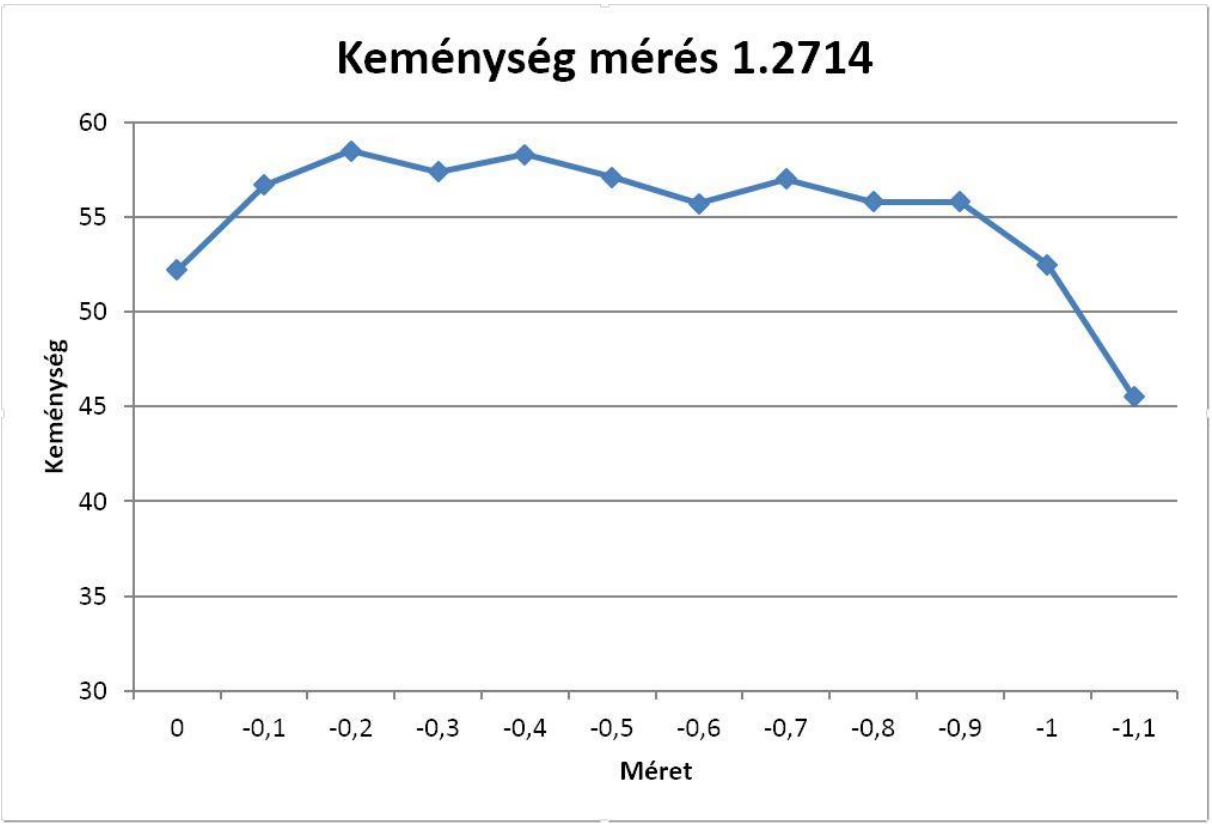
Quality check in he laboratory

We have the capability to check the hardnes by many kinds of measuring methods including more types of ultrasonic testers leeb testers, Rockwell tester and calibrated scratch pins. The depth can be measured by microscope after making prepared sections for measurement.

Metallurgical laboratory

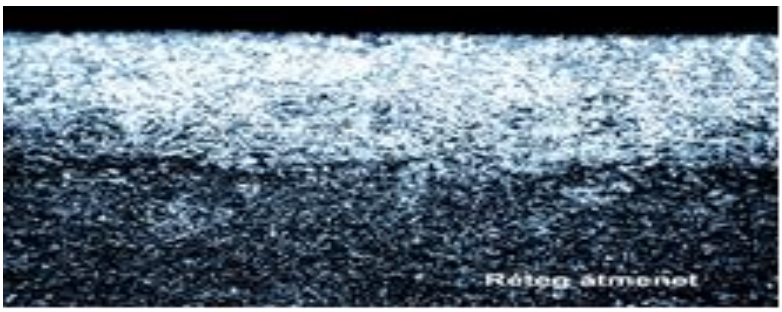


Layer by layer hardness measurement



Hardness diagram

Hardened layer of a cuttig tool 1.5 x 17 mm

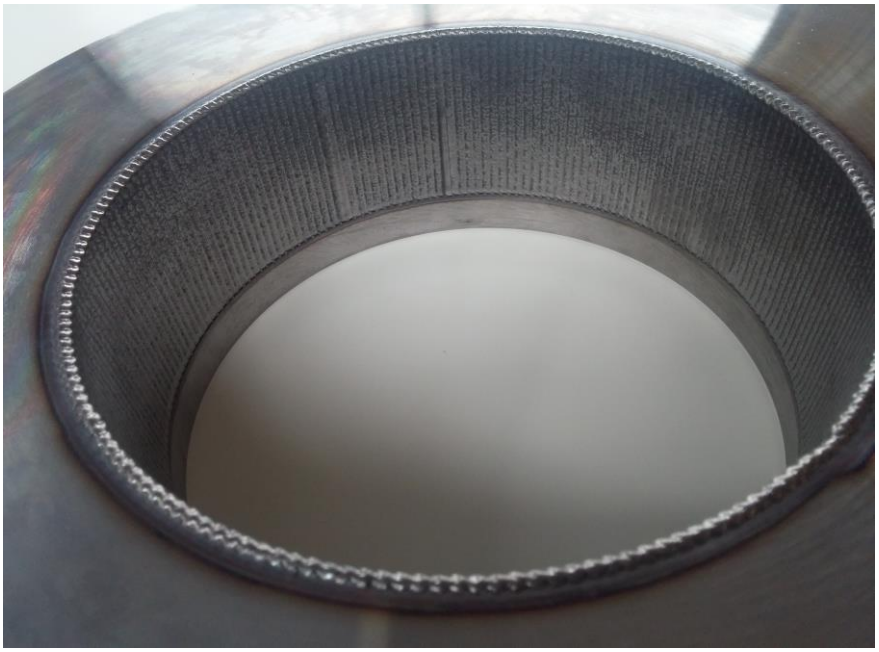


Material structure transition

Laser up-welding

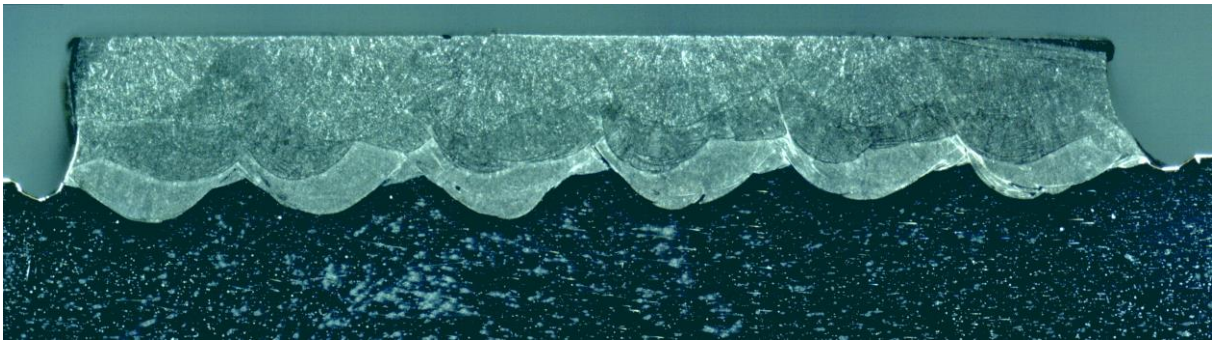
By the use of laser technology a very effective way becomes available for repair or making new surface levels on metal parts.

Repair of shaft

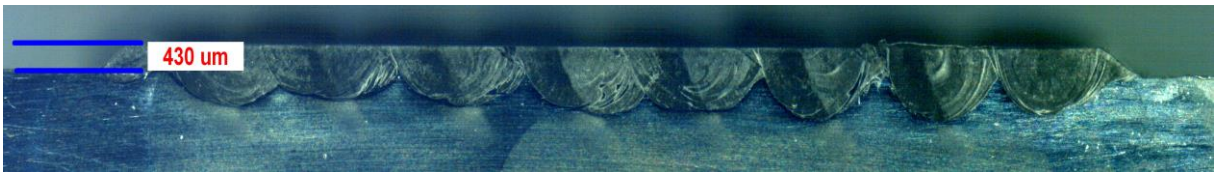


Repair of inner side of a wheel

Sample welding



Sample welding for demonstration of forming of different layers
Base material is stainless steel, up-welding material is C45



Sample welding for demonstration of forming of different layers
One layer welding, different base material and up-welding material

Sample welding for demonstration of forming of different layers
Two layers welding, different base material and up-welding material

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