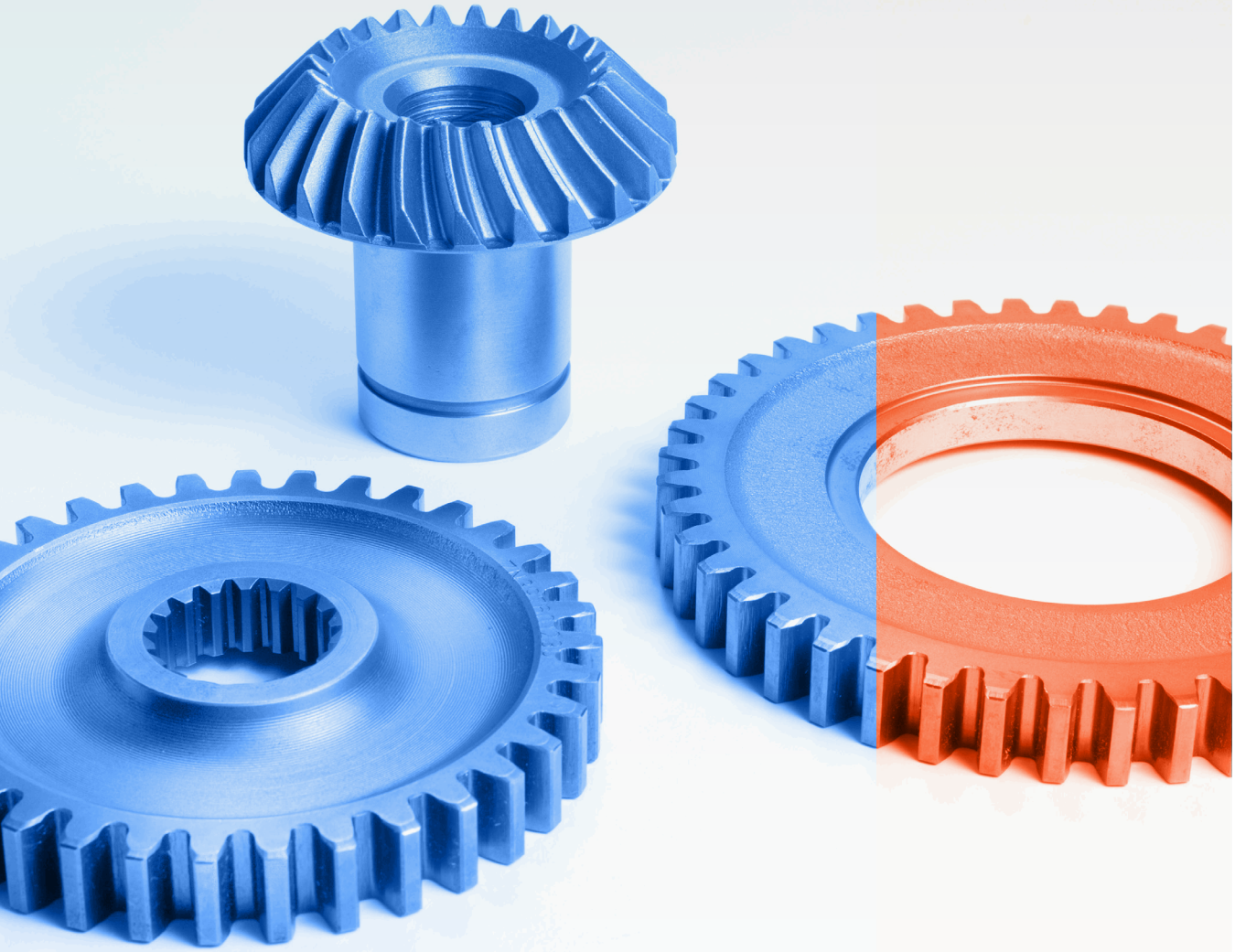
Thermochemical processes I Heat Treatments



Carburizing / Carbonitriding

Surface hardening of Steel

High wear resistance

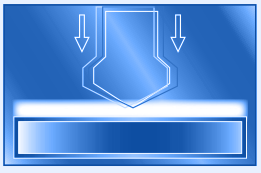
Increased mechanical properties

High stability

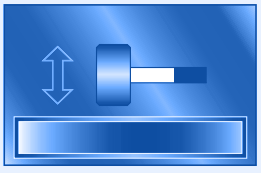
Improved fatigue strength

High surface hardness

Improved ductility



Increased impact resistance



High resistance against impacts

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Carburizing / Carbonitriding

Surface hardening of Steel

What is case-hardening?

Case-hardening is one of the thermochemical processes. During this process the edge of workpieces is enriched with carbon (carburizing), or a combination of carbon and nitrogen (carbonitriding) to improve the mechanical properties of the edge layer of the workpiece. Typical case hardening steels include a carbon content of 0.10% to 0.25% carbon and are easily machined in soft state. The alloyed case hardening steels contain chromium, nickel and molybdenum as the most important elements. These increase significantly the hardenability of steel.

How does case-hardening take place?

Case hardening typically consists of three steps In the first step, workpieces are exposed to a carbon and/or nitrogen emitting environment. This increases the carbon and/or nitrogen percentage at the edge of the workpiece. The carbon profile and the penetration depth depend on the time at temperature, the amount of supplied carbon, the temperature and the kind of steel used.
In the second phase, quenching (hardening) takes place. This can be performed directly from the carburizing temperature, or after an interstage cooling or new heating to a new material-specific curing temperature. In order to minimize distortions, it is also possible, instead of directly in cold oil or water, to quench in oil or in a warm bath.
The third step is tempering and mainly serves to diminish the highest stresses in the structure and to diminish the grinding crack sensitivity. If required, a deep cold treatment is possible. In this case, the workpiece is cooled to temperatures far below zero (at least below -80 °C) in order to reduce the residual austenite percentage and thus improving the dimensional stability after hardening.

Process Variations

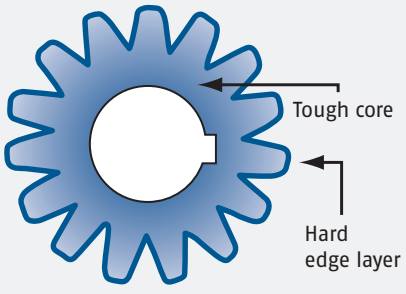
In both carburizing and carbonitriding, the chemical composition of the workpieces and the structure of their edge layers changed. Combination and carbonitriding is performed in liquid and gas media. Contrary to carburizing, carbonitriding reaches higher hardness and higher hardness penetration depths (Case hardening depths) in unalloyed steel types. For both variations, different techniques are available such as in-and-out furnaces, conveyor-belt furnaces, low pressure installations etc., and further it is also possible to partially to case-harden due to appropriate insulation techniques. The repeatability of the processes is achieved through continuous monitoring of the process parameters.

Case Hardening Depth

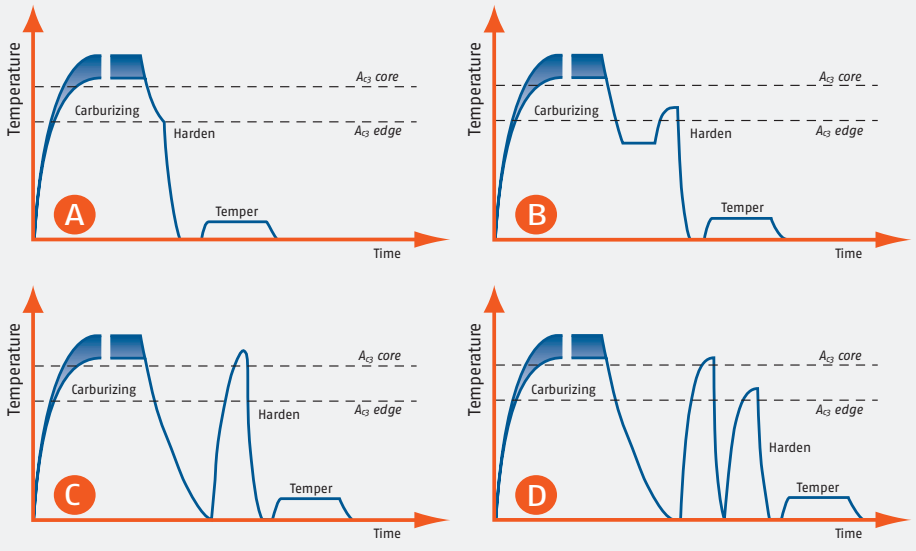
The Case Hardening Depth, in short CHD or EHT (Einsatzhärtetiefe), is the vertical distance of surface, where hardness has decreased to a defined value (core hardness + 50, HV1). The case hardening depth with its corresponding border hardness and test load must be agreed between the customer and the heat treatment company, depending on the material and the application, in conformity with the applicable standard.
The case hardening depth is measured by means of a destructive research to the product or the provided test piece.

Properties

- Higher wear resistance
- Higher surface hardness
- High toughness
- Improved resistance against fraction
- Improved fatigue strength
- Partial hardening possible



Graphical representation of a case-hardened component



Possible temperature-time paths when carburizing

- A *Direct hardening*
- B *Single hardening*
- C *Hardening after isothermal transformation*
- D *Dual hardening*