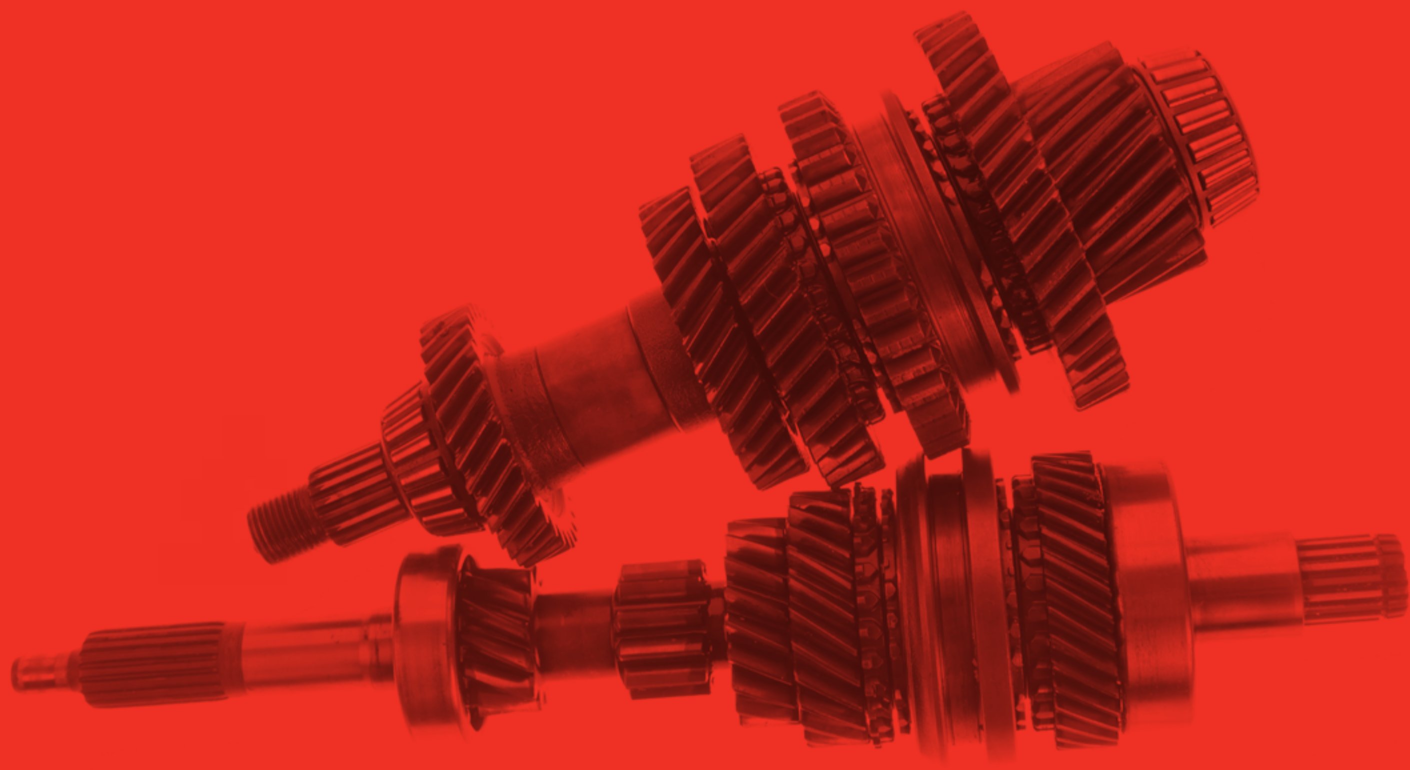


WHITEPAPER

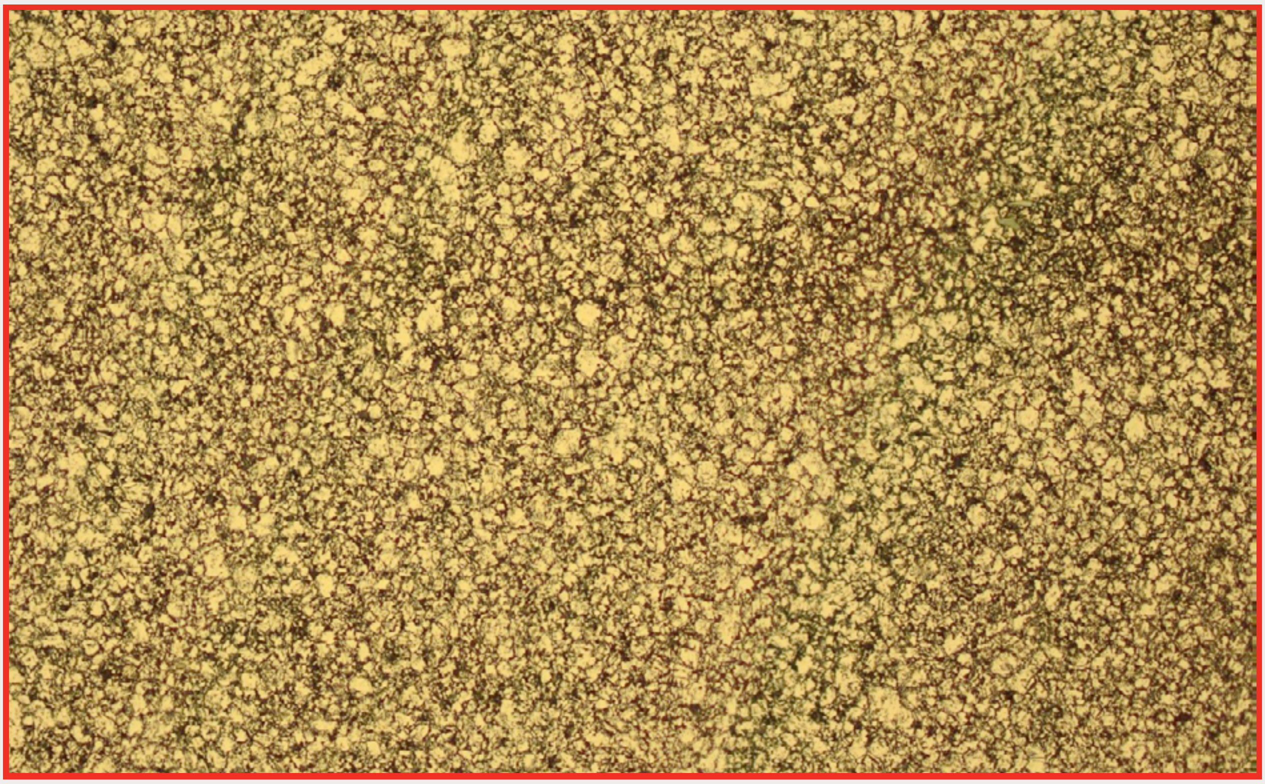
Austenitic grain size control
in MnCr case hardening steels for gears and shafts

sidenor

Any power driven machine does require a determined ratio between its operating speed and that of the engine/motor powering it. Such ratio is provided by means of a contraction composed of one or several pairs of gears linked to shafts, we call this device reducer or gearbox.

This type of gears/shafts were usually manufactured out of highly alloyed case hardening steels (such as 18NiCrMo7-6) but the current trend is to reduce the use of alloyed materials in their manufacturing.

Traditional steels used for car transmissions with MnCr alloy are one of the options under consideration. These are medium alloy steels therefore much more price competitive than their highly alloyed brothers.



Fine and homogeneous grain size following simulation of case hardening heat treatment.

In general terms one of the critical manufacturing aspects of these components is to keep an adequate grain size even after case hardening (960ºC, 80h) has taken place. The life fatigue properties of these components depend a lot (among other steel manufacturing parameters such as inclusionary cleaning and mechanical properties) in obtaining a fine grain size after case hardening (see picture below).

As is well known, the austenitic grain strongly tends to increase under case hardening temperatures and long processing times. In general steel manufacturing techniques for grain size control by means of microprecipitation present limitations when applied to MnCr steels as opposed to nickel and chrome alloyed steels.

The ferrite-perlite properties of MnCr steels usually lead to more abnormal grain increases than the bainitic properties of nickel/chrome steels. These difficulties increase when the parts originated from bars with diameters over 100m, and mainly show up on the surface.

Sidenor has a product/process design which can ensure a stable austenitic grain size in the entire bar diameter, including the median surface:

- Precise adjustment of chemical composition.
- Improved forging and rolling processes