WHITE PAPER

Development of steel intended for the manufacture of a direct use steering worm

sidenor

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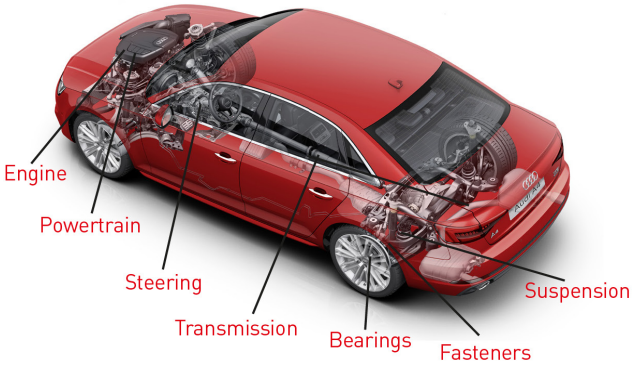
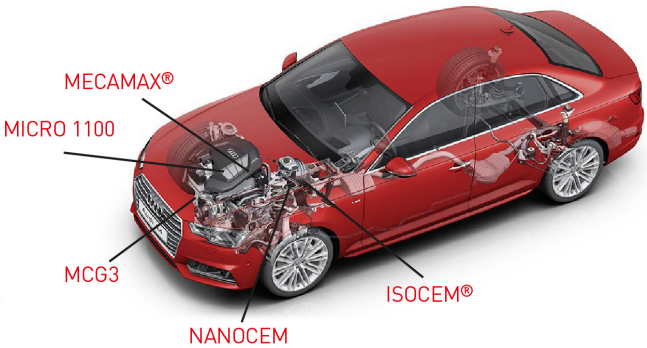
Within the framework of the Hazitek programme, under which aids are granted for supporting the implementation of industrial research or experimental development projects in the Autonomous Community of Euskadi, Sidenor and Cie Alfa Deco have carried out a common project focused on designing a steel intended for the manufacture of a steering worm for direct use, that is, whose proper performance does not require any thermal or surface hardening.

A steering worm requires high mechanical properties which ensure a proper transmission of the steering effort to the wheel, eliminating any possible risk of breaking or deformations.

The standard method for improving the mechanical properties of a steel consists in applying a hardening and tempering treatment to the material, but this process makes the part more expensive and favours the generation of distortions and oxidations.

At national level, the manufacture of the worm implies a significant machining process and high costs; for this reason, it is essential to ease the machining of the material intended for this purpose by adding machinability enhancing elements (fundamentally, the S) which enable the lubrication of the material and increase the fragment ability of the chip generated in the cutting tool.





To conclude, the worm is a slender part which is subject to deformations after machining. Due to the narrow geometric dimensions required by the car, straightening operations must be performed after machining. The new material intended for this part must have a structure that is as neutral as possible in terms of residual stress, in order to minimise twists, and thus reprocessing times, as well as related rejections, in order to comply with the geometric dimensions.

This project, which was carried out over two years, aimed at designing the process/product of a material for the worm which does not need any hardening process by means of thermal treatment, enables a proper level of machining and minimises residual stress.

During the development of the project, different variants of chemical compositions, which are all based on micro-alloys (V, Nb, Ti...) as well as different patterns of solidification and rolling processes (casting speed, solidification temperatures, secondary cooling flows, soaking temperatures, removal of scale...) were tested. The selected design combines the following elements:

- Required mechanical properties:

Parameter	Target values
Breaking strain [Rm]	830-1020 MPa
Yield strength [Re]	>500 MPa
Elongation at break [A]	>10%
Brinell Hardness	245-301 HB

- An adequate behaviour against machining, that is, a level of machining comb wear which enables the production of 100.000 parts without need for replacement.

- A minimal distortion of the part after machining. For this purpose, the percentage of parts rejected because they could not be hardened in a minimum space of time was used as an indicator. In the final stage of the project, results below 0.75%, that is, far below the usual average values, were obtained.

The material is currently used for steering worms, with a fully satisfactory, much more competitive material that shows the same mechanical performance in service.