

THE ALL-ROUNDER **BÖHLER E185 AMPO**

Lightweight parts, freedom of construction and higher economic efficiency belong to the many advantages of Additive Manufacturing. With the newest invention of voestalpine Böhler Edelstahl, the BÖHLER E185 AMPO, the markets of rapid prototyping as well as various engineering applications can be covered.

The BÖHLER E185 AMPO is a low alloyed engineering steel specifically developed for the additive manufacturing process. It excels in easy printability, even without pre-heating, and it shows sufficient ready-to-use properties in the as-built condition. Tailoring the mechanical properties is possible, simply by applying an easy heat treatment or various possible surface treatments after printing. The BÖHLER E185 AMPO is a case hardening steel and can be used for a wide range of applications, from tool holders to dynamic parts such as pistons or gears, therefore very attractive for automotive or mechanical engineering applications.

Chemical composition

BÖHLER E185 AMPO	C	Si	Mn	Cr	Ni	Mo	V
wt.-%	0.2	0.2	0.3	1.0	1.2	0.2	0.1

Compared to the commonly used engineering steel 16MnCr5, the BÖHLER E185 AMPO, with a tensile strength of up to 1200 MPa and an impact toughness of 140 J at 38 HRC, combines high strength values with outstanding toughness.

Due to the alloy composition, the BÖHLER E185 AMPO shows a high thermal conductivity of 37.7 W/mK (outperforming the 316L and the 1.2709 by almost twice the value) and therefore can be applied even in e.g. mold applications where whether corrosion nor wear resistance is of need (shortening of cycle times).

Enhancement through a simple heat treatment

If a functional part is required, an easy heat treatment can be applied on the printed part. With a simple hardening at 850°C for 30 min and a subsequent water or oil quenching, followed by a single tempering step at 200°C for two hours with an air cooling to room temperature. The heat treated part shows significant increase in tensile strength (1370 MPa), yield strength (1150 MPa) as well as in hardness (44 HRC) by only slightly decreasing the impact toughness (85 J). With this simple and economic heat treatment, the BÖHLER E185 AMPO is positioning itself as a highly effective and most interesting additive manufacturing powder.

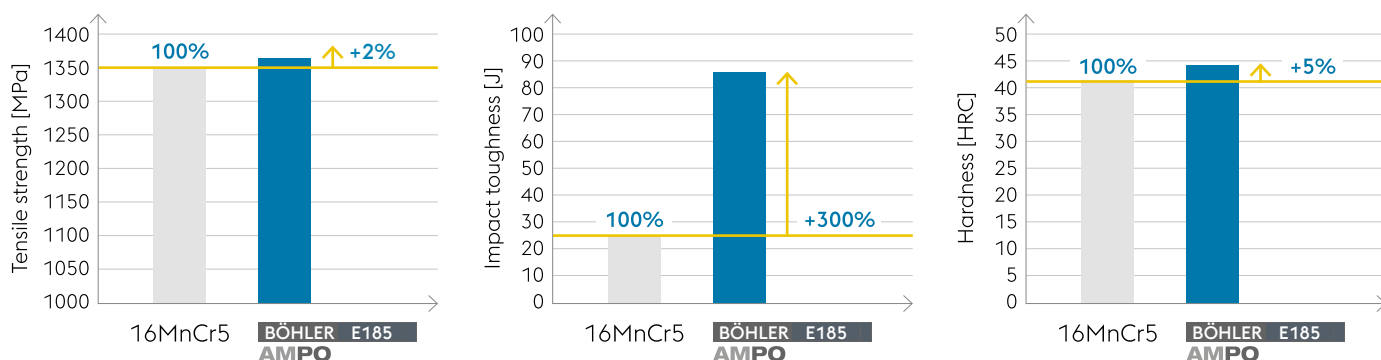
Another major advantage of the BÖHLER E185 AMPO is the exceptional fatigue strength, as it showed a fatigue strength

Comparison of the mechanical properties of the BÖHLER E185 AMPO (as built and heat treated) to 316L and 16MnCr5

	Tensile strength	Yield strength	Elongation	Reduction of area	Hardness	Impact toughness
BÖHLER E185 AMPO (as built)	1150 MPa	1050 MPa	15 %	70 %	38 HRC	140 J
BÖHLER E185 AMPO (heat treated*)	1370 MPa	1150 MPa	13%	60%	44 HRC	85 J
316L (AM)**	622 MPa	502 MPa	48 %	76 %	24 HRC	165 J
16MnCr5 Heat treated bar steel	1350 MPa	1090 MPa	12 %	50%	42 HRC	25 J

Typical values / * HT accordingly / ** Datasheets of various powder suppliers

Comparison of the mechanical properties of the 16MnCr5 and the BÖHLER E185 AMPO

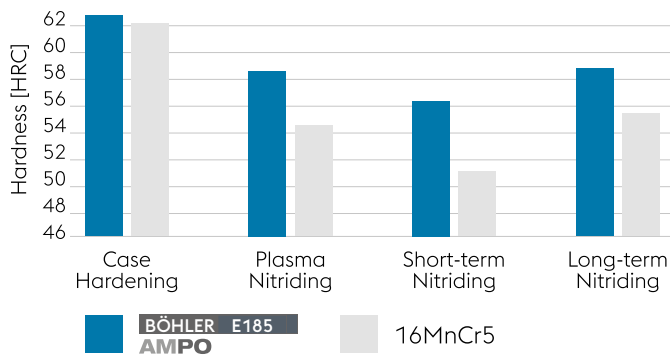


BÖHLER AMPO

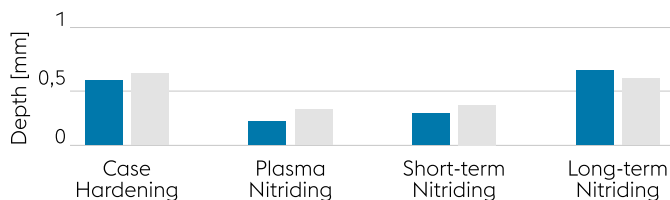
Additive
Manufacturing
Powder

Surface Hardness

Comparison between BÖHLER E185 AMPO and 16MnCr5



Hardness Depth

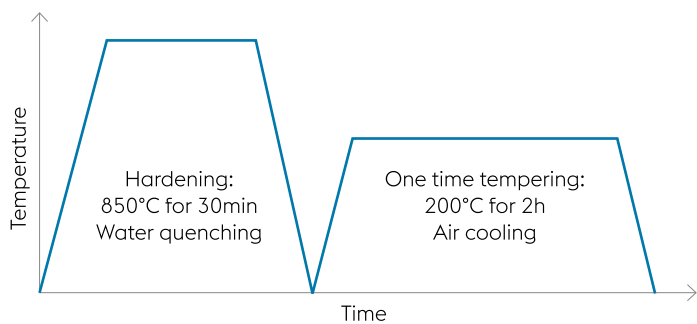


of about 540 MPa, alternating load and $5 \cdot 10^6$ cycles with a part density >99.98% without applying hot isostatic pressing (HIP). This fact leads to an additional field of applications, where dynamic loads are present, such as gears, pistons, bearings and even connection rods.

Tailoring of specific applications

Another advantage of a low alloy steel is the possibility for various surface treatments to increase the surface hardness and wear resistance. But still maintaining the materials high resistance to impacts or shocks. The BÖHLER E185 AMPO shows basically the same through hardenability as the 16MnCr5 when case hardening is applied. The hardness near the surface, however, can be additionally increased with a subsequent subzero treatment. If the material is plasma nitrided, the BÖHLER E185 AMPO can reach an even higher surface hardness value of up to 60HRC compared to the

Schematic depiction of an appropriate heat treatment



16MnCr5. This trend continues when gas nitriding is applied with significant higher hardness values achieved by the BÖHLER E185 AMPO. Further surface treatment details on request. When applying plasma nitriding and a subsequent PVD coating with e.g. EIFELER CARBON-X®, surface properties can be elevated additionally. Therefore showing an excellent performance at friction and wear tests.

Summary

The newly developed Additive Manufacturing powder, BÖHLER E185 AMPO, combines ductility, toughness and strength, while still maintaining high thermal conductivity. Therefore, it can be used for functional prototyping or high performance parts. As the material is able to be tailored for the exact purpose needed with additional surface treatments, the BÖHLER E185 AMPO, is the new trouble-shooter for many applications.

The BÖHLER E185 AMPO at a glance

- » High strength and toughness in the as-built condition
- » Increasing the strength with a simple heat treatment
- » High possible density (above 99.98%) and easy printability
- » High thermal conductivity and stiffness
- » Tailoring the part for a specific purpose with a surface treatment