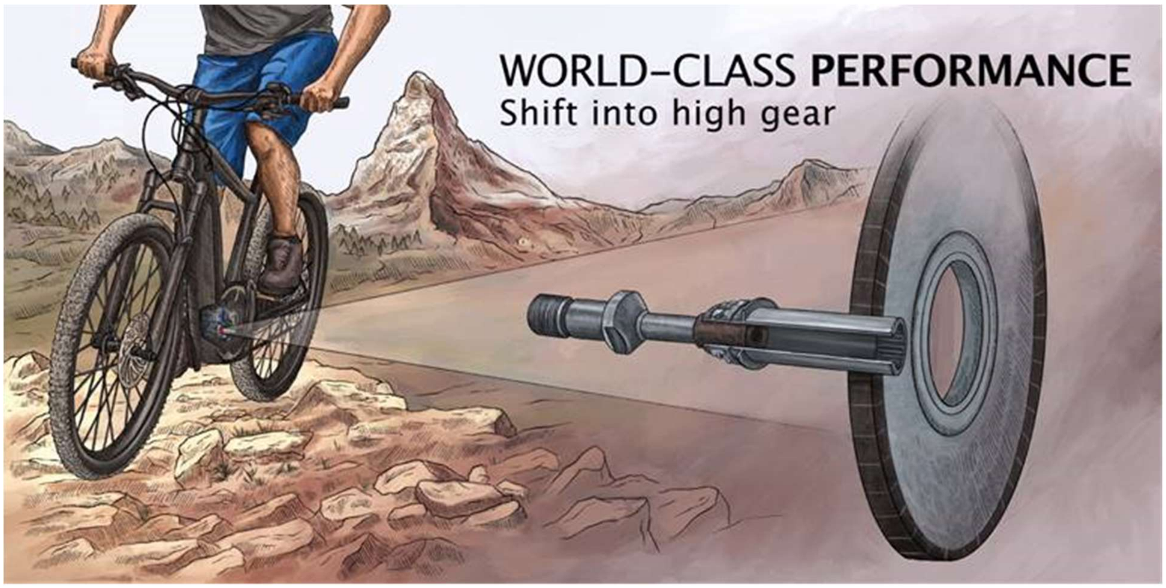
E- mobility with Meister **HPL technology**

Alfred Zenczak



Growth in the e-bike sector is accelerating with global pedelec sales topping 14.7 billion US dollars in 2019 alone. A study suggests that this growth is not likely to end any time soon. Numbers have quintupled in the past 10 years and reached 2.6 million units in Europe in 2018. Annual growth of 6.25% is expected from 2020 to 2025. The main markets are Germany, France and Italy.

The pandemic led to an explosion of the e-bike business in 2020. In Europe, retailers reported a doubling to tripling of sales figures compared to the previous year. In China, they quintupled. Manufacturers were under pressure due to the complex delivery chains, with over half of the individual parts being imported from Asia.

Much has changed in the various drives and drive technologies in the e-bike and pedelec market in the past few years. Typically, a centrally mounted motor with an average output of 500W and battery power of 500Wh is installed, which has a range of 100 - 120km. But, at their peak, some drives can provide double, triple or even quadruple this performance. Leading brands can reach a torque of up to 120Nm.

Figure 1 E-bike hollow axle shaft

An important component of the drive is the hollow axle shaft, which transmits the torque from the motor to the chain ring via a gear. The current and future requirements in the area of urban mobility are reinforcing the need to consider, develop and manufacture mechanical gears, assemblies and components from a completely different perspective. Quality excellence, quiet operation, freedom from vibrations and light weight are becoming increasingly important in modern e-bike drives.

For the machining of the hollow axle shaft in figure 1, the bore hole and the external diameter are ground on interlinked machines. Tolerances lie in the range of thousandths of a millimetre and, in large-scale production, they are reliably met using Meister Abrasives grinding and dressing tools. The Meister HPL bonding technology has proven to be particularly helpful in establishing this application.

The **HPL** – **H**igh **P**erformance **L**ubrication bonding system combines high removal rates (higher feed values) with high tool service lives based on extended dressing intervals. These kinds of customised CBN tool solutions are amongst the première Formula-1 candidates in the machining sector. The cycle times are extremely short and the commercial requirements of the processes can only be achieved with coordinated grinding tools. The process is generally tuned on-site by the Meister application engineers, who work together with the customer to optimise the parameters to get the most out of the tool performance.

Meister HPL bonding for modern CBN grinding tools

Following on from free-cutting bonding systems HPB and HPC, the Meister development team set itself the task of developing a bond with a lower coefficient of friction. The result is the newly developed **HPL** – **H**igh **P**erformance **L**ube bond. The significant reduction in the surface friction during chip formation allows the grinding tools in **HPL** bonding, together with adapted CBN grit types, to achieve a new dimension in the specific metal removal rate.

Thin-walled components, like the hollow shaft shown in figure 1, are extremely sensitive to high heat input and display abnormalities when complying with defined tolerances, if the tools used generate too much grinding pressure and the drive power applied by the spindle leads to frictional heat resulting in structural changes or even abrasive burning. A factor that cannot be underestimated is the selected combination with the Meister hDD dresser designed specifically for the process, which ensures high service lives and premium process reliability.

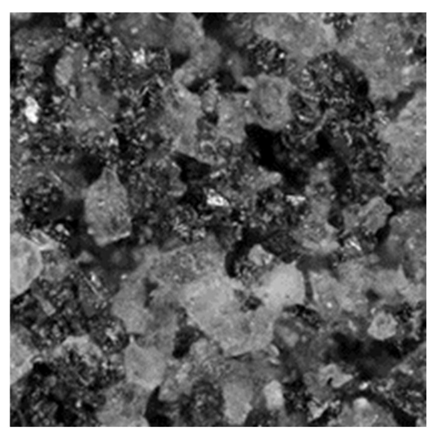


Figure 2 Meister HPL structure

Meister dressing tools in hybrid technology

As a systems supplier, Meister provides a perfectly coordinated combination of grinding and dressing tools in extensively tried and tested applications. Meister hDD (Hybrid Diamond Dresser) and cDD (Hybrid Dresser with edge reinforcement) tools make an important contribution to optimising grinding applications, with a constant focus on maximum process reliability and efficiency. Adapting the dressing tool to the grinding wheel is one of the most important challenges that the application engineers tackle together with the customer. In contrast to conventional metal-bonded diamond dressing tools offered by competitors, the Meister hybrid bond represents a technological milestone. The ceramic- and metal-bonded hybrid tool permits a huge degree of freedom when specifying the diamond grit type, grit size, density and concentration. These kinds of high-grade, flexibly adapted dressing tools can be perfectly aligned to the grinding wheel used. In practice, the oft-criticised grinding behaviour does not occur after dressing with the hdd/cDD tools and a constant process flow is ensured. For the user, in many cases, this means an extended service life of the premium quality CBN grinding wheels, which have to be dressed less often.

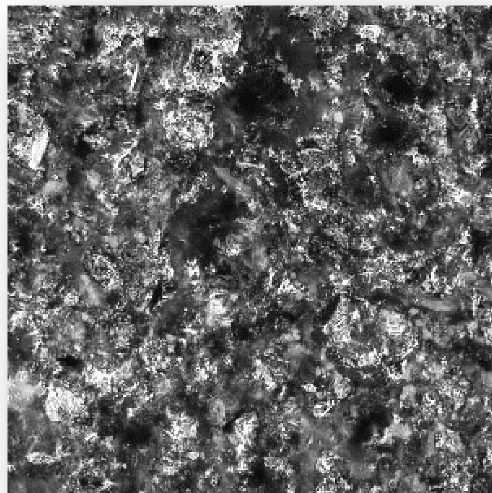


Figure 3 Meister hybrid

A real-life example

Workpiece	Hollow axle shaft
Material	X46CR13
Hardness	58HRC
Machining allowance	0.05mm on the Ø
Surface	Rz 3.5µm
Machine	EMAG VLC100
Cycle time	21sec
Dressing interval	60 components
Dressing amount	2 x 2µm
Dresser	Meister hDD
Grinding wheel	Meister CB47-151-200-V
Coolant	Emulsion

The external cylindrical grinding operation is covered by Junker and Lizzini machines and the HPL recipe in CB47-126-125-V is applied in the form of a segmented grinding wheel

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