



DVS UGrind: Hard-fine machining for the mobility of the future

Reliable and economic hard-fine machining of hollow shafts for electric drives

Efficient manufacturing solutions for the mobility of the future. Using the innovative machine series DVS UGrind, BUDERUS Schleiftechnik GmbH, based in Asslar in central Hesse/Germany, is already solving this challenge: especially developed for the hard-fine machining of small to medium-sized series of shafts and chucking parts, the machine series combines the flexible execution of grinding, turning, milling and measuring operations in one clamping, intuitive operability and maximum machine stability. This makes the machine series the optimum solution for the high-precision finishing of complex powertrain components for

electric vehicles, as the DVS company impressively proves using the example of hollow shafts for electric drives.

Within the context of hard-fine machining of rotation-symmetrical components in large series, constant innovations in terms of process and tool technology lead to successive increases in efficiency. Thus, for example, the pure process times during grinding are continually being reduced by the use of CBN high-performance cutting materials which permit enormous cutting speeds – yet increasing the service lives of the grinding tools used at the same time. In contrast to large series production, the focus within the manufacturing of smaller

Highlights

- Grinding, turning, milling and measuring operations in a single clamping and with minimal traverse path
- Flexible guaranteed highest productivity and process ergonomics
- Hard finishing as part of an integrated DVS production solution for complete machining of electric drive shafts

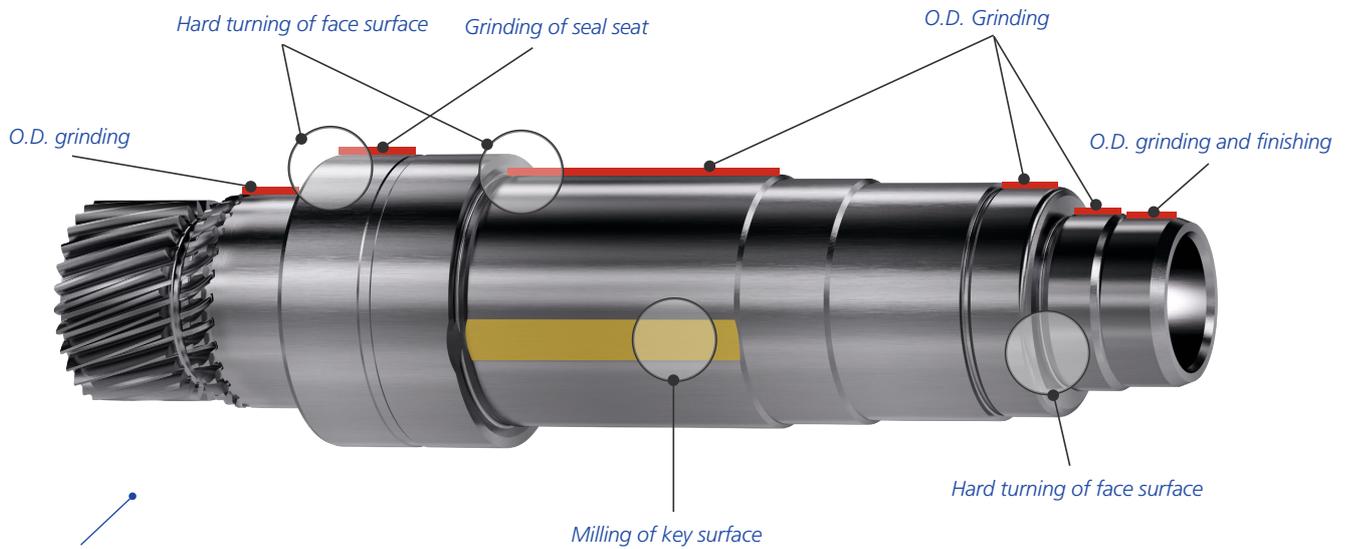


Image1: Hard-fine machining processes carried out on different surfaces of the hollow shaft

to medium-sized batches such as are usual for the series production of powertrain components for electric vehicles so far is less on the optimisation of process and tool service lives and more on reducing the significant time and work effort required between the first clamping of a workpiece and the achievement of the required final dimension.

Grinding, turning, milling and measuring processes in one single clamping

Innovative answers for reducing this effort are provided by the DVS machine series DVS UGrind, through which the DVS TECHNOLOGY GROUP is utilising its

expertise from the field of the hard-fine machining of large series for medium to small batch sizes. Thanks to the multifunctional turret and the intuitive operability using an in-house developed user interface, the overall machining time for manufacturing corresponding components is reduced by up to 50% – at the same time ensuring maximum flexibility. Depending on customer- or component-specific requirements, the machines in the series perform grinding, turning, milling and measuring processes in one clamping and with minimum travel thanks to their extraordinary compactness. The integrated measuring probe controls and monitors machining until the required final di-

mension has been achieved, which means time-consuming processes such as successive feeding and re-measuring are no longer required. Optimised lever arm ratios and the vibration-damping machine bed made of granite guarantee a high degree of dynamic and thermal machine stability, thus ensuring constant reproducibility of the required manufacturing qualities.

These are optimum pre-requisites for the use of the machine series for machining powertrain components for electric vehicles. On account of the comparatively higher rotational speeds and transmission forces in this context, as well as the striving for greater concentricity and



High-precision turning of left and right-hand plane surfaces by using a combi-turning steel holder with two cutting edges.

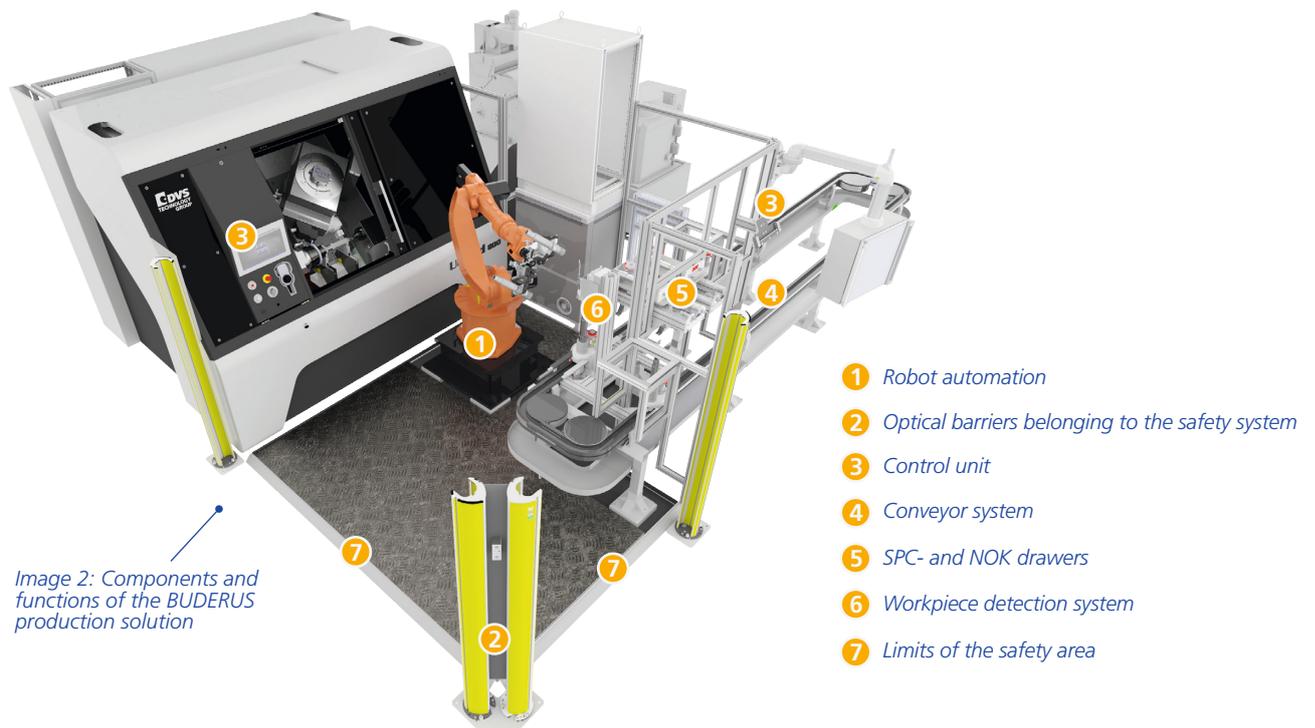


Image 2: Components and functions of the BUDERUS production solution

NVH-reduction, the requirements related to shape and position tolerances become more demanding. This in turn results in the necessity of even more precise machining of the respective components. With the aid of the DVS UGrind, BUDERUS Schleiftechnik fulfils this premise reliably and economically, as the company demonstrates using the example of hard-fine machining of a complex hollow shaft for electric drives. Image 1 shows the different machining operations that can be carried out on different surfaces of the hollow shaft using the flexible multi-function turret which can be configured accordingly using appropriate tools.

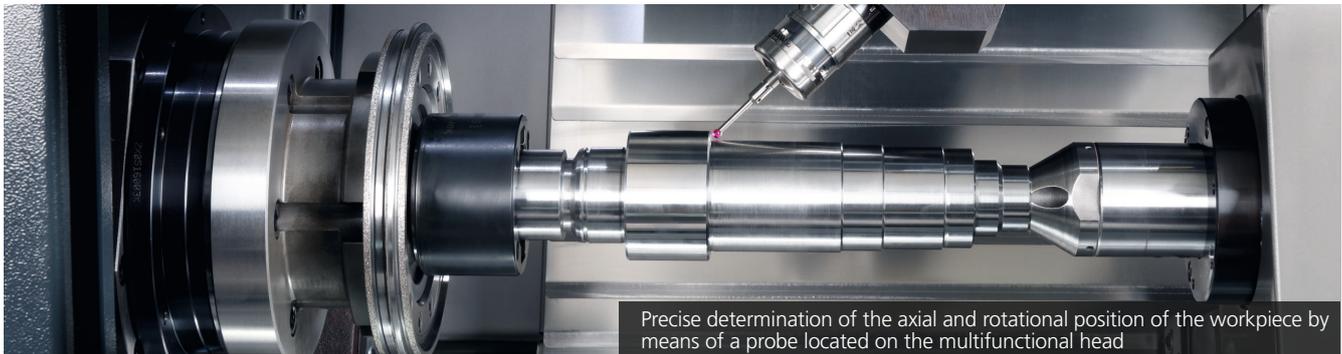
More stringent shape and position tolerances require maximum manufacturing precision.

First, a level surface is measured using the measuring probe located on the multi-function turret that permits a radius of action of 270°, in order to exactly determine the axial and rotation position of the workpiece and ensure that all the lengths and a complex key surface are complied with precisely. On the basis of this, the control system calculates optimum feeding and forwarding parameters, after which the key surface is manufactured exactly using a CBN hard milling tool. Then a combined turning steel holder with two blades is

used for high-precision hard turning of various flat surfaces on the left and right, which is followed by the CBN grinding of several outer diameters down to the last μm . For the precise grinding of the long outer diameter, plunging takes place at several points first, and then peel grinding is carried out from left to right. The CBN grinding disc, which stands out thanks to its extremely fine grit, is then used to finish the seal seat of the hollow shaft, during which a surface roughness of $R_z < 1 \mu\text{m}$ is achieved. A reference outer diameter is machined measurement-controlled with the aid of in-process measuring equipment. The other outer diameters are traced following this reference. Since the



Mu-exact CBN grinding of various outer diameters of a hollow shaft



Precise determination of the axial and rotational position of the workpiece by means of a probe located on the multifunctional head

execution of all machining operations takes place in one single clamping, set-up times and the number of manual handling steps are reduced and reclamping faults avoided completely. The use of high-quality and high-performance tools and short travel paths permits minimum cycle times.

Flexible robot automation and integrated safety system

To further ensure the productivity of the overall process, a 6-axis robot with a range

is concerned: a sensor-controlled safety system shields the working chamber using optical barriers, thus guaranteeing that the loading and unloading process comes to a standstill directly should an object enter the protected area. Image 2 illustrates the individual components and stations of the manufacturing solution.

The complete hard machining and finishing of the hollow shaft by the DVS UGrind is part of a pioneering integrated production solution by several members

schinenbau Ziegenhain. The last link in the process chain which results in a ready-to-install hollow shaft is gear honing using a machine from the DVS gearing specialist PRÄWEMA Antriebstechnik.

With this special version of the DVS UGrind for the universal and flexible hard-fine machining of hollow shafts for electric drives, BUDERUS Schleiftechnik is successfully proving its innovative skills and future orientation with reference to the machining of components for the mobility of tomorrow. ■

Integrated Single Source Production Solution for complete Machining of Hollow Shafts for Electric Drives

WMZ
WERKZEUGMASCHINEN
Soft Machining:
Turning, Drilling, Milling,
Gear Cutting

Buderus
SCHLEIFTECHNIK
Hard-fine Machining:
Turning, Milling, Grinding

PRÄWEMA
Hard-fine Machining:
Gear Honing

of a good 1.6 metres takes over the equipping of the machine. The loading and unloading of the hollow shafts via robot is carried out pre-positioned from a conveyor system which also has a camera system that permits precise part detection using a dot matrix code and exact traceability of each and every hollow shaft for the customer. Safety is also an extremely important issue as far as this manufacturing solution

of the DVS TECHNOLOGY GROUP – specially designed taking quality requirements in the field of machining complex components in the powertrain of electric vehicles into account and in use at the DVS company DVS Production GmbH. Because the finishing is preceded by the complete soft machining of the hollow shaft, which is performed using a complete machining cell from the DVS company Werkzeugma-

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