WMZ
WERKZEUGMASCHINEN

Ready for the next shaft

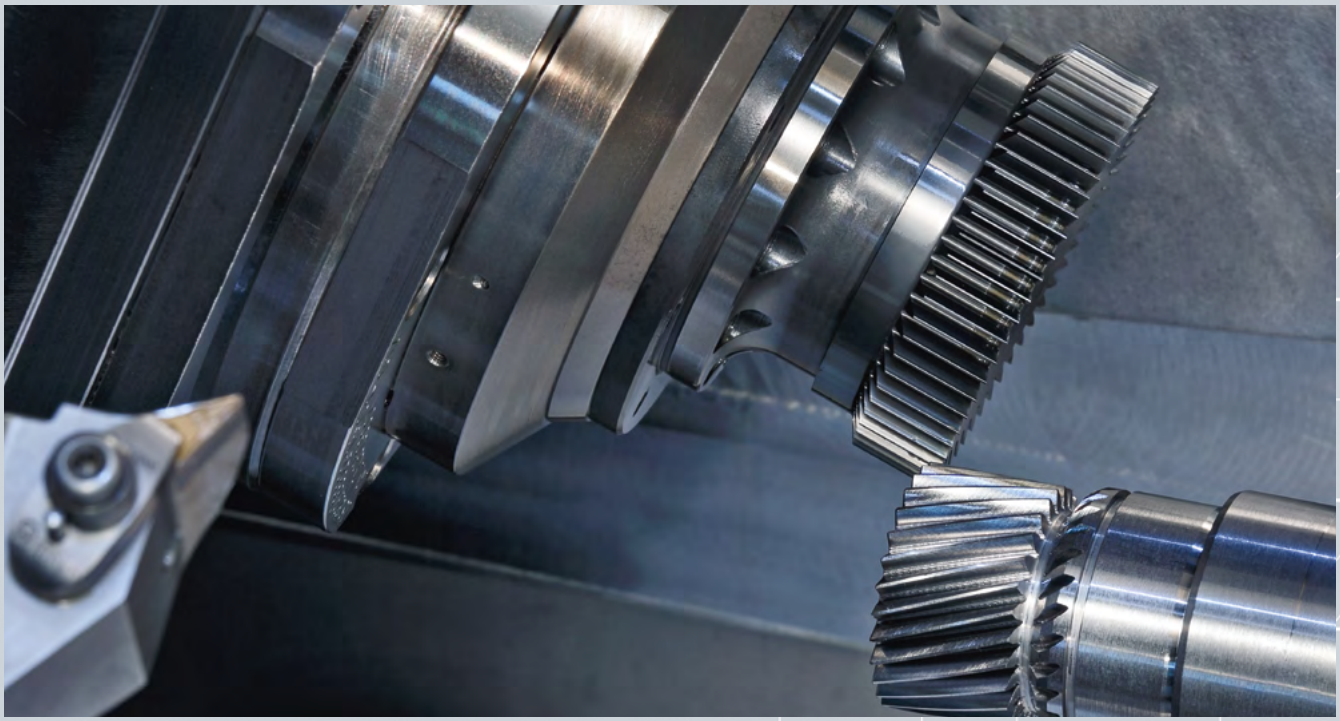
WMZ manufacturing solution for the complete soft machining of hollow shafts for electric drives

By realising an efficient complete machining centre for the holistic soft machining of hollow shafts for electric drives, Werkzeugmaschinenbau Ziegenhain (WMZ) is demonstrating its innovative strength and future sustainability with a view to manufacturing complex components in the powertrain of electric vehicles. In one WMZ machine and only two clampings, the hollow shafts are turned, milled, drilled and gear cut using the Power Skiving method – at the same time meeting extremely stringent shape, position and surface requirements. With this the company is also part of an integrated production solution developed in cooperation with several DVS members. In a nutshell: WMZ and other DVS companies are designing the machining concepts for the mobility of the future today.

The ambitious target of the Federal German government to have one million electric vehicles on German roads by the year 2020. The strategic decision by the Swedish vehicle manufacturer Volvo to no longer equip new passenger car models with conventional combustion engines from 2019 onwards. Increases in sales rates in the year 2016 for hybrid and pure electric vehicles of 53 % on the lead market China and 38 % on the US market, as reported

Highlights

- Turning, drilling, milling and gear cutting - in just two setups
- Teil der DVS-Komplettlösung vom Sägeabschnitt bis zum einbaufertigen Hohlrad
- Holistic processing concept minimizes total processing time



by the renowned Center of Automotive Management. These are all examples of aspects which underline the continually increasing importance of electro-mobility.

In view of the expected dynamic development of this trend, the international automotive-related machine tool industry – which of course includes WMZ and other DVS companies – is being increasingly confronted by changing challenges in terms of machine concepts and production processes which need to be solved using innovative approaches. Because in order to achieve the required drive torque, drives of electric vehicles require a very high gear transmission ratio. The accompanying engine speed rates of up to 17,000 rpm have a negative impact on noise sensitivity and wear behaviour. For example, noises which occur near the powertrain are perceived much more clearly due to the lack of background noise associated with a combustion engine. To solve these problems, enormous requirements are made with regard to the balance quality of moving components in the powertrain of electric vehicles, which results in tighter shape and position tolerances and thus the necessity of machining the corresponding components even more precisely.

WMZ soft machining as part of an integrated DVS solution

Taking these quality premises into particular account, WMZ has realised a pioneering integrated production solution for the complete machining of hollow shafts for electric drives – from the raw to the finished part – for a renowned German automotive supplier, working in cooperation with its DVS sister companies BUDERUS Schleiftechnik, PRÄWEMA Antriebstechnik and DVS Production. For this purpose, WMZ has developed an efficient complete machining centre for the holistic soft machining of hollow shafts,

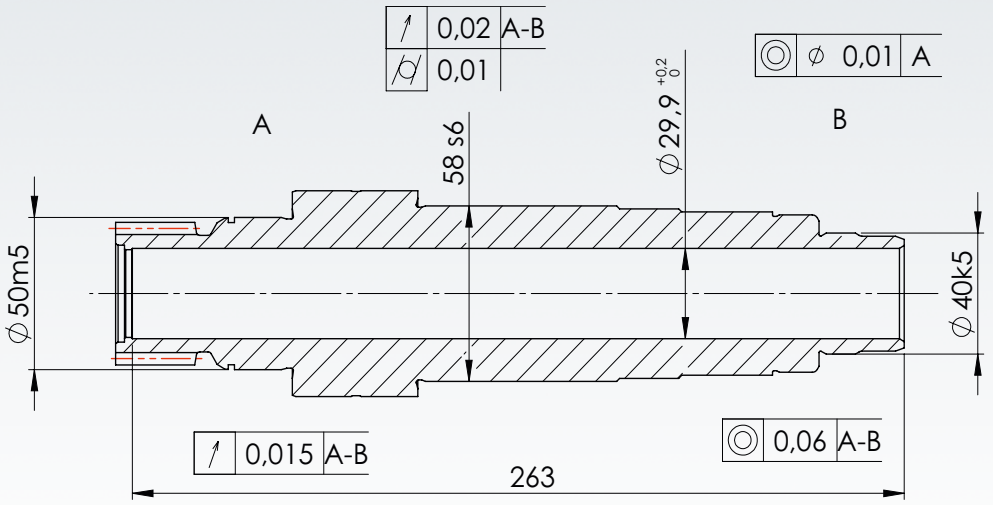


Image 1: Important dimensions as well as shape and position tolerances

which is then followed by hard-fine machining processes using a machine from the DVS UGrind series designed by BUDERUS Schleiftechnik and a gearing honing machine from PRÄWEMA Antriebstechnik. The series production of the first shaft type is currently in the ramp-up phase at DVS Production GmbH in Krauthausen in Thuringia/Germany.

The design space available is extremely limited in the electric drives segment, so that motor and gearbox almost merge into one unit by means of function integration. For this reason, the drive gearing is integrated into the hollow shaft of the motor. The electric motor rotor is located between the bearing seats (Image 1: reference A and B). In addition, corresponding motor shafts are characterised by a through hole which both serves to reduce the mass inertia and makes the power take-off possible on the opposite drive side. A hardening processing is also necessary due to the running gears. The most critical circumstances for hollow shaft machining resulting from this, shown in image 1, are the tight run-out tolerances of the shaft bore and gearing to the bearing seats and the low tool run-out during gear cutting caused by the design space. With a view to the required manufacturing quality and cycle time of the subsequent hard-fine machining, the soft machining process must produce the complete inner contour, several external surfaces and grooves, the gearing as well as the bearing and rotor seats already to the finished dimension or with only a very small allowance. Otherwise the final shape and position tolerances will not be achieved.

Complete machining including gear cutting using the Power Skiving method

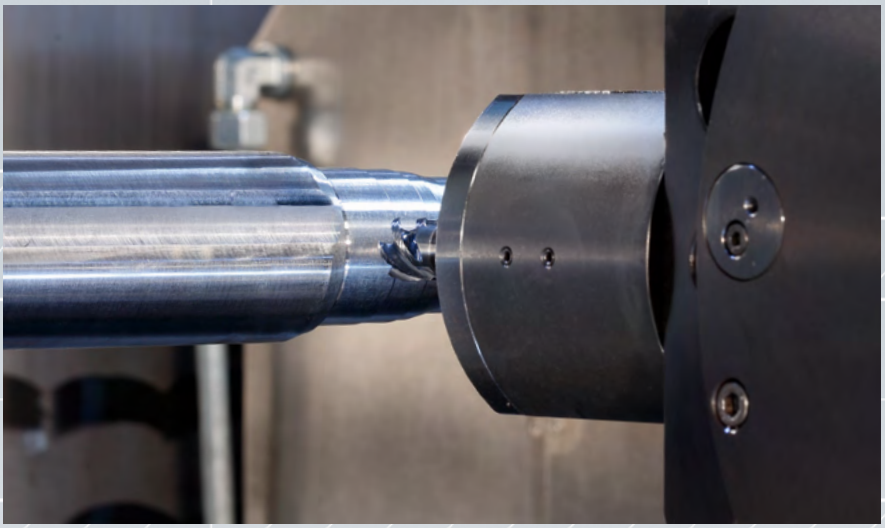
In order to fulfil all requirements and guarantee maximum process and cost efficiency, WMZ has created a multi-technology manufacturing solution that combines turning, milling and drilling operations as well as gear cutting using the highly productive Power Skiving method. In order to minimise reclamping errors which have a negative impact on manufacturing quality, the option of distributing the machining steps to several individual machines was excluded from the very beginning. As a side effect, retooling, transport and waiting times – and thus the overall processing times – can also be reduced. Nevertheless, the complex variety of technologies used

Integrated Single Source Production Solution for complete Machining of Hollow Schafts 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



makes the fulfilment of various attributes of a machining centre absolutely crucial: while turning and milling work needs maximum flexibility and dynamism, both precision drilling and Power Skiving require maximum rigidity and geometric accuracy. Moreover, the drilling of bore holes to the required depth and tolerance makes enormous pressures and volumes necessary with regard to the cooling lubricant system in order to facilitate the fast and safe clearance of chips.

For this reason, the successful WMZ H200 was chosen as an adequate machine base, since its modular design permits the flexible implementation of a wide range of different machining operations. Numerous series applications based on this machine concept, which stands out on account of its flat bed construction, confirm its remarkable dynamic and thermal rigidity. Whereas the turning and milling requirements were able to be realised using tried-and-trusted components, the WMZ design engineers – in close cooperation with the DVS Power Skiving specialists PITTLER T&S and PRÄWEMA Antriebstechnik – came up with an innovative combined Power Skiving module for the high-precision manufacturing of the running gears and the shaft bore. With the development of this module, that can be adapted flexibly to different gearing geometries, WMZ is expanding its range in the field of the complete machining shaft-shaped components and can fall back on this development for upcoming applications.

Precision chuck prevents reclamping faults

The complete soft machining of the hollow shafts is carried out completely automatically by an H200 machine and only two clampings. A tried-and-trusted WMZ loading module guarantees automated loading and unloading as well as the onward transport of the hollow shafts from OP10 to OP20. Thanks to the optimum interaction between the machine's internal automation and the specially developed precision chuck made by the DVS partner SWS Spannwerkzeuge GmbH, reclamping faults are negligible and thus have no negative impact on the manufacturing quality. The subsequent hard-fine machining can then be carried out using optimally pre-machined workpieces. After the manufacturing process has been completed, the workpieces are marked with a dot matrix code by an engraving laser station integrated in the finished part conveyor, enabling clear part identification and traceability. Within an extremely short cycle time, a simple cut off piece is turned cost- and process-efficiently into a hollow shaft with more than 150 complex characteristics and meets the most stringent of precision requirements – exactly as required for the components of the increasingly important electric drive. ■

Author:
Mario Preis, Managing Director
Werkzeugmaschinenbau Ziegenhain GmbH

Please contact us for more information.

WMZ
WERKZEUGMASCHINEN

Werkzeugmaschinenbau Ziegenhain GmbH
Am Entenfang 24
D-34613 Schwalmstadt-Ziegenhain

T. +49 (0) 6691 9461 0
F. +49 (0) 6691 9461 20
info@wmz-gmbh.de
www.wmz-gmbh.de

DVS TECHNOLOGY GROUP