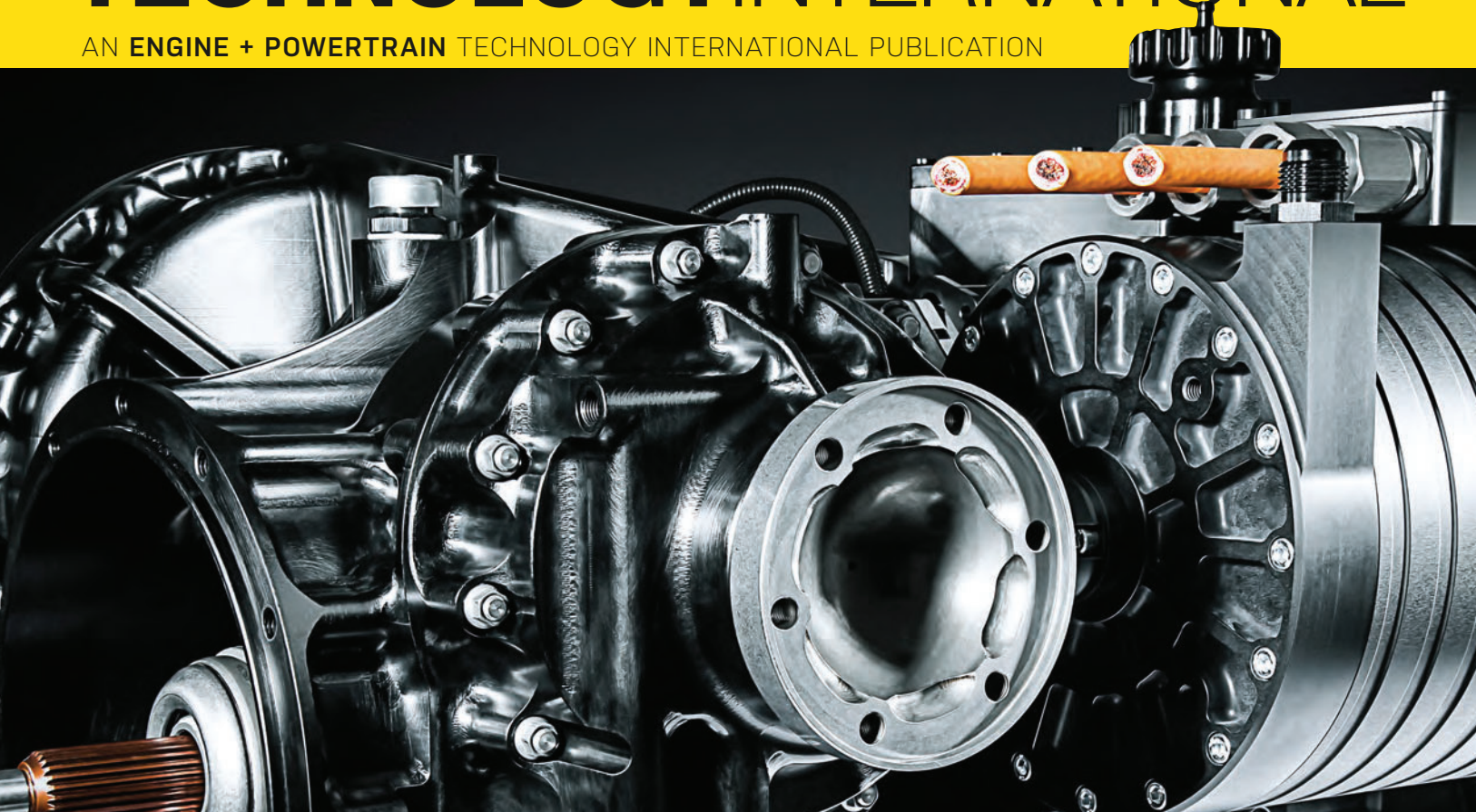


# transmission

## TECHNOLOGY INTERNATIONAL

AN ENGINE + POWERTRAIN TECHNOLOGY INTERNATIONAL PUBLICATION



# TECHNOLOGY SHOWCASE

The very latest in new transmission systems design, architecture, innovation, research and testing – including key breakthrough automotive industry developments that are set for market launch

### OEM INTERVIEW

VW's head of transmission development, Andreas Felske, discusses the importance of a modular gearbox framework

### WHAT'S NEXT FOR THE MANUAL?

Leading industry engineers and experts debate the future of the much-loved stick shift

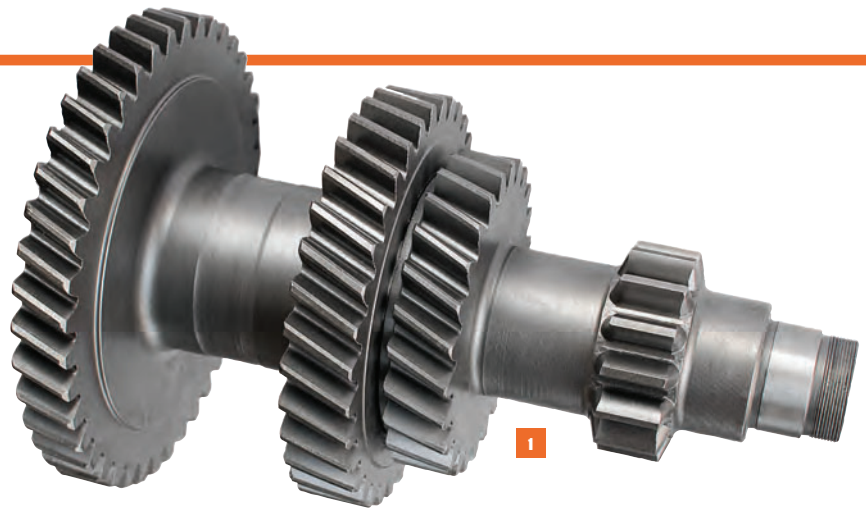
### THE NEW GENERATION

The technical lowdown on all-new cutting-edge transmissions from Zenvo Automotive, Volkswagen Group and Hyundai-Kia

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# Hybrid transmissions



Electrification is changing the industry, but transmission manufacturing systems and the fine finishing of key components can offer a solution to many of the challenges

**T**he automotive industry has been through very challenging times recently. With electrification of the powertrain, which requires a paradigm shift for both OEMs and suppliers, it's probably the most challenging time within its entire history. Despite the increasing popularity of battery electric vehicles, which commonly use rather simple transmissions, there are many indicators that hybrid technology will serve as the dominant powertrain for the foreseeable future. In light of tightening regulations and the push to abandon fossil fuels and therefore reduce carbon emissions, internal combustion engines and transmissions need to evolve.

Alongside interesting developments such as synthetic fuels and hydrogen-based concepts, electrification of the powertrain will play a major role in this evolution. The result will be a large variety of diversified hybrid powertrains used in modern automobiles for decades to come. A key element within this development will be the dedicated hybrid transmission (DHT).

While there are numerous versions of DHT, many of them share a few key components, including high-precision pinions and hollow shafts. While these workpieces are not entirely new to OEMs and suppliers, the increasing requirements that come with them require new, cost-efficient manufacturing solutions. NVH requirements, overall quality and changing production criteria such as smaller lot sizes and an increased mix of variants are just a few of the challenges. Fortunately, innovative machine tool builders such as Bahmüller have recognized this trend and developed new solutions to overcome these challenges.

## FLEXIBLE PINION MANUFACTURING

Pinions, for example, have been produced and used in conventional automatic transmissions for many years. But the increasing variety of transmissions like the DHT requires a more flexible manufacturing approach. The traditional production method often separates the grinding and honing process, which often requires more machines, workpiece handling, part buffers, operator intervention and floor space, which can result in an inferior quality product.

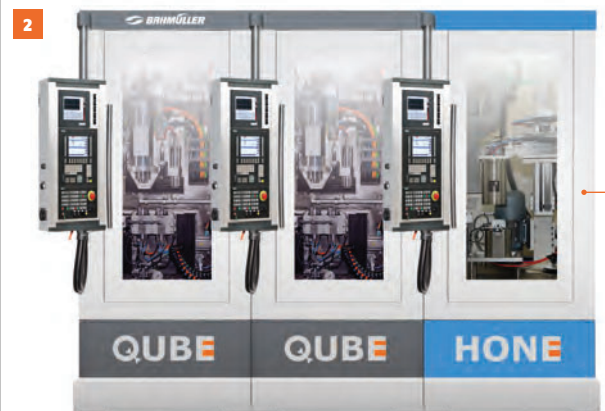
Typically, each pinion has two ground faces and a honed inner diameter to provide optimal performance over the lifetime of the

1. A special mid-clamp workholding allows the Bahmüller machine to grind the exposed sides of a hollow shaft using two independent tools
2. Bahmüller's in-line grinding and honing cell can carry out the entire finishing process for the pinion's bore and faces

transmission. Following the principle of lean manufacturing, Bahmüller has developed a unique solution that finishes the bore and faces of pinions in a single in-line grinding and honing cell. The first operation is carried out on a Bahmüller Qube vertical grinding machine, which finishes the first pinion face and rough grinds the inner diameter at the same time. The workholding is specifically designed to clamp the part in the pitch line of the gear teeth, therefore minimizing the stock allowance for the final gear teeth finishing process.

After the first step, the workpiece is automatically flipped by 180° and moved to the second operation, which is also carried out on a Qube machine. Here the remaining face of the pinion is finish ground. The third and final step takes place in the high-speed honing machine, featuring a single tool to finish hone the inner diameter with a unique process capable of up to 40 honing strokes per second. Throughout the entire process the same coolant is used. This distinct oil was developed specifically for Bahmüller's in-line process. The high-performance oil enables the customer to use just a single coolant throughout the manufacturing process without any concern about contamination between machines or the need for part washing.

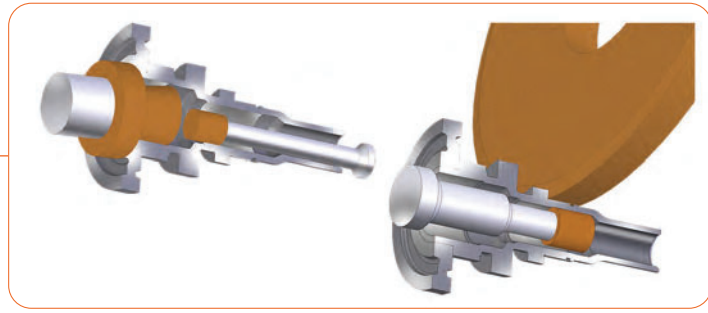
After the honing process, an automated postprocess gage verifies the size of all components and provides an automated feedback







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loop to the cell for trend corrections. The internal automation is optimized for fastest possible workpiece change times and maximum uptime. As far as the external automation and part buffering is concerned, several solutions can be accommodated depending on customer preference. The footprint of the cell itself is highly compact, measuring just 3m (10ft) wide, and it is perfectly suited to scalable production. The simplicity of the Bahmüller manufacturing solution enables easy and fast change-over with superb process capability.

**HOLLOW SHAFT GRINDING**

Bahmüller's unique solution for the hollow shaft is centered around a special workholding, called a mid-clamp, which chucks the part in the middle. This allows the machine to grind the exposed sides of the workpiece simultaneously using two independent tools. The first operation is the inner diameter grinding of multiple diameters in combination with face grinding. The second operation is performed subsequently in the very same clamp and consists of outer diameter grinding a journal and a shoulder while finish grinding another inner diameter feature at the same time. After this, the workpiece is unloaded via an integrated robot, a new part is presented to the chuck and the cycle repeats.

The Ultra machine is customized specifically for the grinding of hollow transmission shafts, featuring one outer diameter and three

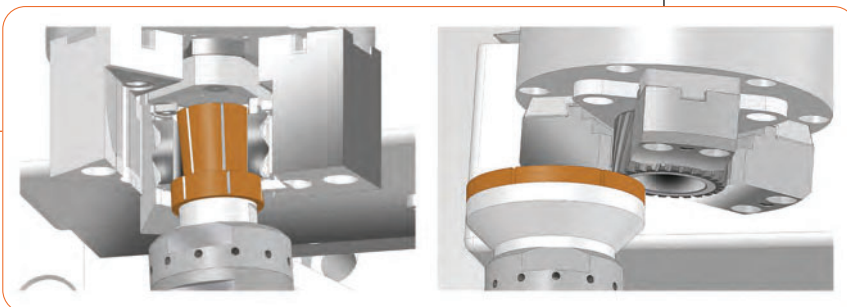


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- 3. The Ultra machine is specifically designed for the hollow transmission shaft grinding process
- 4. The ground faces and honed inner diameter of a pinion ensures that a transmission system performs to its optimum

inner diameter grinding spindles, each on independent hydrostatic and linear motor driven slides. Automated postprocess gauging of the finished workpiece with a closed loop feedback to the machine ensures trend correction and reduces the need for any manual statistical process control. Multiple high-frequency dressing units with acoustic emission technology enable automatic conditioning of all grinding wheels. The unique machine concept and Bahmüller's extensive experience with super abrasives such as cubic boron nitride yield higher performance and reduce cost per part even further. Using a single clamp ensures perfect geometry, especially in regard to the runout between the inner diameter and outer diameter features of the workpiece. By finishing all hollow shaft grind operations in a single machine, Bahmüller provides customers with a solution that is easily scalable and offers flexibility, even for smaller batch sizes.

Bahmüller incorporates the latest technology including direct drives, linear motors, a polymer concrete base and connectivity for Industry 4.0 features, which – in combination with state-of-the-art automation and gauging capabilities – enables lights-out component manufacturing. ©



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