Machining and CNC

KADIA refines "Ultra-precise" Honing Spindles

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With the HMC100 machine controller, the operator gets the most out of his LH honing spindles.

Every micrometer counts when it comes to honing of high-precision components, such as those required for injection systems or hydraulic applications. In order to meet these high quality requirements, the honing machines manufacturer KADIA Produktion GmbH + Co. in Nürtingen uses a direct drive technology for the spindles and the stroke. Meanwhile, the second generation of the so-called LH honing spindles has become available.

The first Lean-Highspeed honing spindles, in short LH honing spindles, with direct drives for rotation and stroke, presented by KADIA in 2004, were a genuine innovation on the market, a thunderbolt. Immediately convinced of the success, the Nürtingen-based company patented its concept worldwide. Henning Klein, managing director at KADIA, puts it in a nutshell: "The direct drive technology is unbeatable in terms of smooth operation and control behavior's precision. Its use in the small to medium diameter range – this is our specialty – has led to a leap in productivity and quality, which is rarely the case with new developments nowadays".

In detail: The direct drive used for the first time for the stroke movement via linear motor offers an optimally adapted drive and dynamic performance, both of which are prerequisites for a high material removal rate. Moreover, the linear motor works contact-free, basically wear-free and transfers practically no vibrations to the honing tool. In contrast, the conventional honing stroke systems rely on components that are subject to wear, such as ball bearing spindles. The deceleration and acceleration in the reversal points of the oscillation quickly impose limits to the constantly high precision. Similar advantages are also featured by the spindle drive, a directly driven synchronous built-in motor. The low-maintenance motor spindle transfers its high torques without causing the tool to vibrate. But that is not all. The tool expansion takes place electromechanically by means of a high-resolution servomotor with precision screw drive. On the honing stones, feed is possible down to the nano range.

KADIA has managed to combine all these high-tech individual components in one unit, which could hardly be more compact. The spindle motor and the expansion motor are arranged coaxially one above the other and in the immediate vicinity of the linear drive. The directly initiated expansion movement of this arrangement increases the rigidity of the entire system.

The innovative concept is completed by the inner coolant supply, which provides optimal process cooling. Henning Klein comments: "Due to our LH honing spindles, even demanding high-precision applications, such as match honing with clearance tolerances <1 µm can be safely implemented." As the Nürtingen-based company additionally states, in nearly ten years, more than 700 high-tech spindles of the first generation have been supplied, in five variants. They perform reliably in a wide range of single- and multi-spindle machines of the customers.

Even more compact

Ten years ago, constructors would have surely excluded the possibility of achieving a more compact design. But the march of progress never stops. "Many experiences have flown together in the meantime. The individual parts and components as well as the applications have continued to develop. It was therefore time to adapt the successful concept to the current state of technology", Henning Klein says. For example, there was room for improvement in terms of inner coolant supply and this enabled a shorter design and a more comfortable accessibility for maintenance purposes. The tool clamping also showed a potential for optimization: the customized hydraulic expansion chuck is now seated directly in the honing spindle and no longer on the spindle tip. This not only has impact on the construction length, but leads especially to an "ultra-precise radial spindle runout".

Top-notch energy efficiency

But the most important improvement has been made to the overall design of the individual drives, in terms of performance, size and weight, so that every honing spindle has now the best possible configuration. Another consequence of this measure is that the number of initially five variants has been reduced to two, with the designations LH2 and LH3 – however, several variants are possible for the stroke and different standard lengths are available. According to the experts in Nürtingen, despite the smaller size and weight reduction of almost 30%, LH2 achieves the same forces and torques as the previous KADIA standard spindle. The larger LH3 lies in the range of the formerly most powerful predecessor model at nearly 20% less weight. "Due to the even more compact design, the dynamic range and the chip removal capacity have increased further. The power consumption is now lower at the same time – an advantage not to be underestimated", says Henning Klein. Therefore, the new generation is also convincing in terms of energy efficiency, not least due to the possibility of feeding electricity back into the grid. To give just one example: The power consumption of an LH2 spindle during a typical honing process is of the order of 0.0025 KWh/workpiece. Another aspect is, however, important to the users: KADIA offers a five-year warranty on the linear stroke drive. This represents an above-average value, which indicates high levels of reliability.

Among the leading players in the "supreme discipline"

A leading manufacturer of petrol-injection pumps deploys the KADIA T line honing machine, equipped with five LH spindles, which is responsible for the key process: final processing of high pressure bores. Because of the narrow tolerances of a few µm, the components are match honed. For that, the previously manufactured pistons are measured in several measuring planes; the measurement results serve as target dimensions for the honing machine. The process flow is stored in the machine control system and is thus highly automated, so that handling costs are reduced towards zero. The new LH2 shows what it can accomplish in this challenging application – match honing is said to be the supreme honing discipline. "Compared to the previous state of the art, the geometrical precision of the bore has improved by 5-10% and the matching clearance tolerance even by 50%", Henning Klein sums up. "In his overall evaluation, the user confirms a process quality increase of 25%. A giant leap forward."

Technical data of the LH honing units

LH2LH3	
Max. stroke rate	50 m/min 50 m/min
Max. spindle speed (with inner coolant supply)	5,000 rpm 3,000 rpm
Material removal rate (rough machining, 80% utilization)	18 mm³/s30 mm³/s

LH2/LH3 range of application: Processing diameters from 0.8 to approx. 80 mm, depending on the specific processing requirements.

Typical applications: Injection pumps, gearwheels, hydraulic components, turbochargers, small precision parts, aerospace components.

Smart Dynamic Honing Technology

A highly developed piece of hardware can demonstrate its strengths only if controlled by a software which plays in the same league. Therefore, the LH honing units offer the greatest benefit in conjunction with the HMC100 high-performance machine controller, also developed by KADIA in Nürtingen. HMC100 represents the latest honing processes and measuring methods. The complex processes are translated into a simple presentation on a 19" panel. This enables an intuitive machine operation, even when it comes to sophisticated processes.

LH honing units and HMC100 are the two key components of a new overall concept referred to by KADIA as "Smart Dynamic Honing Technology". The aim of this concept: "Less complex. More efficient." The user finds these aspects rigorously implemented in both components.

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The LH honing spindles from KADIA show what they are made of, when it comes to high pressure bores for petrol-injection pumps. This application requires the "supreme discipline" of honing: match honing. In the end, the matching clearance between bore and piston is only of a few µm. Due to the higher pressures, the clearance is even smaller in the case of diesel-injection pumps.