

A Look at Intelligent Workholding and Toolholding

New Solutions Aim at Reducing Changeover Times and Improving Reliability

Matthew Jaster, Senior Editor

The notion of smart workholding and toolholding is a bit redundant when you think about it.

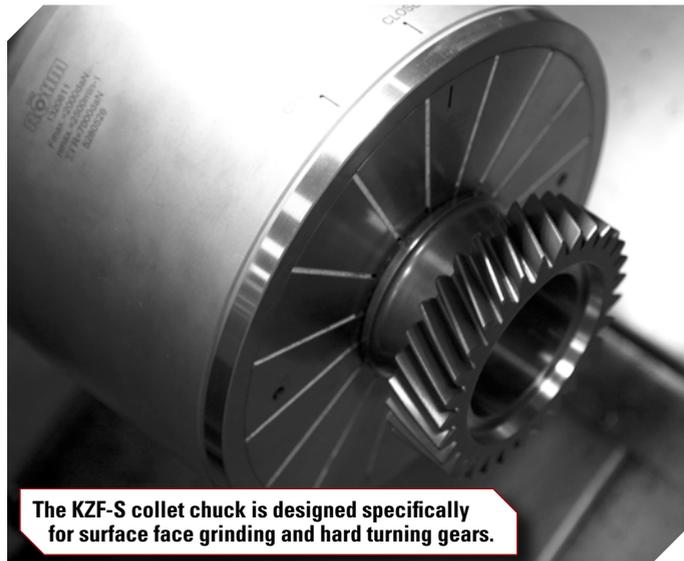
Sure, the marriage of information, technology, engineering and communication to change how products are manufactured can be called smart, but isn't it just workholding and toolholding in 2018?

We're simply at a point in manufacturing where robotics, automation, sensors and condition monitoring can be applied to everything from heat treating to inspection to gear grinding. Workholding and toolholding are just other areas in manufacturing that are getting "smarter" because the gear industry is demanding that mechatronics and digitalization play a significant role in the development of new products.

The "smart" designation won't last long because every process will be smart, every gear application integrated and every shop floor will be paying close attention to quality, efficiency and cost savings potential. Here's a few ways these concepts are being applied to workholding and toolholding today.

Röhms Takes on Challenges of Robotics in Workholding

Advanced turning machine chucks especially designed for gear production now provide quick-change capability. More importantly, they offer the repeatability and precision necessary for low-to-high-volume part production while simultaneously reducing changeover times. In a recent article by Matthew Mayer, CEO, Röhms Products of America, Mayer examined a shop that has benefitted from these innovative chucks: Global Gear & Machining.



Global Gear is a Downers Grove, Illinois-based manufacturer serving Tier 1 and Tier 2 diesel engine OEMs and other engine manufacturers in the broad automotive and construction/agriculture industries. Their choice of workholding is the KZF-S collet chuck from Röhms, an external clamping chuck designed specifically for surface face grinding and hard turning gears.

In the past, Global Gear would dedicate seven operators to seven machines for a single gear family. Now, with the KZF-S chuck, a single operator can handle one cell with eight machines or multiple four-machine cells.

The key to quick-change workholding solutions is a BT-style collet that mounts to a machine in a manner similar to how a bayonet-style lens mounts to a camera body. The resulting collet is longer and supported by the back face and taper for parallelism and accuracy, respectively. To change from one collet to another with this system, including clamping down on the part and verifying its orientation, requires no more than 60 seconds in total.

A big part of the quick verification process comes from the fact that the system uses a gear tooth pattern and clamps on every point of a gear's diameter rather than only three or six points. By clamping onto every tooth, the chuck ensures the precision of the gear's diameter in relation to its pitch line. This approach delivers exceptional repeatability and gear cylindricity without arduous inspection processes as the chuck can simply take an average of all teeth locations to eliminate inspection errors.

Robots can present challenges when it comes to modern quick-change workholding. It was easy to integrate traditional pin-style collet systems into automation solutions, but chucks

that clamp onto every tooth of a gear require more complex robot movements. The solution is a free-floating rotational axis.

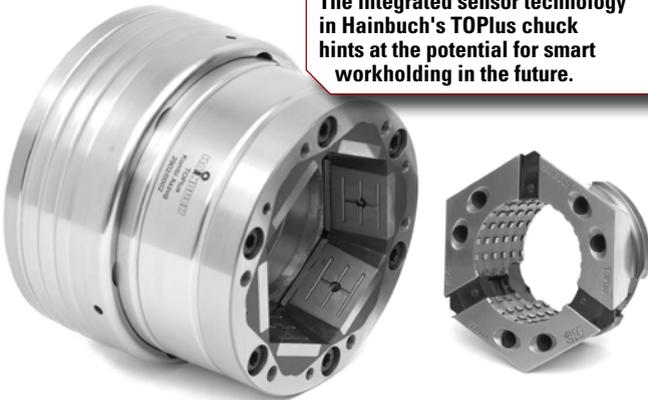
Even helix-shaped gears can be mounted into these chucks by robots when programmers instruct them to utilize a free-floating rotational axis. While applying pressure toward the chuck, the part's free-floating state in the robot's gripper allows the gear to guide itself in, much the same way as when gears are loaded manually. Of course, every system is vulnerable to human error, whether it occurs when manually changing a chuck or programming a robot to do so. To avoid any issues, workholding OEMs equip quick-change chucks with air sensing that will detect improper part seating and warn the operator. Operators can load a gear, make an initial cut, inspect it and produce a perfect gear, all with the assurance that any mistake will be easily detected and corrected before it can slow down production. For Global Gear and other gear suppliers, products like Röhm's KZF-S chucks have made it possible to thrive in a globally competitive market. The quick-change capability is what ties together every aspect of their production cells – as long as the chuck's location is established, perfect repeatability can easily be maintained from one collet to the next. As the automotive industry continues to transform transportation, suppliers and the manufacturing system OEMs they rely on have succeeded in matching their pace and creating innovative solutions that will help build the future automakers envision.

Intelligent Clamping with Hainbuch

Hainbuch's TOPlus chuck is just one example of a product that hints at the possibilities of the future of workholding. The TOPlus chuck offers more holding power and higher output due to its pyramid arrangement of guide surfaces. The clamping head rests with full-surface contact in the chuck body—even with large workpiece tolerances. This geometry ensures that TOPlus is less sensitive to contamination. The chuck is suitable for raw material, cast and forged parts as well as fine-particle non-ferrous metals such as brass.

Additionally, it offers integrated sensor technology that permanently measures the actual clamping force applied to the workpiece. Using contactless transmission of both data and energy, measurement results are sent directly to the machine's control system for processing. The control system performs a comparison with the target values and then outputs messages or makes adjustments as required. In-line checking of the

The integrated sensor technology in Hainbuch's TOPlus chuck hints at the potential for smart workholding in the future.



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dimensions of each workpiece when it is clamped can even be performed directly using an integrated system of measurement sensors. The temperature near to the workpiece is also monitored to allow temperature compensation.

Using the data harvested by the control system, it is possible to perform condition monitoring for both safety and machine efficiency. This is a mandatory prerequisite for need-oriented and status-oriented preventive maintenance and servicing. However, many modern condition monitoring systems put very tough requirements on the sensor systems, data capture and automated measurement data processing, as well as system specific knowledge.

But the cost savings potential is noteworthy because the expected working life of critical machine parts can be exploited while any required maintenance interventions can simultaneously be planned to mesh with production schedules. This makes it possible to prevent unnecessary downtime which in turn increases machine availability and reduces production shortfalls.

Essentially, the chuck can detect reject parts. If a workpiece breaks, it is discarded and the value-adding process is interrupted. This improves quality and reduces personnel costs. As a result, employees can focus more on proactive tasks. Permanent monitoring reduces the risk of workpiece loss and the resulting damage to man and machine.

The chuck has even won accolades as an innovative intelligent clamping solution. First from the Baden-Württemberg Industry 4.0 Alliance and then again at the AMB trade fair in Stuttgart.

Smart Gripping with Schunk at Hannover

In the years to come, digitalization, mechatronization and automation of production processes, will inspire the emergence of a new mindset in industrial production. The focus here is on three aspects: communication between all the components involved, maximum transparency on the system, component, control and company levels, and finally, flexible responses to external and internal events. Reduction in production costs and set-up times as well as providing efficient, intelligent, mechatronic components is Schunk's objective moving forward. Intelligent, compact, and easy to operate – that's how Schunk sees the gripping of tomorrow.

One of Schunk's latest innovations is the EGL 90 mechatronic parallel gripper. The EGL 90 offers variable gripping force between 50 and 600 N and was specifically developed for industrial applications.

Since the finger position, closing speed, and gripping force are freely programmable within a maximum stroke of 48 mm per finger, diverse components with a weight of up to 3 kg can be precisely handled in force-fit gripping. The gripper fingers can be prepositioned to reduce cycle times. The entire control and power electronics of the EGL are integrated to save space allowing decentralized operation and even mobile use due to the 24V DC operating voltage.

Standard Profibus DP and CAN-Bus interfaces allow fast and easy integration in higher level system controllers. The gripper also features a USB-port as a service interface. A brushless servo motor ensures continuous and reliable operation with no

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maintenance required. To maintain the position in the event of a power outage, the gripper features an electrically operated brake.

Since the EGL fulfills industrial standards and the basic version is connected only by means of industrial connectors, installation time is greatly reduced. The powerful mechatronic gripper is compatible with the world's most extensive standardized line of modules for gripper systems from Schunk. In combination with quick-change systems and other robot accessories, it can significantly increase the flexibility and efficiency of handling processes. It is ideal for diverse applications in the field of industrial assembly technology, mechanical engineering, and lab automation.

Schunk believes the collaboration between humans and robotics will play a significant role in the future. At Hannover Messe 2018, Schunk is exhibiting clever mechatronic components to visionaries as well as practical technicians. With their plug and play 24 V modular system, the gripper system specialist defines a new standard in assembly automation.

“Even though pneumatic components will continue to play an important role, the trend is clearly moving towards mechatronics,” said Henrik A. Schunk, CEO of Schunk. “The digital transformation of industrial production requires a networked interaction between all components involved, especially in the field of handling and assembly. At Hannover, we’ll show how broad the spectrum of mechatronic gripping is, how easy the intelligent modules are to use now, and what opportunities they offer for process monitoring closest to the part, i.e. directly on the workpiece.”

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Schunk will be focusing on the mechatronic aspects of workholding for the foreseeable future.

Small Toolholding Changes Lead to Job Shop Milling Improvements

Despite the fact that more than 750,000 CNC mills were put into service in the past 15 years in the United States, CNC machining job shops often hover at the bottom of the totem pole where there's little room for error—as most bids are won by a 1-2 percent price variance. Most low-to-mid volume run production machine shops struggle in achieving their share of the 5-10 percent maximum profit margins typically realized on most jobs.

Given these constant challenges, along with changing consumer demands, overseas competition, a lack of skilled labor, and across-the-board changes in industry—the goal becomes how to improve efficiency, quality, and profits in every business phase. CNC machining job shops are essentially multi-stage process operations where there is

potential for improvement at each stage. Consequently, achieving a shop's potential while expanding its business largely depends on how many of those improvements can be capitalized upon.

Ultimately, being better and faster keeps costs lower while raising the bar on potential profits. The ability to quickly adopt new machine tool technologies and cutting tool strategies becomes paramount to the overall success equation for today's machining job shop sector.

Vibration and chatter can result in added man hours for gear production. A complex gear must have flawless edges. If it doesn't, the manufacturer is forced to spend more time on finishing operations to get the component as precise as possible. While the future points at robotics, sensors and automation in workholding and toolholding, there's also an argument to be made that simple, efficient toolholding

changes can be effective for any job shop.

One of the quickest, simplest investments a job shop can make starts at the spindle with JM Performance Products, Inc. (JMPP) high torque retention knobs. The knobs overcome a key design flaw inherent in CNC v-flange tooling, eliminating the toolholder expansion responsible for costly and ongoing CNC milling and boring issues.

JMPP designed the knobs to be used in existing toolholders to eliminate the bulge at the small end of the holder, which stops it from making full contact with the taper of the spindle. By increasing contact with upwards of 70 percent more spindle surface, a wide range of CNC milling issues are overcome including: vibration and chatter, poor tolerances, non-repeatability, poor finishes, shortened tool life, excessive spindle wear and tear, run-out, and shallow depths of cuts.

According to JMPP President, John Stoneback, "Bridging this gap of missed productivity can conservatively help job shop operations achieve a 10-20 percent competitive advantage per hour via faster set-ups, better feed rates, and more rigid tools—reducing tooling cost by 20-50 percent or more. In essence, every tool on the machine works better and faster to make job shops more competitive and increase profit margins dramatically."

The fact is all U.S. manufacturers will have to bundle more technology in their products to compete—at home and globally. The power of combining lean manufacturing with modern technology is even more important to today's small-to-medium job shop where everyone is competing for the same work. The positive short-and-long term effects of optimizing production methods with JMPP's High Torque retention

knobs can help shops realize their full potential with a low risk/high return ROI ratio.

According to JMPP Plant Manager, Craig Fischer, "A small advantage in labor hour savings alone can help impact a job shop's leverage in getting the job. With payroll hours reduced and machine hours freed up, the collective ability to get more work goes up. Additionally, everyone's tooling budget keeps



going up as the cost of buying carbide from China increases. Factoring in a conservative savings on carbide tooling costs of even 5 percent when using our knobs is significant, as all of these value-added factors collectively add up in a job shop winning more work in today's competitive climate."

Key design elements of JMPP's patented High Torque Retention Knobs include: Longer than traditional retention knobs, with a precision pilot to increase rigidity, a relief below the flange forces threads into a deeper cross section of the toolholder. The knobs are hard turned to ensure precision fit, and are balanced by design with threads cut to start and finish 180 degrees from each other. ⚙️

For more information:

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