

The Art of Versatility

Grinding technology on display at Gear Expo and EMO

Matthew Jaster, Senior Editor

Whether you spent time at Gear Expo in Indianapolis or EMO in Hannover, there was certainly new technology attracting attention. Machine

tools are faster, more efficient and can integrate numerous functions in a single setup. Grinding technology is turning science upside down and inside out with high-speed removal rates and increased throughput. The mad scientists (engineering wizards) have been hard at work in their labs to make gear production more flexible in the coming years. The future of some of this technology is just getting started. How fast and efficient will gear grinding become in the coming years? How will gear manufacturers adapt to some of these new technologies? While we don't have the answers, it's safe to say productivity is definitely increasing and the versatility in machining processes continue to add value for both job shops and OEMs.

Klingelnberg Viper 500 Series

The Höfler Viper 500 series from Klingelnberg offers pre-finishing and finishing of complex gears including process design, cutting, measuring, deburring, grinding and quality control. "We offer three machining configurations including the Viper 500 (profile and internal grinding), Viper 500 K (profile, internal grinding and spindle option K) and Viper 500 W (profile, internal and generating grinding)," says Ralf-George Eitel, managing director, sales and service at Klingelnberg. "These machines are highly adaptable, offer a quick changeover, low maintenance and optimal energy efficiency."

The Viper 500 series can go from generation grinding to profile grinding by swapping out the grinding wheel, grinding wheel flank and dressing wheel in less than five minutes on the 500 W (which was on display during Gear Expo). "We're offering the customer high productivity with the lowest possible cost per piece," adds Eitel. "This is made possible with our comprehensive service offerings and the technical expertise and support from the Klingelnberg engineers."

Eitel is also proud of the energy efficiency highlights on the machine including cooling units, optimal axis weight compensation and energy-optimized grinding oil nozzles. This overall modular approach gives gear manufacturers the tools necessary to succeed in areas like agriculture, mining, material handling, aerospace, wind power and maritime propulsion technology, Eitel says.

Overall, the Viper series allows optimized five-axis machining of an entire range of modifications in the shortest possible grinding time. The proprietary *GearPro* software offers routine operation for the attendant even when the applications are complex.

GearPro includes many module options for best-fit, high-speed and adaptive grinding as well as dressing to enable significant reductions in production times.



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Gleason Presents Titan 1200G

The concept behind the Titan 1200G began when engineers toyed with the idea of combining multiple grinding configurations to increase productivity and throughput. "Let's combine some of the established grinding technologies like profile grinding, known for its excellent quality and threaded wheel grinding, known for its high productivity. The combination of both is what we call Power-Grind to provide more flexibility and productivity to our customers," says Dr. Antoine Türich, director of product management, grinding solutions at Gleason. "This is now possible with our new Titan 1200G including a fully-automatic tool changer, something that is not new in the general machining industry but is totally new to the gear industry."

The Titan 1200G offers a high surface finish quality combined with high productivity utilizing the automatic tool changer. The machine can be individually configured to suit customer requirements and provides maximum productivity, flexibility and quality.

"In conventional grinding there is always a compromise when selecting the grinding wheel specification to match the opposing requirements of roughing and finishing stroke," Türich says. "I compare it to tires on your car; you need certain tires for driving in the summer and certain tires for managing harsh winters. The same can be said about grinding wheels. Some are better for one process than another. With the tool changer we are now able to solve the conflict in the wheel selection and use a dedicated grinding wheel specification for the roughing operation and another smoother specification for the finishing operation. Of course the Titan 1200G can run without the tool changer as well, becoming a conventional profile grinding machine."

Türich adds that the Titan 1200G exhibited during EMO

was set up to manufacture a sun shaft of a planetary gearbox with two gear sets. "We wanted to demonstrate to attendees how the machine concept worked when you needed two different grinding wheels. The process is quite simple. We exchanged the wheel without interference and it produced excellent surface finish qualities."



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“Besides the mechanical development of the new Titan 1200G machine, we have made some significant improvements in the grinding technology as well,” says Türich. “Our new infed strategies—called: A(X) and degressive infed—allow a much better and intelligent partitioning of the total stock removal into the different grinding strokes, resulting in a much shorter cycle time and a higher process reliability.”

Additionally, the Titan 1200G includes wobble compensation, requiring less time to align large and heavy workpieces while improving quality and reducing fixture costs. “Conventional meth-

ods can require significant time to manually align the workpiece,” Türich adds. “This technology was first used on gear inspection machines. In some cases, we’ve reduced the alignment process from one hour to five minutes using wobble compensation.”

Sustainability, an important aspect of manufacturing, remains a priority with Gleason. The Titan 1200G consumes up to 40 percent less energy than older machines and is 35 percent smaller in footprint. “During setup the machine can be set into a standby mode in order to save energy, for example,” Türich says. “We’ve reviewed all energy consuming

components and reduced sizes wherever possible without a loss in machine performance. In addition the machine requires much less floor space, for which our customers thank us.”

The Titan 1200G was a key point of interest for our customers at EMO. “Overall, we had 20 percent more visitors to this show than the last EMO,” Türich says. “We collected leads from every customer, took some machine orders and we’re extremely happy with our presence and with the customer experience we provided this year.”

Star SU/Samp Gear Grinding Technology

Based on established concepts from previous Samputensili models, the G 250 is an innovative, compact and extremely flexible gear grinding machine. It has been developed for very low cycle times and for top-quality and efficient mass production of gears with outside diameters up to 250 mm and shafts with lengths up to 500 mm. The dual work spindle concept efficiently eliminates non-productive auxiliary times. Additionally, the loading/unloading process of a workpiece is carried out in masked time, while the G 250 manufactures another workpiece simultaneously.

The grinding spindle allows the use of long grinding worms to raise the tool life of single or combination worms. The extremely high rotational and linear accelerations offer appro-

prate cycle times, and the G 250 is suited for future developments in the grinding tool sector. The profile dressing unit consists of a standard profile diamond dressing roll mounted on a dedicated spindle, which is located on the rotating table structure. An optional diamond OD dressing stick can be mounted on the dressing unit structure, in order to have the necessary flexibility to dress the OD of the grinding wheel.

If the tooth root diameter must be ground as well, a tip radius dressing roll is applied to create the required tip radius on the grinding tool. When required, the dressing unit is automatically brought into the working position by the rotating movement of the worktable. This guar- antees

an extremely precise and rigid positioning, which is of fundamental importance in order to obtain an excellent result. The dressing movements are actuated by the interpolation of the axes. The possibility to use generic profile dressing rolls on the machine allows you to save money and guarantees a fast supply of dressing tools. You may employ both single- and double-flank dressing rolls, as well as multi-rib type.

Non-productive dressing times can be reduced considerably by dressing via a diamond-plated dressing gear. With its total length in contact and its ten times larger diamond-plated surface, the dressing gear dresses a lot faster and with less wear, thus much more productively than a single dressing roll. Moreover, dressing tool changes are reduced as well. For the dressing cycle, the dressing master is transferred like a workpiece from an external station into the work area. Consequently it always stays clean and is not affected by swarf or heat.

Depending on your application, the G 250 machine can be easily equipped with various automation solutions to produce parts in small and large quantities, with shorter lead times, preserving high quality at lower costs. The G 250 can be linked, for example, to a robotic arm, which is normally installed next to the machine and manages the loading and unloading process of workpieces. Optionally a pallet storage solution can be integrated for a continuous workflow without any interruptions.



Liebherr: Short Grinding Times with High-Production Quality

The newly designed gear grinding machine LGG 180 for profile and generating grinding offers compact dimensions and is suited to handle the high production demands of vehicle and transmission manufacturers. "The advantage is higher quality throughout the entire production. It gives users fast processing combined with the advances of a one-table solution," says Dr.-Ing. Andreas Mehr, grinding and shaping technology development and consultancy at Liebherr.

The machines for 180 mm and 280 mm contain the same dimensions, making it easy to develop a complete high quality production line in which all the gears are produced using a one-table solution. Manufacturers can ground planetary and sun gears, bore-type gears as well as drive and pinion shafts with lengths of up to 500 mm. New features on the LGG 180 include a new grinding head, (speeds up to 10,000 rpm and a spindle power of 35 kW), a thermally stable machine bed and reserve capacities for future grinding developments. The LGG 180 can also utilize the abrasive Cubitron II from 3M.

In addition, the machine will enable undulations to be applied specifically to gear wheel flanks for noise optimization purposes for the first time. The ability to produce sub- μ range waviness cost-effectively gives designers a whole new range of options. Features under consideration include twist-free grinding, grinding of stimulus-optimized corrections (amplitude, wavelength, phase, orientation), truing up of lines and grinding of conical gear teeth (beveloids). The newly designed user interface is individually configurable, enables intuitive operation via touch panel, and allows for mathematical analysis of waviness and twist. It also provides user guidance for process cycles and conversion cycles.



Luren Looks to Job Shops with Universal Grinding Machines

Luren Precision established itself in the industry for manufacturing and engineering gear cutting tools but has expanded in the market to provide gear grinding machines. "The LUG-3040 is a great example of Luren's machining versatility," says Darian Ditzler, sales and service manager at Luren. "This machine is perfect for job shops. It utilizes a Fanuc controller and direct drive motor for the workpiece spindle and a built-in motor for grinding. It offers a wide range

of specifications and software capabilities for multifunctional machining."

In addition to the LUG-3040, Ditzler says the LWT-3080 attracted interest during Gear Expo. "This is our best-selling machine in the States, thanks to its competitive price and the direct drive motor and linear motor." Luren's *Smart Dialogue* software offers flexibility as well as management of the grinding/dressing cycle without the need for the external PC.

The company plans to bring more machines to the States that are being utilized in Asia in the near future. Currently, Luren offers hob sharpening, worm thread grinding, horizontal and vertical grinding, and CNC universal gear tool grinding machines.

Ditzler was happy with the concentrated traffic that visited Luren's booth during Gear Expo in Indianapolis. "We've received some great feedback this week. We're walking away with a couple of prospects for our universal grinding machine. While it's a small show, it's a much better focus than you'll find at IMTS or the larger trade shows. I think we're going to get a larger booth in Detroit in two years and focus on bringing more engineering personnel to talk about our increasing machine capabilities."



3M Offers Grinding Strength and Precision with Cubitron II

Made of precision shaped grain (PSG), the Cubitron II offers a more uniform surface finish, no grinding burn (if used properly) and can cut production time, dressing amounts and dressing cycles in half. It was also widely discussed on the exhibition floor during Gear Expo. Walter Graf, 3M, invented this gear grinding technique and plans to contribute more information to *Gear Technology* magazine in future issues. What we do know is that Cubitron II has been demonstrated on some of the latest and most advanced gear machine tools. Those involved in the demonstrations agree that the abrasive offers great potential to reduce machining time, the number of passes can be significantly reduced



and the possibility of soft/green generating grinding will be examined in the future. Graf presented a technical paper titled "Precision Shaped Grains Turn the Concept of Gear Grinding Upside Down" during the AGMA Fall Technical Meeting (FTM).

Meanwhile, 3M grinding solutions were also exhibited at EMO, including a full range of the Cubitron II abrasives. These are used for the profile grinding of gears as well as for the continuous rolling and bevel gear grinding. According to a company press release, 3M also exhibited prototypes for the external and internal cylindrical grinding of automotive and industrial bearings. Application testing in industrial production has shown that the processing time can be reduced by up to half using these products—and at the highest surface quality. The lifetime increased to three to four times without risk of burning. Initial calculations show that in the future about a quarter of the production costs can be saved when using this innovative abrasive.

Erwin Junker Promotes Grinding Flexibility at EMO

Erwin Junker provided several grinding technologies during EMO, including the Lean Selection series and the Jupiter series. The Lean Selection all-round, with a grinding length of 800 mm and a center height of 150 mm, is designed for the complete grinding of workpieces used in prototype production, mold and tool making, pneumatic and hydraulic applications, precision mechanics, gear manufacture and medical technology. The machine makes short work of wide-ranging different workpiece geometries, including cylindrical diameters, tapers and radii, shoulders using angular infeed grinding, OD and ID threads as well as punches. The machine can be equipped with corundum, CBN or diamond grinding wheels and lends itself to a wide variety of uses. The multifunctional OD and ID grinding machine is flexible for small batch runs through to large-scale series, and is used predominantly by small and medium-sized enterprises. As it offers scope for individual automation, it can also be used in production lines.

With the Jupiter series, grinding means centerless cylindrical grinding—depending on the application

with corundum or CBN. The Junker CBN high-speed technology enables high grinding performance with a simultaneous, long grinding wheel service life and provides considerable production advantages for high-volume applications as well as smaller lot sizes and a broad range of variants. The high axial feed rate, with through grinding, makes the process remarkably fast and delivers exceptionally high output performance. The Jupiter machines enable straight infeed grinding for the centerless grinding process, in addition to angled infeed grinding made possible by the Jupiter 125. The Jupiter 125, 250 and 500 machines offer a large number of functions, which considerably reduces the effort required for set-up and conversion as well as overall production time. The settings on the patented height-adjustable supporting rail are automatically calculated by a software tool. While the regulating wheel is worn down, both the position of the regulating wheel and supporting ruler are automatically adjusted by the patented height adjustment of the ruler. The Junker control electronics compensate this change in position with corresponding tracking of



the grinding and regulating wheel, ensuring precise, constant grinding at all times. Following each dressing process, the position is automatically re-calculated and the grinding wheel is immediately corrected. The quality of the concentricity remains constant while requiring less time to adjust the centerless grinding process without compromising performance. Depending on the workpiece requirements, the Jupiter series can be offered with an internal or external loading system. The loading systems can be combined with various feeding and discharge systems, such as conveyor belts, vibration conveyors or systems adapted to customer-specific requirements. The measuring systems are individually adapted to the workpieces and customer specifications. Junker offers a wide range of options for the Jupiter series, such as retrofitting for CBN grinding.

Gear Grinding 2014

As mentioned earlier, many of these new grinding concepts are in early production runs and will continue to add capabilities and features in the near future. *Gear Technology* will check back in around IMTS next year to see how these gear grinding technologies continue to evolve. ⚙️

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