

Grinding, Finishing and Software Upgrades Abound

Matthew Jaster, Associate Editor

Machine tool companies are expanding capabilities to better accommodate the changing face of manufacturing. Customers want smaller-sized equipment to take up less valuable floor space, multifunctional machines that can handle a variety of operations and easy set-up changes that offer simplified operation and maintenance. Recent grinding and finishing innovations include Mitsubishi's new ZE40A and ZE60A grinding machines, Reishauer's grinding wheel technology, Liebherr's LCS 1200, Gleason's Opti-Grind technology and the multifunctional capabilities of Samputensili's Invento series. These

companies are proving that R&D is essential as they actively seek out more accurate drives and guidance and control systems in an effort to achieve better gear tolerances.

Mitsubishi. With the release of the new ZE40A/ZE60A series and future upgrades to the ZI20A internal grinding machine, Mitsubishi Heavy Industries America, Inc. is keeping busy in the gear market. Ian Shearing, vice president of sales at Mitsubishi, recently discussed the advantages of the company's newest grinding technology.

"High speed, smooth rotation without vibration, resulting in higher

gear accuracy and lower gear noise," Shearing says. "Approximately 50 percent of the floor space for any grinder is occupied by the coolant tank and temperature control systems. Mitsubishi has concentrated on this area to reduce the floor space required by the system while at the same time maintaining its working efficiency."

The ZE40A/ZE60A can accommodate both generating grinding and profile grinding and also enables modification of biased flank shapes, i.e., tooth surface torsion. Mitsubishi's Machine Tool Division will explore demand for the new machine, primarily targeting job shops that produce a wide variety of gears in small lots.

"Owing to the development of special operator software, the equipment is easy to use," Shearing says. "By simply answering easy gear-related questions, the machine's CNC program control is able to write the process program automatically."

The ZE40A, a nine-axis, fully automated numerical control (NC) machine, was developed with features such as high-precision machining for a broad variety of workpieces and easy setup changes. In order to accommodate small-lot production of various gear types, the machine offers easy and simple operation and maintenance and compact size for reduced installation space.

The new machine has achieved smooth revolution of the main (grinding) spindle and table spindle through adoption of a direct-drive system employing built-in motors to elimi-

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The ZE40A/ZE60A series is aimed at job shops that produce a wide variety of gears in small lots (courtesy of Mitsubishi).

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nate vibration from reducers. In the dressing unit, which functions to maintain the shape and sharpness of the grinding device, torsion angle adjustment is automated by NC. The installation space required for the ZE40A, 3,750 mm in width and 4,000 mm in depth, marks a 15 percent reduction, even when compared with the ZE15 and 24A models for smaller workpiece machining, achieved by slashing the size of the coolant device and rearranging the hydraulic and pneumatic devices.

While the maximum external gear diameter of workpieces is 400 mm for high-efficiency machining by the ZE40A, the machine can actually accommodate up to 600 mm diameter workpieces when machining requirements are stepped down, thanks to the wide space secured around its workpiece table. The ZE40A is able to machine gears with between 0.5 and 8 modules. Users can set the desired gear shape, in either generating grinding or profile grinding mode, by inputting NC data. In the case of helical gear machining, it is possible to modify bias generated during crowning.

With the addition of the ZE40A universal-purpose gear grinding machine to its product portfolio,

Mitsubishi will now further boost marketing activities in a quest to expand users of its gear cutting machines.

As far as grinding technology moving forward, Shearing says that Mitsubishi's ZI20A internal gear grinding machine will be enhanced with external gear grinding for cluster gears and shaft-type pinion gears. "This development will enhance and expand the capabilities of the machine, thus opening it up to a wider customer base."

Reishauer. Since the introduction of the current generation of Reishauer machines in 2001, the continuous generating grinding process has become the dominant gear finishing process among the available alternatives for new transmission projects worldwide. This success is mainly due to the fact that the final quality and process reliability, along with decreasing production costs per piece, can be achieved with the continuous generation process.

"Production costs are not only dependent on the machine but as well on the required tooling," says Michael Engesser, CMO at Reishauer. "Reishauer has decided to take advantage of its extensive knowledge of this technology to develop new tools to further reduce the costs per piece."

Reishauer now takes the next step with the introduction of a new grinding wheel that is specifically designed to meet the high requirements of continuous generating grinding technology.

Introduced during the 2010 AMB exhibition in Stuttgart, Germany, the new grinding wheels have been successfully launched into production for various customers worldwide. Based on several applications, the grinding wheels have demonstrated extended life and increased productivity given the tough environment of industrial use. These new wheels are available in a variety of specifications including increased demands in surface finish, hardness of the workpiece material or tool life.

In addition, Reishauer grinding wheels can also be used for discontinuous profile grinding on the latest generation of Reishauer gear grinding machines. Reishauer has invested in a new production site in the state of Luzern, Switzerland for the production of the grinding wheels. "By optimizing production facilities to produce only grinding wheels for Reishauer gear grinding machines, production costs can be kept at a competitive level, despite the technological benefits for the customers. Currently, production capacity is ramped up to meet the increasing demand for this unique new product of Reishauer AG," Engesser says.

Liebherr. The LCS 1200 from Liebherr combines both generating grinding and profile grinding into one machine. It is able to handle workpieces up to a diameter of 1,200 millimeters.

"Gears up to module 12 can be economically processed with the generating grinding method," says Dr. Alois Mundt, managing director at Liebherr-Verzahntechnik GmbH. "The machine has the capacity to produce noise-minimized gears in a two-flank grinding process exactly to a specified twist design."

With profile grinding, gears up to module 22 or a profile height up to 50 millimeters can be ground. Tools with either electroplated CBN or dressable tools with a corundum, sinter corundum or CBN basis can be used for both grinding technologies. The high pro-



Grinding wheels from Reishauer have demonstrated extended life and productivity, according to Michael Engesser, CMO (courtesy of Reishauer).

ductivity machine can be supported by machine integrated automation, also designed and built by Liebherr in Kempten, Germany. For the generating grinding method, the maximum outside diameter of 320 millimeters on a grinding worm and the minimum usable diameter (which depend on the gear data), built in combination with the tool length of 230 millimeters, offer the longest tool life in this machine type class on the market.

The technical data of Liebherr's LCS 1200 includes a maximum workpiece diameter of 1,200 mm; workpiece speed of 250 rpm; maximum module (generating grinding) of 12 mm; maximum module/profile height (profile grinding) of 22/50 mm; maximum axial travel of 1,000 mm; maximum tool speed of 12,000 rpm; total weight of machine of 28,000 kg.

Gleason. Gleason's latest generation of profile grinding machines are equipped to perform Opti-Grind, a process that improves productivity and quality levels for fine finishing cylindrical gears as large as six meters in diameter, and up to module 16. The Opti-Grind process enables end users to achieve both "optimum" productivity, and "optimum" surface finishes, by simultaneously using multiple dressable grinding wheels for profile grinding rather than just the single grinding wheel that is typically used. The process offers end-users a number of variations to choose from to meet their specific applications.

Opti-Grind's multiple-wheel configuration offers advantages for gear producers serving the wind power and other industries requiring optimum surface finishes. Where a single dressable wheel must be designed for compromise in order to perform both roughing and finishing, the multiple wheel configuration of Opti-Grind makes it possible to utilize wheels designed for maximum roughing productivity, up to 40 percent faster than a single dressable wheel. Then a finishing wheel is designed to produce the desired tooth modifications including grinding of the root without burning, and to deliver surface finishes up to four times finer than what would be possible conventionally.

In addition to the new multiple wheel design, the Opti-Grind process

relies on the use of the latest Siemens 840D CNC and Gleason Windows-based *Intelligent Dialogue* software to greatly simplify setup and operation.

Samputensili. Samputensili developed the HG 1200 Invento for production of large gears with a diameter up to 2.5 m and module 35.0. It is distributed in the United States, Mexico and Canada by Star-SU.

While some gear manufacturing machines are limited by the basic difference between the processes of hobbing and grinding, the HG Series overcomes this problem, thanks to its functioning principle: during the hob-

bing process the hob head is blocked to unload the cutting forces to the stable tool column while the table slide actuates the feed travel. In this way the strong hobbing forces can be mitigated without compromising the necessary grinding quality in the long run.

When grinding, the process is reversed. The tool head is unlocked and moves against the blocked work table. In this way the reference axes during the centering and grinding process maintain the right position and guarantee the required highest precision. In the same way, the optional

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Gleason's Opti-Grind process debuted in 2010 and enables users optimum productivity and surface finishes (courtesy of Gleason).



The LCS 1200 combines generating and profile grinding in one machine (courtesy of Liebherr).

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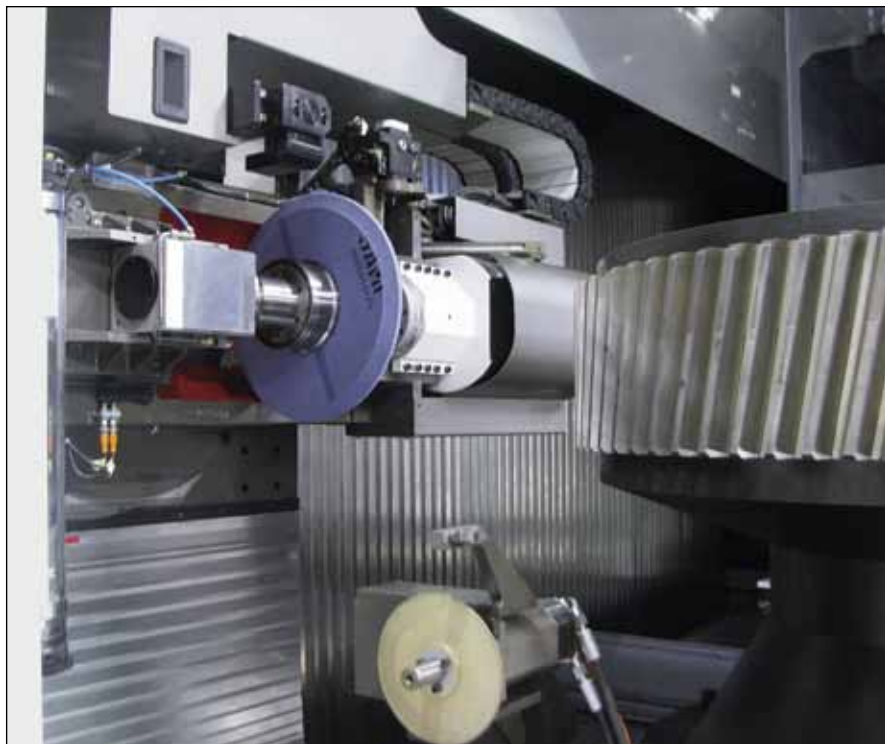
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The HG Invento series executes various processes including grinding with optimal precision (courtesy of Star-SU).

back columns are fixed laterally to the work table so as not to block either the access to the working area or the optimized flow of loading and unloading workpieces.

In order to execute the various processes with optimal power transmission and precision, two tool heads are available with three different spindle inserts. The stiff hob spindle of the HG Series is designed for the toughest cutting conditions. The 100 kW drive runs all state-of-the-art roughing tools—especially inserted blade roughing and finishing cutters in different combinations. Additionally, it is possible to apply a turn-milling spindle in the hob head so as to realize a wide variety of turning functions. The use of the turn-milling process is especially recommended for very small lots and prototypes, including the production of bevel gears. The grinding spindle has been designed for a large variety of different tool combinations, including single-profile grinding wheels and multi-rib wheels, as well as for generating grinding worms. Thanks to a combination of the various processes—i.e., hobbing and grinding—production time can be cut by 25 percent, provided that this is allowed by the module range of the application.

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