

### New Hobbing/Grinding Machine from Gleason

The new P 90 G from Gleason was designed to fulfill a variety of job shop goals—from shortening lead times to increased flexibility to maintaining quality in harsh environments to occupying little floor space.

The machine can be used as both a hobber *and* a grinder. As a grinder, it can use either form wheels or threaded wheels.

“The main advantage of the new machine is its universality and high quality. Hobbing and grinding can be made on one and the same machine by the same operator,” says Willy Häuptli, product manager at Gleason Corp.’s facility in Biel, Switzerland.

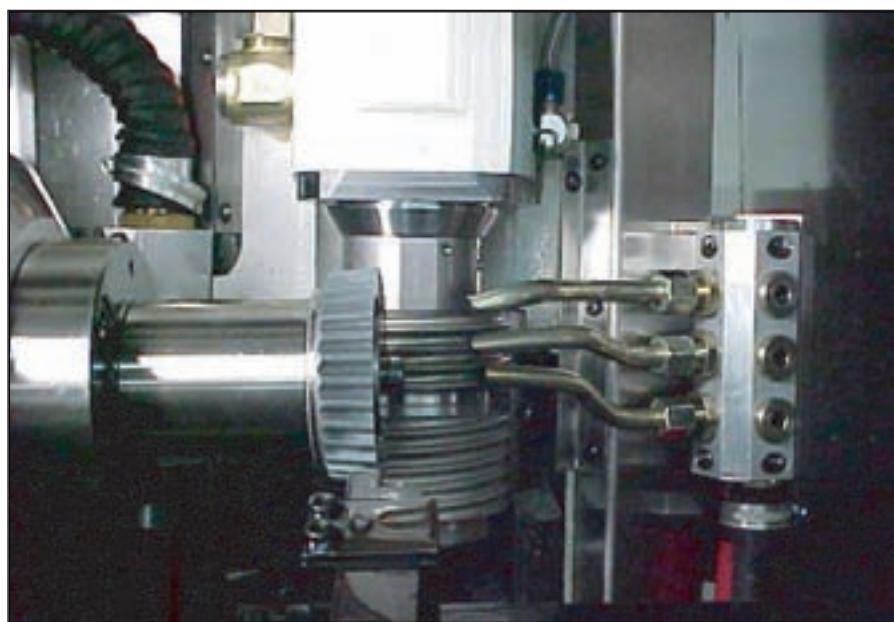
The machine is an upgrade of the company’s P 60 and P 90 series of horizontal hobbing machines with a twist. It can be set up for gear hobbing, worm milling or gear grinding. While the P 90 G does have design aspects that are identical to its predecessor, like the headstock and hob head, its uniqueness can be found in its temperature stability and in the high speed range of its direct drive spindles, says Häuptli.

The P 90 G tool spindle operates at speeds up to 12,000 rpm and workpiece spindle operates at speeds up to 5,000 rpm. These high spindle speeds translate into shorter cycle times, Häuptli says.

“This is really the ideal platform for a grinding machine,” he says. “Special adaptations for grinding have been made on the slideways, measuring systems and the sealing of the machine enclosure.”

The machine controller incorporates use of a direct measuring system, which, according to Häuptli, is a highly accurate system that takes measurements on the slide.

Optimal arrangements are available for profile grinding or generating grinding with a worm-type wheel. The machine is designed to use non-dress-



able, CBN-plated grinding wheels.

According to Häuptli, the shorter cycle times and universality of the machine have been its main selling points. Though job shops are the most obvious beneficiaries of a product like this, its possible applications can reach industries like motor sports or aircraft.

Additional features include the P 90 G’s small footprint—3.5 square meters—and its state-of-the-art Siemens CNC controller with Windows-based software interface and menu-assisted programming.

“Building this product from a proven base with proven parts by a motivated team makes it a reliable piece of production equipment from Day One,” Häuptli sums up.

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## A Leap in Gear Honing Productivity: Fässler's HMX-400

In May, a U.S. automaker will receive its first three HMX-400s, which are—at a minimum—50% faster than previous Fässler gear honing machines, says Roland Rütti, technical director for Fässler AG of Dübendorf, Switzerland.

“Today,” he adds, “the gear honing process becomes an economical alternative to gear grinding.”

Introduced in 2003, the HMX-400 was designed for automotive, truck, motorcycle and aerospace companies, as well as other businesses manufacturing high quality gears. In mid-2004, the first models were sold to companies in Europe’s truck industry and America’s automotive industry.

Fässler’s latest gear honing machine can achieve cycle times of less than 30 seconds. Also, changeover times can be as little as three to five seconds, depending on the gear. According to Rütti, the cycle times—more than anything else—make the HMX-400 economical in high volume production.

The leap in gear honing productivity mainly results from two new features: a second workpiece spindle and direct drives for tool and workpiece spindles.

The machine’s two workpiece spindles reduce both handling and honing times. While a gear is honed on one spindle, a second gear can be hydraulically clamped to the other spindle.

“With the HMX-400, you can machine in parallel where beforehand only sequential operation was possible,” Rütti says.

Of the machine’s nine axes, four use modern, dynamic direct drives. The four include hollow-shaft, linear direct drives for the tool and workpiece drives. The drives are used to meet demands for increasingly higher performance and machining accuracy from the honing process.

Also, the two workpiece spindles allow companies to automate the HMX-400 with a simple gantry loader system. Since introducing the machine, Fässler incorporated such an automated system, integrating it into the HMX-400’s control system. The loader system is now a standard feature of the honing machine.

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### HMX-400 Technical Data

Honing stone diameter	400 mm
Workpiece diameter, external honing	20–320 mm
Workpiece diameter, internal honing	50–350 mm
Maximum workpiece shaft length	400 mm
Machine dimensions (W x H x D)	2,200 mm x 2,150 mm x 3,000 mm or 7.2 ft. x 7.1 ft. x 9.8 ft.
Weight	8,500 kg or 9.37 tons
Maximum speed, honing stone drive	1,500 rpm
Maximum speed, workpiece drive	9,000 rpm
Slewing range, A-axis	+/- 45°
Slewing range, B-axis	+/- 10°

Moreover, with its spindles' drive system, the HMX-400 can perform single-flank honing that's process reliable. This ability allows for advantageous process strategies with certain workpieces, Rütti says.

The honing machine also saves time via its new integrated dressing roller. The dressing tool is diamond-coated and dresses honing flanks in the conventional manner, but it doesn't require clamping on a workpiece spindle.

"A fixed universal dressing ring, mounted on the tailstock, for dressing the inner diameter of the honing stone reduces the cost per workpiece and the dressing time," Rütti says.

The HMX-400 can make crowning and flank modifications, too. The maximum amounts of the modifications depend on gear geometry and tool design, but the minimums are 20 microns for crowning and 25 microns for flank modifications.

Also, the honing machine can improve pitch errors via its controls and direct-driven workpiece and tool spindles. Rütti explains that correcting pitch error depends on gear geometry, stock removal, and tooth thickness variation of the premachined gear, but the HMX-400 can generally improve pitch error to between DIN quality classes 6 and 2. The range roughly converts to Q11–15 using AGMA quality standard 2000-A88.

The HMX-400's two workpiece spindles also allow for online cleaning without increasing cycle times. Gears can be spun to remove oil before being unloaded.

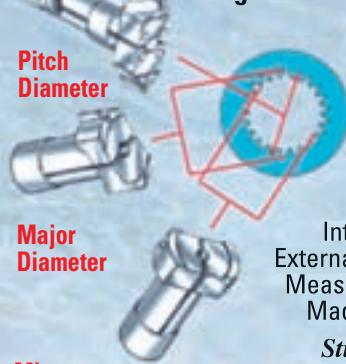
The honing machine uses a Siemens 840-D control, with a graphical operating panel. Some gear data must be entered, but the HMX-400 can use its Fässler software to automatically calculate remaining data via process curves and complex algorithms.

Moreover, the honing machine can automatically optimize many process parameters, helping operators run the machine well without detailed background knowledge.

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The HMX-400 includes new sensors to constantly monitor honing and other machine functions. Possible errors are shown graphically to simplify troubleshooting, and a built-in modem permits direct Internet transmission of data for error diagnosis.

The machine also has a tooling recognition system to monitor the use of honing and dressing tooling. The system can simplify dressing during a tooling change because the last process and dressing data can be saved. "These data help the customer to manage reorders or make the setup easier," Rütti says.

He adds that as a finishing machine, the HMX-400 can improve gear quality an average of four DIN classes.

"Depending on the premachining and gear geometry, we can achieve up to DIN 2 quality," he adds.

That quality roughly equates to Q15 using AGMA standard 2000-A88.

And higher quality offers benefits. "Honed gears produce less noise and have a longer use life than other gears due to their typical surface structure," Rütti says. "The structure of the surface of a honed gear, which resembles a fish skeleton, facilitates the formation of a lubrication film surface from the tip of the flanks to the pitch diameter and thereby positively inhibits the development of noise."

A standard version of the HMX-400 costs about \$840,000, or about €650,000. The standard version includes two workpiece spindles, force control, a fixed dressing ring on the tailstock, an integrated automation system, a Siemens 840-D control, a B-axis for flank modifications or tapered gears, and an easy-to-use operator interface.

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The SDZ broaching machines from Stenhoj Hydraulik.

### Push-Pull Concept for Precision Broaching

MVS Metform, a division of MacLean Vehicle Systems, has recently installed a new type of broaching machine for high volume machining of internal splines in gear blanks. Located in Savanna, IL, Metform expects this technology, from Stenhoj Hydraulik of Denmark, to help it control the lead error on its parts, a critical factor in keeping its auto industry customers happy.

Most modern broaching machines are designed to pull the broach tool through

the part. In some cases, broach tools may be pushed through the workpiece. But this new machine, Stenhoj's SDZ model, uses a simultaneous push-and-pull technique designed to help keep the broach tool perpendicular to the part.

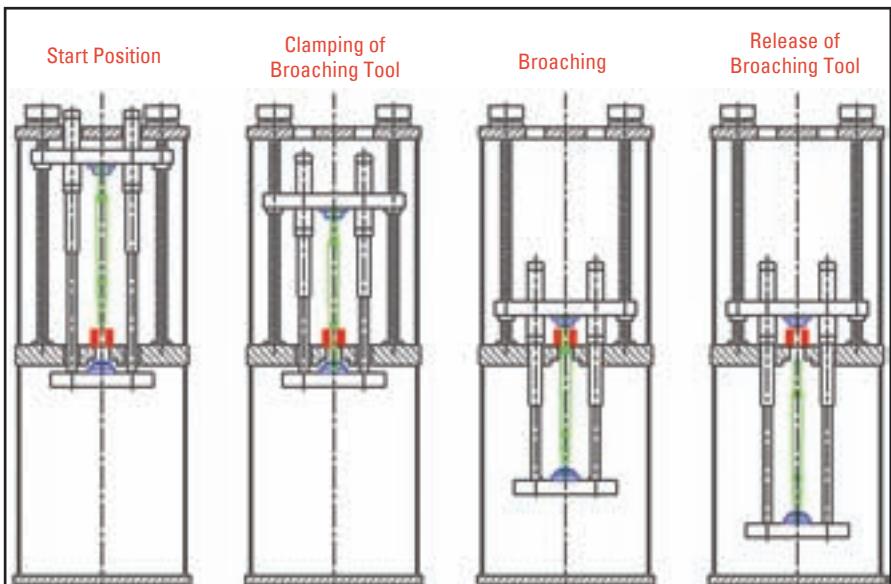
"The key unique factor of the machine is the push-and-pull bayonet collet system that actually very firmly controls the cutting action and the path of the broach tool," says Ken Nemec, president of Broachman LLC, Stenhoj's North American representative. "No other broaching machine has a system like this."

According to Nemec, the broach tool is held both top and bottom during cutting in hydraulically clamped collets. Those collets are mechanically linked so they move in unison.

"They're firmly being held and pushed and pulled simultaneously through the part, distributing all the power very evenly and keeping the broach on a firm, rigid path," Nemec says.

On a typical vertical broaching machine, Nemec says, nothing holds the top end of the broach, which can lead to tool movement on some parts.

For Metform, controlling such movement was a critical factor in



The patented push-pull broaching process from Stenhoj helps control lead error and improve tool life.

deciding on a broaching process.

"The most important feature of the Stenhoj Hydraulik broach machine is that the cutting force and drive mechanism are in alignment," says David Collier, product development engineer at Metform. "The push-pull feature helps maintain alignment of the tool to the part locator, for the full length of the cutting stroke. This helps hold the spline perpendicular to the locating face, which is a critical feature for our customer."

Controlling the lead error is critical for many broaching customers, Nemec says. "If the splines are straight up and down, the lead is good. If they have a tilt to them or an angularity to them, then it creates gearbox noise and premature wear in a gear, and that's what we're trying to avoid."

According to Nemec, the machine controls lead so well that even after heat treating, parts don't need any subsequent finishing operations. Often with other technologies, parts have to be hard turned or re-broached after heat treating. "This application makes both of those unnecessary," Nemec says, "because the lead error can be held so close."

Metform has been using the technology for more than a month. "So far, we have seen excellent results," Collier says.

Another important feature of the



MVS Metform in Savanna, IL, recently installed a new Stenhoj broaching machine.

Stenhoj technology is that it helps increase tool life, says Nemec. The SDZ is an electromechanical machine, which results in smooth motion, as opposed to a hydraulically driven machine, which tends to be less smooth, Nemec says. "The hydraulic action almost acts like sandpaper on a broach. You can feel it when you touch a broaching machine. You can feel the bounce. That prematurely

wears a broach tool."

In addition, because most broaching machines don't hold the tool as rigidly, that also affects tool life, Nemec says. "When it pulls off to one side or pulls off to the other, the broach tool gets uneven wear characteristics."

Between the smooth electro-mechanical motion of the machine and the way it rigidly holds the broach tool,

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most customers can expect significantly increased tool life—in some cases double or more, Nemec says.

The machine at Metform is set up with two stations. In other words, it broaches two parts simultaneously. The SDZ machines can be set up for one, two or three stations.

All Stenhøj machines are equipped with an automatic shuttle table. The parts

are placed on the table by an operator, robot or pick-and-place unit. The table shuttles the part into the machine, and then the tool is loaded and clamped both top and bottom. The part is broached, the tool is released and the part is shuttled out on the table for removal.

The broaching process is driven by planetary spindles, which, according to Nemec, are more accurate and rigid than

ballscrews, which are commonly found on broaching machines. "The planetary spindle has virtually no backlash," Nemec says. "It is rated at having a one micron per foot backlash, which is virtually none."

The planetary spindles also have electronic error correction built into them, so the Stenhøj machine's twin spindles always rise and fall in unison. "Because they're using planetary spindles with a rigid drive system, the planetary spindles are always exactly lined up," Nemec says.

Also, the Stenhøj machines are equipped standard with a self-contained, maintenance-free coolant filtration system. "It makes maintenance a non-issue," Nemec says.

The Stenhøj machines are priced competitively, Nemec says. "We're right about in the middle of where the market is price-wise now," he adds. "When the euro and the dollar stabilize, we feel like we're really going to have an edge in the marketplace."

The Stenhøj machines come in a variety of sizes and configurations, with stroke lengths up to 72".

So far, the people at Metform are pleased with their results.

"The machine has performed well," Collier says. "It is very quiet and uses much less floor space than some other designs we considered. We are now anxious to study tool life to see if this also meets our expectations."

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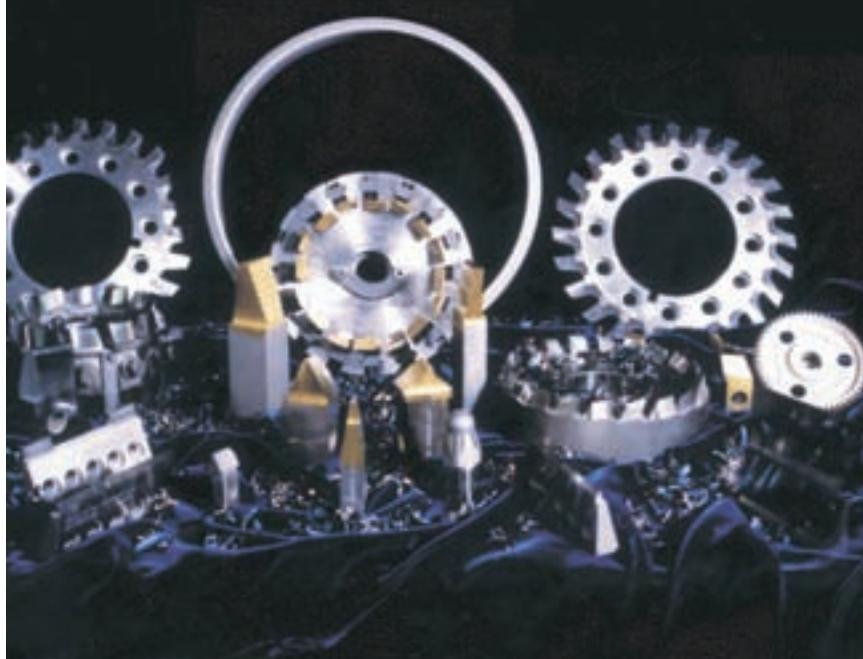
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