

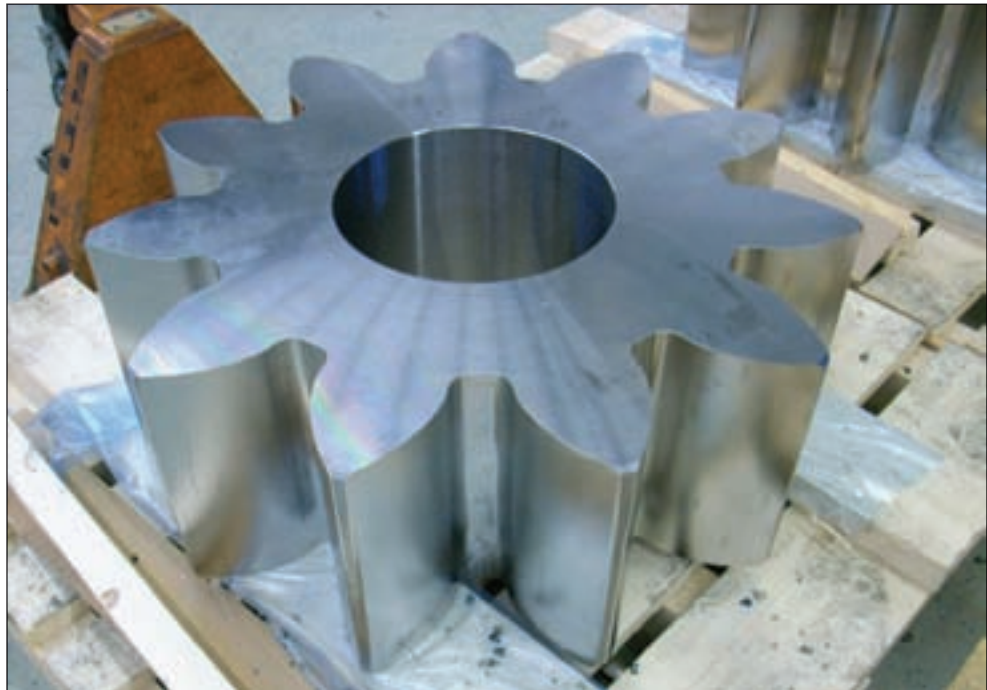
Cutting Gears on a Machining Center

DEPO PROVIDES ALL-IN-ONE MACHINING CAPABILITIES FOR GEAR INDUSTRY

In an age of continuous improvement and lean manufacturing, the gear market seems in favor of flexible technology now more than ever. What if a



A coarse pitch double helical gear completely machined by Depo, including chamfering and deburring (courtesy of Depo).



A large spur gear finished using the Depo concept (courtesy of Depo).

company could provide the software, the CAM system, the cutting tools and multi-axis machining centers capable of cutting any type of gear? This was the question engineers at Depo, headquartered in Marienfeld, Germany, asked in 2005.

High speed machining, a milling process that uses standard, high performance solid carbide and indexable 3-D milling tools, has long been used in the mold and die industry. The technology allows high performance tools, in conjunction with multi-axis machining centers, to run virtually lights out. In addition, it allows a manufacturer to minimize operator involvement, thus reducing labor costs while improving workpiece accuracy and surface finishes.

“Depo transitioned into a complete solution provider in the mid 1990s with its *DepoCAM* software and its own line of optimized, high-end vertical and horizontal multi-axis machining centers,” says Brian Nowicki, vice president of Tech Tool & Abrasives and a North American sales agent for Depo. “This

made Depo globally capable of providing their customers with a fully integrated turnkey machining solution all from a single supplier, with all aspects manufactured and designed in-house.”

In 2005, Depo was asked by a large European gear manufacturer to visit their facility to evaluate the possibility of using their successful multi-axis machining solutions for manufacturing gears. In evaluating this request, the management and engineering staffs came to the realization that a gear tooth form is nothing more than a complex 3-D shape. As they continued their investigation, talking to potential customers, they asked themselves why this technology wasn’t already in use in the gear industry.

“The fact was that every gear print—including all of the necessary gear data to manufacture a gear using traditional gear cutting processes—did not translate for high speed machining,” Nowicki says.

Depo immediately went to work to develop a solution for this issue, starting with spur and helical gears. By the

end of 2007, the company introduced the first version of its *Gear Engineer* software.

“By taking a step-by-step process defining the gear’s or pinion’s dimensions, tool geometry, tolerances and tooth profile data, a 3-D model could be generated from the existing, readily available gear data in less than 15 minutes,” Nowicki says. “This model could then be used in conjunction with *DepoCAM*, which includes a complete cutting tool library, to generate a cutter path for each of the tools in an additional 15 minutes. With the introduction of *Gear Engineer*, the gear industry is now wide open for high speed machining technology.”

The company has sold machines in both the European and Asian markets and is now looking closer at providing its unique system capabilities in North America. Depo has made external and internal spur and helical, straight bevel, spiral bevel, double helical and herringbone gears for both service and production parts.

“Companies in heavy equipment, farm and the mining industry have an interest in this technology specifically for service parts,” Nowicki says.

The system is best-suited for short-run gears ranging from 12 inches to 16 meters. “While cycle times are not as quick as conventional methods on smaller gears, the benefits come as you get into the larger sizes,” Nowicki says.

“In the traditional gear cutting world, each of the gear families requires a different type of machine. With this new technology, one machine is equally effective for all gear types within its given diameter range.”

In addition, the technology can be utilized for both roughing and semi-finishing of pre-heat treated gears, but it also offers the ability to “hard mill” either induction hardened or through hardened gears. From a quality standpoint, all the gears can be machined

either pre- or post-heat treatment to an AGMA 12 quality or better.

“A single machine tool cuts all gear and pinion types, it can machine all lifting and mounting holes, machine gearboxes complete and in some cases, even turn the parts prior to machining the gear teeth,” Nowicki says. “With *Depo Gear Engineer* and *DepoCAM* software,

a new gear can go from gear print to CNC program in less than 60 minutes.”

In order to use these high-speed machining principles to manufacture gears, the machine tools must be incredibly accurate and repeatable, according to Nowicki. “These are the same requirements necessary for some

continued



Inspection software from Depo allows for on-the-machine inspection of a large bevel gear (courtesy of Depo).

Advances in Depo’s *Gear Engineers* software now allow the following gears to be produced utilizing this integrated technology in the following size ranges:

External Gears

- A maximum outside diameter of 16,000 mm
- Spur gears/helical gears

Internal Gears

- A maximum outside diameter of 16,000 mm, depending on the face width dimension
- Complex workpiece up to a maximum outside diameter of 3,300 mm can be cut on a vertical machining center
- Spur gears/helical gears

Bevel Gears

- Straight, skewed-tooth, spiral
- A maximum outside diameter of

4,000 mm

- Spiral (Klingelnberg Palloid and Cyclo-Palloid, Gleason system)

Pinions

- A maximum shaft diameter of 350 mm (depending on the table options)
- Total workpiece length, including the teeth, can be customized as needed by modifying the foundation layout

Double Helical/Herringbone Gears

- A maximum outside diameter of 16,000 mm
- Continuous-tooth herringbone gears also possible

Worm and Worm Wheels

of the high-end mold and die applications that Depo was already very familiar with.”

Depo recently went to work on what is now known as their Depo Expert Line. This new line consists of five- and seven-axis vertical and horizontal machining centers, which are all

dual-column machines with a five-axis simultaneous positioning accuracy of five microns or better. They include thermal compensation, broken tool detection and on-the-machine workpiece inspection; all features necessary to produce gears of the highest quality.

“When gear manufacturers first hear

of this technology, the first question is commonly, ‘What type of tool do you use?’ Understandable, as our industry has been built using hobs, shaper cutters, shaving cutters and stick blades, all with the tooth form already existing to a large degree,” Nowicki says. “Not anymore. Using high speed machining principles, all types of gear forms can be manufactured using standard, conventional, off-the-shelf solid carbide and indexable carbide cutting tools.”

In high-speed machining, the tooth form is generated by way of the CAM software and machine tool control. The result is a fully-integrated gear manufacturing system that includes *Gear Engineer* to generate the surface data, *DepoCAM* to generate cutter path, Depo’s Expert Line machine tools for accuracy and Depo’s high-end tooling solutions, all integrated and designed to produce the gears.

“The flexibility that this technology brings will help to free the industry from the long lead times traditionally considered acceptable in the gear business,” Nowicki says. “Low lot sizes, coarse pitch gears, large gears and much more can now be produced with significantly shorter lead times.

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| Gear Diameter | 50-1000 mm |
| Center Distance Above Table | 360-1360 mm |
| Axial Stroke (Max) | 650 mm |
| Helix Angle | +/- 45°, 90° |
| Module | 1-25 mm <i>(extendable to 34 mm)</i> |
| Profile Height | 41 mm <i>(extendable to 60-80 mm)</i> |
| Grinding Wheel Width | 60 mm <i>(extendable to 90 mm)</i> |
| Grinding Wheel Diameter | 400 mm |
| Table Load | 3000 kg |



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Gleason Cutter Head

IMPROVES TOOL LIFE
AND PRODUCTIVITY



The Pentac Plus is the latest generation of Gleason's Pentac bevel gear cutting system. It is designed to allow much higher tool life and improved productivity, especially for cutters using multiple face blade geometry.

The blade clamp block design of the Pentac Plus is a new feature that makes height and radial adjustments easier and faster to perform, so precise axial blade movement during cutter building and truing results.

The Pentac Plus prevents chip packing, the accumulation of chips between cutter blades during gear cutting, which is a frequent issue with previous cutter designs. Chip flow is often insufficient in front of the outside blades because the side rake angle obstructs the chip chamber in the direction of centrifugal force, which results in weak chip evacuation. If this issue is not resolved, pressure increases and extreme temper-

atures of the highly compressed chip packing will eventually distort blade geometry. The result is early blade failure and rejected parts, and in the most severe scenarios, multiple cutting blades may break.

"To avoid chip packing, machines

are usually operated with fewer cutting blades at conservative speeds and lower feed rates. The new Pentac Plus is designed to enhance chip flow and prevent chip packing," says Hermann J. Stadtfeld, vice president of bevel gear

continued

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technology for Gleason. "Therefore, gears can be cut with more efficient cycles without premature degradation of the cutting blade efficiency. The net result is longer tool life and lower cost per part."

The Pentac Plus cutting system is

available for face hobbing and face milling in all cutter sizes, and it can be adapted to any existing Gleason gear cutting process without new software or hardware. The Pentac type cutters are sold in Japan under the name Superi-Ac.

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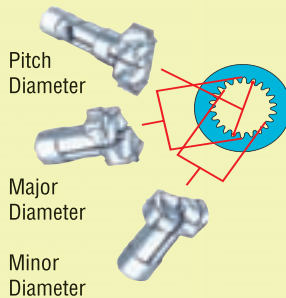
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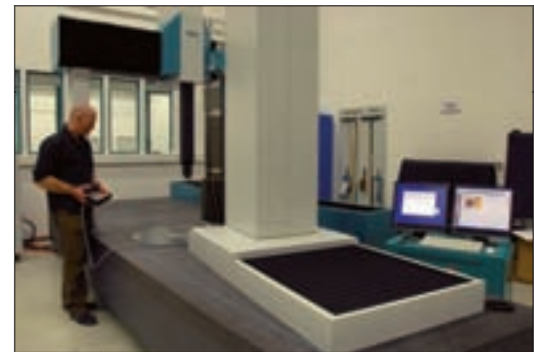
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Hybrid CMM/GMM

MEASURES WIND TURBINE GEARS



**The LHGT 2600 Hybrid CMM and GMM
is designed for wind energy industry
measurement needs.**

Wenzel Geartec introduced a hybrid gear measuring machine at Gear Expo this year, which is specifically designed to measure the large gears and pinions used in the wind energy industry.

The Hybrid LHGT 2600 machine features a prismatic measuring volume of 1,500 mm x 2,500 mm x 1,200 mm, and it has an embedded hydrostatic rotary table flush-mounted inside an Impala black granite machine base. The table and fixture measures and supports gears up to 2,600 mm in diameter and up to 20,000 pounds. The machine features a removable tailstock column that can mount on the base to measure and support pinion gear shafts up to 1,900 mm in length. The LHGT 2600 uses Renishaw SP80 scanning technology.

"Wenzel has developed this

machine to specifically meet the demand of the wind energy gear manufacturing community, where large internal and external gears and pinions require highly accurate measuring as well as traditional CMM measuring of prismatic parts,” says Keith Mills, president of Xspect Solutions, Inc., the wholly owned subsidiary of Wenzel GmbH. “Traditional gear inspection machines are typically mechanical bearing devices with horizontal arms holding the scanning probe. To simply expand this type of machine design concept that was originally developed to measure 500 mm diameter gears, and apply it to 2,500 mm diameter gears, doesn’t work. For that reason, Wenzel has developed this new hybrid machine design that uses an all-granite, air bearing structure, with a bridge-type construction, so the probe can provide a much higher level of dynamics and scanning performance with no mechanical bearing wear over time. In addition, the machine requires no special foundation.”

For more information:

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 Wixom, MI 48393
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 Fax: (248) 295 4301
 kmills@xspectsolutions.com

**Robotic
 Gear
 Deburring
 System**

AUTOMATES
 CHAMFERING

Compass Automation unveiled its Robotic Deburring System at Gear Expo 2009. It features a touch screen HMI, so operators can seamlessly upload specs of a custom gear to the robot for automatic deburring or chamfering of gears, even if the customer is not mass producing the same sizes and

types. The system is customized to individual specifications, and it can be integrated into existing CNC hobbing machines for complete automation.

“This system will help gear manufacturers reduce operating costs and save valuable time in an application

continued

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that tends to be one of their biggest nuisances,” says Patrick O’Rahilly, director of Compass Automation, Inc.

“This can truly be a game-changing product for the gear manufacturing industry,” says Robert Perly, director of engineering for Compass. “It just does not make sense to allocate human

operators to the deburring process. The technology has finally arrived for robots to be able to handle small runs and the varying types and sizes of gears simply and easily.”

For More Information:

Compass Automation
Phone: (847) 426-6696
sales@compass-automation.com
www.compass-automation.com

Leitz CMM

HANDLES EXTRA LARGE COMPONENTS



Hexagon Metrology announced the Leitz PMM-G gantry CMM series at Gear Expo 2009, featuring improved specifications and extra size availability, so it’s appropriate for highly precise inspection of extremely large components, like gears used for wind power, gear segments, gear racks and geared shafts of up to 5,000 mm in diameter.

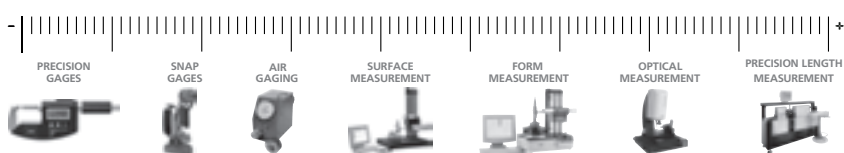
The PMM-G is configured based on customer specifications. It is made in 55 standard measuring sizes from 3,000 mm x 2,000 mm x 1,200 mm to 7,000 mm x 4,000 mm x 3,000 mm. The maximum part load is 15 metric tons. Gear types suitable for inspection include cylindrical gears—spur, helical, double helical, internal and external spline, internal and external clutch, gear segments and gear racks—in addition to straight, spiral and hypoid bevel



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- GMX series class 1 Universal Gear Testers provide fast, accurate analysis for a wide range of gear and gear tool applications on gears with ODs up to 600 mm (23.6 in).
- The Mahr Federal GMX Series systems include a motorized tailstock and a high-accuracy 3-D scanning probe head.
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and crown gears. They can be evaluated to all major standards, including DIN, ISO, AGMA, ANSI, JIS, CNOMO and CAT.

“The PMM-G represents the ultimate in Leitz large-scale gear inspection,” says Pete Edge, product manager of Leitz products. “Unlike other gear inspection products, it does not require a rotary table, which makes part loading and unloading much easier. It also allows a maximum part weight of 15 metric tons. This system is ideal for the extremely large gears used in the wind power industry, for power generation and power transfer products. Even better, the PMM-G system is not a single purpose inspection station just for gears but a fully capable coordinate measuring machine that can be used to inspect many other kinds of large machined assemblies, such as gearboxes and engine blocks.”

For more information:

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info@hexagonmetrology.us
www.hexagonmetrology.us

Air Gaging Honing Tools

PRODUCE TIGHT TOLERANCES

The Precision Hone tooling system from Sunnen uses integral air gaging and an automatic shutdown device to produce non-contact, in-process bore sizing to tolerances of 0.005 mm

(0.0002 inches). They are suitable for honing diesel cylinder liners, compressor cylinders, automotive engines, small engines and aircraft cylinder bores with diameters from 57 mm (2.25 inches) to 300 mm (12 inches).

The air gaging system is a unique

feature. Bob Davis, global communications manager for Sunnen explains how it works. “The PH Precision Hone tooling system incorporates air lines into the tool, which conduct pressurized air terminating in small ports on the edges of the tool. A feedback loop

continued

in the machine controller measures the pressure, which builds up between the hone head and the wall of the part being honed. As the diameter of the part gets larger, the pressure drops. The gaging system circuitry built into the honing machine measures the pressure and translates it into a diameter. The

machine is set up to hone to a certain diameter and automatically stops when that diameter is reached.”

The PH tools have multi-stone tool heads that are custom-designed; the number and placement of stones is dictated by the application. Bayonet air connections on the tool heads help ini-



tiate fast changeovers. The tools can connect to the rotary feed system of Sunnen’s SV-310 for precision stone feeding or the linear feed system of the SV-500 for two-stage roughing and finishing applications. They can also be used with other manufacturers’ machines. They include three abrasive options: metal-bond superabrasive (diamond or CBN), conventional abrasive (aluminum oxide/silicon carbide) and plateau brush (abrasive impregnated filament).

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CAD to project a profile tolerance band onto a comparator screen. The software runs on a standard Windows PC, which can be networked to download CAD files from a server over a secure link for protecting the original CAD files.

Operators line up eCAD projected images with a part image on the comparator screen, and eCAD incorporates various tolerance zones, as defined by the CAD file, to express whether a part is in or out of tolerance, indicated by different color bands.

The projected image can be coupled to the part screen image, so if an operator moves the worktable, the CAD image follows what is on screen. The need to maintain physical overlay templates is unnecessary with eCAD.

“eCAD would allow a customer to manually compare a gear shape to the nominal CAD geometry. A total profile tolerance could be set around the part,” says Bill Verwys, applications engineering manager for OGP. “Of course, this would not be appropriate for all gear classifications, but [it] could be very helpful for some, or as an in-process check.”

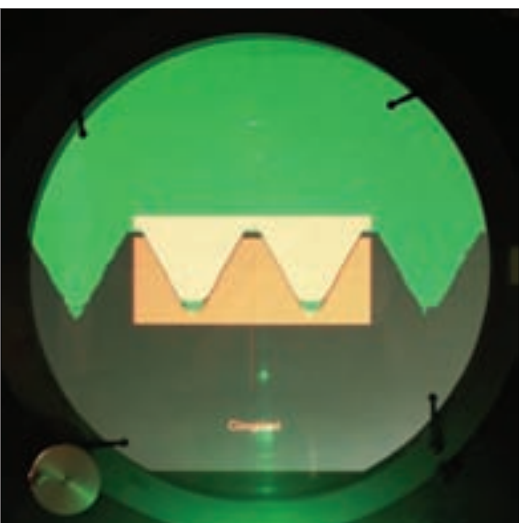
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25 Bar Furnace

ACTS AS ALTERNATIVE TO OIL QUENCH

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Seco/Warwick introduced a 25 Bar Single Chamber Vacuum Furnace as a process alternative to vacuum furnaces using an oil quench. The 25 Bar HPQ provides the same hardness properties as an oil quench, and when it is equipped with optional PreNit and FineCarb advanced LPC vacuum car-

burizing technology, the furnace can reduce cycle time by up to 50 percent in certain applications.

Using helium as a quench medium, the 25 Bar furnace lowers distortion and renders parts washing unnecessary. Loads are both heated and quenched in the same chamber with the single



chamber furnace. Many of the problems associated with oil quenching are minimized with the 25 Bar HPQ including the disposal of spent quench fluids, the requirement for a washer to clean parts and post heat treating machining needed to compensate for part distortion in oil.

Helium is used as a process atmosphere to maximize cooling. Recycling systems are available to recover and reuse the helium, which tends to be higher cost than other process gases; however, there are many choices for supply systems, and helium follows the same installation guidelines as nitrogen.

Seco/Warwick is offering free trials for a limited time at their R&D facility, so companies interested in the process can obtain a full metallurgical report for their samples without any risk.

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Inductoheat's Single-Coil Dual Frequency Induction Gear Hardening System was designed specifically for heat treating gear-like components with fine teeth, and it was recently shipped to an automotive engine and powertrain component supplier. The machine is designed to be capable for optimum hardness patterns of medium and fine teeth gears.

The Single-Coil Dual Frequency Induction Gear Hardening System is appropriate for high-volume single shot hardening of several powertrain components. The machine minimizes distortion of heat treated parts and distributes residual stresses favorably. Medium frequency (10 kHz) and high frequency (120 kHz–400 kHz) power supply modules combine for 1,200 kW of total power, and both modules work simultaneously or in any sequence to optimize gear properties. The total heat time is about 1.5 seconds.

The system uses Allen Bradley controls with a PC touch screen operator interface for monitoring. An integrated closed-loop water circulation system reuses water for quenching and cooling. Other features include a high-speed

servo spindle drive to control rotation speed, a heavy-duty aluminum splash door with safety interlock switch and light curtains as well as other system components with QA, precise position control and safety measures.

For more information:
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