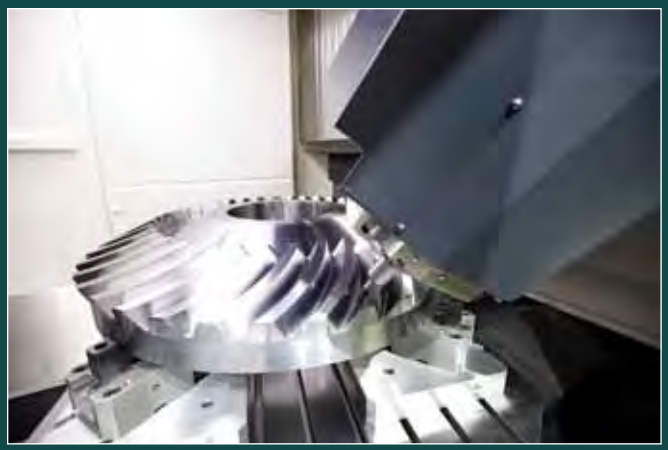
Multifunctional Advancements



The Latest in Big Gear Machining with DMG/Mori Seiki

Matthew Jaster, Associate Editor

While gear milling was one of the last machining processes to be integrated on CNC machines, the functionality and operability has reached a point where it has become a very efficient and flexible process, particularly for large gears. In 2009, *Gear Technology* focused on DMG America's gear milling on non-dedicated machinery for a product news article. Back then, multifunctional machining was making significant progress in Europe and just beginning to gain momentum within the U.S. gear industry. DMG joined forces with Mori Seiki in 2010 and the company has witnessed a growing interest—most notably in the gear community—in the integration of machine operations. Fast-forward to 2012 and you'll notice that multifunctional machining is playing a much larger role in many gear operations. *Gear Technology* recently caught up with Greg Hyatt, vice president and chief technical officer at DMG/Mori Seiki USA, to discuss the latest gear products, technologies and innovations that are now being integrated into the company's machine tools.

Describe some of DMG's latest gear milling techniques and how they are changing traditional gear milling production.

We have added processes/solutions to address the limitations of traditional hobbing specifically for large gear applications. One addition includes our ball nose-based solution that produces one-off or low-volume gears without any special cutting tools (the hob isn't required, a gasher isn't required). Most large gears are being cut from paper drawings or, if there's a solid model, the gear portion of the solid model may not be accurate. The engineers generally assume the part will be cut on a hobbing machine and that the tool path will not be generated directly from the solid model of the flank geometry, for example. They draw it for illustration purposes only. We had to develop special software to reverse-engineer the correct geometry so that we could drive the tool path for the simple tools. A second addition is invomilling, a multitasking application developed for spur, helical and herringbone gears that uses a disc-shaped milling tool. This utilizes a much simpler tool path. Since none of the CAM suppliers had invented software like this, we developed it ourselves so the customer can easily create the tool path to cut the gears. A third addition is a grinding solution for the finishing of gears where we use a disc-shaped tool similar to Sandvik.

What other products/technologies is DMG/Mori Seiki working on to enhance very large, time-consuming gear machining?

The integration of operations does not have to be constrained to the material removal operations. We're doing more and more inspection within the machine today. For the milling processes, we can measure and cut one tooth complete before we measure a second tooth. We can intentionally cut the first tooth oversized so that we will be absolutely sure it will be a good part. We capture deflection in the workholding, deflection in the cutting tools, thermal error due to imperfectly controlled environments—whatever the errors may be that contribute to the total error of the part. We can cut one part in the machine, measure the part, make the compensation and then cut the gear to tighter tolerances in that first pass. We've partnered with several companies to measure by probing. For other critical features, we have a hydrogage option—an air gage with high pressure that has been re-engineered to use the machines coolant. We can now measure diameters to micron level precision within the machine tool. Basically, we can pursue micron level inspection accuracy in a machine that doesn't have micron level positioning accuracy.

How have customers responded to these multifunctional technologies?

The response from our customers has been extremely favorable, particularly for the low-volume producers of large gears. Customers are excited about a single machine that can do all operations prior to surface hardening. For many of these processes, setup and response time is extremely critical. Traditionally, you had a machine on the floor for blanking, one for turning, mounting, drilling and then finally gear cutting. Machine availability is a constraint. Being able to provide multiple operations on a single machine provides several key advantages.

How has DMG/Mori Seiki's software package evolved?

Our software package for developing spiral bevel, worm or spur gears was developed in Pfronten, Germany at DMG in parallel to the work done with Sandvik's disc tool and their work with Mori Seiki. Some of this work had matured by the time we collaborated with Mori Seiki so a decision was made to pull it all together into a single portfolio. We had both been focusing on integrating operations at that time. While the ball nose solution gave us greater flexibility because it could handle worm and spiral bevel gears, the Sandvik disc tool was more productive and could offer faster cycle times for spur, helical and other gears which can be machined with it. The Sandvik disc tool takes us into higher volume applications and is generally competitive with high-speed steel tools. We wanted both packages in the portfolio because they solved different challenges for different applications.

What are the largest gears that DMG/Mori Seiki machines can currently handle?

The largest gear can be 4.2 meters in diameter, 1.2 meters long and weigh up to 20,000 kilograms (48,400 lbs). This can be done on DMG's DMU600 FD. For shaft-based gears, Mori Seiki's NT6600 can handle gears over six meters. We have five different machines that can handle gears over one meter in diameter on the DMG side. These include the DMU340, DMU210, DMU160 and DMU125. On the Mori Seiki side, several machines can handle large gears including the NT3000, NT4000 and NT5000 series. We have a whole range of machines depending on the

continued

DMG/Mori Seiki's NT4250 is capable of handling several large gear machining operations (courtesy of DMG/Mori Seiki).

length, diameter and mass of the gears that need to be cut.

What are the key markets currently for these multi-functional machines?

The most popular area has been customers who are doing contract production of gears in wind, mining and more conventional power generation applications.

They have embraced the technology more quickly than OEMs that are producing their own products.

What was DMG/Mori Seiki's experience like exhibiting at Gear Expo in Cincinnati?

Gear Expo was very valuable to us. While we've been cutting gears on our machines for years, we've never really participated in a focused event like that. We tried to exhibit some of the gear technologies at larger trade shows but it was not a productive way to target the market. Gear Expo was efficient and effective for us to talk to a customer who shared the same focus in the same market, and it's certainly something we will continue to do in the future. The attendees that dropped by our booth seemed very interested in the demonstrations. Many times they would see a demo, leave and come back with a co-worker and then they'd return again with the president of their company. The customers at Gear Expo "got" what we were trying to demonstrate regarding the integration of machine operations.

Where do you think multifunctional machining will be in five to ten years?

I think there are no constraints or obstacles to prevent us from integrating more special operations into the machines. We've seen a decline in many special machines, the radial drill press for example, the transfer lines are almost gone. I think the special purpose machines will either reinvent themselves to become multifunctional or largely disappear. This is happening later in gears because of the tight tolerances.

What new capabilities can customers expect from DMG/Mori Seiki in the near future?

Honing is one area that we are starting to incorporate into our machines. We are actually pursuing partnerships with a few gear companies in honing and grinding applications. We'll have something new to share in these areas at IMTS in September. We're also planning on providing some heat treating capabilities down the road. I'm not ready to discuss the details just yet, but it's something we're working on. We want to have a broad portfolio for all gear operations now and in the future.

For more information:

DMG/Mori Seiki USA
2400 Huntington Blvd.
Hoffman Estates, IL 60192
Phone: (847) 593-5400
Fax: (847) 387-1319
www.dmgmoriseikiusa.com

DMG/Mori Seiki University

With all the new multifunctional capabilities comes a particular learning curve for machinists. Thankfully, DMG/Mori Seiki developed a training program to provide employees, distributors and customers with education solutions that increase innovation, productivity and safety in the manufacturing environment. DMG/Mori Seiki University has a curriculum that focuses on both technical and non-technical skill development.

Founded in 2006 by DMG/Mori Seiki USA as a corporate training facility, the university supports the precision, high technology CNC machine tools, controls and software solutions manufactured and distributed by Mori Seiki and DMG. It serves the Americas with high quality, instructor-led classes and the global marketplace with third-generation online education. The company employs state-of-the-art educational tools and advanced adult learning techniques at the DMG/Mori Seiki USA headquarters located in suburban Chicago. Classes include programming and operation as well as machine maintenance on both DMG and Mori Seiki machines.

Education On Demand (EOD) is DMG/Mori Seiki University's (MSU) solution to online training. EOD offers online immersion into basic manufacturing skills and CNC operations with virtual machine tools that look and act just like the real thing, providing an interactive environment that engages students, keeps their attention and improves retention. For more information on onsite and online courses, visit *www.dmgmsuondemand.com*.