

Reinventing Cutting Tool Production at Gleason

Investment in advanced new manufacturing technologies is helping to reinvent production processes for bevel gear cutters and coarse-pitch hobs at Gleason—delivering significant benefits downstream to customers seeking shorter deliveries, longer tool life and better results.

Manufacturers of bevel and cylindrical gear cutting tools have made enormous strides in recent years to improve the performance, quality, and tool life of their products. New substrates, advanced coatings and new designs have converged with faster, more robust direct-drive CNC machines to revolutionize bevel and cylindrical gear production. But there is another “revolution” underway as well, taking place on the shop floors of some of the leaders in this industry. This revolution has less to do with *invention*, and more to do with *investment*, says Bob Phillips, senior vice president of Gleason Corporation’s tooling products group.

“Highly productive new products are a big part of our ‘solutions’ approach, but of equal importance are the new processes we’re putting into place on every Gleason factory floor,” says Phillips. “Take a tour of our facility here in Loves Park, IL, and



Gleason Cutting Tools facility in Loves Park, IL, where production processes for spiral bevel gear cutting systems, as well as coarse-pitch hobs, have been reinvented (all photos courtesy Gleason Corp.).

you’ll find older machines sitting idle, with all the work they once did now being done much faster and more accurately by far fewer, advanced new machines. That’s good news for our customers seeking shorter deliveries on superior product. Two of the best recent examples are our bevel gear cutters and coarse-pitch hobs.”

Changes in Spiral Bevel Gear Cutter Production

Spiral bevel and hypoid gear cutting has changed significantly over the years. Many high-volume producers have made the transition from mechanical machines performing traditional, single-index, five-cut face milling or, more recently, the completing process, to much more productive CNC machines performing carbide dry cutting completing as face milling or face hobbing.

However, for a significant number of bevel gear “jobbers” around the world, these older machines and processes still get the job done. These jobbers rely on a system of different cutter types still very much in production today: e.g., integral blade (solid-body) type, and segmental or inserted blade type. Gleason has long been a source for a variety of product in each of these families of cutter systems, as well as the machines that run them.

For example, the company manufactures well-known brands such as its Ridg-Ac and Wedge-Ac inserted blade cutter systems for gear roughing and pinion roughing, respectively; its Helixform and Hardac cutter systems, also with inserted blades,



A single Gleason IBG (inserted blade grinder) out-performs many older manual grinders, raising quality and productivity on inserted blade production to unprecedented new levels.



Gleason's coarse pitch hob cell machines tools complete from barstock, even on hobs as large as 450 mm diameter, 530 mm in length and up to 40 module, to achieve 6-week deliveries.

for gear and pinion completing and finishing; and a variety of solid cutters for roughing, completing and finishing.

Until very recently, most of these cutter systems were produced by Gleason at its Plymouth, England facility on dozens of circa 1950s manual machines. According to Gleason's Paul Chadwick, production manager at the Loves Park facility, the production process relied heavily on the skills of highly experienced machine operators and their ability to coax the best possible productivity and quality out of these machines. "Even an operator with 30 years of experience would be hard-pressed to produce from blank a set of blades for a Hardac cutter in less than six hours on these machines, and blades for a particularly large diameter cutter might take 18 to 20 hours," Chadwick explains. "The process was extremely laborious."

The drawbacks inherent in this process were immediately obvious to Gleason's Phillips and his team when bevel gear cutter production was moved to the Loves Park facility. In a manufacturing environment where waste is abhorred and lean manufacturing and Kanban systems have cut delivery time on every



New grinding machines and processes help produce finishing hobs with AGMA Class AA accuracies, precision ground with any desired profile or special involute modification.



For jobbers still using five-cut or completing processes to produce spiral bevel gearsets, Gleason's inserted-blade and solid cutters are now available with much shorter delivery times and greatly improved accuracy and repeatability.

product to well below the industry average, the older machines simply weren't relevant any longer, Chadwick recalls. "While the 'soft blanking' operations for these blades had been modernized with new CNC machining centers in Plymouth, the technology didn't exist at the time to make similar improvements in the hard finishing operations. No one could have guessed that today we would be producing the same inserted blades and solid cutters many times faster, with substantially better quality, and with an operator with just weeks of training versus the many years required previously."

An intensive, multi-year effort involving a team of Gleason engineers on two continents has today resulted in the development of two revolutionary, special-design 6-axis CNC grinders — a Gleason IBG (inserted blade grinder) and a Gleason SBG (solid blade grinder) — both employing proprietary technologies and processes to cut production times to a fraction of what was possible in Plymouth. Blanks now are produced complete in one fully automated setup, taking just minutes per blade.

While faster throughputs translate into shorter delivery times for customers, Chadwick says, of equal importance to the customer are the accuracy and repeatability levels now being achieved by these new machines. "We're already hearing very positive reports from customers in the U.S., Japan and Europe who are the first to receive product produced by these machines," he says. "You can imagine how difficult it was to maintain consistent, repeatable accuracies on the blades coming off the old machines, given their age, all the manual steps required, and the reliance on operator experience to get it right. For the end user, the quality of the blade, particularly the critical edge-rounding radius dimension and the blending between the edge rounding, the pressure angles and the front face where cutting occurs, are critical to achieving lower cutting forces and optimum chip shearing action — and longer tool life as a result." Chadwick points out that a better quality blade also makes the initial process of "truing" the blades to the cutter body within a certain assembly tolerance faster, because the tolerances of each blade are essentially identical.

Coarse-Pitch Hobs: Bigger, Faster, Better

On the opposite end of the gear cutting tools spectrum are the new manufacturing technologies being employed by Gleason for the production of coarse-pitch hobs — some as large as half a meter in length and diameter, and up to 40 module. While the end product and production methods are completely different, says Phillips, the strategic objectives are very similar. “Part of it is attributable to growth in the wind power market, part to our fast-expanding presence in markets like China and India, but suffice to say, global demand for our large roughing and finishing hobs has never been greater. Again, investment in new technology was the solution to meet our customers’ needs for faster delivery on superior product.”

Gleason’s declared 6-week delivery from barstock on its coarse-pitch hobs today stands in stark contrast to an industry average of around 12 weeks. Older machines, long queues and a lot of non-productive time have given way to a new coarse pitch hob manufacturing cell at Gleason that produces hobs complete from barstock, even including on-site final inspection of all critical hob features. Now, all the “soft” manufacturing operations such as gashing, threading and turning that previously required multiple machines are done in one stop on the cell’s single large turning center. Heat treat is performed in close proximity to the cell, and then new grinding machines perform the finish grinding operations many times faster and more accurately than what was possible before. Most importantly, the cell has greatly reduced the costly non-productive time that characterizes most large hob production, where many machines and setups are required to perform all the necessary operations.

“The cell is certainly much more productive than the machines it replaced, and it also ties nicely to our lean manufacturing practices, which eliminates much of the typical time wasted while product waits to be worked on,” Phillips says.


The hob cell has also enabled Gleason to expand its product range to include hobs as large as 450 mm in diameter, 530 mm in length, and up to 40 module. These product offerings include Gleason’s popular E-Z Cut hob, which features a unique flute design that adds extra cutting edges and delivers rough cutting feed rates up to 70 percent faster than conventional hobs.

In addition, the hob cell affords Gleason the ability to produce more accurate finishing hobs, ground to AGMA Class AA



Every operation is totally integrated, even the final step: complete inspection of all critical features on a Gleason GMM analytical gear inspection system.

classification and with any desired profile or special involute modification.

“Yes, we’re busy *inventing* the next generation of advanced new products, but in the meantime we never stop *investing* in existing product,” concludes Phillips. “Ultimately, we’re helping our customers get better results faster, even from cutting tool designs that have been around awhile.” 



Global demand from wind energy, mining, construction and other industries has stretched the world’s large cylindrical gear making capacity, creating unprecedented demand for products like Gleason’s EZ Cut hob (front), and the company’s other roughing and finishing hobs.



The SBG (solid blade grinder) machine performs one-stop blade grinding on Gleason solid body bevel gear cutters.

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