

Delivering Big Gears Fast

When a customer needed gears delivered in three weeks, here's how Brevini Wind got it done.

Randy Stott, Managing Editor

Recently a South American manufacturer needed four large, double-internal replacement ring gears for its sugar mill, and the OEM who provided the originals was quoting eight months lead time. Unfortunately, they needed their parts faster—much faster. Looking for alternative manufacturers, they called on Brevini Wind, in Yorktown, IN.

“We were challenged to produce four large, double-internal ring gears in three weeks,” says Dale Harder, director of facility operations at Brevini Wind USA. Each of the large planetary components contained two internal gears. On one end was a 12-module, 76-tooth, 282 mm face width internal gear. On the other end was an 8-module, 116-tooth, 140 mm face width internal gear.

The biggest challenge in producing these gears so quickly was figuring out the tooling, Harder says. Getting new cutting tools would have taken too long, so they looked at previous projects for parts with similar geometry to see if they could re-use existing tools. As it turned out, they had gashing cutters for previous internal gears with modules of about 12.1 and 7.3. But could these tools be used on *this* part? To find out, Brevini turned to its cutting tool supplier, Banyan Global Technologies LLC.

Even though Banyan wasn't going to be able to sell any additional cutting tools for this project, they were happy to help, says Banyan's Darryl Witte, VP of sales. “We have a fantastic relationship with those guys, and they're a great customer.”

Banyan prepared CAD drawings of both internal gear elements, and then analyzed the existing cutting tools and stock conditions that would result. After their analysis, Witte had good news and bad news. They'd be able to cut the 12-module gear with existing tools, but not the 8-module.



The large planetary component contained multiple internal gears of different geometry. In this view, the 12-module, 76-tooth, 282 mm face width gear geometry is shown. For semi-finishing this gear, Brevini Wind was able to use a duplex milling tool provided by Banyan Global Technologies for a previous ring gear application



Machining Leader Tim Root removes one of the approximately 3,000 lb. planetary components from the Youji 1200 CNC vertical turning center, which Brevini Wind acquired and installed in the third quarter of 2012.

“For the larger internal gear element, we were fortunate enough to have a duplex profile milling tool for an application whose geometry was close enough to semi-finish the internal gear,” Harder says. “Banyan Global provided Brevini Wind with a CAD model of the cutter profile versus the finished tooth profile, illustrating the maximum depth of cut that could be made while maintaining sufficient stock for finishing the gear teeth via a subsequent internal gear grinding process.”

But they still had some work to do. Even though Banyan demonstrated that they could produce the geometry they needed with the existing cutting tools, Brevini Wind still needed a little bit of ingenuity to make it work, Harder says. “Because there wasn’t sufficient room for the cutter radius to break out without hitting an adjacent shoulder in the part, our gear machining leader, Chris Hayes, devised a process to first radially in-feed utilizing our Gleason-Pfauter P2400 hobber at the furthest possible point on the facewidth before beginning to feed axially up the facewidth.”

So Brevini Wind could make the 12-module internal gear with existing cutters. But what about the other side? Unfortunately, Banyan’s analysis revealed they had no cutting tools available with close enough geometry. “So we elected to grind the gear teeth from solid using our Gleason-Pfauter P1600G gear grinder,” Harder says.



A rendering of the duplex profile milling cutter used to generate the semi-finished gear geometry of the 12-module gear. Profile milling using the duplex cutter resulted in a total cutting time of under 55 minutes for the 76-tooth, 282mm face width gear. (image courtesy of Banyan Global Technologies)



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“This permitted us to generate the required gear geometry relatively quickly.”

Harder explains that even though grinding from solid is a much more time-consuming process—in this case six hours versus the one hour that would have been required for gashing—it could be done using inexpensive, off-the-shelf grinding wheels that didn’t require any additional wait time.

After rough machining, the parts were inspected, stress relieved and inspected again in Brevini’s climate-controlled inspection lab. Having heat treating and metallurgical facilities in-house greatly enhances Brevini Wind’s ability to turn parts around quickly, Harder says, and it also allows them tight control over every process.

“Due to considerable material removal from the required machining processes, Brevini Wind elected to stress relieve all of the large planetary components prior to finish machining critical dimensional characteristics and gear geometries,” Harder says.

“Brevini Wind performed analytical inspections on the internal gear tooth geometries before and after the stress-relieving process to determine the level of dimensional movements



Without an available cutting tool to semi-finish the 8-module, 116-tooth 145 mm face width internal gear, Brevini Wind chose to grind the teeth from solid in order to facilitate delivering the large planetary component to their customer in the shortest possible time. The part is shown inside Brevini Wind’s Gleason-Pfauter P1600G gear grinder, which is equipped to grind both internal and external gears.

that occurred,” Harder says. “The information was utilized to confirm green machining dimensional targets that will provide minimal stock removals for the post-heat treating finish machining processes.”

Those finish machining processes included not only final gear machining, but also finish turning on the company’s newly acquired Youji 1200 ATC CNC vertical turning center. With the live tooling capabilities of the Youji, it was also possible to process the numerous M36 threaded holes that were required around the part end face. The holes were drilled and the M36 threads were generated using circular interpolating thread milling technology instead of conventional taps.



Machining Leader Tim Root prepares one of the large planetary ring gears for the final turning process on a Youji 1200 ATC CNC vertical turning center. The machine is equipped with live tooling, allowing Brevini to machine threaded holes in the end face.

“The result was very precise threads, excellent size repeatability and no broken taps,” Harder says.

In the end, Brevini was able to provide these parts on schedule for a customer with a very tight deadline. “Because of our equipment, expertise, innovative thinking and some very dedicated employees, we accomplished the mission,” Harder says. ⚙️



Inspection of components was completed in Brevini Wind’s climate-controlled inspection lab.

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A brief history of Brevini Wind USA

Brevini Wind USA was built from the ground up with wind turbine gearboxes in mind. The company broke ground in 2009 and began hiring staff in 2010. Brand new machine tools began arriving late in 2010.

All told, the company spent over \$35 million on the new factory. During 2011, the processing equipment was installed, staffing was hired, and the factory was prepared for operations.

"We made a lot of Brevini standard industrial parts to begin with in order to give the machining personnel experience and to do run-off acceptance of the machines," says Dale Harder, director of facility operations. In late 2011, Brevini Wind began producing precision planetary components for one of its wind turbine customer's gearboxes. Unfortunately, the business of making main drive gearboxes for the wind market began to slow, leaving Brevini Wind with unutilized capacity, Harder says.

But having extra capacity at a brand new, state-of-the-art facility, custom-built for manufacturing large planetary components wasn't all bad, Harder says. "We would hope that a lot of customers would want their parts made in a facility with this kind of capabilities."

In fact, it allowed the company to attract new customers, particularly in the heavy equipment industry. "Throughout 2012 we manufactured a lot of ring gears for Caterpillar," Harder says. "What makes us unique is our process efficiency. We cut a gear for Caterpillar in 39 minutes utilizing the profile milling "gashing" process that would take a competitor, utilizing a typical gear shaping process, 6-8 hours."

Despite that additional business, the company still has plenty of capacity and can offer exceptional turnaround time on planetary gearbox components, Harder says.

And the company is in it for the long haul. They're confident the wind turbine business will return and that demand for their capacity will be strong for many years to come. "The economy is in some sort of degree of uncertainty," Harder says. "Nobody seems to want to move very quickly. I think when things do rebound, particularly for things that require large gears, we're going to be well positioned, because everywhere you look out there [on our factory floor], you see the latest technologies available for the manufacturing of large, precision coarse-pitch gears."



A partial view of the 105,000 square foot Brevini Wind manufacturing facility. The company broke ground on the facility in 2009 and began installing equipment by late 2010/early 2011. The facility also houses a 6.4 MW capacity back-to-back test bench for full load testing of large planetary gearboxes.

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