



# Making High-End GEARS

Brevini Wind and a You Ji YV-1200 ATC VTL save the day.

By Eric Brothers

**B**revini Wind USA Inc. has a production facility in Yorktown, Ind., that not only supplies the wind energy industry with wind turbine gearboxes, but also stands ready to manufacture large gears and precision planetary components to other industries. A wide range of specialized manufacturing equipment allows Brevini to be a competitive supplier in other markets. This capability was tested recently when Brevini was asked to fabricate a new set of four gears for a Brazilian sugar mill that was in need of replacement parts for a sugar cane shredding machine. The large-size gears were just the challenge the company looks to solve.

Brevini Wind has the capacity to produce high-end large gears with in-house heat treating, according to Mike Veach, the senior manufacturing engi-

neer for Brevini Wind USA. "We have the ability to make ring gears up to 2.4m diameter, OD, ID gash and grind, and make big planetary gear boxes."

Principal industries are mining, construction, wind, oil, and gas, says Jim Dittrich, the firm's purchasing manager.

"We can make big gears for shipbuilding, too," adds Tim Root, who is Brevini Wind's operator and setup man for vertical lathes. "That includes gearboxes used on the Panama Canal."

## MANUFACTURING CHALLENGES

Machining challenges arose at every point in the process. The order to make gears for the sugar mill operation required a month-long turnaround because the gears were needed before the sugar cane season started.

In addition to the challenge of the tight deadline, the gears were 1.1m (43") in diameter and the finished parts weighed 1,360kg (3,000 lb) each. Be-

cause of the complex internal part geometry, the forged blanks weighed almost twice as much. Veach says the gear was larger than what the company usually makes - 750mm tall with one side having a 282mm face width and 12-module gear, and the other side a 140mm face width, 8-module gear.

The gears were made from scratch, Veach says. "We had a rolled ring that we purchased, then we turned the ODs and IDs, and then the gear gasher roughed out the big teeth and the grinder. Because of time constraints, we couldn't get a gasher that size, so we ran the grinder lights-out to finish."

"After the teeth were ground, the next step was heat-treating for stress relief, and then after inspection, we brought them back to the lathe again," Root says. "We didn't want to try to machine the face of the gear with the interrupted cut, due to all the holes in the end of the part. So, we did all of our fin-



## You Ji YV-1200 ATC CNC VTL



Max swing dia.	1,600mm
Max turned dia.	1,350mm
Max turned height	1,200mm
Max cross travel X-axis	1,375mm
Max vertical travel Z-axis	900mm
Table size	1,250mm
Table load	5,000kg
Table speeds (2 ranges)	2-108/108-350rpm
2-speed programmable gearbox	Standard
FANUC alpha spindle drive power	45kW
Max. torque	12,500Nm
Tool changer style	ATC
Number of tools	12
Tool change time	30 seconds
Tool shank	32mm x 32mm
Boring bar size (max.)	63mm
Rapids – X-axis	12m/min
Rapids – Z-axis	10m/min
Machine weight	20,000kg
Control	FANUC 0iT

ishing machining at that point, then all of our thread milling and hole-drilling,” he explains. “Then we went into final grind and back in for final verification.”

Because there was so much material coming out of that part, they didn’t want to take a chance on it moving. “We roughed everything into place that wasn’t critical, and got as much material out of there and stress-relieved it, then we recut it to true-up any inconsistencies from the stress-relieving. That gave us a real stable part to finish machining,” Veach explains.

On a gear that size, it had to be put in an oven at 1,000°F for 4 hours to stress relieve it, which is typical.

As a result, the engineers were able to keep the two diameters that were within about 25mm length held within  $\pm 33\mu\text{m}$ . “That’s like a little over a thousandth over the length of that part,” Root explains. “Stress-relieving has a lot to do with holding the part still so

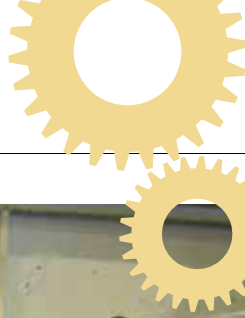
you can achieve that.”

Instead of cutting the piece’s large, M36 threads with taps, Brevini Wind used circular interpolating thread milling technology. “When you get to a tapped hole that large,” Veach says, “one of the benefits is you have a lot more control over the size of it. If you have a tap, you have to hope it cuts it to the right size. With a thread mill, you have the shape of the thread on the end mill and you are contouring around the circle in a spiral manner to generate the thread, from the bottom of the hole.” He describes the sequence: “First, we drill the minor diameter of the hole, then chamfer it, then the last thing is thread it with the thread mill.”

Besides controlling the size, a manufacturer can use that tool for different-size holes where the tap is limited to one hole size. “Anything bigger than the M36, you can use the same tool, so it’s very cost-effective,” he says. “Just







flip or replace the inserts instead of buying a \$300 to \$400 tap every time it wears out.” Accuracy is the main reason, however. “Plus, if one of those big M36 taps breaks, the whole world hears it,” Veach chuckles.

### CUTTING THREADS

The size of the parts to be machined dictated the choice of the You Ji YV 1200 ATC vertical turning lathe. As Veach explains, “We cover parts from 1m up to 2.4m, and the You Ji, with a 1.2m chuck face, was just the right size for the 0.8m part. All of our gear boxes require very large gears and a horizontal lathe just can’t handle the weight of such parts.

“We had the rpm we needed, and the live tooling that came with it,” Veach continues. “The You Ji has been very accurate when it comes to positioning, and when you had to turn something, it was the best choice.” That is because the other lathe, with a 2.8m chuck plate, was so large. “The You Ji was the machine we needed, it was on a boat already headed this direction, and the timing was perfect as far as getting it installed and getting the parts we needed to run on it,” Veach says.

The machine uses a FANUC controller, with Unigraphics NX 7.5 CAD-CAM software. “We use it to draw our process drawings as well as create the programs for our machines,” Veach adds.

“The sugar mill was a first-time event, but we’re able to handle anything they can throw at us here, with the different gear gashers, and grinders, and lathes we have,” Veach says proudly. “The live tooling allows us to drill into the side of a part with it still standing in the position you turned it in. We have large 90° heads that rotate to different angles for angle holes. We’ve got quite the assortment for large ring gears and planetary gears as well.”

Veach explains the reasoning behind obtaining Brevini Wind’s You Ji machine. “We were looking for a small-



Finish Grinding Internal Gear Teeth

er machine, something in the 600mm to 1,000mm range. A large machine can’t produce the rpm that a small one can without sacrificing surface finish. The You Ji specs gets you into the range. And we needed a lathe to handle the smaller parts.

“When we’re roughing, we try to get the most material out,” Veach contin-

ues. “We want to get speed but still get quality parts. We can do that with the right insert and decrease the cut time. We work with Iscar for the turning and live tools, and Banyan for the gear cutting. Emuge is the supplier we use for the thread mills.”

The sugar-mill project challenge was the complexity of the part, yet it



**Top:** Rough Turning of a Gear Ring OD on the You Ji VTL **Above:** After stress relieving, the gear is returned to the You Ji VTL for finish machining.

took only three weeks to produce four of them, Root notes.

"It's actually a vertical turning lathe with live tooling. It holds 16 different tools, and one of the nice things is having two tools on same tool holder, say for OD and ID, without changing tool holders," Veach adds. "The You Ji was the right machine at the right time." 🌐

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**See It Now:**

Watch a video on main gear boxes for wind turbines at <http://bit.ly/1a6flgh>.

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