

OPTI-mizing gear production at Brevini Wind USA



Highly productive new Gleason gear cutting and fine finishing technologies will help Brevini Wind USA meet its ambitious goals of producing up to 1,200 gearboxes per year for 0.9MW to 3.5MW wind turbines for the fast-growing North American marketplace.

The cornfields around Yorktown, Indiana (40 miles from Indianapolis) are among the most fertile found anywhere in the U.S. It's also the perfect environment for cultivating another kind of business. It's here that Brevini Wind USA has set down deep roots – with a \$50 million, 100,000 sq. ft. ultra-modern facility, including North America's only 6.4 MW test bench, for the production of main gearboxes for 0.9 to 3.5 MW wind turbines. This is, of course, the size range typically found in most of today's North American land-based applications. If you think that Brevini Wind is 'betting the farm' on the U.S. windpower market you'd be right. After all, wind turbine deployments in North



Brevini Wind USA will add much-needed gearbox capacity for fast-growing U.S. demand for wind turbines, expected to exceed 40,000 units between 2010 and 2015.

America are expected to exceed 40,000 units between 2010 and 2015. Where five years ago Europe dominated the world market for wind turbines with 70% of new capacity, today the U.S. and China now account for 62% of new capacity, with Europe at 27%. Starting in November, 2010, the new Brevini Wind USA facility will offer many advantages to wind turbine customers seeking to penetrate the booming North American marketplace, according to Brevini Wind Managing Director Dr. Jacopo Tozzi. "Most of the major wind turbine manufacturers are based in Europe, so the logistical benefits of sourcing gearboxes 'locally' through Brevini Wind USA will be significant for them going forward," says

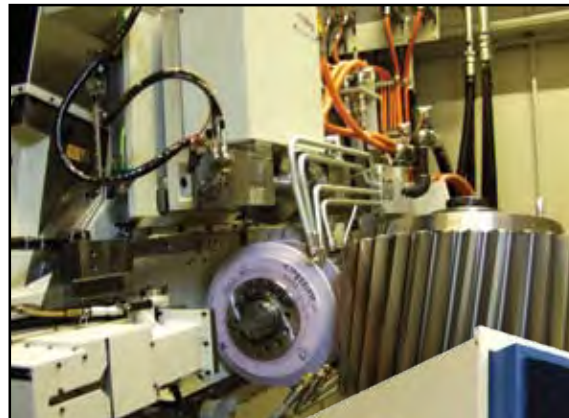


Dr. Tozzi. “In fact, we are already seeing evidence of this, with a large order from Finnish wind turbine manufacturer WinWinD for their 3MW wind turbines.”

OPTI-mizing gear production with new Gleason machines and processes. The gears for WinWinD’s gearboxes and Brevini Wind’s other customers will all be produced by Gleason machines employing new technologies that simply didn’t exist a year or two ago. Dr. Tozzi believes that his company’s investment in these new Gleason technologies and processes will help Brevini Wind to quickly become a major player in the production of a new generation of highly reliable, lightweight and efficient windpower main gear boxes, and give the company a decided competitive advantage going forward. “Brevini Group, and the Brevini Power Transmission

division in particular, is no stranger to windpower, having produced some 60,000 pitch and yaw systems for wind turbines over the years,” explains Dr. Tozzi. “Our division, Brevini Wind, was established by Brevini Group two years ago in order to concentrate on the design, development, testing and manufacture of main gearboxes for wind turbine applications. This is of course one of the most challenging applications for gears, given the high and dynamic loads and the need for extreme reliability. In order to better understand how our competition was meeting these challenges, I had the opportunity to tour many of their plants in Europe, China and India. Almost without exception, the machines they were using for gear production were made by Gleason.”

By November, two new Gleason Profile Grinding Machines, models P 1600 G and P 2400 G, and two Gleason Hobbing Machines, models P 1600 and P 2400, will be up



and running at the Brevini Wind USA facility, producing all of the gears found in a series of new-generation Brevini 2-stage planetary gearboxes. These include ring gears with diameters as large as 2.2 meters and accuracy requirements as high as ISO Grade 6 or better; and smaller gears, ISO Grade 5 or better. These classifications are typical of gears for wind turbine applications, although the Gleason Profile Grinders can actually deliver even ISO Grade 3 or better if required.

These new planetary gearboxes can produce reduction ratios of up to 37:1 with up to 98% efficiency, while at the same time reducing overall size and weight by 25% as compared to competitive models. But perhaps most importantly, Brevini Wind will gain an enormous competitive advantage by producing these gears much faster, more accurately, and using fewer machines, thanks to a revolutionary new Gleason hard finish grinding process called OPTI-GRIND™. Available only on the latest generation of Gleason Profile Grinding Machines, OPTI-GRIND will enable Brevini Wind to cut precious

Here, a Gleason P 1600 G performs revolutionary new Gleason OPTI-GRIND process to reduce by up to 40% the time needed to hard finish Brevini gears.





(Fig. 1) Maximum OPTI-GRIND productivity: an assembly of three dressable wheels rough grinds four tooth flanks simultaneously, as compared to typical use of a single wheel roughing two flanks at once. The center wheel only then is used for finishing, with desired surface finish and flank modifications dressed into the wheel.



Gleason P 2400 G Profile Grinder gives Brevini capacity to spare, with capability to reduce by hours the time needed to produce internal and external gears with outside diameters up to 2.4 meters and accuracy requirements of ISO Grade 3 or better.

minutes, even hours out of the time typically needed to profile grind one of its large gears, since productivity gains of up to 40% are possible as compared to grinding conventionally. In addition, OPTI-GRIND also can be used to deliver surface finishes better than 0.2 microns – a finish 2-3 times the level that is generally achievable with profile grinding alone; so accurate in fact that no additional processes are required after grinding.

According to Gleason Director of Product Management, Grinding Solutions, Dr. Antoine Türich, OPTI-GRIND for the first time solves the dilemma that every gear manufacturer faces: how to achieve, with optimum efficiency, both highly desirable productivity gains and exceptional accuracies. “Wind power gear manufacturers can of course achieve high productivity by using a coarse-grit grinding wheel that will remove a sufficient amount of material when roughing, but these won’t deliver the required fine surface finishes,” explains Dr. Türich. “Conversely, a fine-grit wheel can be used to produce an excellent surface finish, but at the expense of productivity. As a result, grinding wheels are generally used that are a compromise solution, delivering reasonable levels of productivity and accuracy, but well below optimum

levels. But with OPTI-GRIND, we can achieve both ‘optimum’ productivity and ‘optimum’ surfaces finishes, by simultaneously using multiple dressable grinding wheels for profile grinding rather than just the single ‘compromise’ grinding wheel typically used.”

The new process offers end users like Brevini Wind a number of variations to choose from to meet their specific applications. For example, when optimum productivity is desirable, an assembly of three dressable wheels is used to rough grind four tooth flanks simultaneously, as compared to the typical process of a single wheel roughing only two tooth flanks at once (See fig. 1). OPTI-GRIND then is used to finish grind conventionally using just the single center wheel, which has been dressed to produce the desired surface finish and flank modifications.

For planetary gears and pinions, an OPTI-GRIND variation using just the two outer wheels is available, with each grinding a flank on separate gear teeth simultaneously. (Fig.2). This variation reduces the radial infeed required as compared to grinding conventionally with a single wheel. OPTI-GRIND provides a wheel orientation that optimizes the contact angles between grinding wheel and workpiece flank. This variation offers the largest benefit for pinion type gears because of their substantial profile angle variation from tooth tip to the tooth root.

Two new Gleason Hobbing Machines, such as this one, can produce internal and external gears at much higher feeds and speeds, using new OPTI-CUT hobs.

OPTI-CUT hob with replaceable, indexable carbide insert technology can significantly reduce the total cost per workpiece compared to conventional solid body cutters.



(Fig. 2) Ideal for pinion gear production: Another OPTI-GRIND variation shown here uses just the two outer wheels with each grinding a flank on separate gear teeth simultaneously. This variation reduces the radial infeed required as compared to grinding conventionally with a single wheel.

(Fig. 3) Maximum OPTI-GRIND surface finish quality: A third variation uses two outer wheels with an aggressive grit size to each rough grind a flank on separate gear teeth; then the middle wheel, shown here, with extremely fine grit size, finishes left and right flanks.

In applications requiring maximum surface finish quality, a third variation is available. Here, (Fig. 3) OPTI-GRIND uses two outer wheels with an aggressive grit size to each rough grind a flank on separate gear teeth, before a middle wheel, with extremely fine grit size, finishes left and right flanks.

“It’s important to note that OPTI-GRIND uses dressable wheels for fine finishing rather than the non-dressable CBN wheels used in previous multiple-wheel profile grinding techniques,” says Dr. Türich. “With OPTI-GRIND, we give users the flexibility to produce a variety of



highly desirable tooth modifications, including grinding of the root without burning.” Important to note is that on the Gleason Profile Grinders, the dressing unit is actually integral with the grinding head. This unique design helps to reduce dressing times and improve accuracy and repeatability.

Brevini Wind also hopes to gain yet another edge on its competition by optimizing its ‘soft’ cutting operations as well with a new Gleason hob design called OPTI-CUT®. Unlike the solid HSS cutters normally used for large gear hobbing, the OPTI-CUT® family of roughing and finishing hobs (as well as gear gashers and shaper cutters) are very high quality assemblies consisting of either five or six cutter body segments, and utilizing the latest replaceable, indexable carbide insert technology. By using a cutter with the latest carbide materials, coatings, and cutting geometries, Brevini Wind will be able to run its two new Gleason Hobbers at significantly higher feeds and speeds – for both external and internal gears – and even cut dry, helping to make significant reductions in total cost per workpiece. Other benefits include more consistent tool life and surface finishes, while at the same time eliminating the time and expense needed for resharpener and recoating a conventional solid cutter.

“Launching a company to produce main gearboxes for today’s wind turbines is not something that can be done easily or quickly,” concludes Brevini Wind’s Dr. Tozzi. “We have spent a number of years laying the groundwork with the right team of people, and a significant investment in new technologies and processes, with the new Gleason machines being among the most important of these. Now we are poised to help customers take advantage of the enormous potential that exists today and tomorrow in North American windpower.”

