

REINVENTING THE WHEELS

AT

GLEASON
CUTTING TOOLS
CORPORATION

Gleason Cutting Tools' new superabrasives wheel plating facility is helping gear manufacturers keep pace with increased demand for high-performance hardened and ground gears.

By Michael Hayes

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ear designers around the world are seeking to increase their use of hardened gears to squeeze optimum performance out of smaller, quieter transmissions and gearboxes. After all, highly accurate hardened gears offer greatly improved strength and wear resistance (service life), while at the same time delivering a greater load carrying capacity (higher torque) than larger gears.

But if the use of hardened gears solves many problems, it can also create a few. For example: where to find the super-accurate cubic boron nitride (CBN) plated wheels highly prized for the precision finish grinding of hardened gears after heat treat? Sourcing these wheels has always been notoriously difficult. Lead times are often long, quality usually suspect, and costs painfully high—until now.

Controlling the Process

Today, a new multimillion-dollar facility in the heart of the Midwest is doing what few thought would be possible just a few years ago: turning out hundreds of high precision, uniform, single layer CBN and diamond plated products a month for use in the hard finishing and grinding of bevel and cylindrical gears, as well as other non-gear profiles. Jay Werner, plated products manager at Gleason Cutting Tools Corporation, claims that the wheels made in this Loves Park, Illinois, facility are simply the best in the industry, and he has the facts to prove it.

"Holding profile tolerances of 0.0001" to 0.0002" (one to two ten-thousandths of an inch) is routine for our wheels, and we have produced profile tolerances of 0.00005" (50 millionths of an inch) for some aircraft gear applications," says Werner. "I think many in the electroplating industry would be shocked to learn that this is even possible. However, in the gear-



Advanced Plating for CBN Wheels

Gleason's new plating facility is one of the most advanced of its kind in the world, with an expandable, ultra-modern electrolytic and electroless nickel plating capability currently producing up to 500 wheels a month. Products include non-dressable grinding and dressing wheels manufactured with hardened steel bodies, precision ground profiles, and with nickel-plated single layer CBN or diamond crystals. Sizes range from 30 to 500 mm outside diameter, up to 160 mm wide, and can accommodate any customer mounting requirement. Profile tolerances are at a level to meet even the most stringent requirements of aircraft, automotive, tool and die, and carbide industries.

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making industries, these accuracies are imperative because of the critical nature of gear profiles and surface finishes. There is very little margin for error."

Werner adds that Gleason Cutting Tools' ability to consistently produce these kinds of results wheel-to-wheel enables the company to do what few in the electroplating industry would dare: furnish customers with a guarantee of quality, accurate estimates of tool life (the number of gears that can be produced), and recommendations on feeds and speeds to achieve optimum performance.

Werner attributes much of the company's success to its willingness to invest in all of the resources needed to control the production of these products in house. This includes:

- The use of advanced CNC equipment for blanking, turning, heat treating, and finish grinding of the A2 steel body (called the core)—all done in accordance with ISO 9001 International Quality Standards;
- Inspection of the core and its profile after finish grinding using super-accurate computer-driven Coordinate Measuring Machines (CMM);
- Application of a single layer of abrasive CBN or diamond crystals

"WE'VE PROVEN THAT ELECTROLESS NICKEL PLATING PROVIDES A MORE UNIFORM THICKNESS AND HIGHER HARDNESS OF THE NICKEL PLATING."

that are mechanically bonded to the body with a layer of electrolytic and electroless applied nickel, performed in an ultra-modern electroplating facility; and

- Full-profile grinding of a coupon by the finished wheel and final CMM inspection of the profiled coupon, with verified wheel profile and expected K-chart results furnished with every wheel.

Single Layer, Multiple Benefits

The advantages of using single layer CBN (or diamond) plated grinding wheels are well-known. The single layer structure—CBN or diamond crystals of a specified size bonded to the wheel profile in a thin layer of nickel—is considerably harder than ferrite and other conventional abrasives. It also offers the most compressive strength, best wear resistance, and highest heat conductivity, all in an open structure that facilitates chip clearance at even the heaviest stock removal rates. Yet creating a CBN single

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Program Means 21-day Deliveries

Gleason has introduced a new "PDQ" program which delivers gear hobs of all sizes, materials, and designs in just 21 days. Gear, involute spline, straight-sided serration, parallel key spline, roller chain sprocket hobs, and even certain radial feed worm gear designs are just a few of the most common hobs now available as part of the PDQ Program. The program also accommodates customer requests for any popular high-speed steel, virtually any feature, and using the latest TiN, TiCN, and TiAlN coatings. A similar program also exists for Gleason's gear-shaper cutters.



Shaper-Cutter Line Expands with Form Grinding Capability

Gleason has greatly expanded its capacity to produce the gear industry's broadest, most complete line of gear-shaper cutters with the installation of new CNC form grinding equipment at its Rockford, Illinois, facility. The Gleason shaper-cutter line is now available in size ranges from 1.2 to 64 DP, with no limit on the number of teeth, and ground to Class 5 tolerances (DIN AA). The use of the new CNC form-grinding technology also enables Gleason to fulfill customer requirements for small shanks and special forms, and all with much higher levels of accuracy as compared to typical manual machine processes.

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layer with anything approaching the precision needed to achieve the tolerances and surface finishes found on today's gear profiles can't be done without the special technology and expertise found in Gleason Cutting Tools' plating facility.

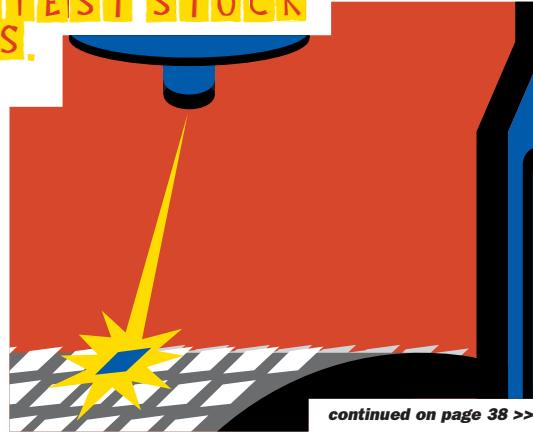
"CBN and diamond abrasive crystals are available in many sizes, from an average diameter of 35 microns (0.0014") for 400/425 USA MESH,

to 76 microns (0.0030") for 20/30 USA MESH," Werner explains. "However, if you were to simply apply, say, a 50/60 MESH crystal size right off the shelf, the deviation in crystal size would be enough to ultimately throw the wheel profile out of tolerance. So we employ a unique method to more precisely control their size and shape."

Gleason Cutting Tools has developed a system of "quarter sieving," or "sub sieving" the crystals prior to the electroplating process. The crystals are put through a series of high quality electroformed sieves, ultimately ensuring that the particle-to-particle size separation in a single layer is within just five microns (0.0002").

This is just one of a whole series of steps that Gleason Cutting Tools believes are required to ensure that the wheel ultimately produces the

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results specified by the customer. Among the most important in achieving uniformity of the abrasive layer is Gleason's proprietary electroplating chemistry. After a thorough ultrasonic cleaning to ensure that cores are free of contaminants, the cores are put in engineered precision masking fixtures to protect non-plated surfaces. An electrolytic process then uses nickel to tack down the abrasive to the exposed wheel profile. The duration of this process and the required amperage is precisely controlled based on the abrasive size and the surface area it covers.


But it's the next step in the process that's really critical, according to Werner. "Once we've achieved this initial bonding of a single layer of CBN to the wheel, it's necessary to 'tack down' the layer and encapsulate the crystals by building up the nickel to perhaps 50 to 60 percent of the height of a crystal," he says. "Most suppliers continue to use the electrolytic process, but we've proven that electroless nickel

plating at this stage provides a more uniform thickness and higher hardness of the nickel plating. Simply put, if you can't control the layering of the nickel, you can't control the tolerances of the profile. Electroless is the only way to gain this control."

The finished wheel is then put through a rigorous inspection process that includes the microscopic evaluation to verify particle distribution, and the full-profile grinding (on an actual CNC grinder) and inspection of a graphite coupon, thus verifying that the wheel will achieve the desired accuracies.

More Leads, Less Lead Time

Since the facility ramped up to full production, Gleason Cutting Tools has seen the demand for its high-quality products rapidly increase—and its lead times decrease. Despite the fact that the facility now produces the industry's highest-quality CBN and diamond plated wheels, it has been able to reduce lead times for these products well below the

industry average of 10 to 12 weeks. "We've actually managed to reduce our delivery from eight to 10 weeks on new wheels down to six weeks or less," says Werner. "Nor are we limited to just gear applications or new wheels. We've found a receptive audience in other industries, as well as for non-gear related applications. We are also an excellent source for the replating and refurbishment of all types and sizes of wheels." 



ABOUT THE AUTHOR:

Michael Hayes is president of Hayes Marketing, which represents the Gleason Cutting Tool Corporation. More information on Gleason's plating facility can be found on the company's Web site [www.gleason.com] or can be obtained by calling (815) 877-8900.



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