

Faster Honing to Mirror Finishes

ON GEAR FACES AND BORES

Stringent NVH requirements, higher loads and the trend towards miniaturization to save weight and space are forcing transmission gear designers to increasingly tighten the surface finish, bore size and bore-to-face perpendicularity tolerances on the bores of transmission gears. Increasingly, most gears used in high-load applications are following this trend.

In the not-too-distant past, a surface finish of $0.15 \mu\text{m Ra}$ on bore faces was considered good. But today, increasingly, we see gear design engineers seeking finishes finer than $0.05 \mu\text{m Ra}$ and sub-micron bore-to-face perpendicularity tolerances.

Historically, achieving such a fine finish would require a 4-station honing machine—with two honing and

two gauging stations—a double disk grinder to generate face geometry, a lapping/polishing machine to achieve mirror finishes on the face and, finally, expensive automation to tie all three machines.

If the volumes are fairly high, this process is fine as the equipment utilization is high. But this becomes undable for low- and medium-volume applications as the utilizations remain very low. Also, this process has a quality drawback—in that a double-disk grinder does not impact the bore-to-face perpendicularity, and it basically carries it over from the prior operation.

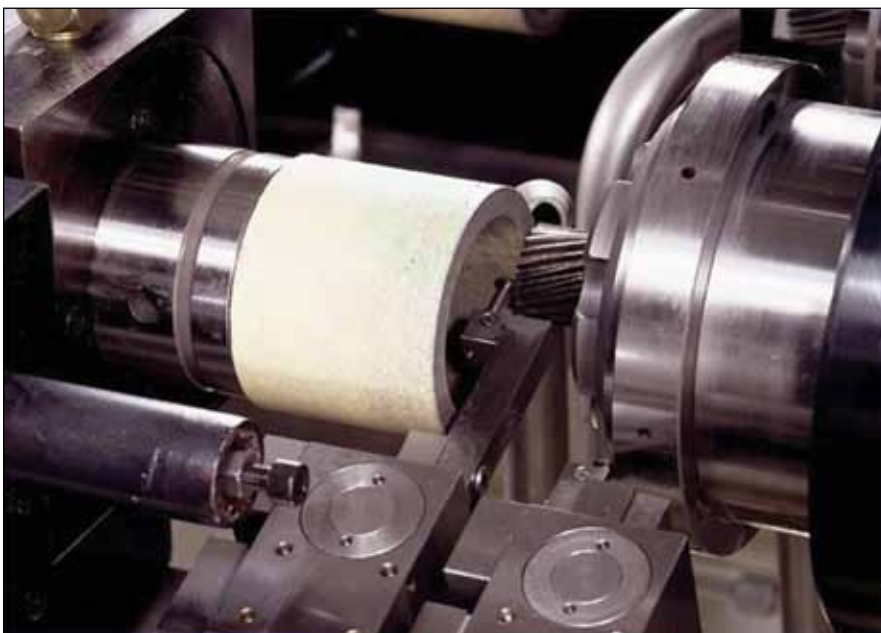
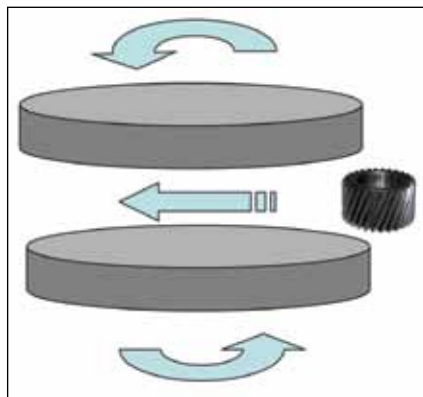
In order to address this issue for low- and medium-volume manufacturers, Nagel Precision (Ann Arbor, MI) has developed a single machine that can take a heat treated gear and yield a mirror finish on both the gear face and bore—with excellent bore-to-face perpendicularity.

The heart of this innovation is seamless systems integration:

- A new Nagel ECO Series 40 flexible honing system that combines gauging and honing into a single spindle, eliminating multiple gauging stations.
- A Nagel SPV cup wheel face finisher.

In the ECO 40 Honing system, gauging is engineered into the honing spindle. Now the honing spindle also gauges the part while performing the honing operation, and this is integrated with a tool expansion system to automatically compensate tool wear.

The tool wear compensation system is designed to further minimize non-cutting time while enhancing bore quality. Once the tool is inserted in the bore, the tool expands at a rapid feed of 200 mm/sec and at high torque (45 percent of available) until it reaches a predetermined position close to the bore; it will then switch to a rapid stock removal mode of about 4 mm/sec at lower torques (15 percent of



available) to avoid tool damage; and towards the end of the cycle, it will further reduce the expansion rate to about 2 mm/sec at 10 percent of the available torque. The system constantly monitors both the tool feed (mm/sec) and the applied torque (as percent of available). If the desired feed is not reached at the preset torque, the operator can either reduce the tool expansion rate if tighter tolerances are desired or increase the torque if quicker cycle times are needed. This is an added key process control parameter available to the operator.

The tool expansion is rapid when there is no cutting and is slowest for the final finishing cut, which results in a consistent bore in terms of finish, size and cylindricity.

In addition, the Nagel ECO 40 automatically senses the form error (for example taper, hourglass, barrel shape, ovality, bend, etc.) and makes automatic adjustments to correct it.

Most of the bore honing machines on the market today have a fixed stroke that is designed to hone a perfect bore, which, as we are aware, is not the case.

However, some machines do provide the operator the capability to dwell for a longer time at the bottom of the blind bore or to program a different stroke length to correct form errors. But this requires that the operator know the exact nature of inaccuracy coming in and generate a program to address that particular form error. The configuration will not be effective should the type of form error change. It therefore would require a skilled operator to inspect the incoming part and modify the stroking accordingly, which is not always feasible and could be time consuming. The Nagel ECO 40 can sense the form error coming in on each and every part and make automatic adjustments in stroke to more effectively correct it.

These enhancements in the hon-

ing technology have enabled Nagel to replace a multi-station system with a compact single-spindle machine without sacrificing part quality.

The SPV 150 Face Finisher differs from conventional grinding operations. The accuracy of ordinary grinding operations depends on rigid fixturing,

as well as the accuracy of the grinding wheel's position relative to the part. Whereas the SPVE 150 utilizes free-cutting cup wheels and the tools self dress and conform to the contours of the part. This automatically compensates for inaccuracies in the machine.

continued

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During this operation, the gear is clamped on the internal diameter of the bore and rotated in a direction opposite that of the cup wheel at a high surface speed. To prevent variations in flatness or axial runout when finishing flat surfaces, the cup wheel tool substantially overlaps the surface of the

part during machining. The machine can remove as little as a few microns of stock to a few hundred microns very quickly. The automatic cup wheel changer enables wheel switching for each part, eliminating batch processing. In-process gauging (Fig. 8) accurately controls the part thickness.

Gear manufacturing is significantly improved by using this process. The conventional process to finish these gears—grinding them with a double disc after heat treatment—yields an axial runout of approximately 40 μm , and cup wheel finishing reduces the runout to less than 10 microns.

Heat treating to a mirror finish with excellent bore-to-face perpendicularity is now a possibility in just one machine. Multiple sensors incorporated in the machine constantly monitor the process and support “lights out” manufacturing for low- and medium-volume production.

For more information:

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Sanjai.keshavan@nagelusa.com
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ing straight bevel gears. According to Gleason, it is the first peripheral stick blade cutting tool system with positive blade seating, which results in cutting time reductions with improvements to gear quality and gear rolling characteristics.

Straight bevel gears are increasingly popular for use in certain applications, but prior to a Gleason's six-axis machining process, there was no other machinery for cutting or grinding them. The process, released in 2006, was wet cutting and used traditional high speed steel cutting tools.

The Coniflex Plus system allows use of coated carbide cutting tools in a dry cutting environment. Coniflex Plus is up to three times faster than its predecessor, avoids the use of cutting fluids and consumes 25 percent of the energy that traditional straight bevel gear cutting tool.

The geometry of existing straight bevel gear designs will be duplicated using the Coniflex Plus cutter system. The free design of profile curvature, dish angle edge radius and blade point provide added freedoms for strength and noise optimizations. The Pentac stick blades are used in the Coniflex Plus cutter heads, and they can be sharpened on existing standard Gleason stick blade sharpening machines without additional software or fixtures.

For more information:

Gleason Corporation
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Rochester, NY 14692
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Stanyl Plastics Steer Handi- capped

DSM Engineering Plastics, through a partnership with the Swiss company Bozzio, has driven its precision gears made of Stanyl PA 46 resin to production in the joystick X-by-wire system that provides people with a disability a safe, user-friendly solution to drive a car. It is available from car modification com-

panies in Switzerland, Germany and the Benelux countries.

“We are proud to have brought to commercial production this important advance for people with a handicap, offering the greater mobility,” says Matthias Hell, Bozzio CEO. “Our patented joystick X-by-wire system is the end result of intensive cooperation by material supplier DSM Engineering Plastics, Bern University for Applied Science, Dynamic Test Center and many others.”

In just three years, Bozzio achieved the strictest level of safety approvals for the European market (TÜV approval according to ECE-R 13H braking system and ECE-R 79 steering system). Bozzio sees a range of potential applications for the patented system in special purpose vehicles, such as municipal and agricultural vehicles, unmanned vehicles and areas requiring a high degree of reliability and safety.

The gear sets made from Stanyl polyamide 46 (PA46) resin in joystick X-by-wire system translate a driver’s steering movements into vehicle control. Two joysticks are mounted and coupled electronically to the vehicle’s steering mech-

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anism. The driver's movement of the joysticks is computed by joysteer, and the data sent to the control module that turns the steering column and thus steers the car. A video showcasing the system's capabilities is available at www.joysteer.ch/uploads/media/joysteer_OnTheRoad.wmv.

The Stanyl gears are part of the steering actuator module. Stanyl PA46 resin fulfills the essential requirements for dimensional stability, low wear and the ability to absorb vibration and noise. Stanyl PA46 resin has an extra strong crystalline structure, which makes it suitable for demanding automotive and electronic applications.

According to Hans Wennekes, DSM business development manager Stanyl, "This patented technology made available by Bozzio opens new opportunities for Stanyl polyamide 46 resin in [a] wide scope of special purpose vehicles."

For more information:
DSM Engineering Plastics
www.dsm.com

Dow Lubricant

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The Dow UCON GL-320 lubricant is a polyalkylene glycol (PAG) based lubricant that combines the PAG base with a proprietary Dow additive package, yielding a product with specific performance properties required for wind turbine and other gearbox operations.

The high inherent viscosity index (VI) of UCON GL-320 addresses the issue of turbines shutting down in cold weather due to filter failures without needing extra VI improvers. The lubricant has a higher heat capacity than **continued**

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hydrocarbon oils, which allows it to move more heat, reducing shutdowns that can occur from high gear oil temperatures when turbine output is at its max. UCON GL-320 also has a better lubricity at ambient conditions, meaning that it has the potential to shift the power versus wind speed curve to the left, leading to

more power output when the production is less than the maximum design output.

High viscosity lubricants, like the UCON GL-320, that provide a thicker lubricant film under operating conditions can help reduce damaging debris and worn particles that can build up. The product is available in bulk, drums or

20-liter containers.

For more information:

The Dow Chemical Company
 Phone: (800)447-4369
wind@dow.com
www.ucon.com

Diaphragm Chuck

CONFORMS FOR PART SEATING



The model DPH-400W from Northfield Precision Instrument Corporation is a four inch diameter diaphragm chuck with special jaws and stops. The stops have three “air detect” holes for part seating conformation, which air is pumped through, and when the part rests on the stop, the air pressure rises, tripping a pressure switch telling the machine to start machining. Four clover adapters have grooves for a CAM follower to snap into for orienting the chuck when stopped. These are mounted to a four spindle Theilenhaus machine.

Northfield Precision also recently introduced the Model 450WHF chuck,

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which uses a four-port air tube and special piston to allow for open/close/autolube/air-detect functions. The top plate with pin is a radial banking surface (side of pin only), which picks up the side of the customer's part when it is loaded and twisted into position into the chuck. The three small pads with tiny holes in the center of the chuck are used to rest the part against tops of pads while the holes are used for the air-detect function. This is a positive indication that the part is indeed loaded into the chuck.

For more information:

Northfield Precision Instrument Corp.
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 www.northfield.com

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cant, eliminates the need for flood coolant and improves drill life.

The multi spindle drilling lubrication system independently controls the amount of the lubricant to each tool, so operators can apply exactly the required amount of lubricant. The Coolube is an

all natural, biodegradable product. It is applied in small quantities, so the concerns associated with excess cutting fluid contaminating a shop or the environment are not issues. Unist offers this unit on a guaranteed free trial basis.

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Weight Savings – As a blank, this large spur gear weighed 55 lbs. As a forged tooth gear with 1 millimeter of stock on the tooth profile for hobbing, it weighs just 37 lbs.



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The EG-225 digital indicator is Ono Sokki's latest multi-purpose inch/metric switchable gage used for a variety of applications. It can be used as a bench-top unit or for in-line measurement. The compact model conforms to AGD Group 2 mechanical specifications, which makes it directly interchangeable with existing mechanical gages, and the compact design ensures easy installation into most fixtures. The EG-225 performs highly accurate measurements to 0.00005 inches throughout its one-inch measuring range, according to the company's press release. This indicator allows you to obtain simultaneously maximum, minimum and range values with only one sweep or rotation of your part. The unit also has an adjustable measuring force, for taking accurate measurements on fragile and soft compressible materials that require low pressure.

A variety of measurement capabilities is provided to satisfy most applica-

tions, including preset, zero/absolute and a counting direction change switch. The EG-225 has a response speed that allows the spindle to travel 20 inches per second without an error reading. The indicator has a built-in rechargeable battery for portable applications or may be used with the supplied AC-adapter. The EG-225 features a data output speed of approximately 40 data per second. Other optional outputs include: RS-232C, USB Plug and Play, MTI, analog and to a wireless gauging system.

For more information:

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LMC Workholding recently announced Richter's installation of a large C-Form Type 5-3 steady rest for a Heyligenstaedt HeynuTurn 2500 machine. This steady rest's capacities include a center height of 1,570 mm (61.8 inches), 1,800 mm (70.9 inches) maximum diameter, maximum workpiece weight of 30 tons and rollers that are 129 mm (5.1 inches) wide. Steady rests turn long shaft type workpieces where cutting can create unstable conditions or cause the parts to bend or deflect.

LMC engineers and manufac-



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Two metrology products from Mitutoyo America Corporation were released: the Roundtest RA-220 roundness measuring machine and the SurfTest SJ-210 portable surface roughness tester.

The RA-220 provides versatile measurement with a compact footprint. Analysis options include roundness, cylindricity, coaxiality, concentricity, radial runout, squareness to axis and plane, wall thickness deviation, flatness and parallelism. The built-in operating panel provides control that is easy to use with an LCD screen supporting 10 languages. The unit has a built-in thermal printer and supports USB RS232C data output.

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rated up to 55 pounds (25 kg) and other features for optimizing rapid inspection, the Mitutoyo RA-220 brings lab-level accuracy to the factory floor.

The SurfTest SJ-210 portable surface roughness tester has a 2.4-inch color LCD display that includes back-lighting, oversize fonts and the ability to re-orient screen content to read vertically or horizontally, left and right. Color tolerance judgment, evaluation curves and all data can display in 16 languages. Self-timed measurement and optional foot switch enable smooth, consistent operation. Up to 10 measurement conditions can be registered, and the ten most recent trace results are stored automatically.

A micro-SD card stores up to 10,000 results and supports screen capture. The SurfTest SJ-210 supports USB and RS-232C connectivity, and security is managed via a password lock. The portable surface roughness tester is appropriate for any manual inspection application with high accuracy (resolution of 0.0016 mm at a range of 25 mm), measurement speed up to 0.75 mm/s, nine optional exchangeable detector tips and features, including gear tooth surface detection.

For more information:

Mitutoyo America Corporation
958 Corporate Blvd.
Aurora, IL 60502
Phone: (630) 820-9666
Fax: (630) 978-5394
www.mitutoyo.com

Roller Hearth Furnace Delivered

J. L. Becker Co. recently installed a 20,000 pound/hour Roller Hearth Annealing Furnace Line for a major manufacturer in Ohio. The furnace processes 5/8 inches outside diameter to 6 5/8 inches tubing in lengths ranging from 10 to 40 feet long.

continued



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The furnace line is around seven feet wide inside by 315 feet in overall length. This includes a 60-foot-long heating section, a 100-foot-long cooling section, as well as load and unload tables.

The furnace atmosphere is provided by a J. L. Becker 30,000 CFH

Exothermic Gas Generator with auto start, variable output and automatic turn-down. The water cooling system consists of a cooling water tank, plate and frame heat exchanger, cooling tower and pumps to provide cooling and circulate the water through the cooling sections. A 300 kW natural



gas-fired standby generator with an automatic transfer switch was provided to keep the system running in the case of a power failure.

The J. L. Becker Computer Management System (CMS) controls the entire line. The CMS touch screen monitors, control and displays the furnace operations, such as heating zone temperatures, roll speed and cooling section temperatures. The CMS also monitors and displays alarm conditions, calculates furnace downtime and measures gaps for production changeovers.

For more information:

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