

Adding High Velocity to High Pressure Gas Quenching

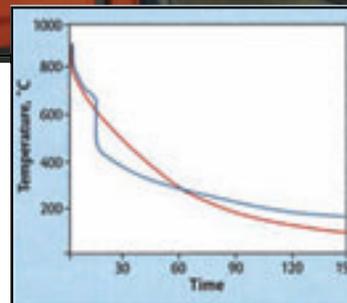


Figure 1—Typical cooling curves for gas (red) and oil (blue) quenching.

When gas quenching, the minimizing of heat treat distortion in gears may be a matter of high pressure and high velocity. That’s what Solar Atmospheres thinks, that’s why the heat treat company sends helium gas into its vacuum furnaces at more than 100 mph.

“The high pressure/high velocity gas quenching technology enables the gear manufacturer to finish machine gears closer to final size,” says Robert Hill Jr., president of Solar Atmospheres of Western Pennsylvania, located in Hermitage. “This process has virtually eliminated post-heat treatment machining, grinding, straightening or plating to size for several types of gears, including many spiral bevel gears, worm gears, miter gears, and herringbone gears. Each of these types of gears has a propensity to severely distort during a traditional liquid quench.”

Typically, gears made of low-alloy, medium-carbon steel (e.g.

4140) or of low-alloy, carburized steel (e.g. 8620) are hardened with hot oil as the quench medium. When liquid quenching is employed, three distinct phases occur. These phases produce large temperature differentials during the quenching process, so the roots, teeth, bores, shafts and webs cool at varying rates.

“These delta Ts cause tremendous internal stress on the gears, that will ultimately result in severe distortion,” Hill says.

Instead of extracting heat by quenching in a liquid (e.g. water, salt, polymer or oil), vacuum furnace quenching uses inert gas cooling that subjects the gears to one cooling phase: convective (see Fig. 1). Since gas cooling is less abrupt and more uniform, this processing achieves acceptable hardened microstructures

with considerably less distortion.

In the past, gas cooling wasn’t fast enough to attain the proper metallurgical results.

“Today, with increased pressure—10 bar—and increased velocity—primarily using helium, gas quenching is able to produce fully martensitic microstructures with much less distortion,” Hill says. “However, there always exist certain limitations that may prevent a fully transformed phase. Therefore, for successful gas quenching, maximum cross sections and minimal percentages of elements within the alloy chemistry must be determined.”

According to Hill, the use of helium for quenching is ever increasing, and improved cooling rates aren’t only a function of pressure but also of gas velocity. By utilizing variable speed drives, Solar Atmospheres is now overspeeding its 300 hp blower

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motors to 5,000 rpm. (Nominal speed is 3,600 rpm.) The exit gas velocity is now well over 100 mph. This quench gas impinges 360° around the workload and is then recirculated back through a heat exchanger.

“Since helium is a very light gas, the power required to recirculate it during quenching is far less than that used

for nitrogen or argon,” Hill says. “When cycle times—cooling times—are reduced by 40%, a substantial savings is realized.”

Shape change is a leading cause of scrap and rework in the gear industry, so the value of vacuum heat treating is less spoilage. Vacuum quenching in the hardening process much reduces the distortion



Figure 2—Sample of parts processed using Solar Atmosphere's process.

caused by residual stress.

Another advantage of high pressure gas quenching is its inert atmosphere. The heat-treated gears are bright, clean and oxide-free (see Fig. 2).

“There is a tremendous added value since gears no longer need to be pickled, shot- or grit-blasted, or ground,” Hill says. “The surface condition of the gears remains the same as the pre-heat treated condition.”

Since high pressure gas quenching eliminates the need for liquid quenchants and the parts are processed in an inert environment, vacuum heat treating is an environmentally friendly process.

“This technique is becoming more and more popular worldwide,” Hill says, “especially when combined with the advantages of vacuum carburizing.”

Solar Atmospheres Inc., a commercial vacuum heat treater, is advancing this technology. “Precise temperature controls, development of vacuum furnace capabilities and the demand for manufacturing efficiency are the driving forces,” Hill says.

Also located in Souderton, PA, Solar Atmospheres has more than 30 vacuum furnaces—from lab size to large production—that serve the gear industry.

For more information:
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Hermitage, PA 16148
Phone: (866) 982-0660
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A collection of various metal gear cutters and bodies, some with spiral teeth, arranged on a dark surface. The lighting highlights the metallic texture and the intricate shapes of the tools.

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Company Offers Technology for “Near-Frictionless Motion of Machines”



For “Near-Frictionless Motion”—Combined micro-relief (CMR) laps a part surface, such as this spline shaft, to create a hydrophobic effect, which works to keep oil droplets from spreading out. CMR also creates non-lapped grooves, which serve as reservoirs. Filled with oil, the reservoirs act as oil bearings and provide lubrication.

Friction Control Solutions Ltd. has a technology to reduce friction and wear, a process the company described as allowing “near-frictionless motion of machines.”

The technology, called combined micro-relief (CMR), was designed to cope with extreme tribological conditions, including poor lubrication, high pressure, low-to-zero velocity and rapid directional changes.

CMR’s ability to reduce wear and friction was checked through independent testing, says Kostia Mandel, FriCSO’s vice president—R&D.

“These tests have been conducted by both FriCSO and by some of the leading manufacturers of various mechanical parts and systems, both in lab tests and in actual applications, including gear parts—like shafts and axles,” Mandel says.

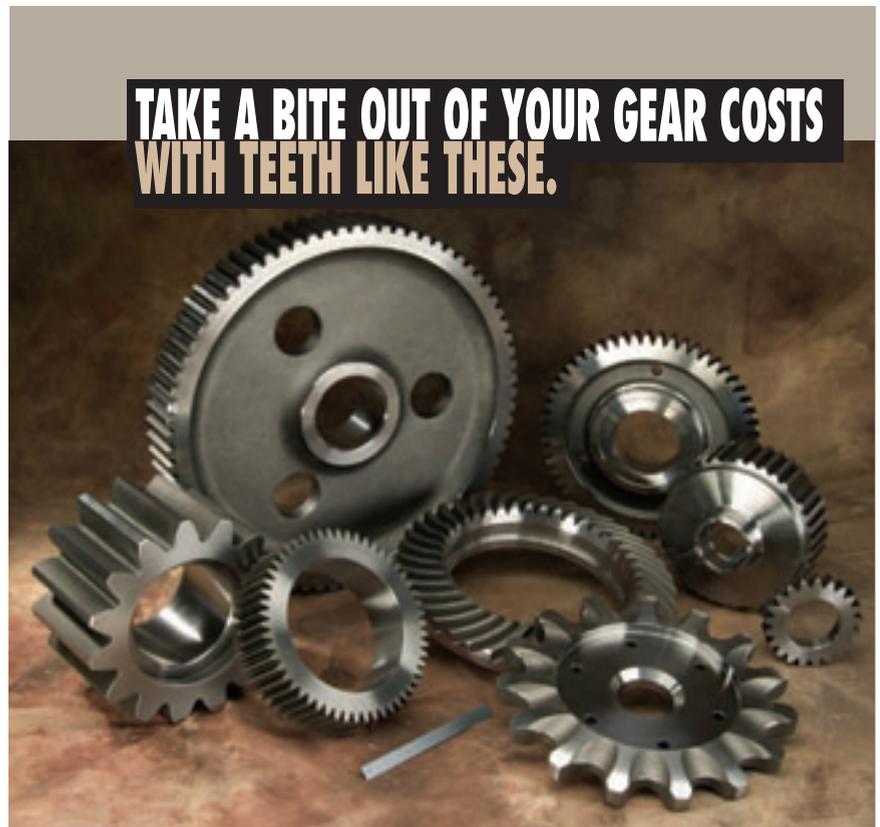
He couldn’t discuss the manufacturers’ specific applications or their test methods, though, because of binding nondisclosure agreements.

According to a FriCSO press release, the technology creates a highly stable, durable and uniform lubricant layer between moving surfaces. The process consists of

lapping and grooving. The lapping is done with tools made of a polymeric compound with standard abrasive material. According to the company, the lapping creates a repelling force against the oil microlayer adherent to the countersliding part. This hydrophobic effect keeps the part afloat, away from the other part—even at a standstill.

“The hydrophobic characteristic is intrinsic to the CMR process and is not the result of applying foreign material,” Mandel says.

The grooving, created with special software, is done through plastic deformation. The grooves are sinusoidal indents, with depths of a few microns. They aren’t lapped, so they don’t repel



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oil. They instead serve as reservoirs for oil repelled by the part's lapped surface. Filled with oil, the reservoirs act as oil bearings and provide lubrication. According to the company, the grooving also strain hardens surface layers, increasing their hardness by 70–80%.

"FriCSO targets two major markets: automotive and heavy machinery," says

Amir Guttman, managing partner at Aviv Venture Capital, which co-owns FriCSO. "The automotive market is huge, but penetration is slow. However, in the heavy machinery market—which includes shipping, oil drilling and military industries—we may generate sales during 2005."

An Israeli company, FriCSO was

founded in 2003 and has offices in Farmington Hills, MI, near Detroit.

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E-mail: info@fricso.com
Internet: www.fricso.com

New Bevel Gear Cutting Machine from Gleason



The new Phoenix II 600 HC CNC cutting machine from Gleason features a monolithic column design that optimizes dry machining, reduces floor space requirements and improves cycle times.

According to the company's press release, this machine was designed for workpiece diameters as large as 600 mm. In addition, it can accommodate both wet and dry cutting processes as well as dry machining.

The need for a conventional machine bed is eliminated as this is the only machine in its class with a cast-iron monolithic column design. In addition, the cutter and work spindle are directly mounted to the column and the cutter spindle pivots to create the root angle rather than mounting the spindle on a rotating base. This enables hot dry chips to fall completely clear of the machine structure into a simple chip conveyor.

Other features include a direct-drive

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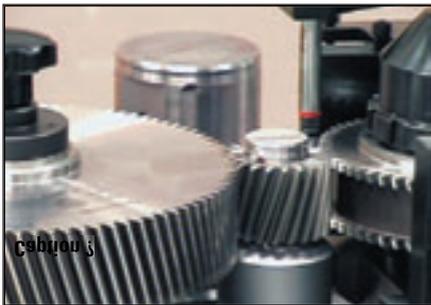
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For more information, contact Gleason Corp. of Rochester, NY, by telephone at (585) 473-1000 or on the Internet at www.gleason.com.

New Gear Roller from Marposs



The M62 DF from Marposs is designed for the dynamic inspection of ring gears with automatic part rotation.

The system can evaluate lead angle, lead variation and taper in addition to the usual double-flank parameters.

According to the company's press release, additional features include a retoolable center distance from 25–200 mm; the ability to accommodate a tooth module up to 5, part height up to 60 mm, and weight up to 10 kg; low pressure measuring devices and an electric gear axis generated by dedicated transducers.

New Gearboxes from ZF



The new right-angle servoworm gearboxes from ZF are designed to meet the demands of servo drive applications.

According to the company's press release, the units are available with high precision, precision and standard levels of accuracy that offer backlash levels of less than 1, 3 and 10 arc-min. respectively. Units are sealed with a high-performance polyglycol lubricant.

Featuring a computer-optimized gear contact pattern that evenly spreads the stress throughout the teeth, these units

also can perform at less than 55 dB. The worm wheel is manufactured from a specially developed bronze alloy.

The oversized taper roller bearings have a configuration that consists of two sets of roller bearings and an additional set of floating ball bearings. Bearings are preloaded for higher temperature variations and loads.

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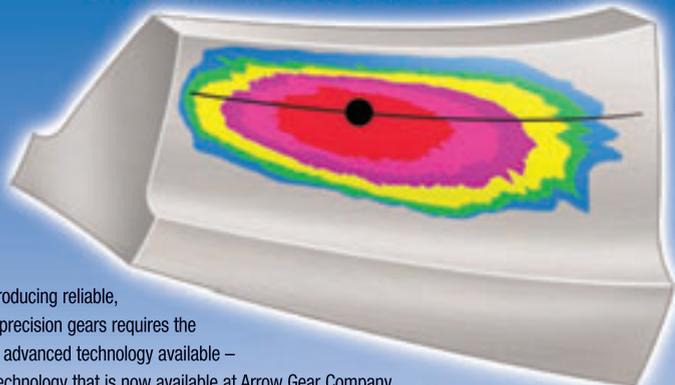
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New Size 17 Gearhead from HD Systems



The Quantum Series from HD Systems is the highest torque capacity harmonic gearhead the company has produced.

According to the company's press release, this gearhead delivers 50% more torque than the CSF Series. It can maintain 1 arc-min. positional accuracy and +/-5 arc-sec. repeatability.

With an outer diameter of 79 mm and a length measurement of 45 mm, the gearhead is available in ratios of 50, 80, 100 and 120:1.

For more information, contact HD Systems of Hauppauge, NY, by telephone at (800) 231-HDSI or on the Internet at www.HDSI.net.

New Thread Rolling Heads from LMT-Fette

The new tangential thread rolling heads from LMT-Fette are pre-

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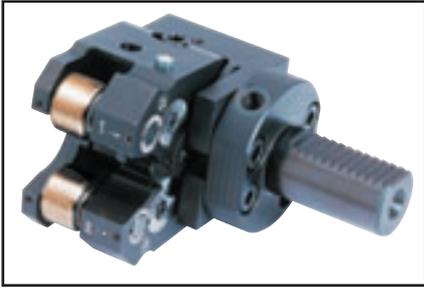
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synchronized for efficient set-up with no roll timing. According to the company's press release, because symmetrical roller repositioning is performed with a central setting screw and away from the rolling systems, operators can expect a 10-minute cycle time.

The lengths of the rolling heads have also been decreased by 20% in order to be suitable for use in CNC lathes and screw machines. Available in T120F, T160F, T220F and T350F, these heads can accommodate thread diameters from 5/64–2". Models can now thread 1/16–1" diameter NPT and NPTF pipe sizes.

For more information,
contact LMT-Fette of Cleveland, OH,
by telephone at (800) 225-0852
or on the Internet at www.lmfette.com.

New Lab Oil from Heatbath



Lab Oil 100 100 is dry-to-the-touch over phosphate coating, low in toxicity, has improved emulsification and high corrosion resistance. The product is designed for manufacturers of metal products requiring rust or corrosion protections.

According to the company's press release, emulsions of oil can withstand 240+ hours of per ASTM B-01117 when applied over zinc phosphated steel panels. Maximum corrosion protection is achieved when concentration is maintained at 20–30% by volume.

In addition, this oil is tolerant of alkaline or acid contamination when either is encountered in black oxide or phosphating cycles.

Recommended operating temperature is 140–180° and concentration ranges from 5–30%. The typical immersion time is 1–2 minutes and tanks can be mild steel, heated with steam or gas and electric heater.

For more information,
contact
Heatbath Corp. of Springfield, MA,
by telephone at (413) 452-2000.

New Furnace from Grieve



The No. 943 pit furnace from Grieve is an electrically-heated top loading pit furnace capable of 2,000°F and is suitable for heat treating applications at a customer's facility.

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For more information, contact
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