

Tight tolerances

Precision operation prevents bar material from grinding to a halt

While the market for precision ground bar stock has grown, suppliers have been hampered in their ability to consistently produce the material with the required tolerances.

This factor recently led Böhler-Uddeholm of South Boston, VA, a supplier of high-speed steels and powder metallurgy produced tool steels, to upgrade its centerless grinding capabilities. The improved process included a

The company has two older Cincinnati centerless grinders capable of meeting the industry standard tolerances of ± 0.001 " to 0.002" on diameter for high-speed tool steel in sizes from 1/8" to 1.5" diameter, according to Steve Lewis, Böhler-Uddeholm's manufacturing manager.

"But we could not achieve the necessary tolerances for precision-ground bars on a repeatable basis without investing in new technology," he explained.

High-volume manufacturers of cutting tools, dental instruments, solenoid valves, and other precision products must have a reliable source of bar material in various sizes, finishes, and metallurgical compositions to meet their processing requirements.

In some cases, specialty metal bars with precise tolerances on diameter are specified, due to the end use application or where machining operations are performed using Swiss-type screw machines with pull-through chucks. These bars are produced in lengths up to 14' using centerless grinders to control size and finish in what amounts to a continuous process.

To evaluate new centerless grinding equipment, Böhler-Uddeholm executives formed a team including several machine operators and maintenance personnel. The team eventually selected a Landis Cincinnati Viking Super Series II centerless grinder from Cinetic Landis Corp. of Hagerstown, MD, to add to its in-house grinding capabilities.

The company recently purchased a second



An automated infeed table facilitates the automatic operation of the grinder by supporting and feeding bars as they are ground.

larger grinding wheel with more abrasive area to reduce the stock removal per revolution of the part and thus increase grinding wheel life, and additional monitoring devices to help control straightness of bars.

Viking centerless grinder for additional capacity for precision finished bars.

The Viking grinders are arranged to automatically grind bar stock using a through-feed grinding cycle. Each machine is fitted with an automatic bar loading and unloading system.

Infeed and outfeed

The automation, which includes an infeed table and outfeed table, facilitates the automatic operation of the grinder by supporting and feeding bars as they are ground. The automation tables and the grinder have been engineered to grind bar stock from 0.100" to 1.125" (2.54mm to 28.58mm) in diameter and from 3' to 16' (0.9m to 4.9m) in length. The grinder uses a through-feed work rest to support the bar as it is ground.

A Zumbach 2000 post-process laser gage system controls the automatic operation of the automation and the centerless grinder. An air blow-off ring is included on the outfeed table to clean bars as they exit the grinder and before they enter the laser gage head.

Rollers on the infeed and outfeed tables, which turn at different rates, are

powered by variable speed motors capable of feeding the bar stock at speeds up to 40' (12.2m) per minute. The outfeed table rollers turn faster to unload the bars at the same rate or a faster rate than the rate that they are ground. These separate rates are programmed in the automation control.

In the automatic mode, the table

rollers laterally adjust to compensate for wheel wear and wheel dressing. This compensation is controlled by signals from the Zumbach 2000 post-process gage.

The infeed table, which incorporates a cradle and elevators, loads and feeds the bar stock into the Viking center-

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A laser gage system controls automatic operation of the feeding automation and the centerless grinder.



The outfeed table rollers turn faster to unload the bars at the same rate or a faster one than the rate that they are ground.

less grinder. It also supports each bar as it passes through the grinder. Straps in the cradle unit raise the bars up to the elevators, which then raise the bars one at a time to the top of the infeed chute.

The infeed chute functions as a magazine-type loading platform for the bars before they are released one bar at a time from an escapement to the infeed rollers.

A carriage for the roller subassembly allows the rollers to be retracted from the grinder during setup. The outfeed table removes bar stock as it exits the grinder.

Fingers in the outfeed escapement lift the ground bars from the outfeed rollers and allow the bars to roll onto the outfeed chute and then to the outfeed cradle to be unloaded from the table.

Close tolerances

"Using the Viking centerless grinders in our precision grinding process, we have been able to produce tolerances as tight as +0.0003", -0.0002" on diameter over a 10' to 12' long bar," Lewis said. "We were hopeful of finding a machine that could handle our complete bar diameter range, from 0.1" up to 1-1/8" diameter.

The Viking grinders gave us that capability."

Lewis said the ability of the Viking grinder to compensate quickly and finitely is essential to maintaining precision tolerances on long parts through a virtually continuous process.

Cinetic Landis engineers attribute this to the Viking's sub-micron control resolution, large 2 1/2" diameter ballscrew, dual-axis slide drives, linear scale feedback, and AC brushless servomotors combined with a rigid, nodular cast iron and epoxy granite base that provides 3 million lb/in. of static stiffness.

Both of the grinding wheel and regulating wheel spindles incorporate "Twin-Grip" mounting to eliminate orbiting and resist wheel-separating pressures under heavy loads. This arrangement provides maximum rigidity between the spindles, a critical element for producing consistent part geometry.

The Viking's user-friendly PC-based control helps to speed and simplify setup and use, while the dual processors provide the ability to create or edit programs, or use third party software for SPC or other management reporting programs while the machine is in cycle.



The Landis Cincinnati Viking Super Series II centerless grinder automatically grinds bar stock using a through-feed grinding cycle.

'THE ABILITY of the grinder to compensate quickly and finitely is essential to maintaining precision tolerances on long parts through a virtually continuous process.' — Steve Lewis

Larger grinding wheel

After conducting test grinds on a Viking grinder at the company's headquarters, Cinetic Landis engineers recommended tooling Böhler-Uddeholm's machine with an 18" diameter by 10" wide grinding wheel, up from the standard 16" x 8" wheel. A 14" diameter regulating wheel was also specified over the standard 12" regulating wheel.

"The larger diameter wheel provides 30 percent more square inches of abrasive to reduce the stock removal per revolution of the part and increase grinding wheel life," said Cinetic Landis' Greg Payne, manager of centerless grinding products.

"We also recommended a resinoid bond grinding wheel instead of a conventional vitrified bond wheel in order to provide some resilience in the abrasive," he said. "When these long rods go through the grinder, they do have some runout in them."

He said that occasionally, a severely out-of-round bar is loaded that would tend to beat a standard vitrified-ceramic type bond wheel to death.

"The resinoid bond abrasive helps resist the effects of bar whipping," Payne said. "Part-touching details, such as the rollers on the infeed tables, are hardened as well."

Böhler-Uddeholm's Lewis acknowledged that supplying straight bars to the grinders is one of the company's biggest challenges in attaining tight tolerances.

The company uses both an in-line drawing machine and rotary-type straighteners for processing the long bars prior to grinding.

The firm has recently installed additional monitoring devices to help control

straightness of bars coming to the grinders.

"Our objective is to both control straightness and to monitor it," Lewis said. "These upstream operations, in combination with the Viking grinders' inherent stiffness and accuracy, have enabled us to consistently hold tighter tolerances than ever before."

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