In an effort to provide increased productivity to the diesel engine crankshaft manufacturing process, Cinetic Landis has enhanced its LT2 machining systems. The development of its new LT2-1400 orbital crankshaft grinder in combination with more efficient CBN grinding processes, including the patent-pending Vector Grind method, can offer opportunities for suppliers of large diesel crankshafts to cost-effectively meet the growing demand for their precision manufactured components.

AWAY FROM THE USUAL GRIND

New system targets greater flexibility, productivity in machining of diesel engine crankshafts

For years, most diesel engine crankshaft manufacturers have found crankshaft lines made up of traditional style indexing-type crankpin grinders with conventional grinding wheels to be a cost-effective solution to their manufacturing requirements. More recently, however, the growth of the global diesel engine industry has begun to put a strain on the ability of older grinding machines to meet demand. Today, many firms are running 24/7 on equipment that averages 40 years of age and in some cases may be more than 70 years old. Meanwhile, the market continues to grow.

Crankpin grinding using an indexing-type cylindrical grinder involves rotating the crankshaft in a fixture in which the shaft's main bearings are offset by one-half the distance of the stroke while the crankpin sidewalls, radii and diameter are plunge-ground using a wheel dressed to full width. Positioning of the crankshaft for grinding each pin is accomplished using a complex indexing fixture that repositions the shaft to the predetermined location prior to each plunge of the grinding wheelhead.

Indexing crankpin grinders inherently lack flexibility due to their mechanical nature. Changeover is complicated and time consuming compared with the latest generation of orbital CNC crankpin grinders. For example, switching from one crankshaft style to a different one requires changing the crank fixture tooling, which consists of the half-rounds and clamp shoes, and adjusting the work rest depending upon the amount of diameter change between the pins and the throw change. The gage tooling must also be changed to accommodate the different part. Then everything has to be carefully lined up. The grinding wheel must also be changed and dressed for the appropriate width and radii before grinding can begin.

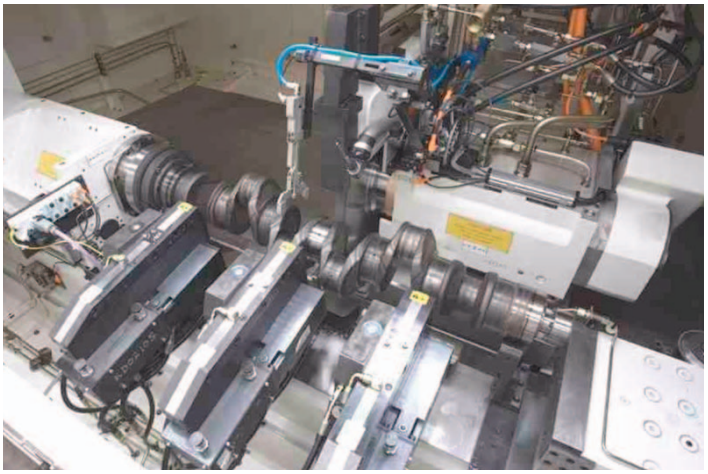
Another major issue with the older generation grinders is the complexity of the indexing crank fixture in terms of reliability and maintainability. Other concerns involve the frequency and duration of dress that negatively affect productivity. In many cases, grinding diesel crankshafts with a conventional aluminum oxide abrasive wheel requires dressing once or twice per pin, which means that the grind cycle is held up waiting for the dress to be completed.

Diesel crankshaft manufacturers are now under tremendous pressure to maintain high throughput with their grinders, according to Russell Kaiser, vice president of engineering at Cinetic Landis Grinding Corp., Waynesboro, Pa. "Orders from diesel engine OEMs to their suppliers are almost universally 'just-in-time'," said Kaiser. "Any downtime that would normally be considered minor is now major and anything major is a catastrophe.

"The age and condition of the equipment not only affects reliability but also serviceability. Finding experienced maintenance personnel in the plants, as well as sources for repair parts, is getting harder every year."

In an effort to respond to the need by manufacturers of large diesel crankshafts for improved productivity, reliability and quality, Cinetic Landis undertook researching a flexible, yet cost-effective crankshaft grinding process in 2004. "We approached the task from several angles," explained Kaiser. "We set out to reduce the ongoing abrasive costs and parasitic downtime for wheel dressing in grinding these huge forged parts. We also targeted reducing the indirect labor

costs associated with part changeovers and wheel changes. Finally, we studied methods to increase flexibility and boost the productive capacity of the machines to improve the capital vs. capacity ratio."



To handle large diesel crankshafts that average 440 lb. with 3.8 in. diameter pins and 4.7 in. diameter mains, Cinetic Landis expanded the capacity of its LT2 orbital grinder to accommodate shafts up to 55 in. long. The machine is especially well suited for grinding truck and heavy-duty crankshafts to precision tolerances at very high production rates due to a combination of advanced technological features that contribute to overall system stiffness and responsiveness.

Switching to more durable CBN grinding wheels from conventional aluminum oxide wheels was the obvious first step. Because a conventional wheel typically begins breaking down at the corners midway through the sidewall plunging operation, frequently the grinding cycle must be interrupted to complete a dressing operation prior to grinding the radii and the crankpin OD. This dressing must be repeated for each crankpin on the shaft. With a CBN grinding wheel, the dressing frequency is significantly reduced.

To accommodate the use of CBN wheels for processing large diesel crankshafts, Cinetic Landis engineers applied a specially modified version of its LT2 Twin wheelhead orbital crankshaft grinder that was originally developed for CBN grinding of smaller automotive crankshafts. Cinetic Landis first introduced the LT2 in the late 1990s, when the company pioneered a technique enabling pins to be precision ground with the crankshaft rotating about the centerline of the main bearing journals.

In the orbital grinding process, a highly responsive CNC-controlled wheel feed system permits the wheel to precisely follow the orbit of each pin about the main journal axis, thereby eliminating indexing crankheads and special indexing fixtures. By centering and supporting the crankshaft on the main journal centerline, there is a direct correlation between the grinding process and the crankshaft's operation in the engine. Extensive testing and actual production experience have shown this approach to be significantly better than conventional processes in holding crankpin geometric tolerances, as well as shaft index and throw, which are critical to controlling diesel emissions.

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According to Cinetic Landis engineers, the use of hydrostatic bearings on all of the grinder's major components, in conjunction with the linear motor drives, increases system stiffness, producing a dampening effect and providing accurate, repeatable performance that eliminates the need for in-process compensation for roundness. Replacing rolling element spindles with hydrostatic spindles that are designed and manufactured exclusively by Cinetic Landis eliminates a source of downtime and cost associated with repair and replacement of maintenance-prone systems.

The LT2-1400 grinder's exceptionally stiff, vertical spindle rotary dresser, coupled with the linear motors on both the cross slide and wheelhead slide, is designed to produce accurate dressing of the wheel radii while simplifying the dressing of back tapers on the wheel.

Special attention was also paid to the efficient application of coolant. Cinetic Landis engineers developed an innovative method of ensuring coolant application at the grind zone. This technique eliminates the need for adjustments as the wheel wears, the company said.

The grinder's advanced mechanical features are combined with the Landis 6400 CNC, a PC-based, open architecture machine control developed exclusively for grinding processes. This powerful control provides the fast interpolation speed and 1 ms updating necessary for efficient orbital grinding along with the ability to store a vast number of part programs. According to company engineers, the Landis 6400 CNC used in conjunction with a rigidly mounted sizing gage to target the feed parameters for individual pins and mains yields a much straighter shaft, better roundness capability, as well as improvement in runout.

Cinetic Landis engineers initially proposed orbital grinding of crankpins on large diesel crankshafts while recognizing that the concentric main bearing journals of these parts have

typically been ground on single-wheel, inline cylindrical grinders. The company deviated from that approach, however, by processing both the nonconcentric pins and concentric main diameters using twin wheelhead grinders of a common design and with much of the same tooling. Chucks, for example, are identical for either a pin grind or a main grind operation. Work rests may also be the same for the different operations. In some cases, different in-process gages used to control the grinding feed cycle may be required for the individual operations depending on the diameters of the pins and mains.

The development by Cinetic Landis of its new LT2-1400 orbital crankshaft grinder in combination with more efficient CBN-grinding processes, including the patent-pending Vector Grind method, can offer opportunities for suppliers of large diesel crankshafts to cost-effectively meet the growing demand for their precision manufactured components. Now, diesel crankshaft manufacturers can have the ability to grind all features on a crankshaft with only one fixture using either dedicated CBN wheels on separate wheelheads, identical CBN wheels for more flexibility using a twin-wheelhead grinder, or a single-wheelhead version depending on their production needs.

"The ability to put a large crankshaft in a machine, fixture it one time and do mains and pins offers the potential for optimum control of geometry," said Kaiser, "because you can alter the process for whatever that shaft needs. Of course, some shafts will be better served than others. But the capability is now there." **dp**