Holroyd Launches New Gear Grinder

New machine promises DIN2 accuracy and unique features at a low cost

Holroyd, long known for its expertise in creating machine tools for manufacturing rotors and other helical components, has now applied that expertise to the manufacture of gear grinding machines with the October 2004 launch of the GTG2, a machine tool specifically designed for small- to medium-batch production of high precision helical gears.

"Our design aim was to produce the lowest cost, highest accuracy grinding machine for helical and worm gears in the world," says Dr. Tony Bannan, Holroyd's engineering director, who led the design and manufacturing team that developed the machine.

The GTG2 has all the features of a modern gear grinding machine—including on-board inspection and grinding wheel dressing. But it also comes with some uncommon features that stem from Holroyd's experience with helical components *other* than gears.

"We've approached the development of gear grinding from a rather different angle, which we think has led to many strengths," says Dr. Chris Holmes, Holroyd's R&D director.

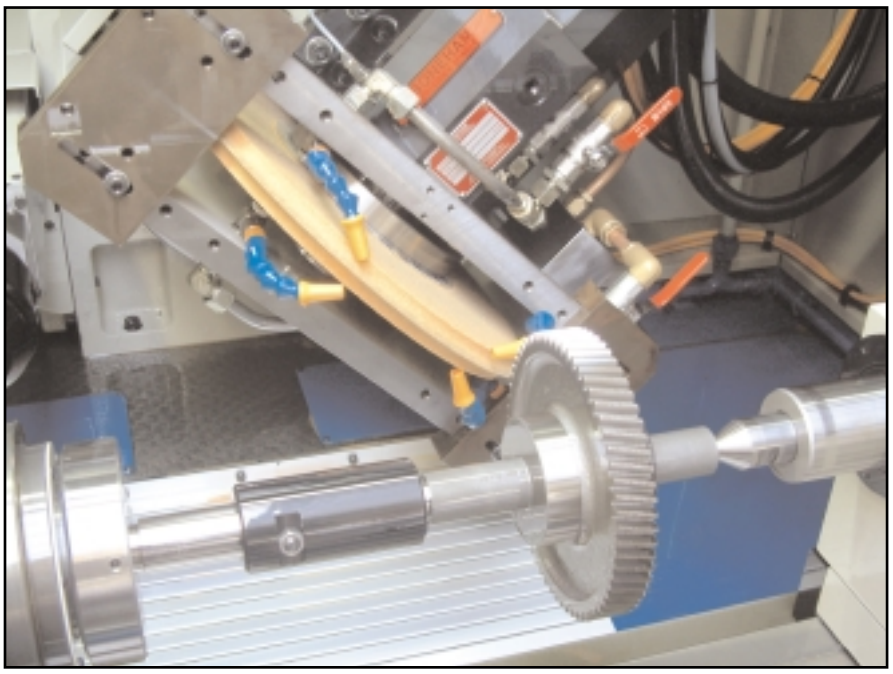
One of the GTG2's uncommon features is its approach to topological modifications of the gear teeth. The Holroyd method, say its developers, solves the problem of flank twist on helical gears. Many older models of form gear grinding machines use a method called "bob crowning," which varies the depth of the grinding wheel in order to achieve tooth modifications.

"When you do bob crowning, you get a distortion of the gear," says Alan Stephen, special projects manager for Holroyd. "This is unavoidable, because of the way you're generating the shape. It's correct in the middle, but not near the ends."

Helical twist causes the profile of the tooth to vary across the face. In many applications, this "error" is not of concern, but in high precision and low noise applications, it affects gear performance by concentrating loads on particular areas of the teeth during meshing. "You may actually want the gear to have this kind of relief," Stephen says, "but the problem is, you can't control it. It depends on the wheel diameter, and you get what you get. Our object was to make an improvement on this."

Holroyd's improvement was to apply a different kind of motion to the grinding pass. Instead of the workhead depth, the GTG2 varies the workhead's swivel angle in order to achieve crowning. This method is patent-pending.

"What we do is, as we're grinding through the gear, the grinding head will



Holroyd's New GTG2 Gear Grinder promises DIN2 accuracy and unique features at a low cost

actually noticeably alter its angle of swivel as it passes through the gear," says Paul Hannah, Holroyd's VP of global sales and marketing. But varying the swivel angle alone isn't enough to solve the problem entirely, Hannah says.

The GTG2 also comes with a built-in simulation package, which allows the machine to simulate the actual cut, assess any inaccuracies, and make adjustments to the grinding wheel. "We then correct the wheel," Hannah says, "making the wheel wrong, if you want, to make the gear right."

The mechanical motion, the simulation package and on-board inspection combine to create a closed-loop feedback system, which enables this machine to provide the highest levels of accuracies, Hannah says. "After we've ground the first one, we measure it, feed back and correct all over again. So instead of something that becomes an approximation of a target profile, we're actually creating the target profile that the designer has wanted. That's something which, I believe, is quite innovative in the field of gear manufacturing."

The on-board inspection is accomplished through the use of a Renishaw CMM probe. "This Renishaw scanning probe that we use on our machine is a full 3-D scanning probe," says Holmes. "It's not a touch-trigger probe. It's the sort of scanning probe that you would have on a full, high-accuracy CMM. The deflection in each of the three directions is measured. It can measure deflections of two microns."

The development of the technology associated with the GTG2 has resulted in Holroyd receiving the British Queen's Award for Enterprise 2004, in the category of innovation. "We are delighted that the awards committee has recognized the ingenuity of our designers, their hard work and effort," says Hannah.

Some of the machine's development was carried out at the Design Unit at the University of Newcastle upon Tyne. "We looked for what we felt was the strongest gear development center in Europe," Hannah says. "We found it very useful that one of the top gear development centers in Europe is the Design Unit at the University of Newcastle, so we forged strong links with Professor Dieter Hofmann of the Newcastle gear design center. We worked with him and his students—we put some of our guys working with them—and they also worked with us at our facility, sharing a lot of knowledge that developed the first machine. The first one went into Newcastle. Then we continued adding on after that."

The first GTG2 machine for production has been sold to Micro Precision Ltd., a Hemel Hempstead, U.K., manufacturer of precision components for the aerospace, medical and Formula 1 industries. "We're still going through a learning curve with the machine," says Barry Cave, director at Micro Precision, "but we are extremely satisfied with it. In our brief experience with it, it is holding very close tolerances."

Holroyd developed its own software and controls for the GTG2.

In some cases, under optimum conditions, those tolerances are being held to DIN 1 levels for some measurements, Cave says. He also notes that "on some components, our set-up times have been reduced from three days to three hours. In addition, we now also have the flexibility to quickly change gear forms to meet our customers' requests."

The staff of Micro Precision had plenty of experience with the GTG2 before making their purchase, says Hannah. "We actually took them into the Newcastle design center. They started to produce their gears on our machine at Newcastle before they actually bought the machine."

Micro Precision also conducted machine trials at Holroyd before making their purchase, Cave says.

According to Hannah, allowing the customer to try the machine out is normal operating procedure for Holroyd. "We recognize that we have a high profile in the rotor industry, but in the gear industry, whatever our history was, we're the new kid on the block now. So we're willing to come to people like this and say, 'What do you need from us? We'll prove it to you. Don't take the risk. We'll happily put our money where our mouth is. I'm not talking about a quick demonstration. Let's make a batch of gears, let's make 10 batches of gears. You can, in fact, send your own operator to work the machine in our plant or some other place to make the gears on it. Then you can make your decision.'"

To make that decision easier, Hannah says, the price of the GTG2 will compare very well with competitive machines. "We designed this machine the way we design all machines now, looking at a design for cost. And, in doing that, we set ourselves aggressive cost targets. We're well within those cost targets, and we have a product which is very aggressively priced in the gear industry."

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