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cover story

Hard Times

Competition, e-commerce and the introduction of new technologies are making it easier than ever for buyers to find good products at low prices. The same market realities, though, make it harder for sellers to survive.

Distributors of metalworking tools face acute price pressures and markets that are slow-growing, at best. Beyond cutting profit margins paper-thin, a distributor needs to distinguish itself from competitors. Among the ways to do this are by offering unique products, timely delivery and in-shop technical assistance.

Those strategies are employed by Just in Time Factory Supplies Ltd., a full-line industrial distributor based in St. Thomas, Ontario. As its name implies, the company vows to deliver its products and services "on time, every time, just in time."

JIT Factory Supplies' offerings include CNC tooling, abrasives, bandsaw blades and specialty tools made of carbide, ceramic, polycrystalline cubic boron nitride, polycrystalline diamond and HSS. It has carved out a profitable niche by helping customers apply ceramic tools that boost machining productivity on hard-to-machine materials.

"We made it our business to go after this market," said the company's sales manager, Don Burd. Most distributors can't offer complete information about using ceramics to machine hard materials (50 HRC or harder), he said, because most of their experience is with carbide.

Solving Hard Problems

JIT Factory Supplies succeeds by knowing its products' capabilities and customers' needs. For example, the distributor's technical sales representative, Jim Brown, has a number of customers that supply stampings to the automotive industry. Among them is Precision Resource, Cambridge, Ontario, a division of North America's leading fine-blanking provider. (Fine blanking is a precision, high-volume metalforming process that combines stamping and cold-extrusion technologies.)

The hardened-steel dies used to produce the stampings must be able to endure thousands of impressions, and occasionally they get chipped. When that happens, "we're under the gun to rework the die," said Steve Kraus, Precision Resource's shop foreman. Obviously, time is an issue in this business, as well as cost. If there is a chip and we have to reduce the height of a die by, say, ¼", we would grind it. We use M-4, which is hardened to 61 to 63 HRC." Grinding a die can take 4 hours.

Brown realized that his stamping industry customers were spending a lot of time grinding. He thought that die repair might be a good place to apply advanced cutting tool materials. He suggested milling the dies with indexable endmills fitted with WG-300 whisker-reinforced ceramic inserts, manufactured by Greenleaf Corp., Saegertown, Pa. (The material consists of a hard alumina-ceramic matrix reinforced with silicon-carbide crystals, commonly called whiskers.)

Brown recommended a 1.00" endmill and two RNGN-32 T2A inserts. Cutting speed was about 500 sfm, and the feed rate was 14 ipm. The cutter was "just flying," he said. The prescribed 0.030" DOC gave Precision Resource 16 cutting edges for each two-sided, negative-rake insert.

"I have customers taking a 0.100" DOC with it," Brown added. "But the deeper DOC uses more of the insert edge, so they lose out on indexing. The feed rates are slower, too."

The cutter has significantly lowered machining times. Kraus said, "What used to take us 4 hours to grind we can now cut in 20 minutes with the ceramic mill." The surface finish is mirror-like, but the die might be ground "just a touch" before returning to service, he noted.

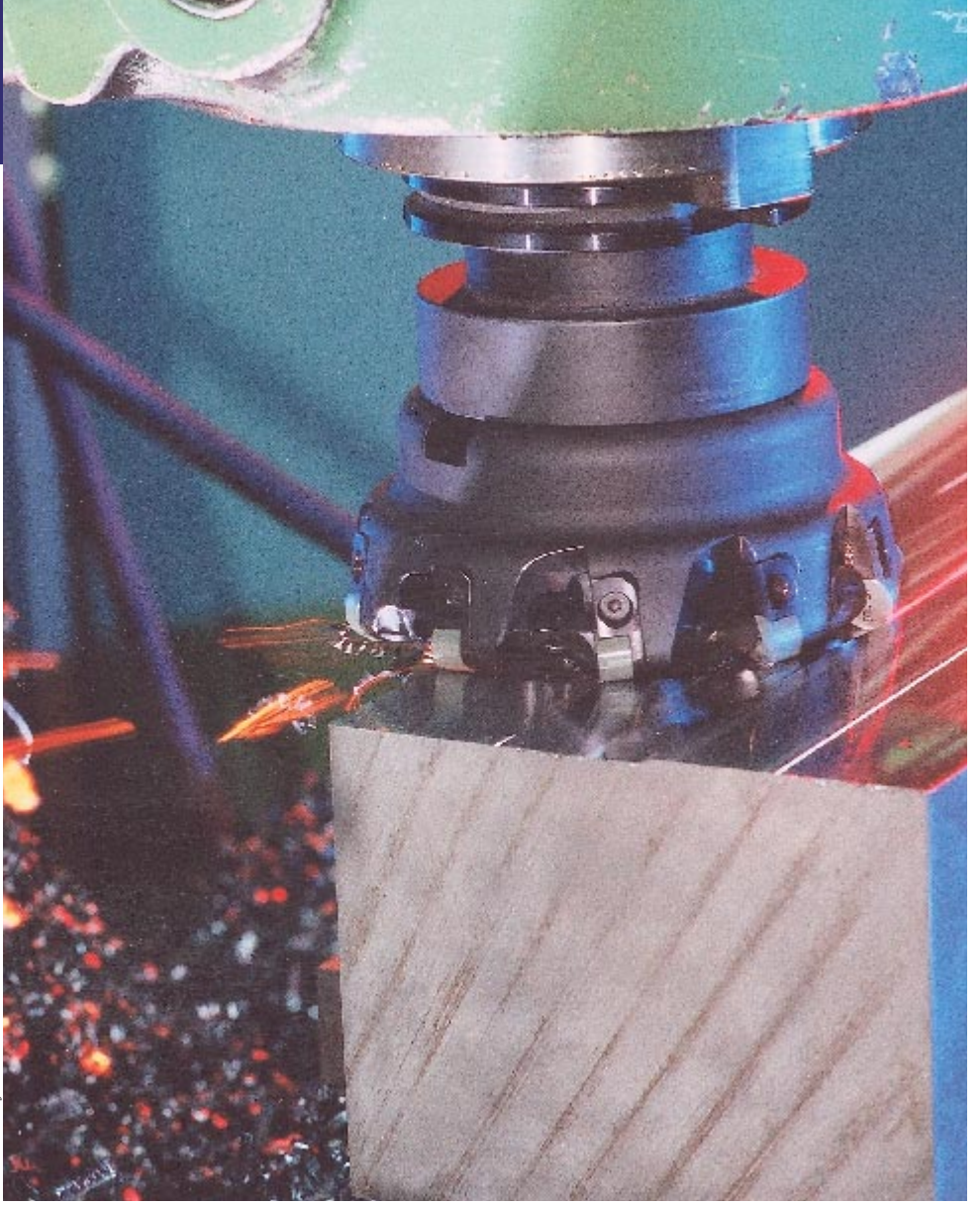
The endmill applied is required to make interrupted cuts because of the chips in the die and holes that are part of its design. "The WG-300 goes through the interruptions like they're not even there," said Brown. "You'll see flank wear, but the inserts won't break unless they're run way too long."

Although the ceramic inserts are expensive, cost per edge is low. Each insert costs $25 (Canadian), which, when divided by 16 indexes, equals less than a $1.60 per edge. "That's cheaper than most of the carbide they have in their shop," Brown said.

Precision Resource has tried solid-carbide endmills. Repairing one die consumed three $60 tools. Brown said, "With the ceramics, [Precision Resource] indexed the inserts one time. So instead of going through a $180 worth of tooling, they used about $3 worth of edge."

Another JIT Factory Supplies customer is Reynolds Custom Machine, Cambridge, Ontario. The machine shop

Distributor specializes in helping customers cut hard-to-machine materials.



B. Kennedy

handles a wide range of difficult-to-machine materials for the fluid-processing and steel industries, including high-chrome white iron, chilled irons and nickel-base alloys.

One job requires Reynolds to hard-mill button-shaped caps for water-circulation pipes used in cooling beds. The 5"-dia. caps are cast from steel that contains 38 percent chrome, 50 percent cobalt and traces of niobium. Hardness is in the range of 45 to 50 HRC.

Part of the machining process involves sculpting a concave, 2.5" radius on the end of the cap that is welded to the pipe. The shop applies a 5.0"-dia. cutter tooled with WG-300 inserts. The cutter accommodates up to five inserts. However, Reynolds discovered that flycutting with only one insert minimizes vibration and chatter. The result, though, is a severely interrupted cut in an extremely tough material.

"Carbide won't touch it," said the shop's owner, Don Reynolds. "We tried a good coated-carbide grade at only 50 sfm, but it would push away. We could not get through the surface."

The whiskered-ceramic insert lets the shop form the radius with two cuts. The cast surface is very hard, which makes the first cut difficult. "The second cut is not quite as bad, but it's interrupted, because you're cutting through a portion of the crust on that cut as well," Reynolds said.

Reynolds Custom completes the task in just minutes. That relatively short machining time took on added significance recently. The shop originally produced 500 or 600 caps a year, but it's currently working on a contract to manufacture thousands.

"It was real important to get the process down pat," Reynolds said.

'Subtle Differences'

JIT Factory Supplies' familiarity with applying the tools it sells enables it to suggest seemingly small changes that can affect whether a job succeeds or fails.

Burd cited a facing operation in Hastelloy that involved an interrupted cut. It took 4 days to machine four pieces. Burd helped the customer apply ceramic tools, and now the parts are completed in 5 hours. He said the shop tried to run the job earlier with the same ceramic tools but failed.

Burd said there were "a couple subtle differences" between the earlier attempts and the recent success. One difference was edge preparation. "They

The following companies contributed to this article:

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Precision Resource
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Reynolds Custom Machine
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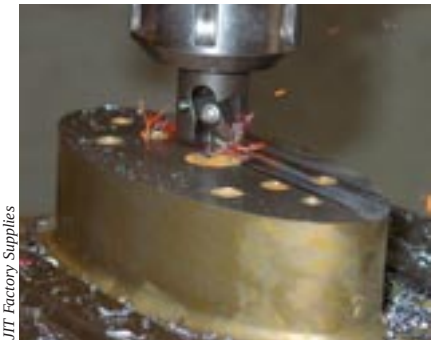

JIT Factory Supplies

A 1.00" endmill tooled with whisker-reinforced ceramic inserts removes ¼" from the surface of an M-4 die (61 to 63 HRC) being reworked by Precision Resource. The job took 20 minutes. To grind the surface would have taken approximately 4 hours.

were running an up-sharp insert, and it couldn't take the interruptions," Burd explained. "We switched them to the edge prep that I use the most, the T2A. It is a 0.006" to 0.008" chamfer at 20°, with a 0.0005" A-hone.

The customer had applied coolant in the earlier attempts. "Because it was an intermittent cut, there was thermal shock buildup, and it actually blew the insert in half and wrecked the toolholder," Burd said. He also recommended raising the speed from 1,000 sfm.

"I said we'll start out at 1,200 sfm, we definitely *aren't* going to run coolant and we'll use the T2A edge prep. Then we raised the speed to 1,500 sfm, and the insert looked beautiful. No chipping, just regular flank wear," Burd said. "The cuttings coming off there were about a foot-and-a-half long, and they were red hot."

The changes worked. The facing pass took just 3 minutes from the outside to the center. Burd estimated the job would have taken 45 minutes with a carbide insert.

Need to Run Hot

When running ceramic tools, it's imperative to generate enough heat to plasticize the workpiece material directly in front of the tool. Doing so reduces tool pressure and allows material to be removed more easily. Approximately 80 percent of the heat generated in the cutting zone should enter the chips.

"If you run too slowly," said Burd, "the tendency is to chip out prematurely. It's better to start too fast and then adjust the speed to control flank wear than to run too slow and have the insert chip or fail catastrophically."

Width of cut also affects chip temperature. Taking a full WOC in steel with a 1"-dia. cutter, for example, the cutting speed might be 400 or 500 sfm. "But if you're only making a 0.50" WOC, you need to 'fool' the cutter and run it at 600 or 700 sfm to keep the heat in the chip and keep the insert under compression," Burd said.

When recommending tooling, Burd first asks the customer about the material to be machined and its hardness. Tool manufacturers publish charts that provide basic cutting speed guidelines, based on workpiece hardness. "The chart might recommend 400 or 450 sfm, and that's based on, say, a 0.025", 0.030" or 0.050" DOC. Whenever you make a change in your feed rate, your DOC or your rpm, it always changes the temperature of the chip."

Reynolds Custom Machine

Reynolds Custom Machine uses ceramic inserts to cut steel that contains 38 percent chrome, 50 percent cobalt and traces of niobium. Hardness is in the range of 45 to 50 HRC.

To illustrate the point, he said a cutter running at 2,800 rpm, a DOC of 0.030" and a 14-ipm feed would have a chip load of about 0.002" per tooth. "If we decide to change to a 0.075" DOC, we have to make an adjustment because the chip temperature will be higher. We may have to go from 2,800 rpm to 2,400 rpm."

Precise adjustment of machining parameters is necessary to achieve the best performance with any tool material, but especially with advanced materials like ceramic. Burd discussed the "narrow window of opportunity" when running a ceramic cutter compared to a carbide one. "With carbide, you might have a variance of ±40 percent of the charted speed and still be able to cut," he said. A ceramic tool is a lot less forgiving. But when the user finds its application zone, the "productivity gains are so huge that you can't ignore them."

In a milling operation on rock crusher components made of manganese steel, for example, one JIT Factory Supplies customer achieved a huge boost in cutting speed. "Traditionally, they milled the manganese steel with carbide at around 100 sfm—very slow and painful," said Burd. "We ran ceramic at 1,500 sfm and 80 ipm with a 4.0" cutter."

Boosting cutting parameters that much makes some machine operators nervous. The distributor's on-the-floor support team reassures machinists—and their employers—that ceramics must be run hard. Burd said, "If I'm there, standing by the machine, then the operator's comfort zone is there. He knows he's not alone."

That type of technical support, along with finding unique solutions to its customers' hard-material problems, has helped JIT Factory Supplies prosper—not just survive—in today's highly competitive market.