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▶ BY BILL KENNEDY, CONTRIBUTING EDITOR

How one shop sifts through the ever-growing array of turning inserts.

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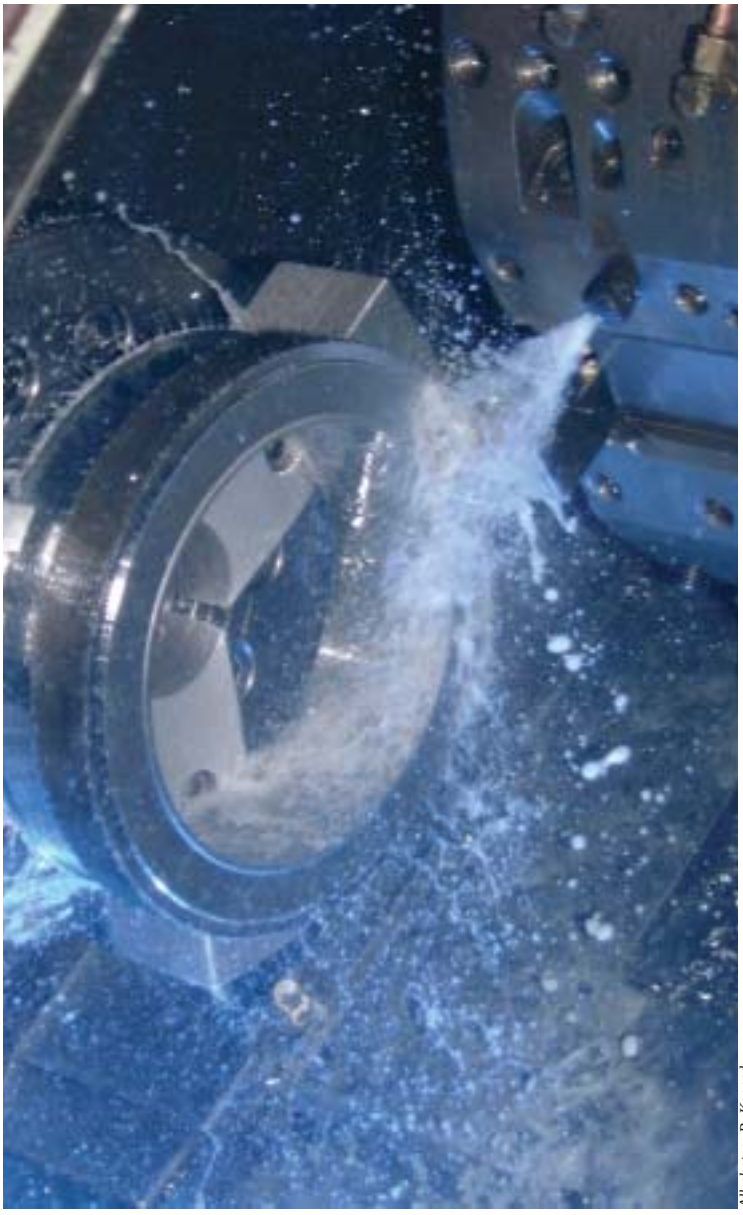

All photos: B. Kennedy

Among the criteria upon which CNC Industries bases its insert selection are experience, supplier support and testing.

Proctor & Gamble offers no fewer than 11 functionally different versions of Crest toothpaste. They sport names like Cavity Protection, Extra Whitening, Tartar Protection, Sensitivity Protection, MultiCare Advanced Cleaning, Sparkle Fun Gel for Kids ... you get the picture.

If you think that's overkill, check out any recently published turning-insert catalog. Nearly every supplier lists multiple fine-grained or high-cobalt or wear-resistant carbide substrates coupled with an alphabet soup of coatings: PVD, CVD, MT (medium-temperature) CVD, TiN, Al_2O_3, TiAlN, TiCN—the list goes. And new grades are regularly being introduced.

Guided by modern marketing strategies and aided by advanced methods of production and inventory control, manufacturers spew out myriad specialized versions of their products. Is this continually growing selection really good for users? Or does it just confuse, or even paralyze, them?

There's no simple answer. Nor is there one right answer. Users have to make their own way through the dizzying array of insert choices available on the market.

One busy job shop has done this by combining practical experience, seeking and receiving expert advice when needed, conducting tests and, over time, developing confidence in certain tooling brands and suppliers.

Using What Works

CNC Industries Inc. (CNCII), Fairmont, W.Va., takes on jobs big and small. It produces everything from small, exotic-alloy medical parts, which it machines to "tenths," to molds from steel castings weighing 600 lbs. or more. The shop operates three CNC lathes, one horizontal machining center, two vertical machining centers, and numerous support, inspection and information-management equipment. Part runs range from 10 pieces into the thou-

The shop tested a number of inserts before choosing one from Valenite to bore cobalt-chrome caps for hip implants.

sands, and lead times can be anywhere from hours to weeks.

CNCII President Greg Morgan has spent more than 30 years in the machining business, which includes time operating the first NC machine in the area. Before founding the company in 1990, he worked at a number of different shops. His experiences convinced him that the top priorities for a job shop should be to always turn out high-quality products and deliver them on time.

That's accomplished through consistent, predictable machining. That, in turn, results from applying consistent, predictable cutting tools. For short-run, routine and repeat jobs, CNCII sticks with specific coated and uncoated carbide grades that it knows will work.

The company's programmer and production manager, Bryan Williamson, said: "There can be a big difference between grades. They can really make or break how a job is going to run. Our program and setup sheets [for a job] specify the particular grade we want to use."

Morgan said his shop uses a number of different toolmakers' products. When a job is out of the ordinary or if problems arise, CNCII consults its suppliers for application assistance. For example, the shop was having trouble machining shafts made of 4140, induction-hardened steel. Usually, a part is only hardened to a depth of 0.050" or 0.030", Morgan said. Operators first machine away the hardened sections with ceramic tools.

"We did that [with the shaft], then tried to cut a slot," he said. "We couldn't touch it." So, Morgan called the company that supplied the shaft to ask for advice, but it had no statistics on depth of the induction hardness in 4140.

"When I asked if it could be hard clear to the centerline, they said, 'Absolutely!'" he recalled.

The shaft turned out to be hardened to a depth of about ½". "We called a tool supplier that had helped us another time with another part that was very hard," said Morgan. "The salesman suggested a new coated-carbide insert. It worked well." The chips came off solid blue, the shaft didn't overheat and CNCII was able to hold the width of the slot to ±0.001".

On new or problematic jobs, CNCII is eager to try new grades. Williamson said, "We don't go back to the old ways." But he admits that the growing number of grades complicates his company's choices.

"I have a real difficult time keeping up with everything new. The suppliers' sales reps help, but you have to keep yourself constantly educated by reading about what's out there. Sometimes, it's a matter of just being on the floor and working with the tools as much as possible to see how things happen," Williamson said.

Testing 1, 2, 3

Testing aids the insert-selection process. Morgan said, "One of our suppliers may come by and say, 'You're machining ductile iron; would you like to try this new insert especially made for ductile?' We'll try them, and if they are better and more cost-effective, we will switch to them and rewrite our programs to match."

Williamson added that it's difficult to test short-run parts. "Some of our jobs are very limited—25 or 30 parts. It's hard to get a good idea what works after only 25 pieces. So what we do first is try to get an idea from the supplier about how that particular grade or style of insert worked in the same material elsewhere."

The large suppliers have already conducted a lot of tests, Morgan said, "so if they say it's OK to run a grade at 1,200 sfm, we'll put it in there and see how long it lasts." Tool reps occasionally will spend an entire day trying different speeds and feeds at CNCII.

On occasion, the shop optimizes an operation over time rather than perform a one-episode test. That was the case with a 12L14 steel seal retainer. CNCII runs 700 to 1,500 of the retainers every month. "Previously, I was breaking inserts, fighting it," said Williamson. "We were making too many offset changes. Even if you knew that after 50 parts you'd have to change, it was still erratic. But I've been trying different grades. And slowly

CNCII's Greg Morgan and machinist Lee Samples examine a part.

Toolmen weigh in on abundance of grades

The tooling industry has plenty to say about the proliferation of turning-insert grades.

Darvel Hansen, director of turning products for Sandvik Coromant Co., Fair Lawn, N.J., admitted that choosing a grade can be tough. But it's not just because of the growing number of grades. He said that Sandvik introduces just two or three new grades annually, but "when we bring out a new grade, we'll bring out a whole bucketful of geometries." When tallying up all the sizes and styles, that translates into 1,500 to 2,000 new products a year.

"We've got 32,000 items in our inventory, and there's a constant evolution of 'out with the old and in with the new,'" said Hansen. "We are always fine-tuning our offerings so we can cover everything from the absolute hardest material cut at the highest speed to the softest material cut at the lowest speed."

Ken Brookes, U.K.-based author of the *World Directory and Handbook of Hardmetals and Hard Materials* and a well-respected carbide curmudgeon, said a lack of carbide-tool standards impedes grade selection. ISO classifications, Brookes said, don't tell much about a grade's actual makeup. The tungsten-carbide content of a commercial P-10 grade, for example, can vary from zero to about 75 percent, titanium carbide from 8 to 80 percent and cobalt from zero to 10 percent.

"There should be real standards for performance and composition," he said, that would let users make straight comparisons between grades.

Brookes is skeptical about testing, too. Years ago, he supplied carbide to a major U.K. automaker. Some of the same carbide also was resold under a different company's name. Brookes said the automaker "proved conclusively" that the grade he supplied was twice as good as one from the other company. But both lots had, in fact, come from the same batch, out of the same furnace, at the same time.

Doug Ewald, manager of the lathe-product group at Kennametal Inc., Latrobe, Pa., said the company offers a large selection of specialized grades engineered for maximum productivity in certain materials, as well as two "universal" grades that are each designed for a wider range of application.

"The products are designed to fit the needs of various customers, depending on the volume of work," Ewald said. For example, long production runs can benefit greatly from fine-tuning with specialized grades and geometries. But for a short run, it usually isn't cost-efficient to take the time to fully optimize metal-removal rates and/or tool life. In that case, a broad-range grade can provide respectable productivity.

Kennametal Inc.

Waverly French, Ohio Valley regional manager for Iscar Metals Inc., Arlington, Texas, said a grade's ability to handle a cut is, obviously, important. "If the user is taking off maybe ⅜" per side, I would recommend a tough grade like Iscar's IC328, a PVD TiCN-coated carbide. It has a fine-grain substrate with a very high percentage of cobalt, for strength. You can almost hit it with a hammer and not chip it," French said.

French lamented that much talk about "cost" reduction is really about "price" reduction. Many users are disinterested in saving money through productivity. "They want discounts on an insert they're already using, rather than going to a new grade, at the same price, that can double their tool life," he said.

Ron Edwards, vice president and CEO of independent insert fabricator Migatron Precision Products Inc., Oscoda, Mich., said tool choice "gets down to human nature. For some companies, the color of the box is what makes it work."

And other factors often come into play. Aluminum-oxide coatings work very well, Edwards said, "but operators don't like the way they look (black). So tool manufacturers flash-coat aluminum oxide with a gold TiN coating. Now it's new and improved, and the operator is happy, because he can see the wear pattern better."

Edwards' company buys carbide blanks, grinds and polishes them, then has them coated. He said independent fabricators play a "catch-up" role. Generally, they imitate what the major tool suppliers develop and then offer similar performance at lower prices.

"Our new grades are based on what we feel are the best ones out there," he said.

The true beneficiary of continuing grade development, Edwards continued, is the tool user. "The customers are the winners in this game. They are getting the best and most efficient carbide ever used."

—B. Kennedy

and surely it's gotten to the point that I can set up the job on our automatic machine and rarely make an adjustment."

Recently, the machine shop tested some grades it uses to produce titanium and cobalt-chrome medical parts. Often, these parts are in families incorporating clusters of different-size parts. The company takes time to test inserts for a family, which might consist of up to 1,500 pieces.

One example involved boring cobalt-chrome caps for hip implants. The four caps have diameters ranging from 24mm to 32mm. Machining the bore is difficult. Its starting diameter is 0.406", and it has a 1.5° taper. Tolerance is ±0.0001". CNCII uses a 0.312"-dia. boring bar and a precision-ground 5/32"-IC VC-2 insert from Valenite, Madison Heights, Mich. Morgan said he tested other grades "but found with the C-2 that if we just slow it down a bit we get very consistent results. The insert wear is 0.0001" on every finishing pass. So the operator automatically changes the finish tool 0.0001" on every part, and after 25 parts he changes the insert and backs off 0.0025"."

The depth of cut on the finish pass is light—0.0015" on a side. Feed is 0.003 ipr, and the cutting speed is set at 150 sfm. For roughing, DOC is 0.100" on a side, and the speed is 180 sfm.

The job requires a 16-rms finish, and, interestingly, the bore is not ground after being turned. The end user wants the small feed lines to remain in the bore, because they help the cap grip the stem of the joint.

Besides its willingness to try a new product if the situation warrants, CNCII gets creative by developing its own specialized tooling or gaging equipment. When the shop couldn't find a simple, precise and relatively inexpensive gage for measuring internal and external bores and grooves, for example, it developed and manufactured one. The gage consists of a dial indicator mounted on a machined aluminum strut, with push-button mechanical operation and contact points that interchange to measure bores or grooves. The measuring instrument has proved so useful and economical to make that CNCII now sells gages based on the original design to other job shops.

The Human Element

Intangibles are part of any decision-making process. One of the criteria upon which CNCII bases its tooling choices is an increasingly rare commodity: loyalty. Morgan explained, "When I started this machine shop 12 years ago, a lot of people helped me and stuck by me." And Morgan reciprocates. He cites Mike Massinople at Mabscott (W.Va.) Supply as one distributor he has stuck with from the beginning.

CNCII's scheduler, Chester Thomas, said, "Basically, we have a good relationship with 95 percent of our suppliers." He added that insert pricing is fairly standardized. "If you buy a thousand inserts, you're going to get a better price than the guy who is buying 10."

One of CNCII's goals is to bring predictability to the pricing of the parts it machines. It has found the best way to accomplish that is through applying tools with predictable wear life—not trying to wring every last drop of productivity out of an operation.

"If you get 20 pieces and then have a major failure, you wipe out tools and add setup time, and you haven't gained a thing," said Morgan, "even if you machined the pieces a hundred times faster. We like to put a tool in there for a 50-piece run, run the 50 pieces and have a little bit extra tool life left.

"It's like the tortoise and the hare. The hare might be ahead 90 percent of the time, but he has problems at the end, while the tortoise ends the race alive and unscathed."