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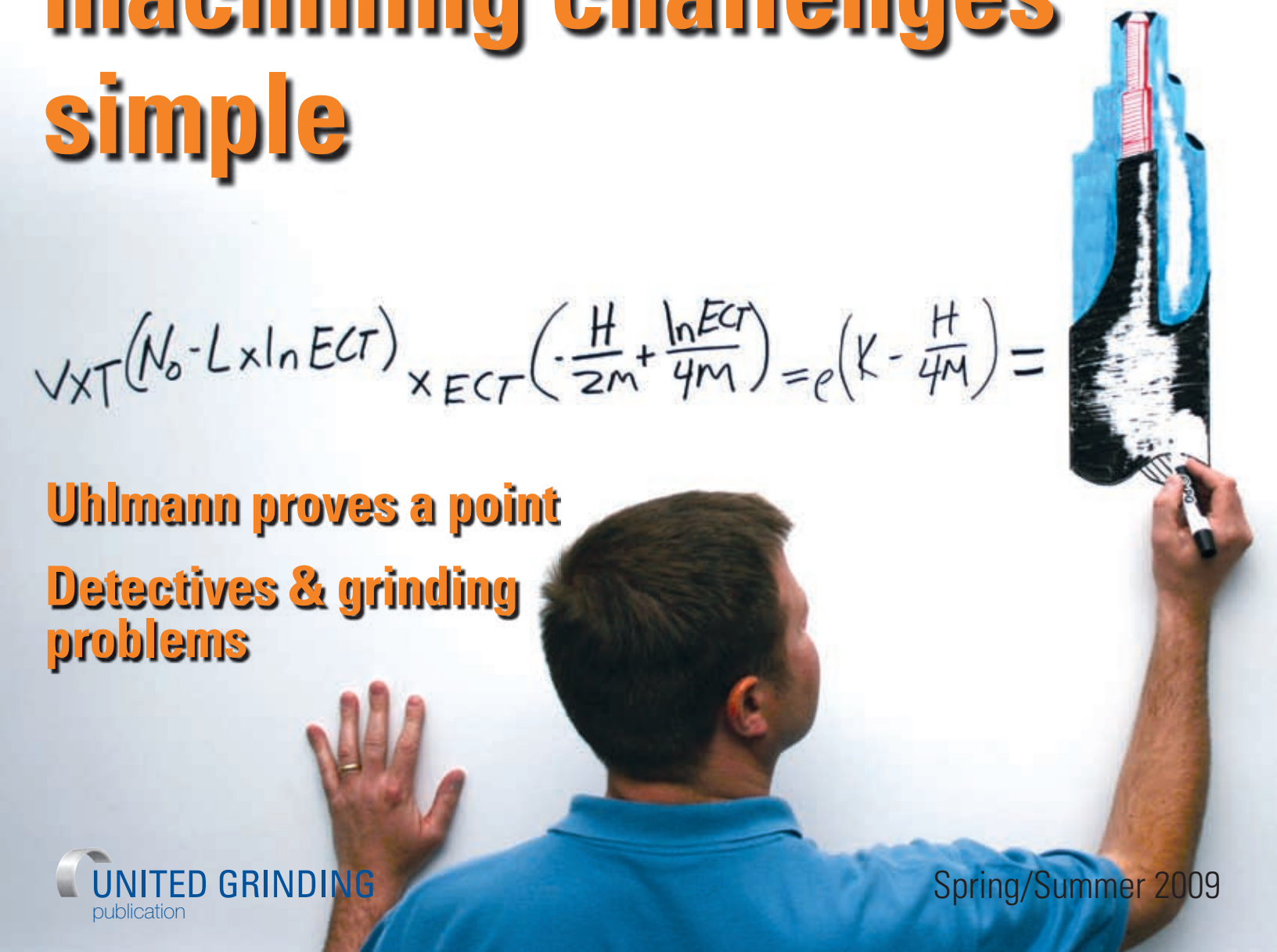
Making complex machining challenges simple



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Detectives & grinding problems

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Making complex machining challenges simple –

With creative cutting tools

Jeff Prom looks at the manufacturing landscape with a mixture of excitement and frustration. Excitement because even after years in business he still sees *plenty* of opportunities to make major improvements in machining operations. And frustration for the same reason! Why, he asks, do so many people struggle with five-axis machining or multiple setups when a $200 cutting tool can remove all that complexity and expense? So one of his key missions at Sharon-Cutwell Co. (Belgium, WI) is educating users about what special tooling can do for them.

Sharon who?

Sharon-Cutwell was founded as a manufacturer of specialized cutting tools in 1945. Jeff's father, Gerald Prom, bought the firm in 1970 and Jeff "sort of grew up there" – cleaning and doing odd jobs until he left for college and a five year stint at Boeing Seattle, where he helped engineer military aircraft. By then, his brother-in-law Willie Perez was working at Sharon-Cutwell and Jeff realized he was better suited to entrepreneurship and the creative freedom it would give him. So the two teamed up to buy the company in 1998, although Gerald still keeps a desk there and can be relied upon for sage advice. And oh – Sharon was the daughter of the *original* owner!

What makes some tools "special" and why should I care?

Jeff explains that any machining application that is complex or demands high accuracy or performance could benefit from a special cutting tool. A special cutting tool is one that combines part features or multiple operations onto a single tool to make a complex job

A small collection of special cutting tools from Sharon-Cutwell that create complex forms and eliminate operations, thereby simplifying machining

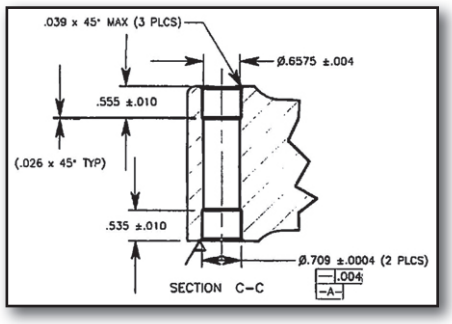
simple, or one that delivers high accuracy or high performance. Special cutting tools should always be considered in these cases because they are generally much more cost effective than other possible solutions. For example, it's much better to solve your chatter problem with an optimized cutting tool than to replace your machining center. In fact, one of Sharon-Cutwell's mantras is to *deal with the existing constraints*. Yes, they may advise you to change workholding or feed rate or something similar, but their goal is to solve your problem *without* adding to your capital investment. In fact, they may help you cut it.

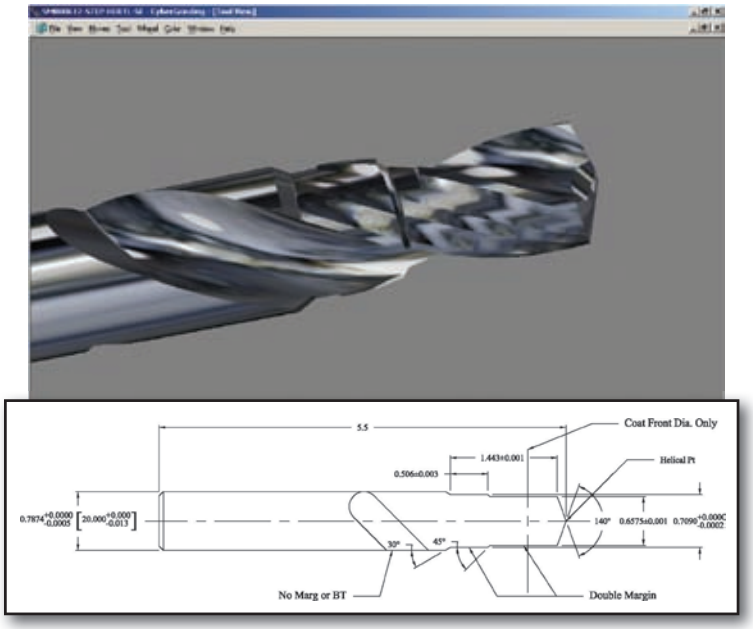
Machine tool people are part of the problem

Jeff adds that "one reason so many manufacturing engineers neglect to consider special cutting tools is because most machine tool people don't see the need for special tooling. They argue that because their machines move in five axes and come equipped with tool changers they can perform all the necessary operations with standard tooling. That may be true, but a tool with three diameters can do it faster and more accurately, to take just one example. Interpolating a form inside a hole is another key example. Most people don't realize that a special form tool can make this easy. Instead, they pursue a much more complex and expensive solution."

They do the complexity so you don't have to

One customer needed to drill and ream into solid ductile iron, plus create several features within the hole (see accompanying drawing). He was using four tools and seven operations: two spotting operations, two drilling operations, two counter-boring operations, plus reaming. The total cycle time exceeded three minutes, including the tool changes, which were automated. Sharon-Cutwell designed a *single tool* that machined all the features in only two operations and cut the total cycle time to 20 seconds! Even though that tool might be considered "expensive" at about $200, the cost is far exceeded by the obvious benefits of a ten-fold improvement in cycle time. After all, tooling cost is a miniscule component in the overall cost-per-part in any machining operation.

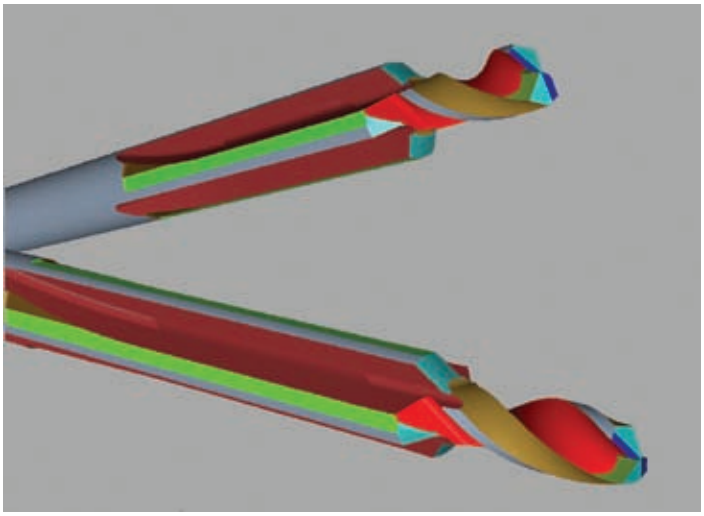




A "Cyber Grinding" (virtual) image and associated drawing of a combination drill-reamer that Sharon-Cutwell created to replace four tools and seven operations, resulting in a ten-fold improvement in cycle time and more consistent part quality

The new Sharon-Cutwell tool also lasted twice as long as the old tooling. And it delivered consistent performance, consistently holding +/- 0.000,4 inches in what had been a relatively unstable process. This is due in part to using solid carbide and state-of-the-art coatings. The tool also featured through-hole coolant.

A similar combination tool (this one brainstormed over a beer at an Irish pub in Milwaukee) drills & reams a feature on a handgun, which then becomes the guide bushing for the tool to reach deep into the gun to



Two views of a combination tool that reams a feature on a handgun, which then becomes the guide bushing for the tool to reach deep into the gun to finish another smaller hole at the end – another example of a creative tool simplifying a machining operation and cutting cost-per-part

finish another smaller hole at the end. The booming gun business (you'll excuse the pun) needs such process improvements to keep up with demand. Other firms should consider this type of tooling to cut costs and improve profitability.

Sometimes it's a complex, tight tolerance external form...

Cutting the groove forms for turbine blade mounts is a tough challenge in two of today's busier industries: energy and aerospace. The most efficient way to do this is with a "Christmas Tree" or root form cutter, but making those tools requires grinding a complex form to a very tight tolerance. That's a routine challenge at Sharon-Cutwell, as shown by the recent example to the right. The tool replaced a "quasi-standard" tool and held a part tolerance of 0.000,1 inches.

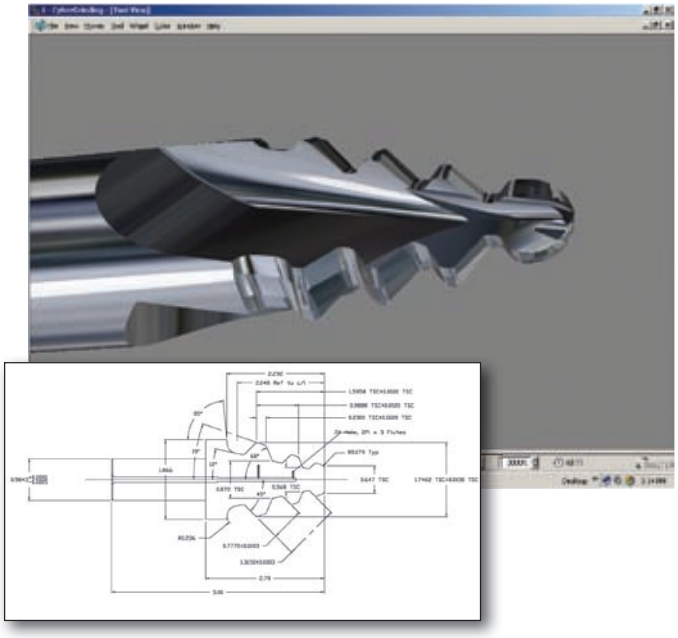
A high performance drill, a step drill, and a step reamer. Another example (not pictured) being ground during our visit combined drilling, chamfering, and back chamfering in one tool.

How do they do it?

Sharon-Cutwell takes a disciplined three-step approach to solving tough manufacturing problems. First, they seek to understand the requirements of the application at hand: material, tolerances, surface finish requirements, and so forth. Second, they study the constraints imposed by the machinery: workholding, coolant options, horsepower, and so on. And they tackle these two tasks efficiently, thanks in part to their proprietary interview form, which quickly organizes all the pertinent facts. The third step, of course, is developing a cutting tool solution. That's where the creativity comes in. But at Sharon-Cutwell, "creativity" doesn't mean runaway dreaming or costly experimentation. Instead, they embrace innovative tools from Walter Grinders to reduce complexity and waste – applying the same lesson they preach to their customers.

Tools go from head to mouse, before they go to the machine

Once Sharon-Cutwell understands what the customer needs the cutting tool to do, they begin to think about what geometric features they can combine to accomplish that most efficiently. And as Jeff puts it, "the more creative you are and the more you're willing to take risks the sooner you find truly game changing solutions."



A "cyber" image and drawing of a turbine blade root form cutter created by Sharon-Cutwell. The new tool ensured the customer could consistently cut a required form to within a "tenth" (0.000,1"). Sharon-Cutwell maximizes their own efficiency by doing all their tool programming and basic setup on PCs in the shop, rather than on their grinders, using Walter software that includes realistic 3D simulation.

But to arrive at creative solutions quickly, especially ones that can actually be implemented in the real world, Sharon-Cutwell uses Walter's *Cyber Grinding* and *Helitronic Tool Studio* software to design the tool and simulate the grind in 3D so that everything is proved out in a virtual – albeit realistic – world.

"That's one of the beautiful things about *Cyber Grinding* and *Tool Studio:* You can take all the risks in the world. The fear element is gone, whereas in the past when you were doing a live setup with carbide in the machine, fear was always present. And if you get the wrong personality – the guy who's afraid to make a mistake – nothing would get done. Now – I love watching it. It's kind of like playing video games. The operators will say to each other – 'Try this. Try that. Oh, it doesn't work here…let me go there…' And you can see their brains work as their hands work the mouse and the keyboard."

The wheel changer is also a game changer

One of Sharon-Cutwell's key investments in producing specialized cutting tools efficiently has been a Walter Helitronic Vision with auto-loader and automatic wheel changer. Although this type of configuration has typically been used to fully automate production runs of hundreds of large tools, an unexpected benefit of the wheel changer for Sharon-Cutwell has been greater *design freedom*. That's because some tools are so complex as to *require* multiple setups on even a two

Operator Andy Brill builds a wheel pack for the Helitronic Vision tool grinder. Like programming the tool, this task can be performed "off-line" so the machine stays productive

spindle machine – and even one that accommodates up to six grinding wheels like a standard Walter Helitronic Vision or Helitronic Power. Other complex tools can be ground in one setup using six wheels on a two spindle machine only after a difficult setup that figures out how to use each wheel without another wheel interfering with another part of the tool or the machine itself. The wheel changer liberates the operator from the complications inherent in having multiple wheels on a pack, so it's much easier to do one-chuck setups.

A Walter Helitronic Vision with an automatic wheel changer has allowed Sharon-Cutwell to produce game changing tool designs very efficiently

Using the tool below as an example, operator Andy Brill explained that, "I *could* get by with fewer changes, but I'd need at least four. One thing I could do is mount my polishing wheel behind my fluting wheel, but now I'm using a 5 degree fluting wheel. Normally, I'd use a 1A1 but then I'd run into clearance problems on certain tools." Instead, he uses the wheel changer to apply six different wheel sets – none with more than two wheels on the spindle - in grinding the complex tool.

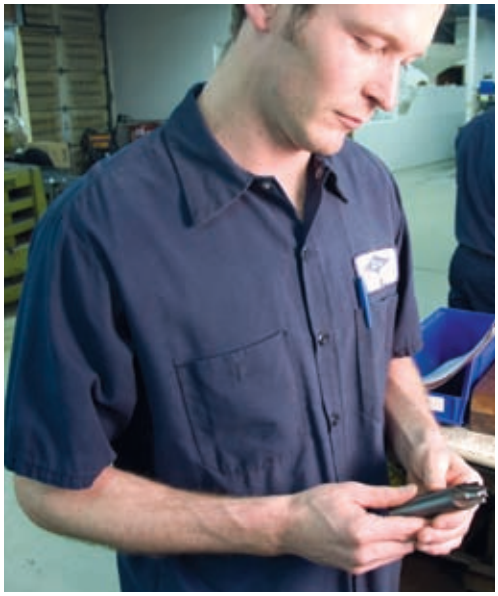
"I still double-up certain wheels, because you always use them together and they don't interfere with each other. But there are plenty of times in which if I had another wheel on the spindle I'd either be hitting the tool or hitting the chuck."

The freedom to design the perfect tool

"That's a key point," adds Jeff. "We've always tried to do things in one chucking. But without a wheel changer you're constantly breaking down and building new wheel packs, because there are an infinite number of possible combinations required to do the variety of tools we have to make. Now, we don't care. We can pick this wheel, this one, and this one – or that one, that one, and that one – because we don't have to have them combined. The other thing it allows Andy to do is to free his tool design. He'll get a better designed tool because he's not worrying about the constraints imposed by one wheel interfering with another."

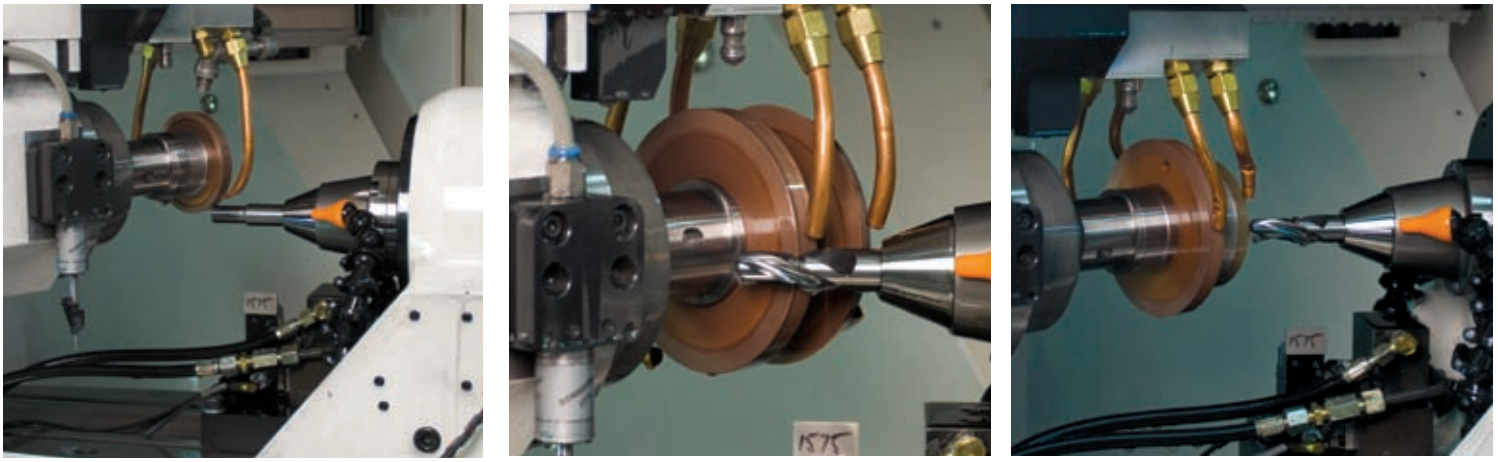
Cloning your best operators

"You may not think the difference between a one-chuck setup and a two-chuck setup would be that big a deal, but it really is. You just don't realize the amount of time



Andy marvels at the finish he's getting on the Helitronic Vision. "I don't know if our customers notice it but we sure do!" he says.

"Just as we may simplify a customers' operation by allowing him to do three operations in one setup, Walter has simplified our operation by allowing us to combine six different wheel sets to grind the tool in one setup." – Jeff Prom



Three of six wheel sets in use during the grind of one complex step tool: Starting the fluting operation, cam relieving the step, and point grinding

wasted in trying to join the two setups and the two grinds. When the Vision machine is running, that setup employee is truly able to do other things. So you can take a very skilled employee and essentially get two of them. And who wouldn't want another highly skilled employee?"

Creative solutions to manufacturing parts other than cutting tools

While Sharon-Cutwell's main product is specialty cutting tools, they also manufacture a variety of other interesting parts as needs arise or opportunities present themselves. For example, they refurbish tooling for a bed spring manufacturer. As Vice President Willie Perez explains, "Bed springs are made using a specialized process and unique machines, with lots of cutting, crimping, holding, and tempering. Consequently, there are many little, hard-to-replace wear parts." So Sharon-Cutwell has developed various methods of repairing them and improving their wear characteristics.

Combining EDM, glue, and a tool grinder

In one case, the steel "hand" that holds the wire during a tempering operation wore prematurely. It also created a dead spot in the tempering operation, owing to its conductivity (springs are tempered by running electric current through them). Given their experience with another machine, the spring manufacturer realized that a non-conductive ceramic might solve the problem. But the steel hands are unique and can't easily be recreated in ceramic or anything else. So Sharon-Cutwell devised a process in which they EDM a hole through the steel hand, glue in a cylindrical ceramic cylinder, and then grind the necessary slot and radius form into the ceramic. The new hand doesn't hinder the tempering process and wears much better than the all-steel version. And how do they grind the form? Using a Walter Helitronic Power tool grinder!

A bed spring is held in the base of this groove during tempering, in this old style "hand."

Sharon-Cutwell improves both the wear characteristics of the hand and the tempering of the spring by EDMing a hole, gluing in a ceramic cylinder, and then grinding the required groove – which has a particular radius at the bottom – with a Walter tool grinder

Another part used to crimp the spring also experienced excessive wear where the wire seats. Sharon-Cutwell EDMs the basic form, brazes in carbide inserts, and then grinds the appropriate groove - also on a Walter Power machine.

Vice President Willie Perez shows how the bed spring is crimped by another part, a wear spot that Sharon-Cutwell fixed with carbide inserts

Spring is always blooming for the creative

Another, perhaps surprising, aspect of this story is the fact that the bed spring business is very healthy. Like other products, beds go through cycles. And whereas foam beds were popular up until a few years ago and the spring manufacturer suffered accordingly, they are now so busy they can barely keep up with demand and Sharon-Cutwell is likewise busy keeping the tooling in good shape. The morale of the story is that creativity and diversity makes it possible to survive in any market.

Maybe it's time to put creative cutting tools to work for you

One way to summarize Sharon-Cutwell, is to simply quote Jeff: "We are constantly either proposing something – like an idea that combines operations – or solving a problem that's occurring with the tools currently in use – like a bad finish or problem with a hole size."

Challenges never end, they just change. It's always a good time to partner with people who can adapt to whatever that change brings you. ■

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From tiny drills to sophisticated form tools… from crush rolls to bed spring "hands," Sharon-Cutwell embraces the manufacturing challenge so you don't have to