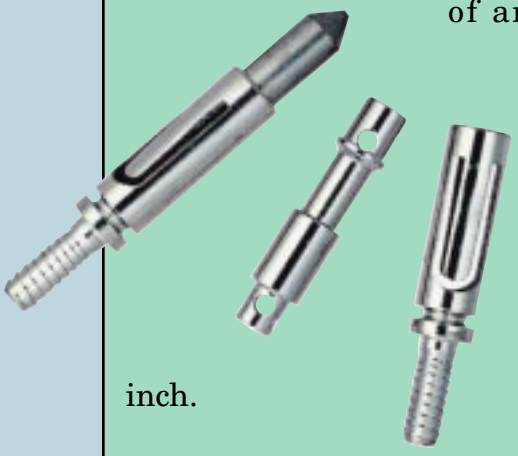
This article has been edited for size considerations.

The full article is available at http://metalworking.penton.com/

The Big & small of it all

Imagine spending 45 minutes painstakingly machining complex features into a part — slots, grooves, angled holes, and the like — until it's practically perfect. After all this work, someone sneezes, the part drops to the floor, and everyone gets down on hands and knees to look for it. But to no avail; it's gone. Hard to picture? Not for those making parts with overall sizes as small as ten-thousandths of an inch.



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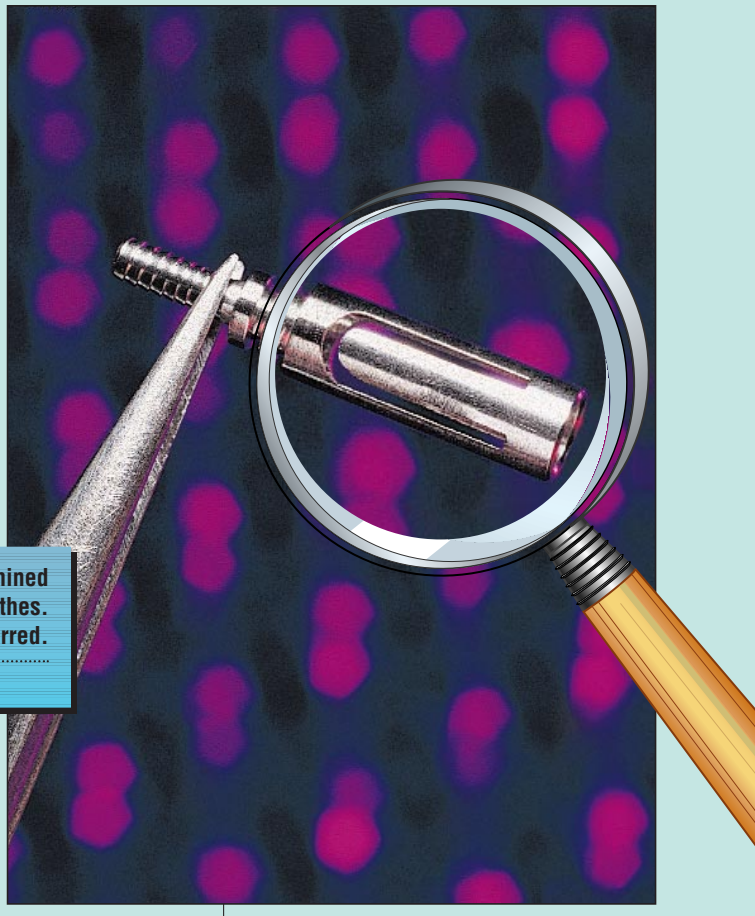
Micro Med of Miami Lakes, Fla., knows the problem all too well. Says Joe Davis, vice president, "We've even had parts stick to the bottom of someone's shoe. You spend 20 minutes looking for it, and there it is, ruined." The company specializes in machining medical parts with some diameters as small as 0.010 in. and holes even smaller.

Among the products Micro Med makes are catheter components, pacemaker leads, and small jaws for holding biopsy tissue. All machining involves tiny, intricate components, which are held to a ±0.0002-in. tolerance. "When we first started in this business," says Davis, "we would ship parts in sandwich bags. One bag might hold $15,000 worth of parts and probably represented six weeks of work."

Micro Med machines all its parts from barstock, mainly on CNC Swiss-style lathes. In most industries, these types of machines are often producing large numbers of parts or part families. However, Micro Med pushes its Swiss-style machines to the limit, proving that these machines can produce small batches too.



All of Micro Med's jobs are machined from barstock on Swiss-type lathes. The parts are then hand-deburred.

Swiss-style lathes from Marubeni Citizen-Cincom tackle tricky multiaxis jobs with ultratight tolerances. The key to Micro Med's success is using only one setup on these machines.

One setup is the secret

"We hate to give into a secondary operation," says Davis. The more a part is handled, moved, and refixtured, the greater the chance for damaging delicate walls and other features. If a secondary operation is necessary, it usually means that the lathes can't handle the part geometry. In this case, the part is moved to one of the company's other machines, such as its mills, grinders, or EDM systems.

Even though the company has plenty of equip-

ment to choose from, it prefers to do 100% of its dimensional work on any of its 54 Swiss-style machines from Marubeni Citizen-Cincom Inc., Allendale, N.J. Running at high speeds, the machines crank out batches that average 800 pieces/run, and turnaround on jobs is typically six to eight weeks.

Where the CNC Swiss-type machines excel, says Davis, is in the flexibility provided by their multiaxis capabilities. "A lot of people get confused when you say multiaxis," explains Davis. "We're not talking about different axes of movement in a plane of geometry. When someone says 'a machine has 12 axes,' you're talking about independent axes that you can control. Yes, two of them might move together in an *X* direction, but they are independent features on a machine." This flexibility means that if Micro Med drills off-center holes in a part face, it can use a live spindle to move in and then off-center. The machines can also maneuver into position and cut angled holes or slots. The more axes the machine controls, the more options it has when manufacturing a part.

Micro Med is quite happy with its Citizen E16J and M20 CNC automatic Swiss-style lathes, but it is always on the lookout for newer systems with more capabilities. "As far as we're concerned, a machine that is five years old is outdated, because the technology is changing so quickly," remarks Davis. For instance, the company started out with cam machines in its arsenal, but quickly moved to all CNC systems.

Operators set up jobs using microscopes, some of which are mounted on the machines. Once the lathe starts, though, operators can't visually judge how a part is shaping up or make corrections on-the-fly. "We've hired operators, skilled workers coming out of the aerospace field, who had problems dealing with the idea of machining something they couldn't see."

Although the company has plenty of machining capabilities under its own roof, it sometimes farms out jobs such as EDM work. But, says Davis, "Finding vendors that can deal with tiny parts is hard." EDM houses can't always get their electrodes down into Micro Med's tiny parts, and customized tooling and fixturing become necessary, adding extra costs.

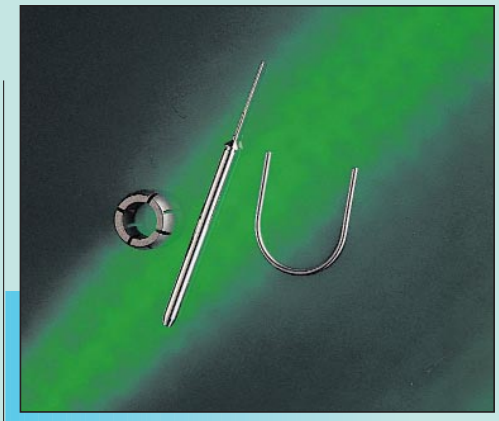
Tools and fixtures

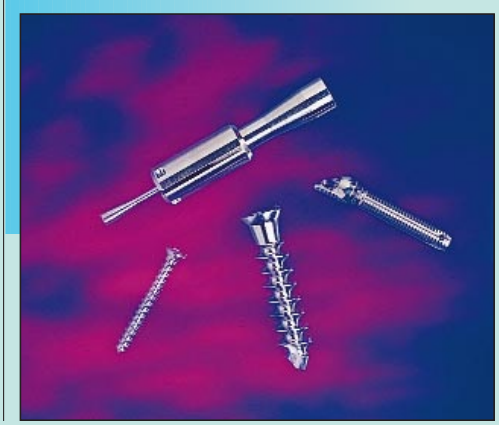
Roughly 65% of the parts Micro Med makes are titanium, another 25 to 35% are stainless steels, and 5 to 7% are precious metals. Making these parts is hard enough, based on size alone, but the material makeup can add a new wrinkle to the problem. For instance, the leads for pacemakers are made of platinum and iridium, which can be rough on tools.

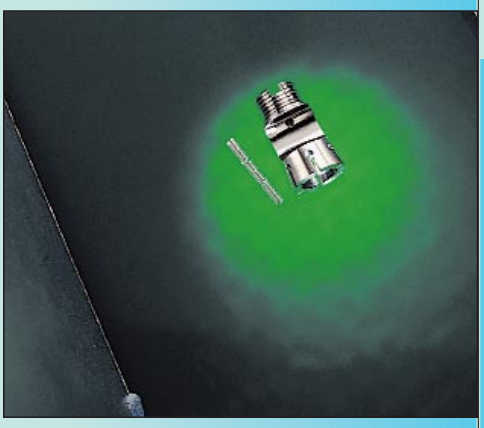
Micro Med routinely machines medical parts with diameters as small as 0.010 in. These parts are frequently used in Class III medical devices such as invasive surgical instruments and implants. Among the products machined are bone screws, catheter components, and pacemaker leads. The company also makes parts for the aerospace and connector industries.

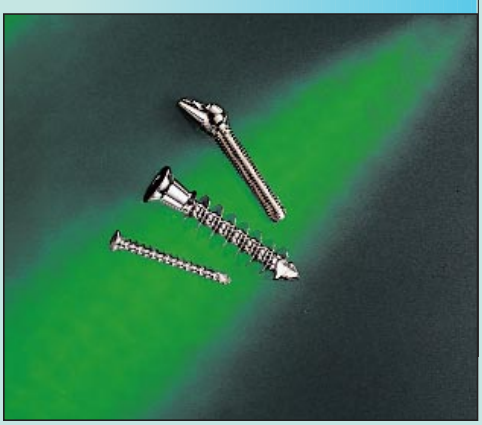
One might think that many of Micro Med's applications require specialized tooling. However, the company's standard tooling isn't all that specialized; it's, well, standard. But the company does ensure that its tools are sharp and that they accurately cut small parts.

In its early days, Davis admits, Micro Med bought off-the-shelf tools, which it cut down for specific applications. Today, though, the company uses production tooling from companies like Ken-









nametal and Sandvik. It also tries to use standard fixturing. In fact, most of its custom tools and fixtures are found only on machines performing secondary operations.

Final touches

A large percentage of the parts must be hand deburred. "There is an unspoken rule in the medical field that the cosmetics of the part must be perfect," says Davis. Therefore, tool marks, scratches, and burrs are unacceptable.

Micro Med makes its tiny parts from materials including titanium, stainless steel, precious metals, nickel alloys, brass, and aluminum. Parts such as pacemaker leads (shown at top right) are held to tolerances of ±0.0002 in. The company says its biggest challenge is not in making these parts, but in verifying size and surface measurements.

Obviously, hand deburring takes quite a bit of time. Workers, mainly women who can handle the arduous task of hand deburring parts under a microscope, use X-Acto knives and some customized tools to deburr every part coming off Micro Med's machines.

But why not use deburring equipment? According to Davis, electropolishing and grip blasting don't work well when you're dealing with small, fragile parts.

Too tiny to tell

"We feel that we have the capability and repeatability to make exceedingly small parts with the equipment we have," says Davis. One of Micro Med's biggest concerns is verifying a dimensional or surface measurement. "We can know that a part is perfect, but we can't always verify it," he explains.

That's why, before a job is even started, the company and its customers try to agree on just how parts are to be measured.

Micro Med has used optical measuring devices, such as laser or vision systems, but says they only work to a degree. Part verification can also take longer than the actual machining. "We may have a 6 to 8-min cycle time, but verification takes 18 to 20 min," reports Davis.

And when it comes to surface finishes, many of the parts don't have enough surface area to check. "It's almost a joke. Engineers will put a surface finish tolerance on a part. For example, in one area they might want a #8 finish." In this case, the company tries to talk its customers into doing a visual comparison, which can be better suited to the job than using devices like profilometers.

The company has also used videoscopes to measure part surfaces. "They can go from 20× to 160× magnification, which is what we need to check a part," says Davis. Unfortunately, videoscopes can't always discern edges on round diameters. ●

Patricia Smith

Managing editor