



EDM builders continue to introduce new products marketed specifically for medical-parts manufacturers, such as this Mitsubishi manufacturing cell, MD+CELL. Mitsubishi division MC Machinery is offering complete cells so robots and shelves are sure to be suitably sized for each manufacturer's medical workpieces.

Ever Developing Machines

EDM builders continue to advance their machines tools' capabilities and pay special attention to medical-parts manufacturers.

More speed, higher precision, greater efficiency. These are constant demands in the electrical discharge machining world.

Recently, EDM builders have introduced machine tools to satisfy those demands: a feature that boosts speed in poor flushing conditions, greater precision in small and large EDMs, and enhanced cutting efficiency to conserve wire and other consumables.

Also, the builders remain mindful of a particular industry, designing and marketing new EDMs and more to medical-parts manufacturers.

In the latter part of 2006, MC Ma-

chinery Systems Inc., Wood Dale, Ill., a division of Mitsubishi EDM/Laser, introduced a work cell for medical-parts manufacturers, MD+CELL.

Manufacturing cells aren't new to wire EDMing, including medical-parts EDMing, but MC Machinery decided to offer its own cell to ensure that its customers received robots and shelves appropriately sized for medical workpieces.

A manufacturer could create a cell for its medical-parts EDM by purchasing a robot and workpiece shelves from any of several companies. However, sometimes this leads to cells with mismatched components.

The robot might have a 350-lb. capacity, too large for medical workpieces, which usually weigh less than 20 lbs., said Greg Langenhorst, MC Machinery's technical marketing manager. Likewise, standard shelves might have niches too large for their workpieces, so the manufacturer wouldn't be able to store as many workpieces. Also, the company could encounter problems with the components, such as the machine tool and robot interface not communicating.

The MD+CELL, though, has a robot sized for and tested with its MD+PRO EDM, and MC Machinery customizes the shelves for manufacturers.

Also, the 6-axis robot can turn workpieces 90° for chucking, so the EDM wouldn't need an indexing head or rotary table. However, the receiver chuck can only index 90°. If another angle were needed, the MD+PRO would have to be equipped with a B-axis indexing unit.

A Faster Cut

Moreover, the cell will soon feature a faster EDM. MC Machinery expects to offer the MD+PRO II in the U.S. in June.

The EDM builder installed a faster generator, the V350, Mitsubishi's latest version of its high-speed antielectrolysis power supply. The generator improves the EDM's cutting speed in poor flushing conditions. "We've seen a 20 percent improvement from the MD+PRO," said Mike Bystrek, product manager—wire EDM for MC Machinery.

The new generator produces a higher voltage spark than the old one, so the V350 can maintain a more efficient spark gap, allowing it to optimize cutting speed in poor flushing conditions during piece-part machining, Langenhorst said.

MC Machinery also modified the EDM to reduce its downtime. For example, it enlarged the machine tool's wire drive rollers by 150 percent, so they have more surface area over which wire can run. "You can index the rollers more times, making them last three times longer," Langenhorst said.

Also, the machine tool's grounding cables were replaced with a solid-copper plate grounding system. According to Langenhorst, the plate system eliminates the need to replace cables every 3 to 5 years due to corrosion, which decreases EDM performance. He added that the system has been in Mitsubishi's FA series wire EDMs since 2000 without deterioration.

The MED 322

In late '06, EDM Network Inc., Sugar Grove, Ill., joined other builders in offering a wire EDM specifically to medical-parts manufacturers.

EDM Network offers the new MED 322 as a distributor for EDM builder Ching-Hung Machinery & Electric Industrial Co. Ltd. (CHMER), Wurih Township, Taiwan. The new machine tool is a version of CHMER's 322 wire EDM reconfigured to have the features needed by manufacturers for prototyping and production EDMing of medical parts.

Point Technologies S.A., La Aurora de Heredia, Costa Rica, a manufacturer serving the medical device, biotech and semiconductor wafer test industries, has been using standard 322s to machine medical parts. The company bought its first 322 in 2004

and now uses three to manufacture parts for medical devices via 15 different recurring jobs. Also, Point Technologies operates another EDM equipped with a rotary transfer robot to perform 24/7 submerged machining of medical parts.

One of those parts is a titanium component for an implanted cardiac device. The part includes a cutout that Point Technologies could achieve

only through EDMing. To make the cutout, the company needed an EDM that could accurately and repeatedly autothread a 0.016"-dia. start hole and could create the cutout with a ± 0.0003 " tolerance. "A complex assembly of wires passes through the [cutout], and EDM was required due to the tight tolerances," said Kevin Shutes, Point Technologies' vice president of manufacturing.

Features for Medical Parts

Point Technologies illustrates that a medical-parts EDM is like an EDM for



An operator prepares a program on a high-accuracy Vertex EDM for cutting a die insert that will be used in a progressive die for semiconductor production.

any other industry, such as aerospace. Whether or not it carries a medical designation, an EDM requires only a few specific features to manufacture medical parts. Beyond those universal features, others are present in the machine tool based on specific medical parts.

One required EDM feature for medical parts is the programming for machining stainless steel and titanium. Stainless steel is common for medical instruments and implants, though titanium is often preferred for implants. Titanium is lighter than stainless steel, and weight for sizable implants, like a hip joint, makes a difference to patients. The two materials are favored because they have high strength-to-weight ratios and aren't rejected by the human body.

Also, a medical-parts EDM requires an antielectrolysis power supply to prevent changes in the workpiece that would increase people's risk of infection from the parts.

For example, copper shouldn't transfer from the EDM wire to the workpiece. If not removed, the copper could later be transferred into a person via a surgical instrument or implant. Copper isn't healthy in the human body. "Copper [contamination] is the biggest concern," said Ron Vogel, president of EDM Network.

Also, medical parts should have no recast layer—the thin, difficult-to-remove film that forms from wire and workpiece sludge. The layer appears as a blue tint on titanium medical parts.



Medical-parts EDMs are wire EDMs configured for antielectrolysis cutting of materials common to medical parts, such as stainless steel and titanium. EDM Network's new MED 322 is based on the 322 model from CHMER, the builder that EDM Network represents.

That layer interferes with inspectors' efforts to check the parts for contaminants. "They become part of the blue layer and become harder to detect," said Eric Ostini, a product manager for Agie Charmilles Corp., Lincolnshire, Ill.

After materials programming and power supply, other features aren't universally required on medical-parts EDMs.

These features include indexing and rotating. At EDM Network, Vogel's experience indicates that 6th-axis motion is only sometimes required for making medical parts. "Some people need it, some people don't."

An application that needs it is the EDMing of a bone-saw guide, which requires a taper angle. A surgeon applies the guide to cut a bone at an angle that complements the implant's angle. The angle contributes to a stronger connection between the bone and its implant, according to P.J. Naughton, marketing manager for Sodick Inc., Schaumburg, Ill.

Also, submerged EDMing may or may not be desired, depending on how medical-parts manufacturers view the watersolution. Submerged EDMing may be wanted to minimize oxidation. "It helps reduce surface rust because air can't get to the part," said Ken

Baeszler, an Agie Charmilles product manager.

Submerged EDMing may not be required, though, if the manufacturers prefer to spray only clean water on their workpieces during EDMing. "They don't want their parts left in a contaminated water solution," Vogel said. Also, high-volume manufacturers may view draining the tank to change workpieces as slowing down production.

Like other parts, medical parts' surface finishes vary based on their applications. For example, an implant may need a relatively rough finish so bone and muscle can better adhere to it.

"Some implants are not very smooth," said Agie Charmilles' Ostini. "They have a texture."

Surgical instruments can require better finishes. A bone-saw guide needs a finer finish to have a good sliding surface so the bone saw will cut smoothly along the guide's edge.

EDM builders are mindful of more than medical parts and have introduced EDM technology to meet the constant goal of more precision, speed and cutting efficiency.

Smaller and More Precise

Makino Inc., Mason, Ohio, created the EDAC1, its smallest sinker EDM. Announced last June, the machine tool includes X-, Y- and Z-axis travels of 8.66", 7" and 8.66", respectively, and a table size of 13.77"×9.85".

Also, the EDAC1 is more precise than the sinker EDM most like it, Makino's EDGE2. That machine tool can achieve a corner radius of 10 microns, a surface finish of 1.2 microns R_y and a pitch accuracy of ± 5 microns. The EDAC1 can create a corner radius of 5 microns, a surface finish of 0.6 microns R_y and a pitch accuracy of ± 1 micron.

The EDAC1 features a more accurate C-axis indexing head, too. Makino's earlier head had an indexing accuracy of ± 15 arc seconds. The EDAC1's head can achieve an accuracy of ± 2 arc seconds.

Larger and More Precise

Meanwhile, Agie Chamilles achieved greater precision in larger

wire EDMs by developing larger models of its high-accuracy machine tool, the Vertex, and by extending the Vertex generator technology to its Classic and Progress wire EDMs.

The Vertex technology has been available since 2003, but Agie Charmilles offered it in only one model, the Vertex 1.

In July, Agie Charmilles extended the generator technology into the five models of its Classic and Progress lines.

In August, Agie Charmilles introduced the Vertex 2 and the Vertex 3. The Vertex 1 accepts maximum workpiece dimensions of 11.8"×7.9"×3.9". The 2 and 3 models accept maximum workpiece dimensions of 29.5"×21.6"×9.8" and 41.3"×25.6"×9.8", respectively.

The new Vertex models can impart surface finishes of 0.05 microns R_a , while the Vertex generator-equipped models can impart surface finishes of 0.2 microns R_a and have an optional feature for finishes of 0.1 microns R_a . "They take advantage of the cutting efficiency of the Vertex technology," Baeszler added.

That efficiency can reduce the amount of wire needed to EDM a workpiece. Baeszler cited the technology's ability to achieve a 0.8 micron R_a in the same time with a 0.15mm-dia. wire via a main cut as a 0.25mm-dia. wire using a main cut and two trim cuts.

"You're saving 40 percent on wire," Baeszler said.

More Cutting Efficiency

Fewer cuts with thinner wire is also the means of saving wire and other consumables for the Robofil 240SLP and 440SLP, which were introduced in November by Agie Charmilles.

According to the EDM builder, the two models deliver virtually identical results via one cut that applies 0.008"-dia. brass wire with good flushing conditions as can be achieved via roughing and finishing cuts with 0.010"-dia. brass wire. Ostini said the results were the same for surface finish and were within 0.0001" of the same for accuracy in steel up to 3" in height.

Agie Charmilles added that compared with the former FI240 and FI440, the two new models consume



Intricate EDM faces poor flushing conditions with these Stellite workpieces. The machine shop compensates for the conditions and can therefore increase cutting speed by applying Makino's HEAT, an EDM technology specifically developed for EDMing workpieces in poor flushing conditions.

Makino

three times less wire and 40 percent less wire-feed related wear parts, their filtration costs are 20 percent lower, and their cutting speed is 15 percent faster.

For Poor Flushing

At Makino, greater cutting efficiency is the goal of HEAT (High Energy Applied Technology). HEAT is for EDMing in poor flushing conditions, such as when upper and lower nozzles are detached or workpieces are of varying thickness, so the EDM won't have to cut slower.

In poor flushing conditions, HEAT can increase cutting speeds by 20 percent or more, according to Jeff Kiszonas, Makino's EDM product line manager. HEAT increased cutting speeds for Intricate EDM, Columbia, Pa.

In April '06, Intricate EDM installed a Makino SP43. In July, the machine shop had the EDM fitted with HEAT.

Owner Tom Frick cited the increased cutting speed in a 2"-thick, cast Stellite part for the construction industry. Frick described the workpiece as neither round nor square, adding that its shape made it difficult to fixture and that good flushing conditions weren't possible.

Without HEAT, the SP43 cut the workpiece at a speed of 9 sq. in./hr. With HEAT, it cut it at 16.8 sq. in./hr. In both instances, the workpieces were machined with 0.010"-dia. brass wire and had one-cut tolerances of ± 0.0003 ". "You're able to maintain

close tolerances with the high speed," Frick said.

Its Largest Model Yet

In August, Sodick extended its wire EDM's upper limits on workpiece size and weight with the AQ900L. The machine tool is the largest of the company's wire EDMs, able to machine a 48"x36"x16" workpiece that weighs up to 4,400 lbs.

The AQ900L is for EDMing large molds and aerospace parts. Such molds and parts are often thick and require large taper angles. The AQ900L is able to EDM a 30° taper angle in 16"-thick workpieces. The ability is better than that of Sodick's next largest wire EDM, the AQ735L. That machine tool can EDM a 30° taper angle in workpieces up to only 6" thick.

All Linear Motors

Lastly, in January, Sodick introduced one of its smallest sinker EDMs, the AD3L, to replace its AM3L.

The two EDMs are practically identical in their axis travels, work tank dimensions, workpiece weight capacity and electrode weight capacity. However, the AD3L has a better drive system. The older EDM features a linear motor drive in the Z-axis, but has ballscrew drives in the X and Y axes. The new AD3L is equipped with linear motor drives in all three axes.

The linear motor drive permits Z-axis movement at a top speed of 1,440

The following companies contributed to this report:

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ipm with a 1.2 g acceleration rate.

Thus, through changes to details and main features, EDM builders improve their ever developing machines, continuing to meet the constant demands of the EDM world: more speed, precision and efficiency. \triangle