Charmilles Technologies

▸ BY ALAN RICHTER, MANAGING EDITOR

cover story

Quite Conventional

Considerations and cost justifications when buying an EDM for the first time.

Electrical discharge machines (EDM) are gaining favor and market share—even though many metalcutters still consider EDMing a nonconventional machining process.

In the early ’80s, the primary advantage of EDMing was thought to be for making stamping dies, because an EDM can machine elaborate, one-piece molds and dies, said Carl Sommer, owner and president of Reliable EDM Corp., Houston. In contrast, a die must be produced in several sections on a chip-producing machining center before those sections are precision-ground and assembled into a single die. However, he soon discovered that production jobs shops were—and still are—his primary customers, not users of stamping dies. Sommer’s EDM shop owns 28 wire EDMs (WEDM).

Currently, EDMs represent about 7 percent of worldwide machine tool sales, reports EDM builder Charmilles Technologies Corp., Lincolnshire, Ill. And, according to a spring 2001 survey of metalcutting professionals conducted by CUTTING TOOL ENGINEERING, 33 percent of the respondents said their shops perform EDMing.

But what about the majority that doesn’t EDM? This article takes a look at what shop owners and managers—especially production shops—need to keep in mind when considering the purchase of an EDM.

Taking the Plunge

With prices starting around $30,000 for a new sinker machine and ranging to $300,000 or more for a top-of-the-line WEDM, determining the need for and purchasing an EDM, obviously, requires careful planning. (See “Back to Basics” on p. 18 for a discussion of the differences between wire and sinker EDMs.)

The selection process starts by considering the materials and types of parts a shop is looking to EDM, said Greg Langenhorst, EDM product manager, Mitsubishi EDM, Wood Dale, Ill. He said a WEDM is ideal for producing difficult geometries, such as sharp internal corners or extremely thin sections, on medical, automotive and aerospace parts made of high-nickel alloys and alloys containing molybdenum, zinc, aluminum and titanium. Langenhorst added that unlike milling and grinding, an EDM doesn’t generate surface stress or leave burrs.

“Wire and sinker EDMs used in production shops can replace a lot of milling and grinding of materials that are difficult or impossible to endmill or grind effectively,” Langenhorst said.

Dean Brink, president and technical director of EDM Technology Transfer, an Orem, Utah, technical society dedicated to promoting the use and acceptance of EDMing, agreed that EDMing can “pretty much replace any conventional machining operation,” with turn-

ing being the exception.

Brink formerly managed a shop's EDM operations. He recalled that EDMing was either considerably faster than other machining operations when secondary operations were factored in or the only way to cut materials such as polycrystalline diamond, polycrystalline cubic boron nitride and very thick tungsten carbide. Even laser cutting wasn't effective.

"The thermal damage from the laser was so severe we couldn't use it to cut thinner pieces of diamond," Brink said. "It was fast, but it could not give us the quality of cut or the accuracy. Wire EDM was, by far, the best choice for cutting materials like that."

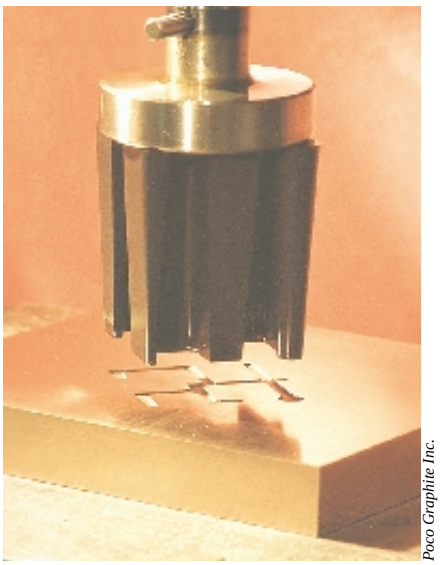
Choosing between a wire or sinker machine also depends on the type of parts a shop produces, Brink said. Most general job shops choose a WEDM as their initial entry into the field, but if they're doing any kind of mold work or producing parts with blind holes, a sinker EDM is needed. "A lot of shops will buy both," he said.

Next, a shop needs to justify the expense of an EDM. For shops sending parts out to EDM houses, Langenhorst said if the monthly cost of jobbing out is more than the monthly payment on an EDM, then bringing the process in-house makes economic sense. Plus, having in-house control of the EDM is a major benefit, he said.

Gisbert Ledvon, marketing manager for Charmilles Technologies, agreed that a shop should consider bringing a machine in-house if its outsourcing of EDM work is close to a monthly machine payment, which is about $1,800 to $2,000 for a WEDM. Then the shop can do all its EDM work in-house, as well as acquire additional work from the outside, he said.

Jeff Runyon, president of South Metro Wire EDM Inc., Shakopee, Minn., said many mold shops that don't have an EDM send their parts to South Metro. Some of his customers spend up to $90,000 a year on EDM services. "When handing over the check, they threaten to buy an EDM," he half-joked.

The days of sending out parts to be EDMed are going by the wayside, according to Dave Kinney, toolmaker and EDM specialist for Tru-Line Tool & Mfg., Eagleville, Tenn. In addition, he said a shop with a sinker EDM needs to be able to produce electrodes in-house. "You wouldn't be able to make money on a job if you outsourced the electrode production, which is ridiculously expensive."



Poco Graphite Inc.

A. Richter

When sinker EDMing (top), an electrode, which has the inverted image of the final required shape, is gradually impressed in the workpiece. Wire EDMing erodes metal using a wire electrode moving longitudinally through the workpiece to produce the desired shape.

However, Kinney said its tough to justify purchasing an EDM based solely on the dollar amount of the parts the machine is expected to produce. "An EDM by itself is not paying for itself," Kinney said. "If a machine cost $250,000, for example, it's difficult to get that money back in a reasonable amount of time just selling the EDMed parts."

Kinney said the rationale for buying an EDM resides in increasing a shop's other machining operations. "A shop without an EDM is limited in the work it can accept. Customers subcontracting parts want one-stop shopping. For example, the parts might have to receive 20 to 30 hours of EDMing, but the shop gets 300 hours of mill and grind time as well."

But even the best-laid cost-justification plans can go awry when market conditions change. A couple sources indicated that they know of shops that had to return EDMs shortly after purchasing them because of the declining manufacturing economy.

Additional Costs

Of course, the outlay for the machine is only part of the total cost of adding EDMing to a shop's process mix. According to Reliable EDM's Sommer, some of the additional costs include shipping, rigging, fixtures, inspection equipment, climate-control equipment, consumables, operator training and utility expenses (Table 1). And potential expenses that are more difficult to calculate involve machining errors as a result of inexperience and machine downtime due to an economic slowdown.

"Cost- and profit-conscious businessmen should carefully calculate the costs of operating and maintaining an EDM before making a decision to purchase," Sommer said. "Often, the money spent in equipping a shop with a wire EDM can be spent more profitably on a piece of equipment the company is familiar with. A small shop can really get hurt when going into EDMing, and it probably won't make money with just one EDM."

Although an EDM can be operated next to other types of machines, South Metro's Runyon recommended creating a separate air-conditioned, clean-room environment for EDMing to ensure the production of accurate parts and to avoid clogging filters, which increases maintenance and downtime expenses.

"The air-conditioned room should stay within ±2° F of approximately 74° F on a daily basis to avoid thermal expansion of the part," said Runyon, who added that a shop needs to hire someone or have an existing employee operate the machine.

Kinney concurred that a shop has to

consider operator costs and programming requirements. Programming is especially important with a WEDM. Most of the work is performed on a computer, so understanding CAD/CAM is essential. "You may have to hire an operator or train a current one," he said.

However, a WEDM with an automatic wire threader can run unattended once the machine is set up, said Charmilles' Ledvon. He said this lowers the labor cost, since the workpiece can usually be cut in one setup or multiple workpieces can be set up simultaneously without operator intervention, and the parts are ready to ship after EDMing.

While wire threaders are available from numerous EDM builders, Ledvon noted that Charmilles offers a couple other technologies to improve productivity when performing unattended EDMing. The company's Robofil 2030SI-TW has a dual-wire system capable of switching automatically between two wires with different diameters.

Charmilles also offers the Eject automatic slug-removal system. In addition to knocking out the slug, Ledvon said the system rethreads the wire.

General Broach Co.

An assortment of tools produced with a CNC wire EDM.

"Without the Eject system, an operator has to go into each cavity and manually remove the slug," Ledvon said.

On the other hand, Mitsubishi's Langenhorst said an automatic slug-removal system isn't mandatory for unattended, lights-out EDMing. A robot can load multiple parts onto a pallet for roughing, leaving the slug hanging by a microjoint to be knocked out automatically off the machine, he said. He noted that one customer without automatic slug removal is able to achieve 22 hours of burn time daily.

Regardless of the specific machine and accessories, Ledvon said that with the amount of technology built into EDMs today, it's a mistake to wait for machine tool builders to introduce better technology before purchasing an EDM if a shop already has a need.

"Similar to computers, you need to understand the process first," Ledvon said. "If a shop has a need and enough potential EDM work to do, it's better to jump in and buy a machine, just not one with all the bells and whistles. However, it should be robot-ready and allow retrofits and add-ons, so you can keep up with automation and increase productivity down the road."

Estimated Cost for 5 Years	Cost
Wire EDM	
Loan interest	
Shipping	
Rigging	
Property taxes	
Fixtures	
Inspection equipment	
Additional room	
Air conditioning	
Attending classes at supplier's training center	
In-house training	
Machine maintenance	
Wire	
Filters, power contacts and resin	
Out-of-town service repairs	
Electricity	
Programmer/operator costs	
Other expenses	
Total cost	
Minus machine's value after 5 years	
Actual cost	
Divide by 5	
Estimated annual cost	

Table 1: Worksheet for determining annual machine and operating costs for a wire EDM.

Wire EDM Handbook, by Carl and Steve Sommer

New vs. Used

Many job shops only buy new equipment. They want to obtain the latest productivity-enhancing technology, factory technical support and warranties. Other shops are comfortable buying used machines when a good deal comes along. One such shop is Scotts Tool, Kingston, Wash., which only buys used equipment. It does this to avoid going into debt, said owner Scott McClure. He said he waits for low-cost equipment to appear at auctions, adding that he paid only $500 for a Charmilles Eleroda 400 sinker EDM with a Charmilles Isopulse EP-3 50-amp power supply and Acu-Rite 2-axis DRO.

"With a used machine, I can afford to put the money into it to make it work fine," McClure said. "Used EDMs also require a ton of maintenance, which I do myself."

He said his two-man, 3,000-sq.-ft. shop is not in a hurry to buy equipment and will continue to farm jobs out until the equipment it needs is available at the right price. Auction houses keep him informed about what's available and online auction sites can also be excellent sources for low-cost EDMs, wire and other cutting tools, McClure said. For example, a Hansvedt SM-150B sinker EDM was recently offered on eBay.com with a minimum bid of $2,225. "You have to be a bargain-

hunter," McClure said.

Mitsubishi's Langenhorst concurred that a used machine can be a great way to go and noted that he's witnessed hundreds of shops get started with used EDMs. He added that whether a shop buys a new or used Mitsubishi EDM, the company provides equal treatment, including technical support via telephone. Of course, he said a customer with a used machine would have to purchase replacement parts when needed.

"If it's a big contract and you're leery about managing it, you want to have factory support," Langenhorst said.

Ledvon said Charmilles' factory refurbishes its EDMs and sells them with a 6-month warranty. A list of available equipment can be found on the company's Web site (www.charmillesus.com).

However, Tru-Line's Kinney, a former EDM salesman, emphasized that a shop should only buy a used EDM after it has acquired a new one as its first machine. With a new EDM, the factory provides replacement parts when needed, service personnel, warranties and training, he said.

"Buying a used EDM is like buying a used car—you're on your own. It's a big headache," Kinney said.

Although South Metro's Runyon has purchased only new EDMs, which achieve tolerances of +0.0002"/-0.0000" and finishes of 14 to 18 rms, he said a shop might consider a used WEDM for regular stock removal that doesn't require tight tolerances and that complements the other machines in the

Cutting tool manufacturer uses EDG, considering wire EDM

DeHart Tooling Components has experience with an EDM process few U.S. manufacturers have knowledge of: electrical discharge grinding (EDG). In addition to traditional profile grinding with diamond grinding wheels, DeHart, Hickory, N.C., EDGs form tools for cutting metal, plastics and wood.

The EDG wheel is similar in size to a standard grinding wheel, but it contains no abrasives. Instead, the graphite, copper or brass wheel erodes the workpiece as the electrically conductive rotating wheel discharges sparks across the dielectric gap.

Owner Anthony DeHart said EDG is more common in Europe, which creates procurement, training and servicing problems for U.S. users because of their distance from overseas suppliers. "There are not as many U.S. toolmakers using EDG, because it's difficult to find support and training for the technology," he said. Nonetheless, he said EDG imparts the required surface finish and reduces grinding with expensive diamond wheels.

EDG's disadvantage is that the process can't perform roughing, requiring a cutting tool to be preshaped on a conventional machine. "With a wire EDM, I could take a blank, rough out the shape and save the cut remnant," said DeHart, who is in the process of purchasing a WEDM.

Unfortunately, DeHart said a WEDM isn't able to provide the desired surface finish—at least not efficiently. "Wire EDMs can go down to a 2- or 4-rms surface finish on carbide, but the ones that get down there are just taking skim after skim after skim after skim."

In addition, one of WEDM's productivity pluses—its ability to produce parts unattended—is potentially detrimental in the production of carbide tooling, DeHart said. During lights-out EDMing, carbide is submerged in dielectric fluid overnight, which increases the risk of chemically etching it, he said.

This is because the fluid leaches into carbide's cobalt binder, causing potential wear characteristics and surface pitting. The risk of carbide corrosion can be overcome by selecting a nonsubmerged machine, but that dramatically decreases the cutting efficiencies. There are material-handling systems that automate parts removal and even offer workpiece-drying capabilities, but that adds to the machine's overall cost. There is also an added risk of chipping or cracking the fragile carbide if it is not handled properly.

One extra cost DeHart won't have to worry about when adding a wire EDM to his company's metalworking facility is a climate-controlled clean room. "Our shop environment is somewhat of an anomaly, and I think a wire EDM would just fit right into it. The shop is climate-controlled and it's very clean. We literally take it to the extreme," he said.

Despite the cons, DeHart said he still plans on purchasing a WEDM. "We're going to bite the bullet and move into the wire EDM world, but we're going to utilize it for producing fixtures and ancillary tooling to support our own manufacturing operation. And we're going to do roughing with it," he said. "But we cannot rely on a wire EDM solely as a production tool for carbide inserts."

With applications established to justify the need, the tricky part becomes deciding which make and model to buy. "Don't listen to the sales people," he emphasized. "Do the due-diligence, do the research and do it on your own." That can involve wading through reams of product information, visiting vendor sites and determining which machine will be the most productive, based on test-cut results.

"A number of vendors did some test cuts, and the actual feeds, speeds and number of square inches cut per hour was so close to being the same with each of them it wasn't even funny," DeHart said.

Just as it will find a place in his shop, DeHart feels WEDMing will continue to make inroads throughout the metalcutting industries. "I don't think there's any shop where a wire EDM is not needed or wanted. It's as much a mainstay today, or should be, as the fax or e-mail," he said. —A. Richter

The following companies contributed to this report:

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EDM Technology Transfer
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www.edmtt.com

GISCO Equipment Inc.
(631) 273-5353
www.gisco-equipment.com

Mitsubishi EDM
(630) 616-5920
www.mitsubishi-world.com

Reliable EDM Corp.
(713) 692-5454
www.reliableedm.com

Scotts Tool
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www.scottstool.com

South Metro Wire EDM Inc.
(952) 403-1415
www.southmetrowire.com

Tru-Line Tool & Mfg.
(615) 274-6434

shop. For example, an EDM could be applied for slotting parts instead of milling, he said.

"In a basic machine shop, you can find metal-removal applications where an EDM can compete with CNC [chip-producing] machines," Runyon said. "And a used EDM can be cost-effective for roughing materials such as stainless steel, which is more difficult to machine."

Final Considerations

OK, let's say your shop has determined that it needs a new EDM. What's next?

You'll want to physically see the candidate machine operate, which can be accomplished by attending an industry trade show, said E. Bud Guitrau, director of operations for GISCO Equipment Inc., Hauppauge, N.Y., and author of *The EDM Handbook*. "To make it easier on the buyers, the machine builders, importers and distributors go to great expense to present their products at local and national machine shows in order for a potential customer to have every opportunity to see an EDM up-close-and-personal," he said.

Next, a shop needs to have the machine tool builder(s) being considered make one of the shop's parts, documenting all of the processes and the cycle time. "Most manufacturers will push to have your part run on their EDM. It's a big red flag if a manufacturer doesn't have the capability to do that," Kinney said.

Better yet, have everyone involved with the purchasing, part programming, setup and operation of the EDM go to the manufacturer's facility and watch the part being run. "It's worth it to travel," Kinney said. "The cost is gum money, but usually the dealer will cover the travel expenses for a serious buyer."

Guitrau added that by being at the builder's site, you can witness any problems, such as an autothreader that functions improperly or a previously unknown tooling limitation. "All of this information is important when considering what is involved in the daily operation of the machine," he said.

EDM technology has come a long way in the last couple of decades when, according to Langenhorst, a WEDM removed 3 sq. in. of metal an hour and was considered a last-resort process when nothing else worked. Today, an EDM can cut up to 30 sq. in. an hour under ideal conditions and new applications are constantly being found.

"Many shops that have been able to justify a wire EDM for one or two specific piece-parts have found the need for a second machine within 6 months because of all the other work that suddenly finds its way onto the machine," Langenhorst said.

But needing an EDM doesn't make the procurement process any easier. "Make no decision until you have a full understanding of the features and capabilities of both the EDM and your suppliers," said Guitrau. "Do not allow yourself to be *sold*; educate yourself so you can *buy*."

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