how to select and justify an EDM machine

by E. Bud Guitrau

INTRODUCTION

With the increases in almost all manufacturing business and the renewed interest in capital equipment acquisition, now would be a good time to re-examine the various criteria that is involved in making the weighty decision of a new machine tool purchase. Buying new machinery is often confusing, almost always difficult, and sometimes even an agonizing venture, especially when pursued without a plan. Without one, you will be focused on and caught between your logical budgetary considerations and several competing machinery salesmen who are eager to help you spend your money.

Having stood on both sides of a capital acquisition desk provides me clarity in what can often become an emotional decision for one who sits behind it. However, in a business transaction that can involve several hundred thousand dollars for a single machine and can seriously impact your department or company, there is simply no room for emotion in this decision, not even if one of the helpful and knowledgeable machinery salesmen is married to your daughter.

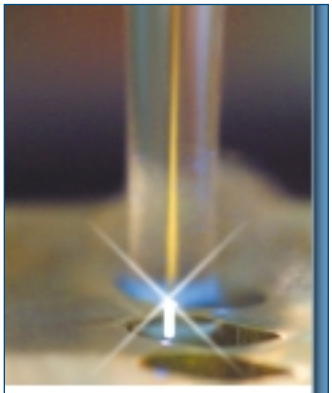
There is an old saying in the business of machinery sales: "The salesman might sell you the first machine, but the machine itself will sell you the next one." I tend to agree with this, so unless it is a case of a repeat order to duplicate an already-running application, every machine tool selection must be made with a totally objective, case-by-case evaluation process based upon specific objectives and machine requirements. I know of no other method of doing this and if done properly, the final results should have nothing to do with how disappointed your son-in-law might be with your decision.

The Economic Climate

In addition to improved business conditions in the manufacturing sector, many economic factors favor buying new machinery right now. With the recession thankfully behind us, the U.S. economy is recovering quite well. As of this writing, the DOW is over 11,000, economic growth reached a high of over 8%, unemployment is under 5%, and although rates have been slowly creeping upward, interest has been at a 40 year low. For long-term assistance, in 2003, Congress passed a much-needed, stimulus package called the, "Jobs and Growth Tax Relief Reconciliation Act", which was to expire at the end of 2004, but based upon its positive results, it has been extended through December 31, 2007.

Part of this package increased tax depreciation on new machine purchases only, as an incentive to stimulate growth in the manufacturing sector, and to improve American manufacturing competency by buying and using the newest technology. As briefly as possible; Title II, Section 201 of this Act allows a qualifying shop that has purchased a new machine tool to depreciate up to 57% of the new machine tool in the first year and 69% over two years, while Section 179 provides even greater tax savings to small businesses (those spending less than $400,000 on capital equipment in a given tax year).

Businesses large and small will benefit from this tax bill, and although this sort of depreciation strategy may have to be taken up with your accountant, all of the items cited above are very conducive to machine tool purchases. In the meantime, now that we know economics favors us, let's buy a WEDM.



Part One or... "ok, so how do I do this?"

Part One

We will examine the entire process of machine tool selection in an outline form using a step-by-step, comprehensive method that goes back to the very first time the thought of purchasing an EDM occurred to you. (By substituting the term EDM with lathe, mill, grinder, etc., and substituting machine features, this can be a basic template for almost *any* machine-tool selection and justification).

The first thing that needs to be done is to determine whether or not this exercise is even necessary. Therefore, first of all you must establish or determine:

Your Need

1) *Do I already have a need?*
a) Am I presently jobbing out my EDM work?
b) Are my prices and deliveries influenced by sending my EDM work out?
c) Should I keep my EDM work in-house?
d) If I do, what are my expected benefits/savings?

2) *Should I consider a need?*
a) Am I presently missing any EDM work opportunities?
b) Am I likely to miss any similar work opportunities in the future?

3) *Do I want a need?*
a) How serious *am* I?

To further qualify this possible need, next examine:

Your Work

1) *What kind of work requiring EDM am I already doing?*
a) Size, shape and type(s) of material
b) How much? (Dollar average.)
c) How often? (Monthly average.)
d) None, but should I consider it?

2) *What kind of EDM work am I sending out?*
a) How much? (Dollar average.)
b) How often? (Monthly average.)
c) None.

3) *What kind of EDM work am I passing over?*
a) How much? (Dollar average.)
b) How often? (Monthly average.)
c) None, but should I pursue it?

4) *What kind of EDM work could I be doing?*
a) How much? (Dollar average.)
b) How often? (Monthly average.)

After deciding upon the type of work you intend to pursue or focus on, you then must determine:

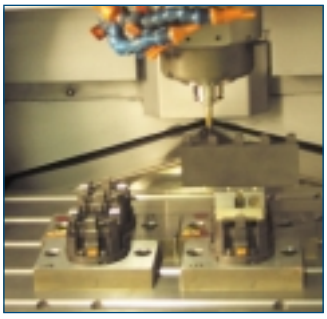
Your Budget

1) *How much money do I have to spend?*
a) What are the financial limitations of this venture?

2) *How much money do I need to spend?*
a) If I purchase everything I need, how much will it cost?
b) Do I have to purchase everything I need all at once?

3) *What kind of terms are necessary / available to complete this transaction?*
a) Cash?
b) Financing?
c) Lease?
d) Other?

Having completed the NEED, WORK, AND BUDGET sections, you can go on to:



Part Two

If you have determined that you have a justifiable need for EDM and have survived the initial budgetary questions, we can move on to the true nuts-and-bolts of this project — actual machine selection. Trying very hard not to sound presumptuous, I must offer a word of caution here: You had best know your *job*, your *business*, your *market* and your *competition,* because if you don't, any mistakes made in the next section can prove ill and perhaps even fatal to all your well-intended efforts and investment.

Prioritization And Scoring

Other than the physical limitations of the machine (size, travels, weight capacities, etc.), you must establish what items or features are a priority or most important to you, and weigh their scores accordingly. Users who expect their machines to run "lights-out" and unattended will be interested in AUTONOMY, while a shop cutting lead-frame dies will need the utmost in ACCURACY, and a production shop would be very interested in CUTTING SPEED. Are we clear? Then let's proceed.

Physical Size

1) *Based on my expected / projected part size and shape, how large a machine will I need?*
a) Is this machine dedicated to a single production part or am I jobbing?
b) Do I need table *size* or table *travel*?
c) Will my maximum part size be limited by the confines of a rigid worktank?
d) What is the tallest part I'm likely to encounter?
e) What is the workpiece weight capacity of the machine?

2) *Are there any limitations of my facility for installation of this machine?*
(Ceiling height, door width, access area, power, water, air, drains, temperature control, etc.)

Cutting Speed

1) *How fast do I have to produce this part to show profit?*
a) Ideally?
b) Marginally?
c) Realistically?

2) *What type of EDM wire is required to support question #1?*
a) What type of wire will be used? (Brass, coated or diffused)
b) What diameter(s)?
c) Is the wire type and diameter readily available from stock?
d) At what cost?

3) *Are my desired cutting speeds compatible with my accuracy and finish requirements?*

Time Out

Cutting speeds can be misleading, so we must temporarily break away from the outline format to examine how to evaluate this sometimes confusing area of selection. While every attempt has been made to keep this plan as comprehensive, yet as simple as possible, the topic of cutting speeds does warrant additional explanation.

As most of us know, cutting speeds for wire EDM are typically expressed in square inches per hour or, $in.^2/hr$. Presently, there is near parity in cutting speeds with average speed claims using plain brass wire range from the mid to upper 20's, while some of the newer, high-performance generators using larger diameter, diffusion annealed speed-wires can exceed 40 $in.^2/hr$. Making a machine selection based strictly upon claims of faster cutting speeds may not always be the best choice, because depending upon the part, cutting too fast can create conditions that can actually make part production slower. Sometimes a slower machine is faster. I'll explain.

If you intend to wire-cut production parts with a single, high-speed pass, speed is obviously important, but you must first consider other things that fast cutting speeds will influence. If at your desired cutting speeds, all blueprint criteria is met — the parts are acceptable in finish, straightness, surface integrity and accuracy — then it's probably safe to consider the faster rated wire machine. If the faster cutting machine adversely

affects any parameters of part specifications, then maybe we'd better slow down.

We'll make an analogy to automobile performance to make this clearer: If you have two wire machines side-by-side making a straight-line cut like a drag race, then, barring breakage, the fastest car will win. If this is the kind of part machining you intend to do — simple shapes, open tolerance, single-pass machining with limited finish callout — then cutting speed is clearly more important to you. However, if your part has a complex wire path that requires good straightness, crisp geometry and sharp corners, then the dragster may be all wrong for this type of race track.

Why? Because high-speed, single-pass cuts will be less accurate and have rougher finishes than parts that have been skimmed. Again, if your part specifications aren't sensitive to this, then OK, buy the dragster. If part geometry, straightness, and accuracy are critical, then the total number of additional passes that will be required to correct the conditions *caused* by the speed cut is also a critical factor.

Remember, if it's not a single-pass part:
It's not how fast you can finish the ***cut***, it's how fast you can finish the ***part***.

Conclusion: Cutting speed alone is less a factor if part accuracy, straightness, and finish are involved. A slower cutting machine might be selected over a faster, one if it can meet finish and accuracy specifications in fewer passes or skim-cuts. There is a big difference between speed and efficiency.

"Ok ... back to the outline."

Part Accuracy

1) *What kinds of accuracies do my average parts call out?*
a) Straightness?
b) Position?
c) Geometry?

2) *What kinds of part accuracies can I expect?*
a) Straightness?
b) Position?
c) Geometry?

3) *What are the best part accuracies I can expect?*
a) Straightness?
b) Position?
c) Geometry?

4) *How long will it take to obtain these accuracies?*
a) Machining time?
b) Number of skims?

5) *What special provisions (if any) are required to achieve these accuracies?*
a) Dielectric chillers?
b) Temperature-controlled environment?
c) Isolated tooling?

Surface Finish And Surface Integrity

1) *What surface finish is acceptable?*
a) What are the finish limitations of the machine?
b) Are there fine-finishing options that can extend these limitations?
c) How long will it take to obtain the necessary finish?

2) *How much influence does the EDM process have on the finished surface?*
a) Is the cut surface acceptable to my customer *as is*?
b) If not, what kind of post processing is required / acceptable?
c) What is involved in post processing? (Time, money, risk, etc.)
d) If post processing is needed and is acceptable, is the part process still profitable?

Machine Features

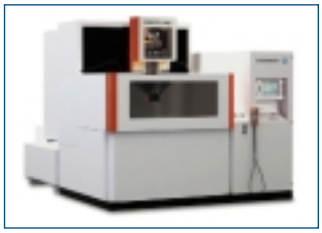
1) *Submerged or non-submerged?*
a) Will my candidate part(s) require submerged cutting?
b) In the case of submerged cutting, will a rigid worktank limit part size?
c) Will 80% of of my work be executed satisfactorily with my choice?

2) *Wire sizes.*
a) What is the smallest kerf or radius requirement on my average part?
b) What is the machine's standard range of wire sizes?
c) Can this range be expanded (if necessary) with options?
d) Can all the wire sizes I require be used in conjunction with an auto-threader?

3) *Is an auto-threader required?*
a) Are there multiple start-holes or parts that will require numerous re-threads?
b) Will the application present a high probability of wire breakage problems?
c) Does the job require continuous operation with minimal interruption?
d) What percentage of time is the machine expected to operate unattended?
e) Is successful auto-threading dependent upon wire type?

4) *What tapering capabilities are available?*
a) What is the maximum *U/V* offset in inches/millimeters?
b) What is the maximum taper angle in degrees?
c) At what height?
d) Does any part of *U/V* offset detract from other axes' travel?

5) *Fine finish options.*
a) What are the finish specifications of my parts?
b) What are the finish limitations of the machine?
c) How will this affect machining times?
d) Does fine finishing require isolated tooling?



Interface

1) What is necessary to communicate with this machine?
a) What kind of programming system/language does it have?
b) Is it compatible with my existing programming system?
c) Does my existing programming system have a 4-axis EDM post?

2) *What kind of man/machine interface does it have?*
a) What kind of control does it have?
b) What kind of processor does it have?
c) Is it interactive / self-prompting / intuitive?
d) Are there macros or wizards resident to aid the operator?

Autonomy

1) *How long can this machine run unattended?*
a) Under my projected operating conditions, what is the reliability of the auto-threader?
b) For high-threading applications, what is the threader's hole-to-hole thread time?
c) What is the average rate of wire consumption? (Run-off speed)
d) What is its wire capacity? (Spool weight)
e) What about wire disposal? (Capacity of disposal system, interval of attention, etc.)
f) In continuous use, how long will the filters, contacts, resin, etc., last?
g) Is it compatible with my choice of aftermarket work changers or robotic systems?
h) What happens if incoming power is lost?

Capability

1) *With everything we've covered, will this machine do everything I need it to do?*
a) For how long?
b) At what expense?
c) Is it equipped with the latest technology? (Meaning, "Is it competitive?")

Economy

1) *How much does it cost?*
a) How much does it cost to buy? (Initial investment, interest, etc.)
b) How much does it cost to run? (Consumables)

c) How much financial impact will it have on my business?

Reliability

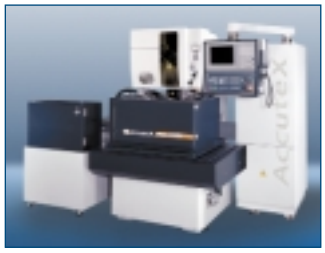
1) *Manufacturer's track record.*

a) How long have they been in this business?
b) Total number of machines in the field?
c) Total number of this type in the field?
d) Are references from similar users available?
e) If it is a brand new model, are there field testing references or records I can access?

Preventive Maintenance

1) *If so equipped, what are the maintenance intervals and time required for:*

a) Automatic wire threaders?
b) Wire choppers?
c) Carbide indexing or rotation?
d) Belt tracking?
e) Lubrication?



Consumables

1) *Depending upon use, what are the replacement intervals and costs for:*

a) Dielectric filters
b) Dielectric resin
c) Resin filters
d) Carbide contacts
e) Wire guides
f) Drive belts
g) Pulleys
h) Air filters
i) Others

Intangibles

This completes the machine-side of the selection process, but there is much more to a machine tool than just the iron it's made of. While researching all of the facts and features of the machine tool itself, you must also seriously consider certain intangibles such as:

Service and Support

1) *Training (in warranty).*

a) What levels of training are offered? (beginning, intermediate, advanced, tailored, etc.)
b) Number and location of training site(s)?
c) Number of students allowed?
d) What kind of follow-up after training can I expect?
e) Phone support?

2) *Training (out of warranty).*

a) Cost?
b) Availability?
c) Phone support?

3) *Applications support (in warranty).*

a) Field applications? (On-site.)
b) Number of technicians allotted for this service?
c) Their average response time?
d) Phone support?

4) *Applications support (out of warranty).*

a) On-site costs?
b) Availability?
c) Phone support?

5) *Field service support (in warranty).*

a) Number of technicians?
b) Their location(s)?
c) Average response time?

6) *Field service support (out of warranty).*

a) On-site costs?
b) Availability?

7) *Replacement parts.*

a) Quantity of spares in inventory? (dollar amount)
b) Location(s) of parts depots or warehouses?

Reliability and Longevity

1) *How long will this machine operate under my expected operation criteria?*

a) Warranty coverage?
b) Warranty duration?
c) Are there any exceptions or limitations to the warranty?
d) Are extended warranties available / recommended / necessary?

2) *Are there any database records available indicating machine / component reliability? (MTBF charts, part inventory logs, etc.)*

a) What percentage of replacement parts are produced overseas? (Being subject to exchange-rate fluctuations, trade disruptions, taxes, duties, tariffs, politics, etc.)
b) How long will existing U.S. parts inventories last without replacement?

Supplier Reputation

1) *What is the market's perception of:*

a) The manufacturer?
b) The machine?
c) The dealer/reseller?
d) Their individual and collective levels of support?
e) Their sensitivity to the customer's needs?

Review

We're not quite finished but we *are* in the home stretch, and almost ready for a final evaluation before making our selection. We've covered a lot of material, so let's review it now.

We first had to determine whether this whole exercise was necessary or not. We did this by confirming that we have three things, the:

1) Need — that is qualified by the combination of the
2) Budget — and the sufficient
3) Work — necessary to support it

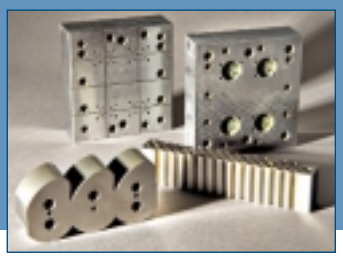
After this, we had to examine aspects of the machine's:

4) Size,
5) Speed,
6) Accuracy,
7) Finish,
8) Features,
9) Interface
10) Autonomy,
11) Capability,
12) Economy,
13) Reliability,
14) Maintenance
15) Consumables

And finally, we had to consider certain intangibles, such as:

16) Service and Support
17) Reliability
18) Reputation

Although we already covered these items, seeing them listed all together can help you assign a priority and weight to



each. As noted earlier, no attempt has been made to list these aspects in any order of importance, because that will be done by the individual shop owner, manager, engineering staff or selection group based upon their specific needs. There may be other salient points to consider (go ahead and add them), but the ones listed here should provide enough information to help you make your decision without getting bogged down in too much detail.

Seeing Is Believing

So far, this process should have reduced the field of candidate machines down to a few or maybe down to one. Regardless, from this point on, you must go shopping. By that I mean literally, physically, *go and see the machines*. I realize that some people may feel that they can't miss work to do this or are reluctant to incur the expense of time and travel and might conclude that they, "...can't afford to do that." I strongly disagree.

Using the car analogy again; I am absolutely certain that you'd never purchase an automobile without learning all about it, seeing it and taking it for a test drive. So why wouldn't you learn all about the prospective machine, see it and take *it* for a test drive, *especially* when it is so much more expensive? The odds are very high that you'll keep the machine much longer than the car, and while both will depreciate over time, the car could never allow you to buy another machine, but the machine will certainly help you buy another car.

For those of you who don't attend a machine demonstration and witness a test cut before you buy it because you, "can't afford to do that"; what happens if you make the expensive mistake of buying the wrong machine? Can you afford to do *that*?

To make this easier on the customer, the machine builders, importers and distributors go to great expense to present their products at local, national and international machine shows, in order for a potential customer to have every opportunity to see a machine up-close and personal. Should you be unable to journey to one of the larger business hubs where the builders have technical centers and dealers have showrooms, try to attend a regional or local trade-show in your area. In the long run, you will be amazed at how valuable either trip will prove.

While you are at a facility where you can see the machines being demonstrated, conduct a thorough investigation into the functionality and ease of use of each machine. Anyone connected with the purchase, part planning, and operation of the machine should be present to witness these demonstrations. Many times a potential customer will submit a part to a salesman or the builder's engineers to be test-cut and returned. Merely sending in a sample part to be cut can often be misleading. Ultimately, you may be provided with a part that meets all of your criteria, but by not actually witnessing the test-cut or demo, you have no idea how difficult or easy it was to execute. Attending and watching a demonstration or test-cut will familiarize everyone with what is involved in the programming, set-up and operation of the machine.

When you are present, simply watching the applications engineer move and work can give you a very good indication of the degree of ease or difficulty of the machine's daily operation. If his tasks appear to be effortless and routine, then you can have the confidence that after training, it can be that easy for you also. By being onsite, you will know if he had problems with the machine itself, or whether other problems presented themselves. For example: you may find that the auto-threader has trouble threading your intended choice of wire, or find that loading one of your existing programs was difficult, or discover that your choice of tooling was met with a previously unknown limitation. All of this information is very important when understanding what is involved in the daily operation of the machine.

Likewise, the engineer may encounter problems that, quite fairly, aren't machine related or indicative of the machine's actual performance. Problems such as unforeseen part movement due to stress or a workholding problem. You need to know all of these things and you can only know them by witnessing the demonstration personally.

By this point, you should have a very good idea as to what your final decision will be although there is still one more item to consider. This item may or may not influence your decision, but it is important to consider the critical nature of the purchase or the:

Timing

1) *How badly do I need this machine?*

a) Urgently: "I am already losing money because I need EDM."

b) Necessary: "I really need an EDM, but we need a new grinder even worse."

c) Casual: "We've been thinking about EDM to please some of our customers."

Hopefully, your supplier's inventory, installation and training schedules coincide with your sense of urgency.

Summary

You should have enough information accrued by now to make an educated evaluation of whether or not you can justify a machine purchase. You may have to examine the financial "cost vs. income" portion more closely to better establish the shop rate for this machine, but while you do this you must also be aware of your existing market. (Meaning, just because you have carefully and correctly calculated that the rate for your intended machine should be $75 an hour, won't help you a bit if everyone else in town is doing the same work for $50!)

Should you have any remaining questions regarding the equipment or the details of the transaction, obtain answers from the sales and engineering staffs of your candidate machine importers and distributors. Make them put forth at least the same amount of effort you are making. Require them to answer any and all of your questions — that is their job. Any professional supplier will do their best to accommodate you.

And finally...

... make no decision until you have a full understanding of all the features and capabilities of both the machine tool and your suppliers.

To do anything else would make this entire survey a waste of time (bad) and possibly jeopardize your entire project (worse).

In closing, I'd offer you luck in your quest to find the "perfect" machine, but you must know that in this quest, luck is not a factor. Just do exactly what you did the last time you bought a car...

Do not allow yourself to be ***sold***. Educate yourself so you can buy.

EDM