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# Estimating your cutting costs

## Cost of ownership model compares precision plasma, punch-plasma, laser

By Al Julian, Contributing Writer

In comparing cutting costs associated with precision plasma, punch-plasma, and laser cutting, it's important to account for labor costs, operating costs, and depreciation. All three of these processes have benefits and drawbacks cost-wise, depending on how they're deployed.

The recent recession has created a new standard for many fabricators: When capacity exceeds work, the reality is that cost does matter—more than ever before.

Many fabricators bid on jobs simply to fulfill short-term needs: to keep personnel employed and machinery running so they can pay the fixed costs associated with owning the equipment. Often such a job is taken at a loss.

Fabricators generally are still in an overcapacity situation today, working in a price-sensitive market. After months of performing low-margin work, they realize that it's time to analyze what type of equipment offers the lowest cost of ownership and highest potential for profitability in today's competitive environment.

While laser cutting technology grabs the headlines, plasma cutting technology has progressed, making its own mark. Every year approximately the same numbers of laser and plasma cutting machines are sold in North America. Also, many are purchased for the same or similar applications—creating flat parts out of mild steel sheet metal and light plate in low to medium operations.

A model was created to compare the total cost of ownership for laser cutting and plasma cutting equipment. A variant of plasma cutting also was evaluated—the punch-plasma combination. Punch-plasma machines commonly are used for the same applications as traditional plasma or laser cutting machine tables. Punch-plasma machines use plasma cutting to contour the external geometry of the part and a punching cylinder with tooling to create internal features.

Defining Costs

To compare the economics of these machines, costs were divided into three categories:

**1. Labor:** costs associated with running the machine, including the time to handle raw material, finished parts and remnants, and attending the machinery while it's running (when required).

To place a value on these costs, you must know the hourly cost of an operator, the amount of time it takes to run a part on each machine, the percentage of time allotted for machine setup, and the percentage of time an operator actually attends the machine. These factors all may be unique for each application or facility.

**2. Operating:** costs associated with operating the process, including gas and power consumption, consumable items, maintenance and repair, and tooling. These costs occur only when the machine is operating.

**3. Depreciation:** costs associated with the equipment purchase. It may be a monthly lease or loan payment or the initial price of the equipment amortized over a specific amount of time. These costs also include the estimated value of the machine at the end of the payment schedule. Since depreciation costs are fixed, they occur whether the machine is working or idle.

Remember that these machines don't produce parts at the same speed. Because many of the costs just discussed are time-dependent, it's necessary to express the comparative data as a cost per equivalent amount of work, not a cost per hour, which can be misleading.

Also note that these costs all are application-dependent. They may vary depending on part features, the amount of work, and the number of shifts running.

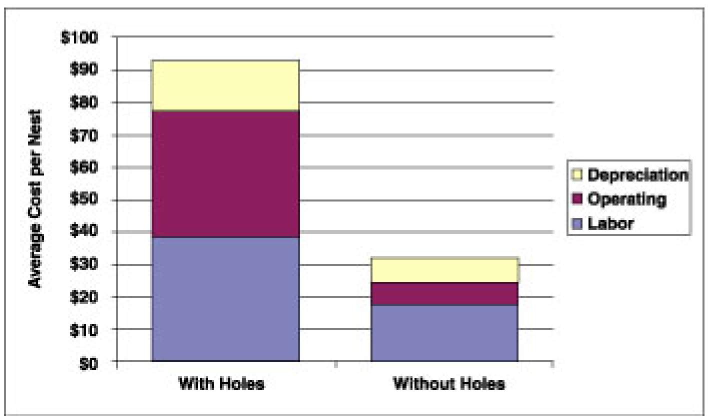


**Figure 1:**
This bar chart shows the effect of using plasma cutting to create internal holes. The test nest consists of 58 parts with an average of 7.5 internal holes per part.

While a job shop may have the ability to solicit additional work to fill a machine’s time, a manufacturer likely will be limited to the amount of product shipped. For this reason, the model was made flexible enough to accommodate a number of different scenarios, using a database of different parameters associated with the processes, the user, and the machinery, each being independently variable.

Using the Model

The model is based on a discrete number of nests (part layouts on standard-size pieces of raw material), each with different features. For example, one nest contains a group of parts with many holes. Another nest has several small parts with no holes.

A total of five nests are available for analysis. These five nests represent the work of many manufacturers and job shops. Processing time is calculated for each nest based on the cycle time of each machine.

Each nest can be produced in eight different material thicknesses, ranging from 14 gauge (2 millimeters) to 1 inch (25 mm). The model can be used to choose percentages of each material thickness for a specific application. As technology changes—with faster cutting speeds or a change in operating costs, for example—the model can be updated so the economic effect of the technology can be seen.

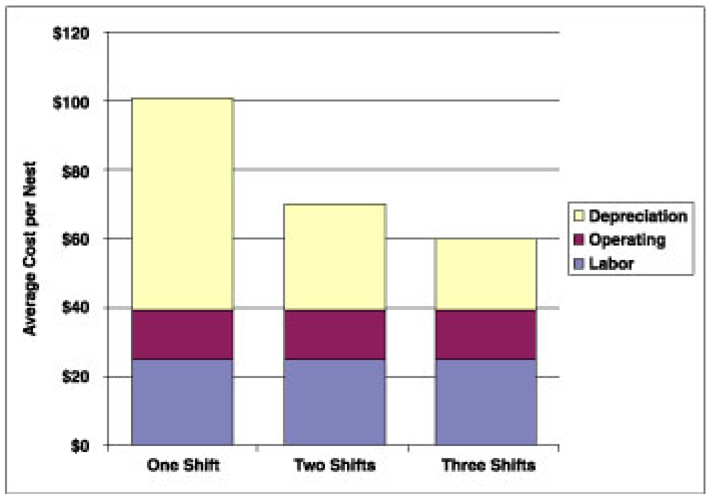


**Figure 2:**
Because depreciation plays a large role in total cost of a laser cutting machine, higher usage lowers cost of ownership.

The comparison shows that each process has a different significant cost set associated with it. For example, the plasma cutting process has the lowest initial investment, so its depreciation (fixed) costs are low. As the amount of available work is reduced—by, for instance, reducing shifts from two to one—the depreciation advantage over the other processes begins to play a significant role. However, this process also has the highest operating cost of the three processes. The operating costs escalate when the plasma process is used to cut internal features, such as small-diameter holes.

The biggest factor affecting total cost of operation is the number of internal features per part. **Figure 1** shows the total cost of operation for identical nests: one producing the external geometry and internal holes and the other producing just the external geometry. This process proves to be a relatively expensive way to produce the internal holes. When calculating the number of internal features versus the cost differential, the model shows that each hole costs 14 cents to produce.

The laser cutting process requires a higher investment than the plasma cutting process for roughly equivalent cycle times. For this reason, the depreciation costs of the laser cutting process play a more dominant role in its total cost of operation. In fact, the easiest way to reduce the cost of this process is to run more work across the laser table.

**Figure 2** shows the effect of the total cost of business for a one-shift, two-shift, and three-shift operation. The cost per nest is reduced by 30 percent as a second shift is added and by another 10 percent as a third shift is added.

Attendance levels provide another opportunity for laser cutting machines to lower operating costs. While all three processes offer opportunities for running at an attendance factor of less than one, it's more common for fabricators to allow a laser cutting machine operator to perform secondary operations or to run additional machines. For example, using one operator can reduce labor costs by 50 percent. **Figure 3** shows the effect of this reduced labor: an 18 percent reduction in total cost of ownership.

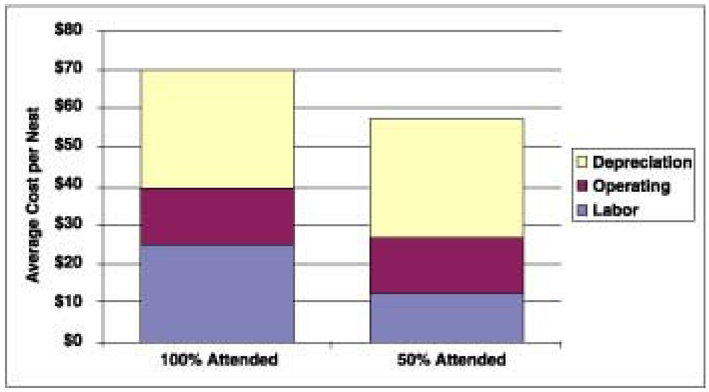


**Figure 3:**
Using one person to operate two laser cutting machines can reduce total cost of ownership by 18 percent.

The punch-plasma process can have floor-to-floor processing time advantages over the other two processes—by as much as three times in some conditions. Furthermore, since internal features are punched rather than cut, it doesn't have the high operating costs precision plasma does; they are replaced with the lower tooling costs. Because of the high throughput, depreciation and labor costs are amortized over more parts than the other two processes.

Process Comparisons

A variety of conditions were explored to compare the three processes. Several parameters were altered one at a time to show the overall effect on the process economics. **Figure 4** shows the baseline process comparison with the following assumptions:

- Labor costs at $20 per hour
- Five-year amortization of the initial investment at 7 percent interest
- Equal percentages of six material thicknesses between 10 ga. and 1¼2 in.
- Attendance levels at 100 percent for all processes
- Default nest consisting of a 5- by 10-foot piece of raw material with 58 parts and an average of 7.5 internal features per part
- Two shifts

**Figure 4** shows that punch-plasma has the lowest total cost of ownership of the three processes over the range of material thicknesses.

If we plot the variation by thickness on a graph (see **Figure 5**), you can see that the relationship is thickness-dependent. Laser cutting offers a lower cost for material about 12 ga. and thinner, while the advantage for punch-plasma increases as material gets thicker. In the heaviest thickness, the punch-plasma maintains a 40 percent cost advantage over laser cutting. In this scenario, the precision plasma cutting process has the highest cost of the three processes.

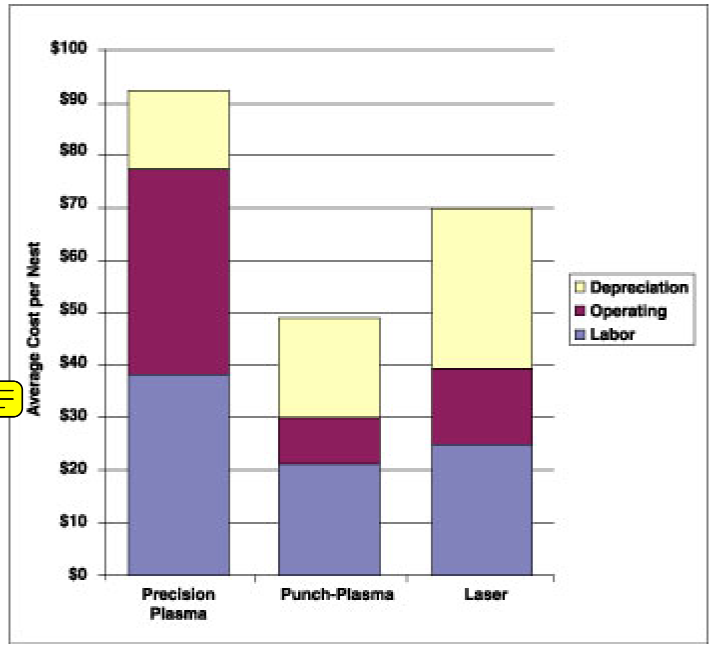


**Figure 4:**
This baseline cost of ownership comparison is based on two shifts working on each process.

In another variation, all of the parts' internal features are removed, and the processes are compared again. In this scenario (see **Figure 6**), the precision plasma cutting process shows cost advantages over the other processes.

It's not surprising that speed plays the biggest role in the laser and punch-plasma cost of ownership. These machines have higher fixed costs, and faster cycle times result in the amortization of the fixed costs over a greater number of parts. Furthermore, speed is directly related to labor costs.

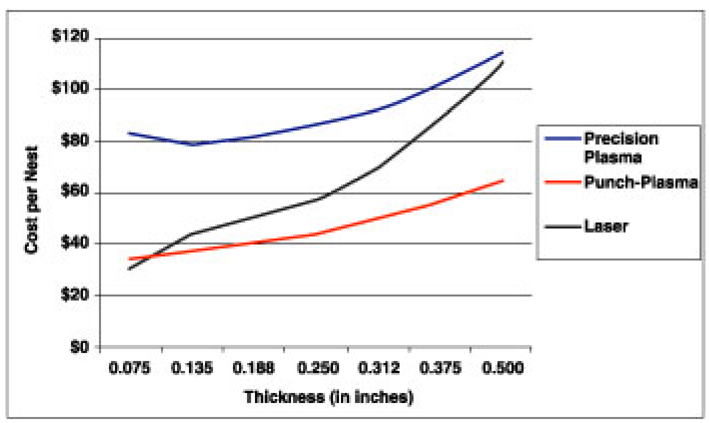


**Figure 5:**
This graph shows the cost per nest as material thickness increases.

Speed plays a lesser role in the precision plasma cost of ownership, because the cost of this process is affected more by operating costs than by fixed cost and labor. For this reason, the cost and life of plasma cutting consumables play a larger role.

A Place for All Processes

The economic cost of ownership model can be used to answer several questions:

- Which process is the least expensive for a given application?
- What is the effect of improvements on these processes? Are they meaningful to the end user?
- Where should resources be directed in terms of improving these processes?
- Which future machine purchase will result in the highest profit for my fabricating business?
- What can I do to reduce the costs of an existing process?

The cost of ownership model demonstrates that there is a place for all processes. The laser cutting process is the most accurate, and many benefits result from this accuracy.

The plasma cutting process offers economic benefits for parts with few internal features and for applications with one shift or less worth of work. The punch-plasma process offers economic benefits for heavier material (10 ga. and thicker), and when volume requires more than one shift.

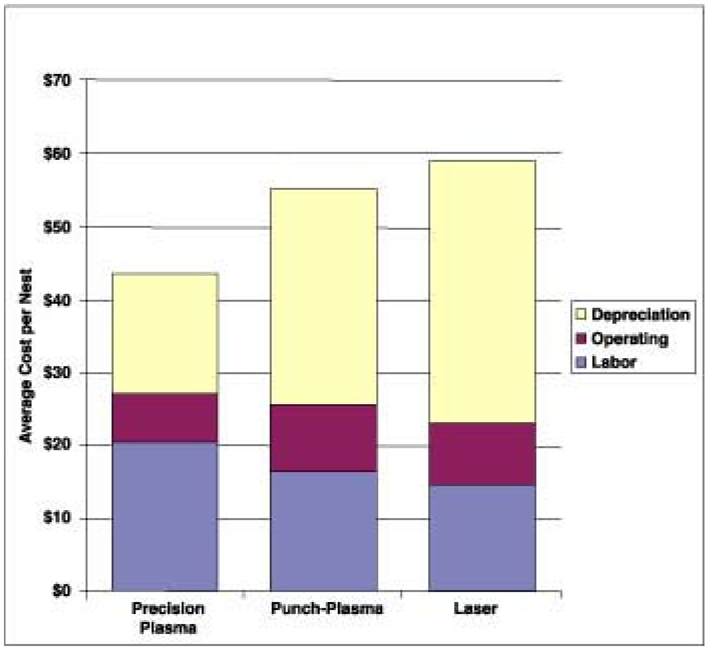


**Figure 6:**
This default nest chart is based on parts with no internal features and shows cost based on a one-shift operation.


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