➤BY KEVIN COLE, ASSOCIATE EDITOR

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Drilling for PROFIT$

Considerations before purchasing an automatic drilling unit.

There are a variety of ways to drill holes, ranging from manual processes to CNC machining. One method that falls somewhere in the middle is the use of stand-alone, automatic drilling units.

Several major types of automatic drilling units are available. They are categorized according to what drives the spindle and what powers the feed. The most common types are all-pneumatic units; electric spindle drive/pneumatic-feed units; electric spindle drive/hydraulic-feed units; and all-electric units. Just examining the intricacies of these options without the myriad of other considerations can be a time-consuming process. So, before spending valuable time surveying the possibilities, a company should determine if it could even benefit from such technology.

Who Can Benefit?

When asked who should consider purchasing an automated drilling unit, a number of experts said anyone performing high-volume holemaking. However, a look at those who have benefited from drilling with this type of equipment provides greater insight.

Companies using labor-intensive manual drilling processes commonly find that a change in drilling

BestMetal finds the best process for the job

Located in Woodstock, Ill., BestMetal Corp. is a 30-person company that operates three shifts and has been around since 1989. The company provides at or near net-shape parts using P/M technology, serving industries such as material handling, agriculture and food processing. BestMetal also offers in-house machining, including drilling, tapping and turning, as well as deburring and steam treatment.

For the first 10 years of operation, the company did all of its drilling on drill presses. Then in 1999, it purchased its first CNC machining center and found that it could drill more quickly and accurately.

The company performed most of its drilling on CNC machining centers up until 2001, when vice president and general manager Sean Kenney decided that a particular high-production part was costing too much and taking too much time to drill. So the company began to look for a cost-effective alternative.

BestMetal worked with Sugino to build a 4-unit drilling machine so it could simultaneously drill four holes in a single part, cutting production time by at least 75 percent.

After reviewing the options, the company came to the conclusion that a multistation automatic drilling machine would be its best bet. With that in mind, it began to look for help.

"We were going to have someone build an automated machine for us, but the lowest price we could find to build the machine we needed was $106,000," said Jim Eddins, president. "So with the help of John Fischer of Sugino, we built it ourselves in-house using Sugino heads and a programmable logic controller. It only cost us about $43,000.

"We built the machine for a part that we make, which has four different drill points in it," Eddins said. The part is roughly a 2"x¾", steel alloy, rectangular component used to make stands to hold up trade show booths. According to Eddins, BestMetal runs 40,000 to 60,000 per year.

"On a machining center, the only way we could do it was to stop and rotate the part, so we had four different operations," Eddins explained. He said that with the CNC machining centers, the company could put 60 parts on a plate, but could only drill one hole in each part before stopping the machine to rotate the parts 90° and then drilling the second set of holes.

Kenney said that the company was only able to produce about 20 finished parts an hour. However, with the stand-alone drilling machine, all four holes in each part can be drilled at once, eliminating the majority of the handling and reducing the time to a quarter of the previous cycle time.

The drilling units on the machine have an electric motor for spindle rotation and air to power the thrust, which Eddins said he chose because "they are the least expensive for the most versatility."

In addition to building the drilling machine, BestMetal also built air-cylinder feeders that go into the machine to handle parts automatically. The same compressor that operates the drill feed also runs the feeding system. "All we do is magazine-load the parts into the machine, and it runs automatically," said Eddins.

According to Kenney, the production rate was boosted from 20 parts an hour on the machining center to a 450 an hour on the automated drilling machine.

Eddins said the company had a short return on investment and he is quite happy with the results. BestMetal is in the process of designing another unit that will drill two holes in a part, rotate it and tap those holes. *–K.Cole*

methodology is beneficial.

"Ninety percent of the companies that call us have drill presses and are manually drilling the holes," said Joe Agro, part owner of AutoDrill, Millington, N.J., a manufacturer of drilling equipment. "Then their volume goes up and they have to decide if they are going to hire another person to hand-drill holes or buy equipment like ours."

Conversely, some companies using CNC machining centers may also find value in automatic drilling units.

"A CNC machining center is an expensive machine to drill with," said John Zagar, president of Zagar Inc., Cleveland. "We tell customers to [keep] their CNC machine, but take their drilling off of it and put it on a relatively inexpensive, special-purpose drilling machine."

A machining center could have a burden rate of $100 or $500, depending on how complex the machining center is, said John Fischer, national sales manager for Sugino Corp., Itasca, Ill. He said that a typical drilling unit has a burden rate of less than 10 percent of a machining center.

Another reason for moving operations from a manual press or CNC machine to a drilling unit is productivity.

"With CNC machining centers, you can only drill one side of a part at a time, and we have machines that can drill five sides at one time," explained Harry Womack, vice president of R&D with AAA Products, Dallas. "The real value of these machines can be seen when you have multiple units mounted on the same table, all drilling the same part simultaneously."

Ann Schmidt, president of Govro-Nelson, St. Clair, Mich., takes that idea one step further by saying that automated drilling units not only increase production, but also decrease handling. "By doing multiple operations at the same time on the same part, it only has to be handled once," she said.

All agreed that companies benefit when they incorporate stand-alone drilling units into cellular operations. Cellular systems often require process duplication, so limited-function, lower-cost alternatives to large, multifunction machines can be key to success.

"When you put one of these machines next to a machining center, you are es-

sentially creating a cell," said Agro. He said this not only allows an operator to run and monitor two machines, but separate part features by process and put them on the machine that will be fastest and most cost-effective.

Another reason the systems are suitable for cellular operations is their relative portability.

"We have mounted wheels on [drilling machines] for some of our customers who want to move machines around into different cells," said Schmidt.

Fischer said he has seen companies with more than one base for the same drilling unit, which gets unclamped and moved to where it's needed. Similarly, Womack said he has seen companies put a unit on a magnetic base so it can be easily moved about the shop.

Once the decision is made that a drilling unit is needed, the process of choosing which type and configuration begins. This is no easy task because many styles are available. Fischer pointed out that his company offers around 270 varieties.

Big Factors

Low-tech shops may want to consider lower-tech units, said Zagar. Sometimes places with lower skilled workers want to go with servo models because they are easier to operate. Other times shops use the air or hydraulic units because they don't need anything more accurate, or the budget doesn't justify a more expensive machine. The important thing, though, is that the decision is well thought out and all of the factors involved are considered.

"When you put one of these machines next to a machining center, you are essentially creating a cell."

Cost. "Most of the time, deciding which drilling unit to buy is a cost-driven issue," said Fischer. "You are going to look at how much money it will cost to buy and operate the machine."

When it comes to the purchase price, the least-expensive unit is the all-pneumatic drill, which uses air to drive the spindle and power the feed. The typical price is from $1,500 to $2,500.

"They are cheaper, but they cost more to power," said Fischer. "The typical all-air unit requires 18 to 30 cu. ft. of air per minute. At 11 cents per kW-hour for electricity, running one shift 8 hours a day, 5 days a week will cost $800 a year for the all-air unit."

The next step up, pricewise, is the electric-air unit, which uses electricity to drive the spindle and air to power the feed. Prices range from $2,000 to $7,000. Despite costing more than an all-air unit, an electric-air model saves on operating costs

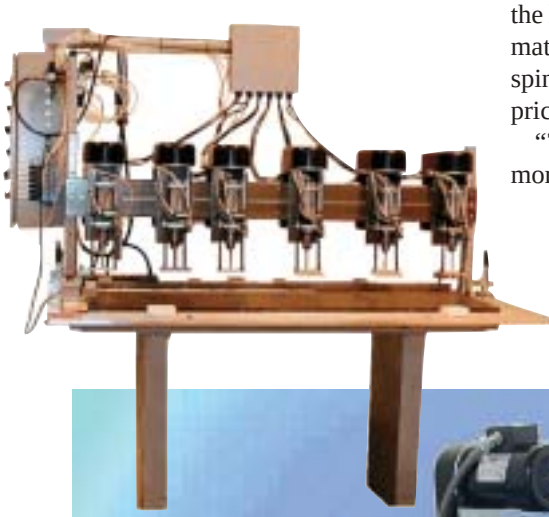
According to Fischer, running an electric-air unit 8 hours a day, 5 days a week at a power cost of 11 cents per kW-hour would cost around $40 to $60 per year. "An electric-air unit typically runs at 0.08 to 2.0 cfm, so you could literally run 10 or possibly even 100 electric-air units on the same amount of air as an all-air unit," he explained.

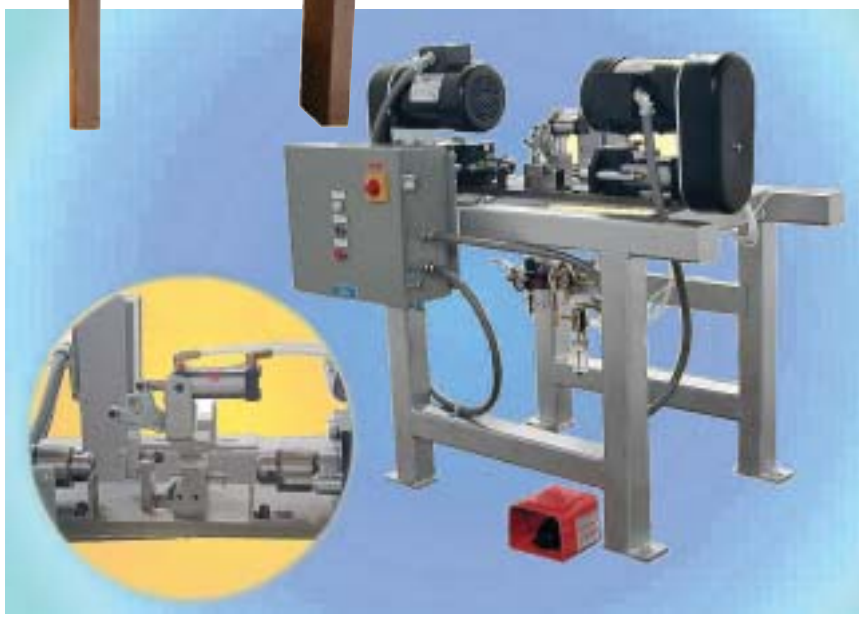
While there is not much difference in operating costs between electric-air and electric-hydraulic units, the purchase price of the hydraulic units is significantly higher. According to Zagar, electric-hydraulic units, which use electricity to rotate the spindle and hydraulic motors for the feed, can cost anywhere from $4,500 to $15,000. And the purchase price for all-electric units can be even higher, depending on if servomotors are used only for driving the spindle or are also used to power the feed. With a CNC, these units can range from $8,000 to $25,000.

Hole Quality. Accuracy and consistency are also important factors in deciding what type of unit will work best for a given operation. The TIR on drilling units varies from 0.001" to 0.0002". The difference largely depends on the spindle power source.

At the least-accurate end are the all-pneumatic units. "All-air units have to be built a little bit looser and there will be more play in the spindle," explained Fischer.

In the middle of the accuracy range lie electric-air and electric-hydraulic units. According to Fischer, the electric motors give better consistency than the





There are numerous ways to mount drilling units, and multiple units can be mounted on the same platform.

AutoDrill

all-air units "because electric units provide a belt and pulley or gear combination that will give you an exact rpm."

AutoDrill's Agro said that while the accuracy of electric-air and electric-hydraulic units is significantly better than that of a drill press, they cannot compete with the accuracy of a CNC machining center. "But, if a CNC machining center is drilling a hole, it could easily be replaced by one of these machines," he said. "If a company has a tolerance of ±0.0005" on the diameter of a hole, they are not going to go in with just a simple drill even on a CNC machining center, anyway. That won't give them their tolerance." The all-electric, servomotor units definitely set themselves above the competition when it comes to accuracy and consistency.

"The all-electric version gives you all the consistency you could possibly want, the same as a machining center," said Fischer.

Power. Another factor that differentiates the types of drilling units is power, which is closely connected to the feed methodology: pneumatic, hydraulic or electric. According to Fischer, thrust can range dramatically—from 150 lbs. to more than 2,200 lbs.

At the bottom of the power pyramid are the all-pneumatic drilling units. According to AAA's Womack, "The air drills are high speed, but they have little power to speak of."

Zagar agreed, saying the pneumatic feed makes them good for light work, but limits their ability to perform heavy-duty operations.

He said the electric-air machines have more power than their all-air counterparts. "The power of these [electric-air] machines is a little above the air-air type because you can put a bigger motor on them, and the electric motor is a little more consistent than the air motor and has a little more torque.

"The next level is the electric motor spindle and hydraulic-feed unit," said Zagar. "With the hydraulic feed, you have a little more control, and it's a little more firm when it's going into the workpiece."

Womack said hydraulic units can provide so much thrust that companies must be careful to mount them suitably.

AutoDrill

A variety of multispindle heads are available for drilling multiple holes that are close together.

He said he has seen cases in which the thrust, rather than penetrating the workpiece, has pushed the unit off of its mounting bracket.

And last but not least are the all-electric units, which have power that's about equal to hydraulic-feed machines. "The servomotors aren't more powerful than the hydraulic, just more exact," explained Zagar.

Application Requirements. The last major factor is the type of work that the company plans to perform with the new equipment. Things such as hole size and workpiece material must be taken into consideration.

"It all boils down to the application," said Fischer. "For a simple hole, you don't need the most complex drilling machine."

The size of the hole determines what type of drilling unit would work best. Air models, according to Agro, are best-suited for smaller holes. He said that 95 percent of holes made with air units are ½" or smaller, although the machines are capable of holes up to ⅝".

Womack said that hydraulic units are capable of producing holes ranging from 1/16" to 1½". "The diameter of the hole being drilled is not going to make any difference as long as the unit can provide the thrust needed," he said.

However, Womack also pointed out that to use a hydraulic unit to drill very small holes is "overkill," and that another type of drilling unit might be better-suited for such work.

With highly adjustable feed rates and spindle rotation, the servomotor models are capable of producing small or large holes.

"The all-electric machines give you infinite control over your feed rate and definite control over your rpm," said Fischer. He added that to drill a larger hole, the operator can slow the feed rate during entry, to minimize deflection, speed it up once the drill is in the workpiece or peck-drill to optimize tool life. Then, when the drill exits the workpiece, the drilling unit can be slowed again to minimize burr formation and eliminate subsequent operations.

"When it comes to materials that can be processed," said Govro-Nelson's Schmidt, "you have to take the feeds and speeds into consideration and decide what kind of thrust you need. However, it is more of a tooling issue."

Other Considerations

Even after the decision has been made as to what type of machine best fits a given situation, there are other considerations, including those pertaining to attachments and mounting options.

Although the units are primarily for drilling single holes, a variety of attachments can be used to provide different or additional capabilities. Among them are tapping heads, cut-off saw attachments, reaming attachments, multiple-spindle heads, deburring attachments, offset heads, milling attachments, screw-driving heads, slitting attachments and friction-welding attachments.

With so many options, it becomes important to have a solid idea of what

the equipment needs to do before an order is placed.

"The attachments are dependent on the type of operations that a company needs to do," said Schmidt, echoing the sentiments of many drilling unit manufacturers. "We can set up the machine to do whatever needs to be done."

Womack pointed out that attachments are highly specialized and have to be sized for the drilling unit, which makes it important to purchase the needed attachment at the same time the drilling unit is being built so everything matches up.

"You are better off engineering some of these options, such as multispindle heads, up front," said Fischer. He explained that a drilling unit designed for a single spindle can be overloaded if a multispindle head is attached to it to drill multiple holes at once .

Womack cautioned purchasers of multispindle heads to make sure that is the route they want to take. "The multispindle heads are usually expensive," he warned, but conceded that they are usually the best choice when two holes need to be drilled close to one another. "Multispindle heads can cost around $5,000. You could buy two drilling units for that, but with most units you can't mount them close enough to drill holes close together."

How the unit is to be mounted is another important consideration. Some manufacturers offer drilling units mounted and ready to use, while others sell only the drill units themselves. Still others sell custom mounts or work with companies that specialize in mounting this type of equipment.

In addition to choosing the mounting platform, companies purchasing these units have choices when it comes to how the units are to be mounted and how many units to have on a given platform.

"These could, theoretically, be mounted in any position, as long as you make a plate to hold them," said Agro. "That's an advantage over the CNC machining center. If you had a box that needed holes drilled in all six sides, with a CNC [machining center] that would be tough to do without continually moving the workpiece. With these units, you could build a fixture that allows one drill to come up from the bottom, four horizontally from the four sides and one from the top, all at once. You can mount them any way you want, even at angles. Angle heads can make this possible on machining centers, but you could probably get a whole drilling unit for the same price as an angle head."

"With the hydraulic feed, you have a little more control, and it's a little more firm when it's going into the workpiece."

Re-Examining Processes

Whatever type of machine is chosen or however it is mounted and configured, the key idea is improving profitability.

"There's been a lot of talk lately about how shops are losing jobs overseas, but sometimes the costs are too high because they are figuring their costs on the wrong machines," concluded Fischer. "If you have a $100,000 or $200,000 machining center, you aren't going to be competitive because your burden rate is higher than it is on a simple machine [like a drilling unit]. People don't look at that. They have a machining center and that's what they are going to quote jobs on."

"I think these types of machines are often overlooked by manufacturers," agreed Schmidt. "The trend in the U.S. has been to make more difficult parts on the CNC machining centers, rather than make mass-produced parts. In order to economically mass-produce parts here, manufacturers are going to have to tool up with machines like these."

The following companies contributed to this report:

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