By Joseph L. Hazelton, Senior Editor

MAY 2008 / VOLUME 60 / ISSUE 5

Trumpf

Coming to More Shops Soon?

Increased power and automated systems for greater efficiency may allow laser machines to be more widely used in job shops that machine blocks of material.

Today's high-power laser machines are more useful in machine shops, according to Rick Neff, market development manager for laser machine builder Cincinnati Inc., Harrison, Ohio.

High-power laser machines have increased in power from 2,000w years ago to 5,000w and higher today. Among the more powerful machines is the Truflow 6000 from laser machine builder Trumpf Inc., Farmington, Conn. The machine's CO_2 laser has a maximum output power of 6,000w. At 5,000w and more, today's high-power machines allow for more efficient laser cutting of thicker materials, up to 1", making the machines more useful in a shop that cuts blocks of material rather than sheets.

"An inch of steel is a lot closer to a block of material than a half inch of steel," Neff said.

Trumpf's James Rogowski, product manager–2-D laser and

Learn more about laser machining

Read more commentary on laser machining by visiting Joseph L. Hazelton's Web log in the CTE Community section online at www.ctemag.com. The redesigned Web site, CTE Plus, features a range of Interactive Reports, a Virtual Company Showcase, daily industry news and editors' blogs at CTE Community.

automation group, agreed with the idea of a high-power laser machine being more useful to a parts manufacturer. "We can call this more of a job shop machine," he said.

Also, greater power means faster processing. For example, a 2,500w laser machine can cut a ½"-thick piece of mild steel at about 36 ipm, while a 5,000w machine can cut that steel at 70 ipm.

Rogowski said the trend toward higher and higher power would persist because more power means more productive laser machines via faster processing of thicker materials. "As long as the optics continue to keep up with the machine, we'll continue to increase power." A laser machine's power depends on its beam-delivery mirrors and focal lens because they have to be able to handle the laser's energy, directing a suitably focused beam at a workpiece.

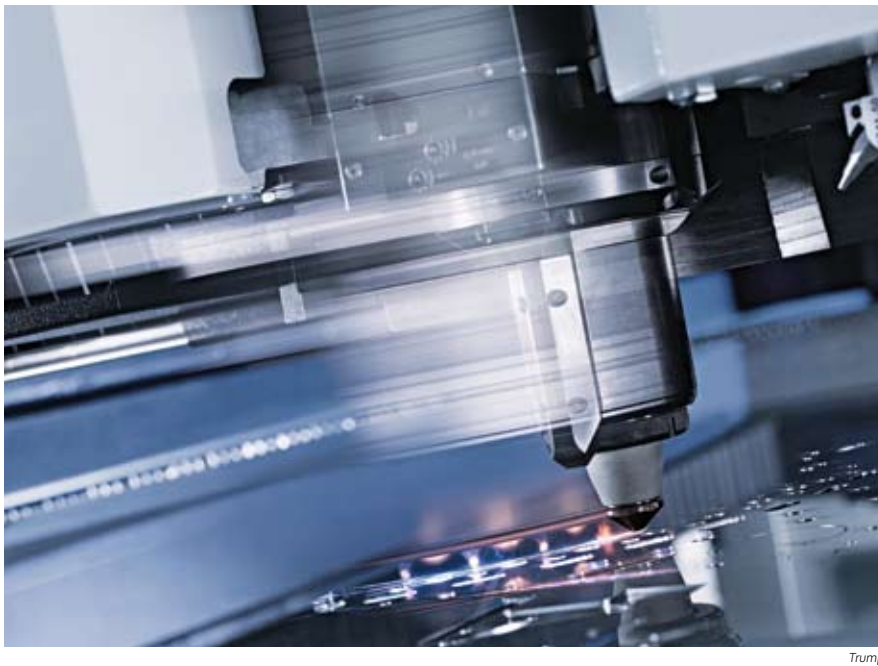
Automated systems for changing laser machines' nozzles and adjusting their focal lenses can make a laser machine more cost efficient when processing different types and thicknesses of workpiece materials.

Lou Derango, Mazak Optonics Corp.'s 2-D product manager, added that today's laser machines are more useful in machine shops because of their tapping features—the ability to cut threaded holes in materials. The Schaumburg, Ill., laser machine builder introduced tapping features on its 2-D laser machines about 3 years ago and on its 3-D tubing laser machines in 2007.

"This is another way to eliminate additional setup, additional handling," Derango said.

Automated for Lower Cost

A number of laser machines include automated systems for changing the machines' nozzles and adjusting their focal lenses and gas pressure, as the machines shift from processing one type



Trumpf

A laser machine's cost efficiency and productivity can be increased by equipping it with automated systems for changing its nozzles and adjusting its focal lenses and gas pressure. Other components can also improve a laser machine's productivity, such the single cutting head shown here, which can process various types and thicknesses of workpiece materials without being changed.

and thickness of material to another.

These systems can make a laser machine more cost efficient and make it a more price-competitive option compared with other metalcutting machine tools because it ensures that the machine will produce the part at the price the shop quoted to the customer, a price that assumed the proper nozzle and focus length would be used. Automated systems ensure that price because they eliminate variables, such as whether an operator equips a laser machine with a nozzle suitable for a new job. "An operator may choose to change it or may not choose to change it," Derango said.

An operator may or may not change a laser machine's nozzle because changing it can take some time, 15 to 20 minutes. But if a nozzle from one job is left in place for the next job, it may be the wrong nozzle for the new job's material type and thickness.

The wrong nozzle can result in the laser machine's expending too little assist gas or too much. If too little, the laser will take longer than necessary to cut the new material. If too much, the laser won't use all the assist gas being supplied, wasting gas and adding cost that may have to be passed onto the customer in the job's price.

Likewise, a machinist may not change a laser machine's cutting head from one job to the next. The head, however, contains a focal lens. Changing heads means changing lenses and therefore changing focus length. If the wrong head is used, the laser will have the wrong focus length.

A parts manufacturer may limit this variable, though, by using a single head that can cut a range of materials. This

contributors

Cincinnati Inc.
(513) 367-7100
www.e-ci.com

Mazak Optonics Corp.
(847) 252-4500
www.mazaklaser.com

Trumpf Inc.
(860) 255-6000
www.trumpf-laser.com

Black Diamond Equipment

Using a laser machine, Black Diamond Equipment Ltd., Salt Lake City, a manufacturer of skiing and climbing equipment, cuts the six metal parts of crampons, or ice climbing spikes (inset), which attach to boot soles to gain footholds on slippery slopes. Black Diamond produces 10,000 pairs of crampons per year for ice climbing of mountains, among other activities on slippery slopes.

type of head adjusts a beam's diameter to adjust its focus length.

Derango said Mazak Optonics began offering automatic changers on a few of its laser machines several years ago. Today, the company offers automatic changers on two 2-D laser machines and one 3-D laser machine.

Besides lenses, nozzles and their positioning, Derango cited seven other factors that affect laser machining's efficiency: laser power, frequency (duty) cycle, assist gas pressure, assist gas quality, feed rate, material and material condition. He added that the 10 are a set of variables subject to change, such as when a machine's optics aren't properly maintained (see sidebar on page 93).

"As the optics get dirty, you're essentially changing those variables," Derango said. "There's nothing static."

Eye Off the Ball

A laser machine's efficiency can also be degraded by the development of a plasma "ball" between the laser machine's cutting head and the workpiece. The ball appears as a bright, white glow between the two during high-speed cutting when there's enough power density. The ball hinders the laser machine's processing of the workpiece because the ball's conductivity prevents the machine from measuring the standoff of the head from the workpiece. "It's sensing the plasma ball and not the material below it," Neff said.

Consequently, the laser machine would "think" that the head is the proper distance from the workpiece but it would be higher. Once a head is pulled back from a workpiece, the cutting process is compromised. "The focus of the beam is

Maintaining by cleaning

LASER MACHINES DON'T USE cutting tools, such as inserts, or metalworking fluids like other machine tools. Without these exterior consumables, a parts manufacturer new to laser machining may forget about interior consumables and consequently view its laser machine as a low-maintenance piece of equipment.

However, as Mazak Optonics' Lou Derango said, laser machines include vacuum pumps, which have seals and gaskets that wear out due to the extreme temperatures that exist inside laser machines.

Nonetheless, a laser machine's most critical components, its optics, have long lives and may require less frequent maintenance than would be expected by a parts manufacturer that's new to laser machining. A laser machine's resonator, for generating the beam itself, may operate for up to 12,000 hours before it needs to be cleaned and up to 70,000 hours before it needs to be replaced. The machine's output coupler, for controlling the amount of laser light emitted, may need cleaning or replacement every 1,000 to 5,000 hours. However, the coupler, a semireflective lens, may have a longer useful life when it's protected with a diamond coating.

Nonetheless, a laser machine's most critical components, its optics, have long lives.

Less frequent maintenance doesn't mean that a machine shop can ignore its maintenance responsibility. If it is ignored and dirt is allowed to accumulate on the coupler, it will heat up too much, shortening its life span and possibly resulting in catastrophic failure.

A laser resonator's output coupler lets about 50 percent of the energy out of the resonator for cutting while reflecting the rest back into the resonator to maintain the chain reaction that creates the laser beam. If foreign matter, like from a bad bottle of gas, sticks on the lens, the matter will absorb the energy, causing the lens to become white hot, crack and implode, said Trumpf's James Rogowski.

He added that Trumpf started equipping its laser machines' optics with sensors 6 months ago to create early warning systems. These systems can sense heat buildup, shut down the resonator and inform the machinist about the situation before it becomes a problem.

A shop would lose some machining time while cleaning its machine's optics, but the early warning system would prevent the machine from suffering a catastrophic failure. "Which will save—in the end—quite a bit of time," Rogowski said.

Also, the shop would avoid the sizable cost of repairing or replacing a damaged laser machine. *—J.L. Hazelton*

---

lost," Neff said, "and you can lose the cut or have a low quality of cut." He added that one way of correcting for a plasma ball is to slow cutting until the ball disappears.

Another way involves noncontact cutting heads with height sensors that can compensate for the plasma. These heads can distinguish an air gap between a cutting nozzle and a workpiece from an air gap with a conductive plasma ball in it, so they can correct the standoff and continue to cut at a faster speed, maintaining the machine's productivity.

"We can maintain the focus of the cutting beam," Neff said, adding that the machine can then use the plasma's heat to quicken cutting. **CTE**

About the Author: *Joseph L. Hazelton is senior editor of* Cutting Tool Engineering. *He has 7 years of experience as a reporter and editor for metalworking publications. Contact him at (847) 714-0177 or via e-mail at jhazelton@jwr.com.*