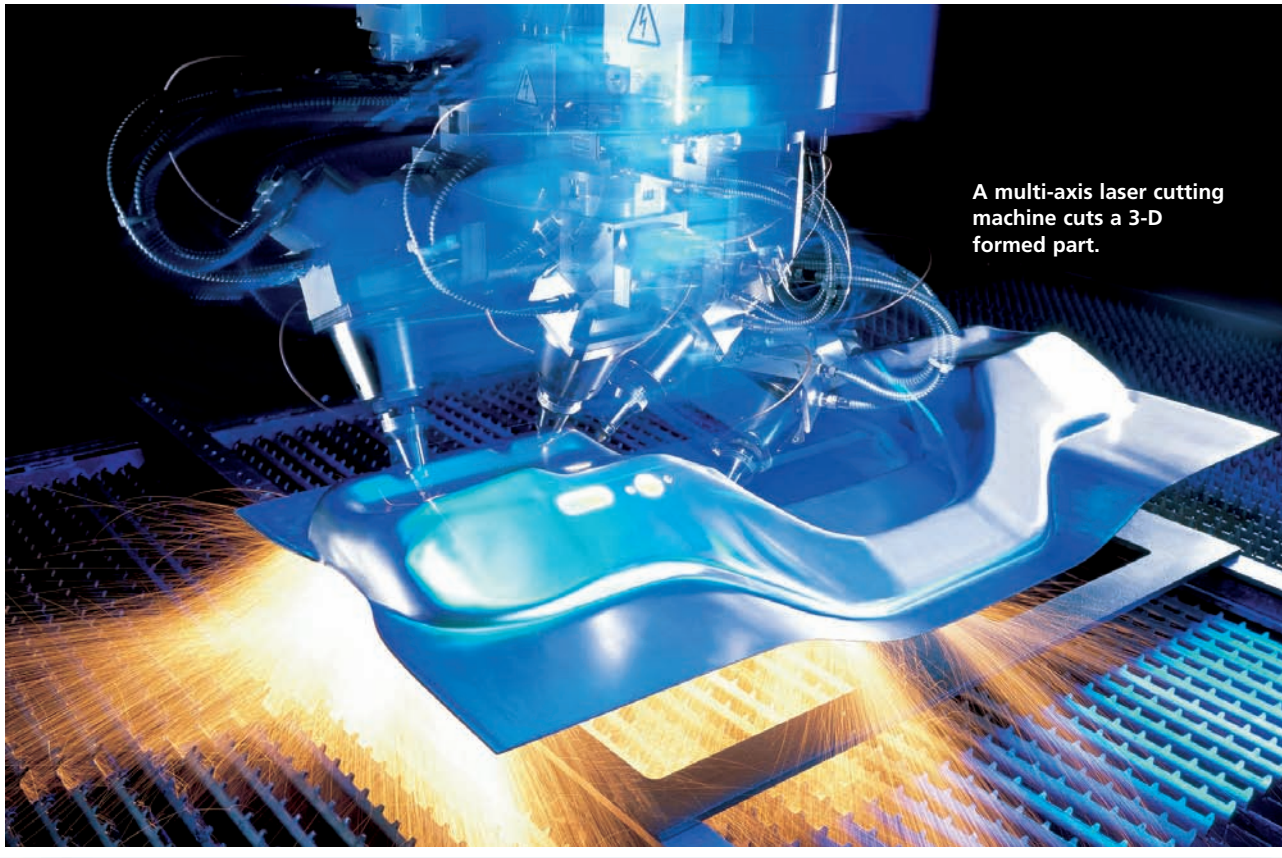
➤ BY SUSAN WOODS, FEATURES EDITOR



A multi-axis laser cutting machine cuts a 3-D formed part.

Trumpf

Laser-like Focus

2-D and 3-D laser cutting machines add value to shops.

Laser cutting has become a widely used manufacturing method during the past 30 years. Most CNC laser cutting applications involve 2-D parts made from flat sheet metal. 3-D laser cutting, such as making holes, is performed on formed parts, such as those that are shaped by bending or stamping. Other applications include bevel cutting on 2-D and 3-D parts, trimming and using a 2-D rotary-axis laser cutting machine or 3-D laser cutting machine for tubes.

2-D and 3-D laser cutting are "two very different processes," said Jim Rogowski, product manager for Farmington, Conn.-based Trumpf Inc.'s flat sheet laser cutting and automation groups. "On a 3-D laser cutting machine, you need five moving axes so you can contour in three different dimensions. On a 2-D laser cutting machine, you need three axes. You can move to the left, to the right and up and down out of the way."

The biggest industry for 3-D laser cutting is automotive. "Probably 50 to 60 percent is automotive and automotive suppliers," said Michael Fritz, product manager for multi-axis laser cutting machines at Trumpf Inc., Laser Technology Center, Detroit. "It stretches from small job shops that have one machine to product shops (shops that make their own product) to the Tier 1s and the automotive makers themselves."

Other industries for 2-D and 3-D laser cutting include manufacturers of heavy equipment, such as agricultural and construction equipment, aerospace and steel processing centers. Also, "medical is one of the newer trends," said Jeff Hahn, senior product manager for Mitsubishi EDM/Laser, Wood Dale, Ill. "Things such as bases for saws."

One example of a fabricating shop that does 2-D and 3-D laser cutting is CNC Laser Cutting, Wixom, Mich. This shop makes 2-D blanks for stamping by the customer and takes stamped

parts and performs 3-D contouring.

The Basics

Lasers can cut a variety of metal but the three most common are mild steel, stainless steel and aluminum. Titanium is also cut. "We have a wide base of aerospace customers that make titanium parts, such as aircraft engine parts or parts that go into the gear of the wheel base," said Fritz.

However, there are metals that are not a good fit, such as copper, bronze and other highly reflective materials. When the laser beam hits this metal, it reflects the beam back instead of absorbing its energy and "melting." This makes it harder to cut.

Cutting speeds attainable by lasers cutting 2-D and 3-D parts depend largely on the power of the laser's resonator, the type of material being cut and the thickness of the material.

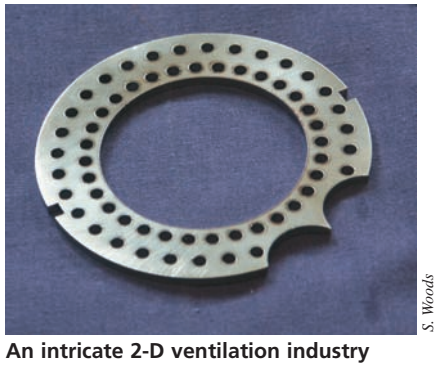
For a 2-D machine, cutting speeds on thin sheet metal, from 0.5mm (0.0197") up to 3mm, or ⅛", thick, can reach up to 1,900 ipm. Typical cutting speeds on thicker materials, from ¼" to 1", vary. Trumpf laser cutting machines can cut 1" mild steel at nearly 40 ipm. For aluminum, limited to ⅝" thickness, cutting speed is around 15 ipm.

S. Woods

Tesko's 2-D laser cutting machine cuts 2-D sheet metal parts.

No limits exist on how thin the metal can be. "You can cut 0.002" shim stock, if you want," said Hahn. However, Dan Spiewak, sales manager for Tesko Laser Div., Norridge, Ill., said his company can't do anything under 0.015" thick. "When it gets real thin, the sheet is so light it sometimes moves," he said. Tesko cuts 2-D parts for the machine tool, automotive and ventilation and refrigeration industries. It is a full fabricating shop that does welding, bending, punching, cladding and other fabricating processes.

For 3-D laser cutting machines, the thickness that can be cut depends on the thickness of the formed part. The maximum thickness that can be cut in mild steel is 18mm (0.7087"), in aluminum is 6mm (0.2362"), and in stainless steel and titanium is 8mm (0.315"). However, the thickness of a typical stamped part is only 4mm (0.1575").



S. Woods

An intricate 2-D ventilation industry part laser cut at Tesko.

S. Woods

Various 2-D sheet metal parts cut at Tesko with its laser cutting machine.

For 2-D laser cutting machines, the tolerance that can be held depends on the thickness of the material. Most manufacturers hold ±0.002" to ±0.004" in sheet metal applications. However, with a 3-D part, it is the part itself that defines the tolerance.

Jim Abbott, general manager of CNC Laser Cutting, said that the tolerance with his Trumpf laser cutting machines is almost as good as what he can achieve with his vertical machining centers, so much so that he stopped using the VMCs for making parts.

"We don't ever make parts on our mills. That is how accurate these laser machines are," he said. "We took all the work out of the milling department and put it into the laser machines. Our mills were sitting there doing nothing so we came up with the idea to start selling our customers dies made with the mills. We know every single one of our laser customers is stamping something and they are going to need a die, so why not provide it?"

Gas Assistance

Most laser cutting machines use CO_2 lasers. With CO_2 laser machines, there is a laser gas and an assist gas. There are generally three components to the laser gas mix: CO_2, helium and nitrogen. These gases produce the laser beam.

In the second step of the process, the assist gas removes the metal out of the kerf, making the cut. The assist gas can be oxygen, nitrogen or compressed air.

When laser cutting mild steel, the assist gas is typically oxygen. With oxygen, the material is melted at the point where the laser beam strikes and is, in large part, oxidized. During this oxidation process, energy is released, which accomplishes approximately 60 percent of the cutting.

With stainless steel or aluminum, the assist gas is nitrogen. Nitrogen doesn't burn, it cools. The laser beam heats up the material and creates a molten pool of metal, then the nitrogen pushes that metal out.

Compressed air can be used to cut steel, stainless steel, aluminum and even titanium when the heat-affected zone is not critical. As a mix of approximately 80 percent nitrogen and 18 percent oxygen, compressed air used as a laser-assist gas combines the advantages of the two gases.

Worth the Investment

There are many benefits to lasers that can justify a high initial investment and actually reduce per-part production costs.

First, there are no tooling costs. "The laser cutting head is the only tool for cutting," said Fritz. "If you want to do the same thing with a stamping press, for example, you need to have expensive tooling to make cutouts in the die. Those tools are dedicated to one shape or hole pattern only. And it takes a lot of time to build the tooling. With the laser, you just program the cutting path."

Hahn added that laser cutting eliminates many time-related costs in fabricating, not only in tool building but in tool changeover.

Also, the end user doesn't have to worry about tool wear. This improves repeatability.

Second, there is little fixturing, at least with 2-D laser cutting. "There are a couple of gage points on the table and we move the sheet to the gage points," said Spiewak. "There are a couple of blocks on the side of the table and we just make sure it touches those and it is in position."

With 3-D laser cutting, there is a little more to fixturing. The part needs to be held and located. That fixturing can have a lot of different looks. "A common way to make such a fixture is with offline programming where software generates a fixture automatically," said Fritz. "You cut it out of sheet metal, put it together and put your part on top." He added that the fixturing is sophisticated, but there are a lot of software tools available that help make the fixture easily.

Third, laser cutting provides a finer finish than other fabricating processes. Laser cutting is touch-free. Usually, with stamping, there are marks on the part.

Mitsubishi

A 3-D part cut on a Mitsubishi laser cutting machine.

Trumpf

A 2-D laser cutting machine cuts sheet metal.

Finally, "the biggest benefit of 2-D laser cutting is the flexibility," said Rogowski. "You can literally walk up to the machine with a CAD file, put it into the machine and be cutting in 3 minutes. It is simple to create the code at the machine or offline and be cutting in a few minutes. This is different than a stamping press where tool creation can take several days. 3-D laser cutting also has to be programmed offline."

Users can buy strictly 2-D laser cutting machines, 3-D laser cutting machines or combinations of both. However, a 3-D machine is best for 3-D laser cutting and a 2-D machine is best for 2-D laser cutting. △

The following companies contributed to this report:

CNC Laser Cutting
(248) 344-7235
www.cnclasercutting.com

Mitsubishi EDM/Laser
(630) 860-4210
www.mitsubishi-world.com

Tesko Laser Div.
(708) 452-0045
www.teskolaser.com

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