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Thick Plate, Tube and More: Laser Cutting Advice from the Pros

From cutting various thicknesses of sheet metal and metal plate or different widths of tubing to navigating intricate materials or process issues, laser supplier offer novel solutions

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As laser cutting systems grow more indispensable to more OEMs and custom fabricators, it pays to learn the nuances of how they work to get the most bang for your buck.

From cutting various thicknesses of sheet metal and metal plate or different widths of tubing to navigating intricate materials or process issues, some of the laser industry's leading suppliers have weighed in with tips and insights into their novel solutions.

Precision Hole-Making in Steel

Compared with conventional machining, laser manufacturing often presents "a good news-bad news paradox," said Mark Barry, vice president of sales and marketing for Prima Power Laserdyne (Champlin, MN), a business unit of Prima Power North America (Arlington Heights, IL).

"The window for acceptable laser processing parameters is large—typically larger than for many conventional

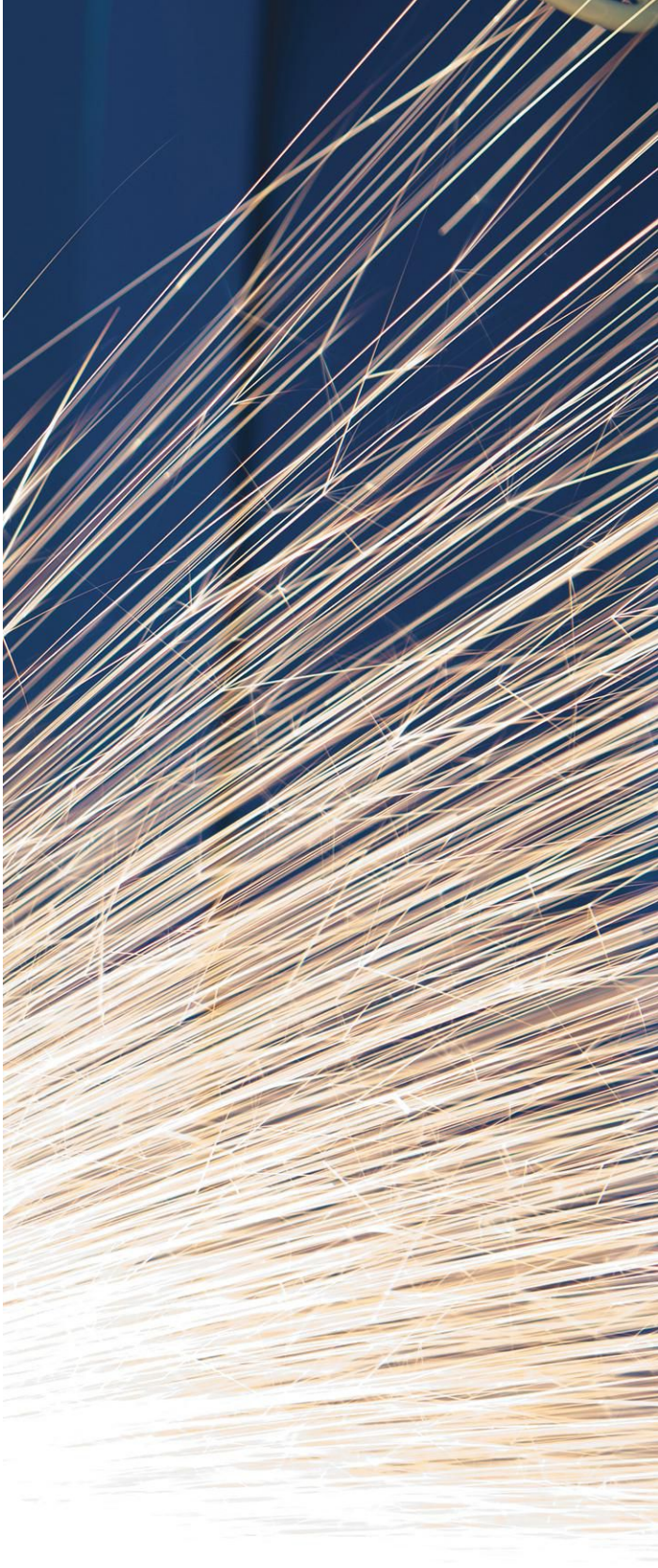

Photo courtesy Prima Power Laserdyne

machining processes," he explained. "This may make obtaining a result easy, but obtaining the optimum result can be a challenge." He contrasts laser and machining approaches to cutting and drilling steel.

Cutting holes in structural steel: Consider an application involving laser cutting hundreds of holes into long, 7-mm thick, high-strength structural carbon steel. "This development project being for a company in the transportation industry justified some experimentation because of their need for the combination of quantity, quality and throughput," Barry explained. "Our process engineers were quick to reach a result through an understanding of the start point followed by a boxing-in of possible parameters. Within the matrix, we isolated the combination of quality and throughput, then settled on a center point for process robustness. This was accomplished in hours of testing. The final manufacturing solution involved manipulation of gas type and pressure to further reduce cycle time." A novel delivery system further reduced cycle time.

Drilling 318 stainless: Consider an HSS 0.50"-dia. (12.7 mm) twist drill to drill through holes in 0.25" (6.35 mm) thick 310 stainless steel. "When using conventional machining, machinery data handbooks tell us that we can use surface speed rates from 60 to 110 sfm," Barry explained. "This results in a varying range of rpm and feed rate when we apply a constant tool feed rate per rotation. At 60 sfm we will have longer tool life and less production; at 110 sfm we will make chips quickly but will be changing tools more often. The quality of the hole does not change significantly, so the deciding factor is probably tool life. Each user can quickly make this decision based on their production needs."

When laser processing the same hole, "we have several additional considerations because the process

Adelman said. “Use of a probe measurement device can add time to the production cycle. Mechanical straightening methods do not guarantee the twist and bow have been corrected and can cause unnecessary wear and tear to the chuck gears.”

To compensate, BLM has developed Active Scan, a real-time tool to counteract errors created by irregular shaped or bowed tubes, he said. The optical measuring system works in the background to calculate the compensation needed to adjust the part program for a section of the tube or the entire tube length, wherever critical features are identified.

“Active Scan analyzes the area at the location of the cutting nozzle to ensure accurate placement of the laser cut feature without sacrificing time, accuracy or quality,” he explained. “At the start of a production run, a user will typically attempt to run a part with the assumption that the tube is within tolerance. The first part is inspected and the operator measures an out-of-tolerance feature. The operator then enables Active Scan to apply corrective compensations.”

Active Scan will first measure the section to compare it to the theoretical CAD data, he continued. “An overlay of the section will be displayed on the control panel and will provide the operator with a detailed analysis of the detected section error, including bow and twist. Active Scan will measure at the point of cutting to compensate and maintain tolerances of the remaining parts. It will also collect all section inaccuracies, which can be shared and used as an inspection report.

“The unique advantage of Active Scan is that compensation, which traditionally took many seconds with other measurement devices, now happens within one second for a single scan. The user no longer has to sacrifice productivity to maintain the highest degree of accuracy. Parts are manufactured to specification, while reducing error, scrap and realizing cost and time savings.”

Thick Plate Cutting

To cut thick steel plate, laser operators must be aware of material quality requirements and special operating techniques, cautioned Frank Arteaga, head of product marketing, market region NAFTA for Bystronic Inc. (Elgin, IL). “Inevitably, as an operator, you will be asked to cut thick plate at some point. Being properly prepared will make your job much easier, as it will bring you better results and consistency.” Arteaga’s checklist for ensuring an optimal thick-plate cutting process includes:

Material quality: The most important aspect of consistent quality in thick plate cutting is the quality of the material. You cannot produce quality parts in material that is inconsistent in both its internal makeup and its surface condition.

A common question is “what is a good material to laser cut thick plate?” The answer is the same no matter the material type: whatever the material spec calls for, you must find a supplier that will deliver a consistent quality product. That means a material that is rust free, maintains a smooth and consistent mill scale surface and the internal contents are consistent for the specification. Also, make sure the material you are ordering is the same material being delivered. Ask the supplier of the material to provide material certification sheets for each order of material, Arteaga advised.

Assist gas quality: Using oxygen to assist in the vaporization and expulsion of the molten material from the cut kerf is critical to thick steel plate cutting. Oxygen is an oxidizer that vigorously reacts when the laser beam makes contact with the metal. The pressure, volume and purity of the oxygen has the greatest effect on the speed at which both the metal is vaporized and expelled from the cut kerf. The purer the oxygen, the cleaner and faster the reaction is completed; subsequently, better edge qualities and faster feed rates can be achieved.

If you are using a liquid oxygen source, you are more than likely utilizing a high-purity oxygen source. If you are using oxygen from a compressed cylinder (green), the purities can

be as low as 99.5. “The difference between using 99.5 and 99.99 purity can mean as much as a 20% difference in increased feed rates and better overall cut quality with the latter,” he said.

Heat considerations: If you have ever started cutting well on thick plate then witnessed the cut quality deteriorate, this could be a direct result of heat buildup in the plate. Depending on material thickness, the program should contain a pre-piercing cycle as well as a staggered cut sequence to avoid heat buildup in any location, said Arteaga. The thicker the plate, the more critical heat becomes in producing quality parts. “Check your parameter to ensure it is using just enough laser power to cut the material. For example, if your parameter is currently calling for 80% power, see if you can get away with using 70% power,” he said. This technique is vital when cutting heat-sensitive materials, such as high-carbon or high-manganese steels. Always cut the smaller features of a part first, as they are more heat sensitive, he added.

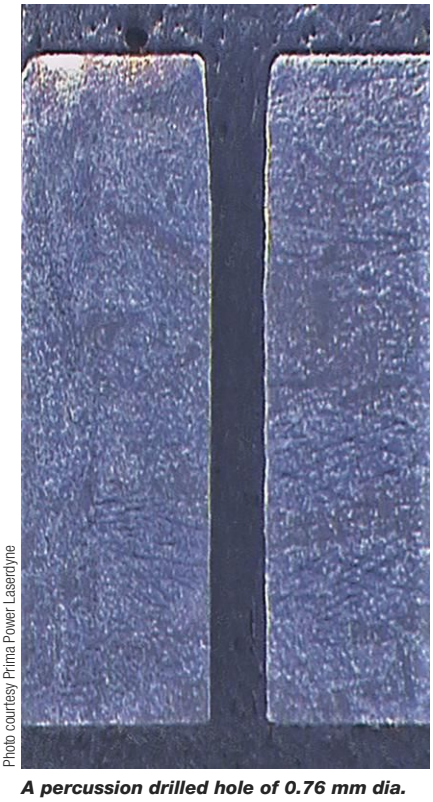

Photo courtesy Prima Power Laserdyne

A percussion drilled hole of 0.76 mm dia. in 5-mm thick stainless steel using 12 kW peak power, 30 shots and five bar oxygen.

Benefiting From a Swiss Mix

Combining the precision of Swiss machining and laser cutting, the Precision Tsugami B0125-III from Tsugami/Rem Sales LLC (Windsor, CT) was unveiled at IMTS 2018 in Chicago. The machine combines the machining of a 12-mm, five-axis Swiss-style CNC lathe with a fully integrated SPI laser cutting system. It is the ninth and most affordable Tsugami LaserSwiss machine, with a footprint of 20 sq. ft.

The machine features 10 tool positions and can be run with a guide bushing or an optional chucker kit. It is paired with lasers available from 200 watts to 500 W and a gas box that allows switching between two assist gases. The laser is programmed and driven with a FANUC 0i-TF control.

"This machine offers tremendous flexibility," said Dan Walker, Tsugami LaserSwiss business development director, in a July press release, "but it's not overly complicated. It's a straightforward machine that's easy to program and use."

New Generation of Quality

Improvements in laser cutting have come about not only because of increased power, but through innovative ways of controlling that power. For example, about four years ago, Amada took turnkey fiber laser cutting systems to the next level with the introduction of its ENSIS 3015AJ machine.

With fiber systems already being cheaper and easier to run than CO_2 machines, the ENSIS added a major wrinkle: a library of 1,000 cutting specifications that lets the machine instantly adjust itself based on the material to be processed. Users can cut thick or thin metals by automatically changing its beam configuration based on the material and thickness being cut.

Now, higher-wattage systems paired with increasingly refined lenses and cutting heads continue to advance the laser cutting process, said Dustin Diehl, laser division product manager for Amada America (Buena Park, CA).

"Higher-wattage lasers have definitely improved edge quality in the thicker range of materials like mild steel, aluminum and stainless steel," Diehl explained. "Some of those improvements have come from the power itself, and some have come from advancements in lens and nozzle technology. We are seeing the higher-wattage lasers increase throughput by three and sometimes four times the amount of work that a typical 4 kW CO_2 machine was capable of."

To fully harness the advantage of higher laser powers, he continued, "a proven and reliable head design" is vital to keep it from overheating. "Also, having a good clean beam being delivered to the cutting lens is important. This goes back to the fiber engine itself and how the beam is being generated. The number of optics and modules being used affects the quality of the beam. The more optics and modules being used, the lesser quality beam is being delivered."

Laser cutting thick steel plate requires careful consideration of material and assist-gas quality and mitigation of heat buildup.

Photo courtesy Bystronic

Along with the increased productivity from more kilowatts is a twofold cost savings: Fiber systems run on about one-third the energy a CO_2 machine requires, he added. "And, with the cost of consumables going way down due to the lack of optics in the beam-generation system, our customers are seeing great savings in the hourly cost of operation."

Guided by the understanding that fewer power modules also produce a cleaner beam, Amada has ramped up its ENSIS portfolio to include 6 kW and 9 kW versions. Also, Amada combines these machines with "our fast, flexible automation system, the AMS3015CL," Diehl noted. "This style of automation lets the machine run at full capacity and not be held up by the speed of the automation. Also with the flexibility to expand, this system can grow with a business. The automation also allows users to operate during off hours and weekend hours to increase capacity."

FYI

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