Metal Fabricator Improves Laser Processing with New Gas-Delivery System

by David Bell

With manufacturing locations in four states—Ohio, Pennsylvania, Arkansas and South Carolina—Defiance Metal Products Company (DMP) is a QS 9000 company specializing in the forming and assembly of parts and assemblies such as brackets, enclosures, cases, housings, racks and chassis. DMP employs stamping, CNC laser cutting, and manual and robotic welding at each of its production facilities, which are bolstered by support staff working in design, engineering and tooling.

DMP has earned a reputation for efficiency by using technology and state-of-the-art equipment. The company's quality department uses computerized visual-inspection equipment that can verify blank dimensions within five minutes, thereby allowing a $500,000 laser machine to quickly begin a new run. Computer-controlled coordinate-measuring machines, once programmed, can inspect subsequent parts with little human intervention.

Laser Blanking

DMP uses Trumpf 1500 through 4000 Turbo Lasers to blank parts from steel sheet and plate as thick as 3/4 in. The sheetmetal is easily loaded from the front of the laser-cutting machines, and, with the CNC controls located on the right side of the machines, operators can view all processes with a glance. Using Metalsoft Fabriwin CAD/CAM software that coordinates the machine and programming systems, metal processing can be automatic at the press of a button.

Its laser-cutting machines enable DMP to save customers, particularly those that require relatively short production runs, time and money. For example, because many truck parts have annual volumes of less than 5000 pieces, a $15,000 or $20,000 blank die can be hard to cost-justify. Laser blanking obviously fits the bill. Further, if a part needs to be changed, changing a blank die can take weeks in the tool shop. In addition, computer-driven production machines also enable DMP to produce prototypes very quickly.

Quality laser-cutting offers DMP customers these advantages:

- A very narrow kerf;
- A true square-edge cut;
- A clean and true cut free of dross or burrs or surfaces requiring additional cleaning before welding;
- Laser-cutting is a non-contact process and causes no tool wear;
- The process is easily automated and tool changes are handled by reprogramming.

Compressed Gas at the Center of it All

The laser-cutting process depends on several system components performing together to accomplish the desired results. These components include the laser-beam generator, shutter control, beam-guidance system, focusing optics and process-gas control. All of these components require the proper use of compressed gases, and specific pressures, purity levels and flow rates, in order to function correctly.

To generate the laser beam, the laser resonator combines helium, nitrogen and carbon dioxide, supplied in individual cylinders. Maintaining the purity of the laser gases is critical to alleviate any work stoppage resulting from contamination of the gas streams.

The actual cutting process will require gas, referred to as assist gas, supplied in the correct pressure and flows. The type of assist gas will depend on the type of material to be cut—typically oxygen for ferrous materials and nitrogen for nonferrous materials.

Bob Yant, manufacturing-process-improvement manager for DMP, conducted a study to determine the full utilization of the firm's lasers. After his initial study, Yant concluded that the methods of handling the gases for the lasers were not cost- effective. Too much laser-processing time was being lost, the result of either handling of gas cylinders or not having ample gas supply available for a job. A switch to bulk supply of gases was in order.

Bulk Storage of Cryogenic Gasses

Cutting gases can be required in high flows and pressures. Oxygen flows and pressures are not overly demanding, but when using the lasers for clean cutting of stainless steel, the flow and pressure requirements can be high. The use of high-pressure cylinders, Yant felt, was not a cost-effective method of supply. He decided to switch to gas supplied in cryogenic form.

Cryogenic gases store on-site in tanks commonly referred to as bulk tanks. These tanks, refilled on a regular time schedule, guarantee a supply of gases when required. The tanks store gas in liquid form; as the gas changes to the gaseous state, it flows to the lasers at the correct rates and pressures thanks to a series of ambient air vaporizers and pressure-control regulators.

Storage pressure in each bulk tank is typically limited to 200 psi, but since many applications require higher-pressure nitrogen for clean-cut stainless, DMP installed a pressure-boosting system, supplied by Chart Storage Systems. This system, called the Trifecta, can produce pressure up to 400 psi and flow rates of 2000 cubic ft./hr.

Resonator Gases Must be Pure

Each of the seven lasers requires a supply of helium, nitrogen and carbon dioxide to the resonator to produce the laser beam. Gas-delivery systems must provide constant delivery pressure and eliminate the introduction of foreign particles and impurities. If impurities exist in a cylinder, they are typically present when the cylinder is nearly empty. Therefore, when the fabricator exchanges the nearly empty cylinder for a full cylinder, air may be introduced into the resonator gas stream. The air may contain water vapor, oxygen, and possibly hydrocarbons.

A purge can be used to expel these impurities from the gas stream, or a pressurized gas system can be used to prevent the introduction of the impurities. A zero-permeation system for laser gases is recommended.

To avoid downtime when the resonator gas cylinders are empty, fabricators can install an automatic gas-switchover system that allows for a continuous uninterrupted supply of gas, and eliminate the possibility of contamination. They can opt for a simple pressure differential system, or a more elaborate automatic system with remote visual and audio notification of cylinder supply depletion.

Mr. Yant decided to contact the laser manufacturer (Trumpf) for assistance in the selection of the preferred method for the delivery of the three laser gases. The Trumpf suggestion was to contact Concoa, based in Virginia Beach. Mr. Yant collected his data on the use of the laser gases and the number of cylinders required supplying the gases.

The suggestion from Concoa was to maintain a centralized supply of gas cylinders. For distribution of the gases to each laser, additional pressure control was to be placed at each laser for final control of the gases. The system selected was the Concoa 621 Automatic Switchover system for each of the three laser gases, with a model 624 Laser Gas Panel to be installed at each laser.

A Reliable Supply, with Quick Payback

The automatic switchover system supplies the gases in a contaminant-free environment at constant pressure to the gas panels. Audible and visual alarms notify plant personnel of depletion from any of the laser gas sources. Proper reserve of the gases is maintained in the system, which allows for the gas supplier to replenish the gases on a regular time schedule. The gas panels allow for gas control at each laser and eliminate the need for cylinders to be maintained in the work area, providing a safe and cost-effective method of gas supply.

A cost analysis of the new laser gas delivery system by Mr. Yant showed payback on the installation to be less than one year, with the estimated savings for the first year to be in excess of $34,000.

With the proper gas delivery system now installed and the selection of the lasers to handle the workload, Defiance Metal Products is set to be a leader in laser material processing for many years to come. **MF**

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