New CO₂ 2D Laser Processing System
ML3015LVP-45CF-R

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1. Introduction
In the sheet metal cutting industry, recent requirements for laser processing systems include: productivity improvement, applicability to high-mix low-volume production, low power consumption to reduce running cost, and enhanced reliability to ensure stable longtime operation. In response to these market needs, Mitsubishi Electric has released the new CO₂ 2D laser processing system, ML3015LVP-45CF-R, which is presented in this paper.

2. Improved Processing Performance
By increasing the power output of the laser oscillator, improved laser processing is expected, such as higher cutting speeds for thin- to medium-thickness plates and a wider range of thicknesses for high-thickness plates. We have thus released the 45CF-R by improving the efficiency of the conventional 4-kW type laser oscillator to successfully achieve an output power of 4.5 kW. Higher performance has been realized by the combination of: a beam stabilizer that generates uniform beam intensity over the entire processing area; a beam optimizer that controls the beam characteristics and focus position to the best conditions for each material to be processed; and a capacitance sensor that achieves, during high-speed processing, high-precision control of the distance to the material surface. Compared with the previous model, up to 20% higher processing speed is achieved for a wide range of materials including medium-thickness mild steel plate (SS400), stainless steel (SUS304), and aluminum alloy (A5052) (Fig. 1).

When processing medium to thick mild steel plates, the piercing process accounts for a large percentage of the total processing time. Thus, for mild steel plates 9 mm thick or more, we have adopted a new piercing method (beat pierce), which controls the optimum peak output in a stepwise fashion by taking advantage of the Mitsubishi oscillator’s unique output response characteristics. When processing a 12 mm-thick mild steel plate, the piercing time is reduced by up to 50% while maintaining a pierced hole diameter of 1 mm or less. The reduction in piercing time together with the improvement in processing speed due to the increase in output power has reduced the processing time by about 30% compared to the previous model (Fig. 2).

In addition, the improved processing speed also improves the quality of the cut edge by reducing the contribution from the iron combustion reaction to the melting of the base metal. Compared with a 12 mm-thick mild steel plate processed by the previous model, the roughness of the cut edge is reduced by about 45% (Fig. 3).

3. Running Cost Reduction
In order to further improve the oscillation efficiency of the CO₂ laser oscillator 40CF-R, which offers the high output required for high-speed processing and high beam quality for high-quality processing, we have

Fig. 1 Comparison of feed rate (Material: SS400 and SUS304)
experimentally determined the optimum light-focusing characteristics for medium-thickness plates and applied quality engineering techniques to design a resonator that achieves the required focusing characteristics in a stable and efficient manner (Fig. 4).

The capacity of the high-frequency power supply unit, which generates a discharge current in the excitation space where the laser beam is generated, has been enhanced by modifying the cooling fin structure to improve the cooling efficiency and by applying the optimum frequency control method to reduce the heat generation from power devices. In addition, we have adopted the just-in-time discharge system that enables prompt laser beam generation at the time of operation while minimizing power consumption during standby mode, thus reducing total power consumption by 11%.

Meanwhile, the reduction in processing time has also reduced the use of assist gas. In combination with the reduction in power consumption, the running cost has been reduced by 20% (Fig. 5).

4. Improved Reliability

We have improved the quality of key components of the laser oscillator by using our achievements and engineering know-how acquired through 30 years of in-house development, manufacturing and maintenance of laser oscillators, thus dramatically improving reliability. Consequently, for the first time in the industry, we now offer a three-year warranty for the laser oscillator.

5. Conclusion

This paper has described the main features and processing performance of the LVP-45CF-R. As a comprehensive manufacturer of laser processing systems, we will continue to improve the performance and proactively respond to the shop-floor needs of the automobile, electronics and other manufacturing industries.
Fig. 4 Improvement of laser oscillation efficiency

Fig. 5 Comparison of cost (Material: SUS304, thickness: 16 mm)