

“Jenoptik Automatisierungstechnik” uses EtherCAT technology



The mobile laser system from Jenoptik Automatisierungstechnik GmbH for manual welding and brazing can produce weld seams with comparable quality to that achieved with machine or robot-controlled laser welding.



Jan Grieger, who works in the Technology Center at Jenoptik Automatisierungstechnik, presents the mobile laser system.

Manual laser welding is increasingly used to complement fully automatic material processing. For this type of application, Jenoptik Automatisierungstechnik GmbH developed the mobile, manual VOTAN@H laser welding system for manual welding of thin sheets. The real-time EtherCAT Ethernet system ensures safe and fast communication.

Real-time control for hand-operated laser system

Jenoptik Automatisierungstechnik GmbH is a subsidiary of the Jenoptik group, with head office in the German technology region of Jena. The company develops and produces industry-specific, complex system solutions for laser material processing and handling as well as assembly systems for the North American, European and Asian markets. The core competency of the company is the development and manufacturing of highly flexible systems for laser material processing of workpieces.

In autumn 2003, Jenoptik Automatisierungstechnik introduced a mobile system for laser welding and laser brazing. The quality of the manually welded or brazed galvanized sheet metal matches the quality that can be achieved with machine or robot-controlled laser welding.

Flexible and mobile application

Classic laser welding is not suitable for certain applications. This is not due to the laser parameters, but due to the lack of mobility of such systems. In stationary machining stations, robots with specified ranges and sophisticated programming limit the applicability of classic laser processing systems. For these types of applications, the one-hand-operated laser processing system has advantages. Its mobility and the versatility of its safety devices (resulting from the design and the manual control) make it stand out from all other conventional laser processing systems. This manual laser welding apparatus can also be used cost-effectively in SMEs, the building trade, and other trades. The mobile laser welding system is

based on high-power diode laser irradiation. It features a hand-operated processing head and a light-weight laser power supply unit.

Examples for areas of application include the welding of large sheets of metal that cannot be processed on smaller machining stations, or welding of steel, stainless steel, galvanized sheet, or aluminum alloy components with a thickness of up to 1.5 mm. The hand-operated laser welding system can also be used for the production of individual parts or small-lot production, and for on-site installation of sheet metal components.

Automation for process integration

Automated welding applications are characterized by the fact that optimized processes and their defining sub-processes, e.g. joining, motion control or workpiece handling, have to be brought together and coordinated. The welding control system and the manual processing head feature various electrical and mechanical interfaces that ensure safe operation, depending on the application. A micro-controller controls the process and the laser power. It interfaces to a PLC, deals with status and parameter displays as well as coupling of the distance sensor (wheel), releases the laser according to the laser safety specifications, and controls the power supply unit and the wire feed via analog outputs (0 to 10 V). The PLC controls the diode driver and the cooler. Via associated interfaces the operating modes, the parameters, laser safety and laser enable signals can be coordinated.

Control with modular system configuration

The control for the laser welding system consists of a Beckhoff C6320 control cabinet PC that couples the peripherals via the Ethernet fieldbus EtherCAT. It is operated via a CP7801-0011 Control Panel. A Visual Basic interface is used for operation and recipe administration. Recipes in this context refer to the settings of the welding machine for butt welds, fillet welds, overlap welding, sheet metal thickness and material, e.g. through specifications such as "stainless steel, 0.5 mm thick, butt weld."



A CCD camera in the processing head enables monitoring of the welding process via a swiveling 2.5 inch display. LEDs located near the nozzles illuminate the welding zone.



The processing head of the mobile laser welding system

The ability to control the laser power in relation to the speed is crucial for the quality of the weld seam. The fast EtherCAT system was chosen for I/O communication because it meets the stringent performance requirements. Since the welding is carried out by humans, the motion is not constant and – unlike with robot welding – cannot be programmed. The welding head is manually guided across the seam on small wheels. The modular auxiliary wire feed that is coupled to the processing head is operated with a speed that is adjusted to the processing speed and realized via a stepper motor control. The motion speed has to be monitored and the laser power controlled accordingly. This is done – via EtherCAT – with an incremental encoder, which is monitored by the EL5101 incremental encoder terminal. EtherCAT enables scanning rates of less than 1 millisecond, so speed can be calculated at very short intervals. The laser power is supplied via EtherCAT, an analog EL4102 output terminal for 0...10 V, and high-performance, highly dynamic power supply units (0 to 60 A in 130 μs) from Jenoptik Automatisierungstechnik GmbH.

The feed rate of the wire (required for clearances of more than 0.1 mm) is also controlled via this speed monitoring system and the Beckhoff stepper motor Bus Terminal.

The hand-held processing head for laser welding or laser brazing is fiber-coupled. High-performance diode lasers or Nd:YAG lasers can be used. The glass fiber transfers the laser power to the hand-operated processing head. A CCD camera in the processing head enables monitoring of the welding process via a swivelling 2.5 inch display. LEDs located near the nozzles illuminate the welding zone and allow the welder to see both the weld pool and the contour to be welded or brazed. A coaxial inert gas supply protects the weld pool from atmospheric oxygen.