Flexible laser system technology for welding applications

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ERLAS Erlanger Lasertechnik GmbH, a German medium-sized company with 20 years of experience in the field of laser beam welding technology has successfully completed more than 200 projects in the automotive sector to this day. Significant trends are recognizable regarding the specifications of parts to be welded and therefore system technology that has to be realized. First projects were just simple robot welding cells, where standard articulated robots carry the laser welding head as guiding machines towards the clamped workpiece. Parts to be welded are manually feeded. There are two working stations on a rotary indexing table. While the laser is welding on the first station inside the cabin, the worker removes the finished assembly from the clamping device at the second station outside the cabin and feeds new single parts for the next welding process. Due to the rising number of weld seams as well as their orbital positions around the assembly, the motion axes of common industrial robots are no longer sufficient to reach all welding areas in one single clamping. The next step was the development of machine concepts where one or more axes act for the positioning of the workpiece in relation to the working head. This hybrid kinematics enable for example the manufacturing of shift forks, welded of six single parts with twelve weld seams in one single clamping. The significant improvement of beam quality of fiber-guided laser beam sources led to the next step of development, the introduction of laser scanners for welding applications. The main advantage of using laser scanners is its fast positioning movement with speeds of 60 meters per minute and even faster. A pursued approach of many system suppliers was (and is even to this day) the positioning of the laser scanner with standard articulated robots. Due to relatively poor guiding accuracy (in terms of positioning accuracy as well as path accuracy) of the industrial robots and the huge image distance of the laser (being the tool) the limitations of application are reached quickly. The preferred types of weld seams for laser-compatible part design are butt weld and fillet weld. In a robot - laser scanner - combination, these types of weld seams are either not realizable at all or additional seam tracking devices are needed. **ER**LAS therefore developed kinematics, which are particularly suitable for the integration of laser scanners into the laser welding process. The Erlanger specialists invented a modular system, called **ER**LASER® UNIVERSAL which represents the following three extension levels of these kinematics: 1) resting workpiece below stationary mounted 3D laser scanner, 2) moving workpiece (moved by turning, tilting or swiveling axes or a combination of these) below stationary mounted 3D laser scanner or 3) moving workpiece below cartesian-moved 3D laser scanner. Key component of the latest generation of laser beam welding systems is a 3D laser scanner developed by **ER**LAS. The use of servo drives instead of galvo drives enables a direct control of the scanner axes simultaneously interpolated with the other machine axes. The programming of welding-on-the-fly applications is significantly simplified; also, the creation of wobbling-shapes along 3D seam contours is possible. The invention of the modular machine concept **ER**LASER® UNIVERSAL generates a win-win-situation between customer and manufacturer. The advantages for both parties are: development from «engineering to order» towards «configure to order», reduced delivery times, reduced costs, reduced risks, flexible extendable. **ER**LAS delivers turnkey ready machines including process as well as assured production quality and productivity.

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Beam extraction using non vacuum electron beam by reduced acceleration voltage

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One of the disadvantages of the non-vacuum electron beam (NVEB) systems is a high acceleration voltage, which leads to an increase of defense against X-ray radiation. Due to the reduced acceleration voltage, on the one hand, the size of the beam generator is reduced, which is why a significant weight reduction compared to the conventional EB technology, so that a robotic operation is possible. On the other hand, the requirements for the X-ray protection are reduced because the penetration ability of the X-radiation decreases. For applications such as brazing, cladding and surface heat-treatment, by the low acceleration voltage non-vacuum electron beam (LAVNVEB) system is of great interest.

Some of the first experiments on electron beam emission into the atmosphere with a low acceleration voltage (from 60kV and below) were carried out at an available LAVNVEB system at the Institute of Materials Science at the Leibniz University Hannover.

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