

# Laser welding techniques

With the utmost precision and huge productivity gains, laser welding in transmission manufacturing is growing in importance

■ **From dual-clutch** transmissions to the classic differential, modern transmission technology has long been a pivotal research sector in the automotive industry. With the advent of new materials and altered geometries, designers are today optimizing the functionality of gearwheels. Furthermore, these wheels are now required in growing quantities owing to the fact that the number of speed-gears in many passenger cars is beginning to increase.

The innovations furthering the effectiveness of new production processes being applied within transmissions development include laser welding. A key player in this area is EMAG, with its ELC series of machines that offer integrated and developed solutions for the application of production processes with high output rates. The company's in-depth knowledge of production processes used for many transmission components has added to its overall competency.

The challenges are obvious when it comes to the development and production of typical transmission components, especially as even a small wheel with integrated synchronous gears represents a relatively complex design for engineers. To manufacture this subsystem efficiently and with the greatest precision calls for the two parts to be produced separately and subsequently brought

together in a joining-plus-welding process.

"It is at this point in the manufacture of modern transmissions that laser welding really comes into its own," explains Dr Andreas Mootz, managing director of EMAG Automation.

He continues, "The process enables engineers to concentrate on the welding point a carefully dosed amount of the energy emitted by the laser, therefore minimizing possible warping while maintaining high welding speeds." In addition to this key advantage, the EMAG welding process uses solid-state lasers that boast outstanding energy efficiency. Whereas a classic carbon dioxide laser will achieve an efficiency factor of just 8%, the EMAG specialists can rely on an efficiency factor of approximately 20% when using their technology. As a result, the power used to achieve the same optical performance is noticeably less within the entire process, with energy costs in the production department massively reduced.

## Stationary welding

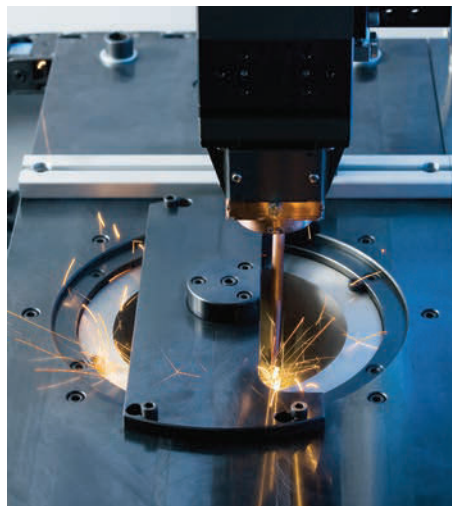
Similarly effective within the transmission production process is the integration of different production sequences in the ELC system. For starters, the work spindle uses the pick-up principle to load itself within the system. The components involved are

then clamped and pressed together in the joining press. The clamping technology used ensures the highly accurate positioning of the components, providing ideal conditions for the welding process. The design of the stationary optic ensures greater operating safety and optimal stability of both machine and welding process. Dependent on workpiece or material, the components can be induction-preheated prior to the welding process and brushed afterward, with this intricate processing possible to complete in a single step. In total, the whole joining-plus-welding process for a gearwheel takes just 12 seconds, ensuring that the components for a differential are finish-welded within no more than 40 seconds.

Laser welding leads to advances in lightweight construction, and a good example of this is the differential housing, which has benefitted from this advanced new technology. For the past few years, automotive companies have been replacing the screw-type connection between the differential housing and crown gear with a welding seam. The result has been dramatic reductions in material costs, with considerable weight reductions. "These kind of savings in lightweight construction mean the world for all automotive companies," adds Mootz.



Laser welding the differential housing and the crown gear has meant a weight reduction of 1.2kg for this assembly



Laser welding a synchronous wheel onto a gear. The new fiber laser on the ELC 160 halves total operating costs



Gearwheels made with the high-tech laser-welding process result in a more compact and efficient gearbox



The ELC 250 DUO is a highly efficient laser welding system for transmission components and other rotation-symmetric workpieces. This includes transmission components in hardened steels and more complex components, such as differential casings in SG iron, which are paired with finish machined gears

### Rich history

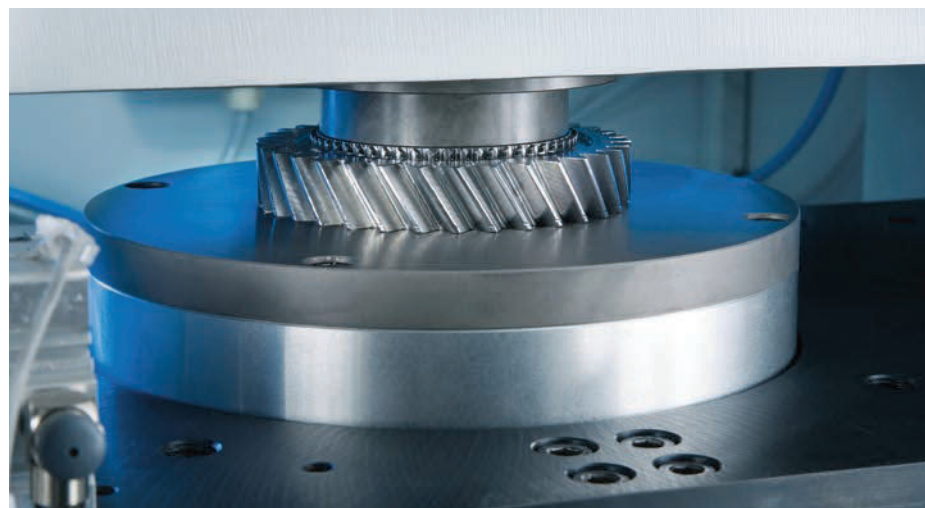
The welding specialists at EMAG, which is headquartered in Heubach, Germany, are able to tap into the company's rich history, which goes back to the middle of the 19<sup>th</sup> century. More recently, over 50 ELC systems have been sold in the past decade, with all leading

automotive OEMs using the technology. As such, EMAG is a recognized world leader in solid-state laser systems for the production of transmission and powertrain components. Mootz explains how this success came about: "It is of the utmost importance that as a company we have at our disposal a large

reservoir of know-how in the manufacture of these components. We know the whole of the manufacturing process, from turning, grinding and welding right through to the concluding ultrasound testing process. With our experience and know-how we can develop and construct the entire production process for our customers. This massively simplifies the planning of new production sites and the expansion of existing ones."

Furthermore, says Mootz, the general trend of the market plays into the hands of the German machine builder: "It is not only the dual-clutch transmission that ensures the need for more gears, but conventional transmission systems also tend to have more speed gears, as it reduces fuel consumption and improves driving comfort."

"Having said that, though, as a company we are also offering a well-proven welding technology that provides an energy-saving, high-precision manufacturing process and helps advance lightweight construction and reduce production costs. This is no doubt a very successful and highly persuasive combination for both the present and going into the future." **TTI**



Joining a gear and a synchronous ring on the ELC 160, a modular laser-welding machine allows for the use of any common laser technologies, including the likes of CO<sub>2</sub> lasers and fiber-coupled solid-state laser systems (fiber and disk)