

Laser welding of heavy-duty instruments

Clear vision in tough conditions

The laser welding of plastics is increasingly finding its way into series production. Users are especially adopting the still relatively new technology, if there are specific requirements concerning the quality of the weld seam. Siemens VDO in the Swiss town of Rüthi has opted for laser welding with diode lasers as a means of fastening viewing glass for heavy-duty instruments which are primarily used in outdoor applications.

Laser welding has assumed its place alongside conventional joining processes, such as ultrasonic, vibration and heated-tool welding. Users benefit from numerous advantages like non-contact and gentle energy application. There are different options for applying the laser radiation to the component. Various concepts have consequently been developed. Besides contour welding and simultaneous or quasi-simultaneous welding, mask and globe welding as well as other methods have become established. This wide

variety of options, also in regard to concepts, allows application-specific requirements to be fulfilled in the optimum way.

Problem: Expensive and complex joining

Sealing against penetration of water is tremendously important when manufacturing instruments that are used in outdoor applications. The instruments must correspond to the strict IP 69 standard and exhibit resistance against diverse media, depending on the intended use. Thus, for example, resistance to salt mist is, above all, required in addition to resistance to fuels in the area of boat construction. Frequently, it has only been possible to fulfil such requirements by using extra rubber seals. At Siemens VDO, situated in the Swiss town of Rüthi, the housing parts were joined using snap-on connections so as to apply the required force to the seal. Furthermore, for other instruments the cover glass was fastened by flanging metal rings onto the housing after mounting the rubber seal. Adhesive bonding represents another option for fastening and sealing. This process is regarded as critical by production experts owing to the adhesive handling, amongst other factors. All three options share the fact that they are relatively expensive. They require additional design elements such as snap-on hooks, extra components – for example rubber seals and flanged rings – or accessory materials such as adhesive. This calls for further production stages, thus making the joining more expensive.

Tight and firm joining with laser welding

Laser welding provides an effective solution to joining and sealing problems for outdoor instruments. It satisfies the quality requirements and is a real substitute for unpopular and expensive processes. There is no longer any need for additional fastening components and elements. The strict requirements in regard to tightness and strength are fulfilled by the laser-welded seams. Joining thermoplastics using the laser transmission technology requires both an absorbent join partner as well as a join partner which is transparent for laser radiation. In the

Instruments in tough everyday application on a leisure boat. The PMMA cover glass is welded to the PC housing using laser welding for the round instruments.



instruments, the cover glass is made from transparent PMMA and the housing from black coloured PC. The pre-requisites in respect to optical radiation properties are therefore fulfilled by the material. The components are brought into contact using a clamping fixture. The radiation energy required for fusing the plastic penetrates the joining plane through the cover glass. The radiation is absorbed in the housing where it is converted to heat, generating melt. Due to heat conduction, also the joining area of the cover glass is being melted. In termination of the joining process, the melt solidifies, resulting in a firm and tight connection.

Three systems from Leister

As Siemens VDO has gained extensive experience concerning the laser welding of plastics since 1999, it was decided to utilize this method for further products as well. The third system of Leister Process Technologies was hence able to be installed in 2007. The three systems have been designed for different applications, each with a different throughput. Instruments for use in a quad are produced on a standard workstation: Here the parts are manually introduced into the laser system and the laser process is being started. Another laser system, on which the instruments for a construction machine are welded to become watertight, is featured with a rotary indexing table. In this way, the throughput can be increased: while the



workpieces are fed and removed in the one position of the table, the welding process can be performed in the other position.



The NOVOLAS laser systems can be optionally equipped with rotating tables or can be integrated into existing transfer systems. Many further adaptations can be implemented specific to the application.

Fully-automatic processes

The third system from the Novolas WS series is integrated in a transfer system. The viewing glass is welded onto the instrument housing for the product line «Viewline». The process runs fully automatic. The modular instruments are available in three sizes with diameters of 52, 85 and 110 mm. They are used for a wide variety of functions, above all in leisure boats. All three sizes are produced on the same laser system. The machine detects the incoming, coded workpiece carriers, automatically selects the appropriate program for the relevant version and loads the corresponding contour data and laser parameters. There is no need to retool the machine between the three sizes, as the clamping device is also designed so that all sizes can be held. This does away with retooling costs and enables all variants of the instrument platform to be produced flexibly in line with demand.

Cost efficiency

In comparison to other joining methods, the laser welding of plastics is not only innovative but also an efficient alternative for heavy-duty weld seams. The investment costs are to some extent higher than for the other methods mentioned above. However, the investment rapidly pays off thanks to lower maintenance costs and savings from not having to use additional components as well as greater flexibility of the laser systems. Not least, the good quality of the weld seam in regard to tightness and the reproducibility of the welding process ensures an economic advantage.

The instrument platform «Viewline» for motor and sailing yachts has a modular construction. The three different sizes are all welded on the same laser system.



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