LEISTER

LASER PLASTIC WELDING

Success Story

1 / 2013

Laser transmission welding with Leister

Medical

Device component for blood analysis

Leister has many years of experience when it comes to laser transmission welding of medical components. As a result, we have been able to gain one of the largest manufacturers of medical products as a valued customer in China. The component to be welded is designed as an end product in a medical analysis device. This can separate constituents of human blood (plasma, erythrocytes and hematoblasts) for analysis in a matter of minutes. The component comprises a transparent, 20 mm thick housing and an equally transparent, 4 mm thick cover. The sensitive sensor integrated in the product must not be damaged during welding. Both the housing as well as cover are made from transparent PETG. 20,000 to 50,000 parts a year are produced (fig. 1).

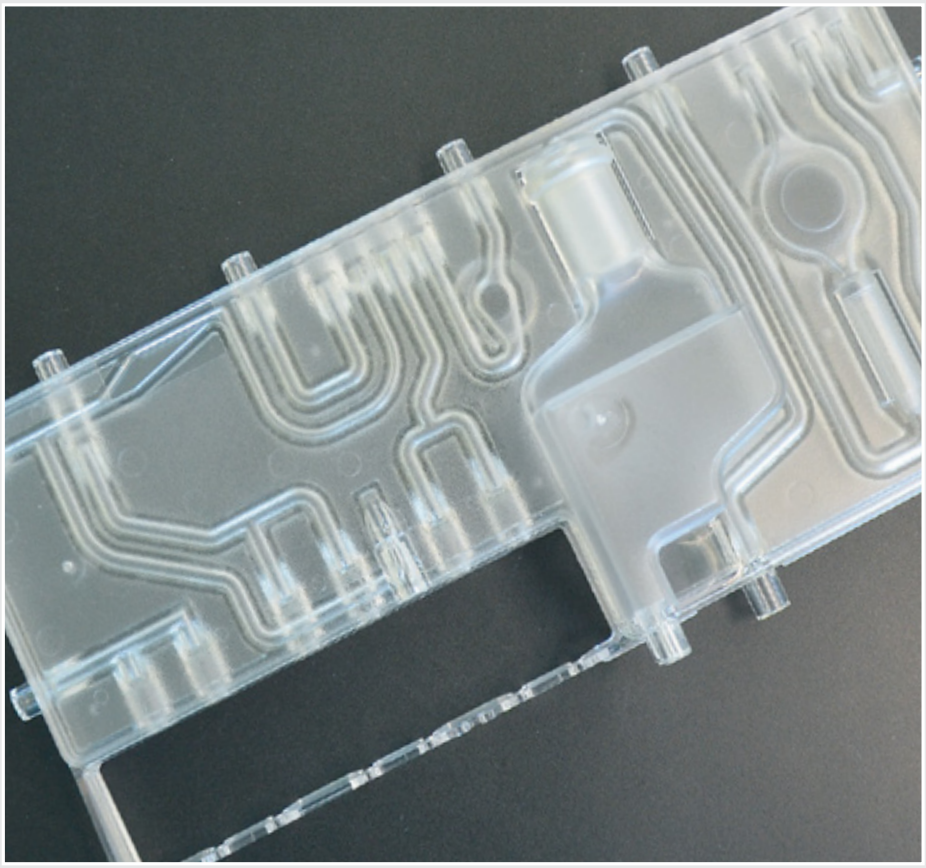

fig. 1: 2-part device component for blood analysis.

High requirements for the welding process

Complex fluid channels and reservoirs, through which the blood is routed, are located in both the housing and the cover. The requirements for processing quality are extremely high for this product: The blood must not escape from the channel during application. That means the weld seams have to be completely tight! The weld seam width measures only 1.5 mm, and the total weld seam length is 3800 mm for a component merely 225 x 110 mm in size (!). Above all, it is important that only small welding beads result from melting, as blood could accumulate here. And not least, the part has to meet visual requirements while remaining transparent after welding.

Laser welding as suitable technology

The customer had tested different plastic welding technologies before contacting Leister China. Ultrasonic welding was ruled out on account of the large-scale and complex weld seam geometry. The vibrations triggered by the ultrasound could also damage the sensitive sensor. A good and tight weld seam was realized with heating element welding, but this resulted in an excessive melting rate. The resultant welding beads and particles were not acceptable for the customer. Firstly, this would have increased the risk of blood accumulation, while the visual impression was imperfect. Only the laser transmission method can fulfill all requirements regarding leak tightness and visual appearance. Neither particles nor emissions are released with this clean technology. It is also ideally suitable for disposable medical products that come into contact with blood. As welding can be performed from both sides of the product, the

complex welding geometries could also be joined tightly – and without any contact (fig. 2). To be able to find the suitable laser welding processes, various methods were tested in Leister's application laboratory. Besides mask and quasi-simultaneous processes, the contour method (fig. 3) was also examined and finally selected. In contrast to welding with a line laser or scanner optics, the contour method requires lower investment and is also flexible for other applications.

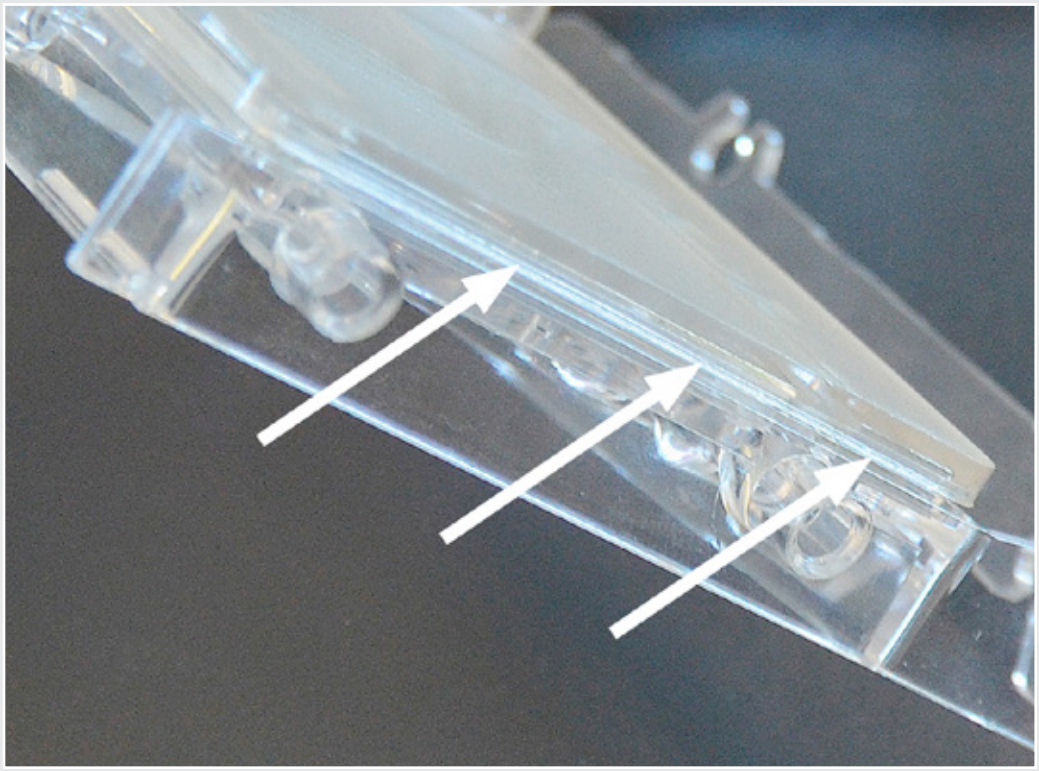

fig. 2: Joining planes welded neatly and tightly.

Absorption performance – a tough challenge

In order to absorb the laser beam, the upper part must normally be transparent and the lower part absorbent for the joining. However, both mating partners – housing and covering part – are transparent here. "Clear Weld® LD140F" is therefore applied onto both parts as a laser beam absorber before the actual welding process. This absorber is stored in a carrier liquid and must be applied onto the surface of the components. In this application, an ultrasound nozzle is routed along the welding geometry, this volatilizing the carrier liquid and thereby only leaving the absorber behind on the surface. As the two mating partners are injection molded, they are usually slightly warped. However, level connecting planes must be attained during joining. A leak-tight joint can consequently be welded, this resulting in only a small amount of melt on which the blood constituents could accumulate. Components are joined under great pressure to prevent this.

Special clamping device provides a solution

It is not possible to weld the component from just one side, as some of the installed nozzles and the sensor would block the laser beam. Welding is therefore performed from both sides. To this end, a pressing device was customized to allow two-sided welding. The housing part is first placed in the clamping device. After positioning the covering part on the housing part and closing the clamping device, the contour welding can commence. The clamping device is then opened, the welding part turned and the next one placed in the clamping device. The clamping device is closed again and contour welding performed once more. To ensure that all channels are sealed, a leak test is conducted after the welding process. Despite manual insertion and turning, the cycle time lasts only three minutes in total. A diode laser NOVOLAS Workstation WS-AT (fig.4), coupled to the Spot Optic AT (fig. 5), serves as a laser source for contour welding, both provided by Leister.

Extensive options thanks to in-house laboratory

Leister is the only supplier in China able to offer the customer tests involving all laser welding concepts. The company also provides advice and assistance regarding the development of fixtures, and can even have these manufactured locally. Its longstanding experience also enables Leister to help customers in selecting material and searching for suitable colors and pigments. Thanks to extensive laboratory equipment, Leister is able to perform weld tests with different processes for the customer.

Contour welding

A focused laser beam travels over the weld sequentially and melts it off locally. At the same time, the welding volume remains small on account of the geometric relations and melted material is prevented from escaping. The relative movement is realized by moving the component, the laser or a combination of both.

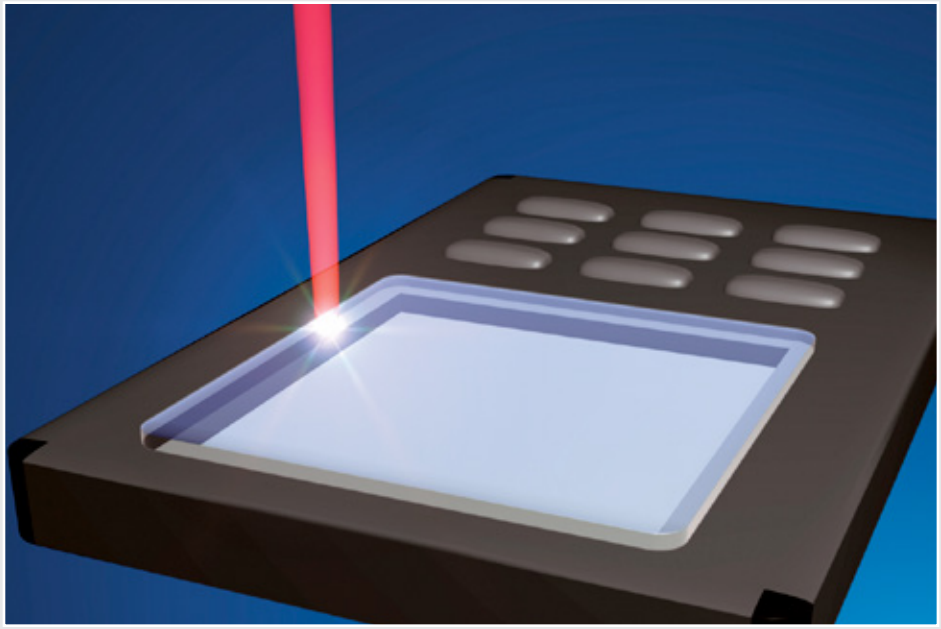

fig. 3: Contour welding principle.

Text: Sheng Cai / Christophe von Arx, Leister Technologies AG, www.leister.com
Photos: Leister

Leister devices in use

NOVOLAS Workstation WS-AT

fig. 4

- Turnkey laser system for all laser-welding concepts
- Comprehensive and intuitive human machine interface
- Use of multiple laser and optic modules per system increases throughput and efficiency
- Online process control integrated in system control
- Modular design for customization
- Easy to integrate into existing transfer systems

Spot Optic AT

- A range of focal lengths
- Fiber connection control
- Pyrometer (optional)
- Internal laser power measurement

fig. 5

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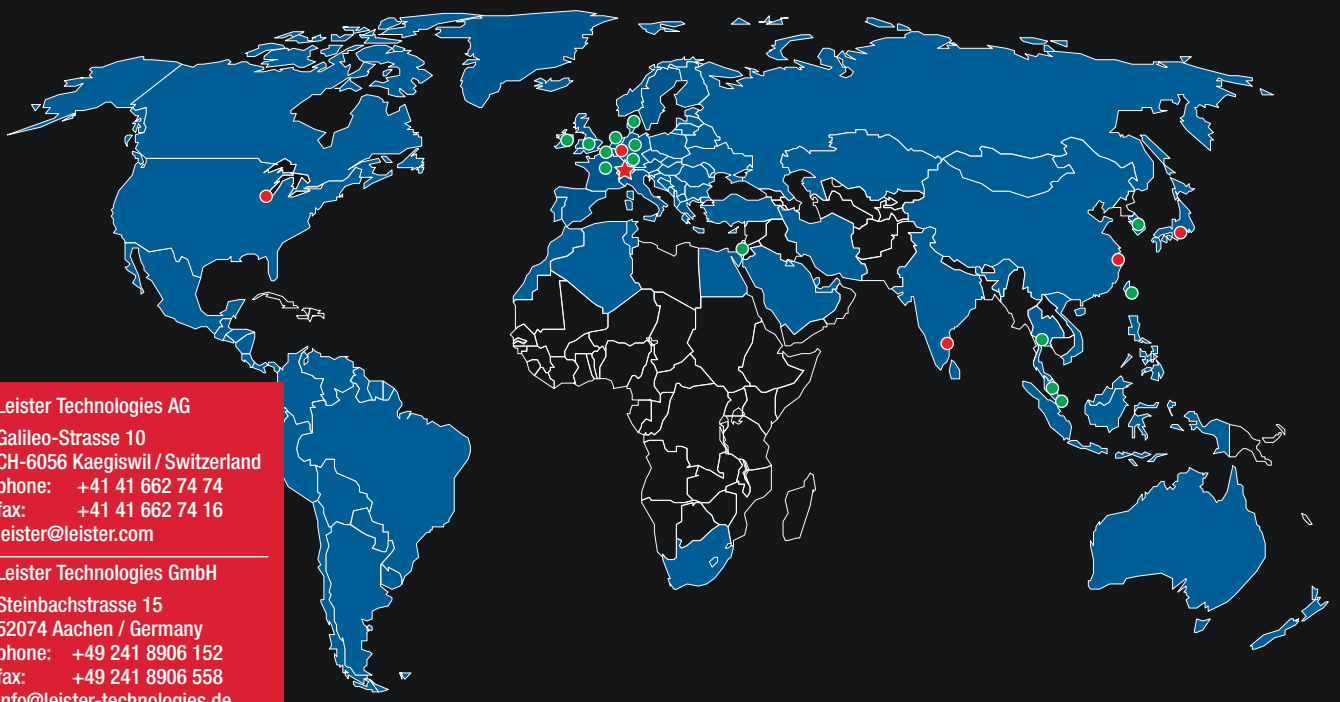

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