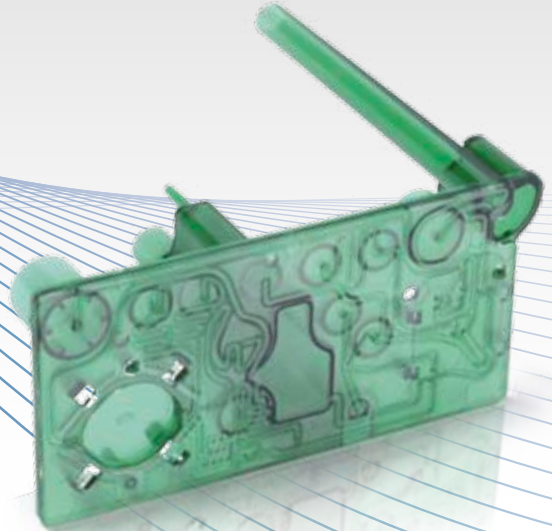


Better Safe than Sorry
Quality Monitoring and Documentation
during Laser Plastic Welding





Control valve



Microfluidic cartridge

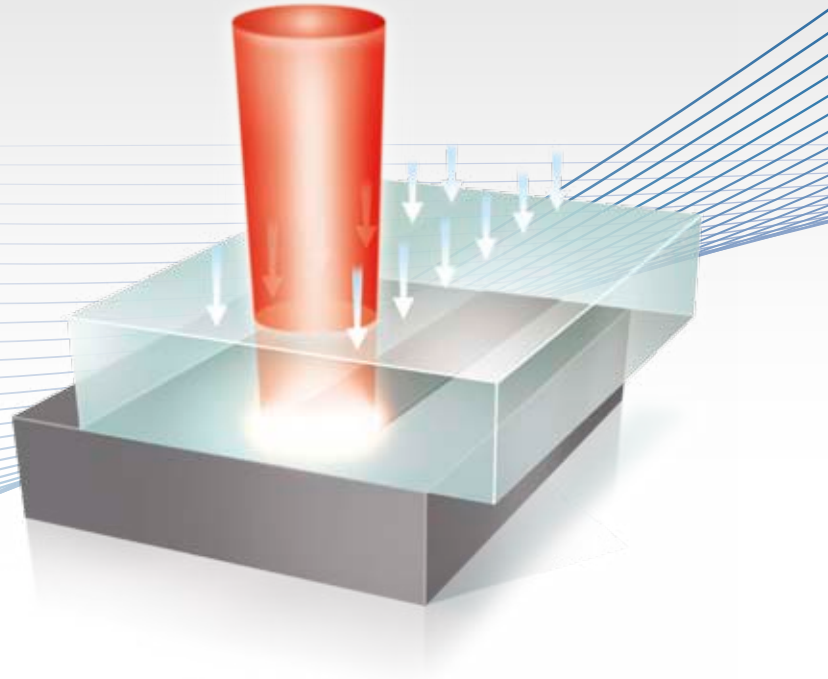
Economical, Innovative and with Assured Quality

LPKF plastic welding is a success story with three prime benefits: economic efficiency, technological superiority, and assured quality. Quality assurance is constantly gaining in importance – an area where LPKF and transmission laser welding have a great deal to offer.

Quality starts with a safe and reliable welding process, and continues with proper testing. The LPKF LQ systems boast integrated process monitoring including regulation mechanisms which correct even the smallest deviations.

LPKF Laser & Electronics AG's Laser Welding Division is a major market player in the manufacture of laser welding equipment, and a leading provider of series-compatible system solutions. The LPKF Group is synonymous with innovation strength and international presence. It combines over 30 years concentrated experience in drive & control technologies, with in-depth all round expertise in the industrial application of laser engineering. LPKF LaserWelding is the quality brand for productive laser welding systems.

Electric shaver component



Today's Hottest Trend: Laser Plastic Welding

Modern laser plastic welding goes way beyond the boundaries of traditional joining methods. The principle: a laser beam penetrates the upper, laser-transparent component, causing the lower, laser-absorbing component to melt and bond. A moderate amount of pressure ensures that heat is also transferred to the upper component creating a common welded seam.

There are several laser plastic welding methods. LPKF primarily uses maskless technologies such as quasi-simultaneous welding (rapidly running the laser beam over the joining line several times), contour welding, radial welding, and the robot-assisted TwinWeld method for large free-form components.

Benefits of Laser Plastic Welding

Economic:

- Rapid product development
- Low Total Cost of Ownership (TCO)
- High flexibility
- Short cycle times
- Simple product solutions

Technological:

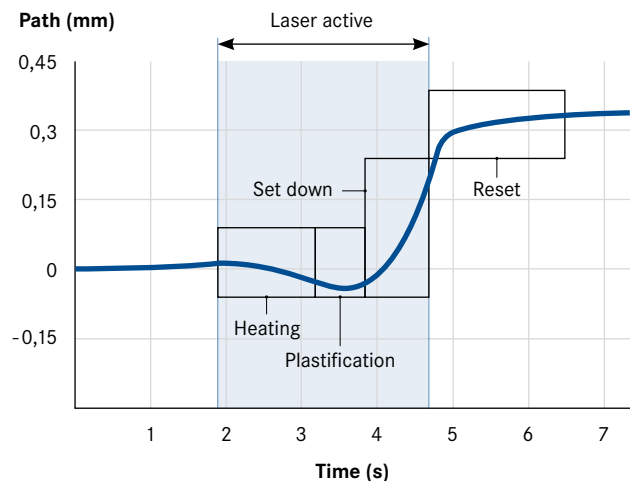
- Online process monitoring option available
- Optically high quality welding seam
- Particle-free welding
- Minor stressing of the components
- No marking, no surface damage

Process Monitoring makes a Crucial Difference

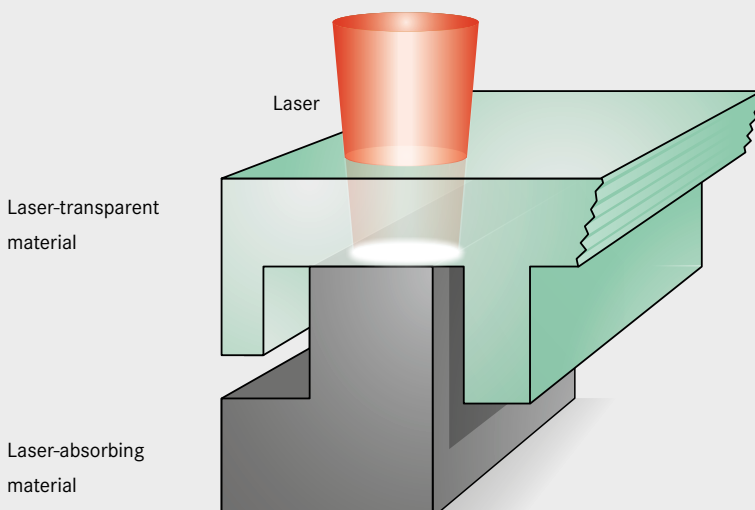
Laser plastic welding is already a very reliable method thanks to its intrinsic technology. On top of this, LPKF has developed a process monitoring system with special testing methods to check the reliability of the bond as the welding process itself proceeds. Benefits: the laser can carry out corrections in real time during the process and avoid expensive rejects. In addition, all of the parameters can be recorded during the welding process and used for end-to-end tracking & tracing. LPKF continuously further develops these techniques to satisfy the demanding requirements specified by the automotive and medical sectors. The most important methods at a glance:

Melt Travel Monitoring

Melt travel monitoring is the most rugged testing method. Suitable for quasi-simultaneous welding processes, this method allows detection of both direct and indirect errors. The principle applied is that only a specific amount of melted material is needed to satisfy the production tolerances of a component, no more and no less. The welding procedure is halted when defined limits are reached such as time, melt path or a fixed stop. This process allows the reliable creation of tight welded seams which satisfy protection classes IP67 and IP69K.



Design Example of Quasi-Simultaneous Welding

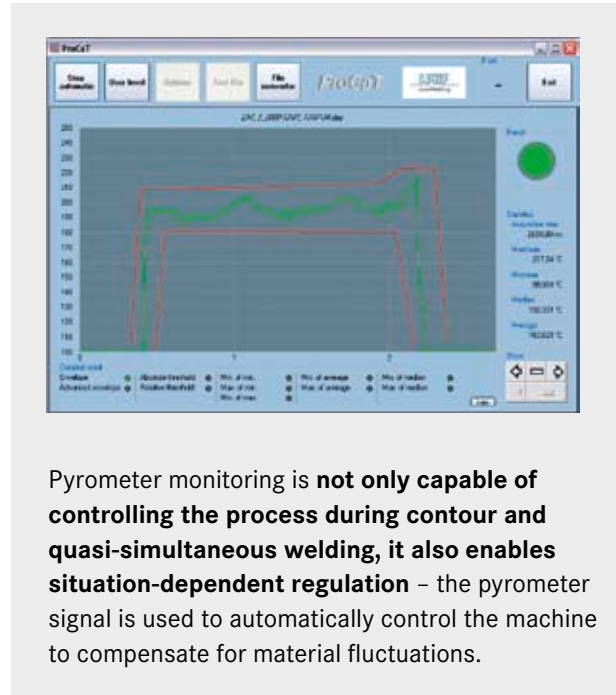


- Configure the welding path
- Take collapse into consideration
- Seam path = welding path + collapse
- All round clamping edge
- Planned space for melt reservoir

Pyrometer Temperature Control Method

Pyrometric monitoring of the laser welding process delivers considerably enhanced detection rates. As developed by LPKF, this method offers the benefits of fast reaction times to temperature changes for the automated evaluation of welded seam quality.

A pyrometer records the electromagnetic radiation in the infrared range (temperature radiation) to monitor the quality of the welded seam. The weld is considered satisfactory if the temperature curve remains within predefined upper and lower limits (the curve envelope). Surface errors such as burn marks or cratering in the area of the welded seam result in anomalies.

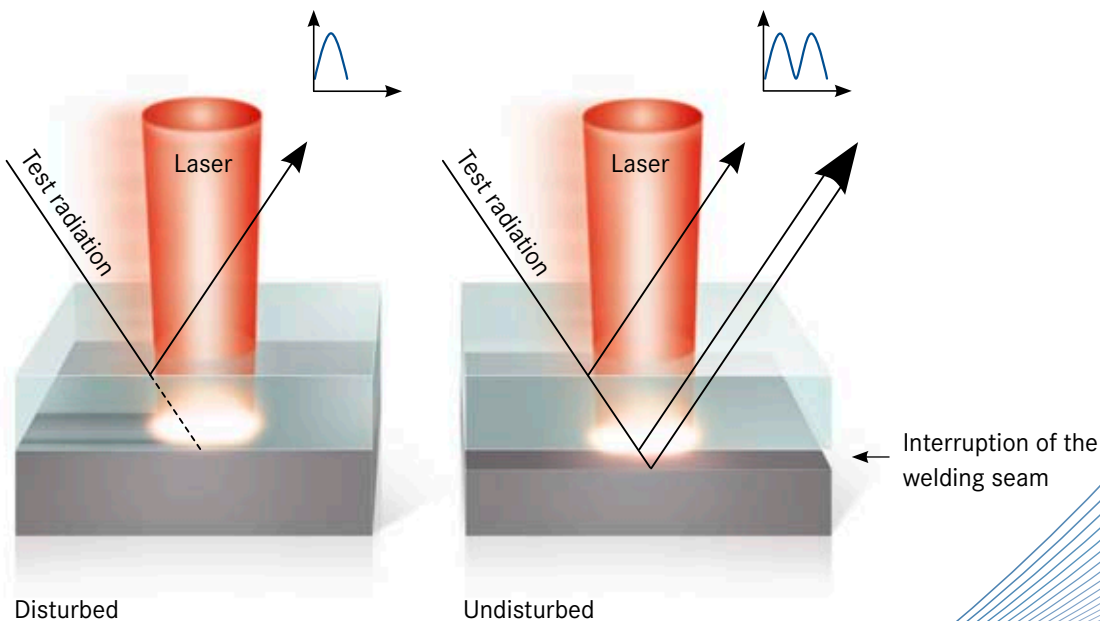


Pyrometer monitoring is **not only capable of controlling the process during contour and quasi-simultaneous welding, it also enables situation-dependent regulation** – the pyrometer signal is used to automatically control the machine to compensate for material fluctuations.

Reflection Diagnosis

Reflection diagnosis is a patented LPKF method. The principle of reflection diagnosis is that the component is illuminated with a defined test radiation (e.g. laser light), whereby part of the light is reflected at the boundaries. During the welding process the boundary between the two welding parts disappears. A reflection only takes place at the surface. Patches on the seam where no welding took place, will have an identifiable boundary surface giving rise to two peaks.

Reflection diagnosis is suitable for example for materials used in car lights. The three-dimensional welding method applied here (LPKF TwinWeld) uses this diagnostic technique to control the processing parameters. Reflection diagnosis will also be available in future on other laser welding systems in the LPKF portfolio – it can also be combined in principle with quasi-simultaneous and contour welding.

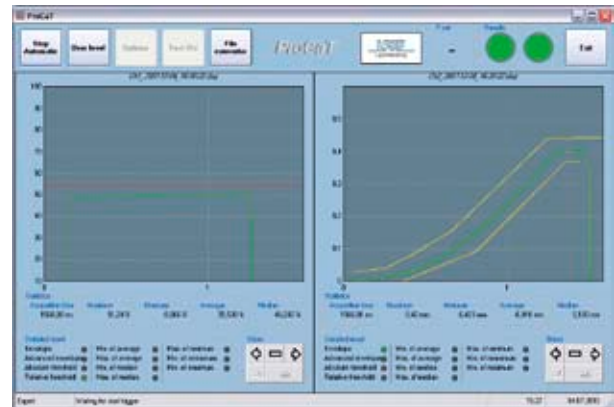


Burn Detection

Burn detection is a method used to reliably detect surface scorching of plastics welded with a laser. This second generation of burn detection systems is enhanced to identify errors on the radiation penetration side of the top layer. Scorches in practice often only measure a few tenths of a millimeter across and therefore have no verifiable influence on seam strength.

However, in some applications, such scorch marks are unacceptable for functional and aesthetic reasons.

The radiation emissions of such scorches range from the visible through to the infrared spectrum. If radiation is detected in these wavelengths, the burn emission pattern is easily distinguished from background noise.



Everything just perfect: Burn detection and melt travel monitoring guarantee faultless welding processes.



Material Qualification with the LPKF Transmission Sensor

Materials with defined properties are essential for reliable welding results. The parameters in the welding process are matched to the transmission and absorption properties of the two parts being welded together. They can be easily detected: the mobile sensor LQ-TMG 2 marketed by LPKF measures the radiation transmitted through a plastic sample. The inline-capable LQ-TMG 3 does the component testing automatically within the welding system. This involves shining light on a component with the same laser wavelength used in the welding process. The transmission parameters are determined within a few seconds and are ready for instant comparison with the original values.

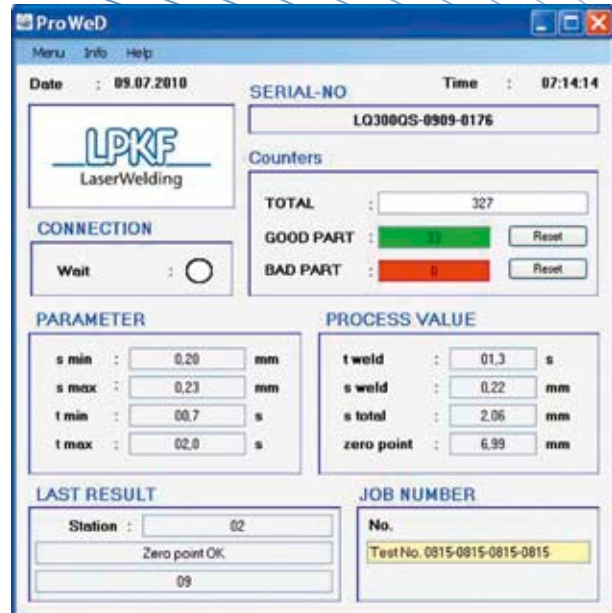
Camera-Assisted Vision Systems

Online CCD monitoring is already in common use. It can be used for strongly contrasting pairs of materials, such as opaque/black. Monitoring systems of this kind are particularly easy to integrate with contour welding methods.

The smallest faults in a welded seam can be reliably identified when using the appropriate evaluation routine. Moreover, the monitoring system can also analyze the width of the welded seam and record it as an extra quality criterion.

Assuring Quality

There are many tricky aspects – so it is good that problems can be identified and nipped in the bud before they have an impact on the production process. Even better is when sources of potential error – such as the different transmission factors of the two plastic parts being joined – are compensated for in the production process by suitable control mechanisms. LPKF has developed the methods and the software needed here for simple integration within the production process.



Continuous process control for the long term assurance of product quality.

Data Matters

An easy to operate, universal data interface: the LPKF ProCaT software records the measurement data from all the monitoring components and sensors, combines the results, evaluates them, and communicates automatically whenever required with the machine control system. The data from melt-travel monitoring, burn detection, reflection diagnosis and pyrometer control, deliver reliable information on the weld quality, and comprehensive process documentation.

LPKF LaserWelding also supplies the ProWeD software for welding data evaluation. It saves all the parameters for the welding procedures from the machine control, and collects them in one file for statistical analysis. ProWeD handles continuous quality control, is a process development tool, and documents the performance of the welding process for as long as you need.



Certified Quality

LPKF's process monitoring methods integrate perfectly within your own in-house systems – to comply with the different quality standards operating in different sectors. The laser welding systems for LPKF show the process data separately for each and every component – for end-to-end tracking & tracing. The continuous measurement series form the platform for Six Sigma process performance analysis.

LPKF therefore satisfies the conditions for process evaluations pursuant to:

- DIN ISO 9001
- ISO/TS 16949 (Quality management systems – special requirements when applying ISO 9001:2008 for volume and spare parts production in the automotive industry)
- VDA 6.x – Regulations for the German automotive industry covering services and production tool manufacture
- GMP (Good Manufacturing Practice) – Regulation for quality assurance of production processes and environments for the production of pharmaceuticals, active substances and medical products

Safe process, high component quality – all certified.

Laser Systems for the World Market

LPKF has been active in laser material processing for many years – with high performance systems for industrial production. Laser plastic welding combines its own development potential with global mass production experience.

Full Round-the-Clock Service

The clients of LPKF Laser & Electronics AG enjoy full round-the-clock service to guarantee optimum availability of their equipment. Service technicians or engineers are available for commissioning the LPKF welding systems and to ensure that production starts smoothly. When the welding systems are running, highly qualified service staff provide professional support via hotlines, remote diagnosis or on-site trouble shooting.



The global LPKF-network for service and distribution:

- Branches/production sites
- LPKF sales/service agents

LPKF Laser & Electronics AG

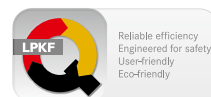
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