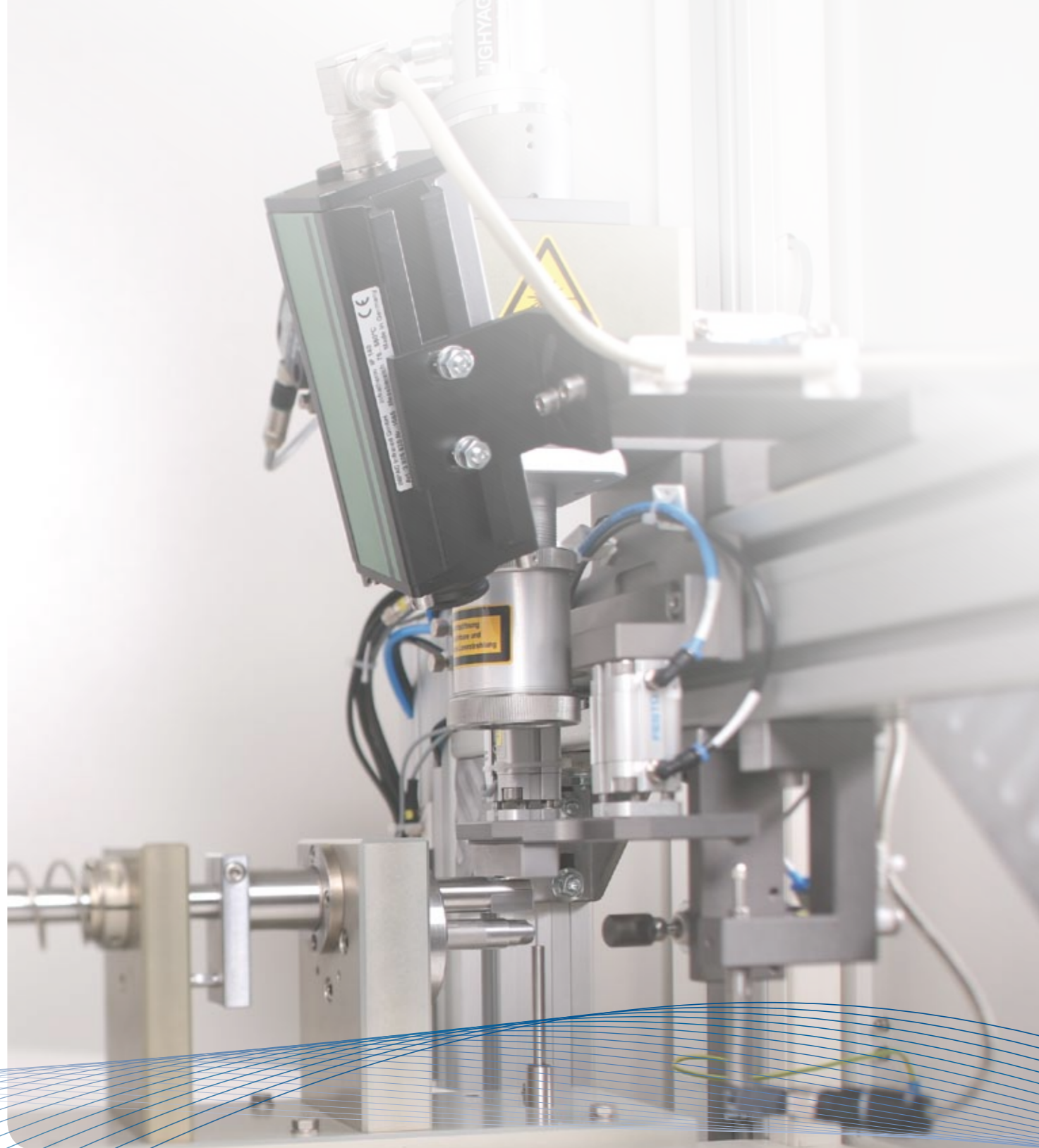


Laser Plastic Welding  
The latest evolution in joining technology  
from the leading system supplier





# Binding Solutions

Lasers are becoming increasingly popular for joining two components together because the technique is fast, reliable and inexpensive. As the leading supplier of serial production solutions LPKF Laser & Electronics AG's Plastic Welding Division has much to offer.

## Transparent and Absorbent Thermoplastics

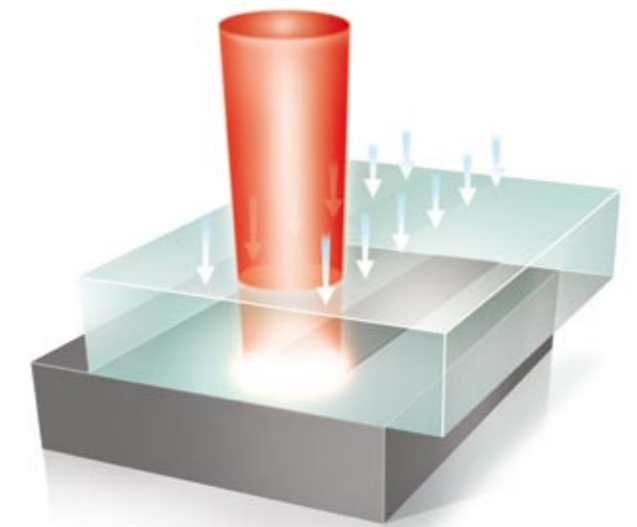
Laser welding relies on two types of polymers, transparent or absorbent. Most thermoplastics in their natural state are transparent at typical laser wavelengths. Additives, such as carbon, in the plastic change the properties so that they become absorbent. The absorbing surface converts the laser energy into heat.

In the transmission laser welding technique, a material transparent to the laser wavelength lies on top of an absorbent material. A clamping tool presses together the parts to be joined. The laser beam penetrates through the transparent component with minor energy loss and melts the surface of the absorbent material. Heat transfers through conduction to plasticize the adjacent surface of the transparent material.

This process is precisely controlled and continuously monitored during laser welding to ensure a repeatable quality weld. After resolidification, the two parts at the joint have been reliably and cohesively bonded.

## Reliable Clamping Technology

A defined pressure joins the materials together during the laser welding process. It is therefore essential that the technology works with complete reliability. Uniform clamping is vital for high process quality. Pressing the parts together is crucial for effective thermal transfer.



## Technology Leader and Pioneer: LPKF Laser & Electronics AG

Innovation, technical strength, and international presence are the defining characteristics of LPKF Laser & Electronics AG. Over 30 years of experience in drive and control technologies meets technical excellence in industrial laser solutions. LaserQuipment is the outstanding brand for efficient laser-welding systems.

The Plastic Welding division emerged from an University of Erlangen-Nuremberg spin-off. The company still maintains close contacts and links with the university's research environment, which is highlighted by its over-proportional involvement in research and development. This creates a positive impact on technique optimization, as well as the discovery of completely new applications.

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# From Ideas to Products

Narrow laser beams for a glowing future. Modern laser plastic welding boasts numerous benefits and goes well beyond the limits of traditional joining methods. Thanks to its specific advantages, it opens up completely new applications and markets.

## New Applications and Material Combinations

High joint quality criteria bring the economic advantages of laser plastic welding into the spotlight. No other method simultaneously combines such a high degree of safety, cleanliness and speed – opening up completely new opportunities!

Laser plastic welding can easily handle complex three-dimensional designs. The beam head itself never touches the material. Even poorly accessible zones or thick layers can be safely joined. Other convincing features are the continuous development of new materials and a wide range of combination options. The process is so gentle, the LPKF LaserQuipment systems are ideal for components with sensitive surfaces.



Automotive, medical and consumer products all profit from the transmission laser welding technique.



## Economic Advantages:

- Fast product development
- Low total cost of ownership (TCO)
- High flexibility
- Short cycle times
- Simple product solutions



## Comparison with Alternative Methods

### Laser compared to ultrasonic and vibration welding

- Minor mechanical impact on the components
- No surface damage
- Completely particle-free
- Highest visual quality joint line
- No tool wear and tear, minor tool costs

### Laser compared to mirror and hot-gas welding

- Minor thermal stressing of components
- Lower melt overflow
- Much shorter cycle times
- Lower machine and tool costs

### Laser compared to hot-melt technology and gluing

- No additives required
- Better options for online process monitoring
- Highest visual quality joint line
- Higher quality and long-term stability
- Shorter cycle times

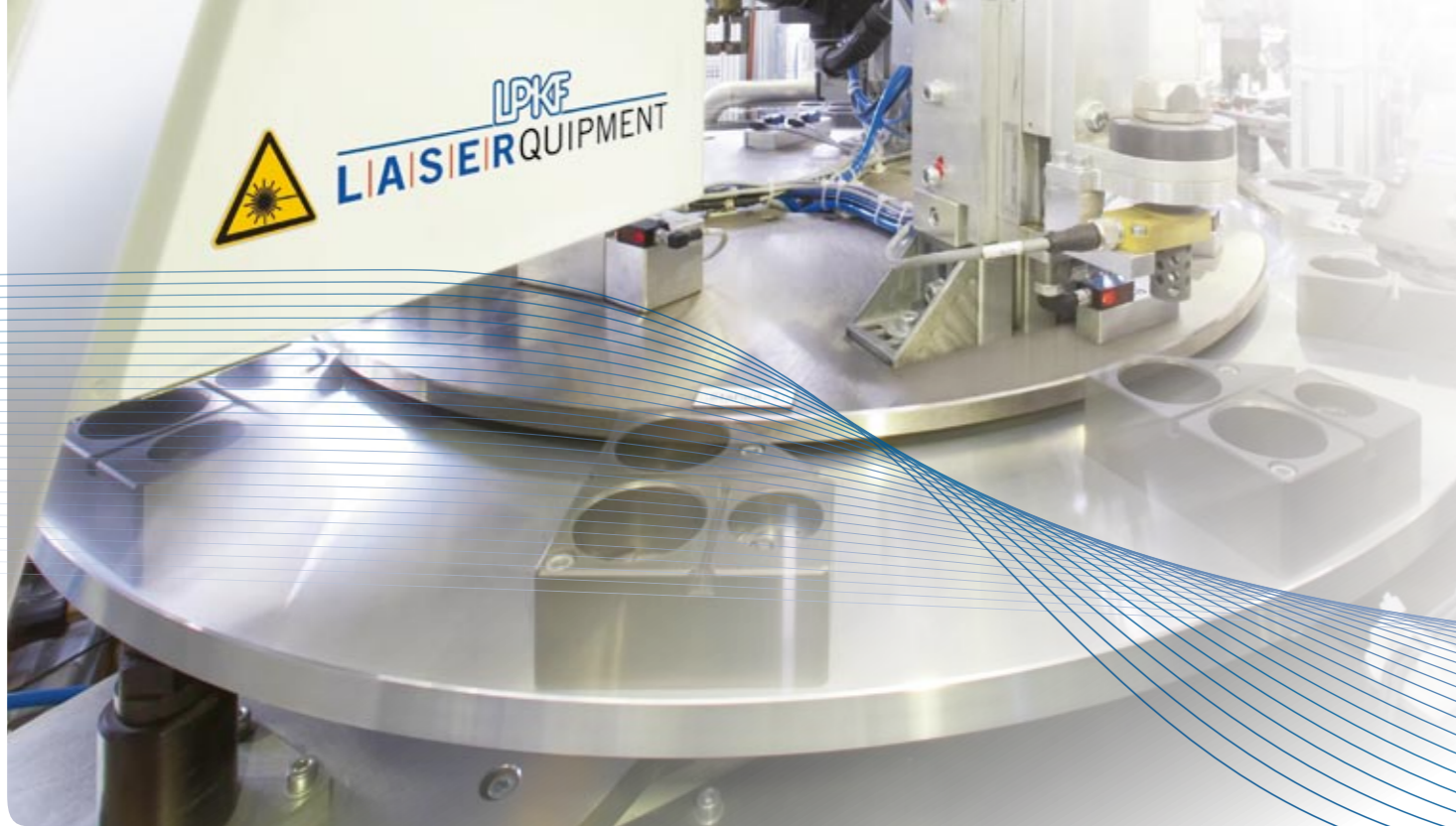
## Application Center for Process Development and Quality Assurance

The results of in-house research, and in-depth practical experience, are made available to a broad circle of users in the LPKF Application Center.

A successful laser welding process begins with the design. Highly qualified engineers help with the process planning; they provide advice on the selection of materials, and determine the best laser parameters. Finally, they jointly work with the clients to develop prototypes and create optimal clamping tools. The Application Center then elaborates quality assurance processes, and trains the operatives. This ensures the economical and uncomplicated operation of this innovative laser joining technology.



The Application Center also provides assistance with batch runs, helps out during production peaks, and produces small to medium-sized runs with internal lab systems.



#### Advantages of Laser Plastic Welding:

- Optional online process monitoring
- Visually high quality weld seam
- Particle-free welding
- Minor stress on the components
- No surface damage

## Optimal Technique – Optimal Result

The key feature of transmission laser welding is transmitting energy through a material. Different approaches can be used. Each method has its own specific strengths; in addition to many shared advantages. LPKF's laser specialists help identify the best method for each application. Their involvement in the production of millions of components gives them the quality experience required for professional consulting.

#### Contour Welding

Contour welding is where the laser moves relative to the component. The width of the joint line can vary from a few tenths of a millimeter to several millimeters. Contour welding is particularly good when rotation-symmetrical or very large components need to be welded without any melt overflow.

#### Simultaneous Welding

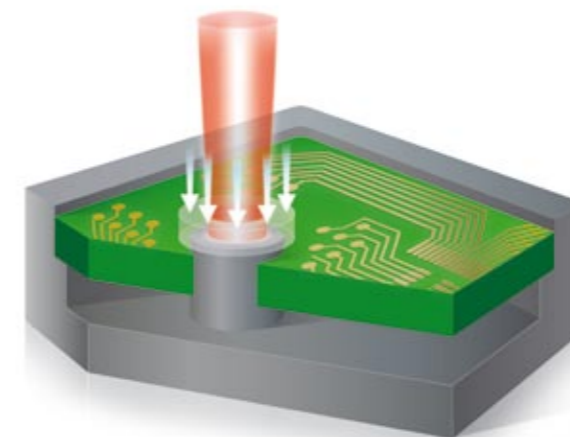
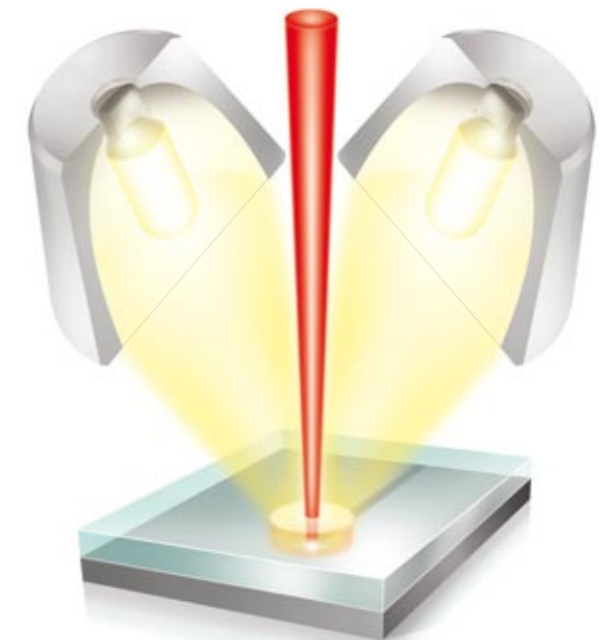
Simultaneous welding is where the entire welding seam is heated at the same time. This method requires power density distribution over the radii and changes in height. It is especially recommended for extremely high production runs which justify the large investment required for the special laser equipment.

#### Quasi-Simultaneous Welding

Quasi-simultaneous welding is a combination of contour and simultaneous welding. A mirror guides a focused laser beam several times along the welding contour at a very high speed so that the entire joint line is effectively heated up and melted simultaneously. Quasi-simultaneous welding enables the melt travel to be monitored and compensates for tolerances in the molded parts.

#### Patented Hybrid Welding

Hybrid welding combines laser energy with infrared thermal radiation from conventional halogen lamps. This increases the welding speed whether the weld path is in two or three-dimensions. The main application for this technology is structural components in the automotive sector, such as: automotive lighting and motor assemblies.



#### Patented Laser Hot Riveting

Laser hot riveting combines riveting technology with laser plastic welding. A positively locked joint between two components is created using this method. The riveting tool does not come into contact with the plastified material. This provides a clean process. Laser hot riveting can be used to join components which cannot be welded directly – for instance, fixing PCBs to plastic housings.

More information on these methods is available at: [www.laserequipment.com](http://www.laserequipment.com).

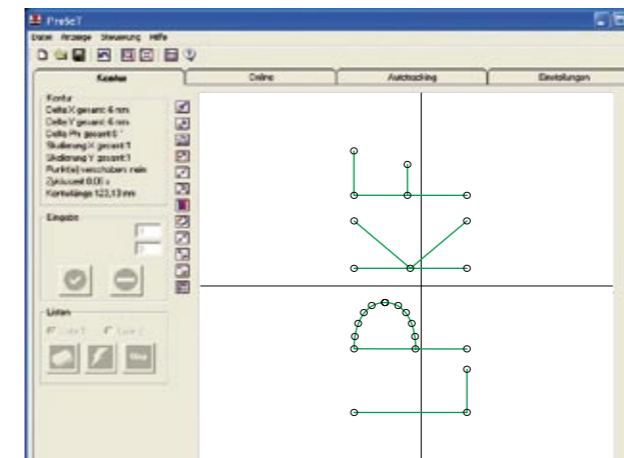
# Benchmark for Laser Welding

Economically efficient laser systems are the product of in-depth experience. LPKF combines applications know-how and consulting competence with successfully tried-and-tested laser welding machines. This brings the users of LPKF laser technology safely to their goal of efficient production.



LPKF – a Strong Partner:

- Guaranteed process capability
- High machine capability
- Comprehensive practical experience
- Intelligent clamping technology
- Laser welding systems for all applications



## Easy-to-Use Machine Controls

Two of the key advantages of LPKF welding systems are comprehensive machine capability combined with simple operation. They are equipped with a fail-safe SPC. The remote servicing capability reduces maintenance costs and increases production availability. ProSeT, the standard set-up software, simplifies the programming of welding contours and laser parameters, for a rapid product change.

## Quality You Can Rely On

The quality of the final product is determined by the whole process chain. Confirming the process reliability – for each separate component – is becoming an increasingly crucial factor. Production data from LPKF systems can be clearly assigned to individual components. This sets up the seamless background for the specified “tracking & tracing”. LPKF welding systems have also been successfully integrated by clients within different Manufacturing Execution Systems (MES).



## Objective Advice

Objective advice can only be dispensed by experts having solutions in their product line covering a broad spectrum of applications. LPKF standard systems range from laboratory systems all the way to fully automatic welding cells. LPKF engineers work together with clients to develop customized system concepts for special applications.

All LPKF laser welding systems are compact and equipped with standard interfaces. They are easy to integrate into existing production environments.

## From Laboratory Systems through to Fully Automatic Welding Cells

- LQ-Vario for laboratory applications, small and medium-sized runs
- LQ-Power for standalone, self-contained production of large lots featuring parallel processing of several components
- LQ-Integration for incorporation into a fully automated assembly environment utilizing multiple stations
- LQ-Hybrid for processing complex 3D-components
- LQ-Axis for 2D processing of large assemblies



## Holding, Clamping, Feeding

High productivity depends on optimal workpiece loading and feeding. LPKF supplies solutions for every application. The spectrum ranges from manual placement in 2-way rotary tables, to conveyor systems and robot-based feeding systems.

Patented dual-clamping tools ensure reliable thermal conduction contact within the welding zone. Clamping on both sides of the joint line ensures particularly uniform pressure distribution. The tools can be optionally equipped with air cooling.



## Assured Quality

LPKF laser plastic welding is designed to satisfy the highest quality standards in production.

It begins with a reliable welding process and continues into the testing phase. LPKF LaserQuipment systems have integrated process monitoring, including regulation mechanisms which correct even the smallest deviations.

### Seamless Control

High quality standards demand seamless control. LPKF welding systems record important process parameters during production, and react to deviations to set values by making automatic corrections or warning the operator. All the data can be easily archived making it ideal for integration within a manufacturing data logging system.

### Recording Process Parameters

The successfully tried-and-true melt travel monitoring system gauges the melt travel during laser plastic welding, providing further quality control. Almost all scanner-based LPKF LaserQuipment systems are equipped with this monitoring method as a standard.

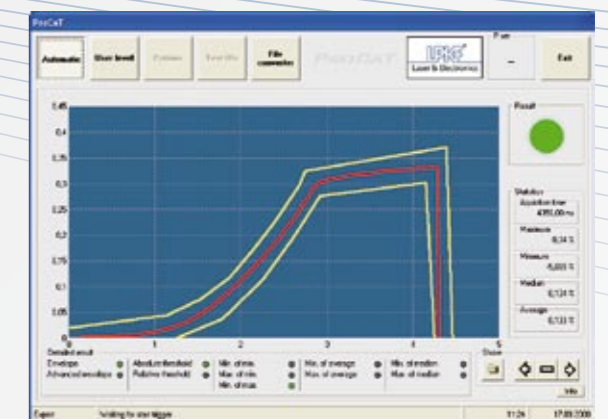
Other methods round off the process monitoring package: a pyrometer measures the temperature in the joining zone to provide information on localized interferences. The burn detection system identifies even the smallest burns on the surface of the components, whilst the vision systems are an option when strongly contrasting materials are used. This range of monitoring systems provides the optimal basis for ISO quality monitoring and documentation.

### Stringent Testing to Check Welds

The LPKF testing laboratory has a wide range of methods at its disposal to analyse plastic welds, such as:

- Leak rate test system up to 8 bar and 20 ml/min
- Water bath leak testing up to 8 bar hot/cold
- Burst pressure testing up to 40 bar water pressure
- Light microscope evaluation with digital archiving
- Transmission measurements
- DSC analysis of plastics

The LPKF Application Center uses the laboratory and also makes its services available to its clients for testing batch production.



Pyrometer monitoring allows successful welding to be documented at all times.



### Transmission Measuring Device LQ-TMG 2

The versatile and handy transmission measuring device LQ-TMG 2 identifies the transmission rate of materials within a few seconds. It is an indispensable tool for controlling incoming goods and real-time process quality monitoring.



### Laser Plastic Welding in the Automotive Sector:

- Traceability / MES integration
- Shortest cycle times
- Low life-cycle costs
- Particle-free processing
- Stress-free energy input
- High flexibility

## Automotive Technology in Top Gear

The product quality and production reliability criteria specified by car makers and the automotive subcontracting sector are very high. Laser welding is one of the disciplines which meet the demand of low-cost/high quality requests. Many car makers and models use components economically joined using LPKF laser technology.

### Sensor-Electronics for Cars

Modern cars are equipped with numerous sensors to boost passenger comfort and safety. The advantages of laser processing stand out when sensitive electronic assemblies are used in these sensors. Instead of screwing, gluing or pouring sensor housings, they are joined by lasers gently, reliably and economically. Additionally, the entire welding process can be documented for later inspection.



### Control Devices for Electronic Steering Systems:

Internal electronic components are first fixed in place using laser hot riveting, and the cover is then welded tight to the housing – this can only be done using transmission laser welding.

### Control Valve for Lumbar Support System:

The tight weld required here can only be performed using the LPKF Dual-Clamping Device (DCD) which simultaneously clamps the outer contours and inner surface of the component.



Complete ABS control-unit for motorcycles



Valve parts – welded and unwelded



Over-pressure/under-pressure unit for car fuel tanks



Fully-integrated transmission control



LPKF plastic welding in the medical technology sector:

- Hygienic energy input
- Particle-free processing
- No adhesives
- Traceability / process monitoring
- Shortest cycle times
- New design possibilities

## Medical Technology – Putting People First

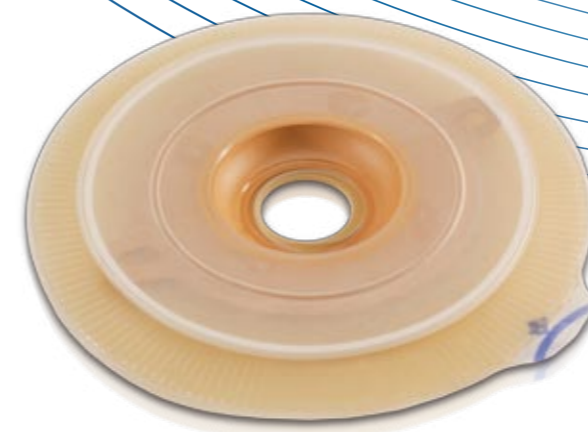
When welding seams in the micrometer range are required, there is only one economical solution – laser plastic welding. Other aspects make this joining technique additionally interesting for medical applications, such as: flexible production options, stress-free processing, and hygienic high-precision processing chains – all assuring high quality and profitability.



Mini laboratory for complex analysis: thanks to modern microfluidics.

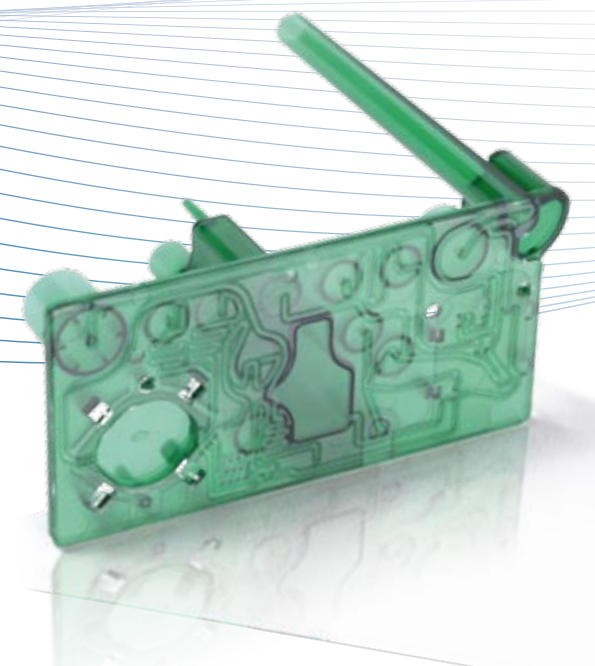
Putting people first – this equates to especially high specifications for products and processes. Laser plastic welding scores on both counts. Particle-free processing, different validation methods even during the welding, and obligatory clean-room compatibility, are just some of the features highlighting lasers as the tool of choice in the manufacturing of medical products.

An area of application which combines all of these demands is microfluidics. It needs extremely precise joint lines up to several meters long. There must be no contamination by foreign bodies or additives; Creating compelling arguments for laser plastic welding.



**A Classic Product of Laser Plastic Welding:**

Ostomy bags of this kind have been mass produced using laser welding since 2003. The joint line is hidden in the interior and satisfies the highest hygiene and quality specifications. Another plus point for laser technology in this application is the minor, easily controllable energy input. Welding machines from the LQ-Integration series are equipped with a pyrometer for online process monitoring.



**99 RNA Sensors in an Extremely Compact Unit:**

This laser-welded microfluidic cartridge is part of a complete, highly specialized mini-laboratory. This opens up a whole new range of opportunities for surgeries and clinics lacking sophisticated laboratory facilities. LPKF was selected to make this product because of the specified two-meter-long joint line, particle-free and additive-free contact surfaces, complete tightness, and guaranteed channel cross-sections.



Microfluidic sensor



PTCA catheter



Micro-atomizer



Cell culture flask

## 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

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