

# Smart Laser Welding Heads Provide Excellent Quality

## Concerted Functionality Enables High Productivity and Efficiency

Equipped with pulsed Nd:YAG lasers, single-mode fibre lasers and “conventional” CO<sub>2</sub> lasers, the BBW Lasertechnik GmbH in Prutting, Upper Bavaria, tackles cutting, drilling, inscribing and welding tasks. BBW mainly processes sophisticated small components in stainless steel, spring band steel, steel and aluminium. A visitor to the works will see complete assembly lines on which highly complex and often safety-relevant parts are processed for well-known companies. Quality monitoring systems, laser welding and cutting heads by Precitec KG contribute to the company’s cost-effective production, which runs at 250 parts per week or up to 300,000 per year.

BBW is ISO/TD16949 certificated, which has until now only been awarded to very few companies – and it underlines the level of sophistication at which BBW can process very small and complicated parts (the ISO/TD16949 Standard describes the special re-

quirements for the application of ISO 9001 for serial and spare parts production in the automotive industry). The company also processes parts for the electronics, clock and watch, medicine and measuring technology industries.

Even during his academic education, Johannes Weiser, today a Doctor of Engineering and a European Welding Engineer (EWE) came to know Precitec as a partner which offers customised solutions for laser precessing with professional diligence and competence. “And I still haven’t changed my opinion”, says Dr. Weiser, conducting us through the spotlessly clean production halls. One of the company founders and Managing Director of BBW Lasertechnik, he trusts the outstanding reputation of the laser system solutions from Gaggenau. This trust is demonstrated in the fact that the Precitec CO<sub>2</sub> laser cutting systems in use at BBW will soon be supplemented by systems for a pulsed laser with distance control. Furthermore three Precitec online process monitoring systems and two laser welding heads are already in operation at BBW.

### For the Finest Structured Seams

Compared with traditional welding methods, laser welding offers several advantages such as concentrated thermal insertion, a

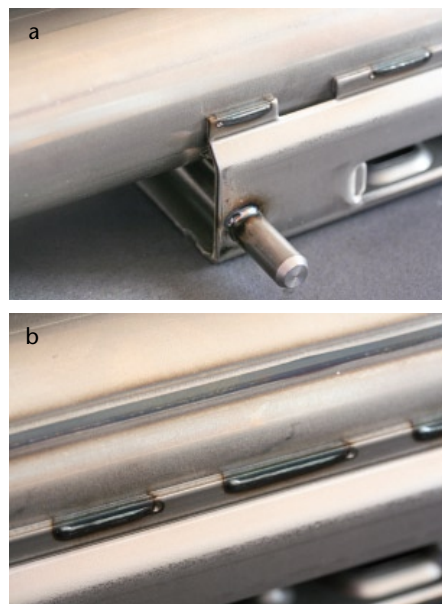
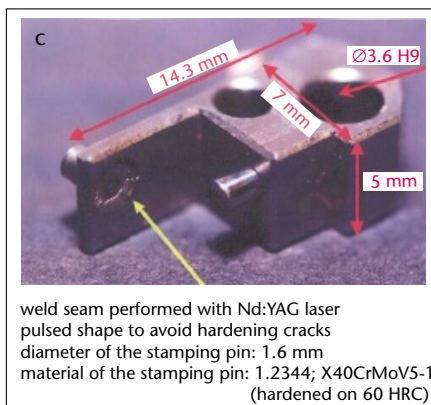


FIGURE 1 A–C: Examples of products welded by BBW



### THE AUTHOR

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Andrey Andreev completed his graduate studies at Stuttgart University, with laser material processing and combustion engines as his main two subjects. He worked on his post graduate thesis at the Daimler AG in the laser center power train, Stuttgart-Untertürkheim. At Precitec KG he is now responsible for welding technology sales to automotive suppliers.



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minimal amount of distortion and much higher welding speeds. Using solid-state laser equipment, BBW Lasertechnik produces small parts (Figure 1) which require a very finely structured welding seam. The high quality of the joint is thanks to the combination of the comparatively low-level laser power and the welding gas used in the process. When a higher welding depth is required, BBW uses CO<sub>2</sub> lasers and fibre.

### Welding Optics for Every Task

Precitec offers laser beam welding optical components for various laser types and power classes up to 30 kW. The YW50 welding head (Figure 2) with integrated sensor technology can be used in all systems with solid-state lasers, e.g. in the processing of customised blanks, welding power train components and in the body-in-white seg-

ment. Special features of the YW50 welding head are its integrated protective window monitoring system for all laser powers, temperature sensors plus integrated sensors for the LWM online welding process monitor. The YW50 can be combined with the LPF Seam Tracking System and the SGM Seam Geometry Monitoring System.

### Just Like a Football Team – the Right Combination Brings Success

For Dr. Weiser, the combination of welding head and sensor technology together with LWM process monitoring is what makes Precitec laser welding products an excellent practical solution. "Everything works well together – it's a very carefully thought-out solution. Thanks to the integration of sensor technology into the welding head, there are no disrupting additional fixtures on our fibre laser heads. No drilling of holes and no extra assemblies ... just two cable connections." If the protective window gets soiled, a sensor emits a corresponding signal and this ensures that the laser systems have a high operational availability rate. Dr. Weiser also finds the scraper sensor on the CO<sub>2</sub> laser extremely practical "the Precitec solu-

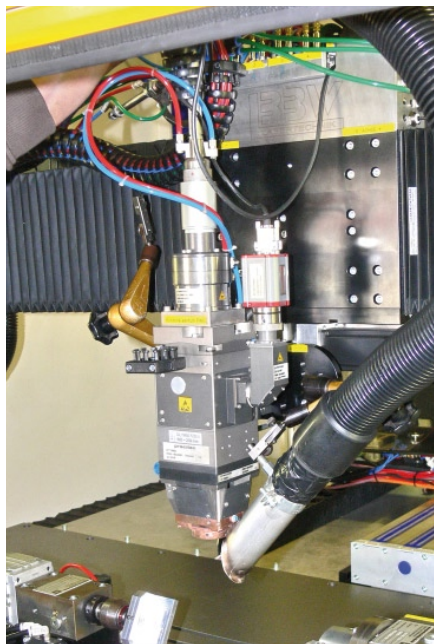


FIGURE 2: Precitec welding heads in use at BBW Lasertechnik

tion works." It is a ring-shaped mirror, which focuses the ray of light from the welding process to the LWM sensors and at the same time allows the laser beam to pass through coaxially.

### Indispensable – the LWM Laser Welding Monitor

The LWM is a real time monitoring system for mass production. It provides an abundance of quality and productivity-relevant information for BBW Lasertechnik, about changes in

- laser power
- focal position
- protective gas supply or its volume flow
- component deviations (burr on the welding edge) or defective fixture mechanisms resulting in joint gap changes.

The LWM also recognises when partial welding occurs (so-called lack of fusion) and provides information about penetration depth.

Just a few welding samples are sufficient to create the position-related welding process reference. The signals from the current process are compared with the saved reference values and the differences are analysed in real time. A display of the process drift of the last welds shows e.g. the operator any laser beam power loss or soiling of the optics. The process signals are 100 per cent documented and stored in an SQL database. Component traceability is also possible if simultaneous component identification is enabled. Depending on the beam

source (CO<sub>2</sub> or solid-state) and application, the welding process is monitored by one or more detectors that work in different wavelength ranges. These include plasma, temperature and back reflection detectors. The plasma detector documents the UV light from the plasma plume by recording and analysing the amplitude. A temperature detector captures changes in thermal distribution or thermal conduction in the welded workpiece. This enables the identification of lack of fusion. In the case of welding applications with solid-state lasers, the acquisition of the laser beam reflected from the workpiece is carried out by the back reflection detector. The reflected signal is directly correlated with the keyhole geometry, thus providing information about the penetration depth.

In the case of solid-state lasers, the detectors are installed on the camera flange located directly on the welding head. The internal optical path in the welding head is used here. This means that the sensors are always aligned coaxially to the welding spot and optimally protected from contamination. CO<sub>2</sub> lasers use built-in scraper detectors or flange-mounted detectors on the welding head in the optical path.

The crucial element here is the software used by the LWM – and it's not only the professionals at BBW who are highly aware of this: At the "Kolloquium für Lasertechnik AKL" in Aachen in 2004 (Laser Technology Congress), Claus-Werner Deutschmann lectured audiences on the use of process monitoring systems (Mr. Deutschmann worked for the Dynamit Nobel GmbH, where products like igniters, gas sets and micro-gas generators for vehicle airbags and seatbelt tensioning systems are manufactured and welded). "Straightforward process control for reducing the risk of rejects and guaranteeing the standard of quality is an absolute priority. A laser welding monitoring system by Precitec is used, and this assures non-destructive online control in real time. The Laser Welding Monitor evaluates the signal characteristics and outputs them in the form of Good or Bad verdicts", Deutschmann explained. [1] Dr. Weiser also stresses this point by example: "Time and again we had problems with one product, because the high-resolution sensor technology identified the punch burr of the blank and output an error message. Ultimately we were able to deliquesce (melt down) the burr; from a total of 220,000 processed parts, we then had 530 identified as bad, and 370 of these were eventually classed as good. 100 per

## THE COMPANY

### Precitec KG

Gaggenau, Germany

The number of Precitec laser cutting and welding heads in use all over the world has exceeded 30,000. Precitec laser systems complete with process monitoring and electronic units for sensor signal processing, linear drive control and process control make Precitec the ideal global partner for machine manufacturers and users. Founded in 1971 in Baden-Baden, Germany, the company currently possesses more than 200 patents and offers a comprehensive range of quality monitoring systems which can be easily integrated into all industrial standard plant concepts. Various processing heads with integrated sensor systems for non-contact seam tracking and process control are also available for all established types of laser.

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cent error detection and at 0.25 per cent, absolutely minimal error identification rate! Yet another positive element about Precitec LWMs is the fact that the operator learns to understand the process. The software which runs the sensor technology and evaluates its signals is simply superlative – it helps us to guarantee outstanding product quality.”

The material preparation is also very important. Errors are caused by inadequate fixture mechanisms or occur during the preliminary stages of part treatment, e.g. through worn stamping/punching equipment. Irrespective of where the error is located, the LWM helps to identify the causes and optimises the welding process as quickly as possible (Figure 3). Since all the acquired signals and part numbers can be stored together with the welding data, the system enables 100 per cent traceability for every workpiece.

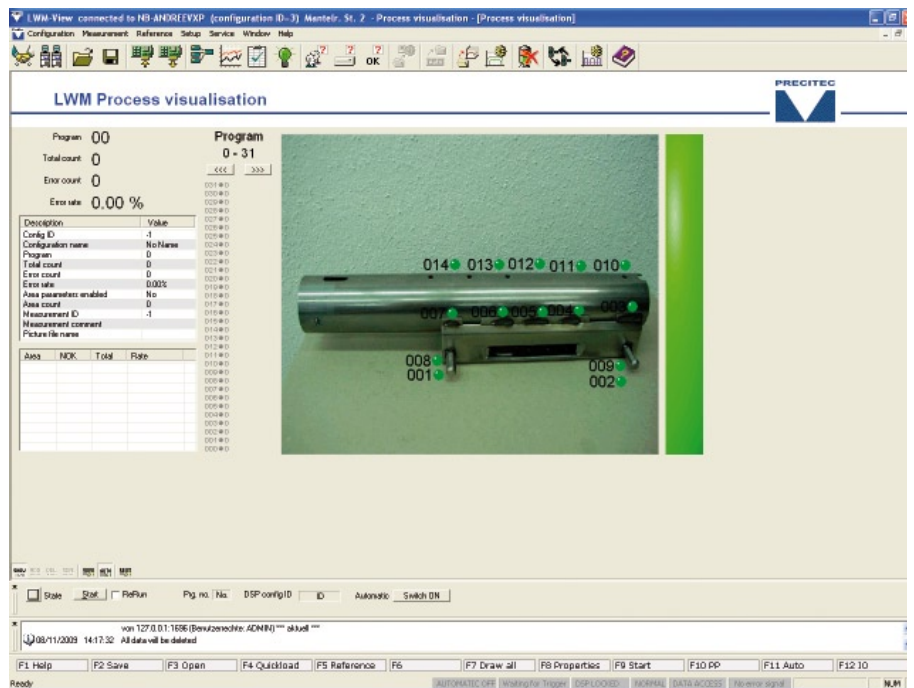


FIGURE 3: Laser Welding Monitor for online process monitoring

### No Fear of jet lag... CrossJet Keeps Everything Fresh!

A CrossJet hinders the deposits of fusion spatter and the residue from fumes on the surface of the protective windows in front of the laser optics. “This equipment is also a decisive factor in our targeted level and quality of productivity”, Dr. Weiser stresses. An air jet, diagonally oriented to the processing laser beam, flows out of a nozzle at roughly 5 bar – this jet prevents workpiece fusion particles and the residue from fumes from being deposited on the optics or on the optics’ protective window. The CrossJet thus contributes to increased process safety and lengthens the operating life of the optical components. Its in-depth protective effect is possibly one of the reasons why more and more customers are replacing their welding heads – irrespective of make – with the Precitec CrossJet Solution.



FIGURE 4: Dr. Eng. Johannes Weiser, Managing Director, BBW Lasertechnik GmbH

### Problem Solvers in Demand

When asked why BBW Lasertechnik cooperates closely with Precitec, Dr. Weiser stated that Precitec and BBW were both problem solvers. BBW could order complete systems, or individual components like welding heads, sensors, CrossJet or LWM – and Precitec would fine-tune these products to BBW requirements until the targeted solution functioned perfectly. And the supplier was in Germany and not halfway across the world. Another cost-relevant factor for Weiser was that BBW could use the welding heads for all the laser types the company actually used – so they only required one supplier. However, the most important factor of all was that Precitec’s products had been tested rigorously by us time and time again ... and had passed with flying colours. “We do have a maintenance contract which stipulates annual maintenance of the Precitec systems, but nothing has broken down or gone wrong to date ... perhaps a mirror might be dropped accidentally during assembly”, he says.

### References

[1] Rolf Chung, Aachen. Report on Aachener Kolloquium für Lasertechnik AKL’04 Aachen, 28th–30th April 2004 (Laser Technology Congress)

### THE COMPANY

**BBW Lasertechnik GmbH**  
Prutting, Germany

The name BBW Lasertechnik is synonymous with solutions for the most challenging welding, cutting and drilling tasks. One of the company’s strengths is the development of special processing methods to produce a customer-specific product of the highest quality. Founded in 1997, this supply company undertakes laser processing tasks and the inscribing and mechanical processing of metal sheets and solid materials for small and large production series. Welding and auxiliary devices developed and built in-house (e.g. rotary drives, holding devices and pneumatically-operated fixture devices) provide solutions for seemingly impossible manufacturing and processing tasks, and/or ensure a high level of productivity. Experienced, dedicated employees and a wide range of special machines and equipment enable the company to react flexibly to even the most challenging customer requirements.

[www.bbw-lasertechnik.de](http://www.bbw-lasertechnik.de)