

THE OPHIR BEAMWATCH SYSTEM OPTIMIZES LASER PROCESS DEVELOPMENT



The laser seam welding of sheets of zinc-coated steel – a combination of metals with disparate melting and evaporation properties – used to be a major challenge for the automotive industry. But Volkswagen AG is pursuing a promising approach with multi-focal laser welding: A newly developed process enables significantly higher welding speeds than is otherwise possible with conventional mono-focal laser beam welding systems. After a development period of just three years, the process was registered for a patent. The development of this multi-focal laser welding process was significantly accelerated by the compact Ophir BeamWatch measuring device from MKS, which measures laser beams in real time without touching them.

Measuring time = development time

With more than 6 million deliveries per year, the Volkswagen brand is a central pillar of success for the Volkswagen Group. The company's beating heart is in Wolfsburg: Not only are the headquarters and the development center located there, but also the main factory. Worldwide, VW produces at more than 50 locations on all five continents and employs over 200,000 people. In addition to designing new vehicle models, VW experts also research process technologies, as in the department known as 'Manufacturing Automation and Digital Production Laser Technology'. One of the team's projects was to develop a multi-focal laser welding process, for which a patent application was filed in the spring of 2019. Considering the overall complexity of the technology, three years' development time for a new laser welding process is rather short. Alexander Franz, graduate engineer and the person ultimately responsible for the project, explains: "Especially in development processes, measurement technology plays a key role. Every design change must be meticulously quantified and documented. The time it takes to measure thus has a direct effect on the overall development time."

Product:

- BeamWatch

Area of application:

- Materials processing

Direct uses:

- Development of multi-focal welding technology
- Optimize production processes

Benefits:

- Significantly shorter development time
- Real-time analysis of focus shift
- Easy and flexible use of the measurement device
- Overall improvement of laser process quality



With conventional instruments, it takes a lot of effort to meet this challenge. This is different with the Ophir BeamWatch system. Here the beam to be measured is deflected through the measuring device without ever touching it. The Rayleigh scattering of the laser beam is measured by a camera in the X and Y directions. What was ideal for Volkswagen was that the BeamWatch system also allows the observation of multiple beams that are directed simultaneously through the system. The measurement is done in less than 100 milliseconds; and in another 300 milliseconds, BeamWatch displays all the relevant measurement results. For Alexander Franz, this was an enormous advantage: "We took measurements with the BeamWatch system every time we changed the development system. In this way, we were able to make the effects directly visible. Even the thermal focus shift – that is, when the focus position changes over time – is detected by the system."

Key parameters in real time

Overall, the laser experts at Volkswagen are interested in numerous parameters related to the beam caustics: With each measurement, the beam parameter product, the Rayleigh length and the beam divergence are all determined in real time. Alexander Franz sees great benefit in measuring the focus position with the Ophir BeamWatch system: In contrast to other measuring instruments, the operator can freely select the reference plane and thus obtain greater flexibility in the process. "Many measured values – excepting the thermal focus shift – can also be determined via other measuring technologies. But the effort involved is disproportionately higher," he explains, adding: "Ophir's non-contact technology has completely changed the way the

"The team's willingness to measure, and thus the quality of our results, has significantly improved with the non-contact measurement technology."

Alexander Franz,
Diplom-Ingenieur at VW



With this in mind, he immediately recognized the advantages of the Ophir BeamWatch system from MKS. After a successful presentation of the technology at Volkswagen in Wolfsburg, it was decided to make the instrument an essential part of the research project.

Measuring multiple laser beams

The principle behind multi-focal welding is that several laser beams are generated simultaneously by a laser beam optic. The innovative process technology joins hot-dip galvanized sheets in a zero-gap configuration. In a beam setup with two highly focused, forward laser beams and one main welding spot, two- and three-sheet metal joints are produced with high seam quality. The trick to it, among other things, is keeping the geometry of the laser beams in exact relation to one another – but in order to do this, you first have to measure them.

team views measuring. Their willingness to measure, and thus the quality of our results, have together contributed to significant improvements overall." Whereas previously, because of the effort, the colleagues might have thought twice about whether a measurement was actually necessary, now they just do it. Instead of taking more than five minutes, a measurement is now complete in less than 1 second, and the prep time is also short. A power connection and possibly a network connection are all that are required to run the instrument. Operation of the measuring device is made even simpler by integrating it into the robot-guided welding cell that the development department uses in their offices for testing. The Ophir BeamWatch system is directly connected to the PLC, so all readings can be directly processed and stored as required.

A wide variety of applications

Because the instrument is simple to operate, it makes it interesting for other applications as well: The Ophir BeamWatch system is often called upon to assess process dynamics and optimize production processes. Thanks to its compact dimensions, it is easy to transport and use for troubleshooting purposes or for general process optimization in production. And measuring goes so fast that the usual pause times can be utilized for it. Alexander Franz is also very positive about collaboration with the manufacturer: "There's intensive back-and-forth about technology and we provide input for new functions. At the same time, we also get quick answers to our questions." The laser experts in Wolfsburg also regularly pass along their experience internally: In addition to multi-focal welding, the Group also has applications for multi-focal laser soldering. With this joining technolo-



gy as well, the laser parameters must be closely monitored in order to ensure the required stability when doing, for example, high-temp soldering of roof side panels. The beam arrangement here is completely different, but the demands on the measurement technology are similarly high. Of one thing Alexander Franz is certain: "It's impossible to imagine our daily work now without the Ophir BeamWatch system. It has expanded our measurement capabilities enormously."

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CASE STUDY



WHY MKS?

CRITICAL TECHNOLOGIES	PROVEN PARTNER	OPERATIONAL EXCELLENCE	COMPREHENSIVE PORTFOLIO
World-class technology and development capabilities for leading-edge processes	Recognized leader delivering innovative, reliable solutions for our customers' most complex problems	Consistent execution across all aspects of our business	Largest breadth of product and service solutions for the market we serve

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WHY OPHIR?

Ophir is a brand within the MKS Instruments Light & Motion division. The Ophir product portfolio consists of high-performance laser and LED measurement technology. Ophir stands for:

- **Stability** – For more than 40 years, Ophir has developed laser measurement systems. This integrates perfectly with the long-term stability and growth of MKS, itself founded in 1961.
- **Variety of products** – Ophir's product range includes sensors to measure laser power and energy; beam profilers to measure focus shift and beam quality, including industry-leading non-contact measurement systems; and technologies to measure LED luminaires
- **Individuality** – In addition to the continuously growing portfolio of standard sensors, Ophir develops customer-specific OEM solutions for individual application requirements.
- **Service** – Ophir offers service and calibration centers worldwide that are ISO17025 certified or are in the process of accreditation.

For further information please visit www.ophiropt.com

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