CASE STUDY

INNOVATIVE MEASUREMENT TECHNOLOGY ENABLES NEXT LEVEL INDUSTRIAL AM

Reichenbacher relies on Ophir BeamPeek Measurement System

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Members of the SCHERDELGroup

The metalworking industry is evolving. Additive manufacturing methods — even in combination with machining treatments — are paving the way for more efficient processes and innovative designs. Reichenbacher Hamuel GmbH has recognized this potential. In very short order, the company developed industrial additive manufacturing systems based on the laser powder bed fusion process. Here, measuring technology plays a decisive role: The company uses the compact Ophir® BeamPeek high power laser beam analysis and power measurement system from MKS Instruments for research and development, as well as for quality assurance and maintenance. The Reichenbacher team was impressed by both the system's ease of operation and the wide range of measurement options it offered.

Customized additive manufacturing systems

Reichenbacher, which is part of the SCHERDEL*Group*, is known worldwide primarily for its high-quality 5-axis CNC machining centers, which are used in aircraft, automotive, ship and rail vehicle construction, as well as in the woodworking industry or by manufacturers of components made of aluminum, plastic or composite materials. In the metal processing sector, the company has expanded its portfolio to include the design and production of large-format, industrial-scale additive manufacturing systems. Together with experienced partners, Reichenbacher implements customized systems that integrate the entire process chain of laser powder bed fusion (LPBF). Knowing and verifying the parameters of the laser beam at every stage of development proved to be essential, as Dr. Alexander Kawalla-Nam, Head of Additive Manufacturing at Reichenbacher, explains: "Laser systems for additive manufacturing are very complex. Especially our large-format systems, which have multiple laser sources, must be optimally adjusted to ensure production quality. This is why we were looking for a measuring device that could be used for testing throughout the entire lifecycle of our products, from development to maintenance."

Products:
- Ophir BeamPeek® High Power Laser Beam Analysis and Power Measurement System
- Ophir Ariel Industrialized Laser Power Sensor with Display

Area of application:
- Special machine construction, additive manufacturing systems

Direct uses:
- Research & development
- Commissioning
- Maintenance and service

Benefits:
- Short measuring times
- Simple to use
- No water- or air-cooling needed
- Robust

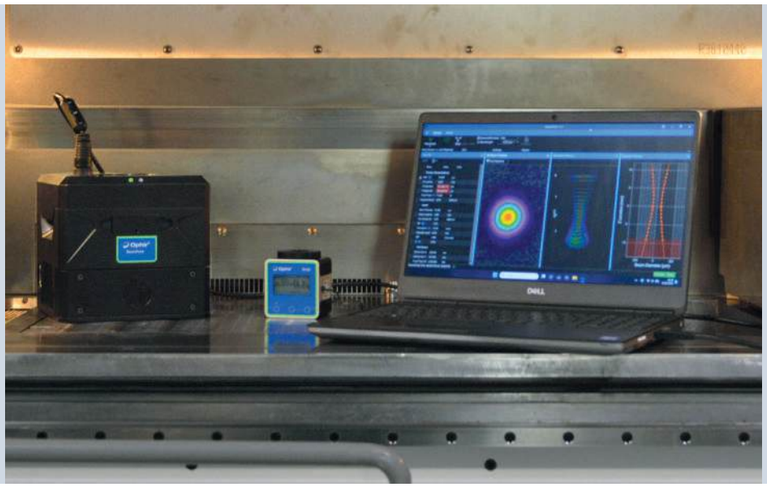


Figure 1– 2: Measurements taken with the Ophir BeamPeek device (while actively measuring, the chamber will usually be closed) are directly transferred to the BeamPeek software on the laptop (outside the chamber). The Ophir Ariel measurement device (Figure 2 in the center) shows results on the display or transmits data eg. via Bluetooth.

Handling without set-up changes

Because the essential first step of any project is to define the requirements, the Reichenbacher team compiled the specifications for a measuring device that would suit their application. In terms of the range of functions, the machine manufacturer was concerned with measuring individual parameters of the beam, such as its diameter, position, and shape, as well as the power and power density. But the system should also be able to display the beam caustics, i.e. a representation of the beam from the processing optics to the focus and any subsequent expansion. Equally important to the team was ease of use: “We work with fine metal powders in space-constrained construction chambers, so we wanted to avoid water- or air-cooling at all costs in order to make it as easy to operate as possible, also for the service technicians,” explains Lukas Gahn, development and application engineer at Reichenbacher.

“The BeamPeek system quickly provides us with all the relevant parameters, both when evaluating the laser sources and when configuring the laser setup. This saves us valuable development time.”

Dr. Kawalla-Nam, Head of Additive Manufacturing at Reichenbacher

Innovation at just the right time

The team started a market analysis and evaluated various measuring devices that were already available. That was right when MKS Instruments was launching its new Ophir BeamPeek analysis system, which was developed specifically to meet the requirements of additive manufacturing.
For Dr. Kawalla-Nam, the timing was perfect: “The BeamPeek system appealed to us straight away: It’s compact, it requires no water- or air-cooling, and its semi-automated analysis software also lets you calculate the beam caustic parameters and display them in relation to the building plane in the AM chamber. As beta testers, we were given the opportunity to share suggestions for optimization with the development team.” The innovative measuring device uses a patented* concept based on replaceable cooling inserts to absorb the resulting laser power. This avoids downtime between measurements without having to use water or active fans in the build space and is thus ideal for measuring the lasers in the Reichenbacher L-PBF systems. In just a few seconds it delivers the beam profile, a focus analysis, and a power measurement, as well as the beam caustic.

Flexibility saves time and money

Additive manufacturing systems from Reichenbacher are built individually according to the customer’s requirements. They are also ‘open’ systems with regard to the material used. In order to optimally adjust the various laser sources, optics and materials to each other, the beam parameters must be measured and compared again and again.

In the AMS 800 (build volume 800 x 800 x 500 mm) and the AMS 400 (build volume 400 x 400 x 500 mm), four fiber lasers with a laser power of 1 kW each work together on a single print job. The quality of the manufactured component can only be guaranteed if all laser systems comply exactly with the specifications.

The team uses the Ophir measuring system regularly, starting with the development process: “Since the customer has free choice in terms of the type of powder they’ll use, the laser source type also has to vary. The BeamPeek system quickly provides us with all the relevant parameters, both when evaluating the laser sources and when configuring the laser setup. This saves us valuable development time,” reports Dr. Kawalla-Nam.

Fast identification of sources of error

The beam analysis system also provides crucial information when it comes to troubleshooting, as this example shows. After an optimization step on the protective glass for a plant’s optical systems, the team carried out a control measurement using the BeamPeek system. In principle, a before-and-after comparison of the laser’s beam parameters should prove whether the optimization was a success. Both the laser beam diameter in various planes and the laser power in the focal plane were measured. But here, there were inexplicable deviations in the measurement values. The reason quickly became clear when one looked at the shape of the beam: It was suddenly elliptical at the focal plane. After checking the optical components, this was traced back to contamination on the outside of the protective glass (not accessible from the build chamber). After the dirty piece had been removed, cleaned and reinserted, a new control measurement showed an almost perfectly round laser beam in the focal plane over the entire 80 W–1000 W power range (see figures 3 and 4).

Figure 3 left: A contaminated protective glass results in an elliptical beam.

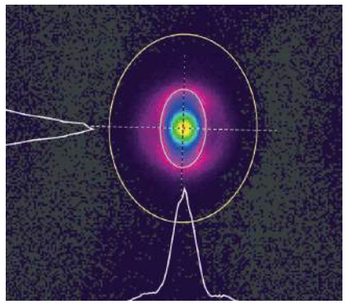
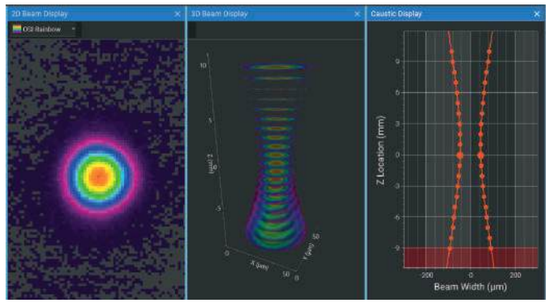


Figure 4 right: After cleaning the glass, the beam is round and symmetrical.



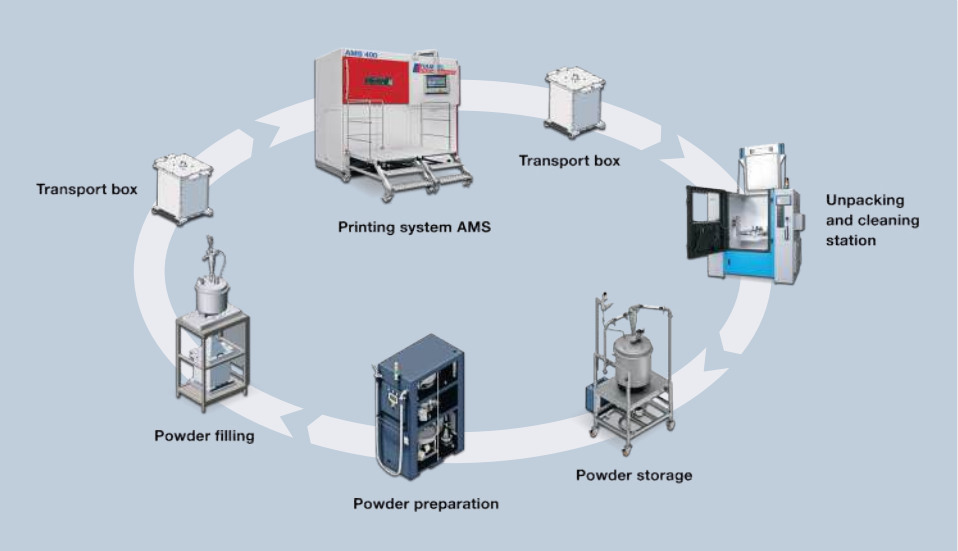


Figure 5 – 6: Reichenbacher implements customized systems that integrate the entire process chain of laser powder bed fusion (LPBF). Ophir measurement devices are key to achieve high product quality throughout the process chain.

A partnership with a future

Measuring the laser beams at the building plane is essential for Dr. Kawalla-Nam's team. Beam shape, laser power and beam caustics are key parameters for ensuring the quality of the system – and therefore also the production quality. When they only need to measure the laser power, the team will also sometimes use the even more compact Ophir Ariel Industrialized Laser Power Sensor with display. But most of the time, Lukas Gahn turns to the BeamPeek system: "Ophir Ariel is great when it comes to measuring laser power. However, since we're primarily interested in the beam caustics, we usually work with the BeamPeek system. Even so, it only takes a few minutes to set up the measurement, which then only takes seconds."

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This case study was prepared in cooperation with Reichenbacher Hamuel by Dagmar Ecker, MBE (Master of Business Engineering). Many thanks to Reichenbacher Hamuel for providing the photographs and the graphic used herein.