

From Users For Users

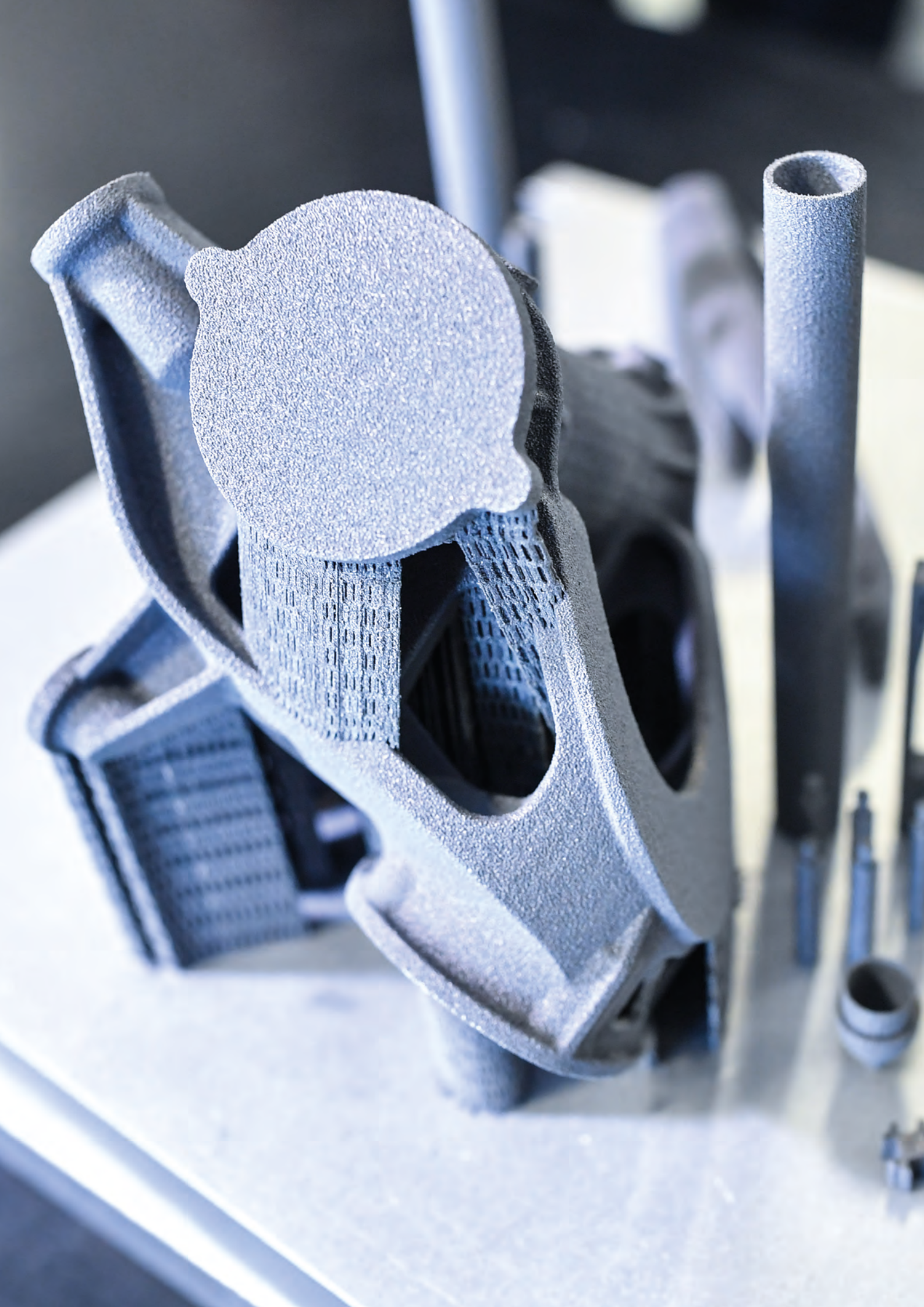


LIGHTWAY / Niederzissen / Germany

Metal printing on the test bench

LIGHTWAY ensures the quality of its additive-manufactured components with the ZEISS COMET





Economic analysts are forecasting impressive growth rates in industrial 3D printing. LIGHTWAY GmbH & Co. KG, headquartered in Niederrissen, Germany, is proof of this trend. As a full-service partner for 3D metal printing, this young company tripled its revenues in 2018 – a testament to the founders' commitment to quality. LIGHTWAY has been working with the ZEISS COMET 3D scanner since 2018.

Is it possible to create a sintered metal part almost entirely without support structures? Thomas Hilger, one of the two managing directors of LIGHTWAY GmbH & Co. KG, knows how to do this. He understands the ins-and-outs of this material so well that he can create optimized designs and then print high-quality parts. As evidence, he holds up an aluminum component no bigger than his fingertip. It resembles the bud of a flower with numerous interconnected filaments.

„We make these without the support or anchoring structures typically used to prevent the part from warping as the laser melts the powder grain by grain. This way, we reduce the amount of metal powder required by a good ten percent,” explains Hilger. „Moreover, we don't have to remove the structures later on, saving us time and money.” And thanks to the company's finely tuned production processes, there is also no need to machine printed parts to correct warpage.



For the trained mechanical engineer, quality controls are „never a cost block to be rationalized away or a time-consuming compulsory task”, but rather the „foundation of our work”, says Thomas Hilger, Managing Partner of LIGHTWAY.

In addition to the grain size of the metal powder, the grain geometry and the laser power, according to Thomas Hilger around 180 other parameters influence the 3D printing and thus the quality of the components.



Thomas Hilger and Pascal Schäfer went into business for themselves in 2016. In Niederrissen they founded LIGHTWAY GmbH & Co. KG, a full-service provider for industrial metal printing.

All shapes and sizes

„The continuous improvement of manufacturing processes remains the exception rather than the rule,” says Hilger. Selective laser melting (SLM) is still a new technology. Since not every customer knows about the opportunities and challenges of SLM, companies contact LIGHTWAY to find out how much it would cost to print a part they currently mill.

“In these cases, switching would almost never pay off,” says Hilger. “Additive manufacturing is not a substitute form of production. Instead, it enhances conventional techniques.” Hence the new company also mills both printed and non-printed components for customers. For Hilger, the primary benefits of additive manufacturing are the freedom companies have when designing the part, and the ability to transform a CAD model into a functional component at great speed.

To show what he means, Hilger holds up two objects: an air vent for a computer designed and printed by LIGHTWAY along with a traditional vent. The difference is astounding. Rather than constructing four aluminum parts around 10 centimeters high for cooling the processors, the customer now only needs to assemble two or three snake-like ventilation tubes measuring four centimeters in height and twenty

centimeters long. These cooling elements comprise individual discs, and the part simply could not be produced with standard manufacturing methods.

“It isn’t just that the customer has smaller components, reducing material costs. What really impresses them is how reliable these parts are,” says Hilger. In the past, the customer had to accept that overheating would mean service calls and consequently system downtime. These repairs proved extremely costly, especially when the company’s computer systems were in use in far off locations like Dubai.

Quality assurance is indispensable

Hilger knows that only high-quality parts will live up to expectations. Inspections, reports and assessments are all familiar territory for this young entrepreneur, who previously worked in the quality management area of an aerospace

„For us, ZEISS was the partner of choice for ensuring our customers get the quality they need.”

Thomas Hilger, Managing Director

LIGHTWAY GmbH & Co. KG

company for several years. And since Hilger understands that quality depends on the actions of every single employee, a mirror hangs in the production area with the question: “Who is responsible for quality?”

“Quality checks are never a cost factor or time-consuming activity that we would consider eliminating – they are the very foundation of our work,” says Hilger, who trained as a mechanical engineer. This attitude is reflected in his company’s quotations. LIGHTWAY usually does not differentiate between quality control costs and other manufacturing expenses. “Inspections are an inseparable part of the additive manufacturing process. End of story,” says Hilger.

This successful strategy was one of the foundational cornerstones for this manufacturer, which creates components for



David Hüls (left), Applications Engineer 3D Scanning at ZEISS Industrial Quality Solutions, in conversation with Thomas Hilger. He is interested in the measurement tasks facing the entrepreneur.

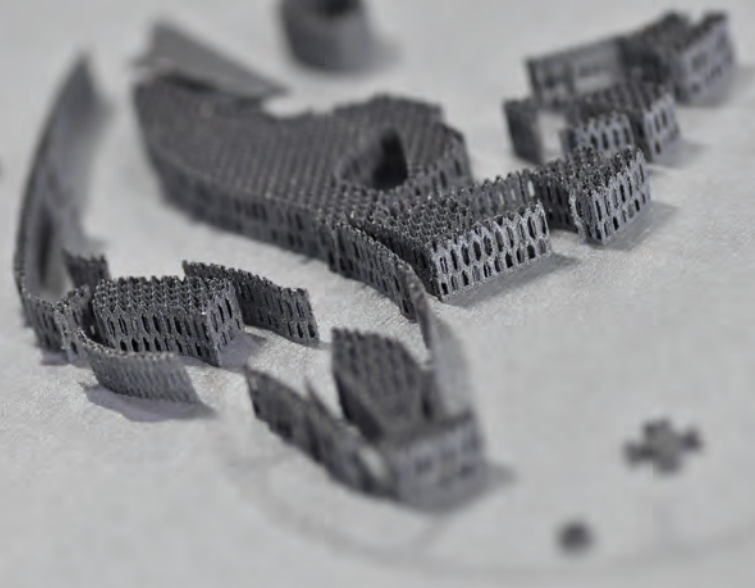
use in industrial production along with prototypes and pre-series parts. With each quality check, Hilger and his team learn more about their own manufacturing processes. This enables them to continually improve. To stay competitive, Hilger does not want to go into any greater detail about the learning curves. Needless to say, just filling a printer with powder and hitting the start button will not deliver the desired results – that much is clear.

Hilger explains that around 180 different parameters affect 3D printing. More specifically, the size and geometry of the powder grains, the gas flow and laser guidance are the key factors. Selective melting with a laser requires that the powder be evenly applied to the build plate throughout the entire printing process. A laser beam then melts the powder one grain at a time based on the CAD data. Hilger proudly reports that “depending on the component geometry, we can produce components with a density of 99.8%, and a tolerance range of just 0.1 mm.”



The ventilation element designed and printed by LIGHTWAY contains a lamella fan on the inside and could not be produced using conventional manufacturing methods. It replaces four aluminium parts approx. ten centimeters high (bottom picture). The additive robot ankle joint (right) is made of titanium.





The 3D printing allows a large geometrical design freedom.



LIGHTWAY received the order for the production of a robot ankle joint from the Technical University of Munich because they were also able to take over the finishing of the high-strength part.

Printing know-how

Together, Hilger and Pascal Schäfer, the company's other Managing Director, have built up this expertise over several years. The two men started devoting much of their time to learning more about additive manufacturing long before the company's founding in 2016. Hilger and Schäfer used to spend up to 14 hours per day on weekends playing

around with this process that had fascinated them from the moment they first heard about it. While still holding day jobs, they decided – without any concrete entrepreneurial ambitions – to experiment on their own, designing complex plastic parts and printing these simply out of curiosity.

Confident that this process would shape the future of manufacturing, the two men decided to set out on their own in 2016. "We would never have dared

to take this step earlier," says Hilger. "But the latest generation of printers is capable of producing robust parts for industrial use."

Hilger believes measuring solution providers have begun to appreciate the relevance of metal printing for manufacturing companies. "What I like about ZEISS is its extremely broad solutions portfolio. Whether you need an electron microscope, a 3D scanner or a computer tomograph, ZEISS solutions enable you



Pascal Schäfer, also managing partner at LIGHTWAY, in front of one of the two 3D printers.



In selective laser melting (SLM), the parts are built up layer by layer from the metal powder. The excess powder is removed after the printing process.

to monitor component quality before and after each step in the production process,” says Hilger.

The Managing Director sees the variety of systems and the corresponding software solutions on offer as “a major plus.” Currently, he works with the 3D scanning software ZEISS colin3D and the measuring software CALYPSO for the quick, easy and reliable capture of standard geometries. While Hilger still evaluates his measurement data in Excel rather than the software ZEISS Pi-Web, he is starting to rethink this choice: “Manual entries are very prone to error.”

Quick feedback

Until the beginning of 2018, all of LIGHTWAY’s quality checks were performed by external service providers, and it usually took a week until the results were available. In order to obtain feedback more quickly, this company located near the city of Bonn invested in the ZEISS COMET 3D scanner.

To demonstrate the speed and precision of this system, Hilger took a printed ankle joint made of titanium for a robot from the Technical University of Munich. The ZEISS system employs fringe projection with phase shift, which projects structured light onto this metal part the size of a small fist. A camera records any deviations on the topography of the scanned object from the model. The software then calculates the distance between the camera and the object pixel by pixel via triangulation. The result, a virtual 3D model of the metal ankle, appears on the screen.



LIGHTWAY uses the ZEISS COMET scanner to digitize the component, here the ankle joint of a robot. It projects a phase-shifted fringe pattern onto the fist-sized metal part.

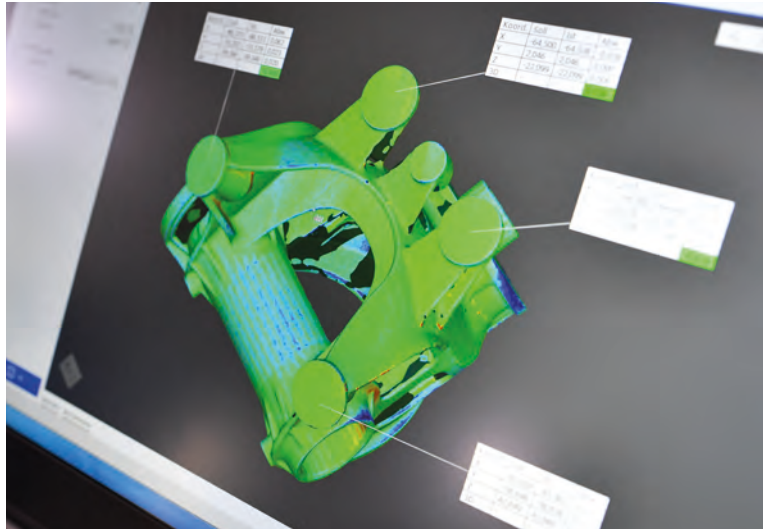


The rotary table of the ZEISS system allows the component to be completely measured in a single measuring cycle.

„For our company, ZEISS was the way to go. Not only do they offer the right systems portfolio for additive manufacturing, but their comprehensive metrology expertise also helps us optimize our processes.“

Thomas Hilger

To identify errors and tolerance overshoots, Hilger compares this image with the CAD model. If the workpiece becomes warped during the printing process or its removal from the build plate, he sees this on the monitor. The COMET system delivers excellent data quality and therefore highly accurate measurement results at lightning speed with a length measurement deviation of up to 20 μm . „All this know-how helps us deliver consistent quality at competitive prices,” says Hilger. This achievement has not gone unnoticed.



After scanning, you can immediately check whether the captured 3D model matches the CAD model or where there are deviations. With the ankle joint shown, everything is in the green range.



Pascal Schäfer sets up the ZEISS COMET sensor. For him, the entire system is „extremely easy to operate and very intuitive“.

David Hüls, Applications Engineer 3D Scanning at ZEISS Industrial Quality Solutions, is learning from Pascal Schäfer (right) how LIGHTWAY uses the ZEISS COMET scanner.



A modified CAD model for optimized printing

The young company's customer directory already contains more than a hundred entries. LIGHTWAY works with 15 of these companies on a regular basis. One of them is an automotive OEM supplier. Over the past weeks, Hilger and his team have been printing aluminum parts about 30 centimeters wide and 25 centimeters in height for this customer.

Confidentiality rules prohibit him from revealing what this part will be used for in the vehicle once batch production of die-cast parts begins. Yet just looking at the component illustrates why LIGHTWAY needs the 3D scanner for more than just run-of-the-mill quality control.

Since the customer can check in pre-production if the cast parts are an exact fit, the dimensional requirements are extremely high. Thanks to the scan, LIGHTWAY was able to reverse the printing errors in the CAD model. "This way,

we achieved perfect printing results very quickly," says Hilger.

In-house measurements preferred

The 3D scanner from ZEISS is just the first step in optimizing internal quality assurance at LIGHTWAY. Next year, Hilger and his team will start working with a coordinate measuring machine (CMM).

Even if the scan can be used to check a large part of the component characteristics, an evaluation is not possible at optically inaccessible points due to the shading. In these cases, a CMM is the way to go. While Hilger is not yet sure which CMM he will choose, one thing for certain: it will be a ZEISS system. "Opting for ZEISS is about more than the quality of their measuring systems and the amount of information these provide – as an employee, I was always very pleased with ZEISS' service and reliability," says Hilger.

Yet LIGHTWAY is planning to invest in more than just a CMM. In light of their healthy order intake, the company will purchase a third 3D printer. This one will be designed for industrial batch production and works with multiple lasers, cutting the printing time for a part in half.

"All these investments will make us better," says Hilger. And thanks to strong economic trends, Hilger and Schäfer have tripled their revenues within a year and are currently generating a seven-figure sum. In honor of this positive growth, LIGHTWAY will build a new production hall with over 1,200 square meters of floor space next year. Quality assurance will be located at the center – you might even say at the heart – of this facility.



LIGHTWAY uses a five-axis metal-cutting machine to further process the titanium ankle joint for the robot at the Technical University of Munich.



Threads were inserted into the ankle joint of the robot. Schäfer holds the part in his hand in front of the processing machine.

A reliable partner

Whether or not Hilger will check the quality of the metal powder in-house with an electron microscope depends largely on how the company develops in the future. Under the right circumstances, this investment would definitely pay off since ultimately, without the right powder, LIGHTWAY cannot print any high-quality parts.

At least three samples are taken from

each batch of powder. An external lab currently checks grain size, size ratios, etc. The customer's specifications determine which powders are needed.

Thus Hilger first has to know what his customer's part will ultimately be used for. LIGHTWAY then validates the defined component properties via a grinding pattern or tensile tests. To check mechanical stability, this innovative company also uses a computer

tomograph to look for cavities and tears immediately following printing, the part's removal from the build base or heat treatment. "Thus we haven't ruled out working with a computer tomograph in the future. The investment just has to be worth it," says Hilger.

"As we grow, we will continue to expand the number of ZEISS quality assurance solutions at LIGHTWAY," says Hilger, who also teaches engineering

The two founders have been fascinated by additive manufacturing for eight years now. After each order, they exchange ideas on what they can do even better in the future.





„As we grow, we will continue to expand the number of ZEISS quality assurance solutions at LIGHTWAY.“

Thomas Hilger

students at different universities about the opportunities afforded by SLM. “For us, ZEISS was the way to go. Not only do they offer the right systems portfolio for additive manufacturing, but their comprehensive metrology expertise also helps us optimize our processes.” The first example that springs to mind is the ZEISS quality assurance chart for additive manufacturing, which links its measurement systems to each process step. “This shows how well ZEISS understands the challenges of 3D printing,” says Hilger.

Having a ZEISS Metrology Center nearby in the city of Cologne to address any problems gives Hilger greater peace of mind. Yet for him, this is all about more than just quality assurance. Hilger wants to learn as much as possible to prevent defects in the design phase: “Here ZEISS has helped us a lot.”



According to Pascal Schäfer (pictured), quality is not a matter for the boss at LIGHTWAY, but concerns every employee. To remember this, a mirror with an inscription hangs in the production area.

Brief Profile

LIGHTWAY

The full-service partner for 3D metal printing is a competent partner in the additive manufacturing of metal parts for a wide range of applications. The young, committed team has experience and in-depth knowledge: From prototyping and product development to design and SLM production.

ZEISS IMT - Application + Success Story

System	ZEISS COMET
Customer	LIGHTWAY, https://lightway-3d.de
Industry	Additive Manufacturing
Created	February 2019

Carl Zeiss

Optotechnik GmbH

Georg-Wiesböck-Ring 12
83115 Neubeuern
Germany

Phone: +49 8035 8704-0
Fax: +49 8035 1010
Email: optotechnik.metrology.de@zeiss.com
Internet: <http://optotechnik.zeiss.com>