Application Note

WESO-Aurorahütte GmbH: Optical Metrology Supports the Continuous Improvement of Processes

Location/country: Gladenbach, Germany
GOM systems: ATOS Triple Scan
GOM software: ATOS Professional
Sector: Foundry

In order to remain competitive, WESO focuses on the continuous improvement of processes. By means of optical metrology and the necessary expert knowledge, the foundry has managed to guarantee the quality of finished cast parts and to optimize the entire production process.

Imaginative and future-oriented – buzzwords which both fully describe WESO-Aurorahütte GmbH. The foundry, with its headquarters in Gladenbach, has a long company history to look back on. It was founded 130 years ago and has maintained its original spirit of progress to this day. Therefore, it should come as no surprise that in the field of quality assurance, more efficient processes are also being continually developed. The company takes the approach of viewing manufacturing metrology as an integral part of the production process – from design through to final checks. The goal of modern manufacturing is to guarantee product quality through the optimization of processes. In other words: Modern metrology entails process knowledge and, therefore, process control.

Full-field measuring results ensure process knowledge

In order to be able to develop any approaches for process optimization at all, it is particularly important to have knowledge on all actual states at hand. This applies to tools, patterns, core boxes and molds but also to the final product to be manufactured. Only when you have complete knowledge of all parameters involved can you derive potential ways in which processes can be optimized. Against this backdrop, WESO-Aurorahütte invested in optical metrology as early as in 2004. In contrast to tactile metrology, non-contact functioning technology delivers full-field 3D measuring results. Simultaneously, the foundry industry demands practical solutions for a robust production environment. In order to do justice to the special characteristics of a foundry, WESO decided on a 3D measuring system from the ATOS series. The system meets requirements in terms of accuracy and precision without neglecting the needs of the foundry industry. Moreover, the 3D coordinate measuring system enables flexible handling, meaning that whole tools can also be measured from the point of production. The ATOS Triple Scan System's Blue Light Technology is an additional advantage: Due to the narrow-band blue light from the LED projection unit, the 3D scanner can carry out precise measurements, regardless of the ambient lighting conditions.

Getting creative with digital data

Since the new measurement technology was introduced at WESO, reworking time has significantly reduced and the manufacturing processes have been optimized and sped up. "Manufacturing a gear box is an example of this," explains Achim Beimborn, engineer. "With this particular cast part, we measured a deformation on the surface of the cast after the cooling process which could be traced back, not to the pattern or mold, but to the material behavior."

At first glance, you may identify that the actual geometry significantly deviates from the nominal geometry, especially on the working surfaces (Fig. 1). "The problem here was, however, that the deviation was not distributed uniformly, instead, each point had a different level of deviation," explains Beimborn.

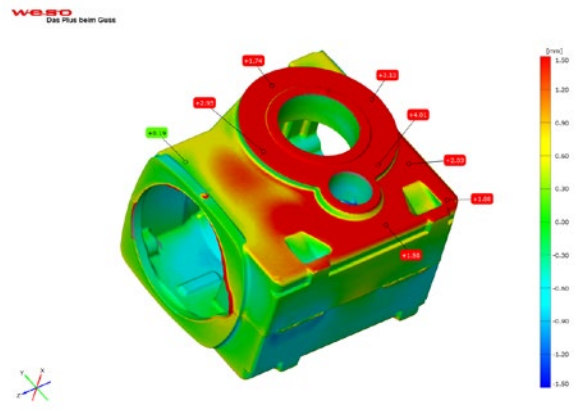

Fig. 1: Full-field measuring results after the gear box's first casting

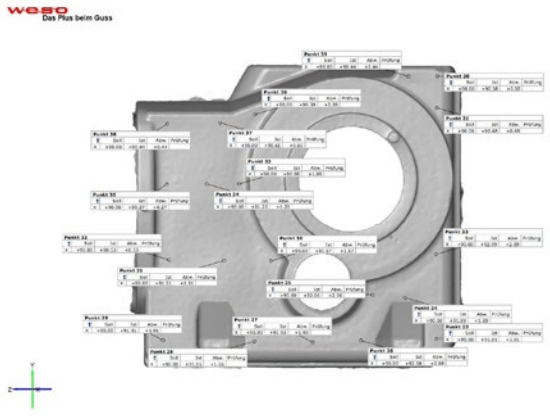

Fig. 2: The inspection of the individual points shows that the deviation is distributed nonuniformly between 0.19 mm and 4 mm.

Using surface deviation points within the GOM Inspect software, we were quickly able to detect that the deviation varies from point to point (Fig. 2). Overall, the deviation spanned within a range of several millimeters. Of course, this creates problems if the cast's raw parts are inserted and clamped in the processing device for finished part processing.

The prerequisite for a perfect component is for the attachment point, or contact point, to be compliant with the 3D data in the measuring comparison. If the component on these surfaces buckles or falls, the processing of the entire finished part is shifted to the raw cast. In comparison: Although tactile measurements would have generated punctually accurate measuring results, they do not make comprehensive knowledge of the entire surface possible. Finding the problem in this way would be very laborious and would also require blindly trying out a solution. In contrast, comprehensive knowledge about all the surface defects, with the option of being able to select individual points, offers a solid basis for efficiently finding a solution.

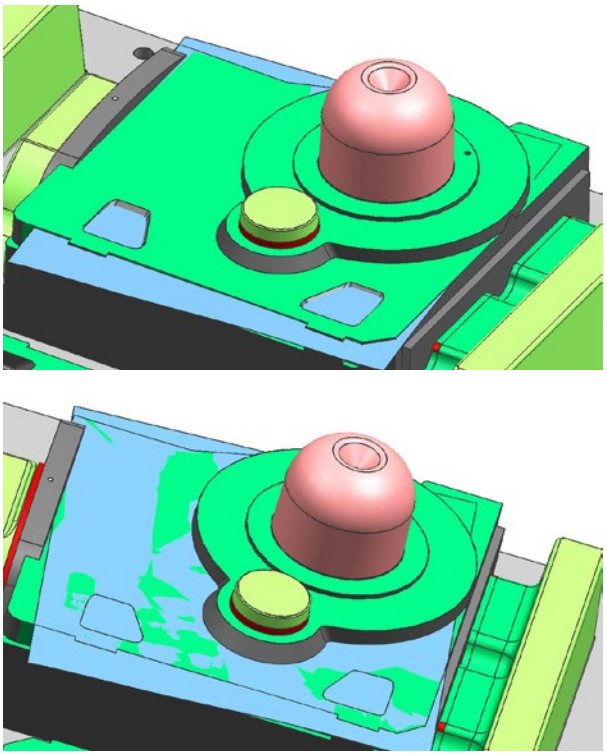

Fig. 4: The CAD model (green) is adjusted to match the freeform surface created (blue).

Combination of 3D metrology and engineering

With the knowledge of where exactly the problem lay, WESO exported the 3D measuring results in the form of a point cloud in the CAD model in the Siemens NX Software as the first step towards a solution. Using the best-fit alignment, the surface deviation points can be placed directly on the pattern. Within the CAD software, the individual points, which were convexly deviating during the first casting and thus overcome, could simply be shifted by twice the corrective value in the opposite concave direction. Therefore, a correcting freeform surface is constructed based on the first scan, which counteracts the warpage, boost and residual stress of the deviating cast surfaces. "Additionally, we have to shrink the scale by 1 % on the point cloud. When constructing the pattern, the material allowance was also calculated, but not included for the cast gear box, and, therefore not included for the point cloud either."

Fig. 3: The constructed freeform surface based on the 3D measuring data

The newly constructed freeform surface (Fig. 3) lies significantly below the CAD contour as a result. For this reason, the CAD model must be adjusted („morphed") to match the newly constructed surface in the next step. Through this procedure, the CAD model is adjusted to match the recreated freeform surface. The CAD models in the upper and lower boxes are then rounded again.

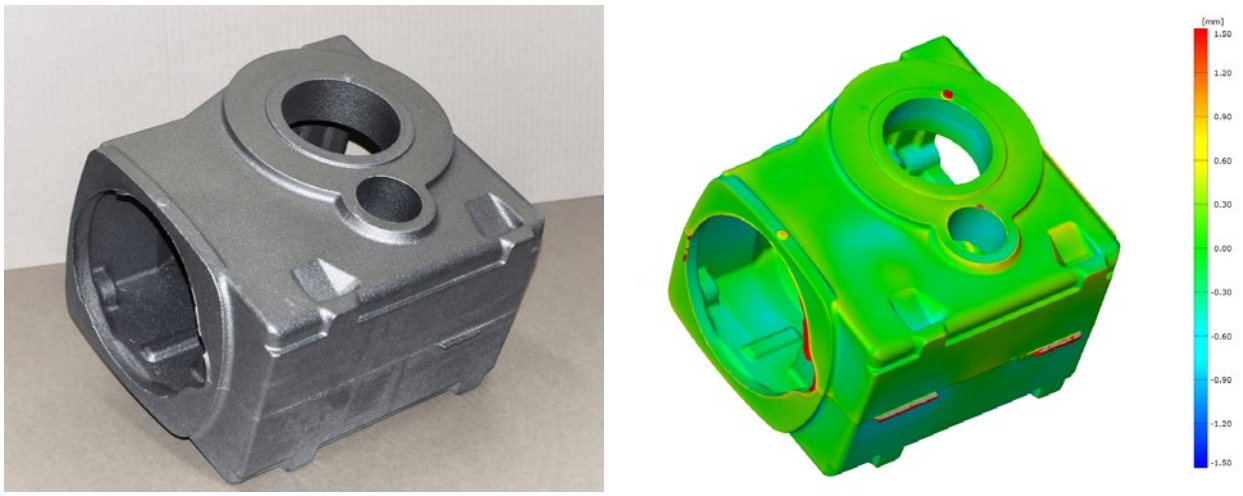

Fig. 5: The nominal-actual comparison after casting shows that the cast part now lies fully within the tolerance range.

"It even works when several patterns are placed on a pattern plate," says the designer. "On the pattern plate in this example, half of each of the four patterns are in the lower box and half in the upper box. As the position of the individual patterns is known, we can directly scan in all four casts and then import, position and edit the point clouds in one process step." The pattern halves are then re-milled in the pattern making stage and molded and cast a second time. "Since we developed this process for ourselves, we have been able to get to the appropriate result through just one correction loop and can start the series," explains Uwe Strobl, Divisional Manager for Technology.

The close collaboration between design and production, in conjunction with optical metrology, has been crucial in the development of this approach to finding solutions.

Furthermore, wear inspections of the pattern equipment, tools and core boxes are carried out using ATOS Triple Scan after an agreed amount of molding.

"The full-field ATOS measuring results are no longer at all comparable with tactile ones. Even communication with customers has become significantly easier with 3D visualization," concludes the Head of Technology.

Overall, it is evident that process knowledge is essential for the efficient optimization of processes. Full-field quality measurements can speed up process optimization, especially during the first few process steps. For the foundry industry, optical and mobile measuring systems like ATOS 3D coordinate measuring system offer the possibility to intervene early in the process and can be flexibly used in the measuring room or directly in production. In light of rising quality demands, increasingly flexible solutions will be required, which are robust and which simultaneously meet the necessary requirements for precision. A large number of influencing variables and factors have an impact on the foundry process. In order to meet these requirements, it is necessary to ensure the technical preconditions are in place. Innovative measuring technologies offer possibilities, because they digitally supply full-field measuring data and thus comprehensive knowledge. This is how intelligent and targeted answers to the challenges emerging from foundry process chains can be found.

WESO-Aurorahütte GmbH

As one of Germany's major foundries with a workforce of more than 400, WESO-Aurorahütte GmbH specializes in producing high-quality grey-iron castings that are used internationally for various demanding applications. With a production capacity of currently 28k tons, the casting components are distributed to customers in diverse industries (e.g. heating-, agricultural- and railway-technology). As system partner, WESO supports its customers in the component construction, internal model-making as well as final processing and turnkey assemblies.

GOM GmbH

GOM develops, produces and distributes software, machines and systems for 3D coordinate measuring technology and 3D testing based on latest research results and innovative technologies. With more than 60 sites and more than 1,000 metrology specialists, GOM guarantees professional advice as well as support and service. More than 14,000 system installations improve the product quality and manufacturing processes in the automotive, aerospace and consumer goods industries.

Fig. 6: The projection unit of the ATOS Triple Scan system is based on Blue Light Technology. Since the sensor works with narrow-band blue light, interfering ambient light can be filtered during image acquisition.