

Application Report – Image-based, fully automated inspection upon blowholes sized 0.4 mm upwards

An eye on everything

Every manufacturer of die cast parts would like their products to be free from blowholes – however, these cavities may form by shrinking material volume in the melt solidification process and impair the function of a component. Since 2016 Gruber & Kaja has been using a multi-camera system developed by AUTFORCE to reliably detect blowholes 0.4 mm and larger in components sized 350 × 400 mm to ensure customers receive aluminum die cast parts free from blowholes. With the help of six industrial cameras from the Baumer LX series, the specialists in image processing succeeded in solving a task where automation was deemed to be impossible.

As an automotive supplier specializing in engine-related aluminum die cast parts, it is imperative that Gruber & Kaja High Tech Metals GmbH produce components free from blowholes. This is critical to their success in ensuring their capability for producing quality and durable products. Particularly in the sealing process of flat, CNC-machined surfaces the sealing lip must be properly in place to fully rest on the surface. An increase in demand led Gruber & Kaja to realize the need for a higher automation level which drove the need for automated visual inspection which up until now has been a manual process. The task: components sized 350 × 400 mm should be reliably inspected

for blowholes 0.4 mm and larger. It took Gruber & Kaja more than one year to check out and evaluate the approaches by several component and system manufacturers. AUTFORCE Vision Systems GmbH in Lienz/Austria was the only one to meet the demanding specifications of Gruber & Kaja. The system approach of the Austrian experts for image-based inspection systems was convincing – also because quality inspection is followed by laser marking in rapid 50-second production cycles to ensure unambiguous component traceability.



Tiny cavities caused by shrinking material volume in the melt solidification process may impair the function of a cast component.

A successful piece of pioneering work

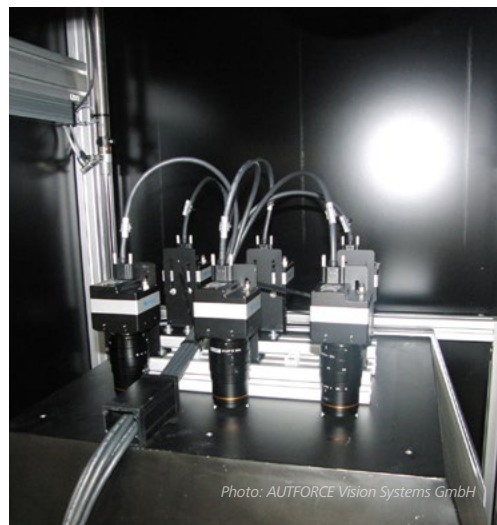
"We've broken new ground here. Neither we nor Gruber & Kaja knew of any system on the market that could automatically spot and evaluate such small cavities in components of the given dimensions", explains Stefan Perg, one of the managing directors at AUTFORCE. In addition to the blow-hole size, the minimum surface roughness within the specified active and passive sealing limits was a complex challenge. For example, the image was expected to reveal traces of surface machining such as milling grooves. The AUTFORCE solution: A multi-camera system with a particularly designed illumination dome. "Image acquisition by multiple cameras minimizes distortion and increased optical resolution. Additionally the illumination dome provides the optimum illumination to filter machining and milling traces to make them literally invisible", Mr. Perg explains the architecture of the system's center piece. Also space requirements were a challenge in the overall concept because there was a great lack of space at Gruber & Kaja compared to the relatively large components. "The existing installation at the intended location consumed all the space, requiring the system to be mounted on this unit. And of course, we also had to consider the maximum height of the robot arranging the parts in the cameras operating range", explains Mr. Perg.

The center piece: multi-camera image analysis

The system's centerpiece is an inspection cell with a dome-shaped illumination element equipped with slight overpressure to prevent the ingress of dirt. For image acquisition, AUTFORCE uses six Baumer LX series GigE cameras with 8 megapixel resolution. "The principal benefit of multi-camera image acquisition is minimizing distortion in each image while maintaining the full image resolution", explains Mr. Perg. Third-party-compatibility of the cameras allows for image analysis via HALCON®. For this purpose AUTFORCE designed a program using the individual images for building a pixel-accurate composite image which is compared against the component CAD data to define the inspection area. This all takes only a few seconds. Still in the evaluation process, the clamp holding the component turns 180 degrees for inspection of the opposite component side. The ratio between camera resolution and pixel size was an important selection criterion. "The ideal camera we were looking for had to feature a robust design, a sufficiently large chip size respective pixel size and yet a high optical resolution", explains Mr. Perg. Equipped with CMV8000 global shutter sensors



The illumination dome provides optimum conditions for surface metrology to filter traces of machining the component surface.



The individual images acquired by six Baumer LX cameras with 8 MP resolution are used to build a pixel-accurate composite image of each component side for evaluation by the help of CAD component data.

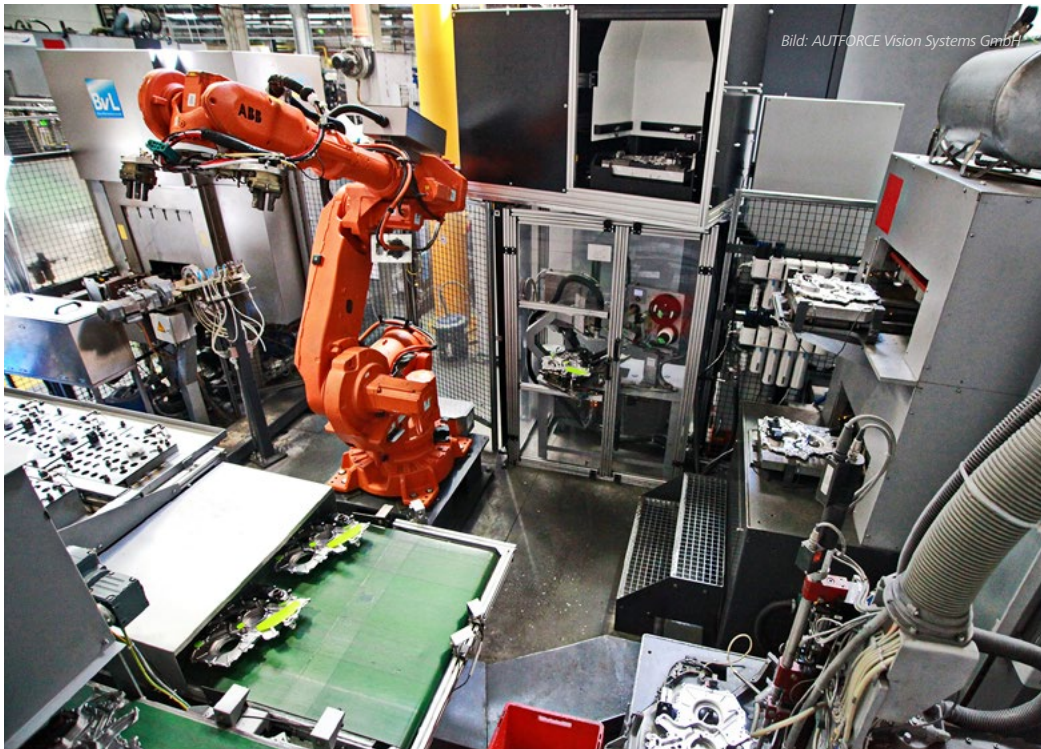


Reliable detection of blowholes from 0.4 mm upward at components sized 350 x 400 mm, with logging of position and size.

by ams (formerly CMOSIS), the high performing, industry-capable LXG-80 Baumer cameras with $5.5 \times 5.5 \mu\text{m}$ pixel size and a resolution of 3360×2496 pixels were the perfect choice. The GigE Vision® compliant interface allows for quick and cost-effective system integration also in the controller environment. "To us, a camera system utilizing a proven, fast and standardized data interface was a prerequisite", says Mr. Perg.



Thanks to 48 megapixel resolution and 337 fps, the LX cameras capture even the finest details with absolute reliability – even in high-speed processes.



Space was tight, reason why the system had to be installed in 2 m height on top of the existing installations. The robot feeds the system with the help of a pneumatic lifting door.

Process reliability thanks to traceability

After the image acquisition, the component is moved to another zone for laser marking. This is where date, time and DataMatrix code are imprinted to ensure full product traceability throughout the entire production process and product life cycle. Failing the blowhole inspection entails partial encoding for later completion after successful rework and when having passed all inspections. "In this way, the component is reported prior to entering the second cycle and any rework is already part of the stored product information", explains Mr. Perg.

Success all along the line

Thanks to the AUTFORCE solution, Gruber & Kaja have been able to increase efficiency and economic viability by a higher automation level with less manual handling and inspection effort, to enhance reliability by reproducible processes and to ensure complete documentation of every process step together with the related result. In addition, durable laser marking ensures reliable product traceability.

More Information:
www.baumer.com/cameras



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