Exactly read as lasered on

Assured Traceability through intelligent Sensors

A customized production control without the identification of various components is hard to imagine. Besides quality aspects, increasingly becoming the focus of attention are marketing strategies concerned with the traceability and trackability of parts: For instance, a custom-ordered car is nowadays assembled from a set of precisely known components. The prerequisite for this: Data Matrix codes (DMC) and high-performance sensors, as seen in the foundry of a leading Bavarian automaker.

Not just theory is all gray ... gray at first are also most of the cast parts made by BMW's foundry in the Bavarian Landshut. The plant currently employs about 3300 people in the sectors foundry, interior work, and exterior work, as well as in the production of universal joints and replacement engines. What is remarkable about the Landshut light metal foundry: For the series production, five different casting methods are employed depending on the technological requirements and the production volume: Sand casting, low pressure and gravity chill casting, die casting, and lost foam casting.

About 38,000 tons of aluminum and magnesium are used to produce approximately 1.5 million light metal components annually for the crankcases and cylinder heads of all BMW engines – from the two-cylinder for motorcycles up to the twelve-cylinder. The cast parts are also rough-machined in the plant. Consumers are the engine works of the BMW Group in Munich, Steyr (Austria) and Hams Hall (UK), where the finishing operation and the engine assembly take place.

Information in a Square

BMW in Landshut early on had the idea of making cast parts identifiable by a unique code, and to read this code fully automatic with a camera system. Used for this is a Data Matrix code (DMC) with 16 x 16 image dots on an area measuring 8 x 8 mm, which used to be dot-peened, but now is applied by laser. Stored are an internal engine number, the production date, and the casting place. This information only serves for the identification of the components in the in the plant. The actual production and quality data for the further production control and tracing is collected and maintained in databases on the central computer. The DMC stays relevant for the entire production, except at stations that supplement or replace it by their own.

As camera system for the rough machining of the V8 engine's crankcases and cylinder heads, BMW has been relying on SIMATIC VS130-2 code readers by Siemens for the past 2 years. In this case, a so-called intelligent camera system with built-in image analysis function is employed, which specializes in the recognition of encoded information in industrial environments. The sensor head is fitted in an IP65-rated aluminum profile enclosure, and utilizes a CCD chip resolving either 640 x 480 or 1024 x 768 square pixels. With the permanently mounted fixed-focus lens, three image field sizes can be captured: 70 x 50, 40 x 30, and 20 x 15 mm. For more flexibility with object distance and image field size, a model with C/CS mount adapter is also available, allowing additional lenses with corresponding bayonet type to be used.

In the right Light

In the rough machining area, the cast parts are deburred, and the casting tabs milled, sawed, or snapped off. Prior to that, though, the components must be identified by means of the DMC. Here, an LED ring light has proven itself as light source, which – mounted around the lens or also independently – ensures optimal lighting conditions. By default, BMW in Landshut employs a red flash (wavelength of 680 nm). For particularly difficult contrast ratios, an infrared flash unit (880 nm) is also available to the system.

The image analysis takes places separately from the actual camera in an analysis unit, which is typically installed in the control cabinet, but also suitable for use right at the line thanks to its IP40 protection rating. The camera communicates with the analysis unit via PROFIBUS but also PROFINET would be possible. The data of the analysis reaches the central computer of the foundry via Industrial Ethernet and the respective cell controller – mostly a SIMATIC S7-400 PLC.

For BMW, the image analysis by the analysis unit is of special importance, since the originally used camera systems of another vendor were not only quite a bit more expensive, but also required a stand-alone PC for the analysis. In particular for data security reasons and for the protection against viruses, BMW is aiming to keep the number of computers on the plant network as low as possible. The 25 code reading systems that by now are in use at the Landshut rough machining, ideally accommodate this strategy.

Optimally supported

The main problem in the automatic identification of the code is the contrast of the DMC image dots to the surface, whose colour can vary considerably from cast part to cast part. Even more so, if the parts were previously hardened. That is also a reason why BMW took advantage of the support by Siemens when performing the system change to the new camera. Of primary concern was the selection of a suitable illumination, so that despite varying surface colors, the fully automatic and accurate identification of the laser-marked codes could be ensured. The close cooperation also included the image processing software, for which the application engineering team of Siemens in Nuremberg wrote new releases, in order to increase the bandwidth of the processable image signals. In this win-win situation, the customer benefited from the optimized application in their plant, and the vendor from the qualification of their product for new implementations.

Siemens AG
Industry Sector
Industry Automation
P.O. Box 4848
90327 NUREMBERG
GERMANY

www.siemens.com/simatic-sensors/mv

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