

Pin-sharp Images

Daimler AG, engine production Bad-Canstatt

Traceability has turned into an essential element of today's quality policy in the automotive industry. Particularly for product liability reasons, this is becoming all the more important as the involvement of suppliers in the production processes increases. A basic requirement is the clear identification of the installed parts. In the cylinder head production of Germany's largest automaker, this is ensured by means of Data Matrix codes and their reliable acquisition through accurately reading and rugged vision sensors.

At the Bad Cannstatt plant branch of Daimler's engine production in Stuttgart-Untertürkheim (plant 10), approximately 1,600 V6 and V8 gasoline engines are made each day in a two-shift operation. The machining-intensive production process of the 3,200 cylinder heads made is closely documented in a so-called product history file – one for each vehicle. Prior to the machining, a Data Matrix code is applied onto the cylinder heads, which makes them uniquely identifiable.

Due to the prevailing conditions (oil-containing atmosphere, cooling lubricants), this code is not printed on, but instead applied onto the component using a dot pen or laser system. Besides the item number describing the component, the code also contains the production year, production day as well as a consecutive number of the respective production series and additional places for further optional analyses.

Read Error Rate minimized – right off the Bat

For the detection of the code, Daimler has been using cameras for many years. However, their read error rate – exceeding 10 percent in some cases – was unacceptable for attaining the company's ambitious quality documentation targets. Also, in order to read the code, the oil left behind by the machining had to be blown off from the surface of the cylinder heads. This in turn led to increased accumulation of lubricating oil on the cameras, which made it necessary to clean them daily. To correct this situation, the production planning department decided to test the vision sensor SIMATIC VS130-2 by Siemens in a pilot project. As explained by production planner Bernd Hofacker – graduate engineer (FH), responsible for part marking and traceability at the Mercedes Car Group / Powertrain, this was to be an alternative to the existing camera system.

SIMATIC Sensors

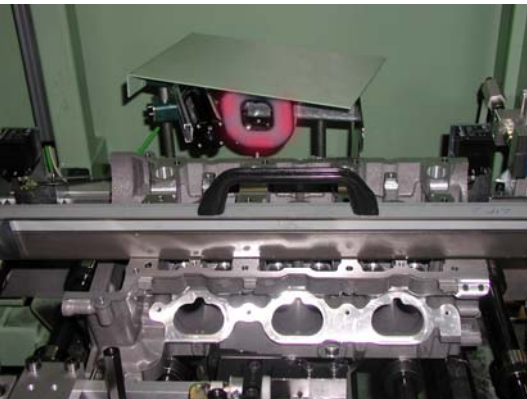
Answers for industry.

SIEMENS

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Well-founded quality: A dot-peened Data Matrix code enables the unique identification and traceability of all cylinder heads installed at Daimler MCG / Powertrain.



Tested, proven, and certified for use in other applications: The vision sensor VS130-2 by Siemens with detached lighting unit at Daimler's cylinder head production in Bad Cannstatt.

"To our surprise, the read error rate with the VS130-2 was considerably lower right off the bat, even before blowing the oil off the Data Matrix code," says Ralf Blesch, the operator responsible for the cylinder head production at the Bad Cannstatt plant. The positive initial impression was confirmed: "In close cooperation with Siemens, the read error rate could be permanently reduced to between 0.1 and 0.5 percent", emphasizes Bernd Hofacker. "We can now completely do without blowing off the oil, since it has been shown that cleaning the camera heads as part of the weekly machine cleaning routine is enough – saving us energy, handling, and investment costs."

A Question of the Viewpoint

At the Bad Cannstatt cylinder head production, a total of 10 vision sensors SIMATIC VS130-2 are in use by now. Before each machining center, the cylinder head is identified again. For this purpose, the camera is mounted diagonally to the surface to be read. Sufficient illumination is provided by an LED ring flash, which is included in the delivery scope of the VS130-2 and features flash times from 10 to 20 milliseconds.

Ralf Blesch on this: "To avoid problems with oil shading and reflections, we installed the lighting unit detached from the camera, and aligned them in a suitable angle to each other. At the same time, Siemens incorporated our findings from the pilot phase, and – in the course of further developing the sensor – had the exposure control orient itself on a freely selectable image segment rather than the former integral measurement." Thanks to this new feature, which now is a permanent element of the VS130-2, the read error rate could be further reduced. Today, the system is even capable of making statements with regard to whether an error image is the result of flawed labeling or contamination (by oil, dirt).

Capture and Analysis with one System

After the reading, the acquired DMC image is transferred from the VS130-2 to the separate analysis electronics, which is installed nearby, but at a slight elevation for protection against oil and shavings. From there, the analyzed data string of the image is forwarded over PROFIBUS DP to the machine controller SINUMERIK 840D of the machining centers or to a SIMATIC S7-300. The built-in CCD chip has a resolution of 1,024 by 768 pixels and allows for the capture of full-frame still images with automatic exposure time. For an accurate identification, the system only requires five pixels per dot of the DMC. As a result, the system is highly versatile in application – from square Data Matrix codes with sizes between 10 by 10 and 72 by 72 dots, up to rectangular codes with sizes between 8 by 18 and 16 by 48 dots. Dot size and read distance are defined by the selected optics and can vary in a wide range from 0.1 to greater than 3 mm and 80 to 3000 mm respectively.

Open and transparent

The new system also offers significant advantages through its simplified integration into the existing communication structures. The analyzed images are visualized "live" via the controller on the operator panels at the production line. The teaching in of new codes/samples – directly on-site – is also of great importance. With the VS130-2, in contrast to the old systems, this is not carried out through complex engineering or parameterization, but through configuration of the lighting and training of the algorithms by means of a code sample – without user specifications. The operator panel OP012 of the SINUMERIK controller also links the vision sensors to the higher-level control system, where machine and operating data is acquired using DaimlerChrysler's in-house Prisma system, and the entry into the product history file occurs. Via their Ethernet interface, the vision sensors in turn communicate with the HMI system TRANSLINE 2000, which was jointly developed by DaimlerChrysler and Siemens. TRANSLINE 2000 provides password-protected access to saved error images and current live images from any connected terminal.

Daimler sees another future advantage in the possibility of configuring the cameras company-wide through a Web browser that serves as a uniform, open standard interface.

The direct access to the images not only enables all functions to be controlled from one's desk, but above all, also speeds up the commissioning of the DMC reader, since the positioning of the lighting unit can be checked online and optimized if necessary. Moreover, in the operating mode "Measurement of the Code Quality", the system can determine whether the labeling is performing correctly or whether the code itself is misaligned.

Ready for new Tasks

Bernd Hofacker underscores the good experiences gained by DaimlerChrysler with the vision sensors, which were installed mid-2005: "Since the successful commissioning through Siemens, all systems have been running completely problem-free. In the context of standardization, we have by now also approved the VS130-2 for further projects of the Mercedes Car Group / Powertrain at the plants Berlin, Hamburg, Untertürkheim, and Köllda."



Built-in intelligence: The analysis unit of the VS130-2 analyzes the camera images and sends the result over PROFIBUS DP to the process control level in the form of a data string.

Siemens AG
Industry Sector
Sensors and Communication
P.O. Box 4848
90026 NUREMBERG
GERMANY

www.siemens.com/simatic-sensors/mv

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