DEVELOPING A COMPREHENSIVE METROLOGY STANDARD WITH CMM

Good Connections

The Weidmüller company, specializing in technical connectors, is interested in shifting from manual to automated operator self-checks. The company has therefore recently developed a standard for geometric measurement tasks and analysis on the basis of a 3D multisensor coordinate measuring machine from Werth Messtechnik, Giessen. This provides the precise, reproducible measurement results from the lab to series production.

No industrial sector today can do without electronics and electrical connectors (known as „Industrial Connectivity"). Industrial connectors are used to transmit the three basic elements of energy, signals, and data. One provider in this sector is the Weidmüller company, based in Detmold. Making perfect connections possible is one of the main areas of focus at this traditional company. Weidmüller requires the highest level of quality assurance, starting with quality management based on ISO 9000 and extending to continuous monitoring by independent institutions that audit production locations as well as quality management and the company's in-house lab facilities (Figure 1).

The essential basis for high quality products is provided by the employees with the quality philosophy firmly ingrained in their consciousness. Olaf Despang, manager for test equipment, says, "Weidmüller has grown large based on quality. This means that every employee, not just the metrology techs, carry responsibility. One of my department's responsibilities is to ensure that quality assurance is correctly structured and that optimal measuring equipment is available."

Future-proof Metrology

Because the products are becoming ever more intricate and complex, these factors must be checked and optimized on a continuous basis. One of Olaf Despang's group has been assigned the task of ensuring that the metrology used at Weidmüller is future-proof. "Our structure is set up with what we call quality stations in individual production areas, in addition to a central metrology lab. The workers themselves are also responsible for measurements taken during the manufacturing process," explains Despang. "Previously, each station had a different measurement philosophy and different equipment. We are now in the process of standardizing

Images: Weidmüller/Werth Messtechnik

them." In the future, the measurement departments and production areas should be compatible, so that products with prototype and pre-production status can be handed off to mass production complete with measurement programs and fixtures.

Many discussions with the participants and related investigations indicated that a common basis for the measuring equipment was indispensible. To reliably handle various measurement tasks, the responsible parties decided on coordinate measuring technology with multisensor capabilities. Weidmüller selected Werth Messtechnik GmbH, Giessen, as its partner for 3D coordinate measuring machines.

An extensive market analysis was performed prior to the purchase of the new measurement equipment. All our quality centers helped to develop the specification and jointly defined the requirements for functionality, precision, and measurement range. Olaf Despang summarizes, "We looked very meticulously at various providers and ultimately selected Werth. Our previous experience certainly played a role in this decision. Werth has been represented with a VideoCheck measuring machine in our central measurement lab in Detmold for several years." The high level of measurement accuracy that this machine features is used to measure individual components and initial samples. International service was also cited as a very important factor. If such machines are used at an overseas production location in the future, then the manufacturer will need to provide the same level of support there as it does in Germany. In recent months, Werth has shipped several ScopeCheck machines to Weidmüller (Figures 2 and 3). They are located close to the production line at various quality stations.

The ScopeCheck S is a 3D CNC multisensor coordinate measuring machine designed for near-production measurement, covering a measurement ranges of X = 200, 300, or 400 mm, Y = 200 mm, and Z= 200 mm, depending on the configuration. Weidmüller ordered the machines with three different sensors: the Werth image processing sensor, laser sensor, and touch probe systems. The laser sensor is intelligently integrated in the image processing beam path of the machine, so that there is no loss of measurement range when taking combined measurements. The patented Werth Zoom function with MultiRing illumination ensures high contrast images of the features being measured. When required, the working distance can even be changed to measure features at a great depth without colliding with the part, or to obtain a particularly flat angle of illumination.

One of the 3D multisensor coordinate measuring machines is located at the quality station managed by Rosario Orovero, the quality assurance group leader for "New Products". This department produces the initial small series for newly developed products, which will later be handed off to series or mass production. The primary task is to measure components produced at Weidmüller for classic connectors, such as pass-through terminal blocks. These primarily include small, delicate plastic injection molded and stamped parts, with surfaces, radii, and angles that can be very difficult to measure.

Rosario Orovero describes their rapidly advancing product development: "Our terminal blocks used to be larger, with fewer functions. Then it was enough to measure the length, width, and height of a part. Today, electrical enclosures are designed to fit as much as possible into a small area, so our products are changing." A terminal block may be about the same size today as it used to be, but it has over ten times the functionality. Contacts and blades are so fine that the use of profile projectors, dial indicators, and other manual measuring equipment is no longer sufficient, even for production monitoring. The trend is therefore moving toward combined optical, tactile, and laser based measurement solutions, such as provided by the Werth ScopeCheck multisensor machine.

The fine components need to meet tolerances that can be as small as ± 20 µm. This requires the measuring machine to have a precision range of no greater than 2 µm. Rosario Orovero confirms: "The ScopeCheck meets this specification, which is needed for our products. Werth has even more precise machines available in the VideoCheck series, but they would have been overqualified for our production area application."

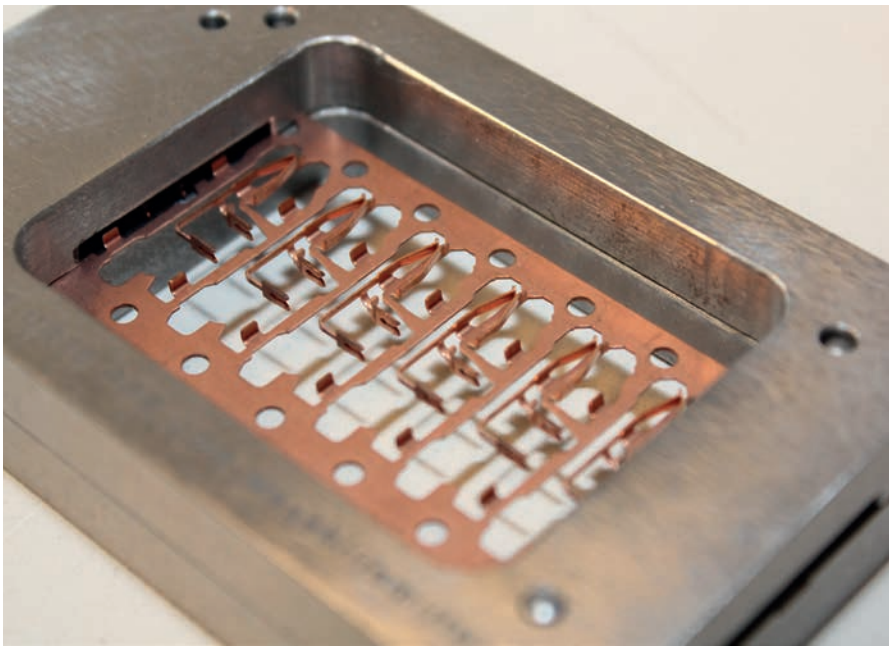

Figure 1. Filigree and sensitive components present a great challenge to metrology.

Shorter Inspection Times

The 3D multisensor coordinate measuring machine also has many benefits for measurement tasks at the quality station, such as measuring the flatness of large plastic sheets. "Previously we took care of these with a dedicated optical machine," explains Rosario Orovero, "where we had to set the focus at various points and then relate them to each other. This took about two minutes. On the ScopeCheck, we use the laser, and it now takes only about 40 seconds. For a single part, that is not very critical. But if process capability needs to be analyzed and measurements taken on over 50 parts, then the time adds up."

Multisensor capability is important for Orovero's team in any case. This quality station runs all new products on the machine, so it needs to be flexible enough »

Industrial Connectivity Specialists

The Weidmüller Group supports customers and partners all over the world with products, solutions and service in the industrial area of energy, signals and data. The company has production locations, sales organizations and representatives in over 80 countries. In 2012, Weidmüller achieved the best results in the company's history, according to its reports: with 4400 employees, the company had sales of 621 million Euros. In 2013 the company continued to expand. Currently about 4800 people work at Weidmüller around the world, with about 1900 at their headquarters in Detmold.

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Figure 2. Measuring the flatness of plastic sheets. The laser on the 3D multisensor coordinate measuring machine reduces the inspection time by about two-thirds.

for any measurement task. Rosario Orovero points out that any time savings is critical in this phase of development. "The products have to go to series production as quickly as possible in order to gain an advantage in the market. With our ScopeCheck multisensor measuring machine, we can now measure many parts at once in a single setup, which was previously impossible. This also saves time and money, and generates the information that we need in order to control production."

Figure 3. For tactile measurements, the components must be properly clamped to prevent them from moving. The fixtures are later used for process control in production as well.

The metrologists thus combine modern probe methods for capturing component geometry and control the automated measurement sequences using the WinWerth software package. This produces traceable and reproducible results. "With the multisensor concept, we can combine all of the measurements taken on one or more components within the software—basically at the push of a button. Operator and data entry errors are nearly impossible," says the metrologist happily. Documentation is also easier than before. An interface has been installed at Weidmüller for the measurement results to be transferred to their SAP system directly with no errors or loss of data.

To provide the production areas with the same high quality measurements as Orovero's measurement lab, additional Werth measuring machines will soon be located near the stamping and bending press and the injection molding machines. The stated goal is to get away from manual inspections, replacing them with automated solutions. Therefore, the quality headquarter will provide to production the entire measurement. "Our colleagues at the production sites receive from us a USB stick with measurement programs and the fixture that we have already built. This means that they only need to make minimal adjustments on site, and the programs can run just as they are—fully automatically."

This helps the operators, who are specialized in their own processes, but are not metrologists. The prefabbed measurement programs mean that the same measurement points are captured in the same way, producing reliable and reproducible measurement results. The operator also gets the green light for continuing production sooner than with previous methods. Even if the last step in production has not yet been completed, Olaf Despang and Rosario Orovero agree that they are on the right path: "The ScopeCheck machines are perfectly suited for our intended use, and our work with the Werth company has developed into a true partnership. Their service is great and we are convinced that we will continue to find more future-proof metrology solutions together." □

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