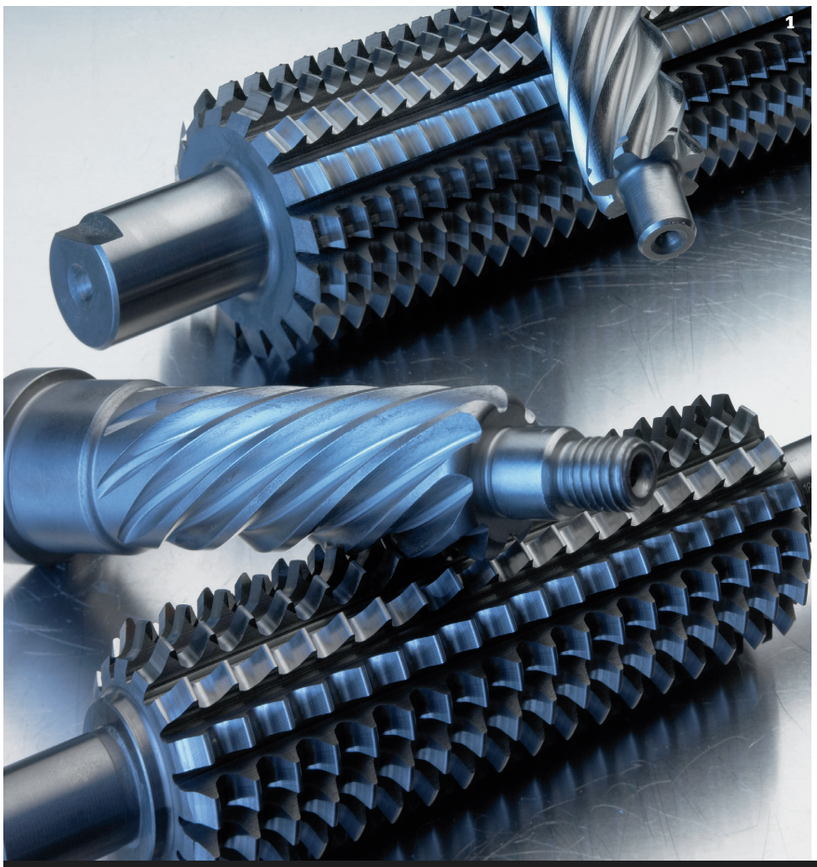
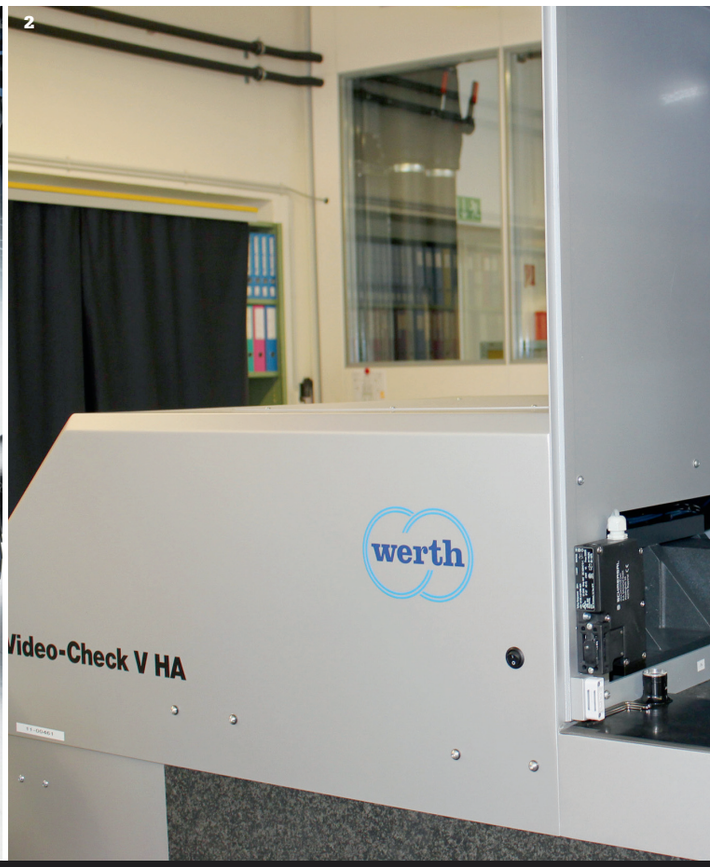
A Network of Measuring Machines

METROLOGY – Schnyder SA, specialist for gear cutting tools, has invested in several high precision multisensor measuring machines from Werth. The network of measuring systems increases the productivity and efficiency of the quality assurance.

The company headquarters of Schnyder SA is located in Biel in the middle of the so called »Watch Valley«, which extends along the Swiss Jura mountain range from Geneva to Basel. Since the 15th century, this region has been the center of watch manufacturing and therefore of gear cutting technology as well. The family company Schnyder has existed since 70 years and is considered one of the leaders in technology and quality for the manufacture of gear cutting tools with modules from 0.05 to 2.5. Managing director Marc Schnyder is convinced that his gear cutting tools – whether hobs or form milling cutters, pinion/shaper cutters





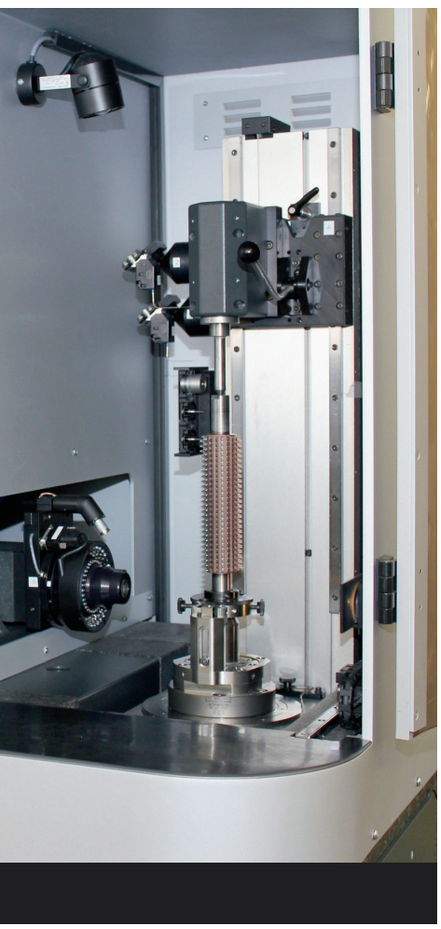
1 Schnyder SA specializes in customer specific gear cutting tools. **2** This vertical VideoCheck V HA from Werth is in the metrology room at Schnyder.

or skiving tools – provide top quality with high precision and above average service life. »Our customers confirm this again and again, not only in the watch industry but especially in the challenging automotive and aerospace industries, for transmission and drive train manufacturing.«

A tradition of inspection

To maintain the high quality standards of its customers, Schnyder has always had strict quality control during the entire production process. Back in the 1950s the company used profile projectors from Werth Messtechnik, which for many years defined the state of the art for inspecting tool profiles.

Meanwhile metrology at Schnyder has undergone a radical transformation. Marc Schnyder explains: »We have developed a digital measurement concept with data that is available continuously from production to shipment and can even be provided to the customer with each order.«



The first step towards implementing this concept was the procurement of a new generation of measuring machines that allow comparative and absolute measurements of ground profiles and profile grinding wheels close to the processes on the shop floor. These machines were intended to allow measurements direct in the clamping systems used in production and to provide production employees with clear results that can be applied directly to their next process steps.

In respect to the integrated sensors the management at Schnyder also has a clear concept. Powerful image processing is indispensable because it is much faster and more productive for many measurement tasks than tactile sensors. Areas such as relief that are not optically accessible must also be measured reliably using tactile sensors even on the smallest cutting tools with module 0.05.

Right from the start, Werth Messtechnik had been among the favorites as a partner for the new metrology concept. The company from Giessen is one of the leading providers of modern coordinate metrology and specializes in multisensor technology.

"With the VideoCheck series, Werth provides various models of powerful 3D CNC multisensor coordinate measuring machines that are ideally suited for tool measurement. One substantial feature for Werth is the patented ‹Werth Fiber Probe« that can be used to measure microstructures and even roughness,« explains Marc Schnyder.

Tactile-optical probe

The »Werth Fiber Probe« (WFP) consists of a glass fiber with a probe sphere at the end that has a diameter down to 20 µm. In contrast to tactile measurement with a conventional probe, the fiber probe operates on a tactile-optical basis. The probe shaft serves only to position the small probe sphere, but not to transmit a mechanical signal to a sensor in the probe head.

The position of the sphere is captured optically. This makes it possible to combine small probe geometries with high precision (probing error ≤ 0.3 µm). As with a conventional probe, the software uses the probe sphere radius to calculate the corresponding measurement point. The contact forces are minimal due to the thin probe shaft and ensure that even very sensitive workpieces cannot be damaged.

With the WFP, Schnyder is now using the optimal sensor for measuring even relief areas that are difficult to measure. In addition, the roughness of the ground flanks and the rake surface of the tools is evaluated in accordance with international norms. Beat Klöti, Quality Inspection department manager, praises the system: »The results are substantially more reliable than with a separate roughness measuring machine that the user guides by hand and they are more reproducible as well.«

VideoCheck machines

Schnyder invested in a total of five Werth VideoCheck machines in various configurations. One vertical high-end unit, a VideoCheck V HA (High Accuracy), is located in the metrology lab. According to Werth, this is the world's most precise multisensor coordinate measuring machine for measuring tools. The mechanical construction, a granite base with special low vibration air bearings, high scale resolution and design features to reduce hysteresis, guarantees reproducible measurement results with low measurement uncertainty. For the metrology lab unit, Schnyder opted for telecentric optics for image processing, a »Renishaw SP25« scanning probe and the Werth Fiber Probe.

On the production floor, Schnyder uses VideoCheck IP machines with various sensors and fixture systems. A horizontal unit is used to measure the profiles of grinding wheels directly and also to measure test plates that can be used to evaluate the actual results of grinding. The profiles of smallmilling cutters are measured by another machine.

A vertical VideoCheck IP unit is used in the semi-finished product area. The cutting face of tools is ground before the customer specific profile is applied. Vertical machines are used for measuring sharpened tools, pinion/shaper cutters and skiving tools and measuring the profiles of larger milling cutters.

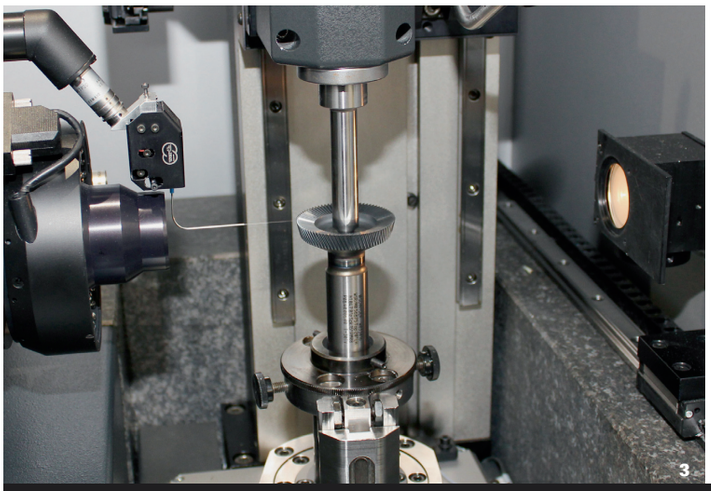
These multisensor coordinate measuring machines handle a wide variety of tasks. For hobs, form milling cutters and pinion/shaper cutters, for example, optical scanning of the cutting edge is used to measure the radial runout of tips of teeth, profile form, lead deviation, line of action deviations and axial pitches. Scans of the land including the root area give the flank profile, the flank and root relief. The shape and position of the tool face are also measured optically. A point measurement on the tooth face provides information about the flute spacing and orientation. The runout of the hub/securing collar, the shaft and the shaft end and the axial runout of the hub must also be measured. Significantly fewer features are measured and evaluated when measuring grinding wheels. Here, the profile is measured optically and compared to a required profile form.

Marc Schnyder summarizes: »As a rule, we use image processing to measure contours because this provides a time advantage. For other tasks, such as radial and axial runout measurements, we use tactile sensors.«

To measure relief, particularly for small modules, we use the Werth Fiber Probe WFP with a probe sphere of 16 µm diameter. »Not even our 0.05 modules tap the full potential of the measurement precision that this can achieve. The WFP also allows us to directly measure surface roughness.«

Data exchange

The new Schnyder SA metrology was not just about ordering →



3 The Werth Fiber Probe enables measurement of flank relief on skiving cutters, among other features. **4** Beat Klöti, head of the Quality Inspection department, praises the Werth Fiber Probe because the results are much more reliable than with a separate roughness measuring machine.

new measuring machines. The focus is now on introducing digital measurement within a network on the shop floor. The plan is to connect all measuring machines in the manufacturing area and the measurement lab, allowing data exchange among all units and with management and construction departments.

»This helps us achieve positive effects in terms of higher productivity,« explains Marc Schnyder. »In our system, every workpiece has a serial number that tracks all of the critical data from administration and design, as well as measurement results from manufacturing and the measurement lab.«

A production employee can access these data, check his work directly and immediately take corrective actions. Each measurement is also recorded and traceable. This makes final inspection in the measurement lab easier. Good measurements from manufacturing do not need to be repeated a second time. Only borderline cases are remeasured. Schnyder has worked for many years with the software company esco in Herzogenrath for designing gear cutting tools. For this reason, esco and Werth developed an interface between the WinWerth measurement software and esco's HAWK software. HAWK measures the parameters from the tool layout at the push of a button and creates the three dimensional model of the tool being inspected. Using features selected by the user, HAWK generates the corresponding measurement program that is subsequently processed by WinWerth.

The geometric data obtained are fed back to HAWK. The results are evaluated in accordance with industry standards and are displayed numerically and graphically. »Using the ‹Closed Loop› software function, we can even trace back measured deviations directly to a correction at the manufacturing machine. This saves the time that was previously used for manual entry and eliminates one potential source of error,« says Schnyder.

The same is true for the data obtained from grinding wheel measurements. Schnyder uses these in the initial setup for grinding tools. Soon the digital measurement data will be provided to the customer along with the gear cutting tools.

For resharpened cutting tools, the corrected dimensions of the diameter, reference position, lead and flute position are used to set up the gear cutting machines. Marc Schnyder says, »By working together with Liebherr we have already implemented a project where the final customer receives relative correction values from the positions measured precisely on the Werth machines, which can be directly transferred to the machine controller.« This means that the customer can use resharpened tools reliably without first needing to produce a sample part.

www.werth.de
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5 The horizontal VideoCheck S 400 measures the profiles of small hobs and milling cutters.