QUALITY ENGINEERING
Special Edition
Issue 01.16

werth Messtechnik

Cross-Border Network in Micro-Metrology

Micrometer Precision all the Way

In order to be able to produce a diamond-coated micro-mill with a diameter of 0.1 mm in a reliable process, you need experienced employees, precision grinding machines – and special measurement technology. At Karnasch Professional Tools, CNC machines such as the Nano Matic from Werth Messtechnik are indispensable if you want to maintain shape tolerances in the micrometer range for series production.

The author:

Wolfgang Klingauf
k+k-PR
On behalf of
Werth Messtechnik
www.werth.de

15 years ago, Karnasch Professional Tools GmbH made the first micro-tools with diameters of less than 1 mm a part of their product range. Sales manager Sascha Karnasch remembers: „Back then we were pioneers who captured the niche market of micro-tools. Today we are a market leader in this segment, which speaks for the breadth, depth, and quality of our products." Within the company, as well, micro-tools have now captured an important position. They are among the leading sellers in the CNC Tools product division.

Karnasch, a member of the founding family in the third generation, considers openness to innovation to be their most critical success factor. „Again and again we have been able to act on the cutting edge as we introduce new products and technologies." In order to guarantee this ability, the family-owned company has moved from being a pure distributor to become a developer and manufacturer. Karnasch explains: „We have taken the experience in tools that we have collected over many years and converted it into new ideas. Most recently we took over production at various manufacturing sites in Germany and Switzerland ourselves. There we have the latest CNC production and measurement equipment, to maintain production tolerances in the µm range with good process reliability, and can provide tools of the highest quality."

This is vital for micro-tools, which impose tough requirements on the entire production chain due to their fine geometry. High-end grinding machines and precise measurement technology are indispensable. „Even ten years ago it became clear that the desired diameter for a mill was getting smaller and smaller, and that only special measuring equipment would allow us to produce at the defined tolerances," explains Volker Mayer, who is responsible for technical support at Karnasch. Back then, those responsible went looking and found what they wanted at MT Microtool, now Tool MT. „Their Microtest measuring machine was just right for us – highly precise and extremely stable for this application."

Series Production with a Reliable Process

The growing success of micro-tools, however, meant that numbers were increasing and the customer's demands were, too. Ultimately, it came down to setting up optimized tool production that could reproducibly maintain very tight production tolerances for batches of between 100 and 2,000 parts. Karnasch talks about „Quality without compromises. We don't want to leave anything to chance. We do not divide our products into A and B quality, depending on the tolerance band the

The Nano Matic CNC tool measuring machine at Karnasch for measuring micro-tools in a shop floor environment. It is equipped with an image processing sensor and high-precision zoom optics.
Images: Karnasch/Werth

tools fall into after the production process. If we offer a ball-nose mill with a form accuracy of ± 3 micrometers over the entire contour, then this will also be shipped to the customer in that condition – exclusively at the A quality level."

This would not be possible without high-end measurement technology. A basic prerequisite is that the grinders can produce µm-precision parts in a stable process. In order to actually tap this performance, the worker must be able to set up, check, and correct the machines in temperature controlled production facilities by applying measurements from the machining process.

Because the Microtest measuring machine is not fast enough for series-production measurement due to its manual operation, Volker Mayer and his team of specialists looked around for a better solution. He found it at Werth Messtechnik – where Tool MT had, since 2009, become part of the Werth family of companies, specialists in coordinate measuring technology using optical sensors, multisensors, and computed tomography.

Their choice was the Nano Matic CNC tool-measuring machine, equipped with an image processing sensor and high-precision zoom optics. The Nano Matic is the successor to the Microtest machine proven at Karnasch and is also designed to measure micro-tools in a shop-floor environment. Mayer: „The Werth Nano Matic is CNC-controlled, like a machine tool, and is easy and fast to operate, which is what our series production needs. We use it to measure runout, diameter, and ball-nose or corner radii on our tools. We also have a partner in the Werth Group whose size provides an enormous variety of measuring technology and great security."

Werth Nano Matic Delivers Rapid, Precise Measurement Results

Mayer emphasizes three essential factors of the Nano Matic: the principle of clamping and guiding the tool in a prism, the high-precision zoom optics, and the easy-to-use software. Christopher Morcom, managing director of Tool MT, explains the technical details: „The tool is guided in a prism, known as the V-block, and rotates about its own axis there without moving axially or radially. Any tumbling error, that is, a runout deviation through the axis of rotation, is avoided. This is absolutely necessary if – as is the case at Karnasch – high-precision external contour measurements are required. This is the only way to maintain a shape accuracy of 0.002 millimeters on the tip of the tool, both when grinding and when measuring."

Another core element for measuring at Karnasch is

Karnasch Professional Tools guarantees dimensional and runout tolerances in the range of micrometers

Sascha Karnasch: „Our goals are set for the future. Because we have the right measurement capabilities and have mastered our processes, we will produce diamond ball-nose mills with a tolerance range of ± 0.002 millimeters as a standard product, starting with our full catalog GK 29 2016/2017."

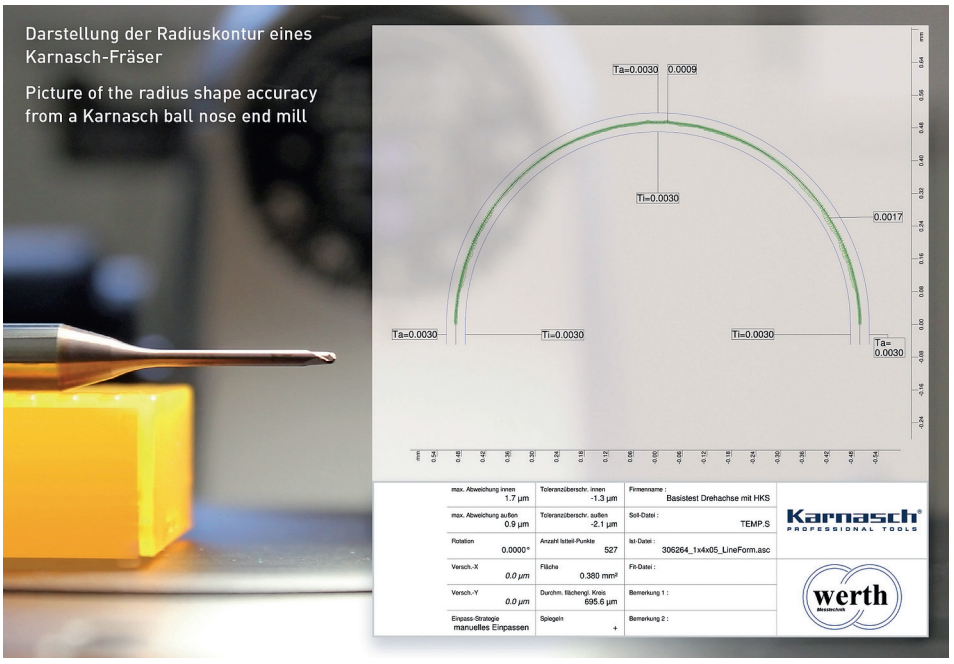
the high-end zoom optics. Mayer is also very satisfied with this aspect of the Nano Matic: „The image processing sensor enables us to traceably measure our micromills with a ten micrometer corner radius, as well as larger tools."

Because some of the measurements need to be performed by the tool grinder parallel with production, simple and fast operation is necessary. This is another strength of the Nano Matic, as the tool to be measured is simply placed on the prism and the measurement sequence starts at the push of a button. Tool specialist Mayer indicates that other systems require more effort: „In a classic chucking system, a sleeve has to be changed, depending on the shaft diameter, which prolongs the measurement process unnecessarily. Here we can make a change-over in seconds, which saves an enormous amount of time for a 100-percent measurement of thousands of tools."

The user interface has also deliberately been kept simple. The measuring machines installed at Karnasch use WinWerth measurement software and a parameter program named Micromills that was specially developed for measuring micro-tools.

Trans-Regional Production Network with Identical Measuring Machines

Karnasch points out another challenge that the Nano Matic measuring machines have mastered: „Because our production is distributed across several locations in Germany and Switzerland, the measurements need to be performed uniformly." This is why it is clearly defined how each tool is to be placed in the prism and which points are to be measured. All of the measuring machines must also provide correlatable re-



Depiction of radius correction for a Karnasch mill

sults. Karnasch has made a reference tool set for periodically checking the machines, with twelve tools of various sizes.

The significance of measuring technology at Karnasch is made clear by Mayer with a particularly critical example. „We make a diamond-coated version of our micro-tools, which is designed for machining graphite electrodes. We guarantee the shape accuracy of such a diamond-coated ball-nose cutter, 0.1 mm in diameter, to be ± 0.003 millimeters. In order to be able to guarantee this level of quality, we perform a 100-percent inspection of the tools after various processing steps during the complex production process."

After an initial measurement of the carbide blank, it is ground at the production site and then inspected on a Nano Matic. If the tool is within the tolerance for release for shipment, it is sent to the central location in Heddesheim. There all products are measured again on a Nano Matic and a measurement report is generated.

The measurement report travels with the tools to the coater, who subjects the tools to an etching process in order to prepare a base for the coating. The coater then takes the dimensions again and applies a diamond coating of the prescribed thickness at the eroded location. After coating, a final inspection takes place – first at the coater, then again on the Nano Matic at the central Karnasch site. This means that only perfect tools are placed in stock. „An enormous effort," as Karnasch is aware. „But we are the global market leader for diamond-coated micro-tools for machining graphite, when it comes to breadth of products and quality."

Specialist for the Machining Industry

The Karnasch family company, founded in 1961 as a wholesaler for saws and cutting tools, is now a globally active developer, manufacturer, and dealer for high-performance tools. The CNC Tools division is located at the headquarters in Heddesheim and has numerous innovative developments for specialized areas of the machining industry. Micro-tools are just one example. For composite machining or materials that are difficult to machine, such as titanium or stainless steels, Karnasch has developed special tool solutions with a wide selection available from stock. Classical carbide tools, such as core drills, hole saws, router bits, and saws are also part of the portfolio. They are part of the second pillar, Industrial Tools, whose products are sold by the branch in Görsdorf, which has been in business since 1991. Altogether the product range of Karnasch Professional Tools covers over 12,000 tools that are shipped all over the world to mold and die builders, aerospace, the automotive industry, shipbuilders and railroad builders, as well as the civil and structural construction industry.