Multisensor

Issue 2017

Full Points with Werth Multisensor Technology

TomoScope® XS | WinWerth® 8.41 | Chromatic Focus Line

Dr. Ralf Christoph and Product Manager for Computed Tomography Tristan Schubert are pleased to present the new TomoScope® XS.

Full Points with Werth Multisensor Technology

The team at Werth Messtechnik GmbH is proud to present the latest edition of the "Multisensor." Once again this year we have collected reports for you about new products, news from our partners, and interesting tips for applications of multisensor coordinate metrology.

In many discussions we see a development toward increasingly complex workpieces. Thus the desire to capture geometries as completely as possible with metrology is greater than ever, and processes for rapidly measuring large numbers of points are gaining attention. Werth's strategy over the past decades to develop multisensor coordinate measuring machines for rapid optical and tactile measurements, and the introduction of computed tomography, is confirmed by this trend.

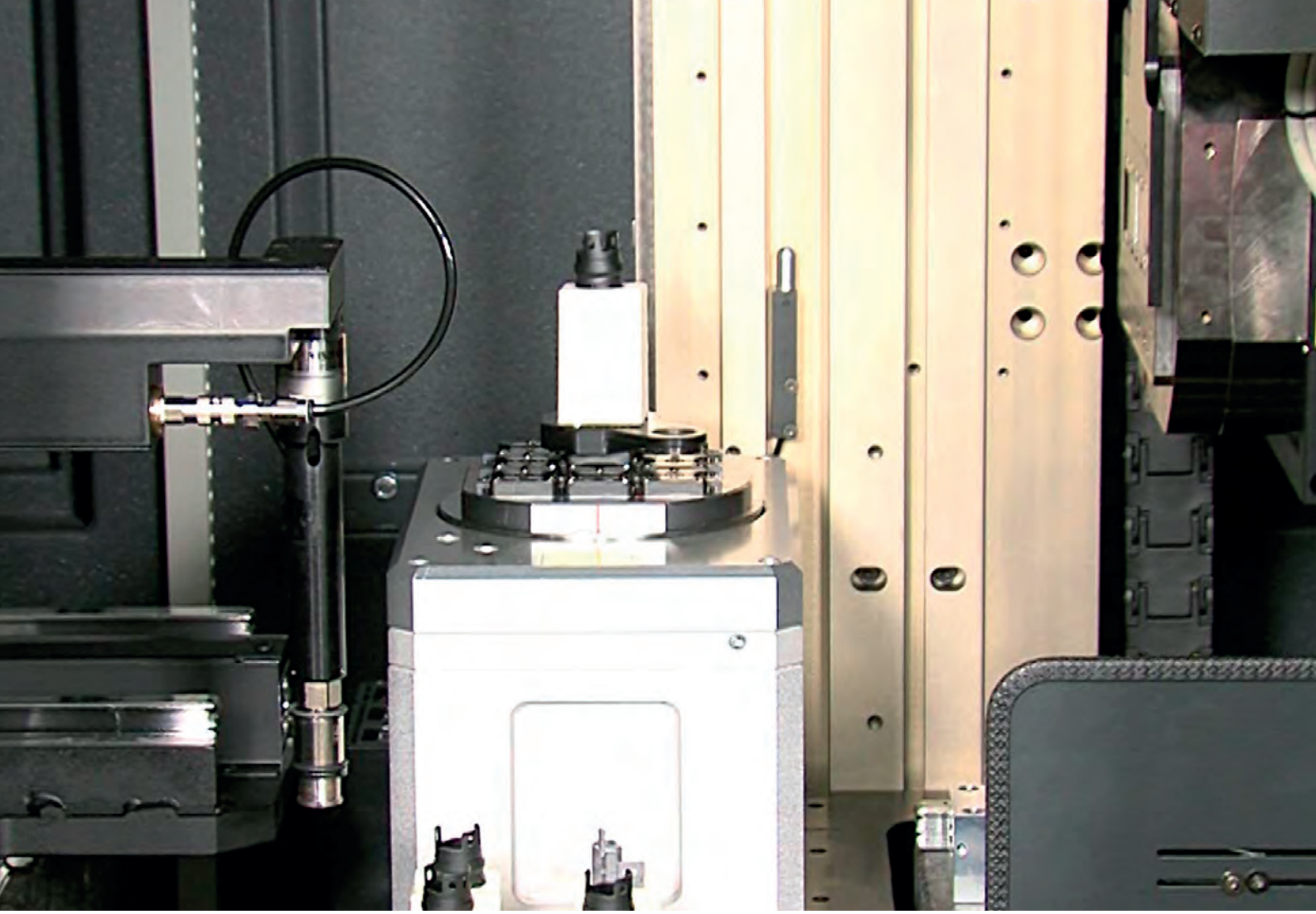
Even thirty years ago, Werth Messtechnik presented a multisensor coordinate measuring machine with a laser distance sensor integrated in the image processing beam path. In this way, surface topography determination and lateral image processing could be combined for the first time. This made it possible to measure workpieces optically in three dimensions. The Chromatic Focus Line sensor (CFL), launched this year, provides these two functions at a completely new level. The line sensor uses about 200 measurement points to capture both the image intensity in incident light and the distance to the workpiece surface, using the chromatic focus principle. Thus the results of a scan are a 3D point cloud and a 2D raster image for analysis.

Ten years ago, the Werth TomoScope® was the first machine with X-ray computed tomography especially developed for coordinate metrology. One of our important goals was making the technology available for as many users as possible at competitive prices. However in the years that followed, the trend was to more and more powerful machines that could also measure larger workpieces made of denser materials. Through intensive development, particularly in the area of X-ray source design, we can now present a completely new machine concept – the TomoScope® XS. This machine combines high performance and precision with moderate pricing to clear the path for the widespread launch of this technology. Complemented by the new OnTheFly technology, it allows complete and accurate measurements in a very short time, for example to use CT technology in production monitoring.

In addition to these two fundamentally new aspects, we also present many new detailed solutions. WinWerth® Version 8.41 follows the trend of recent years in increasing user-friendliness and flexibility for multisensor systems. Here again, the measurement of large quantities of points takes center stage.

Whether optical, tactile, or X-ray tomography – Werth has the right solution for your measurement task.

Dr. Ralf Christoph
President and Owner
Werth Messtechnik GmbH



The workpiece changer allows automation of computed tomography for three-shift operation and process-integrated solutions.

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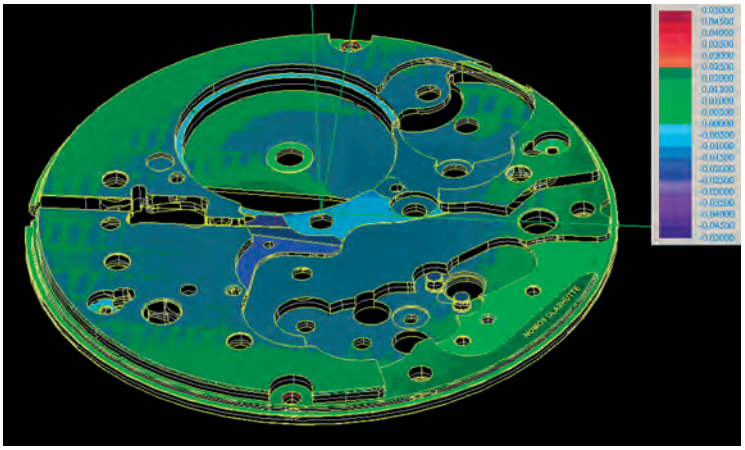
Chromatic Focus Line Sensor – High Accuracy at High Measuring Speed

For Control 2017, Werth Messtechnik presents the latest innovation in its extensive selection of sensors: with the Chromatic Focus Line (CFL) sensor, entire workpiece geometries are captured rapidly. Using different lenses, the measurement uncertainty and range can be adapted to a particular application. Due to the large axial measurement range, exact tracking of the workpiece geometry is unnecessary, so large areas can be rapidly and easily captured by scanning. Workpieces with large variations in height may be scanned along a pre-defined 3D path. The Chromatic Focus Line sensor measures workpieces with diffuse, reflective, and transparent surfaces, as well as surfaces with large inclination.



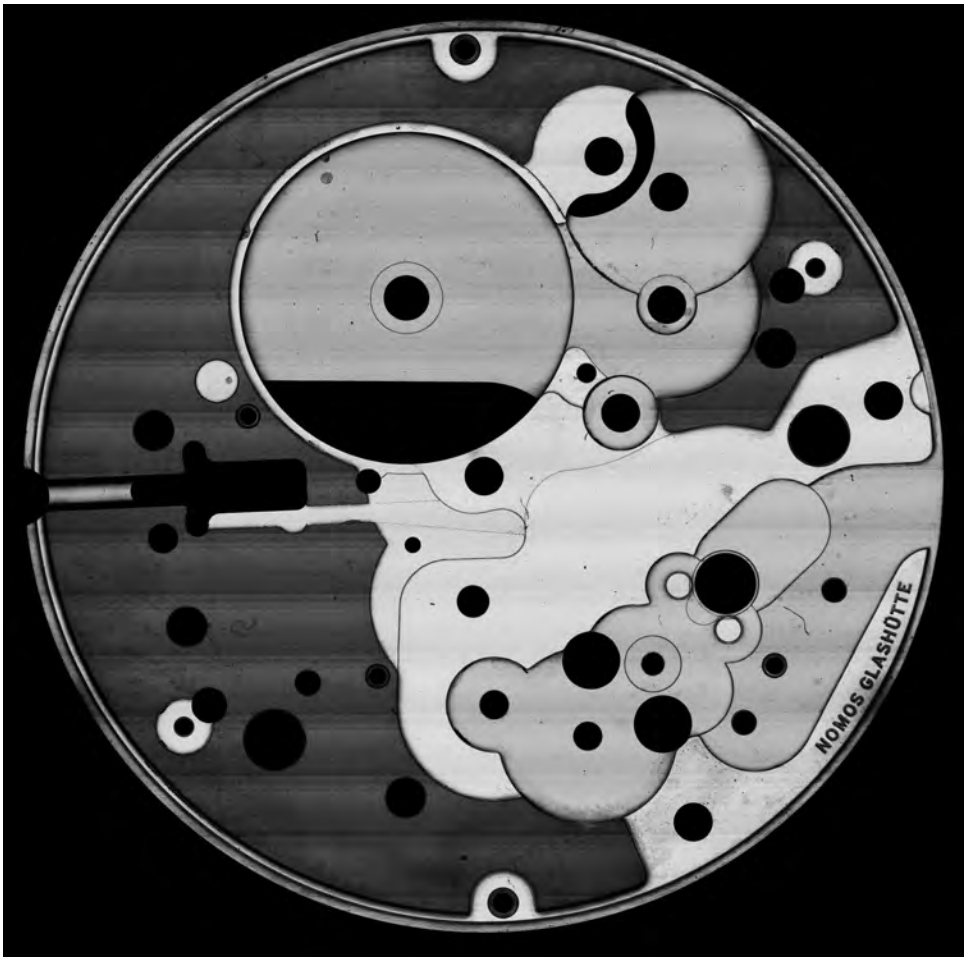
Color-coded deviation analysis between the point cloud measured by the Chromatic Focus Line sensor and the CAD model

The CFL projects a series of about 200 white light points onto the surface of the workpiece. The light reflected from the surface is spectrally analyzed to determine the distance between the sensor and the surface. This new linear sensor is the first to be able to perform a complete 3D capture of the workpiece with both high accuracy and high speed. It measures about one million measurement points in three seconds.

The Chromatic Focus Line sensor provides another interesting function: in addition to the wavelength of the reflected light, its intensity is also analyzed and a raster image of the workpiece surface is generated. Subsequent analysis with image processing software allows measurement “in the image” of geometric features or definition of the workpiece coordinate system. The positions for measurements with a variety of other sensors are determined on this basis, without requiring a sensor change.

With the unparalleled accuracy of the CFL at high measuring speed, precision components and micro-features are measured. The sensor can be used on highly reflective or transparent workpieces, such as die stamps and carbide or diamond tools, but also on diffuse reflective plastic components. The high point density allows the determination of topography for a wide variety of surfaces to be captured, such as precision mechanical workpieces like watch chassis plates. With in-process measurement of LED array coplanarity, semiconductor technology is another typical area of application for the CFL. The measurement result is the entire shape of the workpiece surface in the form of a point cloud, which can be used to determine flatness or roughness and to measure geometric elements. A nominal-to-actual comparison with color-coded deviation plots is also possible.

Raster Image of a watch plate



The TomoScope® XS uniquely combines many advantages of various machine classes.

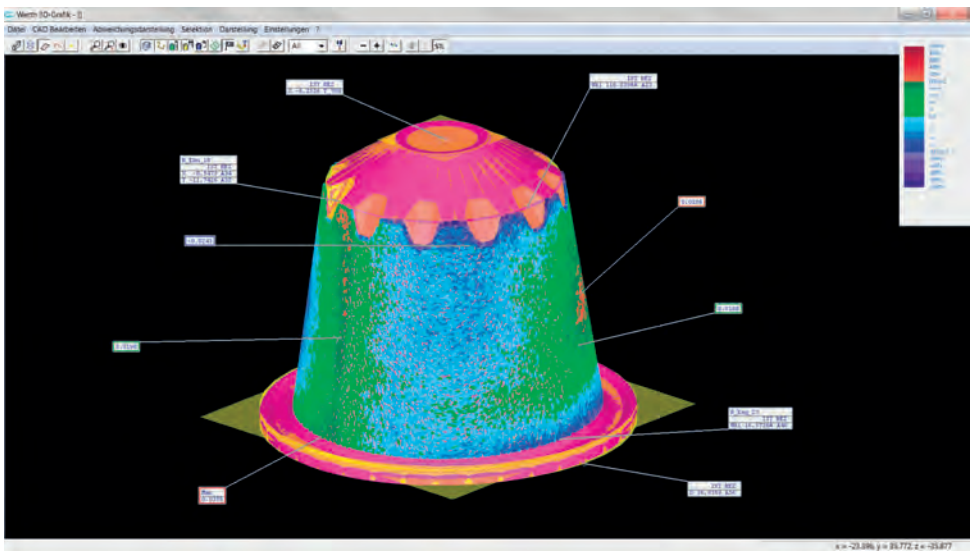
TomoScope® XS – TomoScope Technology in a New Compact Format

In recent years, developments in computed tomography have concentrated on the high-resolution measurement of large workpieces and materials that are difficult to penetrate. To this end, large and heavy coordinate measuring machines were used. X-ray tubes came in two varieties: Closed tubes often need to be replaced after just two or three years, while open X-ray sources require maintenance several times a year. This results in frequent downtime and high maintenance costs.

With the TomoScope® XS, TomoScope technology is now available in a new compact format. The new machine type uniquely combines many advantages of various machine classes. The transmission tube – with a unique monoblock design – produces a small focal spot even at high X-ray power, so that rapid measurements can be performed at high resolution. The new X-ray source combines the advantages of closed and open microfocus X-ray tubes. The monoblock design combines the source, voltage generator and vacuum pump into a single serviceable unit. This results in both long maintenance intervals and a virtually unlimited service life. Downtime and operating costs are minimized. The maximum X-ray voltage is 130 kV, with an available 160 kV for workpieces with greater radiographic length and denser materials. The air bearing rotary axis positions the workpiece with the highest precision to ensure low measurement uncertainty.

Due to the compact design, the minimal space requirement and low weight of the TomoScope® XS, it can be set up nearly anywhere. Low acquisition and operation costs allow rapid amortization. With the exclusive source design, easy upgrade of the X-ray voltage and power to 160 kV and up to 80 W is possible at the installation site.

Like all Werth CT machines, the TomoScope® XS also reconstructs the workpiece volume in real time, in parallel with capturing the images, allowing the system to be used for production monitoring. The use of WinWerth® measurement software for the overall measurement process enables traceability of the measurement results. Werth Messtechnik is the first and currently the only manufacturer to guarantee reliable and traceable measurement results by calibrating all CT machines according to standards, including DAkkS certification. For the first time, a compact, low-cost machine with specifications according to standards is available. With rapid amortization and low maintenance costs for the new highly accurate tubes, the TomoScope® XS allows CT sensor systems to be used across a wide spectrum of workpieces and tasks within any company.



Wide range of applications for CT sensor systems, such as measurements for production monitoring

High Cycle Speeds with OnTheFly CT

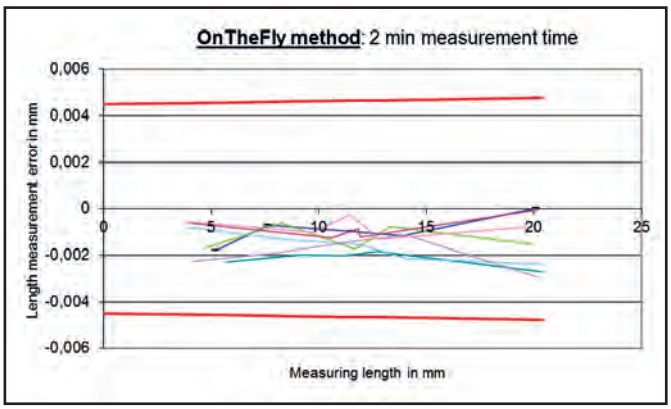
One benefit of computed tomography is that the workpiece is captured completely, including undercuts and internal geometries. Historically, computed tomography has been too slow for measurements during the manufacturing process.

For years, real-time reconstruction in WinWerth in parallel with image capture has been used to minimize measurement time. To move beyond this, several methods have been introduced, each with its drawback. For instance, the power level of the X-ray tubes may be increased, but this comes at a cost of lower resolution due to the larger focal spot. The exposure time can also be decreased by reducing the distance between the X-ray source and the detector. However, doing this will increase the severity of cone beam artifacts. Directly reducing only the exposure time means that the dynamic range of the detector will not be fully utilized. Finally, it is possible to improve measurement time for a multi-cavity measurement, by measuring several workpieces simultaneously. This can be done because the point clouds are separated automatically. This method, however, generally limits the magnification, reducing the resolution for each individual part.

The new OnTheFly CT (patent pending) saves time lag due to start-stop positioning of the workpiece by continuously rotating the machine axis. In conventional start-stop operation, the rotary motion is interrupted in order to capture each radiographic image, so that no motion blur occurs under continuous exposure. For OnTheFly CT, short exposure times are needed in order to minimize motion blur. To achieve the same measurement uncertainty as in start-stop operation, the number of rotary increments is increased. The specification according to VDI/VDE is not affected, despite the greatly accelerated measurement process; ensuring traceability of the measurement results with OnTheFly CT is maintained.

The new OnTheFly CT enables measurements during manufacturing at high throughput.

With the new OnTheFly process, measurement time can be reduced by up to ten times for the same quality of data. The workpiece volume is reconstructed in real time and is available immediately after measurement. Alternatively, the data quality may be increased for the same measurement time. Methods such as raster and ROI (Region of Interest) tomography or higher detector resolution produce workpiece volumes of higher resolution with a better signal-to-noise ratio. The increased measurement time traditionally associated with these methods can be avoided with OnTheFly CT. The new technology opens up further areas of application for computed tomography that have strict measurement time requirements for a given data quality.



Same length measurement error for start-stop (left) and OnTheFly methods (right)

Measuring with Precision and Insight

Multisensor Systems Monitor Quality in Production

Quality assurance uses various measuring machine concepts depending on the measurement task: for production monitoring, extremely fast machines are needed and high-precision multisensor coordinate measuring machines are required for workpieces with tight tolerances. For first article inspection, however, computed tomography that captures the workpiece completely is desired.

When first used in industrial applications, computed tomography was used only for non-destructive workpiece testing for cracks, voids, or similar defects. In order to capture dimensions with sufficient accuracy, however, it had to be combined with coordinate measuring technology. Werth Messtechnik GmbH, Giessen, had just presented the world's first coordinate measuring machine with computed tomography in 2005 (with a multisensor system option) when a pilot project for implementing Werth X-ray tomography in dimensional metrology began at Julius Blum GmbH in Höchst (Vorarlberg, Austria).

The end result of this project so far has been several CT machines, with various equipment levels, that are now indispensible for first article inspections at Blum. The latest machine has a 300 kV nanofocus X-ray tube and has allowed precision measurement of steel components since 2015.

Above: *Indispensable for first article inspection – computed tomography: a TomoScope® HV Compact can capture the complete internal geometry of a workpiece in a very short time.*

The working relationship between the companies, however, has a long prior history. “Back in 1994 we purchased our first Werth multisensor coordinate measuring machines,” reports Heimo Masser (Figure 1), responsible for coordinate measuring technology at Blum. The number of machines in use has since grown to 30 units. “Most machines do their jobs at production locations in Vorarlberg, where they work 3 shifts a day running over 6000 different measurement programs.”

Extreme Variety of Tested Parts

The variety of parts to be tested by the manufacturer of hinges, covers, and drawer systems for high-quality furniture is enormous. Dimensions vary from the size of a pushpin for plastic parts to lengths of over a meter for guide rails. Because the quality requirements for the workpieces also vary greatly, a variety of machine concepts have been selected.

In order to have the highest possible throughput for production monitoring, Werth Inspector® FQ machines (see also Figure 1) with axis acceleration of up to 1 g are used. Thanks to their linear drive systems, they can reach high measurement speeds of up to five axis positioning moves per second. With the patented OnTheFly method, the image processing sensor records measurement points while the machine axes are in motion. This is how the measuring machine reaches up to ten times the measuring speed of conventional machines, with measurement frequencies of up to 15 features per second.

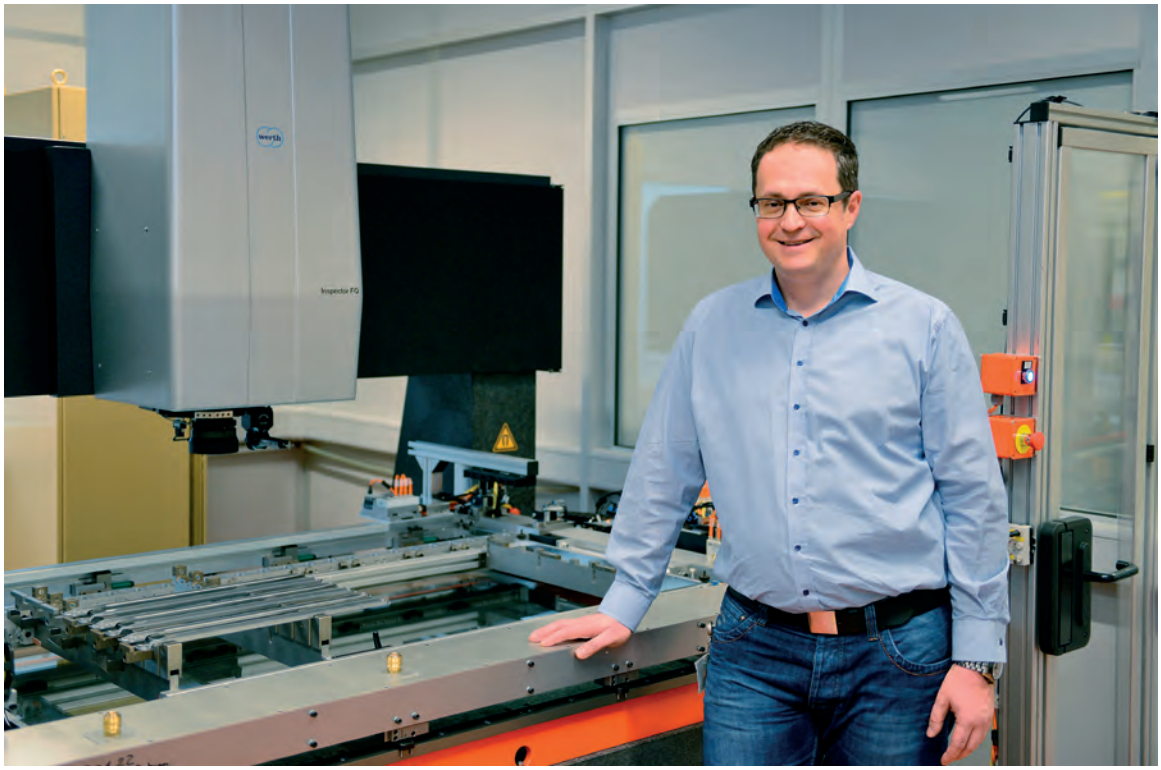
Precision of a Few Microns

Werth VideoCheck® machines have air bearings and stable granite design (Figure 2) with a fixed bridge for high-precision measurement tasks with measurement uncertainty of a few microns. They are the core of the multisensor building block system, with maximum permissible errors in the range of tenths of microns for the highest-precision class.

TomoScope® machines with computed tomography sensors (CT) are used for dimensional first article inspections and non-destructive testing. They are fully enclosed machines, so no further radiation protection measures are needed. Nearly all measuring machines use clamping fixtures developed in house, which the operator typically loads directly. The measurement data are automatically transferred to the in-house SPC system (Statistical Process Control) for process monitoring, allowing the production process to be controlled.

Measuring Machines Keep Up with the Times

When this cooperation began, it was already clear that the existing measurement programs would need to remain upwardly compatible, even after updates and hardware upgrades. Software service contracts and close cooperation with Werth software development and applications engineering have made continuous updates possible over a period from 1994 to today. The users always have access to the latest software functions.



At the world’s fastest multisensor coordinate measuring machine Inspector® FQ: Heimo Masser is responsible for coordinate measuring technology at Blum.

As the software has been updated, some hardware changes became necessary as well. In addition to electronic systems, individual components such as light sources or even scale systems have been modernized. “Many machines were updated to the state of the art several times over the years in order to meet increasing requirements,” remembers Heimo Masser. “These adaptations mean that today even our ‘young-timers’ from the 1990s are at nearly the same performance level as current machines.”

Greater Speed with X-Ray Tomography

Before X-ray tomography was introduced, the company largely relied on conventional 3D metrology to obtain releases for the tool shop. This classical method, however, was very complex and often required several days. With X-ray tomography sensor systems, the measurement results were ready in just a few hours in the form of color-coded 3D images. Measuring the entire workpiece, including internal geometries, meant immense time savings, as the subsequent nominal-to-actual comparison with 3D CAD data identified problem areas on the workpiece at a glance.

“For us, the machines paid for themselves very quickly, even if they seemed to be expensive at first,” says Heimo Masser. First article inspection of plastic parts and the associated tool releases are now the main area of application for CT machines. The current high-performance machines can measure not only plastic parts, but also steel, zinc, or aluminum workpieces. “Entire assemblies can even be measured in the assembled state, and dimensions or position deviations between the components can be determined,” emphasizes Masser. “Even the installation orientation can be evaluated visually.”

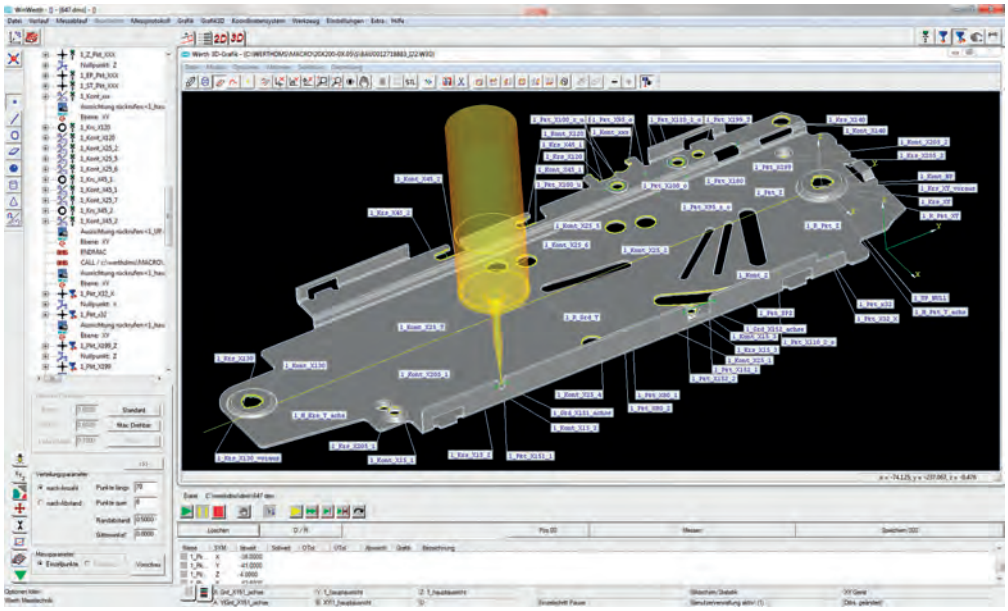
Radiation Protection Included

Depending on the material, size, and desired quality of data, the X-ray voltage must be varied. Werth offers a range of fully protected machines with X-ray voltage from 130 kV to 300 kV, and even specialty machines with up to 450 kV for larger, heavy workpieces. Special mathematical methods for correcting artifacts have been developed in close cooperation, in order to minimize systematic deviations in the tomography process.

A workpiece feeding system integrated in the measuring machine allows unmanned operation around the clock. Because the workpiece changeout system is integrated in the measuring machine itself, no additional precautions for radiation protection are required, such as more complex robotic applications, which means that operational reliability is increased.

For high-precision measurement tasks: the highest-precision class of VideoCheck® machines can reach a maximum permissible error in the range of tenths of microns.

The automated loading process increases the productivity of the machines by up to 300 percent in comparison with conventional operations. “Today we measure over 4000 workpieces a year with our CT machines, which means they are completely utilized,” says Heimo Masser.



Create measurement sequences offline: remote programming and simulation using WinWerth® measurement software

Offline Programming with CAD Data

Today, using WinWerth® measurement software, measurement sequences can be created from 3D CAD data away from the machine. Optimal measurement methods can be determined at the CAD workstation and measurement sequences can be simulated graphically. Programs are thus available prior to the start of production (Figure 3). This methodology minimizes the downtime of the measuring machine due to programming work. Even the lighting for the image processing sensor can be programmed using CAD data. For difficult contrasts, the lighting settings can be adjusted later in stepwise mode at the measuring machine to suit the workpiece properties.

Blum uses parameter programs for families of parts to create measurement sequences quickly. When the workpiece type is entered, they take the remaining variables from the prepared dataset and automatically generate the associated measurement sequence.

Outlook

Increasing production complexity makes it more and more critical to capture measured objects completely and rapidly using 3D sensor systems. X-ray tomography is good for this, while classical multisensor coordinate metrology is valuable for rapid SPC inspection. The measurement software emphasizes offline programmability and intelligent functions for interactive operation. Regular technical exchange of ideas is important for successful cooperation between the user and the machine manufacturer over the years. Early planning helps to incorporate user requests in the development phase, bringing benefits to both sides.

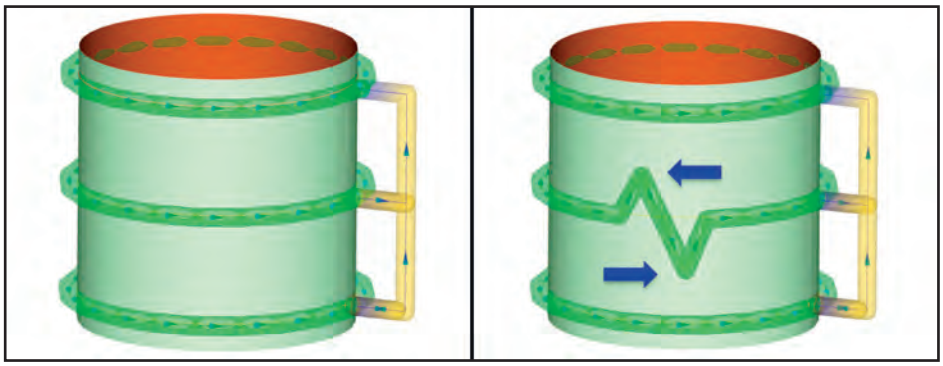
From Horseshoe Studs to High-Tech Furniture Fittings

Since 1952, Julius Blum GmbH in Höchst (Vorarlberg, Austria) has produced high-quality hinges, covers, and pull-out systems for quality furniture. With around 6600 employees around the world, the family-owned company is currently a supply partner for the furniture industry everywhere in the world. Blum has seven plants in Vorarlberg and additional production locations in Poland, the USA, and Brazil. In order to meet its customers’ quality requirements, the hardware manufacturer has used multisensor coordinate measuring machines from Werth Messtechnik GmbH in Giessen for over two decades.

Practical Tips

Easily Modify Scan Paths

For cylinder, cone, and sphere elements, automatic scan path and point distributions are available with the helix, circles, or surface lines strategies. On flat surfaces, scan paths are distributed in a particular shape (grid, star, or spiral), measured as an edge curve, or the measurement points can be distributed arbitrarily as a polyline.

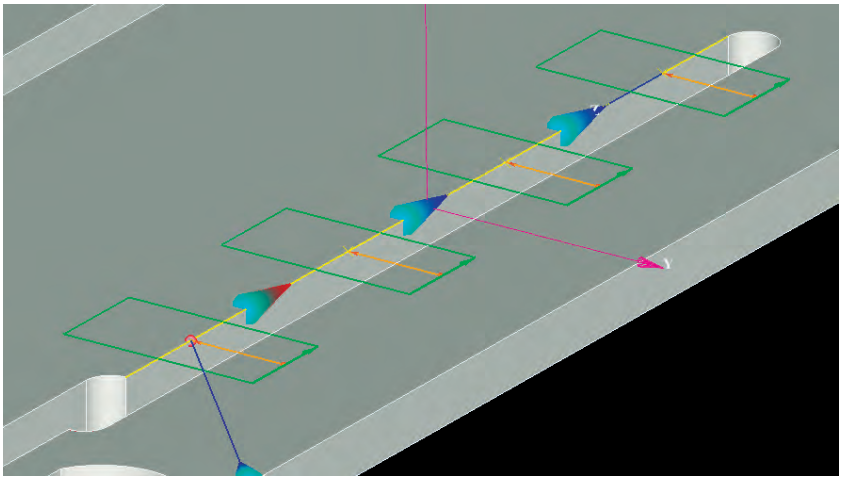


Scan path distribution before (left) and after inclusion of additional points (right)

During interactive measurement, scan paths or measurement points may be moved, deleted, or added in the 3D graphic using the mouse or a manual input field. These editing options and the opportunity to adjust the measurement strategy, light levels or sensor settings are available from a properties dialog even after the scan path distribution has been taught.

All of the required measurements, including analysis, can then be programmed using the CAD model. From there the scan path and point distributions will be adjusted and tested individually either offline or online. If there is no CAD model, the entire measurement sequence will be completed with the minimum number of points required for the geometric element in question. These distributions can be modified at any time after the program has been completed.

Programming with 3D CAD Data



Starting from the base edge of the measurement window, the second contour is captured.

Complete measurement programs for all sensors may be created offline or online on the CAD model from single points, scan paths, and free-form scanning. Sensor parameters such as light settings, measurement strategies, and image processing filters can also be selected and ensure reliable measurements with the image processing sensor.

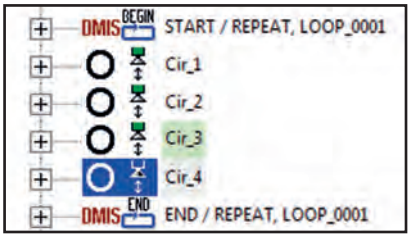
Large measurement windows with specific contour selection allow reliable measurement of even coarsely toleranced workpieces. The user defines the direction in which contours are searched for and in which contours are captured (i.e. first, second, third…). Visualization in the 3D graphics window can be used to check the correct contour selection at a glance. In online mode, the automatic contour selection is available as a supplement to the scan path and point distribution.

Editing Parameter Programs

Various functions for editing measurement programs are integrated in the WinWerth® measurement software. After modifying the position, measurement window size, or light settings, the element can immediately be measured automatically. This way, the adaptions can be tested quickly without running the entire measurement program. With offline measurement of individual elements, parts of subroutines, or loops, it

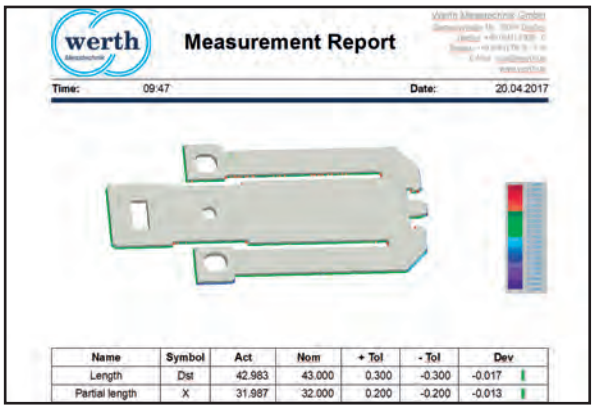
Practical Tips

is possible to create and link nominal elements before the first part is manufactured. These functions are also available for parameter programs that contain DMIS commands such as JUMPTO, IF / THEN, ONERROR and many more. Such parameter programs can be used to measure families of workpieces automatically after entering only a few parameters. The programs may be created by the user with the powerful DMIS programming language, or provided by Werth as a turnkey solution.



Even loops can be easily edited and tested.

Office Report in TeachEdit Mode

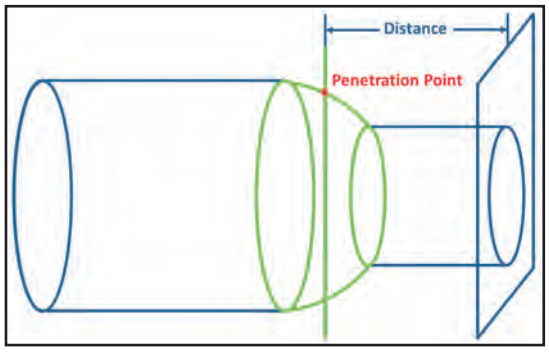


Office report with BestFit plot and measured values

Tables of measured values, 2D and 3D graphs, BestFit and ToleranceFit® plots, camera images from the image processing sensor, or any other images can be documented in the office report. The measurement report can be created any time after the measurement program has run, or during interactive measurement. Output options include screen display, automatic printing, or automatic conversion to PDF format. ODT and PDF files can be optionally signed in order to guarantee authenticity and prevent changes by third parties.

Application Examples for New Calculation Elements

There are several calculation strategies available in WinWerth® for analyzing circles and cylinders. Among others, Gaussian, maximum inscribed, minimum circumscribed, and minimal zone elements can be calculated. Expanding on the maximum inscribed conditions, the two-point dimension has been introduced. For the maximum inscribed circles, the least diameter, and for minimum circumscribed circles, the greatest diameter is output.



Penetration point of a torus and line for calculating a distance

The new “contact plane” calculation strategy makes it possible to determine coplanarity of integrated circuit (IC) leads, for example. Coplanarity is a critical dimension for manufacturing these parts, because the distance between the IC leads and the circuit board influences the soldering process. Ensuring the leads are within the prescribed distance from the board is the only way to solder reliably. The measurement can be performed using autofocus points or the Chromatic Focus Line Sensor and calculating a plane from the extreme points. The form error is the distance between shortest lead and the contact plane.

In addition, the software has been expanded to include the penetration point of a line through a torus. The penetration point is used to obtain the position of a prescribed diameter on the torus. From this position the distance to a plane can be calculated.

Micrometer Precision all the Way

Cross-Border Network in Micro-Metrology

In order to be able to produce a diamond-coated micromill 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 NanoMatic from Werth Messtechnik are indispensable if you want to maintain shape tolerances in the micrometer range for series production.

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 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 NanoMatic CNC tool-measuring machine, equipped with an image processing sensor and high-precision zoom optics. The NanoMatic 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 NanoMatic 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 NanoMatic Delivers Rapid, Precise Measurement Results

Mayer emphasizes three essential factors of the NanoMatic: the patented 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 –

The NanoMatic 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.

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

Depiction of radius correction for a Karnasch mill

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 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 micro-mills with a ten micrometer corner radius, as well as larger tools."

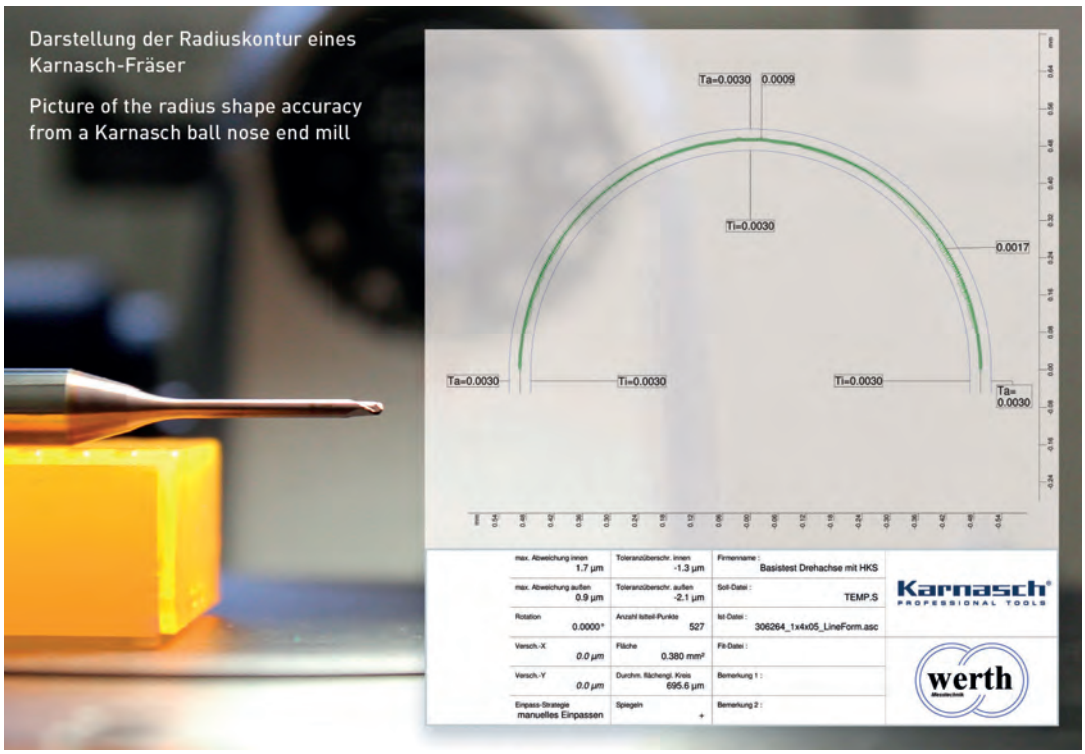
Because some of the measurements need to be performed by the tool grinder parallel with production, simple and fast operation is necessary. This is another strength of the Nano-Matic, as the tool to be measured is simply placed on the prism and the measurement sequence starts at the push of a button. Tool specialist Mayer indicates that other systems require more effort: "In a classic chucking system, a sleeve had 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 results. 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



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."

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 NanoMatic. 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 NanoMatic 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 NanoMatic 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. Microtools 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.

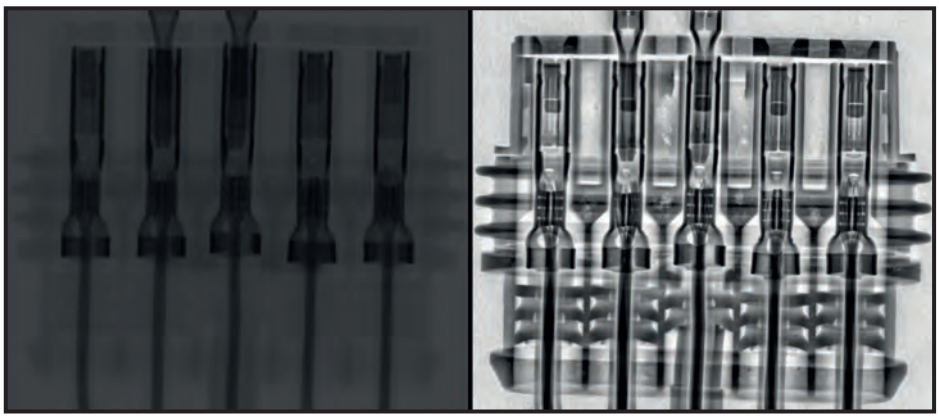
New 2D Functions for X-ray Inspection Tasks

Computed tomography (CT) reconstructs the entire workpiece volume from 2D radiographic images. Inspection tasks such as void analysis or inspection of the situation in an assembly can be performed directly on the X-ray images without measurements.

To support such applications, new options have been added for the CT sensor in WinWerth®. For workpieces that are difficult to penetrate with radiation, assemblies with large differences in density, or workpieces with a high aspect ratio, local contrasts often cannot be shown with sufficient differentiation. The new Local contrast optimization allows both increasing contrast and suppressing noise in the images.

The histogram display makes it possible to use the measurement window to select any desired areas within the radiographic image, for which the optimal contrast for any given application is then set. For multi-material assemblies, the contrast can be optimized especially for one material. Using the histogram, it is then possible to adjust the signal-to-noise ratio for inspection tasks or CT measurements.

In order to position workpieces optimally in the beam path, the 7-axis control via joystick allows independent control of the X-ray tube, detector, and rotary axis.



Radiographic image with low contrast (left) and after local contrast optimization (right)

Automatic Workpiece Changer – More Flexible Than Ever

The workpiece changing system (patent pending) transports various workpieces in sequence from a pallet into the measurement area, then removes them again afterwards. With this automatic loading, the TomoScope® can also be used during “unmanned” night shifts or over the weekend. The workpiece changer is integrated within the radiation protection enclosure of the machine, so that no additional safety systems are necessary. This minimizes set-up times and reduces the time for turning on and warming up the X-ray sources.

Full pallet with workpiece carriers

The changing system is now available for the TomoScope® L, XL and even the TomoScope® S. There are several types of grippers for workpiece carriers of different sizes. A loop function in WinWerth® allows series measurements of identical workpieces to be taught quickly. Since the analysis of the measurement data also takes place within the WinWerth® measurement software, a measurement report is available for each workpiece immediately upon completion of the measurement.

From left: Rostislav Kadlčík (Sales Engineer), Jakub Hrubý (Computed Tomography Specialist), Jitka Mikulincová (Sales Assistant), and Petr Bilavčík (Company Owner)

Prima Bilavčík Celebrates 25-Year Anniversary

Prima Bilavčík, s.r.o. in Uherský Brod has cooperated with Werth for 20 years and sells coordinate measuring machines in the Czech Republic, Slovakia, and Ukraine. It has received the Werth Award for the most successful representative worldwide seven times. For five years the Prima Bilavčík academy has held workshops and training sessions on the Werth VideoCheck®, ScopeCheck®, EasyScope®, Inspector®, and TomoScope® machines. The academy is accredited by the Ministry of Education of the Czech Republic. Prima Bilavčík is also accredited to DIN EN ISO/IEC 17025 for the calibration of coordinate measuring machines according to ISO 10360.

Werth Inspector®

30 Years of Multisensor Coordinate Metrology

In 1987, Werth Messtechnik presented the first multisensor coordinate measuring machine, the Inspector®. The combination of CNC axes and image processing sensor with an integrated laser distance sensor in the same beam path enabled measurement points to be captured automatically in three dimensions.

New Partner in Sweden

Starting in the spring of 2017, sales and service of Werth coordinate measuring machines in Sweden will be handled by KMK Instrument AB. Founded in 1994, the company is based in Västerås and has many years of experience in 3D multisensor coordinate metrology. As a specialist in dimensional metrology and NDT (non-destructive testing), KMK is accredited for length, force, and hardness inspections and testing.

Company owners Anders Vallenfjord and Per-Håkan Kalbhenn (from left)

Promoting the Next Generation of Scientists

In the summer of 2016, the Dr-.Ing. Siegfried Werth Foundation prize was awarded to Dr. Angela Klein for her dissertation on dual-peak near-field microscopy. Prizes were also awarded to Ruedi Jung's master's thesis and the bachelor's theses by Manuel Better and Thomas Fischer. In November of last year, at the 20-year anniversary of the Physical Engineering program at the THM University of Applied Sciences, three graduates were recognized. Two of them, Vanessa Lang and Arne Zimmer, completed their excellent bachelor's theses at Werth Messtechnik.

Award ceremony at the Friedrich Schiller University in Jena: (from left) Dean Prof. Dr. Gerhard G. Paulus, Dr. Angela Klein, Chairman of the Board of Trustees Arno Fink (Dr.-Ing. Siegfried Werth Foundation)

Credits

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