The MultiSensor
The Internal Newsletter of Werth Messtechnik
May 2013

Quality and Innovation for Success

A significant cause of the continued positive growth of many German companies – especially medium-sized companies – is surely the linking of intelligent technical solutions and high product quality. This initiative gives hope that Germany will continue to maintain a strong position among the leading industrialized countries. In particular, this applies to a large number of companies in quality assurance and metrology. Modern coordinate measuring technology has been increasing in significance for decades due to its versatility, precision, and economic efficiency.

Innovations have long ensured success at Werth. In the field of development of modern solutions for coordinate measuring technology, Werth Messtechnik has been one of the leaders for more than 60 years. For example, in 1977 Werth introduced optoelectronic sensors with the Werth "Tastauge". A glass fiber sensor was used in measuring projectors for the first time. In the 1990s, image processing in optical coordinate measuring technology was driven substantially by Werth. Innovative solutions introduced new trends in industrial metrology. This includes the patented 3D fiber probe for measuring microfeatures. The TomoScope®, presented in 2005, was the first machine with X-ray tomography developed especially for the requirements of coordinate measuring technology. By utilizing Werth's persistent pursuit of high-end technology and innovative solutions, customers around the world have obtained solutions for their quality assurance processes and contributed to the competitiveness of their companies. This demonstrates that high-quality products "Made in Germany" often present the most economically efficient solution, despite the higher price.

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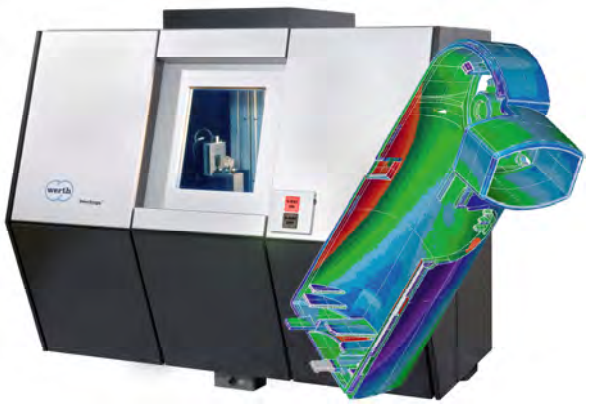

"TomoScope®" Coordinate Measuring Machine with X-ray Tomography sensors for measuring plastic and metal workpieces with micrometer precision – deviations are shown clearly in color code.

Computed Tomography (CT) Enhances Coordinate Measuring Machines

Into the Future in Three Dimensions

A multisensor coordinate measuring machine, combined with the process of computed tomography, allows components to be analyzed with micrometer precision without contact. Deviation analysis between the tomographic data and the CAD model can identify problem areas on the component without requiring that specific measurement points be taken. All deviations are indicated by color coding, making them easy to identify. HARTING in Espelkamp, a manufacturer of high quality connectors for energy, signal, and data transmission for machine connections, network components, and systems cables, uses the TomoScope® HV 500 from Werth Messtechnik, Giessen.

Measurement with computed tomography is recommended for high-quality plug connectors of all shapes and sizes.

It helps them ensure the quality of their products by performing geometric measurements and material analysis. The coordinate measuring machine with computed tomography is used for non-destructive testing and metrology applications to optimize production. Dr. Stephan Middelkamp, from the strategic technology development team, oversaw its introduction to the company. "We use computed tomography to give our existing metrology some relief. This method is also sometimes faster than conventional coordinate measuring technology and provides additional information. Over the long term, we want to convert our entire process to 3D data structures. This will also apply to quality assurance. The required three dimensional investigations can be performed using X-ray tomography.

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Quality and Innovation for Success

For coordinate measuring machines, reliability, precision, measurement speed, and flexibility are critical for optimally meeting the requirements of the user. Another significant element here is the solution-oriented process. At Werth, simply shipping the measuring machine is not the end of the story. Expert advice, start-up support, and even turnkey solutions are important to users and are therefore increasingly a part of the Werth approach worldwide. The knowledge required of our employees is ensured by the clear focus of the company toward coordinate measuring machines with optical sensors, multi-sensors, and X-ray tomography. Compared to competitors with wider product diversification, this is a distinct advantage. Sales and service locations in all important industrialized countries ensure effective, fast, on site support for valuable Werth customers.

As the world's largest trade show for quality assurance and metrology, "Control" in Stuttgart will surely once again provide a broad overview of product innovations in the field (from 14 to 17 May, 2013.) Werth is currently one of the largest exhibitors and is one of the few companies that has been there every year since the first "Control" in 1987. In the field of X-ray tomography, a new coordinate measuring machine will be presented that combines compact design with the ability to measure larger objects at higher resolution and precision. A new 225 kV X-ray source with a very small focal point and an X-ray sensor with a large number of very small Pixels make this possible. Other new product features are based on the increased performance of optical and tactile sensors, as well as of WinWerth® software. For the trade show, the new Technical Publication "Multisensor coordinate measurement technology – dimensional measurement with optics, probes, and X-ray tomography" will also be presented. The fundamentals of this technology are presented in an understandable form. Working closely with our customers, Werth continues to do everything it can to develop innovative products and contribute quality to the global success of "Made in Germany".

The new technical publication in the row: Die Bibliothek der Technik
The English edition is scheduled to be published in autumn 2013

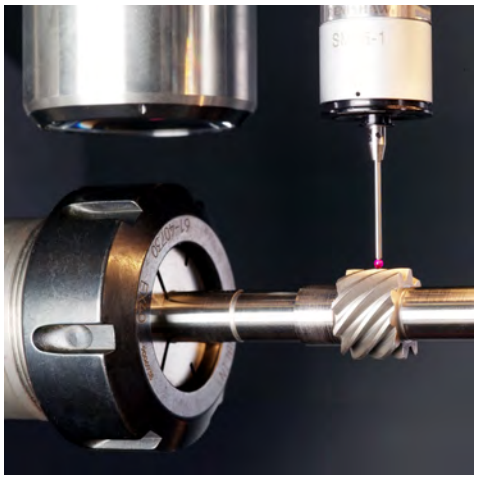
WinWerth® GearMeasure

Measuring Gears with WinWerth®

For many years, gears have been measured with Werth multisensor coordinate measuring machines. Analysis of the measurement values were performed either with the "involute" feature integrated in WinWerth®, with "BestFit" software or in a separate gear analysis package.

To simplify program creation for measuring gears, the functions for gear measurements have now been completely integrated in the WinWerth® measurement software. With WinWerth® GearMeasure, all involute teeth – including spur gears, helical gears, worm gears and worm wheels – can be measured and analyzed.

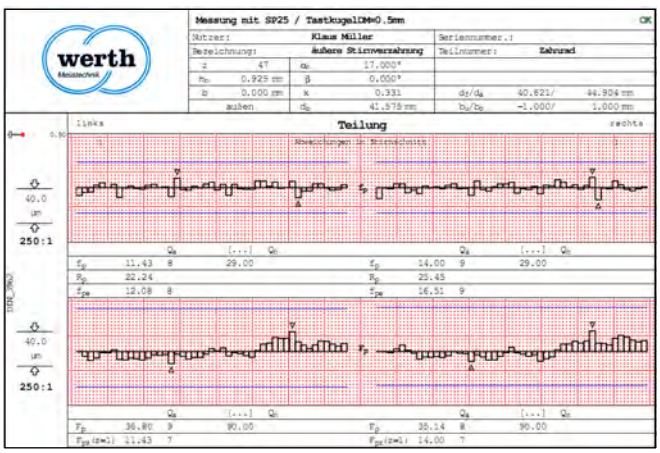
For the data collection, any of the sensors available on Werth coordinate measuring machines can be used. First there are the conventional probes such as the SP25 and SP80.



Measuring with rotary axis and SP25

For measuring small gears, the Werth Fiber Probe WFP is preferred due to its very small probe sphere diameter. Non-contact distance sensors such as the Werth Laser Probe and Chromatic Focus Probe (used with a rotating axis) are also useful. Of course, gears can also be measured on TomoScope® machines with X-ray tomography sensors for data point collection and then analyzed in WinWerth®.

As a result of the measurement, a complete gear measurement report with all gear parameters such as profile deviation, pitch, and runout is created.

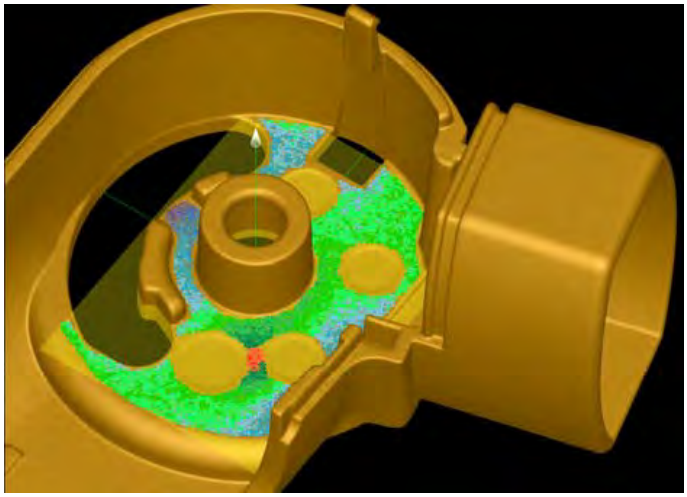


WinWerth® Segmentation

Automatic Measurement of Standard Geometries Are Made on Point Clouds with No CAD Model

To measure standard geometries in point clouds, the measurement points pertaining to the element must be selected. This selection is often tediously done by hand, or by means of an overlaid CAD model of the workpiece.

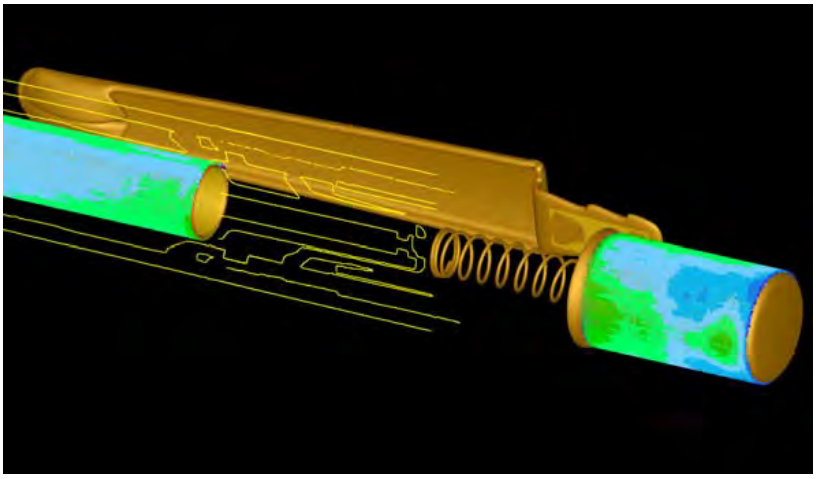
The CAD model serves the measurement software as an aid to select the associated measurement points. If no CAD model available, or if it is very different from the workpiece, then automatic, reliable selection of the points is more difficult.



Plane measured using automatic segmentation

Using the WinWerth® Segmentation function, even point clouds that do not have a model can be measured easily and quickly. The algorithm determines all the associated points after simply clicking on a starting point with the target element selected (e.g., plane, cylinder). The function allows reliable measurement of surfaces with small form deviations that are not included in the CAD model, such as ejector pin depressions on plastic parts.

Cylinder measured using automatic segmentation



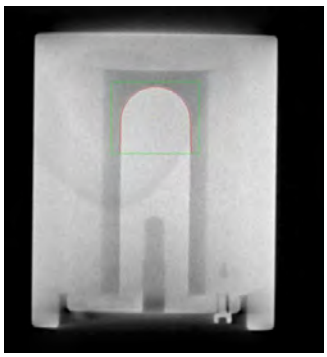
Werth Volume Cross Section

Measuring a Steel Workpiece with Tomography

Due to the large cumulated wall thickness of the cylindrical part of the workpiece (approx. 50 mm), the volume is full of artifacts and the contrast between the dome cap and the air in the interior of the components is very low. For typical reconstruction of the surfaces, the dome is not easy to detect and is hardly measurable.

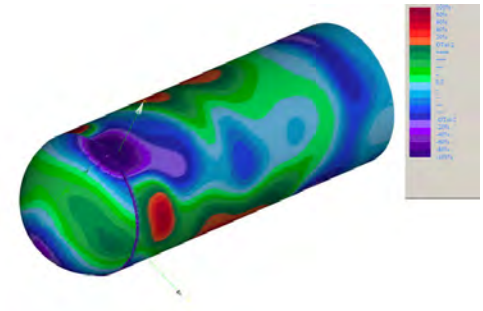
Disassembled workpiece

The volume cross section function makes it possible to capture measurement points and contours in the voxel volume with the powerful Werth contour image processing.



Cross section in the low-contrast voxel volume

These points are consolidated into a point cloud in STL format using the triangulation function in the WinWerth® software. Now the analysis can continue as usual to measure the workpiece in three dimensions.



Measured contours from the volume cross section and from the triangulated point cloud

what's new

DAkkS Lab

First Calibration Laboratory Accredited by the DAkkS for Coordinate Measuring Machines with X-ray Tomography

The DAkkS laboratory at Werth Messtechnik GmbH has been accredited as the first facility of its kind for calibrating coordinate measuring machines with X-ray tomography sensors. Calibration of these machines is based on the latest VDI guideline VDI/VDE 2617 Page 13 (as well as VDI/VDE 2630 Page 1.3), which was produced with the help of experts from Werth Messtechnik GmbH. Similar to conventional coordinate measuring machines, the key variables of the maximum permissible error, form deviation and size deviation are determined. CT machines can thus be easily compared with other coordinate measuring machines.

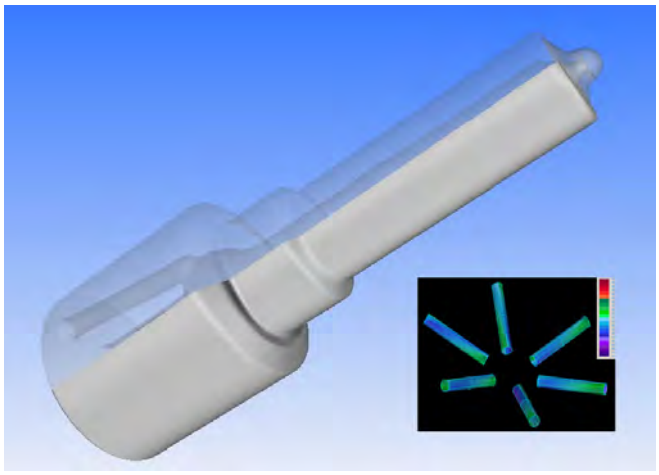
DAkkS calibration ensures traceability of measurement results to the highest level. This also means that Werth Messtechnik GmbH now fulfills the latest requirements for companies working under an ISO/TS 16949 quality management system with its CT sensor coordinate measuring machines. According to this standard, all measurement equipment must be checked and calibrated by laboratories accredited under DIN EN ISO/IEC 17025.

The scope of services of the Werth DAkkS lab includes calibration of coordinate measuring machines with optical, tactile, and X-ray tomography sensors. This also allows acceptance testing with corresponding DAkkS calibration certificates according to ISO 10360-2, VDI/VDE 2617 Page 6, and VDI/VDE 2617 Page 13 for coordinate measuring machine with multiple sensors.

TomoScope® HV Compact – Coordinate Measuring Machine with X-ray tomography sensors, now with DAkkS calibration

Measuring Nozzles with X-ray Tomography

Measuring fuel injector nozzles has been part of the standard repertoire at Werth Messtechnik GmbH for over 10 years. Typically, the injector hole diameters of just a few tenths of a millimeter are measured using VideoCheck® multisensor coordinate measuring machines with rotary/tilt axes and the Werth Fiber Probe. Nearly all manufacturers around the world today of injection systems for gasoline and diesel engines use this technology, patented by Werth.



Diesel fuel injector nozzle, measured using CT

The first TomoScope® for this measurement task has been in use for several months. One significant advantage over the fiber probe is the shorter measurement time for a significantly higher number of measurement points. Areas in the interior of the nozzle that are difficult to access can be measured easily using tomography. The wall thickness and pressure-side volume can be determined completely and non-destructively in a single setup without false castings. Fixturing is also less expensive, because difficult to access datum points can now be measured directly and need not to be defined by the fixture.

X-ray tomography provides very good reproducibility. However, due to artifacts typical of the process, for example, beam hardening and scattered radiation, the "absolute precision" is not sufficient for measuring injector holes with tolerances of a few micrometers without additional measures. The low measurement deviations required, in the sub-micrometer range, are achieved by the patent-pending Werth AutoCorrection process.

The new Werth Nozzle Module, developed from years of experience, has greatly simplified the measurement. Complete parameterization allows measurement of a large number of different types of nozzles without any user programming. With just a few entries, measurement and analysis of diesel and gasoline injector nozzles are performed automatically. This software solution can be used with the full range of VideoCheck® machines with image processing and fiber probe, or TomoScope® machines with X-ray tomography sensors. This ensures that measurement results from different Werth technologies will be comparable.

EasyScope® 200 3D Manual

The entry level model of the EasyScope® series, a manually operated machine, has fully automatic edge detection with zoom optics and autofocus for measuring in the third axis. This puts the EasyScope® well ahead of all other manual video measuring machines. Of course, the machine has been specified on the basis of VDI/VDE 2617 Part 6. The measurement range is 200 mm in the x axis, 100 mm in y, and 200 mm in z.

The base of the machine is a stable granite platform on which the measuring table and the column for the image processing sensor are mounted. The machine is positioned by means of handwheels. Intelligent software functions, such as the patented Werth AutoElement for automatically recognizing measurement elements, or the Werth MeasureGuide for navigating to programmed measurement positions, make it child's play to take measurements with the EasyScope®.

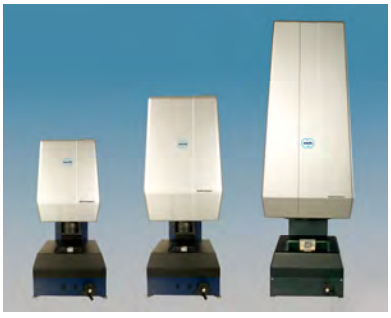
EasyScope® Manual

Another special feature of the system is the opto-electronic zoom. A click of the mouse zooms to the smallest details quickly and easily, or switches back to an overview of the image. The work pieces are illuminated by an 8-segment darkfield incident light and transmitted light. A brightfield incident light integrated in the beam path is available as an option. Zoom and light settings are performed automatically in programmed sequences. To measure in the z axis, only the axis drive is moved manually. An automatic method of focus variation determines the measurement in z independently of the user (patent pending).

Werth QuickInspect

The Family is Growing

To meet various requirements for measurement range and measurement uncertainty, the QuickInspect is available in several versions. The field of view or measurement range of the machines equipped with telecentric optics is between 0.6 mm x 0.8 mm and 230 mm x 180 mm, depending on the lens magnification. The high-resolution camera guarantees very small measurement deviations, even for a large field of view. The optoelectronic zoom can easily resolve and measure the smallest details, even for the machines with large measurement ranges. The QuickInspect is, of course, specified and traceable to VDI/VDE 2617. The maximum permissible error MPE for a machine with a 230 mm x 180 mm measurement range, for example is $E1 = E2 = (9.5 + L / 100)$ µm. For a measurement range of 1.6 mm x 1.2 mm, at 5 times magnification, the MPE is 0.3 µm (E1 and E2).



Werth QuickInspect Series

New Building

Additional Modern Offices at Headquarters in Giessen

At the end of 2012 another section of the corporate headquarters was completed. Employees in our Service and Sales departments can now also enjoy the amenities of modern, climate controlled workspaces. The new wing of the building adds 650 m² of usable space and is architecturally harmonized with the existing building of the Application and Training Center.

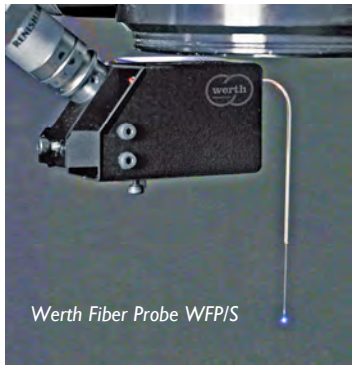
Head office of Werth Messtechnik GmbH

WFP/S: The Most Successful Microprobe in the World

Now in Freeform Scanning Mode

The Werth Fiber Probe, with multiple patents, has been used exclusively with Werth coordinate measuring machines for many years. Due to its outstanding properties, such as maximum precision paired with very small probe sphere diameters, it has been proven many times over in the marketplace. With several hundred installations, it is by far the most successful microprobe in the world. With modern signal processing and 64-bit control technology, a freeform scanning mode is now possible without the use of predefined contours. The user simply selects the start and end points for the scan path and the sensor follows the unknown contour automatically.

Software integration is completely analogous to the functions of conventional measuring probes. This makes it easier for the user to operate. With negligible contact force in the µN range, the Fiber Probe ensures that work pieces will not be damaged, even when scanning freeform contours.



Werth Fiber Probe WFP/S

The probe shank length, probe electronics, sensor offset and sensor drift have negligible effects on the measurement results. Another advantage is simple operation while observing the probe sphere with the camera. The versatile WFP/S can be used in medical technology (implants), the watch industry (miniature gears) and automotive technology (fuel injection systems).

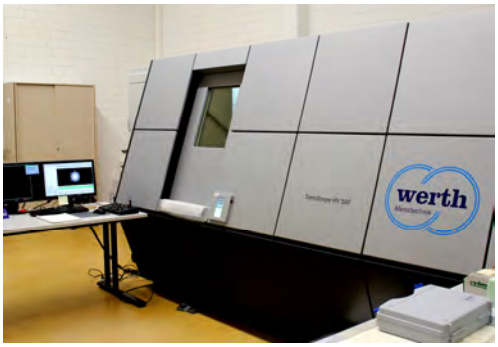
application

Continuation of page 1

Primarily, however, the measurement precision of the machine was the deciding factor for procuring it. It has to provide precision on the order of a few micrometers. We have checked this both with standards for calibration, and with our own components in test measurements. This means that the company can measure very delicate plug connectors (<1 cm) as well as large housings for railroad jumper cables, nearly half a meter long."

Designed for Measurement and Analysis

The measuring machine is currently used two-thirds of the time for measurement, and one-third for analysis. "Measurement" means that the surfaces of housings and plug connectors are captured and the associated dimensions (i.e. lengths, radii) are determined. Previously sliced sections were ground to capture the dimensions of internal chambers, now virtual section images can be produced that reproduce actual sliced sections. This means considerably less time and effort. The section plane can also be shifted digitally. "Where previously, due to the effort involved, only one grinding plane would be used for quality assurance, we can now measure in as many planes as desired with no additional measurement effort. The only additional work is in the post-processing of the information," explains Middelkamp.



Measurement with computed tomography is recommended for high-quality plug connectors of all shapes and sizes.

Within the company, "analysis" primarily means tests during development, where the whole part is observed non-destructively. Examples include testing leak and testing of the progression of casting compounds. By using a CT scan, it can be determined whether the filler material has been properly distributed, or whether there are voids in the plastic or aluminum casting. Depending on the results, the mold shape or injection parameters can be optimized.

Simple Operation and Analysis

The measuring machine is simple to use. The operator does not need to do any setup, just place the workpiece directly on the rotary table, which is located between the X-ray source and the detector. The user then selects the desired magnification, using the WinWerth® software package, and selects rastering, if needed, whereby partial images of the workpiece are taken and then combined into larger volumes. Rastering is used for long connectors, for example, which have just a few rows with a large number of poles. They are set up vertically, scanned in segment by segment, and then precisely merged together. This provides very high resolution and precision. When the operator starts the X-ray process, a user-defined number of X-ray images is taken at precise rotary positions. A 3D reconstruction of the images is then performed, to create a complete 3D volume that describes the entire internal and external part geometry. The result is a set of measurement data with precision in the micrometer range that shows every detail of the workpiece and can be analyzed in various ways.

Ideal First Article Inspection Reports

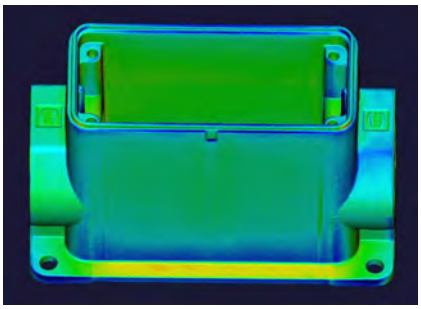
One typical area of application is the first article inspection report for releasing a product. Product developers provide a pre-production sample with drawings and CAD data, as well as inspection reports.

After scanning the component, a deviation analysis is produced from the data, with a color-coded plot and void analysis. The test dimensions are then measured and the result is documented in a first article inspection report. The developer then needs to evaluate the dimensions and release the part for production if the results are positive.

In addition to measurements that provide exact values, the software also provides the ability to run the deviation analysis, including color-coded deviation plots. This name comes from the use of color to represent the deviations between the target geometry and the actual geometry.

The CAD model is imported into the measurement software and merged or "Best Fit" with the tomographically captured data. The deviation of every point is shown in a color code, so that the user can see sink marks or other problem areas at a glance without doing special measurements.

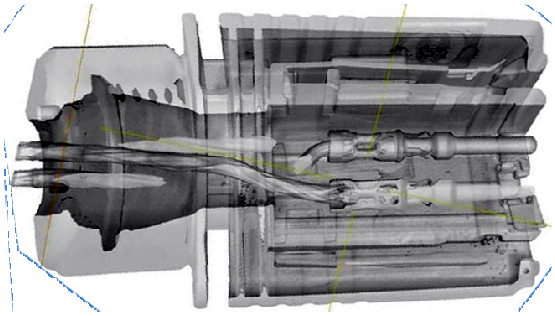
This plot can be used as the basis for correcting the injection mold. This method is also useful for quickly inspecting housings that have dimensions with large tolerance ranges, such as radii, where the precise dimension is not critical to the function.



Deviation analysis: The CAD model is merged or "Best Fit" with the tomographically captured data and deviations are plotted in color.

Modern Measurement Technology Pays for Itself

"From my point of view, the greatest benefit has been that we can obtain significantly more information than before about the entire component with the new machine, by quickly measuring in several different planes. I can use this to get better quality," says Middelkamp. But he is also counting on other long term benefits, for example, when measuring large die cast housings, where the dies need to be replaced relatively often due to wear. The same housing is submitted every year or two for a new complete first article inspection when a new die is used. Once the measurement program has been written, it can be reused whenever necessary. "Naturally, this saves time," says Middlekamp. "For plastic insulators, we have other positive effects as well. We need to capture the dimensions and positions of a large number of internal chambers. With the X-ray, this measurement process can easily be duplicated. The injection molds also often have four or eight nests each, for which one measurement program can be repeated several times.



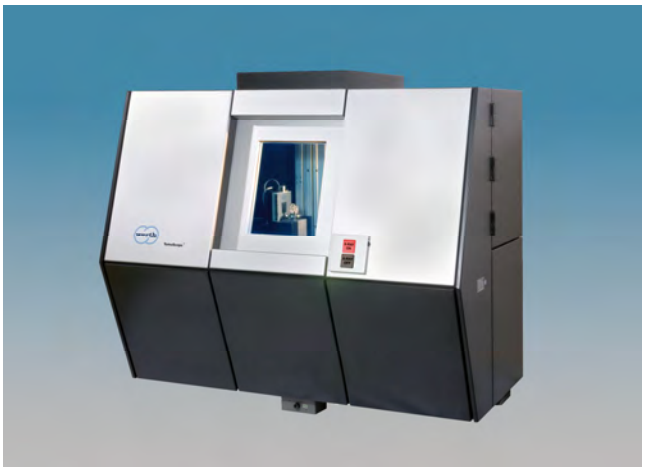
Example of analysis: The section view of the assembled plug clearly shows the cable and insulation displacement terminals.

Compact and Precise

TomoScope® 200 Now with 225 kV

The new TomoScope® 200 / 225 kV coordinate measuring machine with X-ray tomography combines a compact footprint with a new high-resolution X-ray detector. It is excellent for performing dimensional measurements and for material inspection of small and medium sized work pieces. Due to its high pixel density and large detector surface area, measurement times can be greatly reduced. Depending on the application, a significantly higher resolution can also be obtained. The powerful machines, with 190 or 225 kV, are distinguished by very small focal point sizes even at very high power.

The machines in the TomoScope® 200 series can be equipped with transmission and reflection X-ray sources ranging in power from 130 kV to 225 kV, depending on customer requirements. They can be used for a broad spectrum of measurement tasks. The arrangement of the X-ray source, measured object, and detector, which can be positioned relative to each other fully automatically, allows the user to optimize the measurement for resolution and cone beam angle. With highly developed machine technology and the patented process of "local sub-voxeling", very low measurement uncertainty can be achieved.



TomoScope® 200 / 225 kV

Automatic Loading to Closed CT

As with many manufacturing processes, integrated automated solutions ensure more efficient work in metrology, as well. To automate the process of production measurements with the Werth TomoScope®, it is now possible to use a pallet system to automatically feed in several identical or different parts. The unique Werth multisensor concept is used. In place of a tactile or optical sensor, a gripper is mounted on a rotary tilting head.

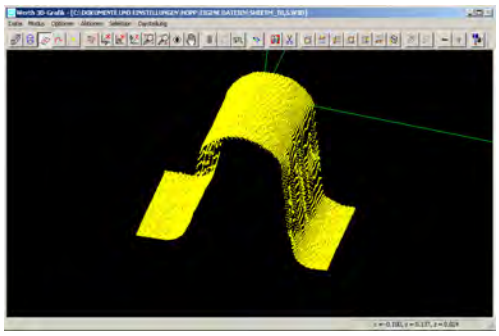
Pallet changer in the TomoScope®

This utilizes the machine axes to populate the rotary table with parts from a pallet located within the machine. The measuring machine thus remains closed during the entire series of measurements. This also eliminates additional safety concerns required when integrating external robots and a loading door. The TomoScope® can perform measurements without operator intervention during an "unmanned" shift. This option is currently available for the TomoScope® HV 500 and TomoScope® HV Compact units.

"3D Patch" at a New Level of Performance

In 2002, Werth Messtechnik GmbH presented the "3D Patch" at the Control trade show. Even then, this method of focus variation was able to capture three-dimensional point clouds for entire material surfaces in a short time.

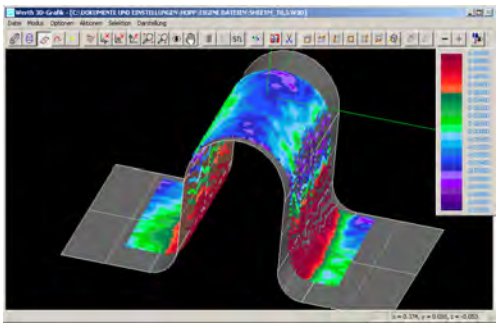
The new version of this sensor is presented at this year's Control trade show in Stuttgart. A new patent-pending method makes it possible to measure topographies over an extremely wide range. Dark and light areas of the same segment of the object can be captured simultaneously with optimal lighting and the measurement point cloud can be calculated.



Point clouds – flanks of a hob

Using WinWerth® software, it is ultimately possible to convert the calculated points into STL format and compare them directly with CAD data. Standard geometric elements are measured either by utilizing the CAD data to select the points, or using the WinWerth® segmentation function. Geometric elements are measured by simply clicking on points on the desired surface and selecting the type of element.

The new "3D Patch" is available for all machines that have image processing sensors. It can be used with either telecentric lenses with fixed magnification, or with zoom optics.



Color-coded deviation from the CAD model

news

Werth says, "Thank You!"

A few months after his 80th birthday last fall, Hans Joachim Neumann will use the upcoming occasion of the Control 2013 trade show to bid farewell to his exhibition activities. Mr. Neumann is one of the founding fathers of tactile coordinate measuring technology. He has been active at one of the market leaders in this industry for many years.

Through his standardization activities he got to know and appreciate Werth Messtechnik GmbH. Since the end of the 1990s, he has supported Werth, particularly in editorial work and graphic design. One focal point has been his involvement in the creation of the technical publications "Multisensor Coordinate Measuring Technology" and "X-Ray Tomography in Industrial Metrology". He also significantly influenced the launch of this newsletter, "The MultiSensor", and has been active in producing the new edition every year.

The Werth Messtechnik GmbH team wishes Mr. Neumann all the best for his "second" retirement, good health, and hope that he will consider an occasional joint project in the future.

New Sales and Service Company: Werth China

Werth is now providing local service directly to its growing number of Chinese customers under the name "Werth Metrology Shanghai". In 2010, Werth established a representative office in Shanghai, which has now been converted to an independent company.

The expert employees of "Werth Metrology Shanghai" have many years of experience with Werth technology. Product consultation, operator training, measurement services and machine demonstrations with fully equipped multisensor coordinate measuring machines are all part of the range of services of this new subsidiary. Werth China will do well in providing local support to their customers and sales partners.

COMMENT

Multisensor says...

Full Speed Ahead!

Weather forecasts have been calling for nothing but storms and rain for months and now they are predicting sunny skies and tailwinds.

But we have had those at Werth for a while now and the seas have been smooth as well – despite the supposed poor outlook.

Apparently weather forecasts have become less reliable (which is actually fortunate). Does this have anything to do with climate change?

We have now officially given the command, "Full speed ahead" and are surprised that the engines are already at full throttle.

It probably affects the perception when bad weather is predicted when visibility is not really bad. We are faster than ever!

In this spirit, Ahoy!
and fair winds from

Your Multisensor

Werth Compact Seminars

In the past year, Werth compact seminars were well received and attended. Due to rising demand, we are planning additional dates in 2013 – as always, at selected locations in Germany. For the first time, we are also offering the event for our customers in Switzerland.

The Werth seminars are free for participants and are – in addition to our demonstrations in the Application and Training Center in Giessen – the ideal platform to find out about current trends in coordinate measuring technology, learning new things, making contacts and exchanging experiences. Additionally, time is allotted for the opportunities to perform test measurements on customer parts.

Seminar dates in 2013:

Buchs (Switzerland)	09/05 to 09/06/2013
Pforzheim	09/11 to 09/12/2013
Amberg	10/09 to 10/10/2013
Munich	10/23 to 10/24/2013
Leipzig	11/12 to 11/13/2013
Dortmund	11/19 to 11/20/2013
Hannover	11/26 to 11/27/2013
Giessen	11/28 to 11/29/2013

For additional questions, please contact Ms. Melanie Mess, Phone: +49 641 7938-540, Email: marketing@werth.de

Credits

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