Bruker alicona

Industries, Applications, Success Stories

How to Master your Challenges with Optical Metrology

About Bruker Alicona
Get to know your Metrology Partner

Technologies
The Secrets behind Accuracy and Precision

Products
Curtain up for the Measuring Stars

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Optical 3D metrology

Dimensional metrology & surface roughness measurement

We are a global provider of optical, industrial measurement technology for quality assurance of complex components of different shapes, sizes and materials. Our non-contact measuring devices are used in all areas of precision manufacturing. Our core competence is the measurement of dimension, position, shape and roughness in the fields of production measurement technology and automation, prototype development as well as traditional quality assurance. Based on the technology of Focus-Variation, our measuring systems close the gap between classical dimensional metrology and surface roughness measurement, since users can measure both GD&T features and roughness parameters robustly, accurately, traceably and in high repeatability by using only one optical sensor.

> We at Bruker Alicona want to inspire.
> Of course, on the one hand, we want to inspire people to switch from tactile to optical metrology in order to promote innovation and progress.
> But on the other hand, we also want to inspire to a higher level of quality in general. Because that's the only way our industry will remain competitive.

Urban Muraus, General Manager

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Timeline

2001 – Foundation
Foundation of Alicona Imaging GmbH in Austria & Germany

2004 – America
Alicona Corporation in the United States of America

2005 – UK
Alicona UK Ltd in the United Kingdom

2007 – Korea
Alicona Korea Pacific Co. Ltd in South Korea

2010 – France
Alicona SARL France

2012 – New HQ
Relocation of the Austrian HQ to Raaba near Graz

2015 – Italy
Alicona Italy

2016 – Growth
New production facilities and doubling office spaces in the HQ

2019 – Bruker Corp.
Alicona joins Bruker - Alicona is now Bruker Alicona

2020 – China
Bruker Alicona China

2021 – New HQ Building
New and modern offices with a high-tech metrology lounge

2023 – Asia Engineering Center
Collaborative Metrology Lounge near Shanghai

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Operating on a global scale

Bruker Alicona stands for agile development, high technological competence and is motivated to constantly drive innovation. Since the company foundation as Alicona in 2001, it has been known for continuously improving both user-friendliness and production-suitability of optical measurement technology. This makes Bruker Alicona one of the driving forces in the integration of measurement technology into production, thus constantly opening-up new opportunities for automation and increased productivity.

Alicona has been part of Bruker since 2019 and now operates globally under the Bruker Alicona brand. Headquartered in Austria (Graz), measuring systems are developed, produced and distributed worldwide. An international sales, service and support team as well as selected distributors ensure regional customer proximity.

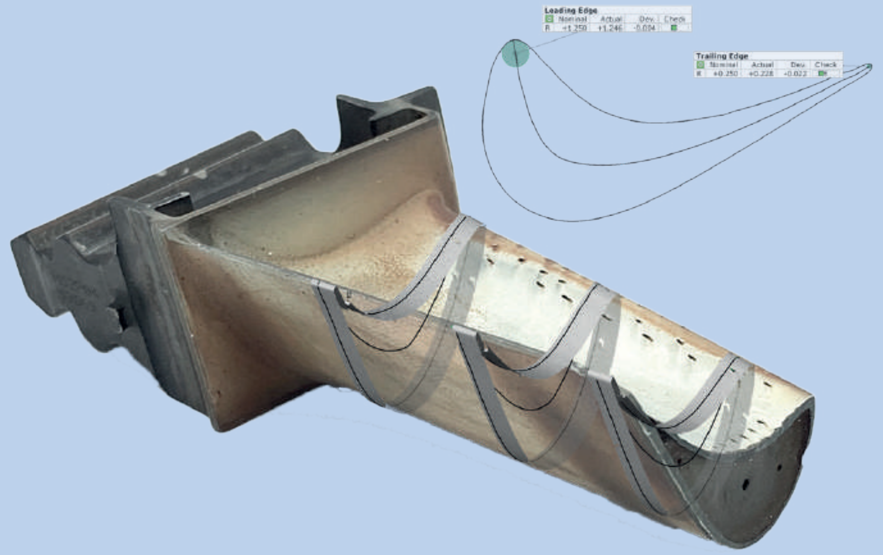
INDUSTRIES

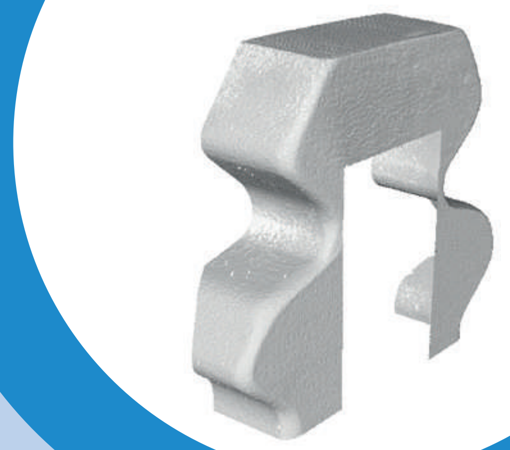
AEROSPACE

Enhanced safety, performance and efficiency for turbine engine components

Turbine engines are highly specialized aircraft components that must meet comprehensive safety requirements. These precision parts feature complex geometries and tolerances down to the single-digit µm range. Functional features like micro holes for turbine blade cooling and defined break edges on high-stress components enhance efficiency and ensure safe operation.

High-resolution 3D optical metrology systems are ideally suited to meet the stringent safety requirements of high-performance aircraft components. They measure width, length, depth, and volume of fractures or scratches and can conduct measurements of steep flanks using Advanced Focus-Variation technology. Additional applications include the automatic verification of angles, sizes, and shapes of up to 500 cooling holes, even for various hole geometries. Furthermore, they can verify coating processes and MRO actions with profile-based (Ra, Rq, Rz) and area-based (Sa, Sq, Sz) roughness measurements. Trust in high-resolution 3D metrology to keep your aircraft components in safe hands.



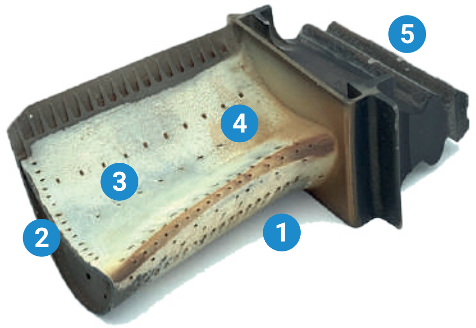


APPLICATION | AEROSPACE

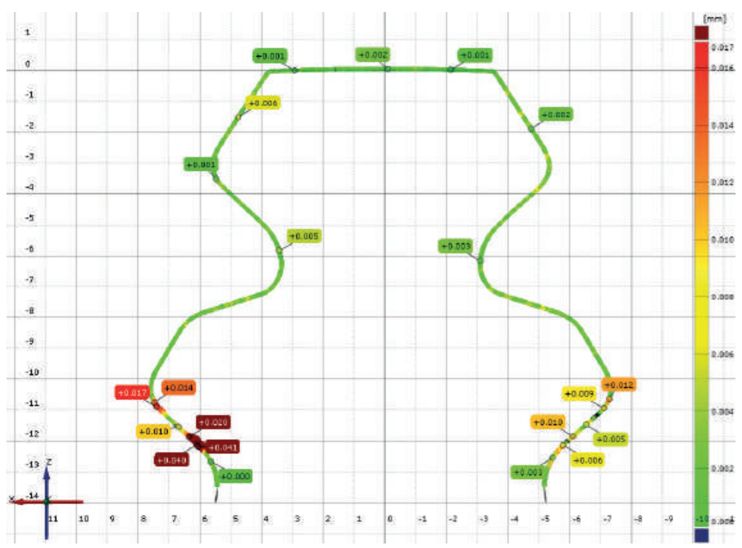
Turbine blades

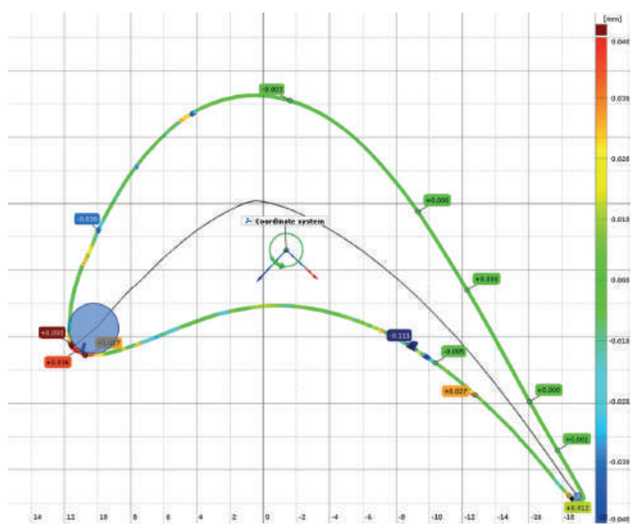
Leading and trailing edge:

The correct edge geometry at the leading and trailing edge of a turbine blade ensures optimized aerodynamic properties, which should result in increased efficiency with lower fuel consumption. The opening angle at leading and trailing edges is typically rather sharp and difficult to measure with conventional methods. Due to a special illumination technology, Focus-Variation delivers accurate results even on steep flanks and is therefore a suitable method to measure this special geometry. In contrast to other technologies, light from different directions positively influences the measurement result. This means that the maximum measurable flank angle is not limited by the numerical aperture of the optics.



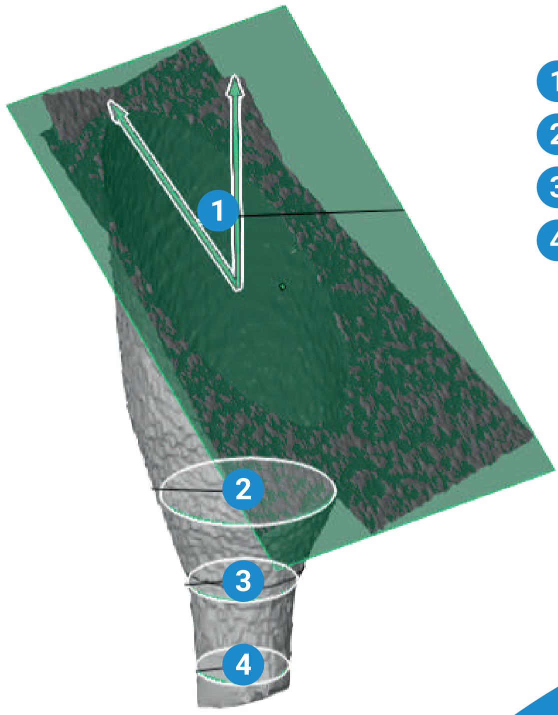
1. **Defect analysis**
2. **Airfoil analysis**
3. **Cooling hole geometry & position**
4. **Areal roughness**
5. **Fir tree geometry**



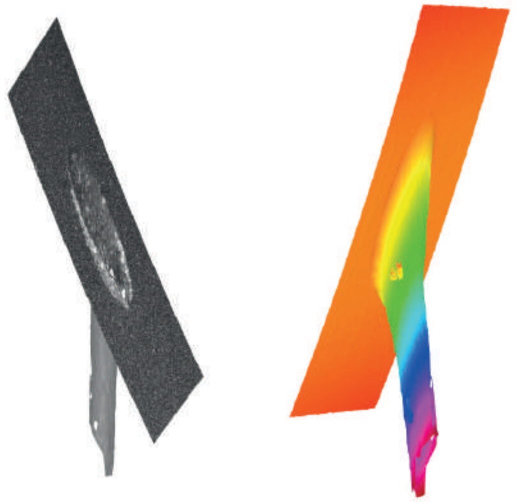


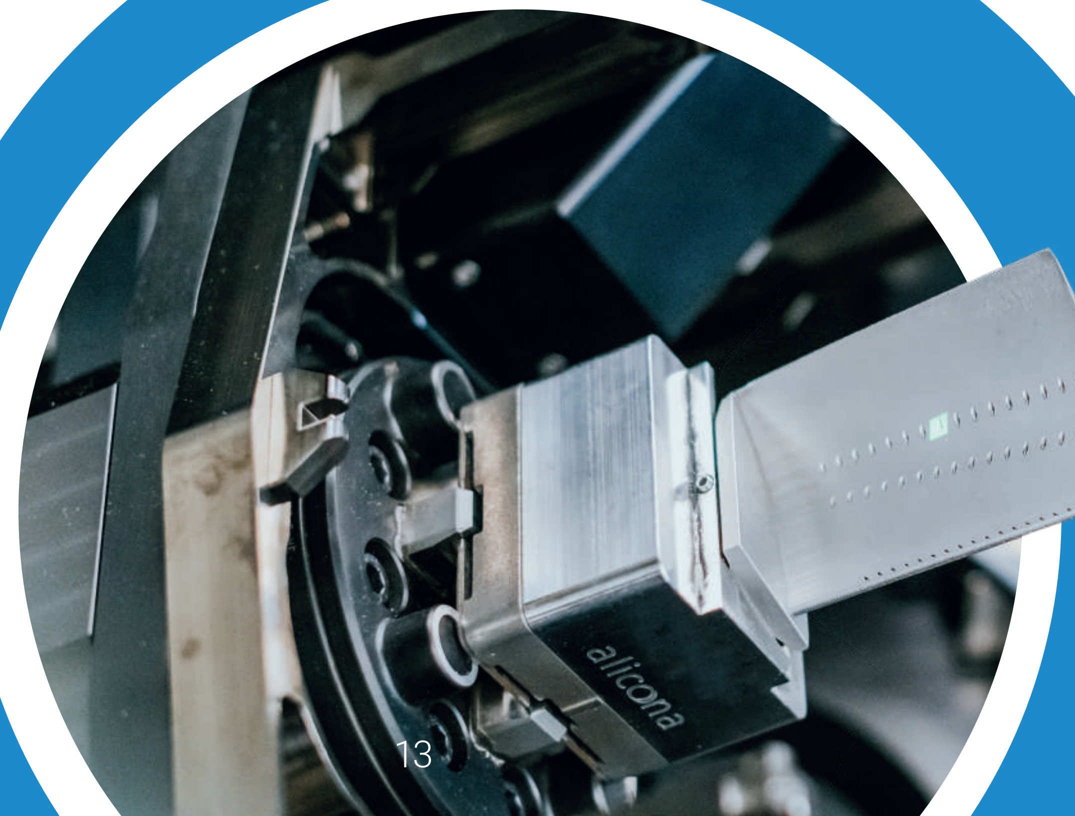
Cooling holes:

Air cooling avoids dangerous heat damage to the turbine blades. In this process, cooling air is blown through specially shaped cooling holes or cooling bores in the turbine blades. The air forms a thin, cooling and insulating layer between the combustion gases and the turbine blade and thereby prevents the material from overheating. For quality control of cooling holes, it is important to ensure that the angle, size and shape of up to 500 cooling holes, some of which have different shapes, correspond exactly to the respective CAD data. Focus-Variation is used to measure the geometry and position of the cooling hole. Also, the transition from the outer surface of the turbine blade to the bore-hole is measured. Of particular interest are hole roundness, diameter and various angles at the transitions. Deviations from the nominal geometry are displayed immediately. The measurement of the cooling holes at different positions can also take place automatically, which is implemented using a CAD/CAM interface.



1. **Hole angle**
2. **Diameter 1**
3. **Diameter 2**
4. **Diameter 3**



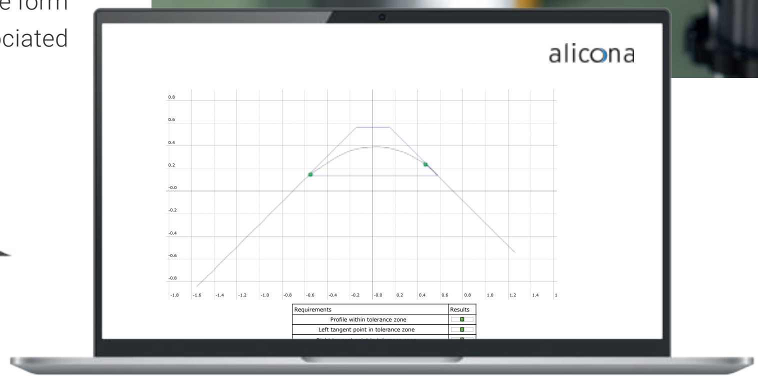


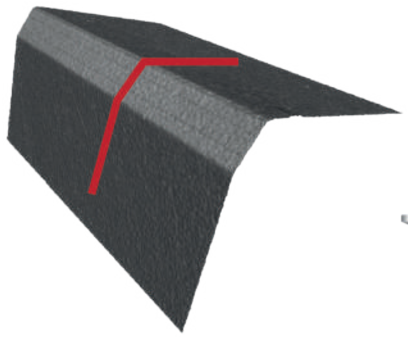
APPLICATION | AEROSPACE

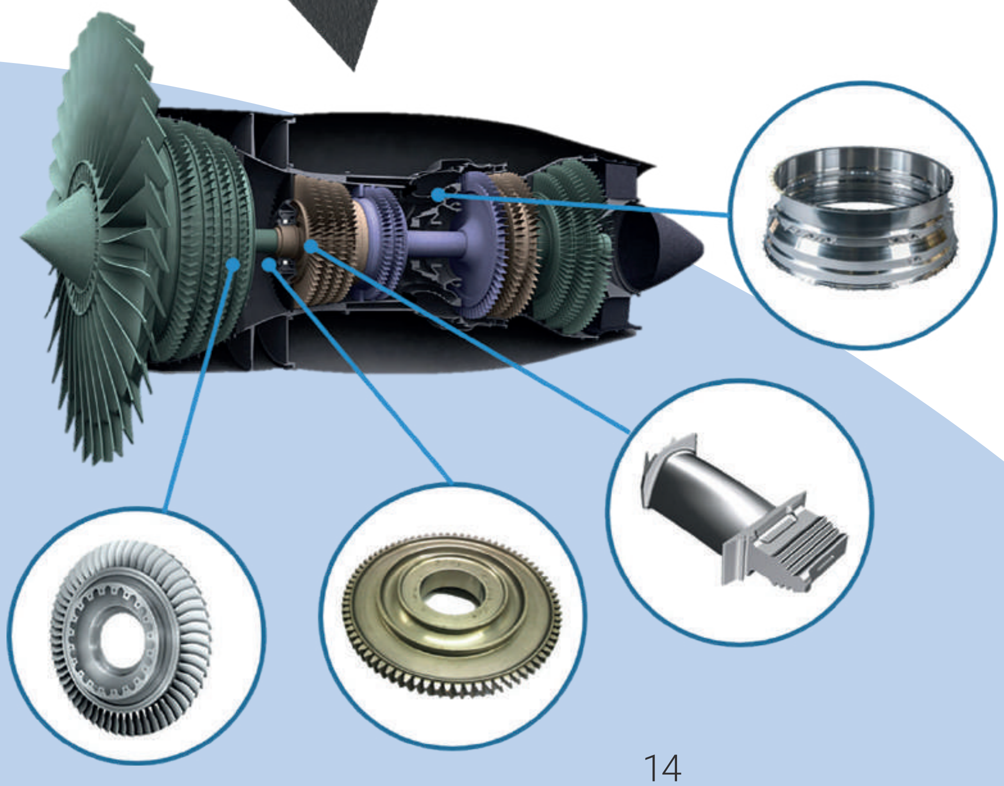
Disk & blisk

(Blade integrated disk)

Break edge measurement:
Common manufacturing processes such as turning, milling or drilling can lead to burr formation and undesirable sharp edges. These in turn can lead to arterial fractures or cracking. Such defects are ultimately a danger to the operation of the turbine engine. Especially for highly critical components such as fan blades, compressor disks, turbine blades, blisks (blade integrated disk) or turbine cases, high demands are placed on edge processing, testing and certification. The broken or rounded edges must lie within narrowly defined tolerances. The geometries to be examined are often only a few tenths of a millimeter in size and can only be measured with great effort. Tactile solutions in combination with replica measurements often cannot measure form deviations satisfactorily and reliably or are associated with a large amount of work.





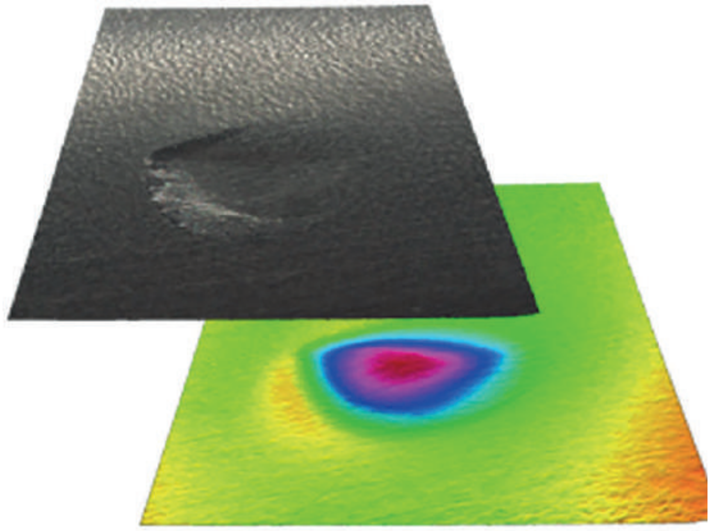


APPLICATION | AEROSPACE

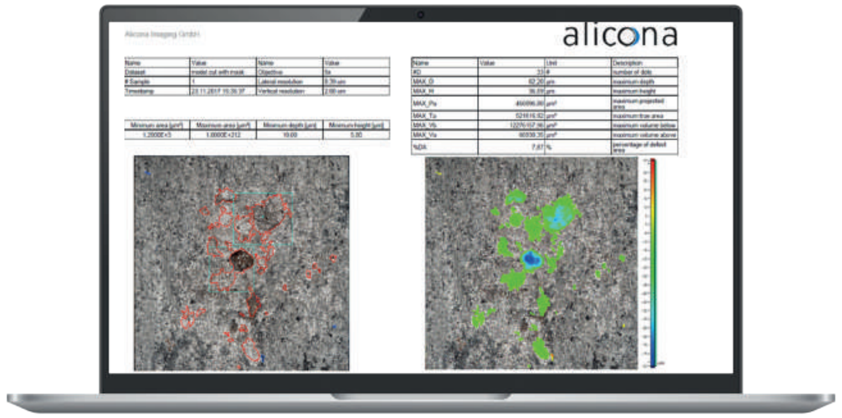
Defect measurement

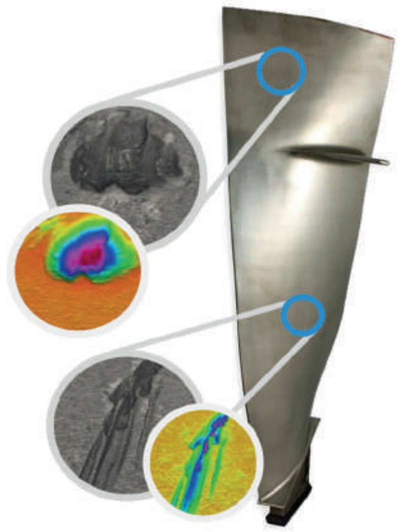
Ensure safety with precise defect detection

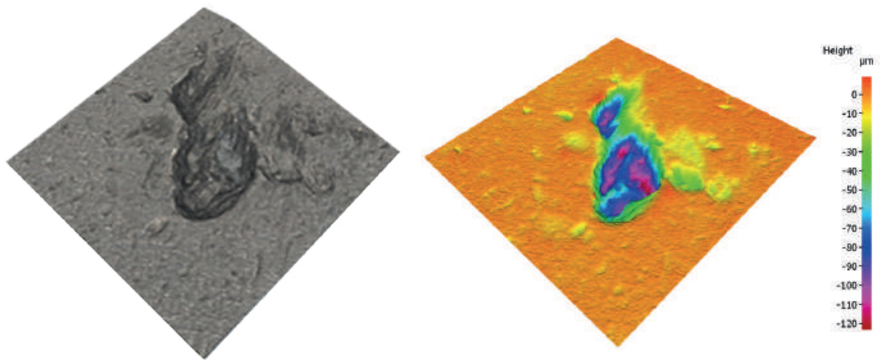
Even small defects in components, such as rotor blades or motors, can significantly impact safety by causing stress concentrations. If left undetected, these defects can lead to critical issues like excessive heat or crack formation, potentially resulting in turbine damage. The maximum depth of a defect is key in determining whether a part should be repaired or replaced.



Our Focus-Variation technology enables precise 3D detection of surface defects and component edges. It accurately measures the width, length, depth, and volume of fractures and scratches, ensuring high-quality control and minimizing risks.







THALES

SUCCESS STORY | AEROSPACE

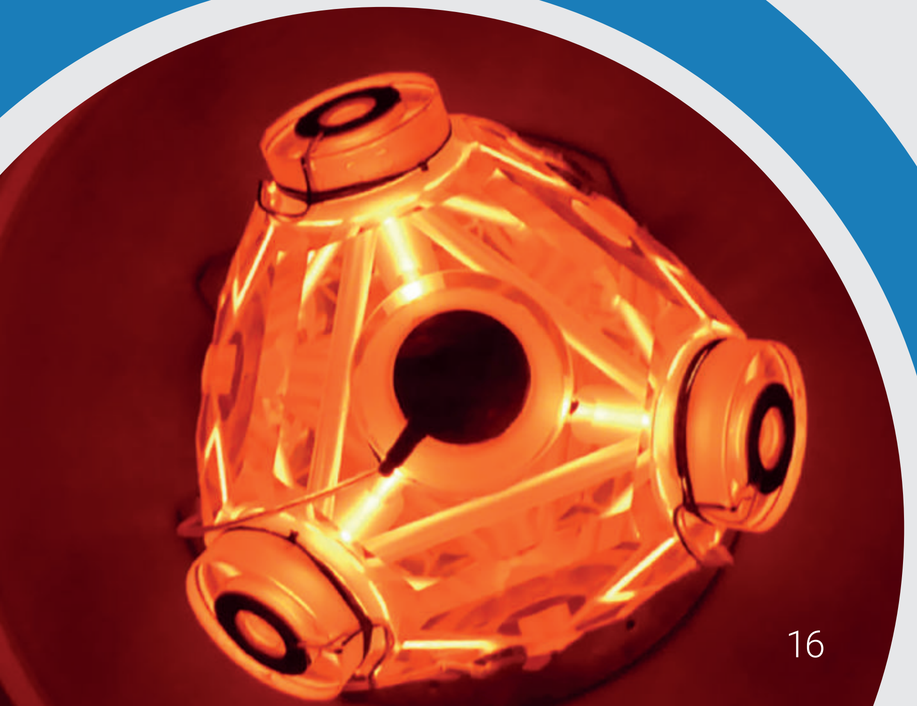
Optimization of manufacturing of “gyrolasers“ with Focus-Variation

World-renowned for its industrial electronic solutions, Thales has an entity in the Avionics division that specializes in Navigation, located on several industrial sites, including La Brelandière in Châtellerault (France - Vienne 86). This site produces inertial systems for the aeronautics industry, a true Thales trademark. These systems, based on glass ceramic sensors called “gyrolasers”, allow the position of the aircraft to be known without the help of GPS satellites.

The “gyrolaser” components are manufactured by high-precision machining in a glass ceramic material block. This high-quality glass ceramic (identical to that used to make the mirrors of large telescopes) is not very sensitive to thermal variations and makes it possible to reach roughness levels of < 1 nm rms after super polishing.

> After evaluating the various technologies available, Thales selected Bruker Alicona as the only company capable of offering a solution that is both efficient and quick to implement. By measuring shape, size, position and roughness with a single system, Focus-Variation bridges the gap between 3D coordinate measurement machines (CMMs) and conventional profilers.

In order to reach these roughness levels, many refinement steps are necessary after machining the “gyrolaser”. One of the key steps of the process consists in eliminating the SSD* resulting from the machining process by chemical etching on the parts. [*SSD: Sub-Surface Damage, are micro cracks present on the surface and invisible to the contact profiler. These micro cracks are generated by the friction of the diamond tools on the glass ceramic].



Glass-ceramic sensor called “gyrolaser”

Operating principle of chemical etching in 3 steps.

Measure shape, size, position & roughness with one single system

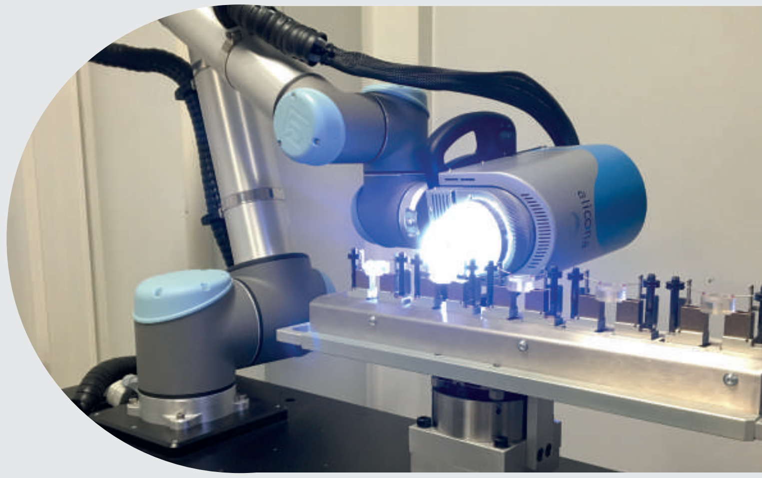
In order to correctly control the chemical etching process and the amount of material removed, it is necessary to precisely know the roughness of the workpieces after machining and before chemical etching.
After evaluating the various technologies available, Thales selected Bruker Alicona as the only company capable of offering a solution that is both efficient and quick to implement. By measuring shape, size, position and roughness with a single system, Focus-Variation bridges the gap between 3D coordinate measurement systems (CMMs) and conventional profilers.

Efficiency and implementation speed

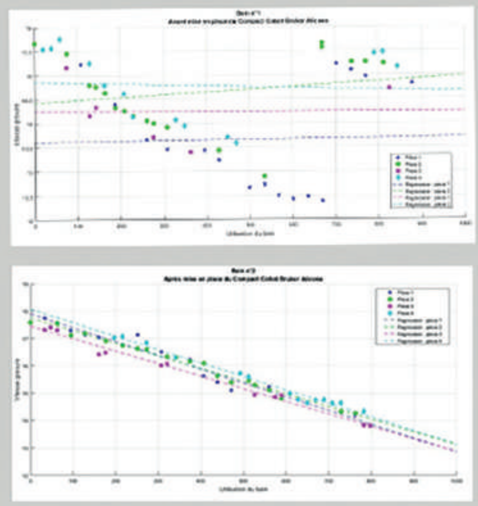
Based on precise technical specifications, the choice was quickly made for a 6-axis collaborative robot equipped with an R25 (Compact Cobot) measuring head. “The main difficulty consisted in structuring the control programs, by passing access issues and meeting cycle times”, says François Cuvillier, Gyrolaser Product Line Indrustrialization Manager at Thales AVS. Thanks to the joint work of the Thales AVS and Bruker Alicona teams, the equipment was quickly validated and put into production.

Towards a fully automated production

Thales is participating with many other manufacturers in the Aerospace Factory of the Future project, a French collaborative research platform aimed at imagining and implementing all the technologies that will make aerospace factories more competitive over the next fifteen years. Current developments thus seek to make autonomous production cells, by connecting all the production elements together, from machine tools, through washing and robotics, to metrology equipment, in order to create an intelligent and self-adaptive production unit.



Compact Cobot, by Bruker Alicona, located in the metrology room at Thales AVS Châtellerault la Brelandière and equipped by the company Rhonax (Thyez 74 France / www.rhonax.fr).



Etching speed vs. bath use before and after setting up the Compact Cobot by Bruker Alicona

In aviation, Cobots are used, among other things, for the automatic measurement and evaluation of radii, chamfers and break edge on turbine disks and turbine housings.

SUCCESS STORY | AEROSPACE

How to quickly, easily and automatically measure radii and defects

The automatic measurement and evaluation of radii, chamfers and break edge on turbine engine components is one of many criteria in modern quality assurance at MTU Aero Engines. Currently three Cobot systems from Bruker Alicona are in use for break edge measurement. Additionally, the optical measuring solutions replace labor intensive replica techniques and tactile methods in defect measurement.

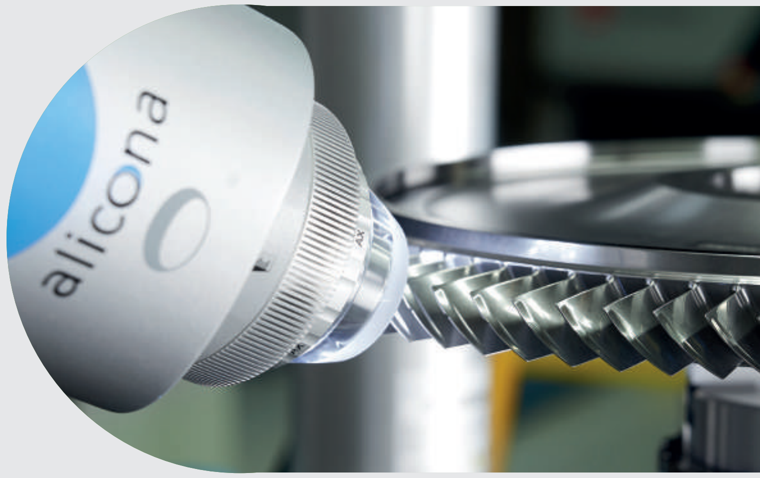
"If there's a burr, this could become a danger point in the engine." Inspection planner Michael Duffek is jointly responsible for quality assurance of turbine engine components at MTU Aero Engines. For the world-renowned manufacturer of aero engines, the automated measurement and evaluation of edges, radii and chamfers of engine components is an important part of modern, state-of-the-art measurement technology. Highly specialized components such as turbine blades, turbine disks or blisks (Blade Integrated Disk) are measured, and they involve a number of metrological challenges.

> What the Cobot already offered 3 years ago at the market launch was unique. All the other manufacturers we evaluated would have had to start at the development stage.
>
> MICHAEL DUFFEK

These include, for example, the complex geometry with steep flanks as well as varying reflection properties of the components. Different surface reflections occur due to varying manufacturing processes, as surfaces to be measured are either coated, and thus matte, or ground, and thus highly reflective. For a suitable measuring system, this means that it must not only offer the required automation options including standard-compliant evaluation, but must also be able to measure complex, difficult-to-access geometries with tight tolerances and matt to reflective surfaces in high resolution and repeatability. A further requirement is the integration into a production process including integration into the existing IT environment. "And the whole thing has to be fast and straightforward," Michael Duffek adds to the list of criteria MTU uses as a basis for continuously evaluating its measurement equipment suppliers. As a result, there are now 15 Bruker Alicona measurement systems in use at MTU locations worldwide, 11 of which are located at the test centers of the German headquarters in Munich. This is also where the automated measurement of turbine engine components takes place, which are implemented with measuring equipment from the Bruker Alicona Cobot line.

Combine an optical 3D sensor with a collaborative robot

Cobots are a combination of a collaborative 6-axis robot and a high-resolution optical 3D measurement sensor to be used for the automatic inspection of microgeometries on large components. In the aerospace industry, the measurement of deburred edges, also known as "break edge measurement", on turbine disks and turbine housings are the most common applications. Bruker Alicona Cobots have been available on the market since 2017, and even then "nothing comparable has existed, at least we are not aware of any system. What the Cobot already offered three years ago at the market launch was unique. All the other manufacturers we evaluated would have had to start at the development stage," Duffek recalls. He is now a "Cobot expert", because under his leadership three systems for the automated measurement of edges, radii and defects are currently in use in Munich.



Inspection planner Michael Duffek, jointly responsible for the quality assurance of turbine engine components. Under his leadership, 3 Cobot systems are currently in use at MTU's Munich headquarters.

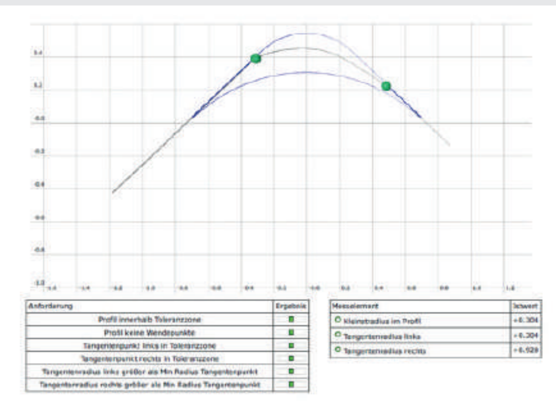
The operation of the Cobots is designed for the use of several operators. Handling, measurement and evaluation by means of programmed test routines are easy to handle, as MTU confirms.

Measure break edges with tolerances in the single-digit µm range

Classical manufacturing processes such as turning, milling and grinding can lead to burr formation and unwanted sharp edges. These represent structural weak points where material breakage or cracks can occur. This can ultimately lead to a potential danger to the safe operation of an engine, which is why high demands are placed on edge processing and its testing and certification.

Cobots, which like all Bruker Alicona measuring systems are based on Focus-Variation, are suitable for this purpose in many ways. The optical technology enables the measurement of highly reflective to matt surfaces with steep flanks and even captures geometries with tolerances in the single-digit µm range in high resolution. This means that even the smallest form deviations can be measured traceably. The evaluation is performed automatically and according to common industry standards, e.g. ASME. In addition, Cobots are suitable as both high resolution and process-stable measurements go along with easy operation of the system, which is designed for the use of several operators. The handling, measurement and evaluation by means of programmed test routines are easy to handle. "Teach-in of measuring programs with the joystick is intuitive," is how MTU sums up the situation. Optionally, measuring routines can also be defined in the CAD file of the component using a CADCAM connection.

Cobots consist of a collaborative 6-axis robot and a high-resolution optical 3D measuring sensor and are a popular measuring device for production-integrated quality assurance.



Even the smallest form deviations are measured traceably. The evaluation is performed automatically and according to common industry standards, e.g. ASME.

Measure length, width, depth and volume of defects

Another field of application for the Cobots is defect measurement. The maximum depth of a defect determines whether a component is reused, repaired or disposed of as a reject part. Conventional, manual methods for defect measurement using replica techniques, profile projectors and tactile methods such as contour measurement systems are labor intensive and cannot be automated. "State-of-the-art technology is very important to us when it comes to measuring technology," says Duffek. He continues: "Using optical measurement technology we are faster, more accurate and, above all, process-capable. With Bruker Alicona we can also measure automatically in a CNC process," he continues. MTU Aero Engines highly emphasizes on repeatable, traceable, automatic and fast defect measurement. Therefore, Bruker Alicona measuring equipment is used for this purpose as well. Defect measurement at MTU includes the evaluation of parameters such as length, width and depth of dents, scratches, cracks etc.

Automatic measurement of more than 100 taught-in measuring positions

More and more Cobot users in the aerospace sector use the possibility to define measurement routines directly on the CAD data set of a component by means of a CADCAM connection. Several hundred measuring positions on a wide variety of components, for example turbine housings, are automatically measured and evaluated. This would also take many times longer with conventional methods such as the use of replica techniques. According to MTU, this means in figures: "This brings a reduction in inspection costs of 25% - 50%!"

AUTOMOTIVE

Driving efficiency and quality in automotive components

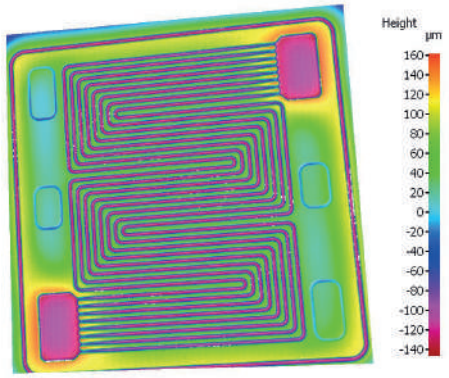
In the automotive industry, precision manufacturing is crucial, with stringent quality controls being essential. Optical 3D metrology ensures the precision of manufactured components through accurate measurements and consistent data, leading to a streamlined and better-controlled production line. This technology enables fast, precise 3D measurements of complex components, significantly automating and speeding up production processes.

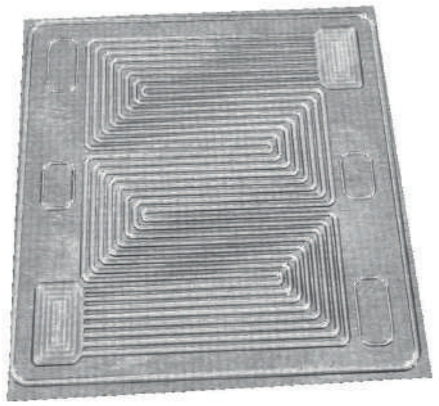
Precise measurements enhance quality control and reduce rejection rates. By integrating these systems, you gain greater control over your production lines, ensuring each component meets the highest standards of quality and reliability. The accurate and consistent data provided by optical 3D metrology allows for real-time adjustments and improvements, leading to more efficient and cost-effective manufacturing processes.

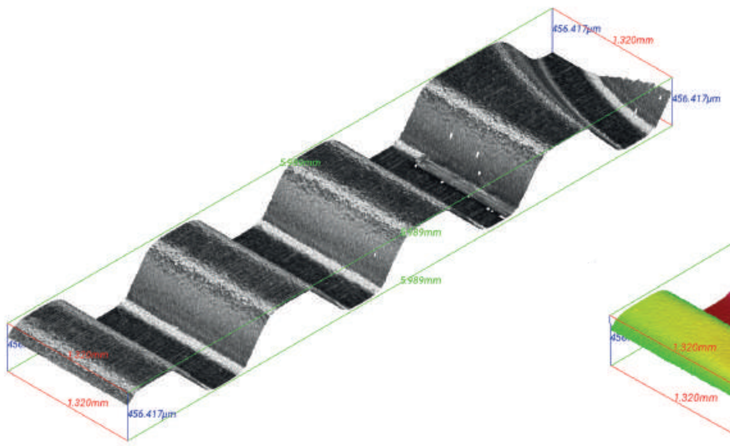
APPLICATION | AUTOMOTIVE

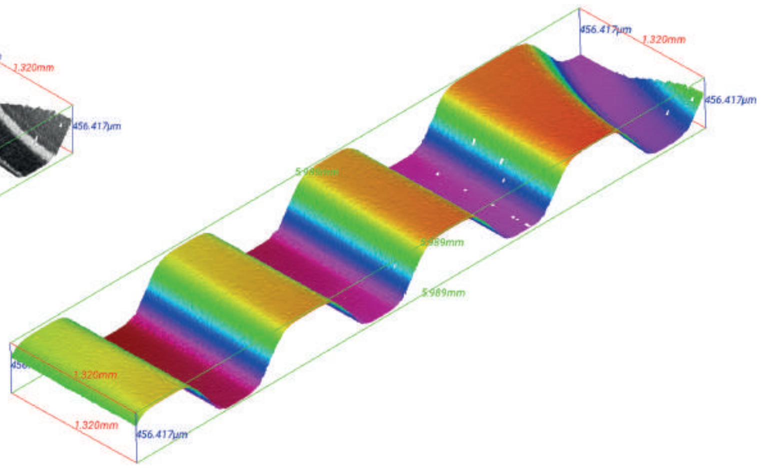
Bipolar plates

The main focus for bipolar plates is on the dimensional accuracy of the flowfields. Their function is to guide oxygen (O2), hydrogen (H2), and water (H2O) through the two plates of the bipolar plate - Anode and Cathode. To ensure the functionality and quality of the Flowfields, various measurements must be performed at predefined positions. With the optical coordinate measuring machine µCMM and the MetMaX software, you gain comprehensive insights into the critical Flowfield. This includes measuring and evaluating the surface profile, line profile, true position, as well as the height steps and distances, angle, and radii of contour. Further parameters are the areal roughness (Sa, Sq, Sz) at the channel bottom and on the die.









APPLICATION | AUTOMOTIVE

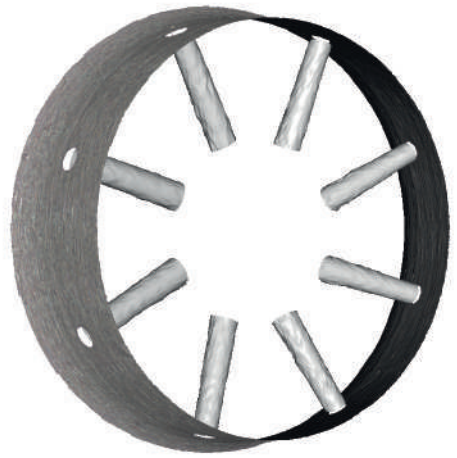
Gears

Gears and gearshafts play a crucial role in the operation of cars, primarily in transmitting power from the engine to the wheels and controlling the speed and torque of the vehicle. Optical metrology plays a critical role in ensuring precision and efficiency in the automotive industry, particularly in the analysis and measurement of gear components. This technology enables accurate measurement of various parameters essential for evaluating gear shaft parts. Key measurements include the coaxiality of gearing concerning the shaft, outer diameters of gearing and shaft areas, shaft lengths, profile and areal roughness on the tooth flank, and parameters necessary for qualifying the gear itself. These measurements are vital for diagnosing potential malfunctions, optimizing performance, and maintaining high standards of quality and reliability in automotive gear systems.

APPLICATION | AUTOMOTIVE

Injection valves & nozzles

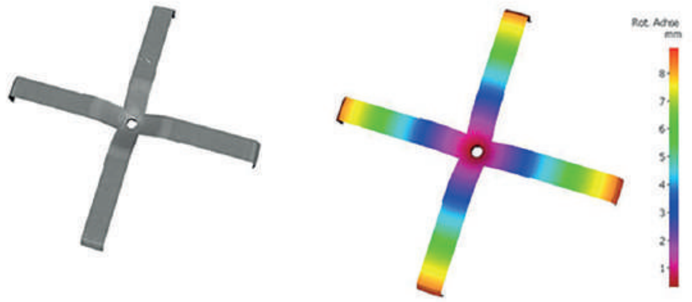
The application of optical 3D measurement technology, specifically using Vertical Focus Probing with the µCMM measuring machine marks a significant advancement in quality assurance for micro injection holes of injection valves. Until now, geometries such as micro holes of e.g. injection valves could not be measured optically. However, Vertical Focus Probing now enables the optical probing of lateral surfaces and the measurement of flanks larger than 90° with precision. This technological breakthrough enhances the ability to accurately assess the shape, dimensional accuracy, surface roughness (Ra, Rq, Rz), and positional accuracy of critical components like injection nozzles. These capabilities are crucial for optimizing fuel atomization, spray patterns, and overall combustion efficiency in automotive and industrial applications, ensuring superior performance and reliability.

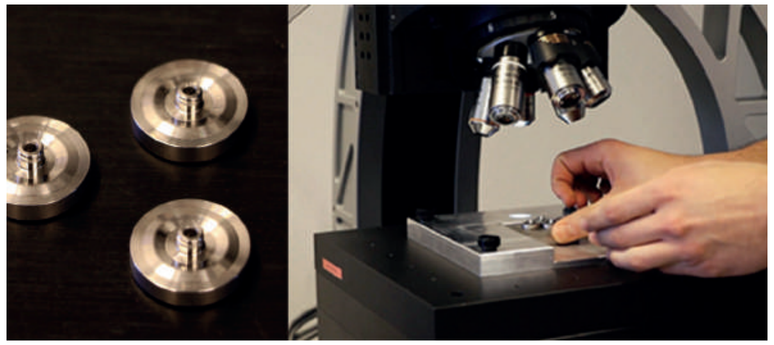


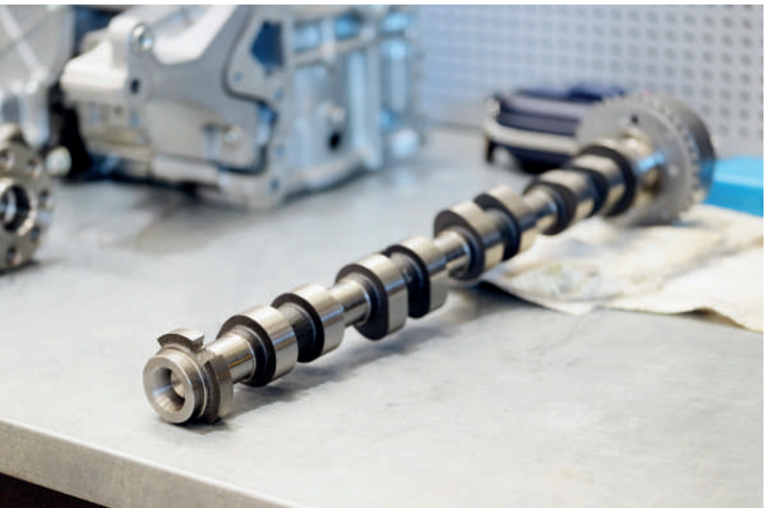
APPLICATION | AUTOMOTIVE

Valve seats

The function of the valve seats is crucial for sealing the valves during engine operation. When the intake valve is closed, the valve seat must ensure that no fuel or air flows back from the combustion chamber into the intake duct. These critical components require precise measurement of roundness, small valve opening angles, and tolerances within the one-digit µm range to ensure optimal tightness and performance. Optical metrology provides repeatable and traceable measurements, allowing engineers to verify the dimensional accuracy and surface characteristics of valve seats with unparalleled accuracy.







APPLICATION | AUTOMOTIVE

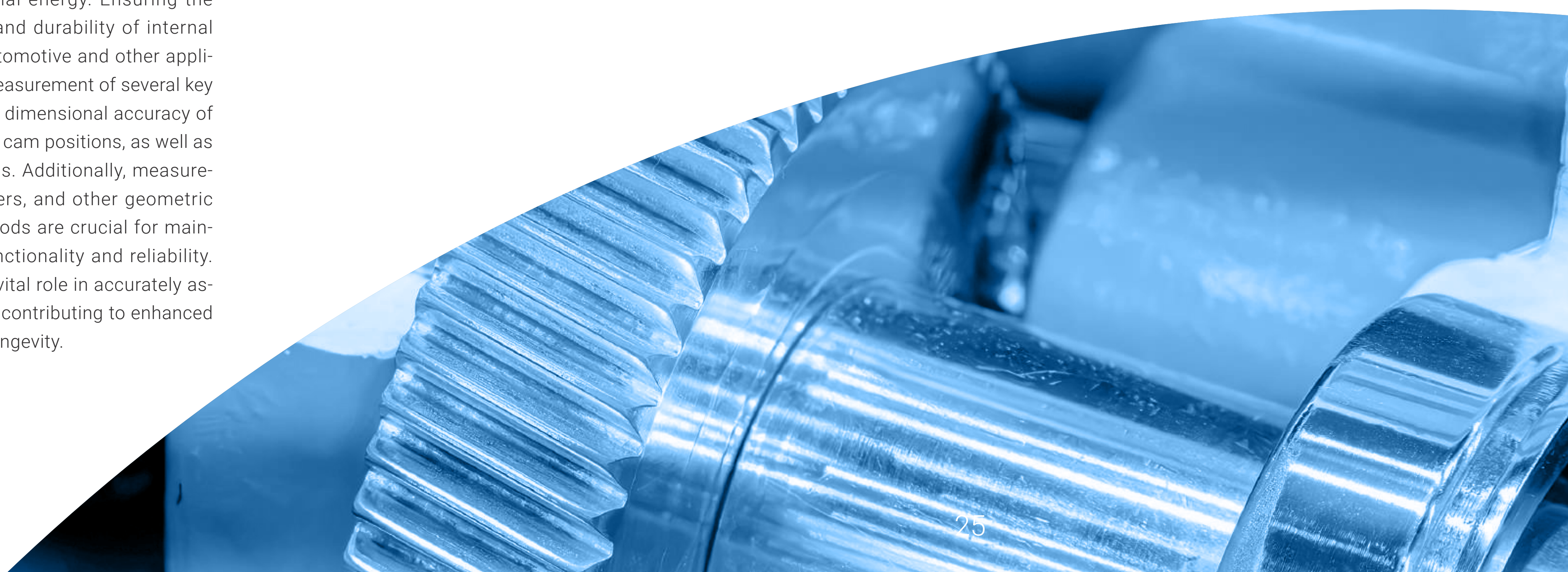
Cam & conrods

Camshafts (cams) control valve operation for efficient combustion, while connecting rods (conrods) transmit piston movement to the crankshaft, converting it into rotational energy. Ensuring the performance, efficiency, and durability of internal combustion engines in automotive and other applications requires precise measurement of several key parameters. These include dimensional accuracy of cam profiles and camshaft cam positions, as well as surface roughness analysis. Additionally, measurements of lengths, diameters, and other geometric properties of connecting rods are crucial for maintaining optimal engine functionality and reliability. Optical metrology plays a vital role in accurately assessing these parameters, contributing to enhanced engine performance and longevity.

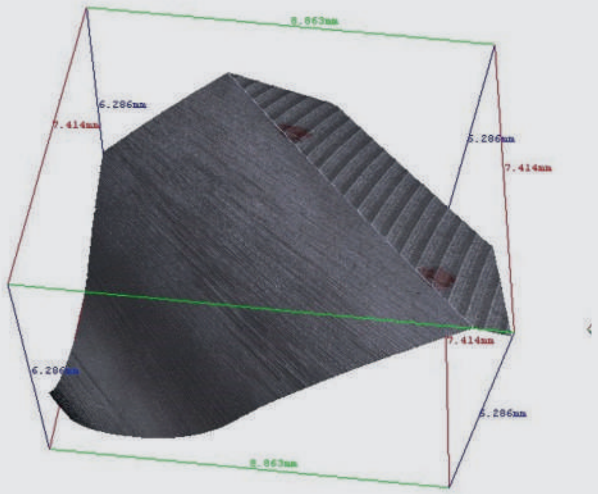
APPLICATION | AUTOMOTIVE

Battery seats

Battery seats in automotive applications serve as critical housings for securely mounting and connecting vehicle batteries to the electrical system. Optical metrolgy plays a decisive role in ensuring their quality and reliability. It measures dimensional accuracy, ensuring precise fitment and alignment of battery components. Surface quality assessments detect imperfections that could affect battery performance or longevity, including surface roughness evaluations to ensure optimal contact and prevent corrosion. This meticulous inspection process guarantees that battery seats meet stringent standards for safety, efficiency, and durability in modern automotive manufacturing.



With InfiniteFocus we measure faster and get much more meaningful information. We have become much more efficient!



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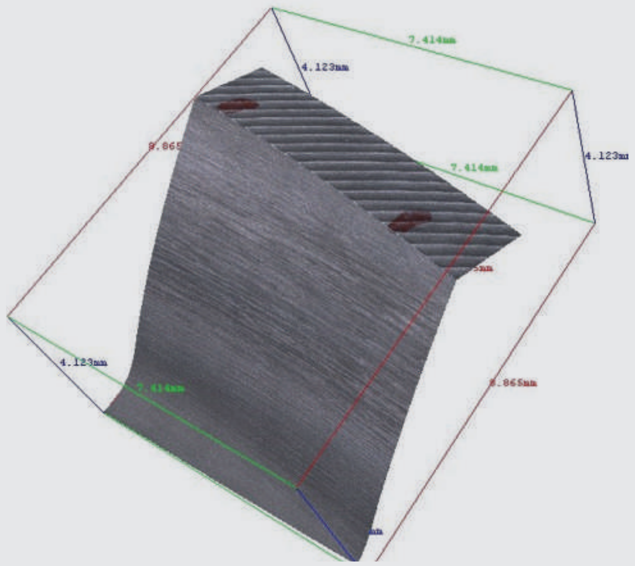


SUCCESS STORY | AUTOMOTIVE

Quantification of waviness on gear tooth flanks leads to new patent

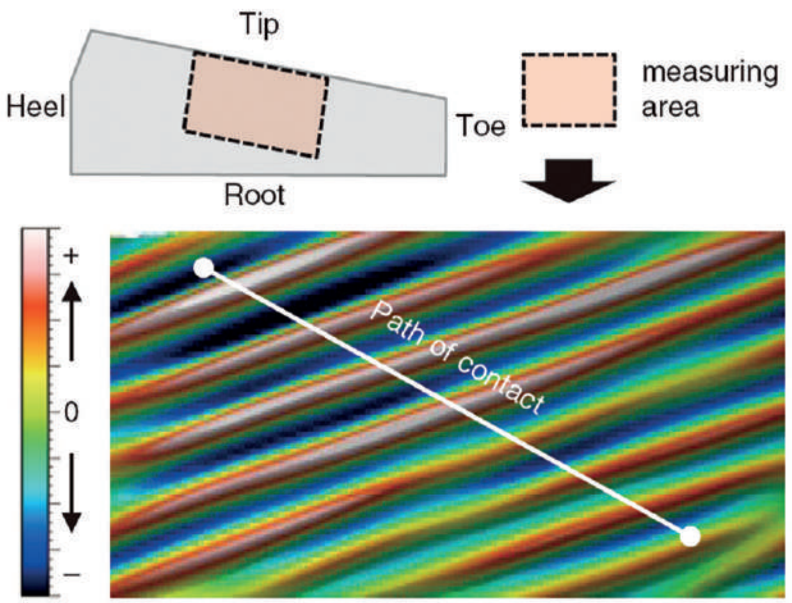
HONDA
The Power of Dreams

The waviness of a tooth flank can cause unpleasant noises in the interior of a motor vehicle. Using high-resolution and area-based measurement technology, Honda has succeeded in isolating and quantifying the waviness from the roughness on a flank. By applying Focus-Variation and frequency analysis methods, the Research & Development team was able to identify and successfully reduce disturbing noises.

Modern driving comfort and a high noise level in the interior of a car are a contradiction. For the automotive industry, this means to avoid NVH phenomena ("noise, vibration, harshness"). Disturbing noises may have their cause in a gearbox´s powertrain. Often, they can be traced back to the waviness on gear tooth flanks. This is why Honda uses an optical 3D measurement system to identify and measure the waviness on the flanks, enabling the global automotive manufacturer to optimize their manufacturing process of hypoid gears and, subsequently, to eliminate unwanted gear noise.

Hypoid gears are particularly challenging in terms of low noise levels because they are high-frequency and therefore tend to transmit vibrations and sound radiation, which in turn leads to unpleasant noise development in the vehicle interior. To find the origin of the gear noise, Honda uses the high-resolution measuring instrument InfiniteFocus from Bruker Alicona. The form and roughness measuring system is the ideal solution for the automotive group for several reasons: On the one hand, it also measures steep flanks in high resolution, and on the other hand, it allows the filtering of roughness and waviness based on dense, high-resolution and areal 3D data.

By using dense and areal 3D data, waviness is quantified. Also, as Honda has done, frequency analysis methods can be applied.



Filter roughness and waviness

One of the biggest challenges in measuring waviness on gear flanks is to filter the waviness and roughness of the surface. For Honda, conventional 2D imaging techniques did not lead to the requested results. The waviness is often superimposed by tool marks caused by e.g. milling cutters, which makes it challenging to isolate them completely from the roughness. 2D surface profiling methods or tactile measuring systems, which only capture single profile lines, are only partly suitable for this purpose. The optical, area-based 3D measuring system InfiniteFocus offers more possibilities here. Naoto Syukushima from the Powertrain Prototyping Department explains: "Ra values are not sufficient to verify the real surface state of flanks, as they only capture single profile lines. With area-based Sa-values, on the other hand, we can map surface features over the entire surface and then completely isolate them from the waviness using various filtering methods." The results of this analysis have enabled Honda to adapt the manu-

NAOTO SYUKUSHIMA

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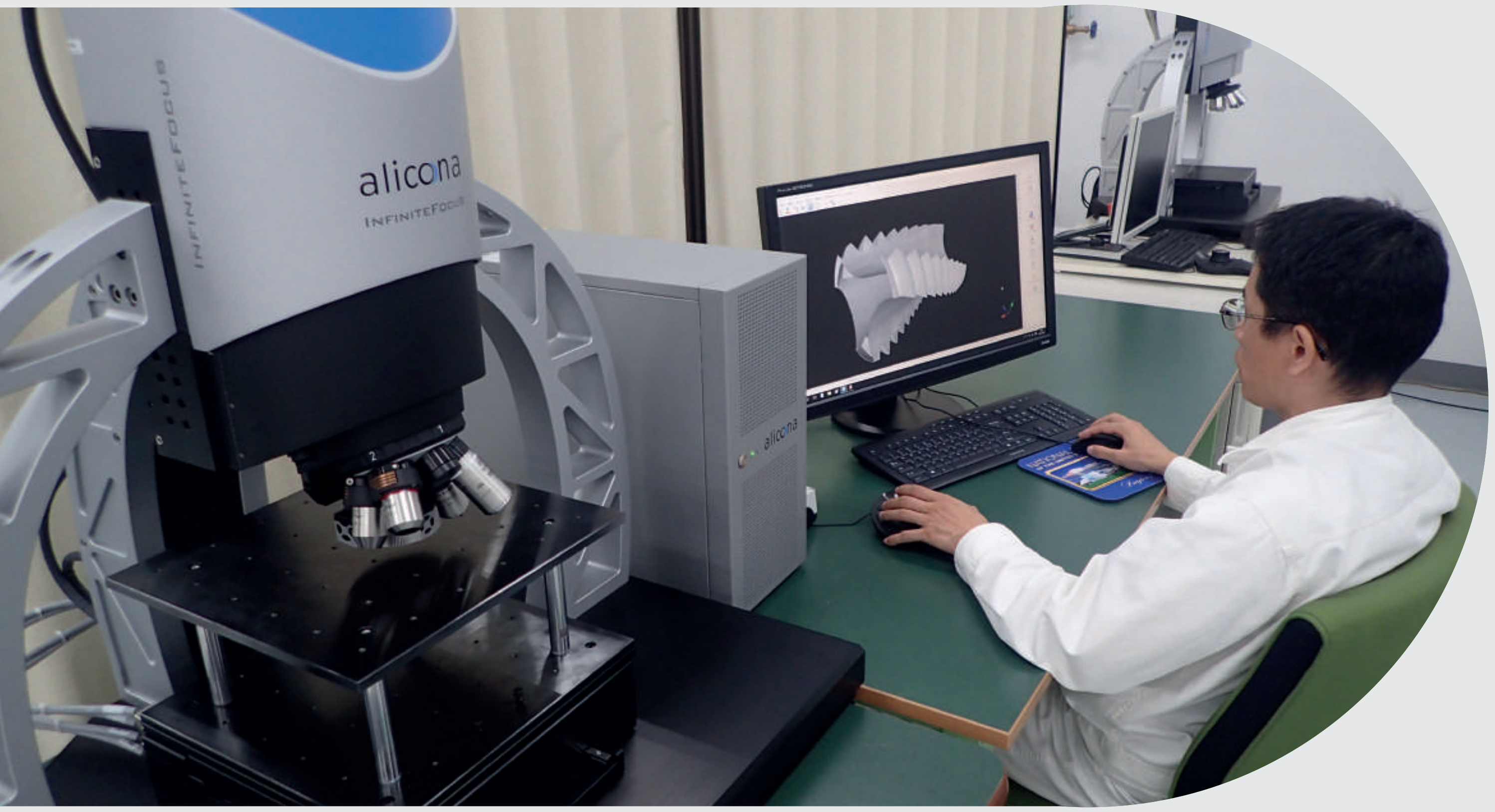
Honda uses optical 3D metrology to quantify waviness on flanks of hypoid gears. This is done to find the origin of unwanted noise in the interior of a car.

With InfiniteFocus we measure faster and get much more meaningful information. We have become much more efficient!



InfiniteFocus measurement device in use to measure gear flanks. The system allows the measurement of steep flanks and to filter roughness and waviness.

facturing process of hypoid gears and, consequently, to help prevent negative noise development in the production of hypoid gears.

Measure steep flanks faster

High-resolution and repeatable measurements even with difficult to access geometries such as steep flanks is another benchmark that distinguishes InfiniteFocus from other metrology providers, according to Honda. This is what Naoto Syukushima says about the original need for a new measuring system: "The cooperation with Bruker Alicona started with the fact that we were looking for a measuring device that could also measure steep flanks." He continues: "The system we used before no longer met our requirements. With InfiniteFocus we measure faster and get much more meaningful information. We have become much more efficient!" According to Honda, other aspects that have also contributed to this increase in efficiency are the high level of user-friendliness of the 3D measuring system, the 3D color information for quick and easy identification of wear, and the high measuring performance for flanks with different surface finishes. The latter is due to wear or different stages of wear and the associated different reflection properties of the flank. Syukushima mentions yet another benefit: "Our components often measure 250mm x 250mm. Other measuring systems that we have tested could not be used for this measuring volume."

For Honda, there is one more decisive factor InfiniteFocus offers to successfully achieve the application of waviness analysis. "We can export the 3D and then apply our own analysis procedures. In our case, these are frequency analysis methods," explains Syukushima. Honda has thus set a new standard in the quantification of waviness on gear flanks. The patent on their process proves the major impact and leadership in this sector.

How the combination of AI and 3D measurement technology ensures reliable powertrain technologies

For the implementation of a new laser cleaning process, Vitesco Technologies, formerly Continental Division Powertrain was looking for a measuring device to monitor the performance and quality of laser processing in series production. The automotive supplier found it in a Bruker Alicona 3D measuring system. In addition to the 3D topography measurement, this offers a new classification software. Based on AI, the software automatically detects OK and not OK surfaces.

The core of every vehicle is its powertrain system. This is what Vitesco Technologies stands for, specialized in the production of modern powertrain technologies for clean and sustainable mobility. Optimized technologies that contribute to the reduction of nitrogen emissions (NOx) can be implemented, among other things, through intelligent solutions in exhaust gas aftertreatment. This also includes the development of NOx exhaust gas sensors, which sometimes pass through critical process steps in production. A critical process step is the application of modern cleaning technologies in which a surface is processed, e.g. by means of pulsed laser radiation and thus prepared for the following processes. "Technical Cleanliness and

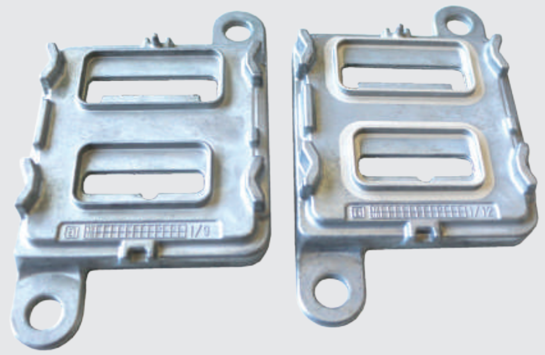
InfiniteFocusSL measuring system, used for roughness measurement of laser-blasted die casting surfaces. An additional classification software enables the automatic separation into o.k. and non-o.k. parts. The evaluation is based on a combination of 2D texture and 3D topography data, which are analyzed during the inspection process.

Cleaning Technologies" is the area of expertise of Hermann Hämmerl, Senior Process Engineer in the Central Manufacturing Technologies department of the Business Unit Sensing & Actuation (Regensburg). He coordinates process development for new technologies through to their introduction in the German automotive supplier's worldwide network of plants. This also includes "searching for methods that allow the process results to be verified," he explains. In this specific case, Hämmerl was responsible for the implementation of a new laser cleaning process that is intended to prepare die-cast surfaces for subsequent bonding to the electronics housing of a NOx exhaust gas sensor. The surface produced by laser has an influence on the durability of the bonding, and measurement technology should help to ensure the long-term function of the sensor in vehicle operation.

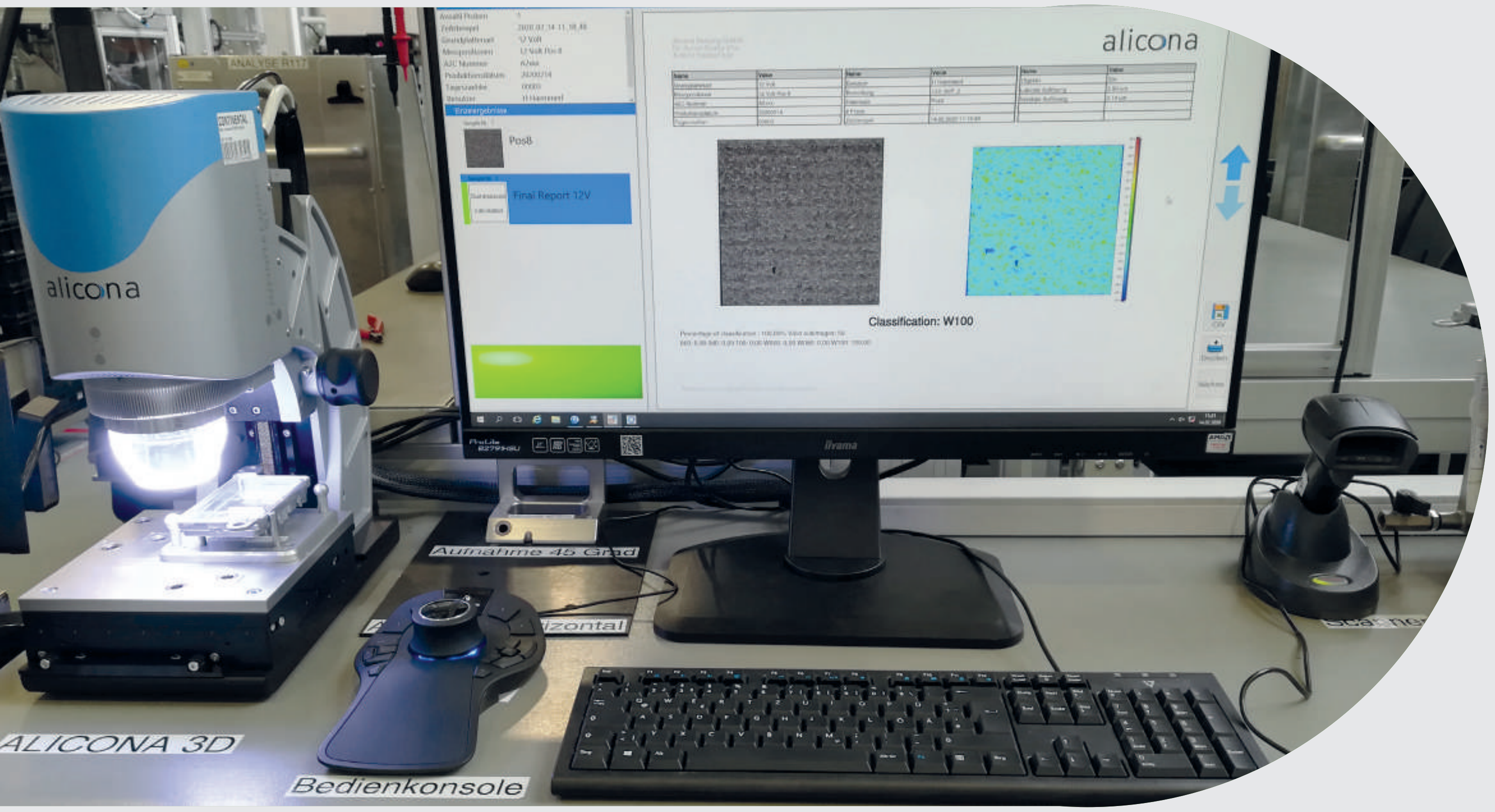
In the search for the right measuring method a hurdle had to be overcome. As this was a newly introduced process no suitable measurement or analysis methods were known that could have been used in production. In the end, they found what they were looking for in a Bruker Alicona 3D measuring device which in addition to 3D depth measurement offers a surface classification software that automatically distinguishes between OK and not OK surfaces.

Automatic recognition whether OK or not OK component

Even minimal process fluctuations in laser processing lead to the smallest changes in the micro surface quality of the processed die-cast surface. These can already have a critical influence on the durability of the bonding. In the evaluation of various measuring devices, great importance was therefore attached to the ability to detect even very small differences in roughness. In this way, it can be verified whether specified tolerances are maintained even if process changes are made. Conventional profile-based methods could not sufficiently quantify the specific roughness of the die cast surface, so Vitesco Technologies switched to optical metrology for this application and today uses Bruker Alicona's technology in series production. The InfiniteFocusSL measuring system detects even the smallest differences in roughness of the laser treated die casting surface. Therefore, deviations in the laser cleaning process can be detected quickly and it is possible to react promptly, e.g. by adjusting system parameters.



Die-cast component before laser cleaning (left) and after (right). The laser cleaning process prepares the surface for subsequent bonding to the electronics housing of a NOx exhaust gas sensor.

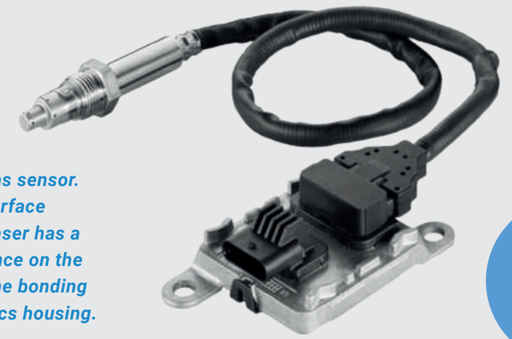


Results report from InfiniteFocusSL. One of the decisive factors in choosing the right measuring equipment was the ability to detect even minimal differences in roughness.

The measuring system offers a further benefit which contributes significantly to the efficiency of the entire process chain. It is an automation option based on AI, which automatically distinguishes an OK surface from a not OK. surface. The corresponding evaluation is based on a combination of 2D texture data and 3D topography data, which are analyzed during the inspection process. Using a so-called classifier, both positive and negative examples ("golden samples") are trained to the measuring system or classification software, which enables the automatic detection of OK and non-OK die cast parts in near-series monitoring.

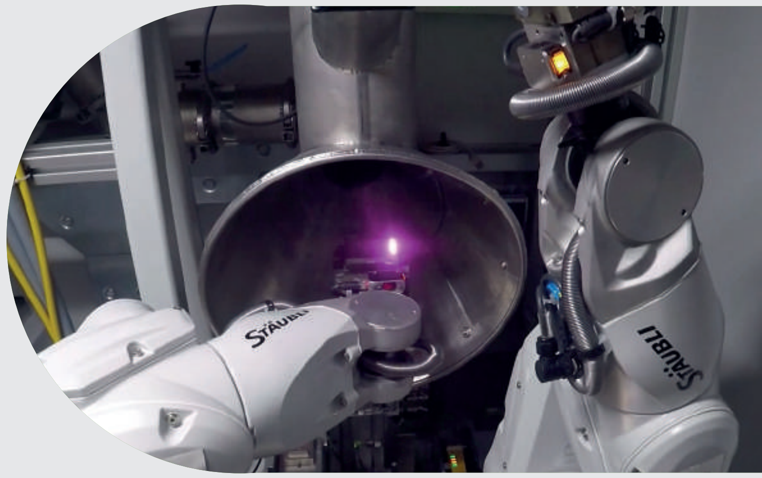
Automatic measuring sequence for each operator in the production

A "production-suitable" measuring system has many facets. On the one hand, there is the need to provide a corresponding robustness, measuring speed and repeatability for use in production. On the other hand, there is the need for a measuring sequence that enables every operator in production to carry out a measurement without having specific knowledge of the measuring system. Automation is a future-oriented keyword at Vitesco Technologies. Currently, they are working with a semi-automatic measurement, but further steps towards full automation are already under discussion. Vitesco has already evaluated other Bruker Alicona measuring equipment and has come to the conclusion that the Cobots can be used here without restrictions.



NOx exhaust gas sensor. The die-cast surface processed by laser has a decisive influence on the resistance of the bonding to the electronics housing.

©Vitesco Technologies



The roughness of the lasered die-cast surface is so unique that it could not be adequately quantified using conventional profile-based methods.

HERMANN HÄMMERL

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Senior Process Engineer, Technical Cleanliness and Cleaning Technologies, coordinates process development for new technologies through to their introduction in the worldwide network of plants.

MEDICAL TECHNOLOGY

Pioneering metrology solutions for medical technology

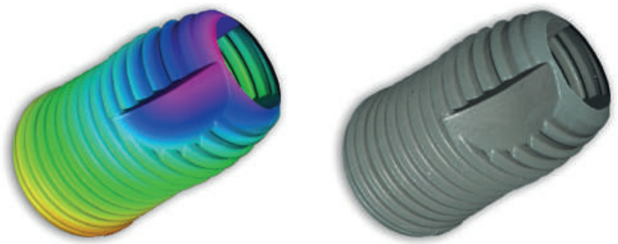
Are you dealing with complex orthopedic implants featuring intricate geometries, steep flanks, and high-gloss surfaces where surface damage is unacceptable? Bruker Alicona's optical 3D measurement technology is your key to maintaining the highest quality standards in medical technology, such as ISO 13485, the FDA's 21 CFR Part 820, or the European Medical Device Regulation (MDR). Our solutions excel in roughness and wear measurement, providing you with non-contact, wear-free, and automatable systems that ensure traceable and repeatable results.

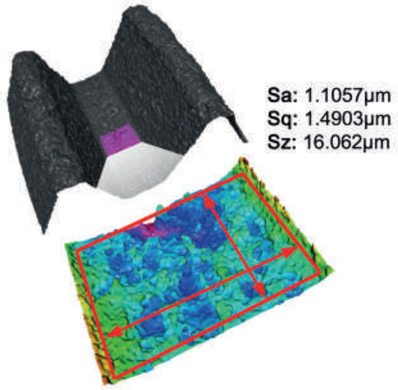
Beyond roughness measurements, verifying GD&T (Geometric Dimensioning and Tolerancing) parameters has become crucial. Bruker Alicona's optical 3D measuring solutions streamline your quality control processes, enabling precise dimensional accuracy and surface finish assessment with a single system. Protect your sensitive medical components from surface damage with our advanced, non-invasive metrology systems.

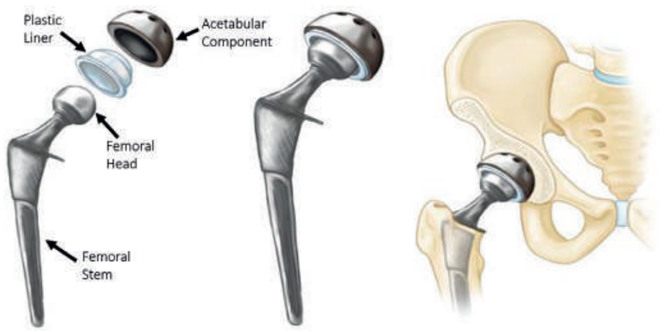
APPLICATION | MEDICAL TECHNOLOGY

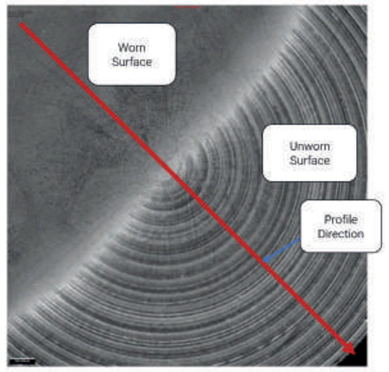
Tooth implants

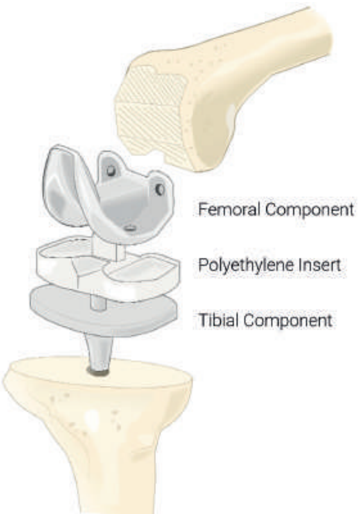
Ensuring the success of dental implants requires precise measurement of both surface roughness and shape. Specialized blasting and etching techniques ensure uniform roughness distribution critical for effective protein binding and seamless integration with the jawbone. Focus-Variation technology provides detailed Sa, Sq, Sz values across thread flanks and roots, evaluating surface quality with high accuracy. Shape measurements further ensure a secure fit between the implant and prosthetic restoration, guaranteeing optimal functionality and patient comfort.











APPLICATION | MEDICAL TECHNOLOGY

Knee & hip implant

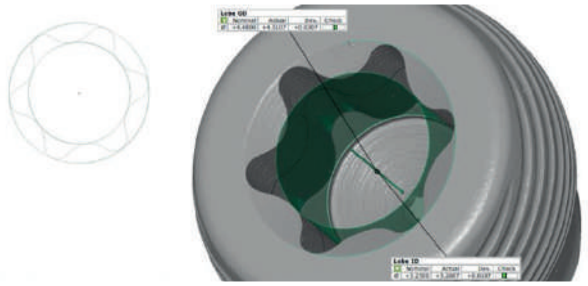
High-gloss knee implants undergo meticulous high-precision measurements to ensure their exceptional quality and functionality. This process involves precise assessment of internal diameters, accurate distance measurements on implant surfaces, and verification of alignment between inner and outer diameters. These detailed evaluations are crucial for maintaining the highest standards in medical technology, ensuring the implants meet stringent quality assurance requirements for reliable performance and patient safety.

Hip implants usually have complex geometries and surface properties that can only be measured to a limited extent by conventional technologies. Especially the accurate measurement of wear and surface roughness is crucial for research, yet conventional methods struggle with the complex properties of implants. Optical metrology provides high-resolution measurements to overcome these challenges and ensure reliable data without damaging the surface.

APPLICATION | MEDICAL TECHNOLOGY

Bone screws

Bone screws are essential medical devices used to stabilize bones during surgery, either independently or with other aids like plates. Their precise design is crucial for safe and effective surgical procedures, ensuring minimal damage during insertion and reducing risks to patients. Focus-Variation technology allows for accurate verification of key parameters such as radii, distances, angles, diameters, and gradients with minimal measurements, significantly contributing to surgical precision and patient safety.



APPLICATION | MEDICAL TECHNOLOGY

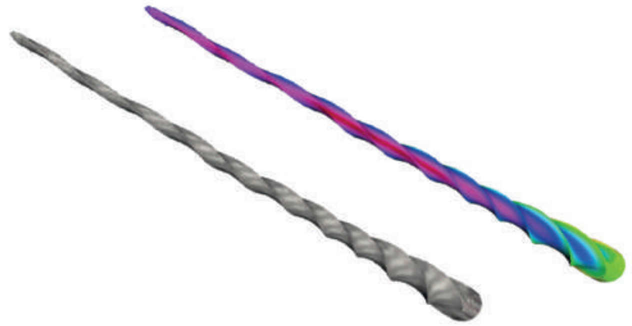
Locking plates

High-precision measurement of locking plates is essential to ensure their quality and functionality. This process involves evaluating the position and orientation of holes, measuring distances between them, and determining the outer dimensions of the plate. It also includes assessing the rounded edges, smooth surfaces, and the dimensions of countersinks, as well as comparing the 3D form to CAD models to detect any deviations. These precise measurements are essential to ensure the reliability and effectiveness of locking plates.

APPLICATION | MEDICAL TECHNOLOGY

Surgical tools

Surgical instruments include all of the tools used by a surgeon, such as cutting tools, drills, screwdrivers or special laparoscopic and endoscopic tools. These are essential for precise medical procedures and require precise measurements such as cutting edges with the smallest radii, different tool geometries, cutting angles, edge integrity and burr formation. Optical metrology provides accurate non-contact measurements crucial for maintaining sharpness, durability, and effectiveness. Through the use of advanced optical techniques, healthcare professionals ensure that surgical instruments meet the highest medical device standards, optimizing surgical outcomes and patient safety.



SUCCESS STORY | MEDICAL TECHNOLOGY

Medical Device Regulation: Stricter rules, better quality management?

Zfx, a long-standing user of Bruker Alicona measurement technology, is facing a challenge that affects all manufacturers of human medical components and implants equally: the Medical Device Regulation (MDR). But like every hurdle, the regulation, which came into force in 2017, also brings new opportunities.

Global distribution of artificial tooth components

Zfx is a global dental company based in Dachau (Germany) and Gargazon (Italy). On the one hand, Zfx develops and produces prosthetic components for dentists and dental technicians. On the other hand, the company offers specially developed equipment (scanners and milling machines) as well as the corresponding materials for the production of crowns and bridges in the laboratory. Zfx is part of the publicly listed US group ZimVie - a life science company specializing in dental and spinal medicine.

Incoming product and prototype inspection

Zfx attaches great importance to quality assurance in two areas. In Italy, both the prototypes are approved and the incoming products are checked. Prototype approval in particular is very extensive in terms of quality control, as these components are measured one hundred percent. In terms of shape, position and dimensions. The measurement technicians have been using the coordinate measuring machine µCMM from Bruker Alicona for several months now.

LUKAS BREITENBERGER

General Manager
Zfx

"Of course, the patient benefits from the stricter requirements. The MDR provides more security. However, it will be difficult or even impossible for start-ups to overcome the financial hurdles of the regulation."

From left to right: Werner Weithaler (Sr. Engineering Manager Zfx) and Lukas Breitenberger (General Manager Zfx)

WERNER WEITHALER,

Sr. Engineering Manager
Zfx

"The biggest challenges we face are in quality assurance for the smallest components. These are less than ten millimetres. In addition, we work with titanium, a highly reflective material, which makes measurement particularly complex."

But why the µCMM from Bruker Alicona

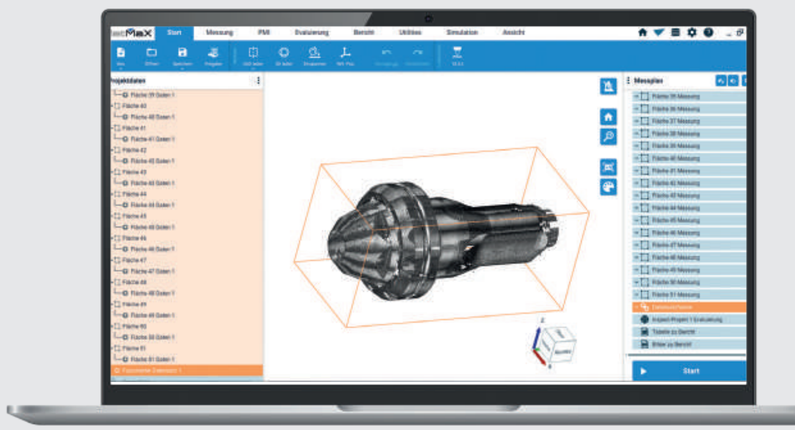
Zfx has been using an InfiniteFocus G5 for five years now. Werner Weithaler confirms: "The InfiniteFocus G5 has met our quality assurance requirements right from the start. We can neither complain about defects nor about insufficient measurements." When asked why a coordinate measuring machine was chosen, Weithaler replied that Zfx had further expanded its quality control, not least because of the MDR. "And because we were already so satisfied with the G5, it was clear that Bruker Alicona would be our first point of contact again." The CMM is ideally suited to the dentistry company's measurement needs, as the accuracy in space is higher and local optical probing can significantly reduce the duration of a complete measurement plan.

Automation with Pick & Place

A few months after commissioning the µCMM , Zfx took the next step in quality management by adding a pick and place function to the coordinate measuring machine. "This means that the machine can also measure overnight and at weekends when no employee is on site." As the pick and place loads the components automatically, the workflow is never interrupted.

What does Zfx measure with the µCMM

Due to the comprehensive measurement of all geometric parameters, the measuring device is also well utilized: Implants, titanium bases, prefabricated abutments (both are connecting pieces between implant and crown), standard abutments and screws are among the measuring tasks. In addition to titanium, plastics and zirconium oxides are also used. External and internal diameters, shape and position tolerances are measured. We are talking about components that



The software shows whether the specified production dimensions have been met and provides information on possible tool wear.

are smaller than ten millimetres in length, with an internal diameter of less than two millimetres. With such small components, the tolerances are correspondingly tight: they are plus/minus 2 µm.

From production and back again

Through this quality control, Zfx not only shows whether production has adhered to the specified dimensions of the development, but can also provide feedback on where there are defects in the production process. The data obtained allows conclusions to be drawn about tool wear or other deficits in production.

Pleasant to relaxing: working with the µCMM

When asked about the daily work with the Bruker Alicona coordinate measuring machine, Weithaler particularly emphasizes the reliability of the device. "We are extremely satisfied with it, there are no failures." He finds the measurements pleasant and even relaxing. This is because it is extremely easy to create the desired measurement programs. The automation is also well thought out and therefore easy to learn. The color comparison provides very pragmatic information about possible deviations.

WERNER WEITHALER,
Sr. Engineering Manager
Zfx

"The µCMM enables us to carry out a wide variety of tests. This gives us a level of process reliability that we no longer want to do without."

Back to MDR - what has changed, what hasn't?

Lukas Breitenberger, General Manager of Zfx, explains: "Quality has always played the biggest role at Zfx and its parent company ZimVie. Our motto is 'Quality begins with me!' So, every single employee is absolutely committed. We didn't need stricter rules for this, it's always been done that way. But the need for control has increased, and the bureaucratic effort has multiplied. This is also associated with high costs. Of course, the patient ultimately benefits from the stricter requirements. The MDR provides more security. However, it will be difficult or even impossible for start-ups to overcome the financial hurdles of the regulation." In any case, the optical 3D measuring devices from Bruker Alicona are ideally equipped to meet the increased quality requirements.

The µCMM measures the outside and inside diameter, form and position tolerances of components less than 10 mm in length.

Behind the QR codes are further stories

Roughness values help monitor manufacturing of blister machines

Uhlmann

Quality assurance of micro gears with optical metrology

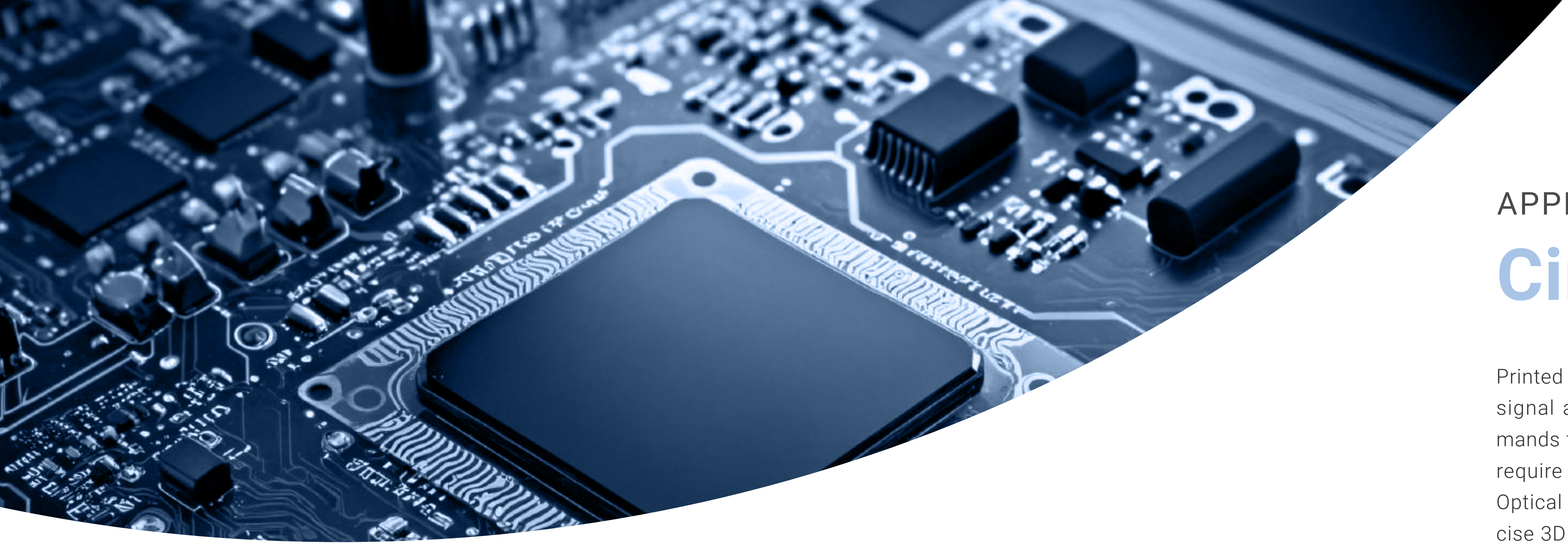
wbk Institute of Production Science, Karlsruhe Institute of Technology (KIT)

Thanks to the Pick & Place automation solution, the µCMM can measure continuously at night and at weekends.

ELECTRONICS

Stay connected:
Optical metrology in electronics

In today’s electronics industry, precision is more than just a buzzword - it is at the heart of successful production. This is where optical metrology comes into play and has become indispensable for quality assurance. Optical metrology gives you the ability to manufacture electronic components with unmatched accuracy and efficiency. Whether it’s tiny sensors, complex circuit boards or robust connectors, the precision of this technology guarantees that even the most demanding and miniaturized components meet the highest quality standards. This is particularly important as the demands placed on electronic components are constantly increasing and components are becoming ever more complex. Optical metrology therefore makes a significant contribution to reducing reject rates by carrying out precise measurements and detecting faults at an early stage. Integrating this technology into the manufacturing process increases production efficiency, improves reliability and ensures consistent quality.

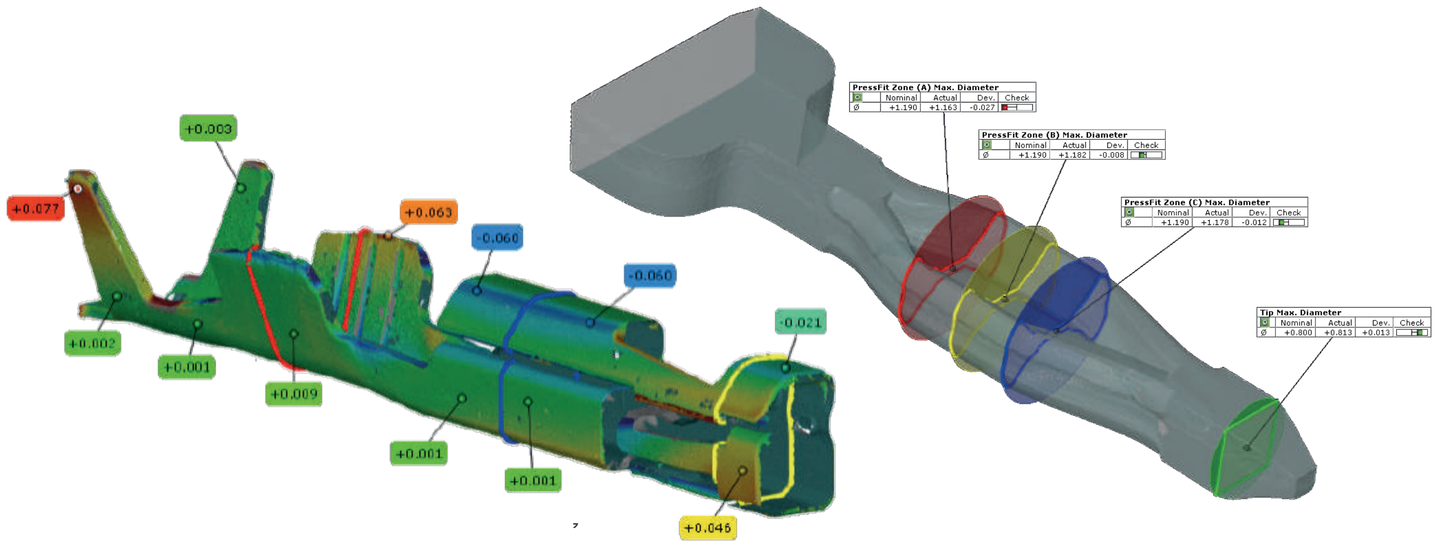


APPLICATION | ELECTRONICS

Electronic connectors

Electronic connectors, such as Press-Fit Pins and Crimp Connectors, are essential for reliable connections in electronic systems. Press-Fit Pins are inserted into PCBs without soldering, while Crimp Connectors are attached to wires using a crimping tool, creating strong, durable connections.

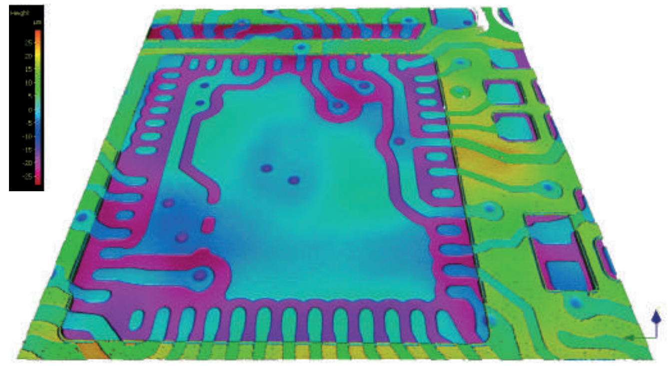
Manufacturing these connectors involves high-speed stamping, which presents challenges such as ensuring correct geometry, maintaining consistent thickness, and achieving precise shapes. These challenges can lead to connector failure if not properly addressed. Bruker Alicona directly addresses these manufacturing challenges with 3 technologies: Advanced Focus-Variation ensures precise measurement of reflective surfaces, which is crucial for maintaining consistent thickness. Vertical Focus Probing and Focus Probing enable accurate measurement of vertical and narrow structures, ensuring correct geometry and symmetry. The Real3DUnitX enables comprehensive measurement of complex geometries. This is particularly beneficial for crimp connectors and press-fit contacts, where detailed evaluations of dimensions such as diameter, width and symmetry are essential.

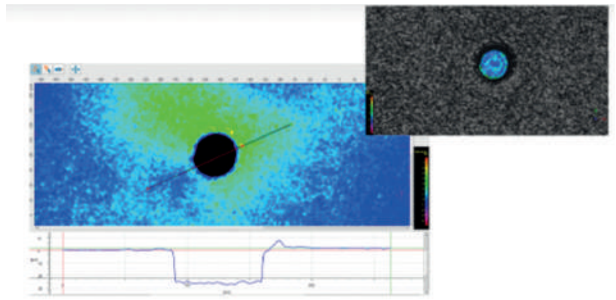


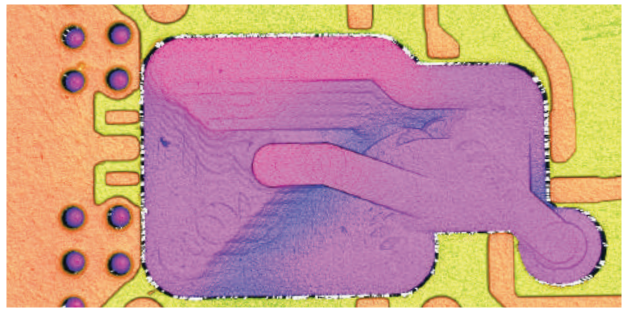
APPLICATION | ELECTRONICS

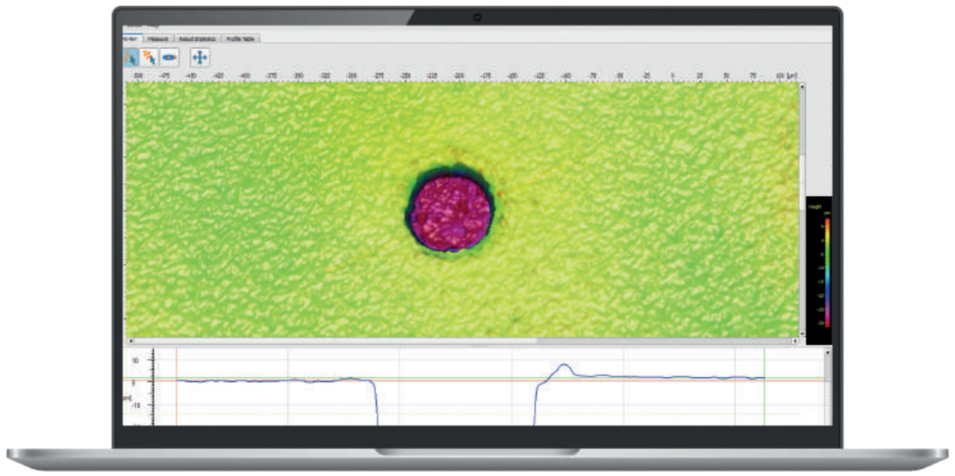
Circuit boards

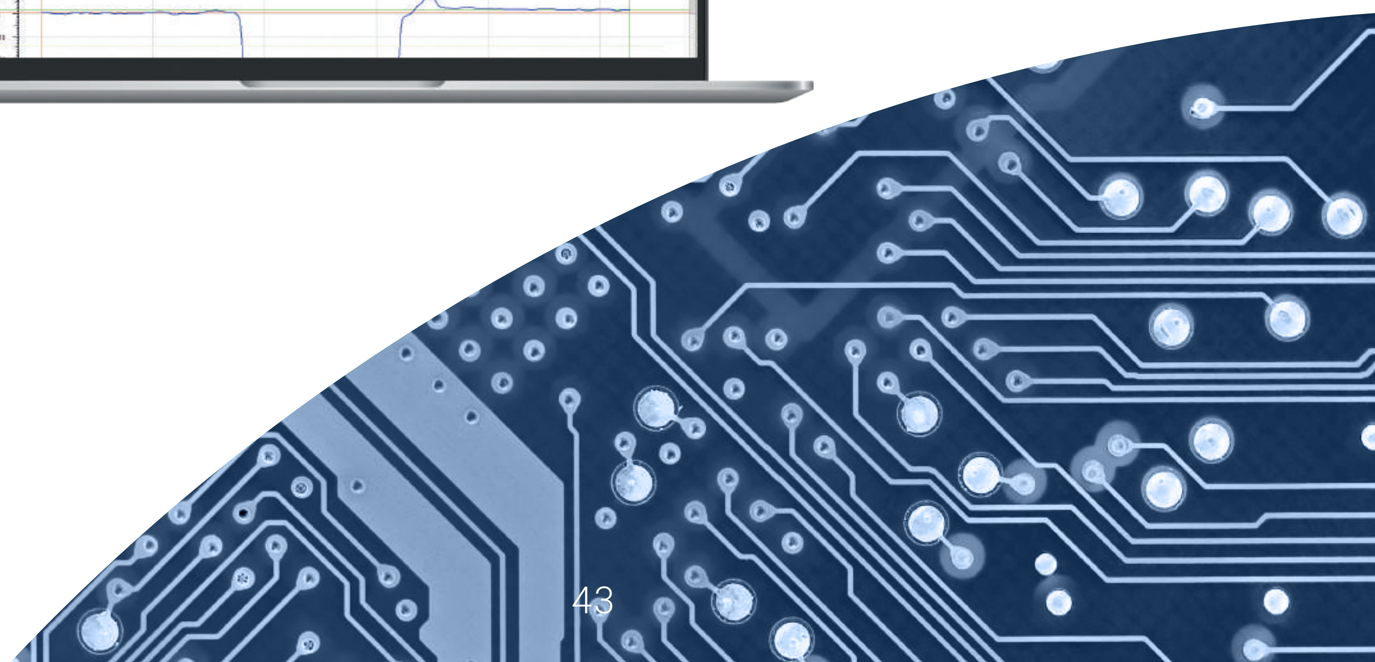
Printed circuit boards (PCBs) are crucial for precise signal and power transmission. The complex demands for size, performance, and reliability of PCBs require highly accurate manufacturing techniques. Optical metrology plays a key role by providing precise 3D measurements of topography and flatness. This technology accurately measures critical parameters such as the shape and flatness of milled pockets (chip pockets) and the depth and diameter of microvias. By using 3D measurement systems, manufacturers can ensure that PCBs meet the highest quality standards, leading to flawless chip and wire bonding processes. This not only enhances manufacturing efficiency but also improves the reliability and functionality of the final products.

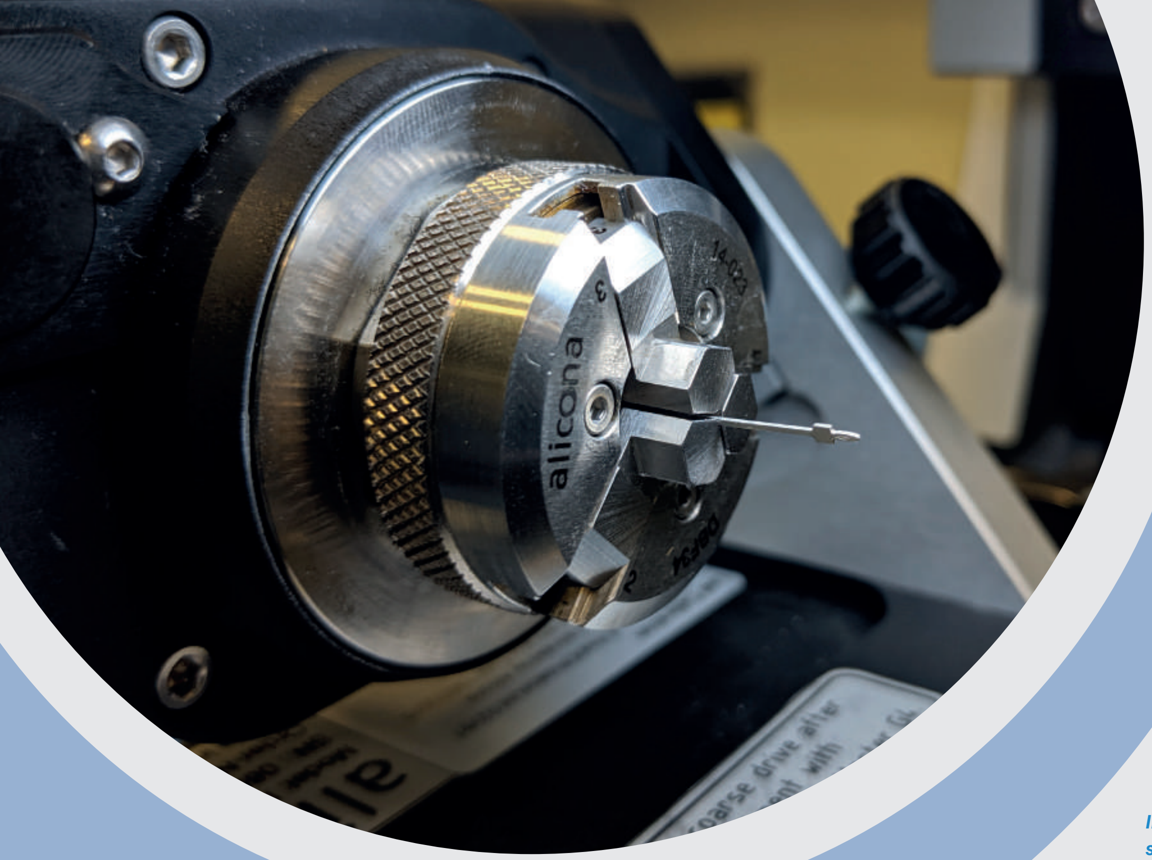












InfiniteFocusSL is a fast, simple and accurate measurement tool.

SUCCESS STORY | ELECTRONICS

UIBEL CONSULTING

New trend in press-fit technology: Measuring the geometry of pins optically in 3D

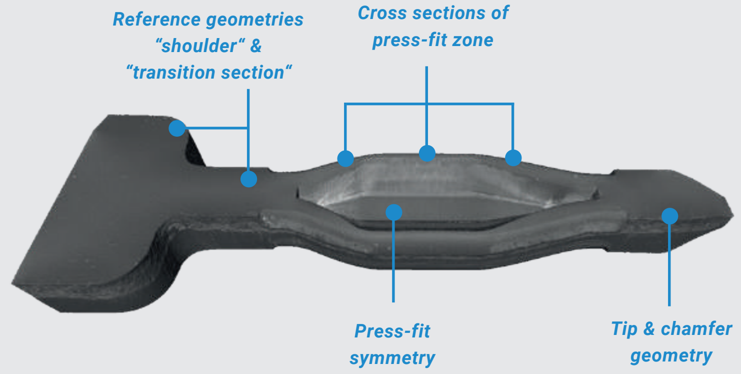
Frank Uibel, a long-time expert in the field of press-fit technology and active member of the IPC, recommends Bruker Alicona technology as a "fast, simple and accurate measuring tool" for the geometric verification of press-fit zones. We wanted to know why and asked him these questions.

What is measured?

Press-fit technology is a special connection technique used to create solderless electrical connections. Contact parts or entire components with press-fit zones are pressed into metallized holes in a printed circuit board. This creates a stable, gas-tight and highly conductive connection between the press-fit zone and the hole wall. There are currently a number of different press-fit zones available that have one thing in common: The geometry is one of the decisive factors for a good connection. From a metrology point of view, the geometry poses a number of challenges. These include the measurement of edge radii, enveloping circles at certain positions or transitions such as that from the press-fit zone to the press-fit tip. Measurements must be available with the necessary accuracy, while at the same time a high measuring speed and documentation of the results are required.

Why Bruker Alicona?

The InfiniteFocusSL measuring system is a fast, simple and accurate measuring device. Compared to complex and user-dependent methods such as microsection measurement or computed tomography (CT), Bruker Alicona technology is characterized by fast measurement times, easy handling and high accuracy. This allows the dimensional accuracy of the pins to be verified within a short time, contactless in 360° and with a one-button solution. Single measurements can be combined to a full 3D measurement of the pin. Deviations from the CAD data set can also be easily determined via difference measurement. Soon the new "IPS 9797-Press fit Standard for Automotive Requirements and other High-Reliability Applications" will be published, in which the optical dimensional measurement of the press-fit zone is included.



How are pins manufactured?

Contact parts with press-fit zones are manufactured using stamping technology. Measurement technology is already used in toolmaking during production to check the active and passive elements. Accordingly, tool manufacturers require high-precision measuring methods for quality assurance of their milled, eroded or lasered punches with tolerances in the single-digit µm range. Stamping companies in turn use measuring technology for in-process control, while OEMs use metrology for incoming goods inspection. Accordingly, quality tests are carried out at various stages of the manufacturing chain. By saving time and being user-independent, efficiency can be created in the field of measurement technology, which generates a considerable amount of added value in the production process.

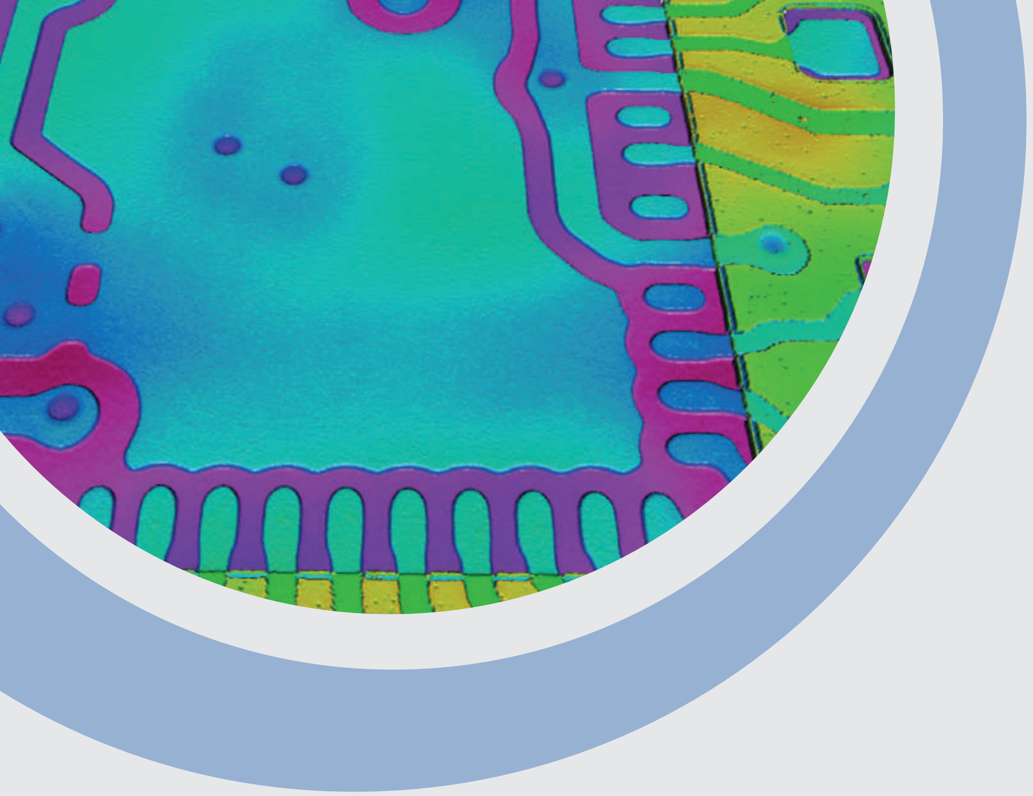
Who needs plug contacts?

Plug contacts are used in every manufacturing industry where component groups with integrated electronics are installed. One of the strongest customers is the mobility sector, where the annual production of connector contacts is in the billions. According to Uibel Consulting, at least 1000 press-fit zones are installed in every car. This results in a worldwide demand of more than 50 billion press-fit zones in the automotive industry alone. Developments in other sectors such as sensor-based assistance systems in the medical and care sector are a clear indicator that this number will continue to increase across all sectors.

Different press-fit zones have one thing in common: the geometry is one of the decisive factors for a good electrical connection.

FRANK UIBEL

has been an expert in press-fit technology for many years. The current owner of Uibel Consulting started his career as a toolmaker, passed through stations in quality management, marketing, sales including sales management. As a managing partner he was additionally responsible for product management for press-fit zones. With his current consulting company "Uibel Consulting" he supports companies in all sales and technical agendas around press-fit technology and galvanic surfaces. Since 2017, Uibel Consulting has been a member of the global IPC trade association, which represents the PCB and electronics assembly industries, their customers and suppliers.



SUCCESS STORY | ELECTRONICS

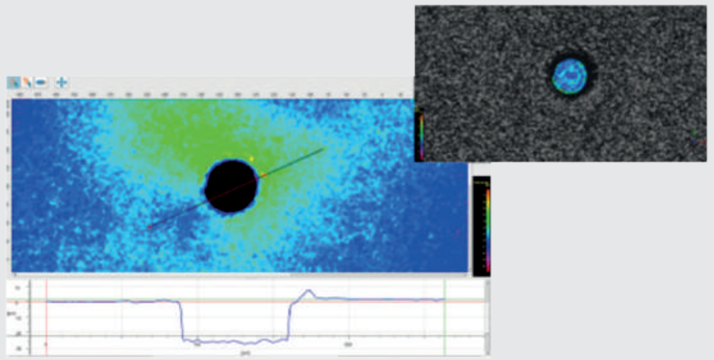
Reliable quality assurance of printed circuit boards

Optiprint

Innovative PCB Solutions

Optiprint is a supplier of highly innovative printed circuit boards for use in medical engineering, the automotive and sensor industries, and space engineering. When the company was probing the market for a non-contact, areal surface measurement system, Bruker Alicona's 3D measurement systems attracted its attention. Optiprint now relies on InfiniteFocusSL in the quality assurance of printed circuit boards. The solution by Bruker Alicona allows Optiprint to measure form and roughness of complex, miniaturized component surfaces with just one system.

Today's printed circuit boards are carriers for simple to highly complex circuits. For 30 years now, Optiprint in Berneck (Eastern Switzerland) has been producing highly innovative solutions for circuit boards. New high-performance materials and more efficient ways of assembly, such as the Chip-on-Board technology, are becoming increasingly relevant. In light of these challenges, Optiprint was in need of a system for areal topography and flatness measurement of so-called milled pockets. "Bruker Alicona's 3D measurement system have allowed us to optimize our processes significantly and take major steps in securing the quality leadership of our products", quality manager Simon Hütter explains. Bruker Alicona 3D measurment solutions have made it possible to ensure flawless chip bonding (attaching of the chips) and wire bonding (attaching wires to connect chip and circuit board carrier).



Area based roughness measurement of the microvia to identify traces of powder

Microvias: optical 3D measurement of diameter and depth

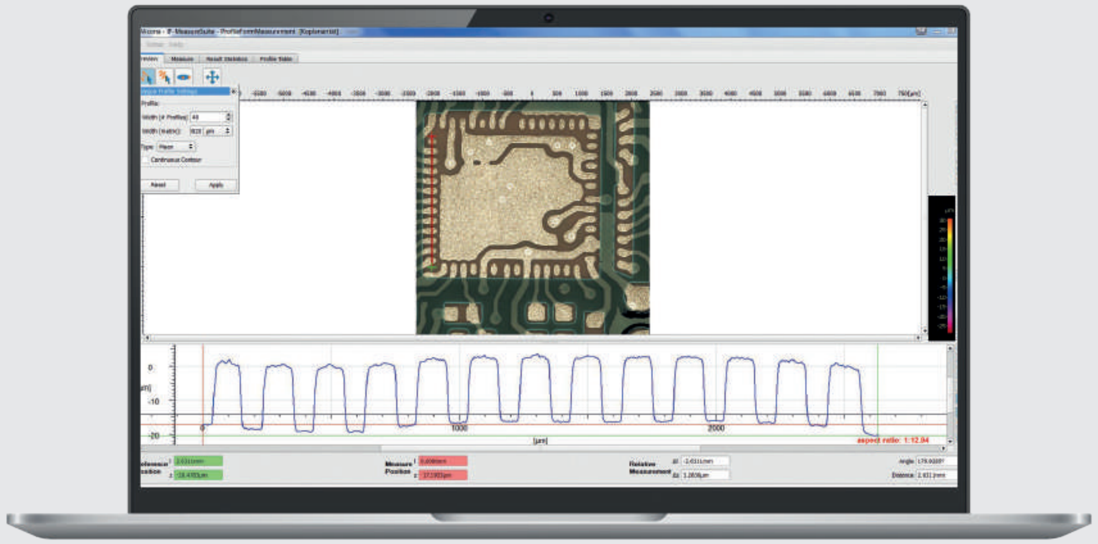
Optiprint's quality assurance puts great emphasis on providing printed circuit boards that are well-suited to further processing by customers. In order to ensure proper electrical bonding (interconnecting) of multi-layered circuit boards, it is vital that the so-called microvias have been drilled according to pre-defined depth and diameter parameters. Bruker Alicona allows Optiprint to verify diameter and height step of the microvias to confirm that the correct layers have been bonded.

Another type of measurement of laser-drilled microvias is checking for traces of powder. Traces of powder form at the outer edge of drill holes when molten material lumps together. With optimized laser parameters for the different materials these bulges are minimized. To identify bulges, roughness measurement is performed to evaluate the planarity at the transition of the surface to the microvia.

In addition to the measurement of depth, diameter, and planarity, microvia bottoms also need to be examined. The most critical fault to check for here is residual insulating material, as this can impede the electrical conductivity of the entire circuit board. It is therefore essential to verify that this area of the microvia is clean before further processing. Optiprint accomplishes this with Bruker Alicona's high-resolution true-color 3D visualization systems.

Chip pockets: Area based measurement of shape and flatness

As the next step of the production process, so-called milled pockets, also referred to as chip pockets, are milled into the circuit board to make room for the chips the end customer will later attach to the circuit board. Attaching the chips to the milled pockets is also called Chip-on-Board technology. In order for the silicone chips to remain in place securely, the milled pockets must have the correct shape and be flat. Thanks to roughness measurement with Bruker Alicona, Optiprint has managed to gain a better understanding of the interaction between surface properties and assembly process. This has resulted in a much more efficient manufacturing process. In order to ensure proper surface quality and, consequently, flawless attaching, Optiprint measures the height steps as well as shape and flatness of the chip pockets. "Only when we started using areal roughness measurement, we mastered the process for milled pockets," says Hütter.



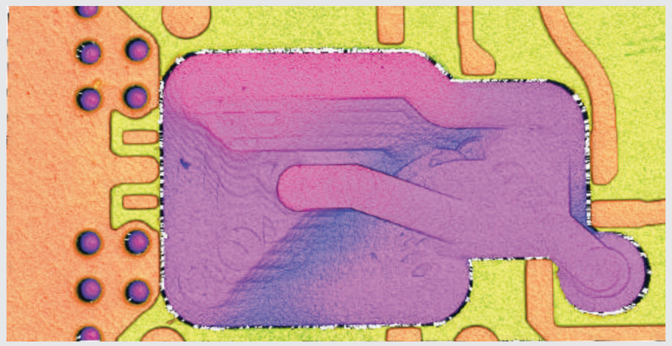
3D measurement of shape and co-planarity of contact pads to ensure perfect conditions for wire bonding

3D profile form measurement of bondpads

Another step in the manufacturing process is the electrical bonding (interconnecting) of the chips on board. The electrical interconnecting of chips with the circuit board with using the so-called bond wires is also called wire bonding. Bondpads must be free of faults such as roughness and dirt, as these weaken the bond interconnection. Bruker Alicona's 3D profile measurement system enables Optiprint to verify the form and co-planarity of contact pads on the printed circuit board and ensure perfect conditions for wire bonding.

The following parameters of multi-layer circuit boards can be measured and documented precisely with 3D measurement systems by Alicona:

- Depth and diameter of microvias
- Areal roughness at the transition of surface to drill hole
- Areal roughness and flatness at the bottom of microvias
- Areal topography and roughness of milled pockets (chip pockets)
- 3D profile form of bondpads
- Analysis and rating of quality characteristics



3D visualization of the chip pocket before surface finish. The visualization has helped to optimize the Chip-on-Board technology. Optiprint has managed to gain a better understanding of the interaction between surface properties and assembly process

SIMON HÜTTER

Quality Manager

Our customers use printed circuit boards by Optiprint to manufacture products of the highest quality. Alicona's customized 3D measurement solutions play a key role in enabling us to provide our customers with the exceptional quality they need. Their systems contribute significantly to our company's success. We can only recommend Bruker Alicona to everyone.

RESEARCH & DEVELOPMENT

Take one step forward in your research & development

Bruker Alicona stands for agile development, high technological competence and constantly driven innovation. That's why our optical 3D measurement solutions will support you in your R&D tasks in, e.g., Industry 4.0, Reverse Engineering and Additive Manufacturing.

Want some examples? Bruker Alicona systems can help you to optimize your 3D printing processes while ensuring the high quality of additively manufactured parts. Our instruments are also responding to rapid developments in digitalization or robotics: Benefit from automation solutions, e.g. cutting edge measurements, measurements of GD&T features of complex components, or software packages based on Artificial Intelligence (AI).

CMM Technical Lead Adam Wiles: "The Alicona system is ideally suited to small features including small radii and diameters of a hole which are challenging if not impossible with a traditional CMM."

SUCCESS STORY | RESEARCH & DEVELOPMENT

The University Of Sheffield.

Advanced Manufacturing Research Centre

BOEING

Measurement without an operator

How to explore more technologies in shorter time

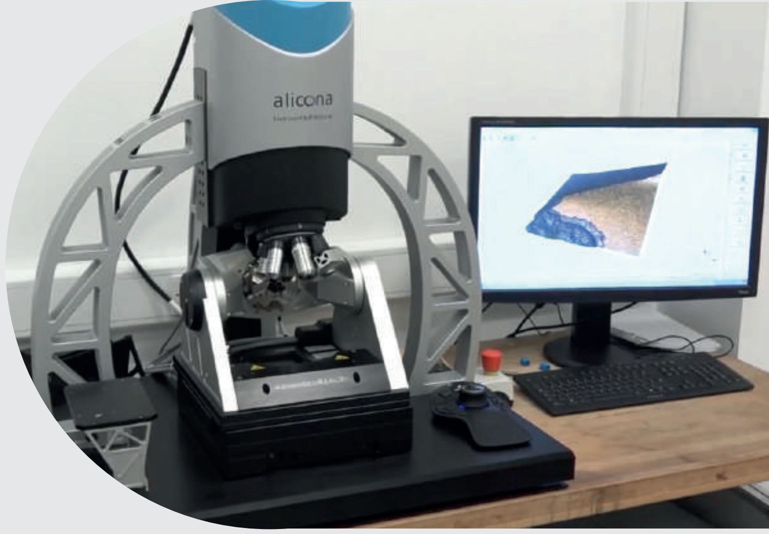
To become more competitive by introducing advanced technologies and processes is the promise of the well-known research center AMRC to industry. Metrology is key to keep this promise and to increase production readiness of new techniques. This is why AMRC recently has acquired its fourth Bruker Alicona measuring system.

The development of new manufacturing techniques and technologies has always been the mission of AMRC, the University of Sheffield Advanced Manufacturing Research Centre based in the UK. It "helps manufacturers of any size to become more competitive by introducing advanced techniques, technologies and processes", AMRC states. To achieve this, metrology is one of the key activities at AMRC. Skilled in many areas of metrology, the team supports the research groups by qualifying novel parts and processes to make sure that they meet physical requirements and industry standards. In the field of optical metrology, Bruker Alicona´s high resolution form and roughness measurement systems deliver the greatest benefits than with any other system AMRC experts are aware of. It is not without reason that the globally well-known research center recently has acquired its fourth Alicona measuring system.

Route to market

"We are developing an automated machining test cell to test new materials such as cutting tools, coolants and overall machining technologies. Combined with a robot, a Bruker Alicona optical measurement sensor is part of the cell, allowing us to automate all kinds of measurements." Thomas McCleay, Head of Research, is enthusiastic about the increased efficiency and higher output he gets by utilizing automated measurements in his test series. "We fully automate a lot of the testing. Automated measurements allow us to significantly increase the number of tests we can do in a single day, so we can explore a lot more technologies in shorter time." The results obtained from the initial test measurements feed into more feature-based trials, which again lead to the next level of technology readiness and thus to production suitability.

Today, measurements in research activities at the AMRC are mainly carried out to explore a broad range of options for tooling and all kinds of cutting materials. However, since the Bruker Alicona measurement systems can be utilized to measure nearly any kind of solid components including miniaturized and complex geometries, this test cell is planned to become accessible to all industry partners. "The automated test cell will be rolled out to industry, so our industry partners will have the chance to gain access to full test automation as well. The uptake of this way of developing is also an answer to a growing market pull, and the Bruker Alicona measurement technology is the best that we have available. The partnership with Bruker Alicona is key to make sure we can achieve this type of automation and integration. Hence, with Bruker Alicona we see the route to market," McCleay says.



Bruker Alicona is used for tool wear assessment and to learn how the tool is wearing as it progresses through life.

Tool wear assessment in composite machining

One of various specific aspects in the development of new manufacturing techniques is tool wear assessment. Oliver Hayes, Composite Development Engineer, uses Bruker Alicona to see how the tool is wearing as it progresses through its life. "In composite machining, we generally see that the type of wear experienced by the tool is mainly flank wear. Because of that we need Bruker Alicona as I don´t know any other system that allows us to measure the steep flanks of e.g. PCD tools," he explains. In his daily work, Hayes also needs to measure surface roughness. For him it is of vital importance to measure roughness areal based instead of measuring only a profile of the surface. "In the context of carbon fibre, the Ra value depends on the angle at which you measure it. Because of that, we prefer to use the areal surface roughness value Sa which we easily get with Alicona." In terms of efficiency and ease of use, Hayes benefits from measurement automation as well. "You can set the system going, have it move to several positions and take surface roughness measurements of several different samples. This is something I really like, and you cannot do this with a tactile CMM", he concludes.

OLIVER HAYES

Composite Development Engineer

"In composite machining, we generally see that the type of wear experienced by the tool is mainly flank wear. Because of that we need Bruker Alicona as I don´t know any other system that allows us to measure the steep flanks of e.g. PCD tools.

More information under

SUCCESS STORIES | RESEARCH & DEVELOPMENT

Behind the QR codes are further stories

上海智能制造研发与转化功能型平台
SHANGHAI PLATFORM FOR SMART MANUFACTURING

Optical metrology drives forward ground-breaking production technologies

Shanghai Platform for Smart Manufacturing (SPSM)

LUND UNIVERSITY

SANDVIK coromant

Determining the optimum surface finish for tooth flanks of gears

Lund University & Sandvik

TAMPERE UNIVERSITY OF TECHNOLOGY

All-in-one measurement system for materials of any kind

Tampere University of Technology

DIE & MOLD

Take tool performance to the next level

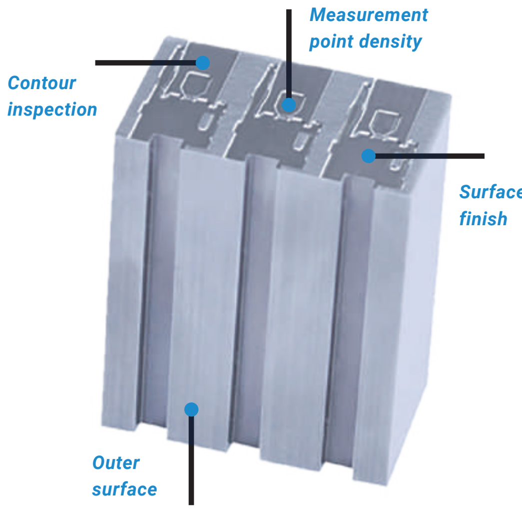
When machining molds and dies, achieving precise measurements of components with steep flanks, highly polished surfaces, and various reflective properties is a common challenge. High-quality materials, exceptional surface quality, and precise accuracy are essential for producing the complex geometries of microcomponents consistently.

Bruker Alicona's optical 3D measurement systems address this need with high-precision, repeatable, and traceable measurements. These systems allow for the identification of full-surface deviations of components from their CAD data, aiding in the minimization of GD&T features during the manufacturing process. Additionally, they provide roughness measurements to determine the surface quality of various component types, shapes, and sizes, thereby optimizing production processes and ensuring dimensional accuracy.

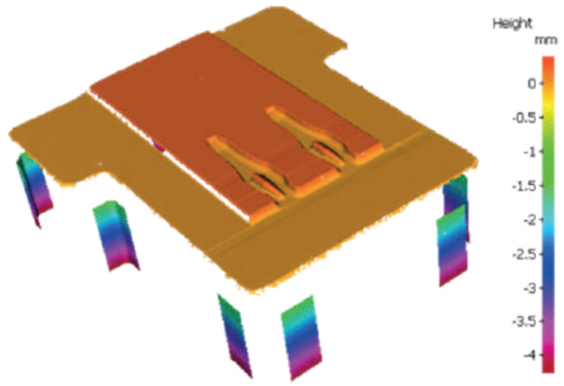
APPLICATION | DIE & MOLD

Precision dies

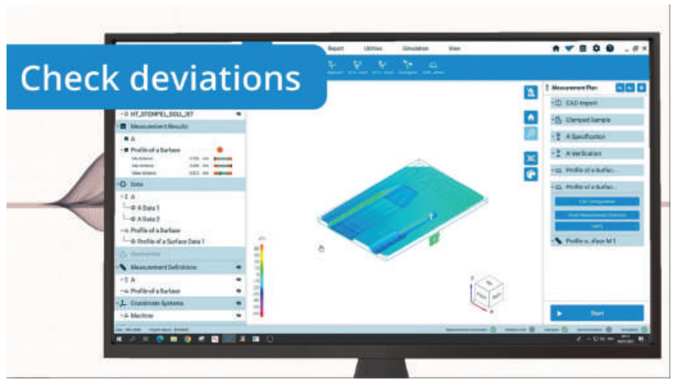
Precision dies, such as punches, stamping and bending tools, are essential for various forming processes such as punching, pressing, bending and deep drawing. They play a crucial role in the manufacture of metal components in a range of industries. Dimensions as well as surface roughness must be checked to ensure that the high-quality requirements are met.



Bruker Alicona provides the solution to these challenges. Technologies such as Advanced Focus-Variation and Vertical Focus Probing allow complete inspection of the forming geometry and measurement of the lateral surfaces, even highly polished or reflective surfaces, which are often found on punches.



The user interface for these solutions is MetMaX metrology software, which breaks the measurement process down to just a few clicks. Using CAD files, which may even already contain PMI, the measurement strategy can be generated automatically, taking into account the deviation of the surface from the shape, the reference points and the offset data of the production machine.



"With Alicona´s Focus-Variation, we now have possibilities in quality assurance that no other supplier could offer!"

KLEINER
Wir denken Lösungen

SUCCESS STORY | DIE & MOLD

Automated production cell with optical metrology

KLEINER Stanztechnik combines machine tools, measuring technology and robotics in a new production cell. It aims at autonomous, fully automatic production of tool components including measuring protocol. Bruker Alicona is not only a selected measurement technology partner because of its automation capabilities.

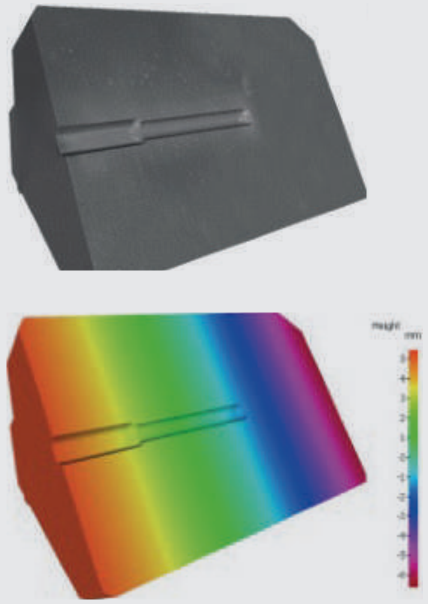
Optical 3D measurement combined with tooling, molding and industrial robotic technologies

Christian Hamann, Business Unit Manager Tool Technology at KLEINER Stanztechnik, remains modest: "I can't just say whether our new production cell makes us stand-alone worldwide. But our customers confirm that they have not yet seen a comparable production cell with integrated measurement technology at this high degree of automation." The German stamping technology company has been proud to combine expertise in the field of precision stamped parts and high-performance stamping tools with new technologies since its foundation, thus meeting increasing customer demands from various industries.

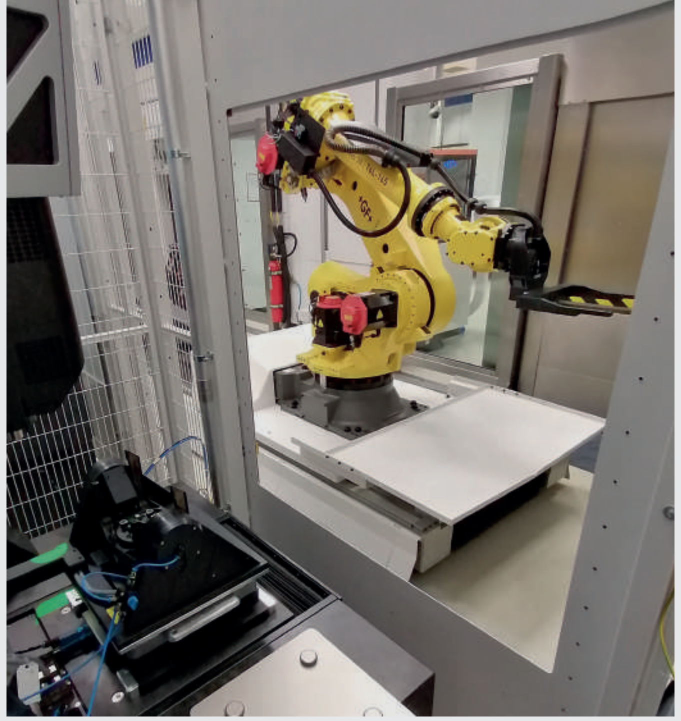
With its new production cell, combining technologies from tool and mold making, metrology and industrial robotics, KLEINER once again proves its innovative strength. For Christian Hamann, the commissioning is a milestone: "At the moment, man and individual components of the cell are still interacting with each other. The production cell in its final state will enable completely self-sufficient production with a fully automatic process. We hand over a raw part to the cell, and at the end we receive a completely manufactured tool including measuring report without any further intervention."

The electrode is measured optically and then transferred to an EDM machine

The KLEINER production cell is based on a combination of different state-of-the-art technologies and machines. Two HSC milling machines, a die-sinking EDM machine, a cleaning system as well as tactile and optical measuring technology are currently in use. A 6-axis industrial robot controls the production and takes care of the assembly. KLEINER describes the process as follows: "We load a pallet system with the raw part, which is transferred to the cell or robot via a transfer station. First, a tactile measuring station determines the position of the workpiece. These references or coordinates are fed to the HSC milling machine, which mills the electrode. The electrode is then optically measured with Bruker



3D measurement of a die in true and false color visualization.

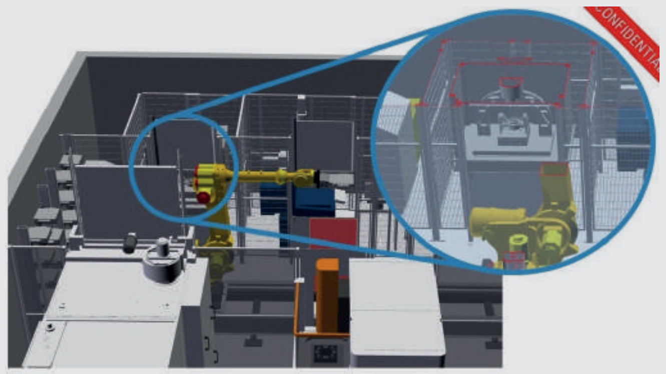


KLEINER uses the optical 3D coordinate measuring machine µCMM in combination with the AdvancedReal3DUnit. "The rotary axis allows us to ideally position and measure any number of surfaces and surface features in just one measuring process," Hamann says.

Alicona in 3D and transferred to the die-sinking EDM machine, that finally produces the individual tool part."

"With Bruker Alicona we are already able to automatically start and execute the measuring process in production"

The optical measurement of the electrode is already automated. Measurement results are currently monitored and processed by a worker, who, based on the measurement data, manually initiates necessary changes in the production process. KLEINER lays the foundation for smart manufacturing à la Industry 4.0: "With Bruker Alicona we are already able to automatically start and execute the measuring process in our production process. We are currently working on enabling networking with other machines so that machine parameters are automatically and continuously adjusted based on the measurement results," explains Haman, initiator and mastermind of the KLEINER 4.0 project. This is how the stamping technology company entitles the production cell and thus establishes the context to Industry 4.0.



The KLEINER production cell combines two HSC milling machines, a die-sinking EDM machine as well as tactile and optical measuring technology. Bruker Alicona is used to optically measure the electrode, which is then further transferred to the EDM machine. Christian Hamann: "The production cell in its final state will enable self-sufficient production."

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CHRISTIAN HAMANN

Business Unit Manager
Tool Technology

With Bruker Alicona we are already able to automatically start and execute the measuring process in our production process. We are currently working on enabling networking with other machines so that machine parameters are automatically and continuously adjusted based on the measurement results.

FESTO

SUCCESS STORY | DIE & MOLD

A unified system successfully meets varied measurement needs

Festo, one of the world's leading providers of automation technology, offers products, systems, and services related to pneumatic and electric control and drive technology for factory and process automation. With the InfiniteFocusG5, Festo manages to combine the requirements of different measurement systems into a single automated measurement process.

Festo is a global player with over 250 branches in 61 countries. Operating since 1925, this family-owned company with over 21,000 employees is setting new standards in automation technology.

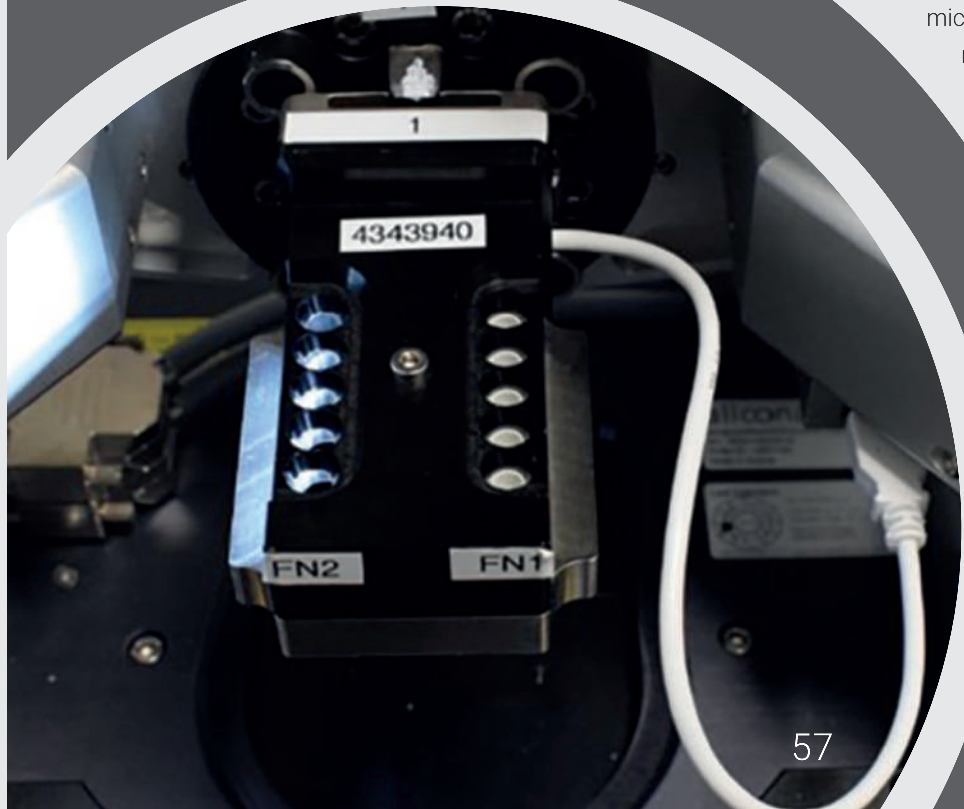
At the Hassel location in Germany, there was a basic quality control process for various components. However, this involved a cumbersome testing process as different measurement systems were used to ensure quality. For instance, optical measuring microscopes were used for mold release, and distances (height dimensions) were determined using a tactile coordinate measuring system. Additionally, continuous measurement of mold release wasn't possible with the existing systems.

"It became evident that the measurement process was not only time-consuming and costly but also failed to achieve the precision required for our high-quality standards," said the Head of Global Operative Production Quality, Horst Lang. Thus, optimizing the testing process became a top priority. The main challenges were to integrate different measurement systems into one system for an automated measurement process and to measure independently of time and personnel. These requirements were met by implementing the Bruker Alicona measurement system InfiniteFocusG5.

Flexibility and precision as crucial requirements

Flexibility is required not only in manufacturing itself but also in metrology. Hence, the InfiniteFocusG5 with automation options is the optimal solution, enabling rapid and reliable measurement of various component shapes, types, and sizes, often made from different materials. The range of measurable surfaces and materials is nearly unlimited. Moreover, users measure micro and precision components with a single multifunctional sensor in high resolution, traceability, and high repeatability.

For example, when measuring a magnetic plate used in Festo's pneumatic and electric control for drive technology, the required results need to be available quickly, easily, and accu-



Additional lighting for optimal measurements: A custom sample holder developed by Bruker Alicona with additional lighting allows the measurement of 10 components in a single operation.

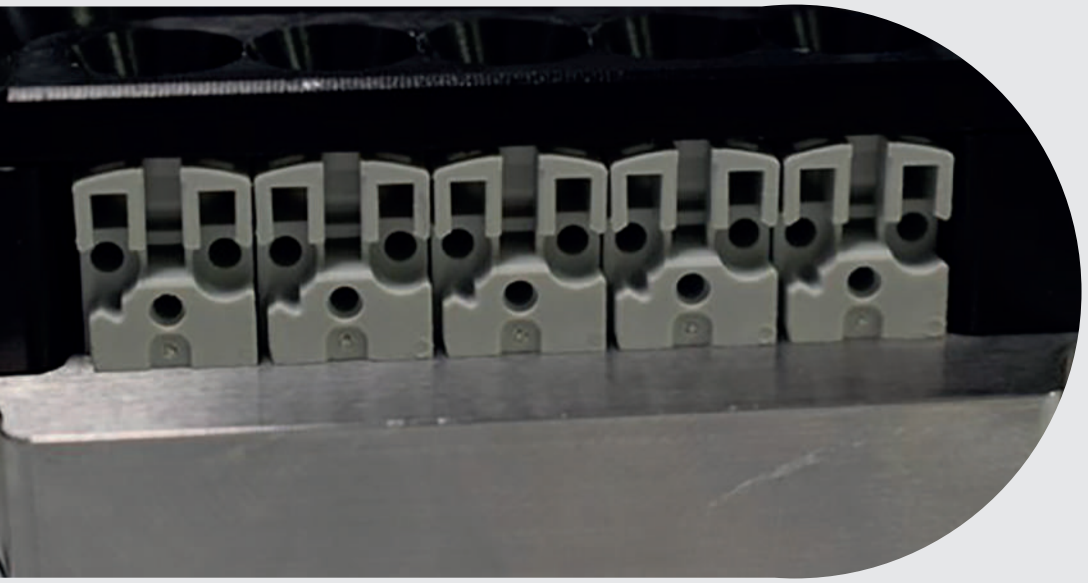
rately. In the case of InfiniteFocusG5, up to 500 million measurement points ensure detailed measurement with tolerances in the range of micrometers and sub-micrometers at a significant working distance. The high density of measurement points from Focus Variation also enables consistently high lateral and vertical resolution over large measuring volumes.

For Horst Lang, accurate representation and depiction of measured parts are indispensable. Result traceability forms the basis for using such systems. Festo has to fulfill specific requirements to achieve automated measurement. For instance, a measuring system must measure various geometric dimensions such as form accuracy, roundness, and coordinates of holes, in addition to surface structures. The challenge lies in accuracies and sometimes geometric shapes like radii and edge profiles. "InfiniteFocusG5 achieves optimal measurement results here as well," Horst Lang expressed.

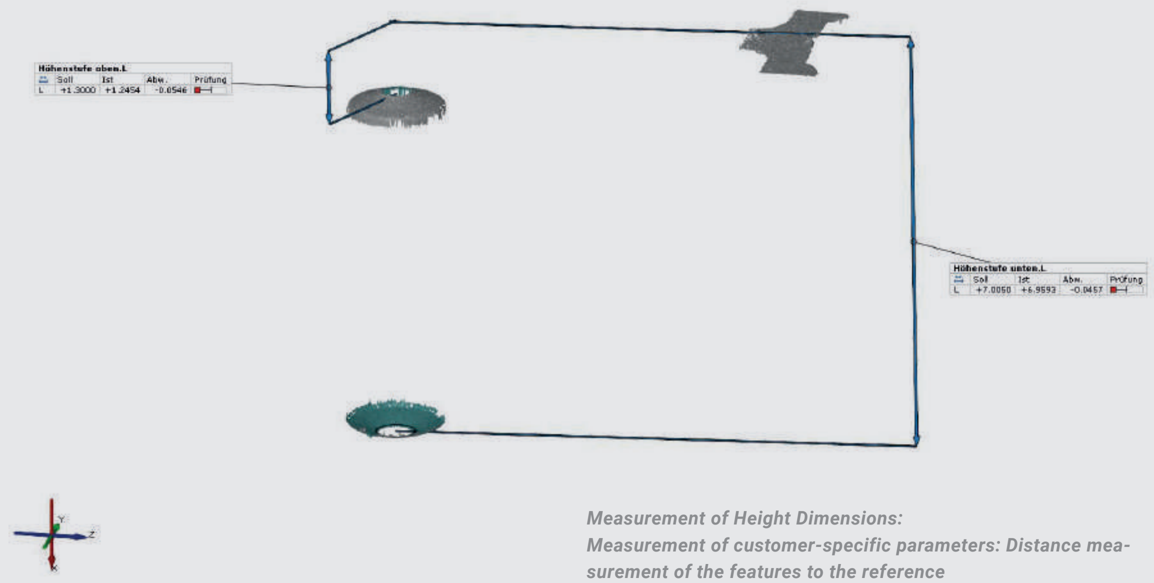
Automation aligned with process optimization

To meet Festo's requirements, the InfiniteFocusG5 measurement system was equipped with a rotation and tilting unit (AdvancedReal3D RotationUnit). A custom sample holder developed by Bruker Alicona with additional lighting allows the measurement of 10 components in a single operation, eliminating the time-consuming process of clamping individual components. "It was also important for us that different components with varying geometries, shapes, materials, and sizes could be measured," Lang noted. Additionally, various parameters are verified with a single system. Moreover, this sample holder can secure parts in a way that ensures all measurements are reproducible. In addition to measuring magnetic plates, the system is used for other applications such as swivel joints, high-precision plastic injection-molded components, or housings where a variety of measurement tasks like different height measurements and roughness measurements on valve seats are solved using the available InfiniteFocusG5 with AdvancedReal3D RotationUnit.

Horst Lang is particularly pleased with the fully automated and user-independent measurement executed with the "AutomationManager" software. "Our employees receive about 1 day of training on the system with the software and can conduct measurements independently thereafter."



Custom-made sample holder: Clamped sample in the custom-made sample holder.



Measurement of Height Dimensions: Measurement of customer-specific parameters: Distance measurement of the features to the reference

To initiate measurement, a barcode is scanned. Based on the scanned barcode, the system automatically selects the correct measurement program and pre-fills keywords. The AutomationManager combines data acquisition and automatic evaluation.

On the results page, data sets and parameters are visible. Red and green indicators indicate whether the result and parameters are within or outside tolerances. The results are exported in selected formats like .csv or .pdf. In Festo's case, results are also exported to Q-DAS. This is an important interface as it transmits data, performs statistical evaluations, and verifies process capability.

"

HORST LANG

Head of Global Operative Production Quality

In the conducted benchmark, the best solution throughout the entire process was Bruker Alicona.

These visualizations and their integration with other systems are crucial for Festo, and the Bruker Alicona complete system has successfully implemented this.

Norms and standards as the foundation

Standardization plays a vital role at Festo. Festo must adhere to reproducible and traceable standards - anything less is not feasible. According to the VDA-5 standard, acceptance measurements must be conducted at Festo. This means that multiple components must be measured by different operators, resulting in a certain outcome. Fortunately, Bruker Alicona achieved successful acceptance here as well.

Using the measurement system directly in production

In addition to in-process and automated SPC measurement (Statistical Process Control) in the measurement room adjacent to production, Festo also has the option of placing the measurement system directly in production (in-situ/off-line, ex-situ). Due to its robust technology and insensitivity to vibrations and light influences, ease of use through a single-button solution, and machine-to-machine communication (Industry 4.0) for adaptive production planning, the Bruker Alicona InfiniteFocusG5 measurement system enables fast and highly accurate measurements directly in production. "With Bruker Alicona, Festo is laying the foundation for modern, integrated manufacturing metrology," Horst Lang concluded.

SUCCESS STORIES | DIE & MOLD

Behind the QR codes are further stories

STEPPER
DIE NEUE DIMENSION DER STANZTECHNIK

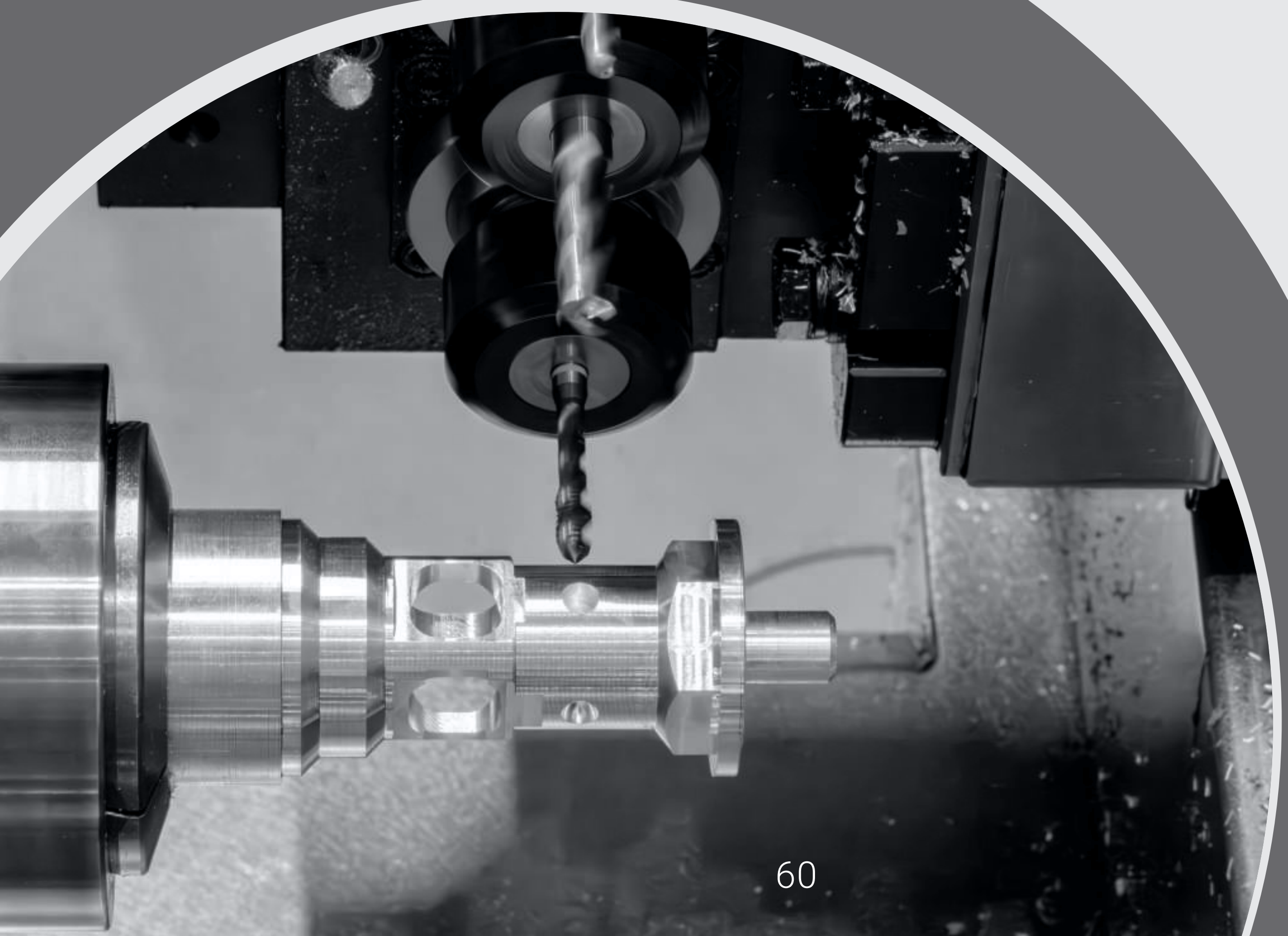
Why Stepper uses Bruker Alicona measurement systems 24/7

Stepper

boehlerit

How optical measurement avoids expensive refining steps

Boehlerit



PRECISION MANUFACTURING

Achieve maximum precision when measuring the smallest components

In the precision mechanics industry, achieving both high-volume production and exceptional quality is a constant challenge. Whether you are producing gears, shafts, rivets, or plastic components for watches or other precision devices, the demand for flawless dimensional accuracy is ever-present. Bruker Alicona's optical 3D measurement solutions offer a versatile, efficient approach to quality control.

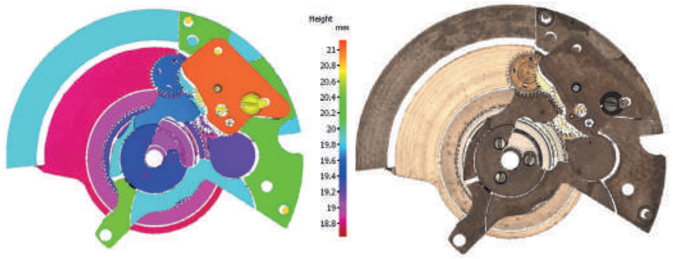
With just one system, you can measure critical dimensions, analyze GD&T features, and assess surface quality, ensuring that each component meets the highest standards. Stay ahead of the curve by integrating advanced optical metrology into your production process, and deliver precision without compromise.

APPLICATION | PRECISION MECHANICS

Watch

A watch is made up of over 100 components, each needing a unique manufacturing process. Precision is vital in both manufacturing and assembling the movement. On the main plate of the watch, components are pre-assembled before becoming part of a movement. Dimensional accuracy regarding distance dimensions, diameters with small tolerances, and shape and position tolerances are required. The position at which the bearings and gears are finally assembled must be exact and precise in relation to each other. The individual height steps are also important to guarantee smooth operation.

The optical coordinate measuring machine µCMM provides fast and highly accurate measurements from only one viewing direction without further manipulation of the component. Measuring holes from above allows users to measure holes with tolerances of up to 2 µm.

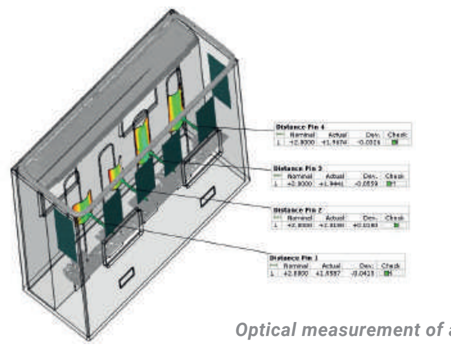


3D data of the main plate of the watch in true color and

APPLICATION | PRECISION MECHANICS

Connectors

The production of a connector involves numerous invisible manufacturing steps, with the measurement of internal geometries being of crucial importance. Stamped or embossed metal plates require precise roughness and defect measurements. One of the most critical areas is the crimp zone, where the connection to the cables is made. Here, the exact groove shape, contact quality and gap dimensions are crucial. Optical metrology plays a key role here, as it enables precise measurements of free forms and references on side surfaces. Particularly for housings, which are usually injection molded, powerful measuring systems are indispensable due to the complex shapes and tight tolerances. Traditional tactile methods reach their limits here, which is why optical metrology has a clear advantage.



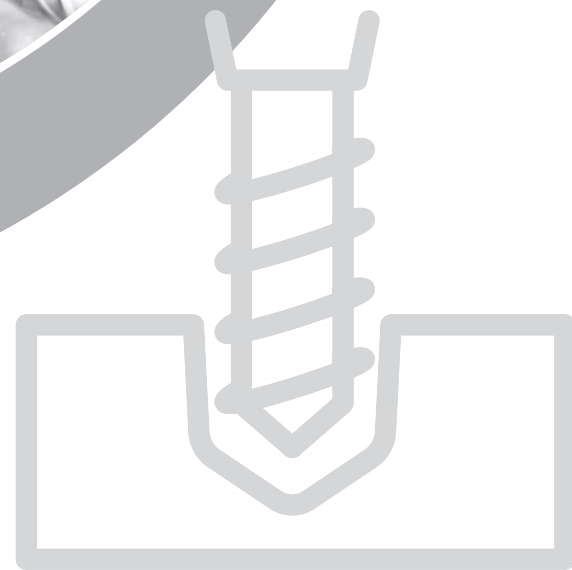
Optical measurement of a USB-port

WEBINAR | PRECISION MECHANICS

Where are optical systems displacing tactile methods?

Vertical Focus Probing as a gamechanger in measurement technology

CUTTING TOOLS



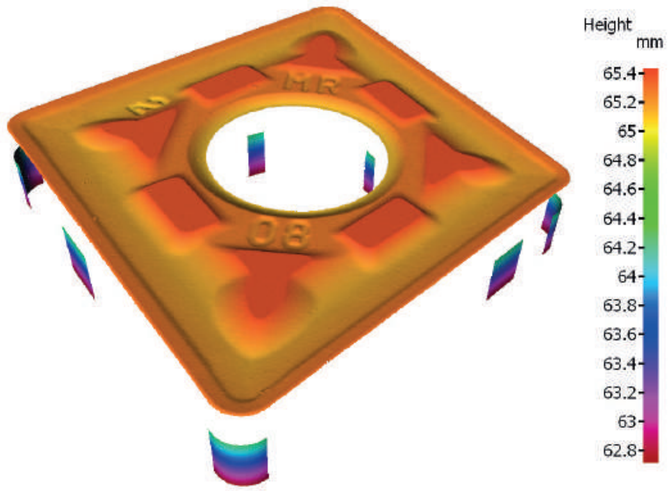
How to shorten machining times and extend the service life of your cutting tools

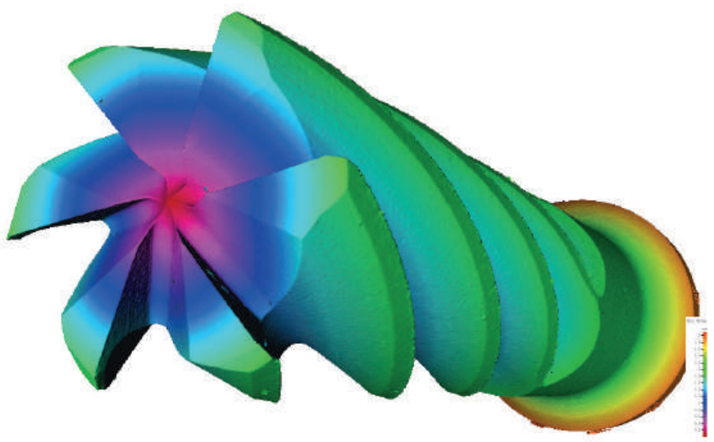
To optimize machining times and enhance cutting tool longevity, manufacturers rely on rigorous testing and continuous measurement during both research and production phases. This approach ensures high-quality tools that meet increasingly stringent customer requirements for precision and performance. By integrating advanced technologies like Focus Variation into quality control processes, companies can effortlessly shorten machining times and extend cutting tool service life. This enables precise measurement of dimensional accuracy and surface finish with unmatched precision, ultimately delivering superior results and reducing defects.

APPLICATION | CUTTING TOOLS

Insert

Optical metrology is used to measure the geometric properties of inserts, such as those used in machining and manufacturing. Utilizing advanced optical metrology, it provides detailed surface characterization and dimensional analysis. The system leverages Focus-Variation technology to capture 3D surface data, allowing for the accurate assessment of parameters like surface roughness, edge geometry, and wear. This non-contact measurement method ensures high accuracy and repeatability, making it ideal for quality control and R&D applications in various industries.

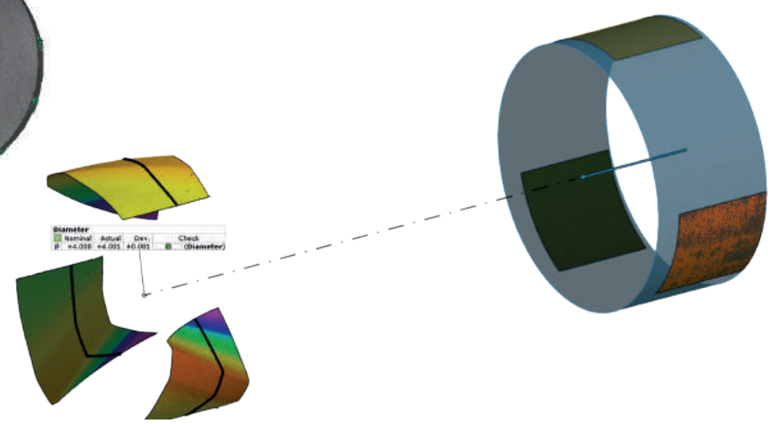




APPLICATION | CUTTING TOOLS

Drills & mills

Bruker Alicona optical 3D technology offers precise analysis of drills and mills by measuring at predefined positions. It automatically analyzes parameters such as edge radius, roughness, and defect parameters. The system also evaluates the overall geometry of the tool, including wedge, clearance, and rake angles. This non-contact method measures roughness and potential defects along the edge, providing critical data that directly correlates to the surface quality of the machined workpiece. By delivering accurate and repeatable assessments, the system enhances quality control and optimization in cutting tool manufacturing.



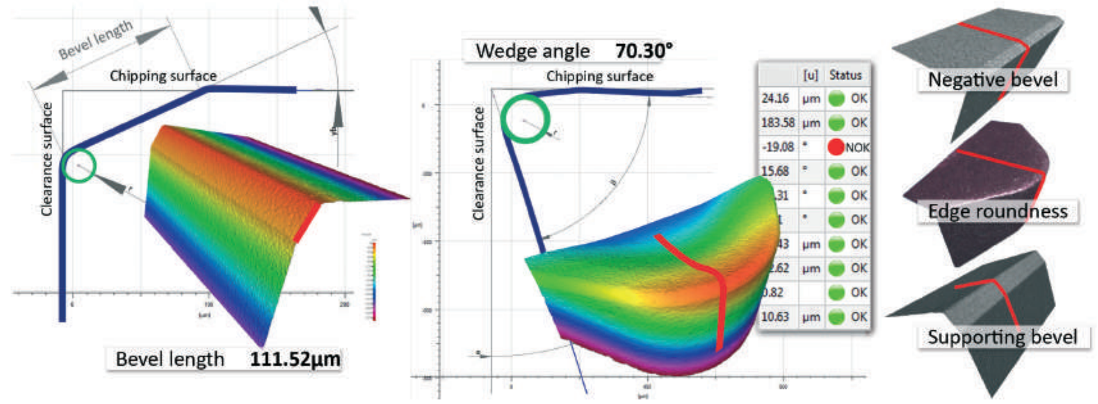
APPLICATION | CUTTING TOOLS

Edge preparation

Edge preparation improves the functionality, durability and safety of cutting tools. Various parameters influence the quality of the cutting tool and the workpiece. After production, a cutting edge preparation ensures optimally rounded edges.

The radius of the edge rounding has a decisive influence on the coatability, chipping, cutting performance, wear and service life of the cutting insert. But the radius is not the only relevant factor at the cutting edge. The chipping, which also determines the wear behaviour and can improve the notch effect if it meets the quality requirements, plays an important role. A profile roughness measurement provides information about the chipping at the edge.

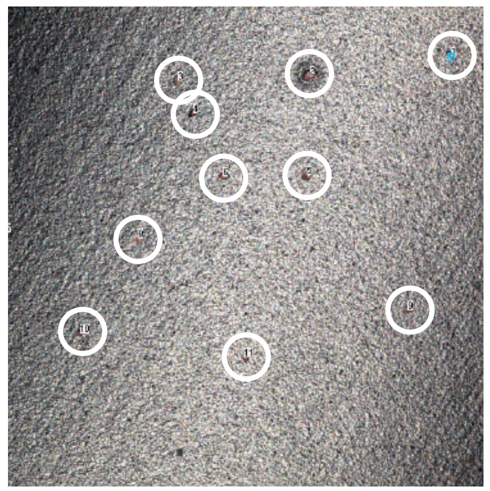
In addition, users measure the clearance, wedge and rake angles, the positive and negative bevels, and the scalloped shape (waterfall and trumpet shape) of the edge. Optical metrology offers a robust technology that delivers high-resolution, repeatable and traceable results even when subjected to temperature fluctuations or extraneous light.

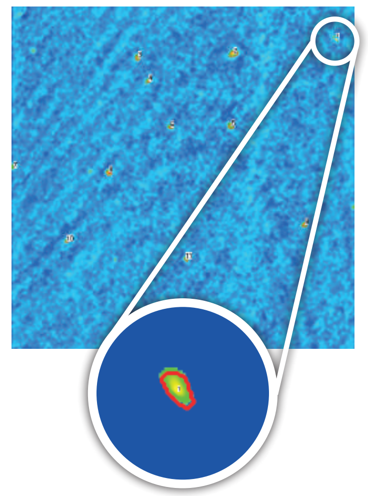


APPLICATION | CUTTING TOOLS

Droplets on coating

During most coating processes droplets are generated on tools. These defects increase the surface's roughness and therefore seriously influence the flow of the chips. By measuring, it is verified that droplet heights are within tolerance or that a polishing process is needed.





Droplet measurement: Areal roughness measurement in the flute informs about the amount of resistance the chip has during its evacuation. In this example droplets are clearly visible (red circles).

"We have seen a 75% reduction in the time necessary to take readings on the factory floor. Most of this time savings is attributed to the ease of use of the EdgeMaster."

SUCCESS STORY | CUTTING TOOLS

Optical tool measurement on the shop floor

IMCO
Power. Precision. Performance.

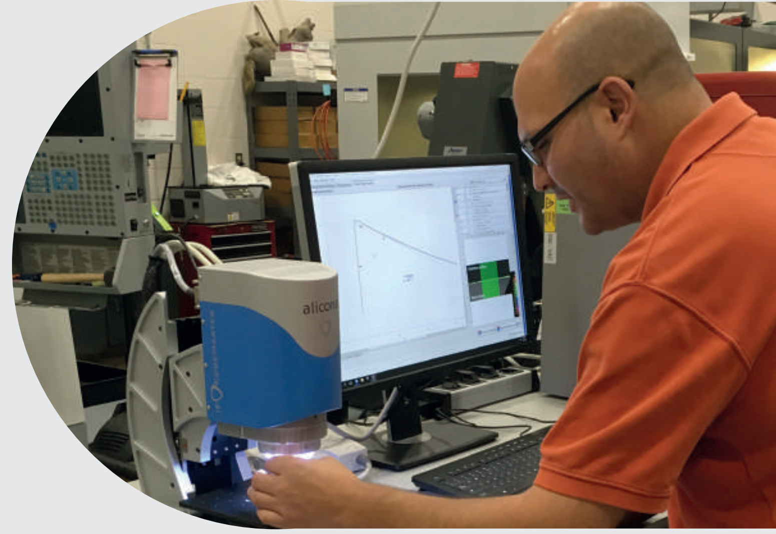
By utilizing optical measurement, the US tool manufacturer IMCO has achieved a reduction of measurement times by 75% on the factory floor. The reliable verification of the micro geometry of their milling cutters is one of the top priorities in the research and development work of the US carbide tool manufacturer IMCO. The high measuring accuracy, repeatability and easy handling of the EdgeMaster tool measuring system impressed the management as much that shortly after investing in its R&D center an additional system for production was purchased.

Micro geometry measurement of milling cutters
"Four features determine the service life and machining result of modern day cutting tools. These are substrate material, coating, macro and micro geometry." Matthew S. Osburn, Vice President & Technical Director of US manufacturer IMCO Carbide Tool Inc. knows what he is talking about. Specialized in the development of milling cutters with multiple flutes, he also knows about the importance of the right measuring technology: "The cutting edge is the wear part of a milling cutter." IMCO views micro geometry as being so critical that they desired a system tailored for only those types of measurements. Recently, the supplier of carbide cutting tools has replaced its existing "outdated device with an upgraded and highly accurate measuring system". Osburn continues: "We are well known for our high level of research and development activities, and reliable verification of edge preparation is of major importance. The most important criteria for the evaluation of suitable measuring systems for us were accuracy and repeatability of the measurements."

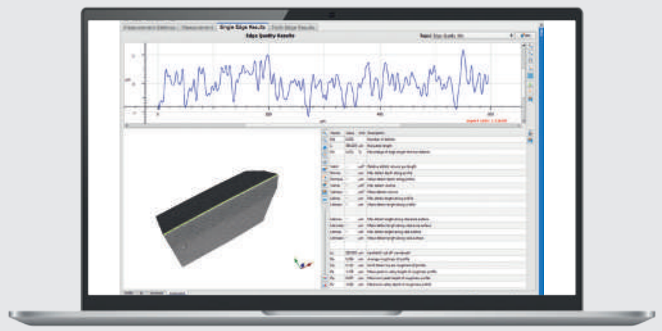
EdgeMaster systems are being used in prototype development as well as in production
In the end, the decision to invest in an Bruker Alicona measuring system for prototype development was an easy one. "I have the utmost confidence in the measurement values the EdgeMaster delivers", Osburn says. However, accuracy is only one advantage that the IMCO Vice President sees in the Bruker Alicona system. "We primarily measured edge hone radius sizes with our old system. With the EdgeMaster, and its ease of use, we now routinely measure many more attributes than before, and we do it quicker and with more confidence in the measurement results."

As a conclusion, Bruker Alicona has not only met but exceeded all expectations in terms of accuracy, repeatability and reliability of measurements. Only shortly after the investment in its R&D center, the management was so impressed by the easy operation and robustness of the optical measuring system that a second EdgeMaster is now being used in production.

Chipping and surface finish measurement on chip-surface
IMCO´s tool design offers "greater productivity results for very small to very large operations", as the supplier says. "Higher productivity is due to increased chip flow and elimination of chip packing." IMCO customers further report on higher metal removal rates and fewer tool changes. All these attributes can be traced back to the supplier´s commitment to the four pillars of a modern cutting tool, one of them being micro geometry and verified by high resolution measurements with Bruker Alicona´s EdgeMaster system. Parameters such as shape and contour accuracy, rake angle, undercuts, chipping and roughness on i.e. the chip surface are decisive for the quality of the cutting edge and thus for the machined workpiece. IMCO offers milling cutters with up to thirteen flutes that achieve above-average surface finish even with materials that are difficult to machine. Development and testing takes place in the internal research and development center, where IMCO can grind, hone, inspect and machine with prototype cutting tools. The EdgeMaster is also used to measure the surface finishes of the flute at various grinding parameters to optimize surface integrity. Osburn further explains: "All tools in prototype development are measured and documented with Bruker Alicona. We then machine with these tools, meticulously logging our machining results. This process enables us to quickly correct the tool geometry if required. The EdgeMaster guides us to developing the highest performance cutting tools on the market."



One of two EdgeMasters in use. The edge measuring system is applied in the R&D center where grinding, honing and inspection of prototypes is done. "We then machine with these tools, meticulously logging our machining results", says IMCO.



IMCO offers milling cutters with multiple flutes that achieve high surface finish even with materials that are difficult to machine.

MATTHEW S. OSBURN

Vice President &
Technical Director

"Particularly on the shop floor, simple handling is just important as measuring accuracy. Bruker Alicona understood that 100%

"Intensive research is now carried through to the production environment"

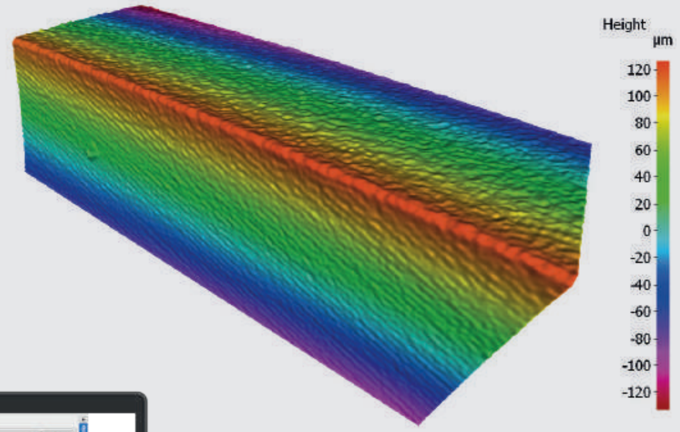
Another important aspect in prototyping is the use of a flexible measurement system that enables highly accurate measurements on different tool shapes, types and sizes. IMCO has to measure a wide variety of sizes and helix angles. According to Osburn, it is "easy to cover this wide variety of tools with the EdgeMaster." He sees the right measurement technology as one of the decisive factors in ensuring a steady flow of new products and to improve upon the tools that are already offered. "Focus-Variation is critical to our ongoing success", he says. With a second EdgeMaster in use, the intensive research is now carried through to the production environment.

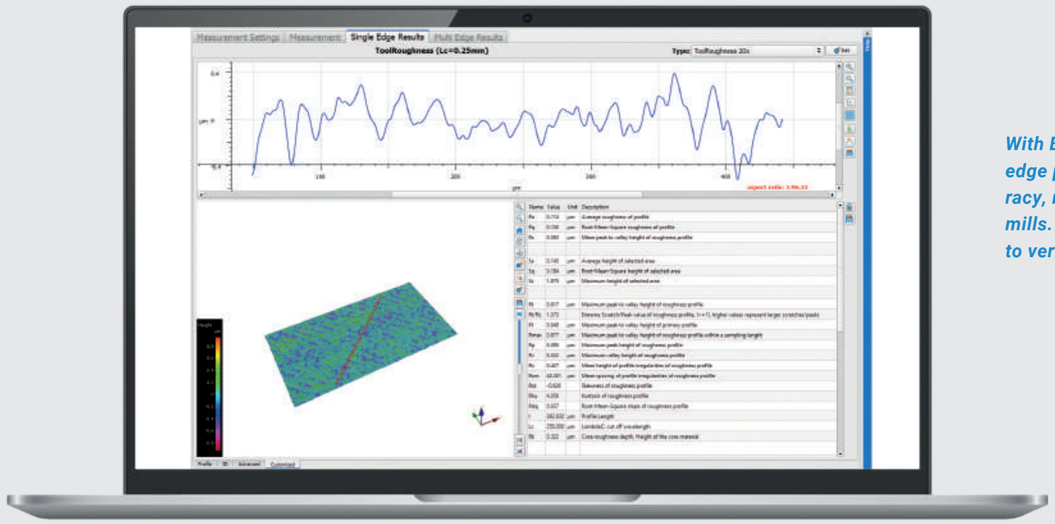
Simple handling is just as important as measuring accuracy

Measurement accuracy, repeatability and robustness of the Focus-Variation technology in combination with the easy handling of the EdgeMaster system has led to the decision to purchase an additional device in manufacturing. "Our R&D center develops exact specifications for the edge treatment on our high performance cutting tools. Once newly developed tools are released for production, using the same measurement technology as applied in research makes perfect sense", Osburn explains. "In production, the EdgeMaster is used to verify that the precise edge treatment developed in the R&D is applied to the tools going to our customers." He is particularly enthusiastic about the ease use of use. "The system worked so well and was so easy to learn that we started training staff on the shop floor. The operators love the new EdgeMaster, it is so easy to learn and use", Osburn says. He is convinced, that "on the shop floor, simple handling is just as important as measuring accuracy. Bruker Alicona understood that 100%."

75% reduction in the time necessary to take readings on the factory floor

A series of clamping tools for easy fixturing, user friendly controls and single-button solutions to perform measurements create this simple user guidance. High-resolution measurements also at vibrations, extraneous light or temperature fluctuations complete production suitability of the system. According to Osburn, IMCO also gains an advantage for research & development through measurements in production. "It is an additional benefit for our research that we can store all measurements for future reference", he explains. In his view, the EdgeMaster ensures that IMCO customers consistently get end millers with optimal micro geometry. Osburn about the ROI that has been achieved so far: "The Bruker Alicona technology is unique. We have seen a 75% reduction in the time necessary to take readings on the factory floor. Most of this time savings is attributed to the ease of use of the measurement system."





With Bruker Alicona, IMCO verifies cutting edge parameters such as radius, contour accuracy, rake angel, undercuts and chipping of end mills. Roughness measurements are performed to verify surface finish of the flute.

Behind the QR codes are further stories

Cobot increases efficiency in tool wear measurement

Institute of Machine Tools (IfW), University of Stuttgart

Validation of physics-based tool wear models

Third Wave Systems (TWS)

Automated surface finish measurement with a Cobot

Element Six

What is Focus-Variation?

Focus-Variation is an advanced optical technology used for high-resolution 3D surface measurements. It utilizes precision optics with various lens systems and objectives to combine a small depth of focus with vertical scanning. This technique provides detailed topographical and color information about a surface's form and roughness in a single measurement, making it highly efficient.

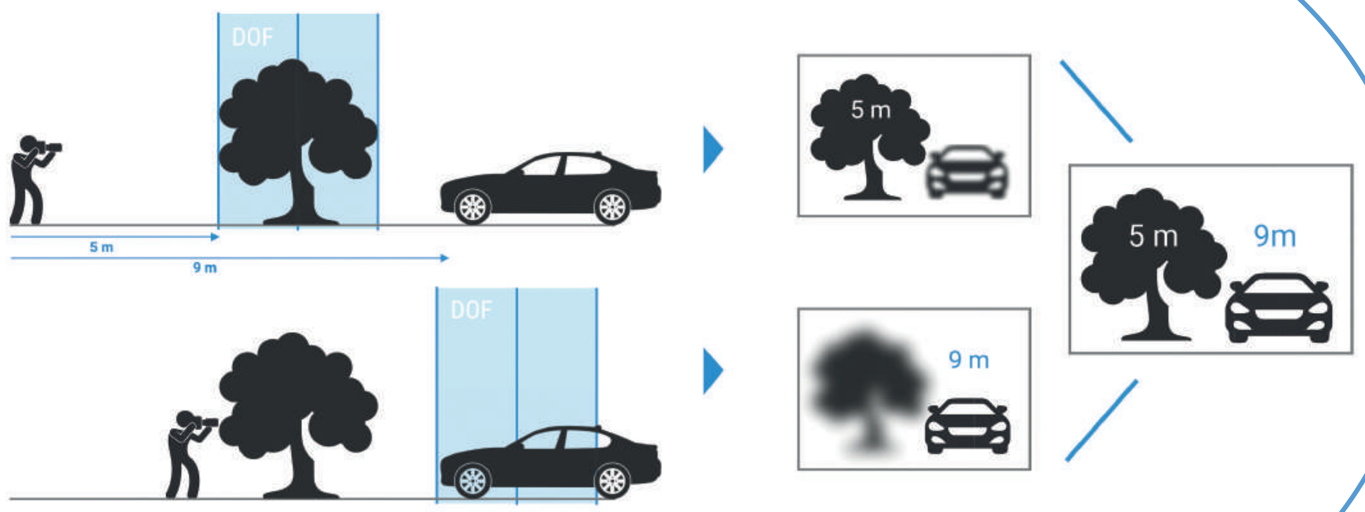
Versatility and flexibility

Focus-Variation is highly adaptable, capable of measuring surfaces with a wide range of optical reflectance values. It can handle shiny to diffuse reflecting surfaces, homogeneous to compound materials, and smooth to rough textures. By using modulated illumination, sensor parameter control, and integrated polarization, it overcomes traditional measurement limitations. The varying illumination intensity, generated by a signal generator, gathers extensive information from the surface.

Key advantages

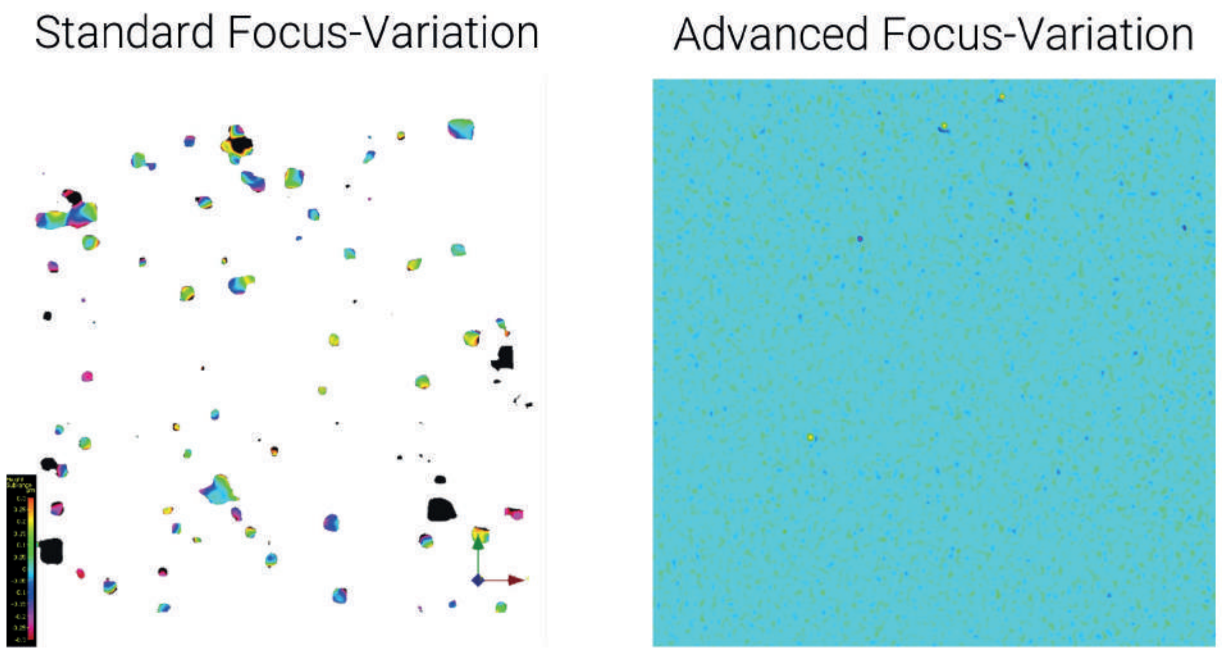
- Measures steep flanks with angles larger than 87°
- Handles surfaces with varying reflection properties and roughness
- Suitable for smooth samples
- Provides repeatable, robust, and stable measurements

Focus-Variation is a powerful and efficient method for comprehensive surface measurements, offering significant advantages for a wide range of applications.



TECHNOLOGY

Unlocking new possibilities with Advanced Focus-Variation



3D data of a mirror. With Advanced Focus-Variation even highly reflective and smooth surfaces can be measured precisely.

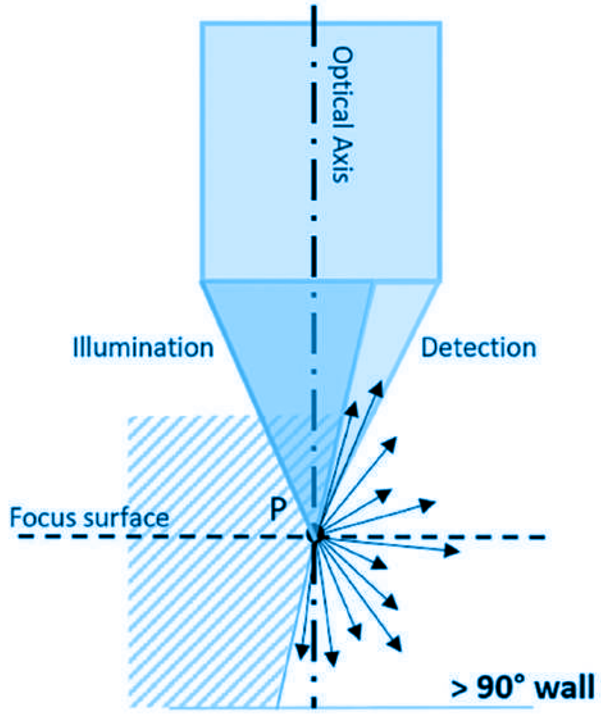
Advanced Focus-Variation represents a significant leap forward in surface measurement technology, specifically designed to measure smooth samples. This innovative approach merges the capabilities of a roughness measuring instrument with those of a coordinate measuring machine. It enables users to accurately measure workpieces with steep flanks, varying reflections, and structured roughness.

Excelling in high-resolution measurements of smooth, reflective, and highly polished surfaces, Advanced Focus-Variation is supported by cutting-edge devices such as InfiniteFocus G6, µCMM, and FocusX. This technology is revolutionizing precision measurement, unlocking new possibilities for a wide range of applications.

TECHNOLOGY

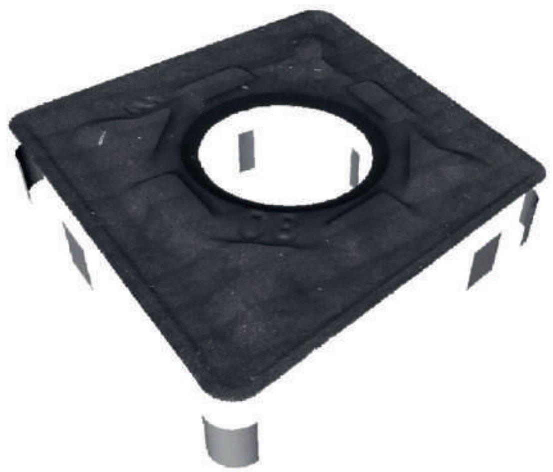
Revolutionizing optical measurement: Vertical Focus Probing (VFP)

Vertical Focus Probing (VFP) introduces a groundbreaking optical measurement technique that captures diffusely reflected light from vertical surfaces, enabling the precise, repeatable, and high-resolution measurement of flanks steeper than 90°. This technology allows for the accurate fitting of workpiece coordinate systems and the optical probing of complex geometries, such as automotive injection valve boreholes, previously only measurable with tactile systems or complex solutions.

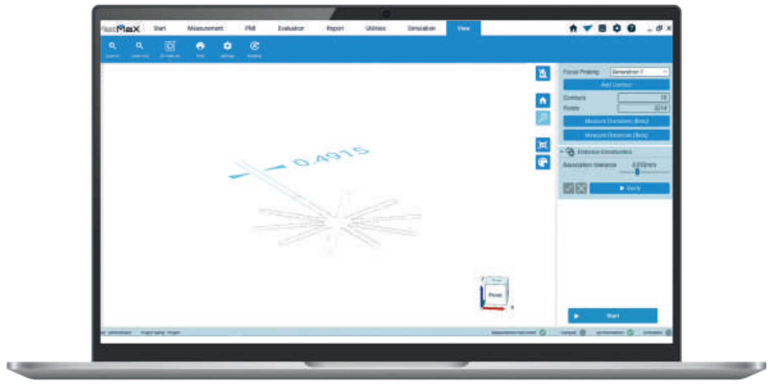


Traditional optical methods could only measure slopes up to 85°, with Focus-Variation being the standard for steep flanks. However, VFP extends this capability, enabling 3D optical measurements of surfaces with slopes beyond 90°. By using partial light and varying light directions, VFP captures reflected light from these challenging angles, expanding the scope of optical metrology.

The effectiveness of VFP depends on the surface geometry, roughness, and the numerical aperture of the objective used, which together determine how much the measurable slope can exceed 90°. With this innovation, Bruker Alicona continues to push the boundaries of optical measurement technology.



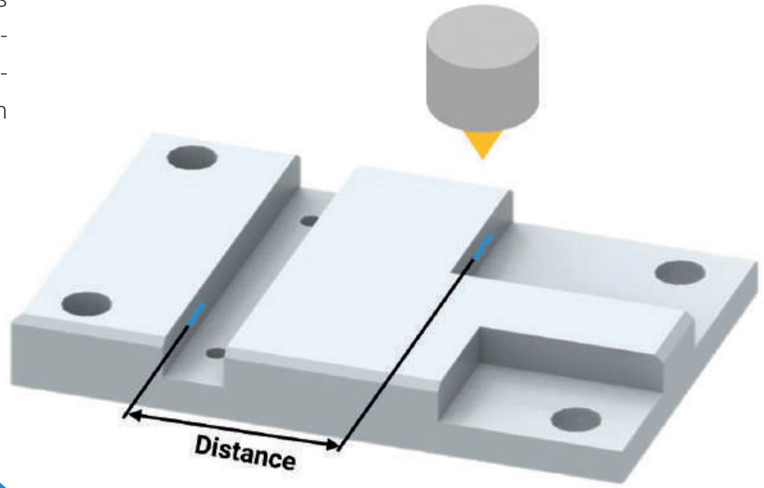
Introducing Focus Probing: Fast and precise 3D measurements



Focus Probing is a cutting-edge technology that allows for the rapid and accurate measurement of single 3D points and contours without the need for vertical scanning. Unlike traditional methods such as Advanced Focus Variation and Vertical Focus Probing, which require time-consuming area-based scanning, Focus Probing captures 3D data directly from sensor data at a single position.

This technique is ideal for quickly measuring features like distances and diameters, or aligning samples with CAD datasets. For example, Focus Probing can efficiently measure the distance between two laser-drilled holes by capturing and aligning their contours within a 3D coordinate system.

The primary advantage of Focus Probing is its speed, significantly reducing measurement and processing times while delivering high-accuracy results in contour-based applications.



Real3D Technology: Precise 360° measurement

Real3D technology enables precise 360° measurement of complex component geometries, offering detailed analysis of even the most intricate profiles and accurate measurement of both flat and curved components. The component is measured at various rotation and tilt angles. Individual measurements are transformed into a joint coordinate system and merged into a complete 3D data set.

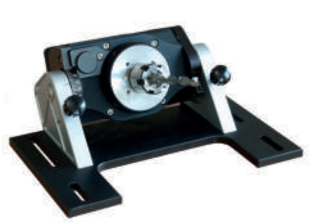
Key Features:

- Versatile Perspectives: Surfaces are measured from various angles and combined into complete 3D data.
- Automated Accuracy: Highly accurate and calibrated rotational and tilt axes ensure automated, repeatable, and traceable measurements of form and roughness.
- Comprehensive Analysis: Visualize and measure surface features such as flank angles, thread pitches, and undercuts.
- Digital Twin: Create a digital twin of the component for target-actual comparisons with CAD data, ensuring precise verification of form deviations.

Applications: :

Real3D is a comprehensive solution for geometry inspection in various applications, particularly for full-field measurement of typically round tools.

Real3DRotationUnit



InfiniteFocusSL, EdgeMasterX

Motorized rotation axis and manual tilt axis

surface features such as contour, difference and form or form deviations

Advanced Real3DRotationUnit

InfiniteFocus G6, µCMM

Motorized tilt axis and motorized rotation axis

compatibility with a range of clamping systems

Real3DUnitX

FocusX

Motorized tilt axis and motorized rotation axis

Shop floor measuring device

More about Real3D measurement

µCMM

High-accuracy coordinate measuring machine - purely optical

The µCMM is the first purely optical coordinate measuring machine (CMM). It redefines precision in measuring small surface details on large components. Combining the best of tactile coordinate measuring technology with advanced optical surface metrology, the µCMM excels in measuring dimension, position, shape, and roughness with a single sensor. Its non-contact, Focus-Variation technology ensures high accuracy in a sub-µm-range across the entire measurement volume, making it suitable for a wide range of surfaces, from matte to highly polished.

Engineered for ease of use and durability, the µCMM features air-bearing axes with linear drives, ensuring wear-free operation and fast, precise measurements. It's built for production environments, offering robust performance with simple, ergonomic controls, including single-button solutions and automation capabilities. Whether dealing with plastics, ceramics, or composite materials, this machine delivers unmatched geometric accuracy, making it an ideal choice for industries demanding reliable, high-precision measurements in large-scale applications.

Technical specifications

General specifications

Measurement principle	non-contact, optical, three-dimensional; Technologies: • Advanced Focus-Variation • Focus Probing • Vertical Focus Probing • Real3D
Number of measurement points	single measurement: X: 1720, Y: 1720, X x Y: 2.95 million multi measurement: up to 500 million
Positioning volume (X x Y x Z)	310 mm x 310 mm x 310 mm = 29 791 000 mm³
Compressed air	maintainance-free with compressed air according to specification, 7 bar consumption 80 Nl/min.
Travel speed of axes	up to 100 mm/s
Coaxial illumination	LED coaxial illumination (color), high-power, electronically controllable
3D data	monochrome; optional color data available
Objective changer	automatic pneumatic four-place objective changer rack
System monitoring	9 temperature sensors (accuracy: ± 0.1 K), internal current and voltage monitoring, incl. long-term logging, retrievable
ControlServerHP	12 Core, 32 GB DDR5, SSD 1 TB, Windows 10 IoT Enterprise 64bit, 2x 27" Full HD monitor

Dimensions

Dimensions (W x D x H)	measurement instrument: 960 x 1109 x 1958 mm (up to 2288mm); ControlServerSF: 180 x 440 x 500 mm
Weight	measurement instrument: 1250 kg (incl. steel stand); ControlServerSF: <20 kg

Measurement object

Max. weight	30 kg; more on request
Max. dimensions	width: 680 mm, height: 375 mm
Max. measurable slope angle	Focus-Variation: 87° / Vertical Focus Probing: >90° (depending on application)

Objective specific features

Objective		1900 WD30	1500 WD130	1500 WD70	800 WD17	800 WD37	400 WD19	150 WD11	80 WD4(³)
Working distance	mm	30	130	69.4	17.5	37	19	11	4.5
Lateral measurement range (X, Y) (X x Y)	mm mm²	3.29 10.43	2.63 6.91	2.63 6.91	1.32 1.71	1.32 1.71	0.66 0.43	0.26 0.06	0.13 0.02
Measurement point distance	µm	1.88	1.53	1.53	0.76	0.76	0.38	0.15	0.08
Measurement noise (¹)	nm	30	180	100	4	25	2	1	1
Vertical resolution (²)	nm	85	510	500	30	71	20	10	10

(¹) Measurement noise NM: Evaluation conforming to ISO 25178-700:2022 and Fair Datasheet V1.2
(²) Vertical Resolution: Defined in ‚Optical Measurement of Surface Topography' (ISBN 978-3-642-12012-1) and the Fair Datasheet V1.2.
(³) Recommended vibration limit for this objective: < 50µg (RMS values of spectrum between 3 and 100 Hz)

Accuracy

3D accuracy ISO 10360-8 (¹)	$E_{Uni:Tr:ODS,MPE}$ = (0.8 + L/600) µm (L in mm) (2) $E_{UniZ:St:ODS,MPE}$ = (0.15 + L/50) µm (L in mm) (3)	
Flatness deviation	1.3 mm x 1.3 mm with objective 800 WD17	U = 0.1 µm
Profile roughness	Ra = 0.1 µm Ra = 0.5 µm	U = 0.012 µm, σ = 0.001 µm U = 0.02 µm, σ = 0.001 µm
Area roughness	Sa = 0.1 µm Sa = 0.5 µm	U = 0.01 µm, σ = 0.001 µm U = 0.015 µm, σ = 0.001 µm
Wedge angle	β = 70° - 110°	U = 0.075° , σ = 0.01°
Edge radius	R = 5 µm - 20 µm R > 20 µm	U = 1.5 µm, σ = 0.15 µm U = 2 µm, σ = 0.3 µm

(¹) Values based on ISO 10360-8 and VDI 2617. Valid for measuring room of quality class 2 according to VDI 2627, further accuracy values available for other environments.
(²) Accuracy of axes based on ISO 10360-8. (3) Valid for single measurements, height step measurement.

InfiniteFocus G6

The swiss army knife for precision manufacturing

The InfiniteFocus G6 is engineered for surface roughness and shape measurement. It is the perfect partner for precise measurements in production environments. The InfiniteFocus G6 delivers repeatable results across various materials and geometries. Notable for its robust Focus-Variation technology and vibration-insensitive design, it supports CAD system and PMI integration and features an automation interface for fully automated measurements, whereby the system delivers the most precise results regardless of the operator. It is the device of choice if you need to measure large production batches of components with geometries that are difficult to access, as the G6 excels in precision tasks where surface finish and complex geometries are critical.

Technical specifications

General specifications

Measurement principle	Non-contact, optical, three-dimensional Technologies: • Advanced Focus-Variation • Focus Probing • Vertical Focus Probing • Real3D
Number of measurement points	Single measurement: X: 2160, Y: 2160, X x Y: 4.6 million ImageField: up to 500 million
Positioning volume (X x Y x Z)	200 mm x 200 mm x 180 mm = 7 200 000 mm³
Positioning volume (R x T)	AdvancedReal3DUnit (optional): Motorized rotation: 360° / Motorized tilt: - 15° to + 90°
Coaxial illumination	LED coaxial illumination (color), high-power, electronically controllable
System monitoring	Automatic self-diagnosis due to temperature sensors, internal current and voltage monitoring
ControlServerSF	12 Core, 32 GB DDR5, SSD 1 TB, Windows 10 IoT Enterprise 64bit, 2x 27" Full HD monitor

Measurement object

Surface texture	Any surface, including polished metals
Max. sample dimensions	Height: 315 mm; more on request / Weight: up to 30 kg; more on request; 5-axes max. sample weight: 4 kg
Max. measurable slope angle	Advanced Focus-Variation: 87° / Vertical Focus Probing: > 90° (depending on application)

Objective specific features

Objective		1900 WD30	800 WD37	800 WD17	400 WD30	400 WD19	150 WD11	80 WD4
Working distance	mm	30	37	17.5	30	19	11	4.5
Lateral measurement range (X,Y)	mm	3.8	1.6	1.6	0.8	0.8	0.3	0.16
Measurement point distance	µm	1.77	0.72	0.72	0.36	0.36	0.14	0.07
Measurement noise	nm	80	40	15	20	5	2	1
Vertical resolution	nm	250	130	50	80	30	15	10

Resolution and application specifications

Objective name		1900 WD30	800 WD37	800 WD17	400 WD30	400 WD19	150 WD11	80 WD4
Min. measurable roughness (Ra)	µm	n.a.	0.7	0.18	0.24	0.12	0.05	0.03
Min. measurable roughness (Sa)	µm	n.a.	0.35	0.09	0.12	0.06	0.025	0.015
Min. measurable radius	µm	12	5	5	3	3	2	1

Accuracy (1)

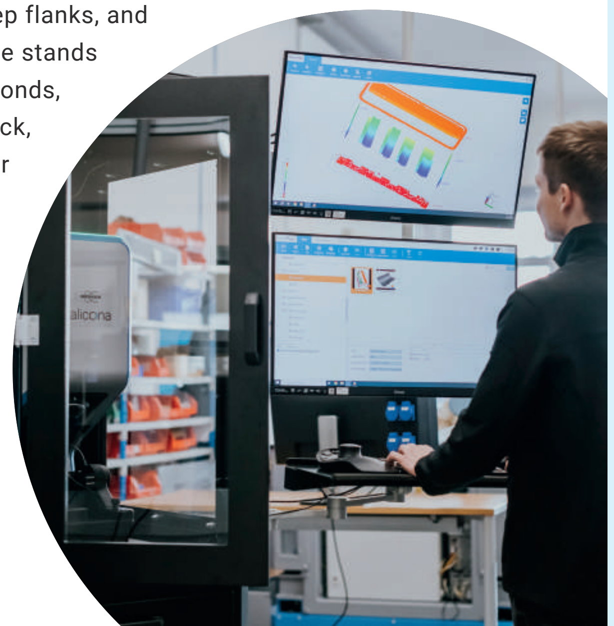
Flatness deviation	1.5 mm x 1.5 mm with 800 WD17 objective	U = 0.1 µm
Max. deviation of a height step measurement	Height step 10000µm Height step 1000µm Height step 100µm Height step 10µm Height step 1µm	$E_{UniZ: St: ODS, MPE}$ = 0.8 µm, σ = 0.4 µm $E_{UniZ: St: ODS, MPE}$ = 0.5 µm, σ = 0.1 µm $E_{UniZ: St: ODS, MPE}$ = 0.4 µm, σ = 0.05 µm $E_{UniZ: St: ODS, MPE}$ = 0.3 µm, σ = 0.025 µm $E_{UniZ: St: ODS, MPE}$ = 0.15 µm, σ = 0.01 µm
Profile roughness	Ra = 0.1 µm Ra = 0.5 µm	U = 0.025 µm, σ = 0.002 µm U = 0.04 µm, σ = 0.002 µm
Area roughness	Sa = 0.1 µm Sa = 0.5 µm	U = 0.02 µm, σ = 0.002 µm U = 0.03 µm, σ = 0.002 µm
Distance measurement	XY up to 1 mm XY up to 10 mm (3) XY up to 20 mm (3) MultiMeasurement XY	$E_{UniXY: Tr: ODS, MPE}$ = 0.7 µm $E_{UniXY: Tr: ODS, MPE}$ = 1.0 µm $E_{UniXY: Tr: ODS, MPE}$ = 2.0 µm $E_{UniXY: Tr: ODS, MPE}$ = 3.2+L/100 (4)
Wedge angle	β = 70 ° - 110 °	U = 0.15°, σ = 0.02°
Edge radius	R = 5 µm - 20 µm R > 20 µm	U = 1.5 µm, σ = 0.15 µm U = 2 µm, σ = 0.3 µm

(1) E_{Uni} and E_{Bi} based on ISO 10360-8 and VDI 2617. (3) Image Field. (4) Measurement at reference temperature of 22°C +/- 0.5K and with reference weight of 15kg +/- 5kg.

FocusX

Unmatched metrology value for production environments

The FocusX is the star in terms of value for money and budget efficiency. It is also the most versatile and fastest optical 3D measuring device in its category, designed to handle a wide range of measurement tasks. It excels in measuring reflective surfaces, steep flanks, and complex forms, delivering high-resolution results with ease. The device stands out for its speed, delivering millions of measurement points within seconds, and offers ISO-compliant roughness measurements with just one click, even without expert knowledge. The FocusX is particularly suited for miniaturized and high-precision parts, offering unmatched value in precision measurement. This measuring device is designed for applications that require extreme versatility and rapid measurement capabilities across a broad range of materials and geometries, making it ideal for fast-paced production environments.



Technical specifications

General specifications

Measurement principle	Non-contact, optical, three-dimensional Technologies: • Advanced Focus-Variation • Focus Probing • Vertical Focus Probing • Real3D
Number of measurement points	Single measurement: X: 2160, Y: 2160, X x Y: 4.6 million Image Field: up to 500 million
Positioning volume (X x Y x Z)	100 x 100 x 100 mm = 1 000 000 mm^3
Maintenance	Yearly service and recalibration recommended
System monitoring	Automatic self-diagnosis due to temperature sensors, internal current and voltage monitoring
ControlServerSF	12 Core, 32 GB DDR5, SSD 1TB, Windows 10 IoT Enterprise 64bit, 2x 27'' Full HD LED Monitor

Measurement object

Surface texture	Any surface, including polished metals
Max. height	Up to 145 mm; more on request
Max. weight	Up to 8 kg; more on request
Max. measurable slope angle	Advanced Focus-Variation: 87° / Vertical Focus Probing: > 90°

Objective specific features

Objective		1900 WD30	800 WD37 (1)	800 WD17	400 WD19	150 WD11
Working distance	mm	30	37	17.5	19	11
Lateral measurement range (X,Y)	mm	3.8	1.6	1.6	0.66	0.3
Measurement point distance	µm	1.77	0.72	0.72	0.36	0.14
Measurement noise (2)	nm	100	90	20	12	6
Vertical resolution	nm	290	260	60	35	20

(1) only with polarizer
(2) Measurement noise NM: Evaluation conforming to ISO 25178-700:2022 and Fair Datasheet V1.2

Resolution and application specifications

Objective		1900 WD30	800 WD37	800 WD17	400 WD19	150 WD11
Min. measurable roughness (Ra)	µm	n.a.	n.a.	0.18	0.13	0.06
Min. measurable roughness (Sa)	µm	n.a.	n.a.	0.09	0.07	0.04
Min. measurable radius	µm	12	10	5	3	2

Accuracy (3)

Max. deviation of a height step measurement	Height step 1000 µm Height step 100 µm Height step 10 µm Height step 1 µm	$E_{UniZ: St: ODS, MPE}$ = 0.5 µm, σ = 0.1 µm $E_{UniZ: St: ODS, MPE}$ = 0.4 µm, σ = 0.05 µm $E_{UniZ: St: ODS, MPE}$ = 0.3 µm, σ = 0.025 µm $E_{UniZ: St: ODS, MPE}$ = 0.15 µm, σ = 0.01 µm
Profile roughness	Ra = 0.1 µm Ra = 0.5 µm	U = 0.025 µm, σ = 0.004 µm U = 0.04 µm, σ = 0.002 µm
Area roughness	Sa = 0.75 µm	U = 0.05 µm, σ = 0.002 µm
Wedge angle	β = 70 º - 110 º	U = 0.15° , σ = 0.02°
Edge radius	R = 5 µm - 20 µm R > 20 µm	U = 1.5 µm, σ = 0.15 µm U = 2 µm, σ = 0.3 µm

(3) E_{Uni} and E_{Bi} based on ISO 10360-8 and VDI 2617 sheet 12.2

InfiniteFocusSL

Cost-effective and traceable precision for your table-top

The InfiniteFocusSL is a cost-effective optical 3D measuring device tailored for the rapid and traceable measurement of shape and surface finish on micro-structured surfaces. It offers high contrast and depth-of-focus color imaging and features a long working distance of up to 34mm. The system is designed for quick measurements, with usability enhanced by a coaxial laser for easy focusing. It does support fully automated measurements in production. However, it is more focused on simplicity and efficiency, making it a suitable choice for less complex measurement tasks, where cost-effectiveness and speed are priorities.

Technical specifications

General specifications

Positioning volume (X x Y x Z)	RL objectives: mot.: 50 mm x 50 mm x 155 mm (Z: 25 mm mot., 130 mm man.) = 387500 mm³ SXRL/AXRL objectives: mot.: 50 mm x 50 mm x 120 mm (Z: 25 mm mot., 95 mm man.) = 300000 mm³
Max. specimen weight	4 kg; more on request

Objective specific features

Objective magnification (¹)		10x	20x	50x	2xSX	4xAX	10xAX	20xAX	50xSX
Numerical aperture		0.3	0.4	0.6	0.055	0.135	0.28	0.42	0.55
Working distance	mm	17.5	16	10.1	34	30	33.5	20	13
Lateral measurement area (X,Y) (X x Y)	mm mm²	2 4	1 1	0.4 0.16	10 100	5 25	2 4	1 1	0.4 0.16
Ext. lat. measurement area (X,Y) (X x Y)	mm mm²	50 2500							
Measurement point distance	µm	1	0.5	0.2	5	2,5	1	0.5	0.2
Calculated lateral optical limiting resolution	µm	1.09	0.82	0.54	5.93	2.4	1.17	0.78	0.59
Finest lateral topographic resolution	µm	2	1	0.64	10	5	2	1	0.64
Measurement noise	nm	40	20	10	1240	155	45	25	15
Vertical resolution	nm	100	50	20	3500	430	130	70	45
Vertical measurement range	mm	16	15	9	25	25	25	19	12
Measurement speed		≤ 1.7 million measurement points/sec.							
Accessibility	°	31	29	19	40	44	51	39	26

(¹) Objectives with longer working distance available upon request

Resolution and application specifications

Objective magnification		10x	20x	50x	2xSX	4xAX	10xAX	20xAX	50SX
Min. measurable height	nm	100	50	20	3500	430	130	70	45
Max. measurable height	mm	16	15	9	25	25	25	19	12
Height step accuracy (1 mm)	%	0.1							
Max. measurable area	mm²	2500							
Max. measurable profile length	mm	50							
Min. measurable roughness (Ra)	µm	0.3	0.15	0.08	n.a.	n.a.	0.45	0.25	0.15
Min. measurable roughness (Sa)	µm	0.15	0.075	0.05	n.a.	n.a	0.25	0.1	0.08
Min. measurable radius	µm	5	3	2	20	12	5	3	2
Min. measurable wedge angle	°	20							
Max. measurable slope angle	°	87							

Accuracy

Flatness deviation	2 mm x 2 mm with 10x objective	U = 0.1 µm
Max. deviation of a height step measurement	height step 1000 µm height step 100 µm height step 10 µm height step 1 µm	$E_{Uni: St: ODS, MPE}$ = 1 µm, σ = 0.1 µm $E_{Uni: St: ODS, MPE}$ = 0.4 µm, σ = 0.05 µm $E_{Uni: St: ODS, MPE}$ = 0.3 µm, σ = 0.025 µm $E_{Uni: St: ODS, MPE}$ = 0.15 µm, σ = 0.01 µm
Profile roughness	Ra = 0.5 µm	U = 0.04 µm, σ = 0.002 µm
Area roughness	Sa = 0.5 µm	U = 0.03 µm, σ = 0.002 µm
Distance measurement	XY up to 2 mm	$E_{Bi: Tr: ODS, MPE}$ = 0.8 µm
Wedge angle	β = 70-110 º	U = 0.15 º, σ = 0.02 º
Edge radius	R = 5 µm - 20 µm R > 20 µm	U = 1.5 µm, σ = 0.15 µm U = 2 µm, σ = 0.3 µm

$E_{Uni: St: ODS, MPE}$ & $E_{Bi: Tr: ODS, MPE}$ conform to ISO 10360-8

EdgeMaster Series

Cutting-edge metrology in every sense of the word

The EdgeMaster Series is designed for high-resolution, fully automated measurement of tool cutting edges in production environments. These systems ensure consistent, precise measurements whether used in a controlled measuring room or directly on the shop floor. Even in challenging conditions with vibrations, extraneous light, and temperature fluctuations, the EdgeMaster systems delivers robust and accurate results. With these systems, users can measure tool radii greater than 2µm, as well as rake, wedge, and clearance angles, capturing detailed profiles of various edge types, including waterfall and trumpet shapes. The high vertical resolution of the EdgeMaster systems not only supports traceable roughness measurements on the rake face but also enables precise wear assessment over time, reducing measurement uncertainties commonly faced in tool wear analysis.

Wear Measurement with EdgeMaster

The EdgeMaster series also excels in the accurate and straightforward measurement of tool wear, offering a solution to common challenges such as high measurement uncertainties. The Bruker Alicona Wear Measurement software, an extension of the EdgeMaster systems, allows users to visualize and quantitatively assess wear on cutting edges using high-resolution 3D measurement data. This software supports automated measurement of differential and wear parameters according to ISO 8688 standards, enabling consistent and reliable tool life testing. Measurements can be repeated over the tool's lifetime, either directly in the machine or separately, ensuring a comprehensive analysis of tool performance and longevity.

Technical specifications EdgeMaster und EdgeMasterX

General specifications

	EdgeMaster	EdgeMasterX
Positioning volume (X x Y x Z)	RL objectives: man.: 25 mm x 25 mm x 155 mm (Z: 25 mm mot., 130 mm man.) = 96875 mm³ SXRL/AXRL objectives: man.: 25 mm x 25 mm x 120 mm (Z: 25 mm mot., 95 mm man.) = 75000mm³	RL objectives: mot.: 50 mm x 50 mm x 155 mm (Z: 25 mm mot., 130 mm man.) = 387500 mm³ SXRL/AXRL-objectives: mot.: 50 mm x 50 mm x 120 mm (Z: 25 mm mot., 95 mm man.) = 300000 mm³
Max. sample weight	4 kg; more on request	4 kg; more on request

Objective specific features

Objective magnification (¹)		10x	20x	50x	2xSX	4xAX	10xAX	20xAX	50xSX
Working distance	mm	17.5	16	10.1	34	30	33.5	20	13
Lateral measurement area (X,Y) **(X x Y)**	mm mm²	2 4	1 1	0.4 0.16	10 100	5 25	2 4	1 1	0.4 0.16
Measurement point distance	µm	1	0.5	0.2	5	2,5	1	0.5	0.2
Measurement noise	nm	40	20	10	1240	155	45	25	15
Vertical resolution	nm	100	50	20	3500	430	130	70	45
Vertical measurement range	mm	16	15	9	25	25	25	19	12
Accessibility	°	31	29	19	40	44	51	39	26

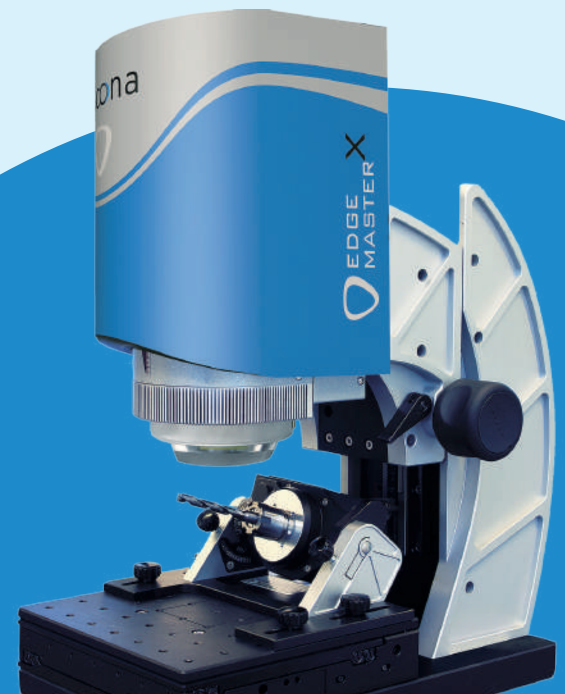
(¹) Objectives with longer working distance available upon request

Resolution and application specifications

Objective magnification		10x	20x	50x	2xSX	4xAX	10xAX	20xAX	50SX
Min. measurable radius	µm	5	3	2	20	12	5	3	2
Min. measurable wedge angle	°	20							
Min. measurable roughness (Ra)	µm	0.3	0.15	0.08	n.a.	n.a.	0.45	0.25	0.15
Min. measurable roughness (Sa)	µm	0.15	0.075	0.05	n.a.	n.a	0.25	0.1	0.08
Max. bevel length	µm	800	400	160	4000	2000	800	400	160
Max. measurable slope angle	°	87							

Accuracy

Profile roughness	Ra = 0.5 µm	U = 0.04 µm, σ = 0.002 µm
Area roughness	Sa = 0.5 µm	U = 0.03 µm, σ = 0.002 µm
Wedge angle	β = 70 ° - 110 °	U = 0.15 ° , σ = 0.02 °
Edge radius	R = 5 µm - 20 µm R > 20 µm	U = 1.5 µm, σ = 0.15 µm U = 2 µm, σ = 0.3 µm



Technical specifications EdgeMasterHOB

General specifications

Positioning volume	Z: 25 mm (mot.), 92 mm (man.) Lifting table: 120 mm (man.) Rotation table: +/- 30° (man.)
Max. specimen weight	30 kg; more on request

Objective specific features

Objective magnification (¹)		4xAX	10xAX	20xAX
Numerical aperture		0.135	0.28	0.42
Working distance	mm	30	33.5	20
Lateral measurement area (X,Y) (X x Y)	mm mm²	5 25	2 4	1 1
Measurement point distance	µm	2.5	1	0.5
Calculated lateral optical limiting resolution	µm	2.4	1.17	0.78
Finest lateral topographic resolution	µm	5	2	1
Measurement noise	nm	155	45	25
Vertical resolution	nm	430	130	70
Vertical measurement area	mm	25	25	19
Accessibility	°	44	51	39

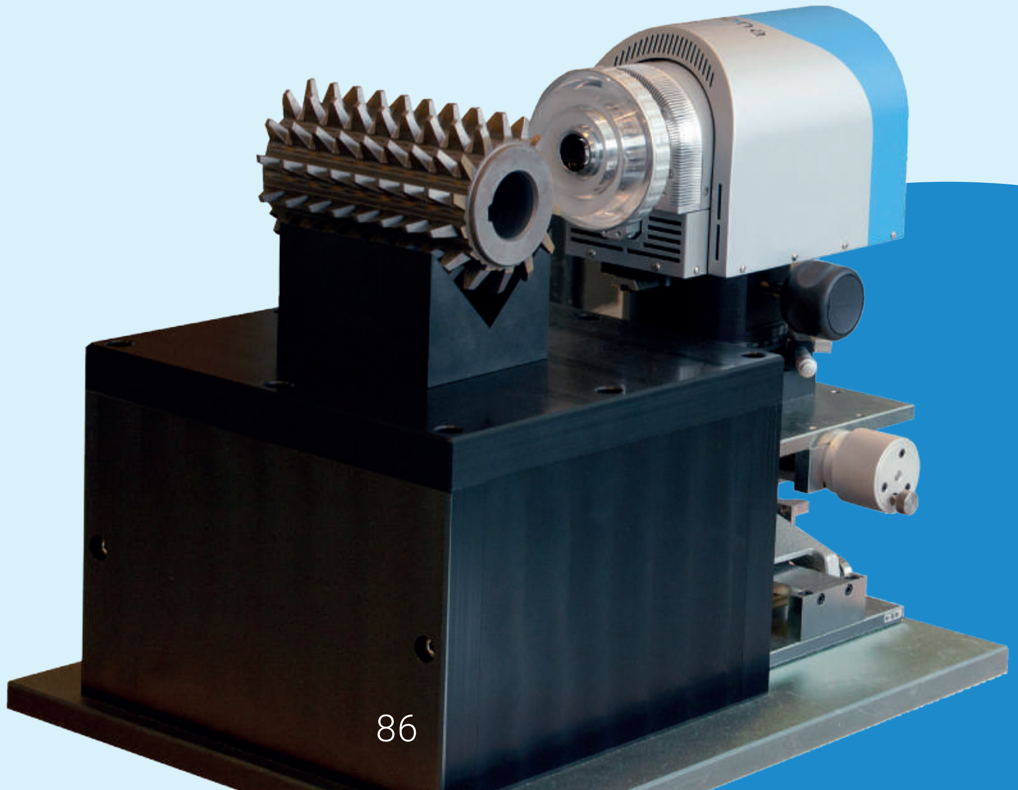
(¹) Objectives with longer working distance available upon request

Resolution and application specifications

Objective magnification		4xAX	10xAX	20xAX
Min. measurable radius	µm	12	5	3
Min. measurable wedge angle	°		20	
Max. measurable slope angle	°		87	
Max. bevel length	µm	2000	800	400

accuracy

Wedge angle	β = 70 ° - 110 °	U = 0.15 ° , σ = 0.02 °
Edge radius	R = 5 µm - 20 µm R > 20 µm	U = 1.5 µm, σ = 0.15 µm U = 2 µm, σ = 0.3 µm



Profiler

One-shot metrology at your hands

The Profiler is a handheld 3D profilometer designed for high-resolution surface roughness measurement on both flat and curved components. It supports both profile-based (ISO 4287) and areal-based (ISO 25178) measurements. The device combines a lightweight, ergonomic design with mechanical rigidity, ensuring ease of use while delivering traceable and repeatable measurements in as little as three seconds.

Technical specifications

General specifications

Positioning volume (Z)	25 mm (mot.)
Specimen radius	100 mm - ∞

Objective specific features

Objective magnification		10x	20x	50x
Numerical aperture		0.3	0.4	0.6
Working distance	mm	17.5	16	10.1
Lateral measurement area (X,Y) (X x Y)	mm mm²	2 4	1 1	0.4 0.16
Measurement point distance	µm	1	0.5	0.2
Calculated lateral optical limiting resolution	µm	1.09	0.82	0.54
Finest lateral topographic resolution	µm	2	1	0.64
Measurement noise	nm	40	20	10
Vertical resolution	nm	100	50	20
Vertical measurement area	mm	16	15	9
Accessibility	°	31	29	19

Resolution and application specifications

Objective magnification		10x	20x	50x
Min. measurable roughness (Ra)	µm	0.3	0.24	0.18
Min. measurable roughness (Sa)	µm	0.15	0.12	0.09
Max. measurable slope angle	°		87	

SensorR25

Seamless integration for measurements in production

The SensorR25 is an optical measurement sensor designed for integration into production lines, delivering high-resolution, repeatable results for surface measurements in the µm or sub-µm range. It bridges the gap between in-line production measurements and laboratory precision, thanks to standardized interfaces that ensure quick and easy integration. When combined with a 6-axis robot, the SensorR25 becomes part of a flexible Cobot system, ideal for measuring microstructures on large components with consistent accuracy.

Technical specifications SensorR25

General Specifications

Positioning volume (Z)	25 mm (mot.)

Objective specific features

Objective magnification (¹)		**10x**	**20x**	**50x**	**2xSX**	**4xAX**	**10xAX**	**20xAX**	**50xSX**
Working distance	mm	17.5	16	10.1	34	30	33.5	20	13
Lateral measurement area (X,Y) (X x Y)	mm mm^2	2 4	1 1	0.4 0.16	10 100	5 25	2 4	1 1	0.4 0.16
Measurement point distance	µm	1	0.5	0.2	5	2.5	1	0.5	0.2
Finest lateral topographic resolution	µm	2	1	0.64	10	5	2	1	0.64
Measurement noise	nm	40	20	10	1240	155	45	25	15
Vertical resolution	nm	100	50	20	3500	430	130	70	45
Vertical measurement range	mm	16	15	9	25	25	25	19	12
Measurement speed		≤ 1.7 million measurement points/sec.							
Accessibility	°	31	29	19	40	44	51	39	26

(¹) Objectives with longer working distance available upon request

Resolution and application specifications

Objective magnification		**10x**	**20x**	**50x**	**2xSX**	**4xAX**	**10xAX**	**20xAX**	**50xSX**
Min. measurable height	nm	100	50	20	3500	430	130	70	45
Max. measurable height	mm	16	15	9	25	25	25	19	12
Height step accuracy (1 mm)	%	0.1							
Min. measurable roughness (Ra)	µm	0.3	0.15	0.08	n.a.	n.a.	0.45	0.25	0.15
Min. measurable roughness (Sa)	µm	0.15	0.075	0.05	n.a.	n.a.	0.25	0.1	0.08
Min. measurable radius	µm	5	3	2	20	12	5	3	2
Min. measurable wedge angle	°	20							
Max. measurable slope angle	°	87							

Accuracy

Flatness deviation	2 mm x 2 mm with 10x objective	U = 0.1 µm
Max. deviation of a height step measurement	height step 1000 µm height step 100 µm height step 10 µm height step 1 µm	$E_{Uni: St: ODS, MPE}$ = 1 µm, σ = 0.1 µm $E_{Uni: St: ODS, MPE}$ = 0.4 µm, σ = 0.05 µm $E_{Uni: St: ODS, MPE}$ = 0.3 µm, σ = 0.025 µm $E_{Uni: St: ODS, MPE}$ = 0.15 µm, σ = 0.01 µm
Profile roughness	Ra = 0.5 µm	U = 0.04 µm, σ = 0.002 µm
Area roughness	Sa = 0.5 µm	U = 0.03 µm, σ = 0.002 µm
Distance measurement	XY up to 2 mm	$E_{Bi: Tr: ODS, MPE}$ = 0.8 µm
Wedge angle	β = 70 ° - 110 °	U = 0.15 ° , σ = 0.02 °
Edge radius	R = 5 µm - 20 µm R > 20 µm	U = 1.5 µm, σ = 0.15 µm U = 2 µm, σ = 0.3 µm

$E_{Uni: St: ODS, MPE}$ & $E_{Bi: Tr: ODS, MPE}$ conform toISO 10360-8

Software

Interface	integrated scripting language; LabVIEW framework; .NET remoting interface; Alicona Inspect (enables GD&T measurement)

PortableRL

Precision anytime, anywhere

The PortableRL is a mobile 3D measurement system tailored for quality assurance of micro-structured surfaces. It features a measurement field of up to 50x50x26 mm and is capable of handling both curved and flat components. Powered by a battery pack, this system is highly portable, allowing users to conduct measurements wherever needed. Its large vertical scanning range supports the measurement of various geometries, making it versatile for applications such as turbine blade inspection, asphalt analysis, and 3D measurement of steel and automotive body parts.

Technical specifications PortableRL

General specifications

Positioning volume (X x Y x Z)	50 mm x 50 mm x 25 mm = 62500mm³

Objective specific features

Objective magnification (¹)		10x	20x	50x	2xSX	4xAX	10xAX	20xAX	50xSX
Numerical aperture		0.3	0.4	0.6	0.055	0.135	0.28	0.42	0.55
Working distance	mm	17.5	16	10.1	34	30	33.5	20	13
Lateral measurement area (X,Y) **(X x Y)**	mm mm²	2 4	1 1	0.4 0.16	10 100	5 25	2 4	1 1	0.4 0.16
Measurement point distance	µm	1	0.5	0.2	5	2.5	1	0.5	0.2
Calculated lateral optical limiting resolution	µm	1.09	0.82	0.54	5.93	2.4	1.17	0.78	0.59
Finest lateral topographic resolution	µm	2	1	0.64	10	5	2	1	0.64
Measurement noise	nm	60	30	20	1240	155	60	30	25
Vertical resolution	nm	150	75	50	3500	430	170	90	70
Vertical measurement range	mm	16	15	9	25	25	25	19	12
Measurement speed		≤ 1.7 million measurement points/sec.							
Accessibility	°	31	29	19	40	44	51	39	26

(¹) Objectives with longer working distance available upon request

Resolution and application specifications

Objective magnification		10x	20x	50x	2xSX	4xAX	10xAX	20xAX	50SX
Height step accuracy (1 mm)	%	0.1							
Min. measurable roughness (Ra)	µm	0.55	0.25	0.2	n.a.	n.a.	0.65	0.3	0.25
Min. measurable roughness (Sa)	µm	0.30	0.15	0.1	n.a.	n.a	0.35	0.15	0.13
Min. measurable radius	µm	5	3	2	20	12	5	3	2
Min. measurable wedge angle	°	20							
Max. measurable slope angle	°	87							

Accuracy

Flatness deviation	2 mm x 2 mm with 10x objective	U = 0.1 µm
Max. deviation of a height step measurement	height step 1000 µm height step 100 µm height step 10 µm height step 1 µm	$E_{Uni: St: ODS, MPE}$ = 1 µm, σ = 0.1 µm $E_{Uni: St: ODS, MPE}$ = 0.4 µm, σ = 0.05 µm $E_{Uni: St: ODS, MPE}$ = 0.3 µm, σ = 0.025 µm $E_{Uni: St: ODS, MPE}$ = 0.15 µm, σ = 0.01 µm
Profile roughness	Ra = 0.5 µm	U = 0.04 µm, σ = 0.002 µm
Area roughness	Sa = 0.5 µm	U = 0.03 µm, σ = 0.002 µm
Distance measurement	XY up to 2 mm	$E_{Bi: Tr: ODS, MPE}$ = 0.8 µm
Wedge angle	β = 70-110 °	U = 0.15 °, σ = 0.02 °
Edge radius	R = 5 µm - 20 µm R > 20 µm	U = 1.5 µm, σ = 0.15 µm U = 2 µm, σ = 0.3 µm

$E_{Uni: St: ODS, MPE}$ & $E_{Bi: Tr: ODS, MPE}$ conform to ISO 10360-8

Cobot

Human-machine synergy for automation on the shop floor

Our Collaborative Robots (cobots) combine a 6-axis robotic arm with a high-resolution optical 3D measurement sensor, designed for seamless use in production environments. These cobots require no prior metrology knowledge for handling, programming, or conducting taught-in measurement series, making them perfect for verifying surface finish and dimensional accuracy directly on the production floor. Models like the CompactCobot, TurbineCobot, and DiscCobot are widely used in industries such as aerospace, automotive, and tooling for quality assurance. The mobile design of these cobots allows for flexible positioning, enabling measurements directly in the machine tool, while connected automation software streamlines the entire process, providing automated control and instant measurement reports.

Technical specifications

General specifications

Robot type	UR10e
Reach (Specimen radius)	1300 mm
Safety	Collaborative - stops at collision with an object 17 configurable safety functions Certified bei TÜV Nord and TÜV Süd
Degree of freedom (Axes)	6 rotating joints
Repeatability(1)	± 0.05mm
Max. number of measurement points	X: 2040, Y: 2040, X x Y: 4.16 million (for a single measurement)
Sensor	SensorR25 travel range in Z 25 mm (motorized) LED ring light with 24 segments
Weight	Approx. 40 kg (robot arm & SensorR25)
Operation	Coarse positioning of the sensor manually via Freedrive mode and handles. Fine positioning via precise joystick movement.
Positioning help	Coaxial laser beam
Software compatibility	**AutomationManager:** Easy teach-in of measurement sequences by adding robot positions; SingleField and ImageField measurements.

(1) Pose repeatability per ISO 9283

CompactCobot

Dimensions (H x W x L)	1 x 0.8 x 1.5 m
Weight	650 kg
Max. sample weight	100 kg
Operation	Drawer with integrated 19,5´ touchscreen, mouse, keyboard & control elements
Interface	Grid of holes to mount various specimen holders or specimens (M8 100 x 100 mm)
Additional Features	Integrated status lights 4 emergency stops on each corner

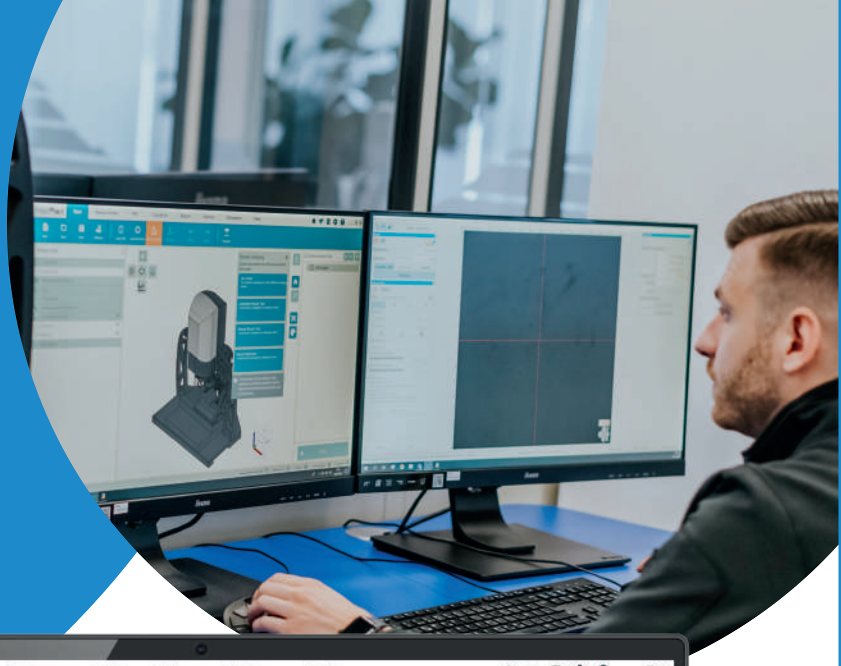
TurbineCobot

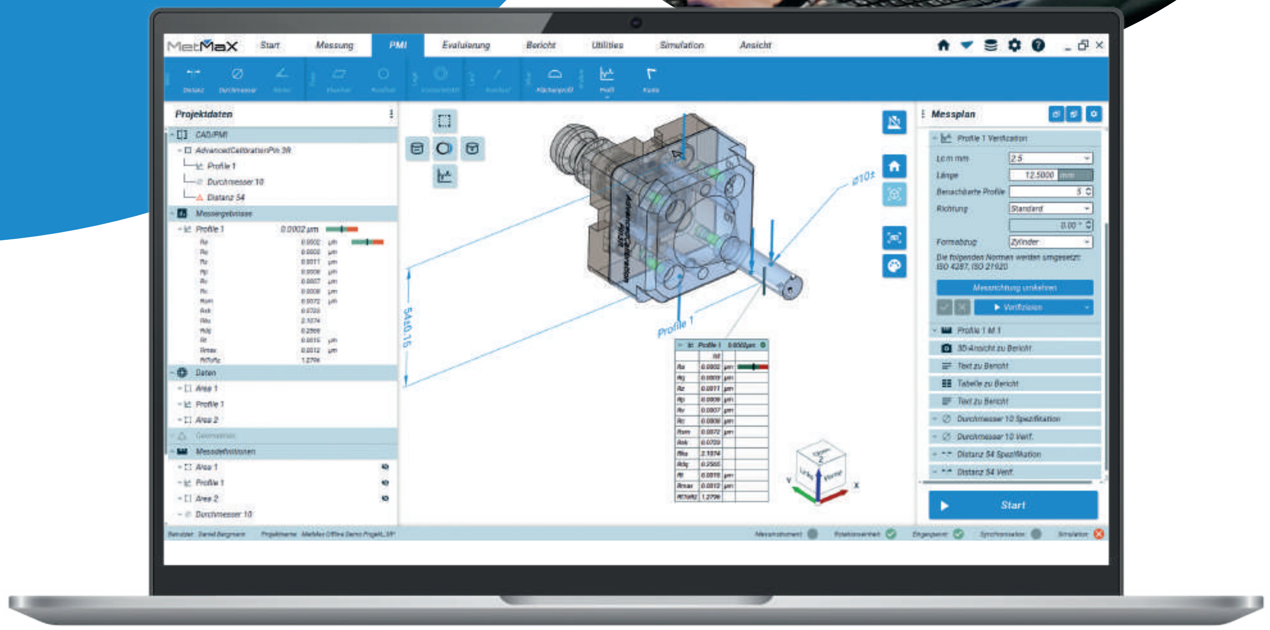
Dimensions (H x W x L)	Operator station: 1.25 x 1 x 1 m Cobotsystem: 1 x 1.3 x 2 m
Weight	Operator station: approx. 150 kg Cobotsystem: approx. 1000 kg
Additional axes	Motorized rotation table
Max. sample weight	150 kg
Operation	External operator station with monitor, mouse, keyboard & control elements
Interface	Grid of holes to mount various specimen holders or specimens (M8)
Additional Features	Integrated status lights 3 emergency stops Safety laser scanner for 360° monitoring the working area

DiscCobot

Dimensions (H x W x L)	Operator station: 1.25 x 1 x 1 m Cobotsystem: 1 x 1.25 x 1.6 m (without shaft)
Weight	Operator station: approx. 150 kg Cobotsystem: approx. 800kg
Additional axes	Motorized rotation axis (horizontal)
Max. sample weight	100 kg
Operation	External operator station with monitor, mouse, keyboard & control elements
Interface	Grid of holes to mount various specimen holders or specimens (M8) & horizontal shaft interface
Additional Features	Integrated status lights 3 emergency stops Safety laser scanner for monitoring the working area

MetMaX





One-stop software for metrology automation

MetMaX is an advanced 3D metrology software designed to optimize manufacturing processes through automated measurement. The optical coordinate measuring machine µCMM, the InfiniteFocus G6 and the FocusX are equipped with the user-friendly metrology software. By simply uploading CAD data and selecting desired features MetMaX automates the entire measurement process, eliminating the need for specialized metrology knowledge.

Bruker Alicona continually advances MetMaX. carefully addressing the needs and challenges of its customers. The measurement software remains at the forefront of technological innovation.

Discover all software features of MetMaX

Initiative Fair Data Sheet

Specifications in blue mark Alicona specific values.

The tech specs are based on the Fair Data Sheet. Exceptions are marked in blue

Bruker alicona

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