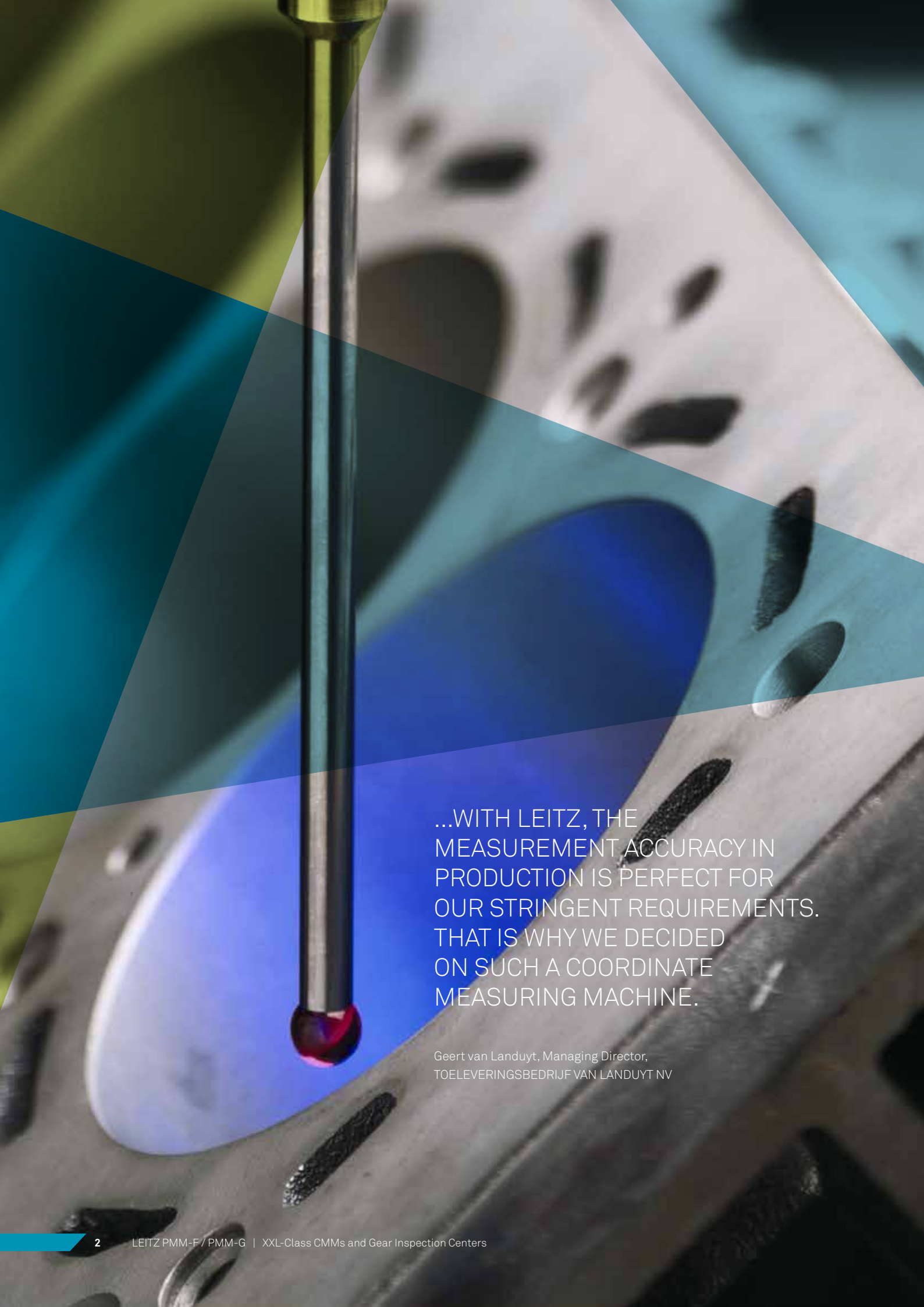
PRODUCT BROCHURE

HEXAGON
METROLOGY

# LEITZ PMM-F / PMM-G

## XXL-Class CMMs and Gear Inspection Centers



...WITH LEITZ, THE MEASUREMENT ACCURACY IN PRODUCTION IS PERFECT FOR OUR STRINGENT REQUIREMENTS. THAT IS WHY WE DECIDED ON SUCH A COORDINATE MEASURING MACHINE.

Geert van Landuyt, Managing Director,
TOELEVERINGSBEDRIJF VAN LANDUYT NV

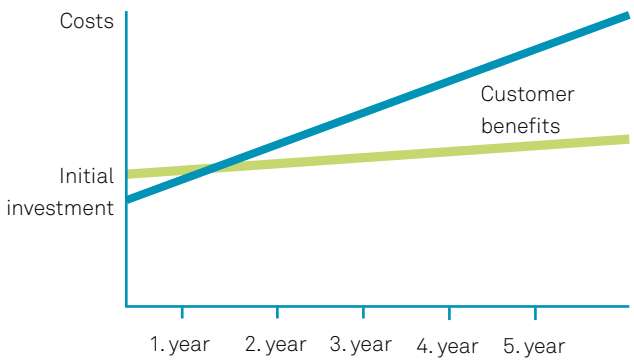
# MAKE THE RIGHT CHOICE INCREASE THROUGHPUT

The bases of economic success are products which are produced cost effectively and in optimized processes.

The manufacturing costs of products are influenced by the production costs as well as by the reworking and rejection costs. With that, the costs for quality assurance are a decisive factor for the selection of the correct coordinate measuring machine.

## The economic laws of measuring technology

The decision as to whether a part is rejected or not is highly reliant on the measurement uncertainty of the process.
What is required is a coordinate measuring machine with a measurement uncertainty as small as possible.
How big should a measurement uncertainty actually be? In order to answer this question, the tolerance that has to be checked must be taken into consideration. With this in mind, a Directive of the Association of the German Automotive industry says: »The capability of the measuring device is determined by the ratio of its measurement uncertainty to the tolerance.« This expert panel requires that the uncertainty of the testing process should only be one-tenth to one-fifth of the feature tolerance.
Selecting a measurement uncertainty that is as small as possible gives the production a greater scope for the exploitation of the permissible component tolerances.




Conventional CMM

Leitz High Accuracy CMM
- Reliable testing decisions for production
- High measurement throughput
- Machine structures stable over the long term
- High availability

The ratio of the standard deviation to the tolerance (s/T) is critical. Measuring device capability:

$$Cp = \frac{0.2 * T}{4 * s} \geq 1.33 \quad \text{gives} \quad s \quad \frac{0.2 * 10\ \mu m}{4 * 1.33}$$

s = 0.38 µm
T = smallest tolerance to be measured, e.g. 10 µm
Cp = Measuring device capability index for testing devices, e.g. Cp ≥ 1.33

Leitz brand high-precision coordinate measuring machines from Hexagon Metrology ensure small, reproducible measurement results in the measuring room and in production, enabling you to make the right decisions in the production and testing processes.

## Throughput and return on investment

Apart from the measurement accuracy, short measurement cycle times and high throughput are a necessity to satisfy the requirements of production.
Important specifications for a CMM to guarantee maximum possible throughput and low testing costs are:
- High probing frequencies
- Fast axis accelerations
- Fast movement speeds
- Variable High-Speed-Scanning (VHSS)

# LEITZ PMM-F
# LEITZ PMM-G
# MIGHTY ACCURATE

When a user chooses a Leitz PMM-F or Leitz PMM-G, they make a choice for maximum accuracy. Both coordinate measuring machines offer decisive advantages for the measurement of large workpieces:

### Overhead design
A modern overhead design keeps the mass ratios of the CMM constant to a high degree during operation. Deformations during the movement as well as during probing and scanning are eliminated. The overhead design allows unmatched dynamics and therefore very high throughput.

### Solid granite guides
The massive guide side columns and cross beams are made of approx. 40-million-year-old natural granite. Aluminum has been avoided in all the structures that determine the accuracy. That ensures insensitivity to temperature changes and a high degree of stability. The guideways in X and Y rest on 2 point support to ensure the straightness for many years.

### Air bearings in all axes
Air bearings in all axes – specially developed precision bearings with failsafe running properties and electronic air gap monitoring. The supporting as well as the guiding air bearings feature the largest possible bearing base, which results in an accurate and wear-free movement.

### Ceramic Z-ram
The ceramic Z-spindle with oversize cross-section is extremely resistant to torsion and has an automatic weight counterbalance. The machine accuracy is reached without any limitation even when the Z-ram has been fully extended.

### Vibration isolation
Isolation against ground vibrations is ensured through the integrated active pneumatic damping system.

The machine level is regulated independently of the workpiece load with a level control system. In this manner, the functions are guaranteed even under difficult ambient conditions.

### Dual drives and dual scales
Measurement errors due to expansion, perpendicularity deviations and contouring errors are avoided. The crossbeam is driven on both sides by precise ball screws. They are connected to the crossbeam by means of a patented coupling mechanism in such a way that no undesired lateral forces are transmitted. Economical usage in the production process over many years is ensured.

Servo-drives with ball screws allow high accelerations without compromises in the positioning accuracy. Very high speeds are reached even on very short paths.

The precision scales of the Leitz PMM-G are made of steel. Therefore, the expansion coefficients of the machine and the workpiece are the same. The measurement deviations in case of temperature changes are reduced. The electronic interpolation of the scales results in a resolution of only 20 nanometers.

### Collision protection and operator safety
The Leitz PMM-F and PMM-G have the most comprehensive safety and anti-collision system among all coordinate measuring machines. The probe head, styli and the Z-ram are protected by sensors, which stop the machine in case of a collision. Expensive repairs will not be required, the »Cost of Ownership« is minimized.

For operator safety, electronical and mechanical safety functions set a new standard.

An electronic controller designed to meet todays requirements carries out the complex movement sequences and measurement data collections. If customer service is required, the »Remote Diagnostic« function facilitates fast assessments and hence keeps the downtimes short.


LEITZ

# LEITZ PMM-G
# MAXIMUM ACCURACY IN SIZE XXL

The Leitz PMM-G was designed for maximum accuracy and maximum throughput in the process control of large workpieces.

### Overhead design

The characteristic feature of the Leitz PMM-G is the bridge construction in "Overhead-Design". That allows minimized moving masses and driving forces as close to the center of gravity as possible. The massive U-shaped machine base made of reinforced concrete ensures optimum functioning under tough ambient conditions. The whole machine rests on an active pneumatic damping system. That's the basis for maximum accuracy in the whole measuring range, short measuring times, maximum reproducibility and high throughput.

### Ceramic Z-ram

The Leitz PMM-G can be equipped with Z-rams from 1200mm up to 3000mm. Hexagon Metrology offers the ideal measuring system for a variety of different applications, e.g. large engines or big gear boxes.

With a short Z-axis, the Leitz PMM-G is the perfect gear measuring centre and delivers extremely accurate measurement results. It is capable of measuring any kind of gear, gear segments and gear racks up to a maximum diameter of 4450mm. There is no rotary table required.

### Easy workpiece loading

The automatic leveling system of the foundation enables rail carriages or hovercrafts to be used for easy loading and unloading of the machine.

The Leitz PMM-G is available in measuring ranges from 3000 x 2000 x 1200mm up to 8000 x 4500 x 3000mm.

# LEITZ PMM-F
# FAST MEASUREMENT IN LARGE DIMENSIONS

The Leitz PMM-F offers outstanding performance for the inspection of medium sized and large workpieces and gears.

It is used for quality assurance in a wide variety of different industries. Whether it's in machine tools, the optical industry, gear production, the automotive industry or aerospace and aeronautics, the Leitz PMM-F is predestined for the reliable measurement of precision parts. Both in the measuring room and in the production environment.

### A superior overall concept

The mechanical all granite design of the Leitz PMM-F features a modern overhead design. It ensures a very stable and robust structure. An active pneumatic vibration damping system makes the Leitz PMM-F insensitive to vibrations and oscillations.

The modern overhead design allows for extremely high acceleration up to 3000 mm/s² and thus superior throughput. The X-axis is equipped with dual drive and dual length measurement systems. This enables travel speeds up to 600 mm/s.

Very high throughput means lower inspection costs. That's why the Leitz PMM-F is clearly more economical than conventional measuring machines.

### Expanded temperature range

The modern and flexible manufacturing of mechanical parts requires accurate information on the stability of the machining process, and it needs it quickly. The Leitz PMM-F meets this challenge, both in the measuring room and in the production environment with a permitted temperature range of 18-24°C.

### No foundation required

The Leitz PMM-F features an integrated active pneumatic damping system and therefore does not require a special foundation. It can be placed anywhere in the factory. The Leitz PMM-F is easy to install and can be moved to other locations if neccessary.

The Leitz PMM-F from Hexagon Metrology is available with measuring ranges of 3000 x 2000 x 1000 mm and 3000 x 2000 x 1600 mm.

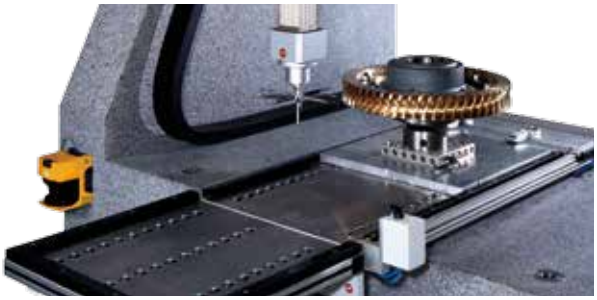
# GEAR TESTING

The Leitz PMM-F and PMM-G machines are also available with short Z-axes for the use as dedicated gear testing machines.

Together with QUINDOS, all types of gears (cylinder gears, spiral bevel gears, clutch gears, gear racks, curvic couplings and many more) can be measured.

Even all types of cutting tools, such as hobs, form cutters, shaper cutters, shaving gears and broaches, can be measured precisely, reliable and economically. Pallet measurement of gears is also possible as there is no rotary table required for the inspection of gears or gear cutters. Time consuming alignments of heavy gears are no longer required, resulting in an unmatched measuring throughput.

Another advantage in comparison to conventional gear testers is the possible gear diameter range. Here, the Leitz PMM-F is capable of measuring gear diameters from 10 to 1,950 mm. With the Leitz PMM-G, gears with diameters from 10 to 4,450 mm can be measured.



# HIGH-PERFORMANCE SENSORS

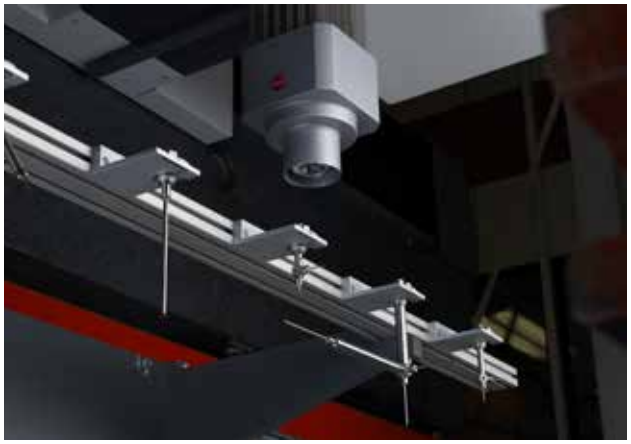
Fast and accurate measurements with long styli and heavy styli configurations – that's why the Leitz LSP-S2 probe head was developed. It is used in all Leitz PMM-G and PMM-F coordinate measuring machines.

The Leitz LSP-S2 features a maintenance free measuring touch system which recognizes the normal direction of the surface, independent of its moving direction.

The axes of the probe head are not clamped during the measurement; this means that the deflection of the measurement system always takes place perpendicular to the workpiece surface. The actual direction of the normal to the surface is determined in every probing point. Bending of the styli are always compensated correctly.

The probe movements in the X, Y and Z directions are carried out with frictionless, hysteresis-free spring parallelograms with high torsional stiffness. The deviation of each parallelogram is measured independently of the others using differential transformers. Naturally, the probe head is equipped with collision protection.

With its outstanding PFTU-value* the Leitz LSP-S2 probe head system also allows form and roundness measurements, even with very small tolerances.



The Leitz LSP-S2 combines outstanding accuracy with an unmatched workload. Styli extensions up to 800mm length and up to 1000g weight can be used for the inspection of large components.

With the integrated automatic stylus changer for more throughput, different styli configurations can be changed quickly and without re-calibration.

The Leitz LSP-S2 is an almost maintenance-free measurement head, since no maintenance-intensive, self-moving parts or active force generators are present.There is an optional temperature sensor to automatically acquire workpiece temperatures during the measurement process. This results in more flexibility and a significant time saving.

* PFTU = Single stylus form error acc. ISO 10360-5

# LEITZ PATHFINDER
# A NEW LEVEL OF SCANNING PERFORMANCE

Scanning with high speeds places the most stringent demands on the rigidity of the machines, the electronic controller as well as the application software. With its innovative design, the Leitz machines are among the fastest and most accurate machines on the market.

### Unknown contours – Free-form surfaces

Whenever unknown surfaces have to be scanned with high precision it is done in the “closed-loop” scanning mode. This applies equally to »Reverse Engineering«.

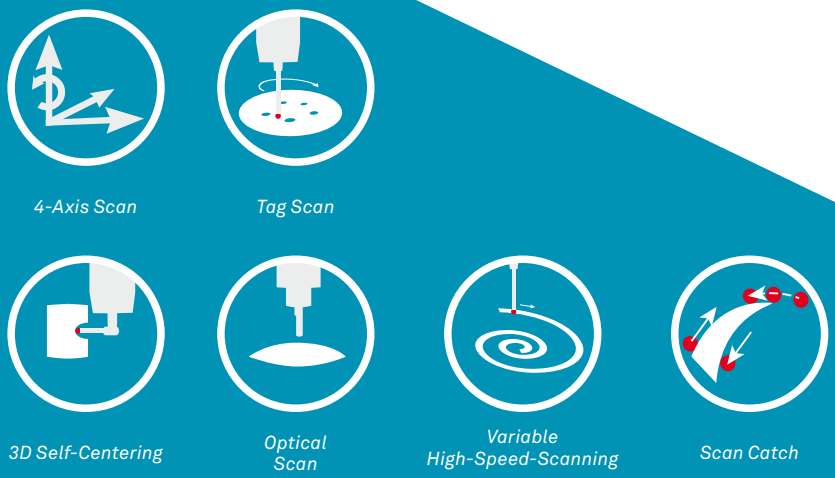
### VHSS – Variable High-Speed Scanning

When scanning workpieces with complex geometries, such as screw compressors, the scanning speed is adjusted to the curve radius automatically. The controller calculates the actual curve radius in real time and optimizes the scanning speed continously. A manual adjustment of the scanning parameter is no longer required.

Straight lines are run with maximum speed but the scanning speed is lowered for smaller curve radii. Automatic adaptation of the measuring speed saves time, while at the same time improving measurement accuracy. The result is maximum throughput combined with optimum measurement accuracy.

### Leitz 3D self-centering

The measurement of a non-linear groove is very complex. With Leitz 3D self-centering, the measuring machine finds the lowest point of the groove on its own and follows it automatically. With Quindos the control cams of camera lenses can be efficiently and reliably scanned in this way. If the Leitz CMM is equiped with an rotary table, even 4-axis scanning is available.



# CUSTOM-TAILORED SOFTWARE

The measuring system is rounded off by an intelligent, powerful software. There is a choice between two solutions: PC-DMIS or QUINDOS. User-friendly and CAD-based, both guarantee efficient programming as well as a highly efficient evaluation of the measurement data.

## PC-DMIS

PC-DMIS is the software for CAD-based, computer-simulated program generation. The software offers: easy program generation, use of CAD-data, graphics-oriented, user-friendly interface and powerful tools for depiction of the result.

With PC-DMIS CAD++, apart from the measurement of regular geometries, acquisition of free-formed surfaces is also possible. With it, three-dimensional surfaces can be measured very fast using the scanning function.

## QUINDOS

QUINDOS is the software for almost all industrial applications – from simple parts to complex geometries. With more than 50 options, this software provides solutions for nearly every problem.

Another focal point is the measurement of gears of all types, as well as gear cutting tools. With Quindos Software Leitz measuring machines can be used as dedicated gear inspection centers.

QUINDOS 7 has a built-in CAD-Core. Thus, all geometries can be displayed in the 3D view: special set points, the touched points, calculated elements and CMMs. For a direct data transfer several interfaces for all common CAD systems are available.

QUINDOS

PC-DMIS

# SYSTEM INTEGRATION

Apart from the procurement costs for a CMM, the associated system integration is a one-off investment decision to ensure a comprehensive economical value in a long term. The reliability of any measurement is only as good as the technology and system integration concept behind it.

The essential features of systems engineering are:

Measurement rooms - innovative climate controlled rooms provide the foundation for ultra-accurate measurement results, possible only on the basis of constant temperature.

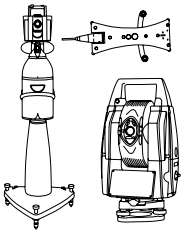
Measurement programs - writing of part measurement programs, the training of staff and start-up support for up to several month ensures trouble-free operations from day one.

Fixtures - professional clamping of the workpieces as the basis of reproducibility of the measurement results.

Loading systems - automatic and semi automatic feeding of workpieces to keep idle times as short as possible. Our engineers can provide a seamless integration of the Leitz CMM into your part transportation system.

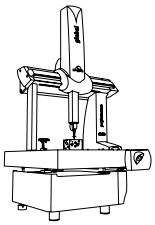
Network integration - connection to databases and CAD systems enables complete integration of the measuring system into the production environment.

Machine base - Hexagon Metrology can provide the complete machine base, which will be tailored to your needs and requirements.

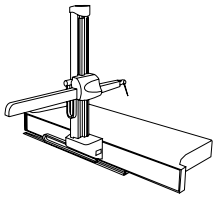


LASER TRACKERS
& STATIONS

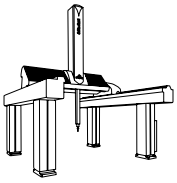
PORTABLE MEASURING ARMS



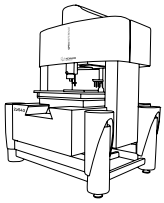
BRIDGE CMMS



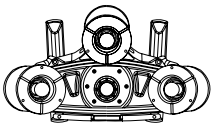
HORIZONTAL ARM CMMS



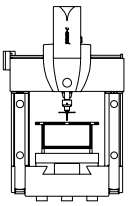
GANTRY CMMS



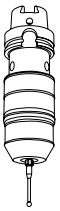
MULTISENSOR & OPTICAL SYSTEMS



WHITE LIGHT SCANNERS

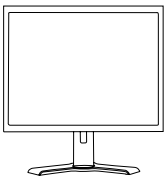


ULTRA HIGH ACCURACY CMMS



SENSORS

PRECISION MEASURING
INSTRUMENTS



SOFTWARE SOLUTIONS

HEXAGON
METROLOGY

Hexagon Metrology offers a comprehensive range of products and services for all industrial metrology applications in sectors such as automotive, aerospace, energy and medical. We support our customers with actionable measurement information along the complete life cycle of a product – from development and design to production, assembly and final inspection.

With more than 20 production facilities and 70 Precision Centers for service and demonstrations, and a network of over 100 distribution partners on five continents, we empower our customers to fully control their manufacturing processes, enhancing the quality of products and increasing efficiency in manufacturing plants around the world.

For more information, visit **www.hexagonmetrology.com**

Hexagon Metrology is part of Hexagon (Nordic exchange: HEXA B). Hexagon is a leading global provider of design, measurement and visualisation technologies that enable customers to design, measure and position objects, and process and present data.

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