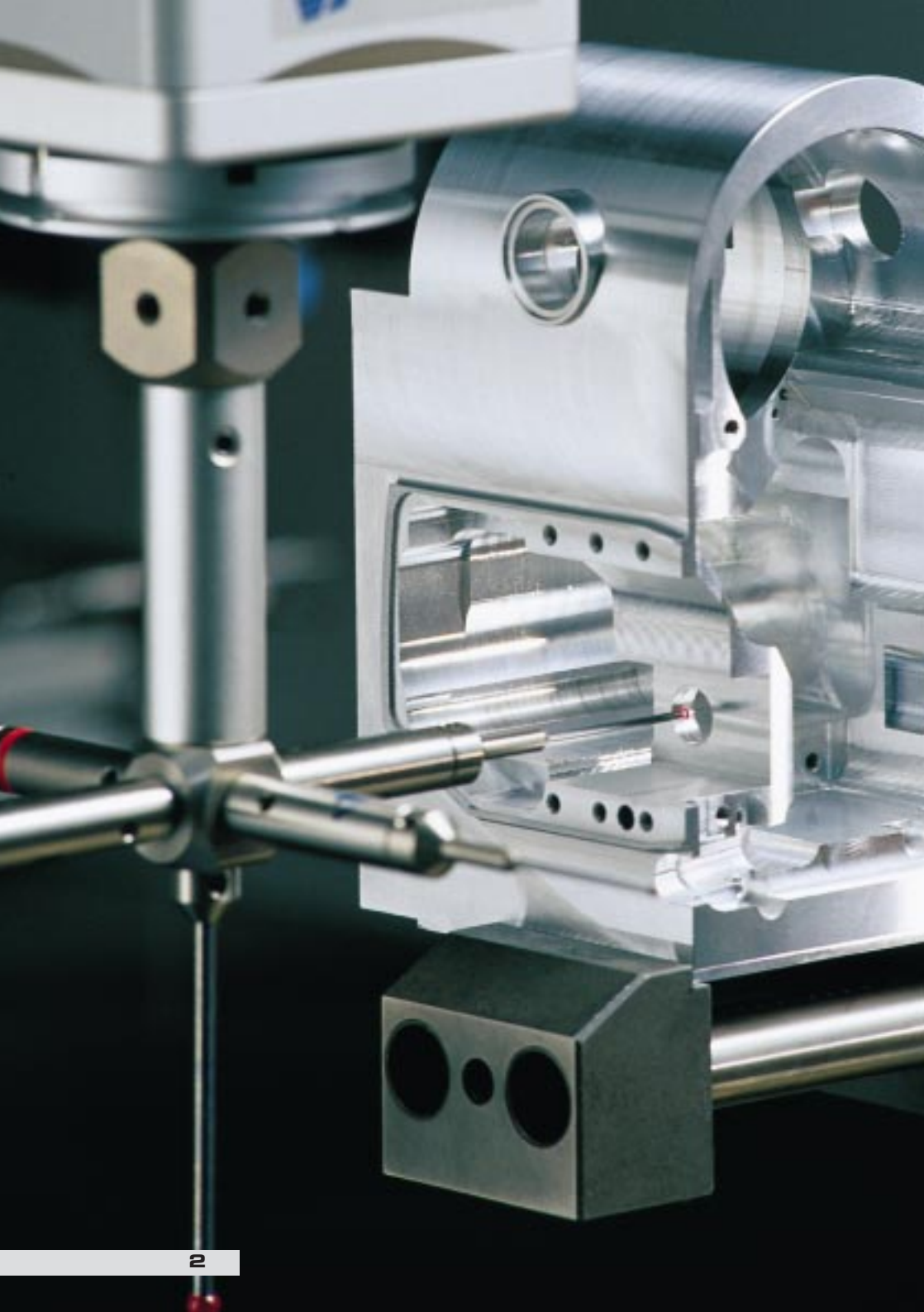
Why Choose Industrial Metrology from Carl Zeiss? 10 Answers to a Very Good Question.

ZEISS

SIMPLY MEASURE



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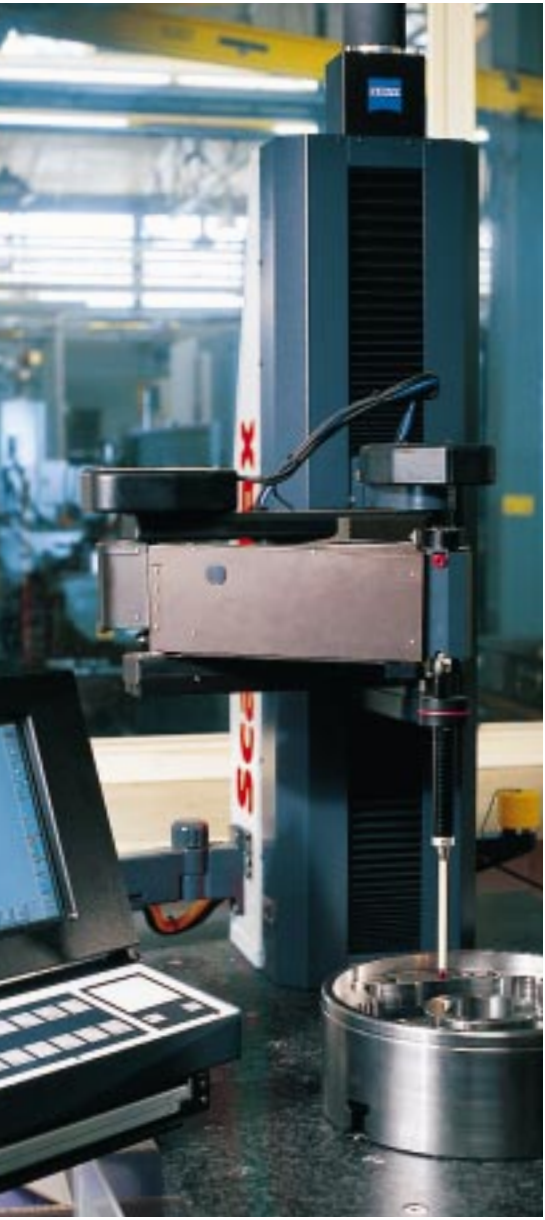
Just compare us to others



Carl Zeiss Industrial Measuring Technology – a name you have known for a long time. But, how well do you know our products, innovations and services? The requirements on quality management have changed drastically over the past years. Shorter set-up times, optimum process reliability, cutting-edge quality and maximum speed – this is what the industry demands.

We want you to compare

The strong and weak points of a product can seldom be recognized instantly. Often, it takes an exact comparison to identify them. To assist you with this process, we have taken a very close look at industrial metrology, from sensor systems and design characteristics to installation conditions.

Excellent design quality is the best foundation for precision

The functionality of a measuring machine and the technical precision which can actually be achieved, largely depend on two factors: the design quality and the type of application as well as the use of state-of-the-art materials. Unlike other manufacturers, Carl Zeiss can access the know-how of its other business groups for the latest in materials and synergies. Because the development and use of state-of-the-art materials is a core competence of the technology-driven group.

Zeiss technology in all components

All parts which are vital for the accuracy of a machine, come from our own production. The probes, the air bearings and the control electronics include high-tech products from Zeiss.

The materials used must measure up every time

Some manufacturers use a specific material such as granite, for example, for all purposes. This is their attempt to ensure stability and also a uniform reaction of the individual components to ambient conditions. Where the material is no longer able to cope with metrological requirements, subsequent mathematical correction methods are used to smooth the results according to basic physical principles. Another drawback is the extremely high weight of measuring machines, which calls for constructional measures such as foundations. As a result, considerable time and costs are involved if a machine needs to be relocated due to changed production conditions.

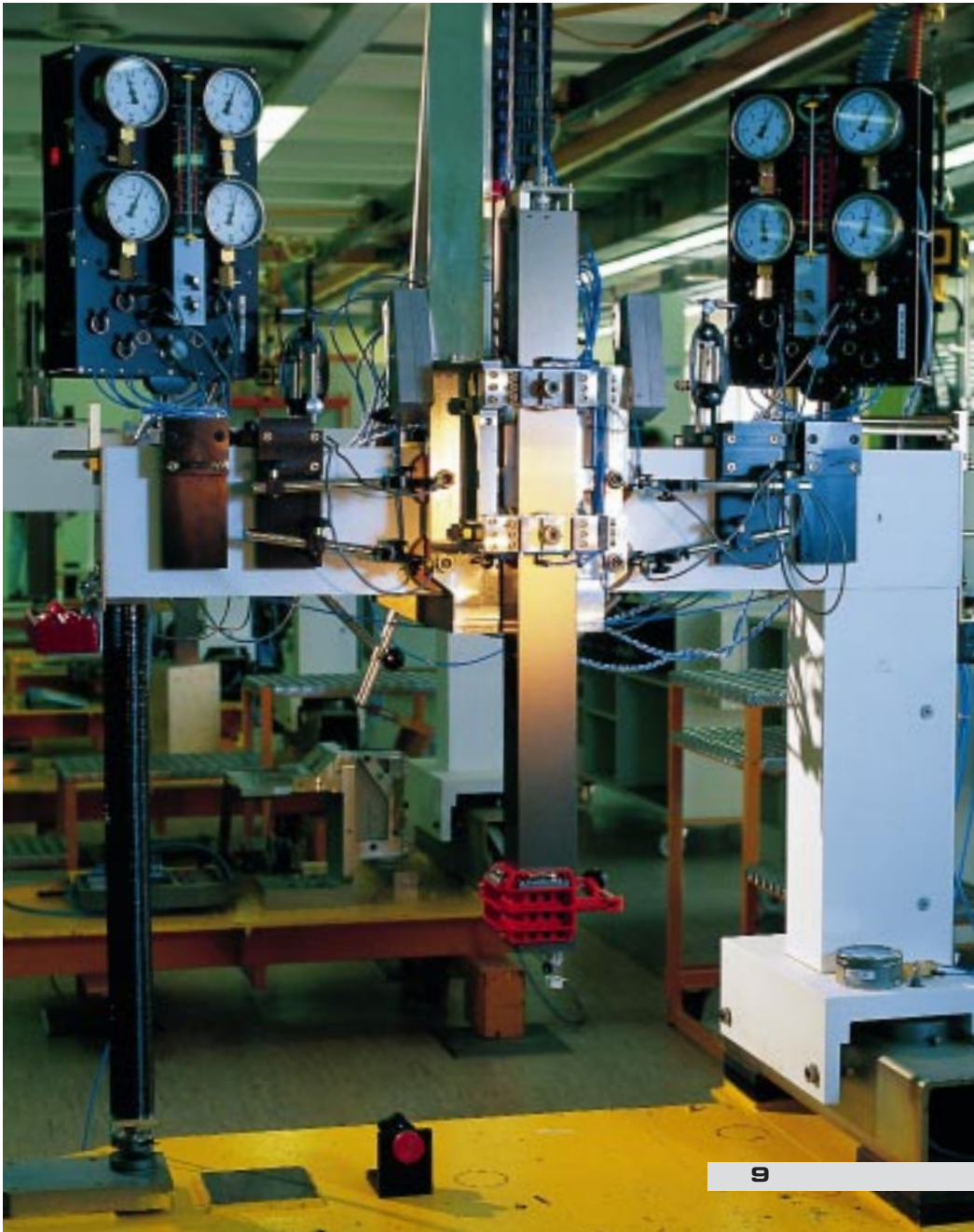
The importance of material for the bridge construction

The bridge is the machine component that is exposed to the most pressure. Its rigidity is vital for the machine's accuracy. With the raised Y-guideway, Carl Zeiss has developed a design that guarantees optimum torsional rigidity. The bridge construction remains extremely stable even with a Z-measuring height of up to 1000 mm. Tilting forces are non-existent, even with high accelerations. The dynamic rigidity ensures an extremely short settling process and reduces measuring times. Therefore, it is not just the travel speeds which need to be considered when calculating the measuring times. The materials used guarantee that the deformations found in conventional systems do not occur in the first place. Because only materials such as the carbon fiber material, specially made for these extremely high requirements, offer the dynamic rigidity that is required for precision measurements.

Take a closer look at design details

Unlike other manufacturers, Carl Zeiss supplies a completely enclosed granite table that insulates the machine against all thermal influences. Covers on all guideways protect the scales against dirt and damage. Take a look at the exteriors of coordinate measuring machines from different manufacturers and you'll soon see the differences.

Function-related combination of different materials: CFK, bridge guideways made of ceramic, the quill made of special aluminum alloys.

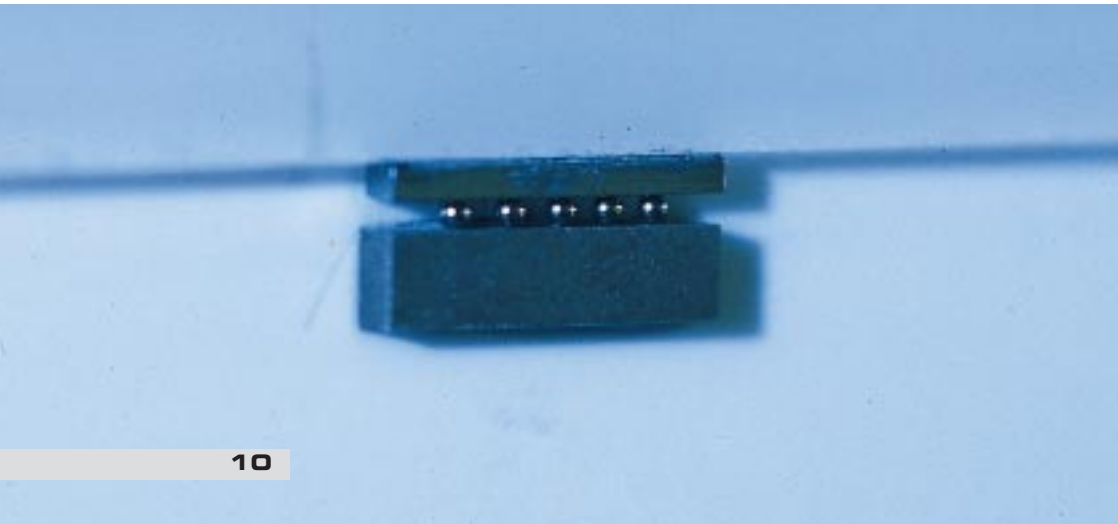


Scale Material

Some manufacturers use steel scales to ensure uniform, quantifiable expansion of the scales. In the respective quality, this material is corrosion-free, hard-wearing, stable and has a high load capacity. Its expansion, however, must be measured and corrected on an ongoing basis as a function of the temperature fluctuations. These scales are therefore equipped with numerous temperature sensors for the calculation of the scale expansion. This results in uncertainty factors: First, a measurement is performed which itself has an inherent uncertainty. Second, the measurement result is falsified if one sensor fails without being noticed. In addition, it is practically impossible to record partial temperature influences. If these inaccurate results are used as the basis for production, rejects are normally inevitable. Other manufacturers use compressed air for controlling the temperature to avoid scale distortion. These refrigerating type air dryers need to be additionally purchased and maintained. And this method is also error-prone with a frequently devastating result for the production process.

Carl Zeiss measuring machines are equipped with scales made of Zerodur. This material has virtually no expansion coefficient and therefore requires no mathematical or mechanical correction. As the cross beam of the bridge is likely to be deformed, we take the additional measure of floating the scales on an oil film on ball bearing supports.

Scale floating on an oil film on roller bearings



This design permits us to do without additional sensor measurement on the scales. On Carl Zeiss machines, it is only the temperature of the workpiece which needs to be measured.

Because of the lighter and very stable materials, the columns can be kept very narrow. The measuring volume is larger and the bridge is considerably lighter while at the same time providing more stability and accuracy.

Minicheck Chapter 2

Design quality Manufacturer				
Manufacturer	**Carl Zeiss**			
Scales **• expansion-free glass-ceramic material** **• steel** **• others**	●			
Machine design **• complete enclosure** **• ceramic guideways** **• rigid, stable bridge construction, optimized mass due to carbon fiber compound materials**	● ● ●			
Additional temperature sensor on scale required	no			
Overall rating				

The Zeiss Benefit:

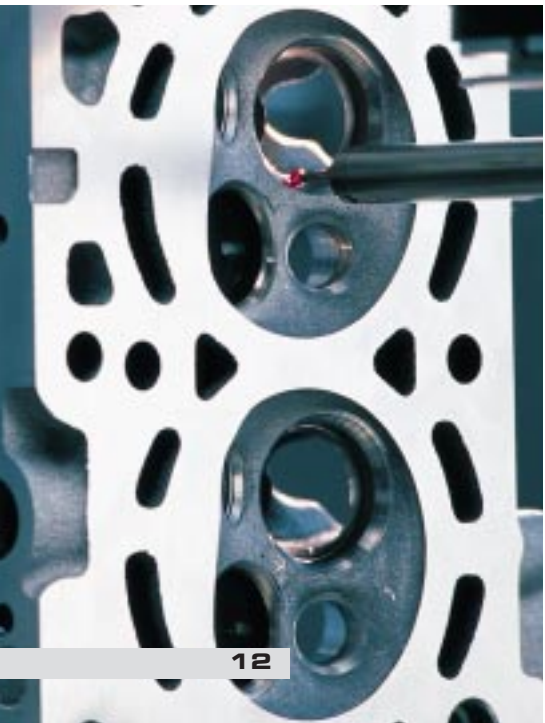
High thermal stability

Bearing Technology

The stationary machine table combined with Zeiss bearing technology guarantees the machine's rigidity from the constructional viewpoint alone. And it can also cope with the dynamic load changes caused by high measuring speeds.

Air bearings and their alignment

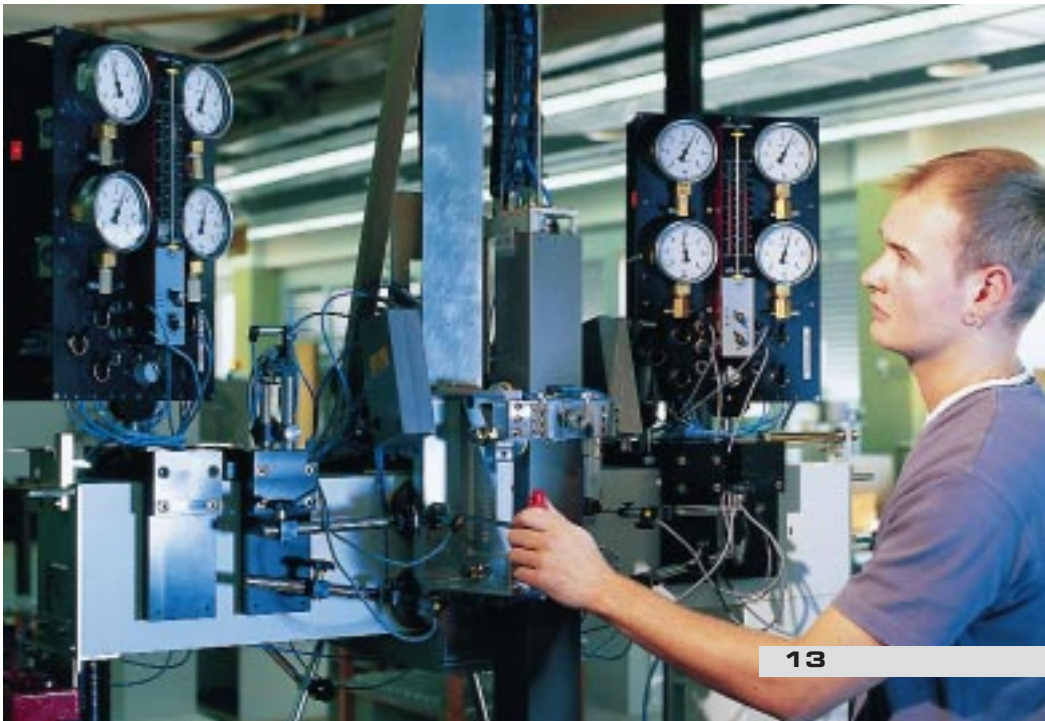
The bearing face, the surface quality and the control of compressed air are what it takes to make the bridge move with amazing smoothness and minimal air consumption. You can literally hear the smooth and clean running characteristics. If a machine whistles and hisses, the air gaps between the bearing and the running surface are not perfect. In this case the machine needs too much air. This air consumption has an impact on the operating costs over the entire life cycle and considerably impairs the machine's dynamic rigidity.



Alignment of the air bearings is one of the vital factors for the utmost precision in our measuring machines – This is the only way to solve complex tasks like the measurement of a complete engine, in the shortest possible time.

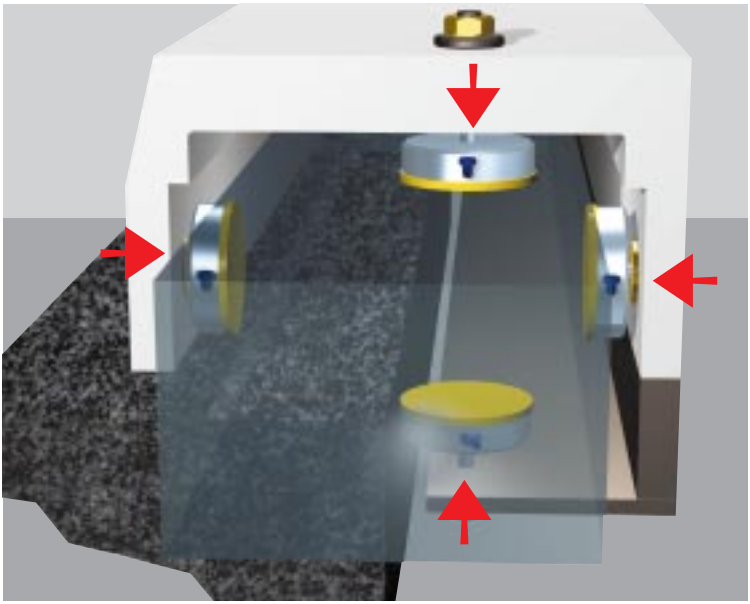
The dry, rich sound of smooth travel can only be obtained if the air bearings are precisely aligned, if the interaction between pressure and gap distance has been optimized. As commercially available air bearings fail to meet these requirements, Carl Zeiss manufactures its own air bearings. In addition to the audible precision, the air gap alignment plays a major role in the dynamic rigidity of the machine and, as a result, in the quality of measured data.

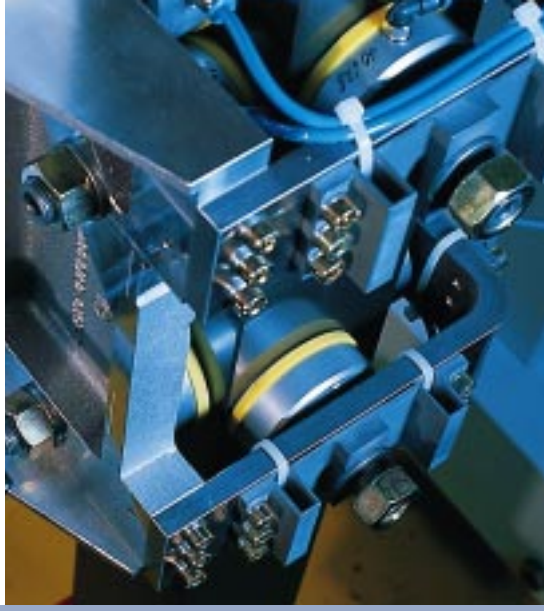
To fulfill our own demands on the setting and alignment of the air bearings, we have developed a special setting and acceptance fixture. Highly skilled experts use this fixture and measurement sensors and special tools to align the individual bearings, adjust them to each other and to perfectly coordinate the relationship between air and gap. The design and acceptance procedures are patented. Due to the high repeatability, the bearings are quick to adjust if they need servicing.



Bearing layout

Perfect harmony between the 21 air bearings integrated in a standard Carl Zeiss bridge-type CMM is another must for dynamic rigidity. The bridge moves on eight Zeiss air bearings featuring emergency running characteristics. The bearings are mounted around the guide beam. This guarantees constantly high precision even with extreme measuring speeds.





The quill top of a Carl Zeiss bridge-type CMM is equipped not only with the standard four air bearings, but with five. This means that a total of nine air bearings need to be harmonized on the quill alone.

Minicheck Chapter 3

Bearing technology				
Manufacturer	**Carl Zeiss**			
Number of air bearings	21 in basic version of Prismo VAST®			
Setting of air gaps	6 – 8 µm			
Audible travel noise	no			
Emergency running characteristics	yes			
Air consumption m^3/h				
Overall rating				

The Zeiss Benefit:

Reduction of maximum error to a minimum

Scanning isn't just scanning

Scanning is becoming the standard technology in metrology. Practically all manufacturers of industrial metrology offer this technology. But there are differences – both in the actual machine and the sensor systems.

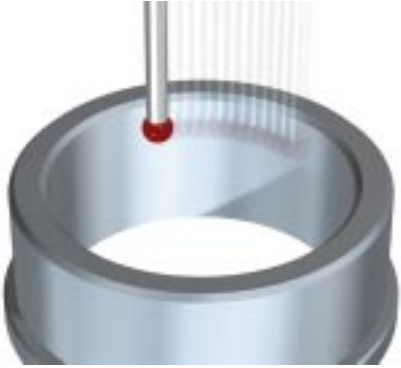
What exactly do we mean when we speak of scanning?

For Carl Zeiss, scanning operation refers to an active probe system. A dense sequence of adjacent points is captured in a single, uninterrupted measuring process by continuous meandering in lines. By contrast, touch trigger systems operate according to the „woodpecker" principle by which every point is recorded individually – a method where the acquisition and evaluation of one point takes two seconds.

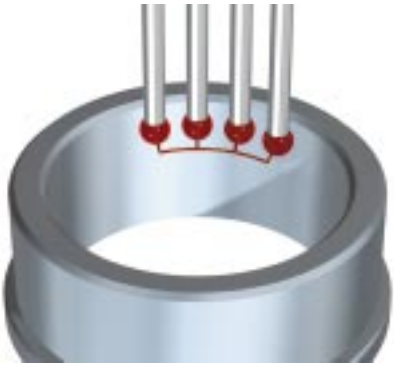
Powerful scanning procedures turn the form inspection of complex workpieces into a simple, fast and highly precise process. In the single point probing mode, the evaluation of such forms involves considerable programming work, unreliable results and excellent skills in the interpretation of results.

In the same time frame, the VAST® scanning system captures and evaluates 120 points, permitting the evaluation of size, form and location in one set-up.

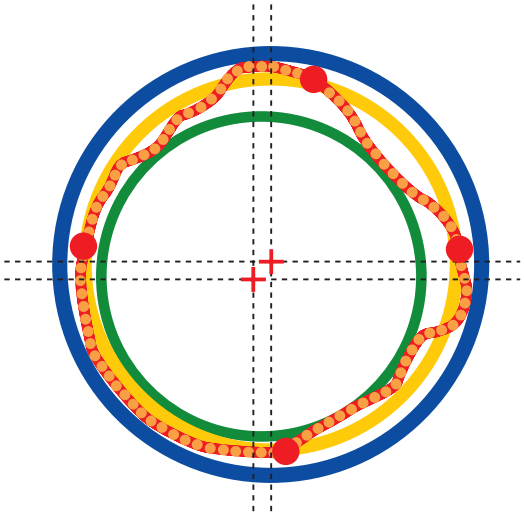
With conventional, passive scanning systems, the design-related, dynamic influences may lead to high scanning uncertainties and widely scattered measurement results. To optically smoothen the measured contour, powerful filters are used that make these fine structures disappear completely.



To Carl Zeiss, scanning is a probe system which determines the form of a workpiece with high speed and accuracy by continuous probing in lines.



The principle of single point probing: each point is acquired individually – a difficult job for the control system. The measuring times required for comparable point quantities are not acceptable from an economic viewpoint.



Minimum circumscribed circle determined from scanning data

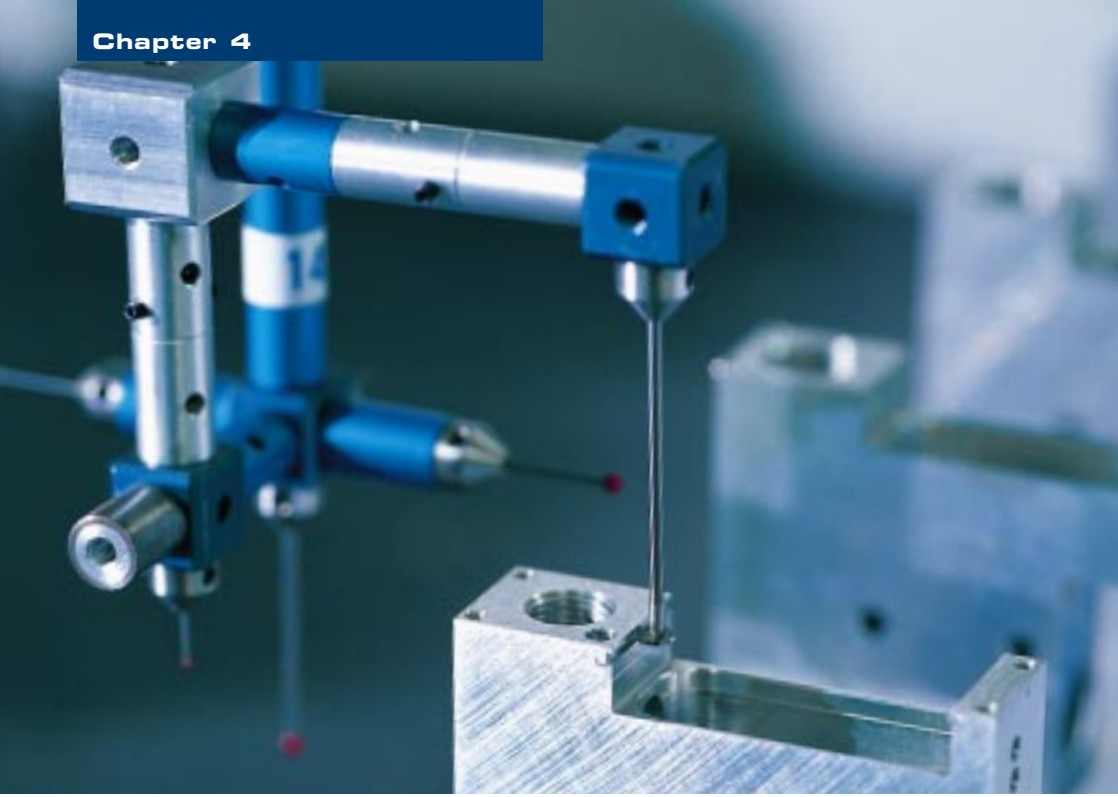
Best fit circle calculated from 4 single points

Maximum inscribed circle determined from scanning data

Form evaluation

Single points (4-point measurement)

Differing center point coordinates of minimum circumscribed/maximum inscribed circles



Active sensors compared to passive systems

With passive systems, the workpiece shape defines the measuring force. Active systems generate the measuring force electronically, and it therefore remains at a constant level.

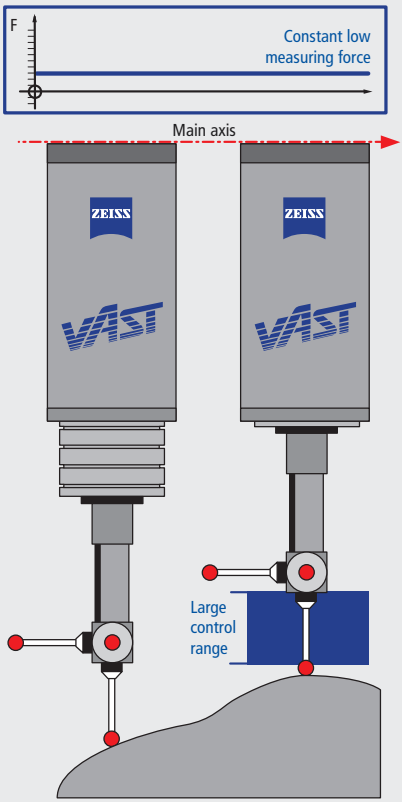
The sensors of passive systems are subjected to constantly changing measuring forces as the control range of the sensor system is very narrow. These dynamic influences lead to changes in probe bending, high scanning uncertainties and widely varying results. All systems operate with three spring parallelograms arranged perpendicularly to each other. The difference lies in the application of the measuring force. With passive systems, the deflected spring parallelogram generates the measuring force. However, as the deflection during the scanning process varies constantly, the measuring forces change too.

The active scanning systems from Carl Zeiss Industrial Measuring Technology measure their own probe deflection on an ongoing basis. In scanning, data is acquired with the probe deflected. As a result, data can be captured rapidly, with the utmost precision and in a dense sequence. The constantly low measuring force is generated, controlled and applied inductively by „electronic springs".
In every point the low measuring force is

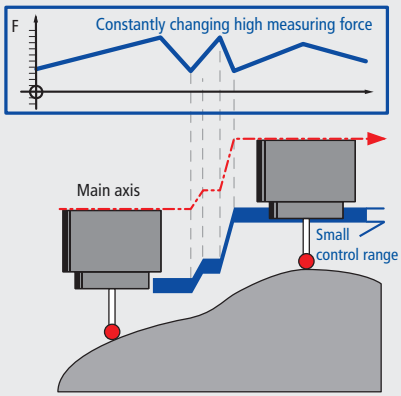
therefore always generated with the same magnitude perpendicular to the workpiece surface. Dynamic influences on the measuring result – inevitable in conventional systems – are completely eliminated with VAST®. The large scanning control range permits fast, contour-related, lag-free data acquisition. VAST® operates highly dynamically, absolutely smoothly and extremely precisely even with pronounced stylus deflection. From the specified accuracy, the VAST® system calculates the optimum speed, the number of measuring points and the perfect filtering.

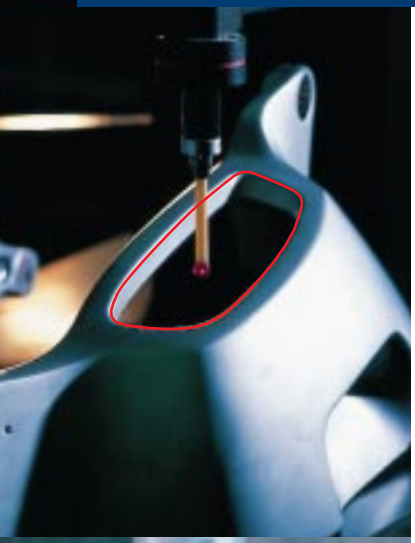
Right:
The active sensor system operates with a constant low measuring force generated perpendicularly to the workpiece surface in each point.
With passive systems, dynamic influences may cause high scanning uncertainty and widely scattered measurement results.

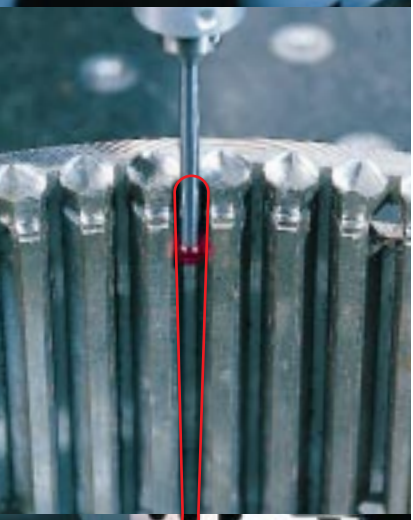
Active Prismo Sensor System

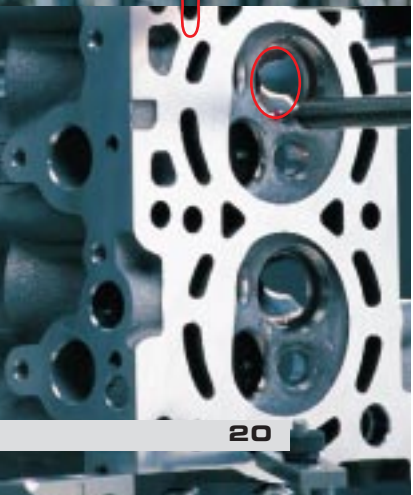


Passive Sensor System









Measurement and digitizing of free form surfaces belong to your standard applications

More and more workpieces are now no longer mathematically designed by engineers, but created as models giving due consideration to ergonomical, streamlining mechanical and esthetic aspects. When a design model is digitized, measuring points are used to calculate a surface model that becomes the basis for all further steps in the CAD/CAM process chain.

A vast difference

Today, practically all conventional systems are able to measure in the scanning mode, with one "vast" difference: a contour description in the form of nominal data must exist. Therefore, the actual scanning process must be preceded by digitizing with another instrument. The VAST® active scanning system from Carl Zeiss measures known and unknown contours, prismatic parts and free form surfaces.

Minicheck Chapter 4

Scanning Procedure				
Manufacturer	Carl Zeiss			
Active	●			
Evaluated measurement points per sec	min. 200			
Unknown contours	●			
Known contours	●			
Expert system	●			
Overall rating				

The Zeiss Benefit:

Size, form and location evaluated in one set-up

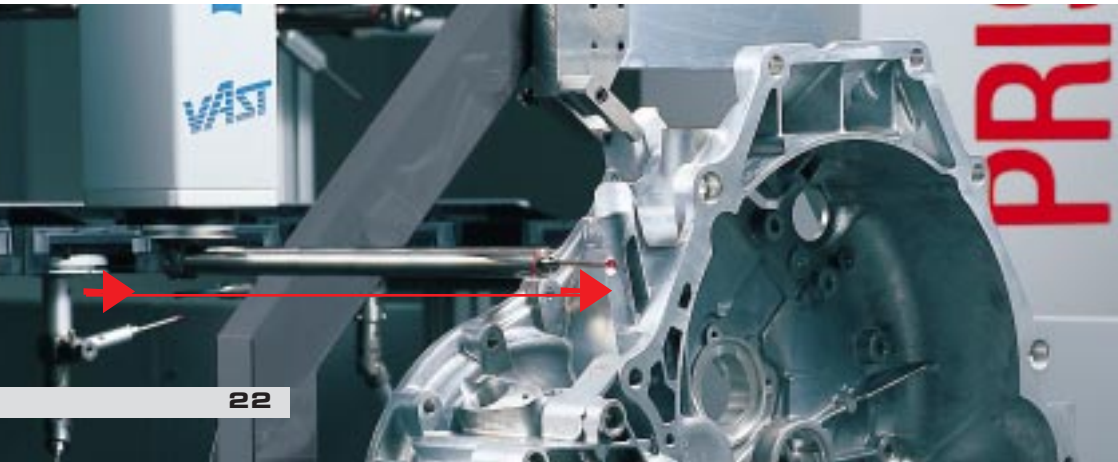
Flexible Application of Stylus Configurations

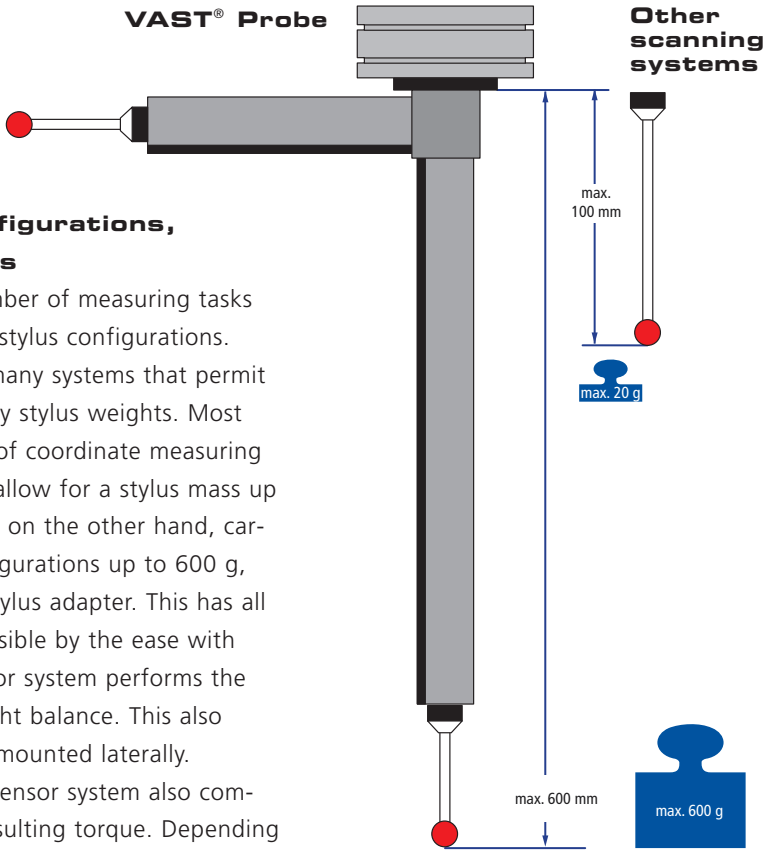
The cycle times in workpiece production are getting faster and faster. Quality assurance is performed in the manufacturing area. To minimize set-up and idle times in production, the process capability must be achieved and maintained as quickly as possible.

Stylus lengths

Complex and hard-to-access geometries are measured with styli of different lengths. Many systems can only handle lengths up to 100 mm. This means that the measuring points in deep bore holes can either not be reached at all or only after rechucking of the workpiece. The Carl Zeiss VAST® accepts stylus lengths of up to 400 mm, still offering 1 µm accuracy with 200 mm styli.

With conventional systems, these standard applications can only be solved with long probe routes and therefore additional measuring volume. The chucking range is hard to access. With its extremely long stylus extension, VAST® measures the entire crank case from only two positions.



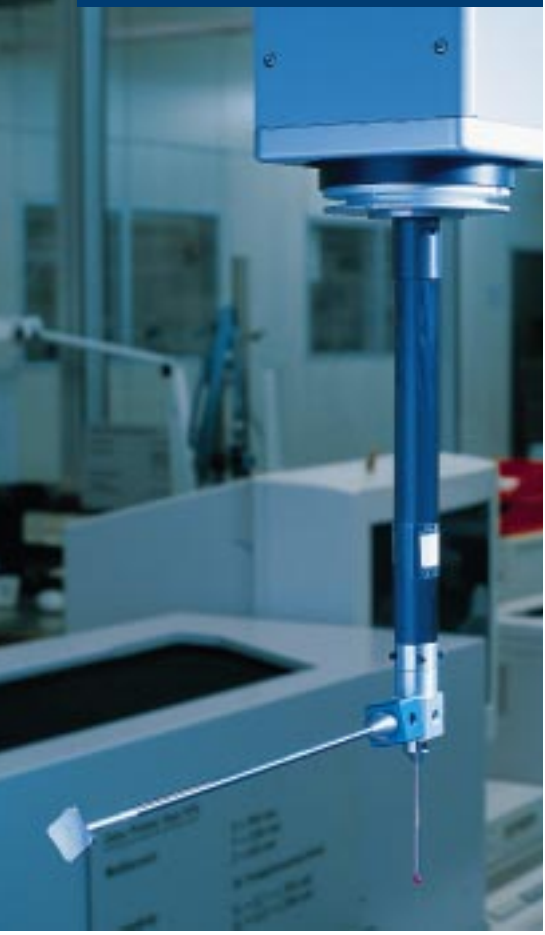


VAST® allows for the use of long extensions and heavy probe weights in any configuration.

Stylus configurations, stylus mass

A large number of measuring tasks call for various stylus configurations. There are not many systems that permit the use of heavy stylus weights. Most manufacturers of coordinate measuring machines only allow for a stylus mass up to 20 g. VAST®, on the other hand, carries stylus configurations up to 600 g, including the stylus adapter. This has all been made possible by the ease with which the sensor system performs the automatic weight balance. This also applies to styli mounted laterally.

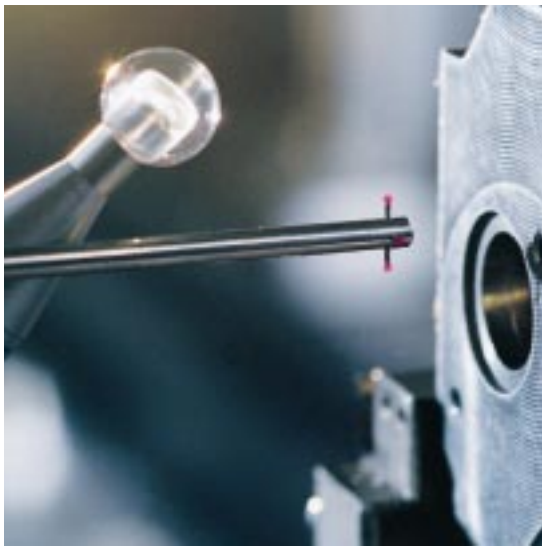
The VAST® sensor system also compensates for resulting torque. Depending on the workpiece geometry, VAST® can therefore hold complex stylus configurations for any measurement. The need for time consuming rechucking of the workpiece is eliminated, and stylus changes are reduced to a minimum.



Fixed stylus combinations guarantee repeatable accuracy.

Size of stylus tips

The geometric conditions of the workpiece define the stylus tip diameter to be used. Conventional systems are not able to carry out measurements with minute stylus tips. Because an essential requirement for trouble-free operation with smallest stylus tips on very thin shafts is a constant low measuring force. In addition to precise positioning this also requires a very powerful electronic control system. In the scanning mode, workpiece edges are often not recognized. With VAST®, even extremely small features such as the gear flank of an inside diameter can be scanned.



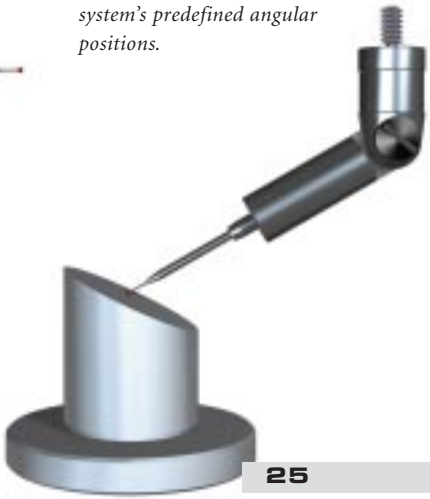
This customer application shows that minute stylus tip diameters (in this case 0.3 mm) are actually used.

Flexibility is a function of the selection and application of probe elements

Measurement points and paths are defined as a function of the workpiece geometry and probing strategy. To capture all measurement points, either the styli need to be changed or an articulating system must be used.

Articulating systems normally offer click-stop settings only. This setting range is too coarse – particularly in high precision measurement – and affects the measuring accuracy. Also, each position (of one and the same stylus) must be re-calibrated.

The optimum probing strategy is achieved if the stylus is always oriented at a right angle to the workpiece surface. In extreme situations, as shown here, the problem can best be solved by the use of dedicated stylus configurations.



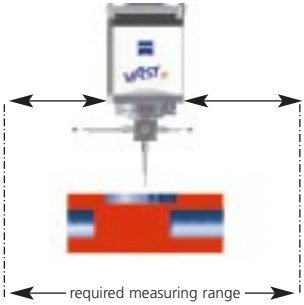
Articulating systems can also solve this problem, but the process is restricted by the system's predefined angular positions.

Stylus changing systems

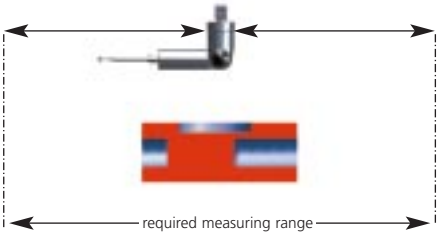
Unlike articulating systems, stylus changing systems not only provide a considerably extended measuring range, but also much higher precision with maximum flexibility, provided they can hold complex configurations. Compared to the changing systems of other manufacturers, the exceptionally wide basis of Carl Zeiss stylus changing systems guarantees the utmost stability. This also applies to maximum loads of 450 g, maximum repeatability in the range of tenths of a micron and a stylus length of 200 mm.

No recalibration is required. We are the only manufacturer to have developed special stylus extensions made of CFK which are highly rigid, thermally stable and light.

Zeiss VAST®



Articulating joint with scanning probe



Conventional articulating systems are not only restricted by the predefined angular positions, but also require a larger measuring range.

Flexible measurement of diversified parts without constant recalibration of the stylus combination.

Minicheck Chapter 5

Stylus configuration and changing systems				
Manufacturer	Carl Zeiss			
Stylus incl. extensions	up to 600 mm			
Thermal stability of CFK fiber				
Stylus lengths and precision	up to 200 mm 1 µm			
Stylus weight	up to 600 g incl. adapter plate			
Diameter of adapter plate	69 mm			
Smallest stylus tip diameter	0.5 mm			
Loss in measuring range in X Y Z	 0 0 0			
Changing repeatability	0.1 µm with 200 mm stylus length			
Overall rating				

The Zeiss Benefit:

High repeatability, no recalibration

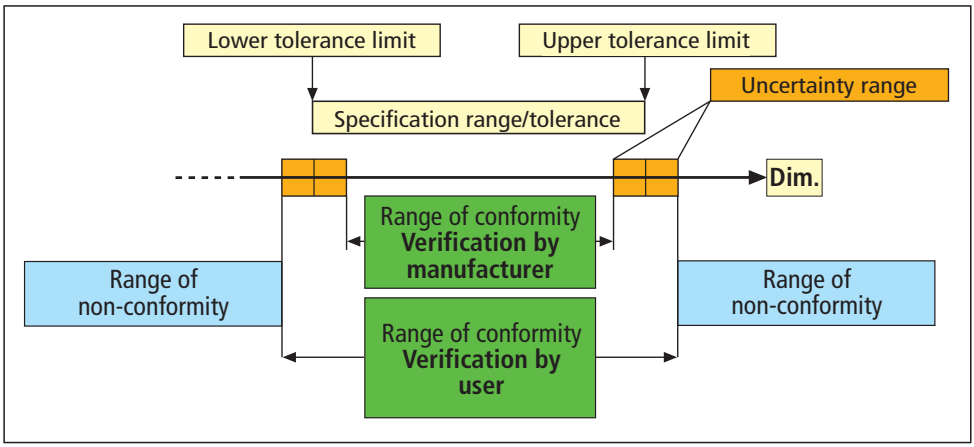
Interpreting the correct length measuring uncertainty

Normally, the accuracy according to ISO 10360 indicated in the technical specifications of different manufacturers hardly differs at all. However, this is not an indicator of the measuring uncertainty of a machine in specific measuring applications. Because the measuring uncertainty achieved on specific features is clearly defined by machine and workpiece related influences.

A simple test to check the feature related measuring uncertainty of a machine.

Place one of your own workpieces with spatially inclined features and interfering edge on the measuring machine. Measure the part in different places on the measuring plate: in front near the drive system, in the center, on the outer right, outer left, ... If the results of the measurement records differ, the accuracy specification as per ISO 10360 applies only to a certain area of the measuring plate, and not the entire measuring volume.

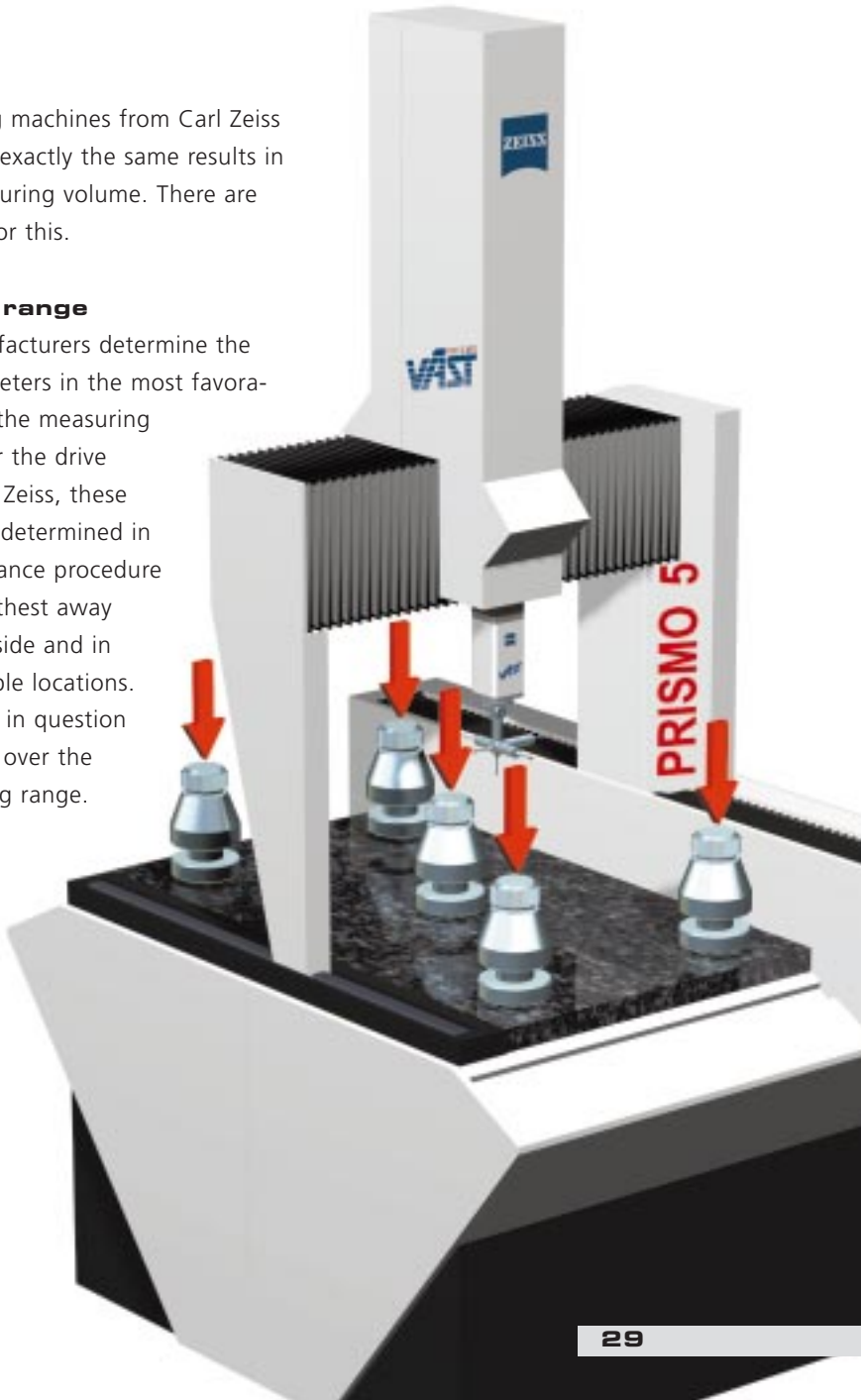
Effect of measuring uncertainty on the useable tolerance in production:



With measuring machines from Carl Zeiss you will obtain exactly the same results in the entire measuring volume. There are many reasons for this.

Measuring range

Many manufacturers determine the accuracy parameters in the most favorable location of the measuring range, i.e., near the drive system. At Carl Zeiss, these parameters are determined in a 100% acceptance procedure in the areas farthest away from the drive side and in other unfavorable locations. The parameters in question therefore apply over the entire measuring range.



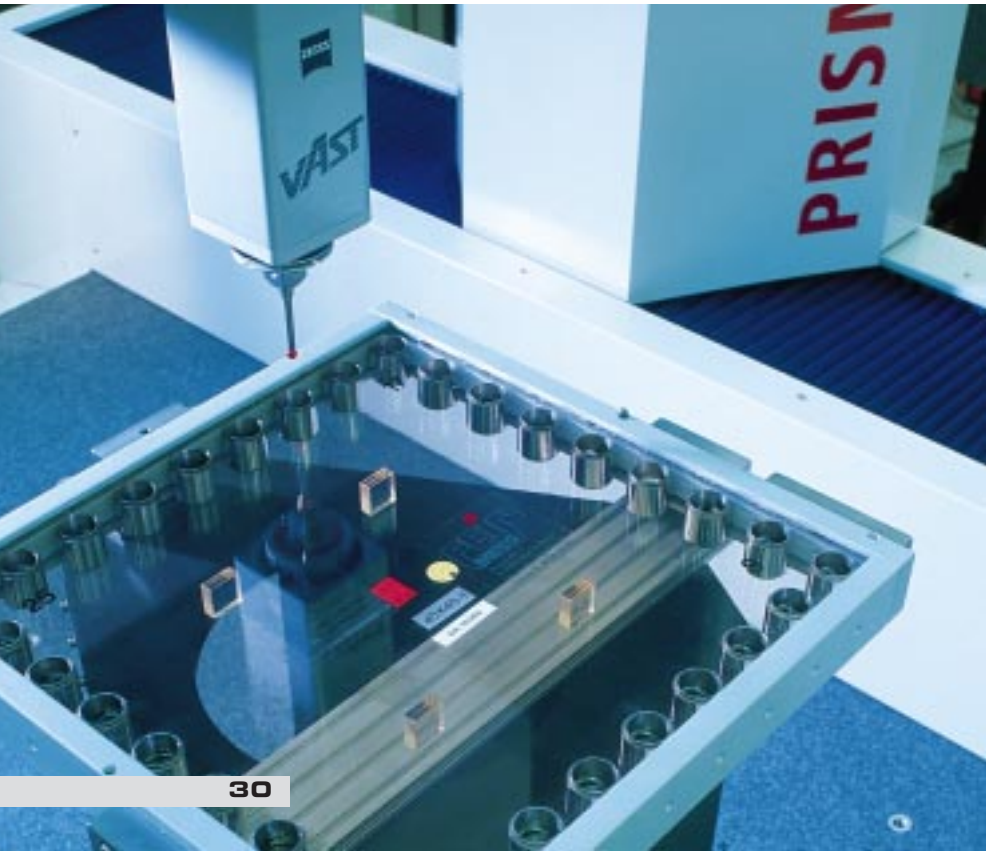
With this method you can check the actual measuring uncertainty of a coordinate measuring machine.

Speed

While others do the acceptance testing of their measuring machines at extremely slow travel settings, Carl Zeiss determines all parameters at maximum machine speed.

Artifacts

In addition to standard gages, Carl Zeiss also uses its own, self-developed artifacts for acceptance tests. Measurements are therefore performed on far-from-ideal geometries with several spatially sloped surfaces. Conventional procedures with standard components such as ring gages or the like do not measure up to the test stringency that guarantees the necessary safety reserves over the entire measuring range.



In climate regulated cabins, we simulate real conditions.

Temperature range

Many manufacturers specify their accuracy for no temperature range at all or only for a very limited one. We specify our machines over the entire temperature range indicated. We feel that mathematical compensation only taking into account the laws of physics is insufficient. Therefore Carl Zeiss is one of the few manufacturers to use air conditioned chambers in which the temperature differences are simulated under real conditions. In this way, it is possible to verify the efficiency of the coordinate measuring machine under the climatic conditions encountered on your shopfloor.

Influence of smoothed measurement results

Conventional systems which are normally made up of purchased components are frequently inadequately matched and therefore display high probing errors. The unfiltered result would vary too widely ①.

Although strong filtering does indeed smooth the contour, fine structures disappear. The marked variance of a less accurate measuring machine makes it impossible to exactly identify the production variance with the result that frequent, unnecessary and costly intervention in the production process is needed. The attempt to compensate for weak points in the design by mathematical operations is normally performed at the expense of precision ②.

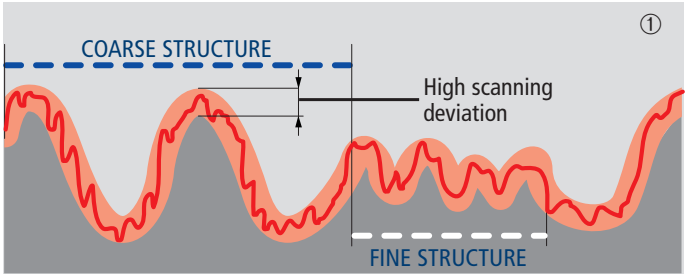
Carl Zeiss therefore develops all functionally relevant components in-house:

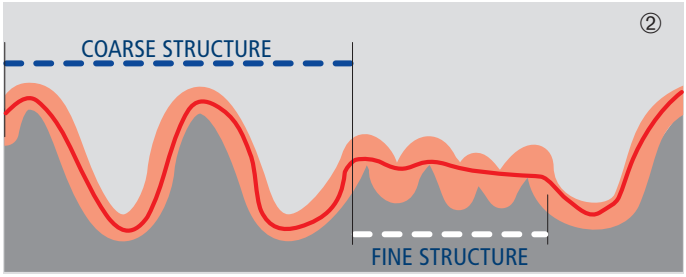
- sensor system
- the entire mechanical construction
- dimensional standards
- bearing technology
- control technology
- software, etc.

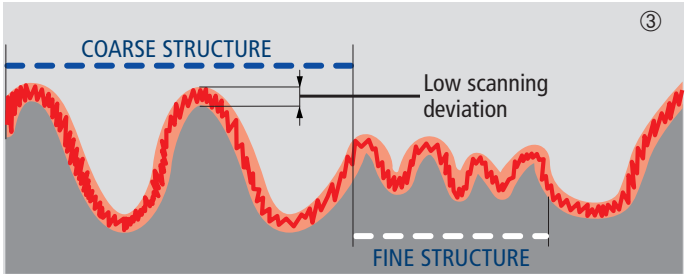
These are optimally matched to each other and therefore guarantee minimum scanning deviations.

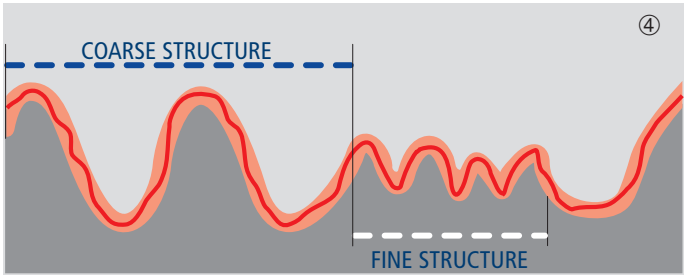
The unfiltered measurement result varies only to a minor extent ③.

Weak filtering smoothes the contour sufficiently well. Due to the high scanning speed, the contours of fine structures can be clearly recognized. Inherent errors of more precise measuring machines are negligibly small due to the consistently low measuring error. The actual production variance becomes evident ④.


①
COARSE STRUCTURE
High scanning deviation
FINE STRUCTURE

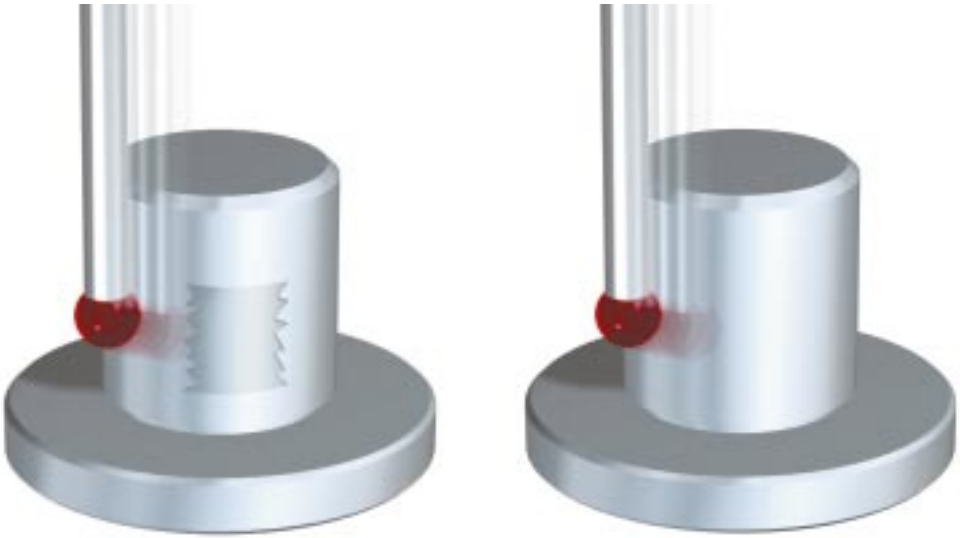

②
COARSE STRUCTURE
FINE STRUCTURE


③
COARSE STRUCTURE
Low scanning deviation
FINE STRUCTURE


④
COARSE STRUCTURE
FINE STRUCTURE

Test it yourself

Measure a form element in the scanning mode with minimum interference, for example a Flick-standard with adhesive tape strips, in spatially sloped alignment and at full speed. Compare the results before and after the interference. If no difference is apparent, the fine structure of the interference has been covered by overly strong filtering.



Test with interference

Minicheck Chapter 6

Measuring uncertainty				
Manufacturer	Carl Zeiss			
Actual length measuring error in complete range at 4 corner points guaranteed				
Measurement of interference area	is captured			
Temperature range calculated				
Temperature range simulated in enclosure	18 – 36 °C			
Length measuring uncertainty MPE_E				
Probing uncertainty MPE_P				
Overall rating				

The Zeiss Benefit:

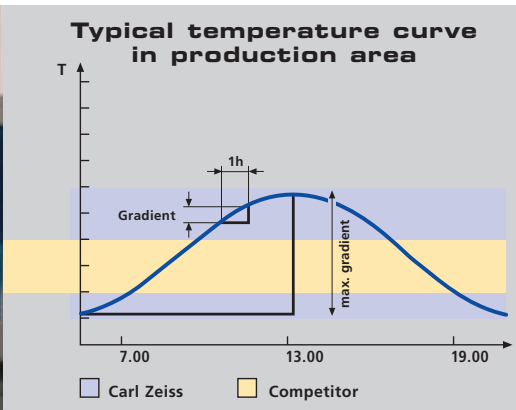
Realistic specification of measuring uncertainty because we indicate the temperature range to which it applies and guarantee it over the entire measuring range.

Measuring in the heart of production

Today, measuring devices are integrated in the entire production process as manufacturing facilities. This means that a measuring machine must meet more exacting demands to operate reliably and with long-term stability in a rough production environment. Also, it should be possible to intervene in the manufacturing process. And when production runs are changed, the measuring device must be sufficiently flexible to be adapted to the new application. The following is needed:

Thermal stability

Conventional systems must correct deformations caused by temperature fluctuations mathematically. A large number of sensors on the scales is intended to provide the required information. If one sensor fails unnoticed, the result will be falsified. This may result in measuring errors with a serious effect on the overall production process – an effect which is frequently noticed too late. Carl Zeiss has developed HTG technology to rule out this risk. It guarantees that the possibility of deformation caused by extreme ambient conditions is eliminated. The harmony between the materials and actual design allows Carl Zeiss to create this thermal stability by purely mechanical means and so to rule out metrological and mathematical risks. This applies to a

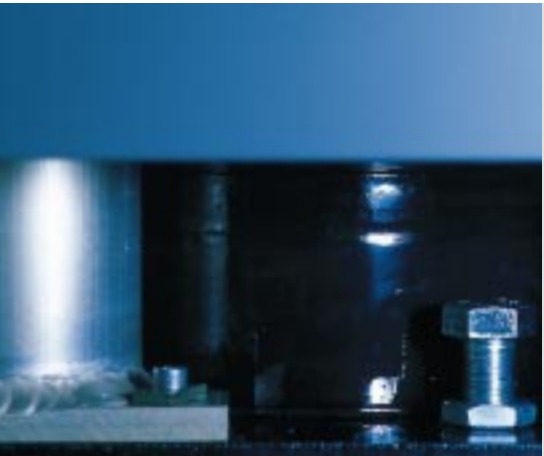


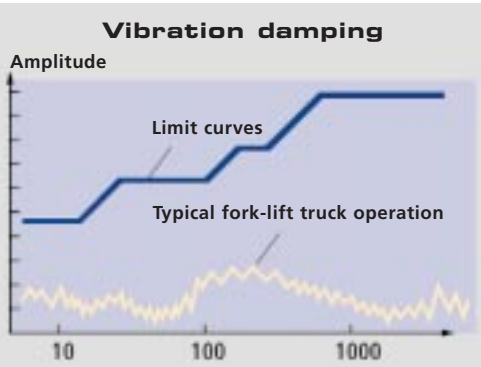
temperature range from 18 °C to 30 °C, to over 30 °C with the accept enclosure and to 35 °C with CenterMax.

Elimination of floor vibrations

Modern manufacturing facilities with linear drives generate floor vibrations and even massive shocks due to their extremely high travel speeds. Even very stable foundations transmit floor vibrations. An in-process precision measuring instrument must compensate for these vibrations. As it must be possible to relocate the machines within the production area, the anti-vibration system should be independent of the basic foundation. A frequently used technique is air damping. Analyses have shown that vibrations – particularly those caused by HSC processing, but also by such normal factors as fork-lift trucks in the direct vicinity – will still be transmitted.

Carl Zeiss therefore uses only highly-effective components as standard equipment. Special material combinations ensure optimum damping characteristics for constant precision – even at maximum machine speeds.



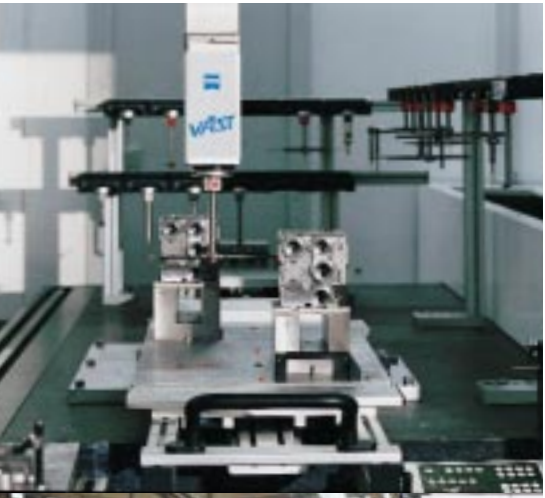


Oil and dust resistance

To guarantee both long-term protection even under extreme conditions and maximum machine flexibility at the same time, we at Carl Zeiss have developed a variety of strategies.

Because of the inherent stability of PRISMO accept's housing, the system can be transported without difficulty to another site of application and is ready for operation within a short time.


ZEISS
accept



Modular design of loading systems

Only individually designed loading systems permit complete production integration. Our team of experts in the System Solutions Department offers intelligent options which through their modular design provide maximum set-up flexibility and allowance for production schedules. Your benefit: the machine can be loaded in fixed positions without any unnecessary time loss.

Simple integration in the production process

It takes a precise interface description to ensure smooth integration of the machine's electronics and software systems into existing production processes. Our specialists in the software and electrical engineering departments will solve even the most complex interface problems.

Minicheck Chapter 7

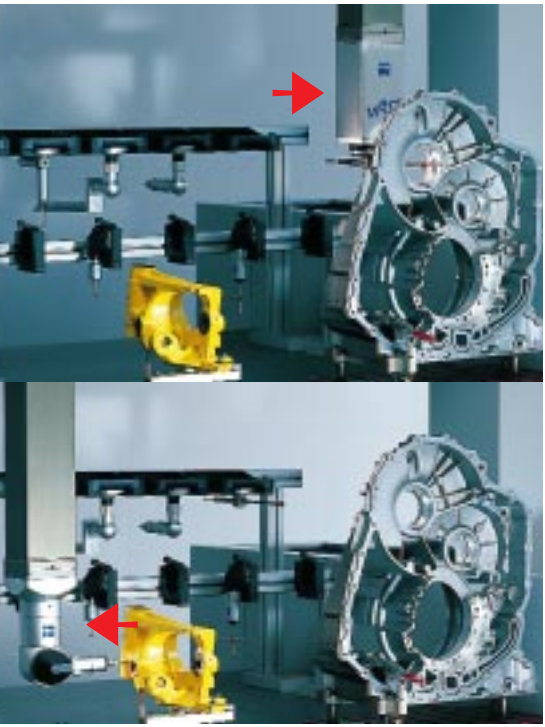
Production integration					
Manufacturer	Carl Zeiss				
Permissible temperatures • range • fluctuations K/h K/d K/m	18 – 30 °C e.g. CenterMax up to 35 °C				
Air damping					
Highly-efficient damping	yes				
Rapid relocation possible	yes				
Loading systems	yes				
Overall rating					

The Zeiss Benefit:

Know-how in production integration

Easy machine set-up

Set-up times are the basis of an efficient production process. Flexible measuring technology helps you to deal with the most diversified measuring tasks in the shortest possible time.



Sensor change performed by machine operator in just one minute

Fast and simple sensor change

Depending on the task, different sensor technologies offer specific advantages when it comes to solving different measuring problems. Whether you are measuring an engine component, a small plastic part or an elastic sheet metal part, there are many instances, where a sensor change is more pratical. The faster, more reliable and simple this can be achieved, the more economical the operation of the machine. With many systems, a sensor change involves considerable assembly work and a service engineer is often needed to perform the change.

With Carl Zeiss measuring machines you can change the sensors yourself: you simply insert them as needed.

Stylus changing systems

Many measuring tasks require several stylus combinations. In most systems these stylus combinations have to be assembled manually. After each change, the new combinations have to be re-calibrated – a time-consuming process.

Stylus changing systems from Carl Zeiss use adapter plates with a dia. of 69 mm which are simply inserted. In view of the high repeatability, recalibration after a change is no longer necessary. The automatic or CNC controlled changing of new stylus configurations is a standard part of the Carl Zeiss product package.

Integration of a rotary table

Carl Zeiss has allowed for the incorporation of a rotary table in the machine's design.. We can prepare the hardware and control electronics of your measuring machine for the integration of a rotary table as a fourth axis.

The importance of an ergonomic design

The control panel accomplishes all important functions for calibration and measuring operation. Speed is also controlled from the control panel even in the CNC mode.

An operator who spends the whole day working at a machine knows the positive effects of an economic design. A sophisticated design ensures fatigue-free and efficient operation – regardless of the machine size.

The exterior of a measuring machine already indicates whether ergonomic aspects were taken into account during the design phase. How high is the measuring table? Can heavy workpieces be lifted onto the table without any problems?

With our machines you'll notice the difference. Their ergonomic design emphasizes how you interact with your work environment, while offering features and performances that give you superior results. It's what you would expect from the metrology leader.

Minicheck Chapter 8

Ergonomic operation				
Manufacturer	Carl Zeiss			
Sensor change by operator	yes			
Stylus changing system (0.1 µm with 200 mm extension)	yes			
All machine functions incl. override controlled via control panel	yes			
Ergonomic design				
Overall rating				

The Zeiss Benefit:

Ingenious ergonomic design

The impact of software

The measuring machine as a production facility is an integral part of your process chain and, as such, is integrated into an existing system or a new installation. Data compatibility between the systems is of paramount importance. Because the greatest benefit doesn't consist of the purchase and maintenance of the machine, but of the individual measuring programs you have developed over the years.

One-stop machine and software provider

Data integrity is a No. 1 priority in Carl Zeiss software. We see our software as an integral part of the machine concept and therefore develop it in-house or with exclusive partners. Only the synergy effects resulting from 25 years of experience in measuring technology and know-how in the development of automation software allow us to create cutting edge, practice-related software solutions. This is the only way to implement complex processes such as scanning

25 years of ongoing data

Protection measuring software has followed the developments achieved in the field of CNC technology. In the host of new developments, we have focused our efforts not only on all-inclusive functionality and greater ease of operation, but also on data integrity. Because a new program is only of use to you if it is compatible with previously created measuring programs. Our software libraries are

→ 1976

→ 1990

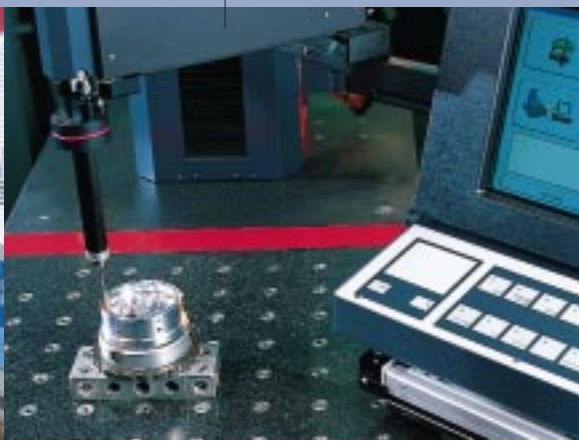
developed in such a way that virtually all existing data can be converted to the new programs or program modifications. This will keep you up-to-date and give you access to all your files.

CMM-OS

CMM-OS (CMM Open Software Interface) is an interface which provides a perfect link between Zeiss coordinate measuring machines and manufacturer-independent evaluation software. If you need to work with the software of another manufacturer, this interface gives you all the metrology know-how of Zeiss Industrial Measuring Technology. This applies above all to the accuracy characteristics and reliability of the Zeiss systems. The compensation of guideway errors, for example, the calibration of stylus combinations, the monitoring of the control system and the use of Zeiss sensor systems are included in CMM-OS. You can therefore rely on measuring with Zeiss quality even when you are using non-Zeiss software.

→ 1997

→ 1998

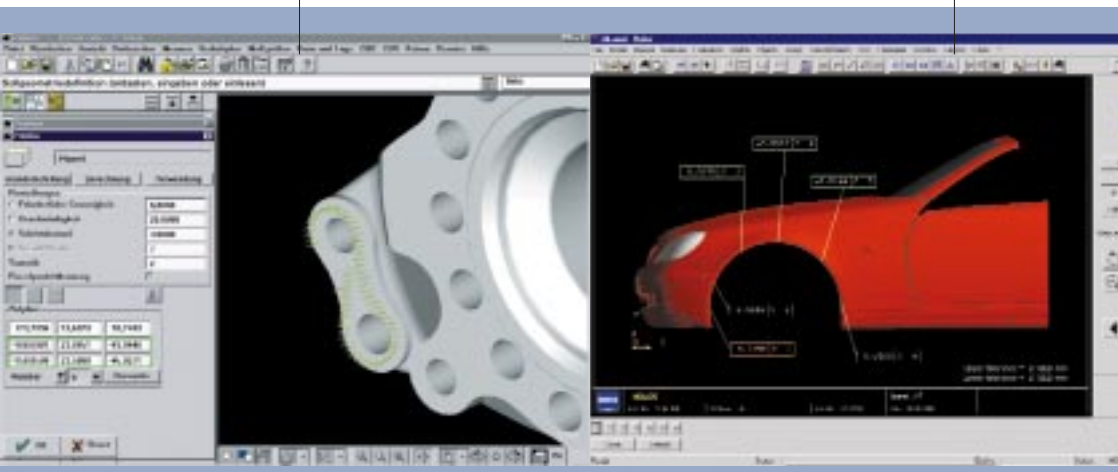


Only metrology-driven software reduces programming times

Take the „expert system", the Carl Zeiss VAST® system, for example. To calculate the optimum scanning speed, optimum number of measuring points and optimum filtering diameter you only need to specify the diameter, tolerance and required accuracy. This allows you to reduce measuring times. During the scanning process the software monitors the captured measuring points, eliminates outliers on the basis of intelligent algorithms and closes discontinuities.

In addition, the Zeiss library offers a customized solution for each user.

→ 1999 → 2000



Minicheck Chapter 10

Software				
Manufacturer	Carl Zeiss			
Consistent compatibility of data since	1976			
Functionality				
Geometry	●			
Form and location MMC	●			
Free form	●			
CAD functionality	●			
Gears	●			
Statistics	●			
Interface	●			
CMM-OS	●			
Object-oriented operation	●			
Automatic test schedule generation	●			
Overall rating				

→ The Zeiss Benefit:

Software with metrology-driven know-how

••• We want you to have real in-depth knowledge about metrology. Our training courses are designed for your individual requirements.

••• Who should receive basic or advanced training to ensure that powerful metrology is used to perfection?

••• What are the conditions on your premises?

••• Do you need customized equipment integration?

••• Which constructional measures will have to be taken in the building?

••• Is the supply of power, compressed air, etc., guaranteed?

••• Do you need advice setting up your network functions?

••• What components does your process chain consist of?

••• How broad is your parts spectrum?

••• How do you rate your mid- and long-term perspectives?

••• What are your investment plans?

••• Do you need a turn-key system or a customized solution?

System Maintenance

••• Do you need any parts programming for complex workpieces?
Or on-site programming and installation of parts programs?
••• Is your measuring machine in need of re-calibration?
••• Do you need special artifacts?

Machine Care and Maintenance

••• Would you like to have your machine serviced in regular intervals?
••• Do you want our service engineers to be on your premises within 12 or 24 hours?
••• Will you need our support service also on Saturdays?

Modernization

••• To what extent have your parts and requirements changed?
••• Where in your hardware and software do you need performance upgrades?

New Acquisitons

••• Do you want to ensure that your measuring technology is state-of-the-art?

value services

Your Measuring Technology is a solid investment.

With our Value Services your machine is protected from the project stage and installation through system maintenance and new acquisitions. Our Value Services really do pay off.

Design quality Manufacturer				
Manufacturer	Carl Zeiss			
Scales • expansion-free glass-ceramic material • steel • others	●			
Machine design • complete enclosure • ceramic guideways • rigid, stable bridge construction, optimized mass due to carbon fiber compound materials	● ● ●			
Additional temperature sensor on scale required	no			
Overall rating				

Bearing technology				
Manufacturer	Carl Zeiss			
Number of air bearings	21 in basic version of Prismo VAST®			
Setting of air gaps	6 – 8 µm			
Audible travel noise	no			
Emergency running characteristics	yes			
Air consumption m^3/h				
Overall rating				

Ergonomic operation				
Manufacturer	Carl Zeiss			
Sensor change by operator	yes			
Stylus changing system (0.1 µm with 200 mm extension)	yes			
All machine functions incl. override controlled via control panel	yes			
Ergonomic design	yes			
Overall rating				

Stylus configuration and changing systems				
Manufacturer	Carl Zeiss			
Stylus incl. extensions	up to 600 mm			
Thermal stability of CFK fiber				
Stylus lengths and precision	up to 200 mm 1 µm			
Stylus weight	up to 600 g incl. adapter plate			
Diameter of adapter plate	69 mm			
Smallest stylus tip diameter	0.5 mm			
Loss in measuring range in X Y Z	 0 0 0			
Changing repeatability	0.1 µm with 200 mm stylus length			
Overall rating				

Software				
Manufacturer	Carl Zeiss			
Consistent compatibility of data since	1976			
Functionality				
Geometry	●			
Form and location MMC	●			
Free form	●			
CAD functionality	●			
Gears	●			
Statistics	●			
Interface	●			
CMM-OS	●			
Object-oriented operation	●			
Automatic test schedule generation	●			
Overall rating				

Production integration				
Manufacturer	Carl Zeiss			
Permissible temperatures • range • fluctuations K/h K/d K/m	18 – 30 °C e.g. CenterMax up to 35 °C			
Air damping				
Highly-efficient damping	yes			
Rapid relocation possible	yes			
Loading systems	yes			
Overall rating				

Measuring uncertainty				
Manufacturer	Carl Zeiss			
Actual length measuring error in complete range at 4 corner points guaranteed				
Measurement of interference area	is captured			
Temperature range calculated				
Temperature range simulated in enclosure	18 – 36 °C			
Length measuring uncertainty MPE_E				
Probing uncertainty MPE_P				
Overall rating				

Scanning Procedure				
Manufacturer	Carl Zeiss			
Active	●			
Evaluated measurement points per sec	min. 200			
Unknown contours	●			
Known contours	●			
Expert system	●			
Overall rating				

Total assessment

Manufacturer	Carl Zeiss			
Design quality				
Bearing technology				
Scanning Procedure				
Stylus configuration and changing systems				
Measuring uncertainty				
Production integration				
Ergonomic operation				
Software				
Overall rating				

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