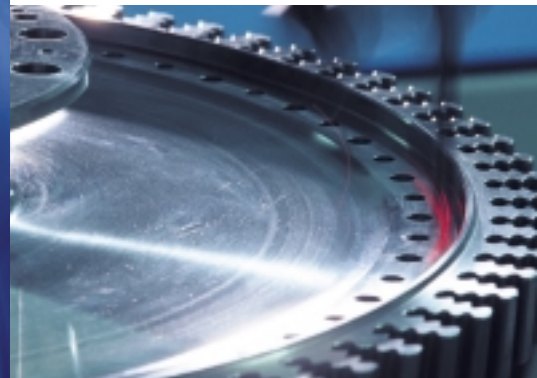
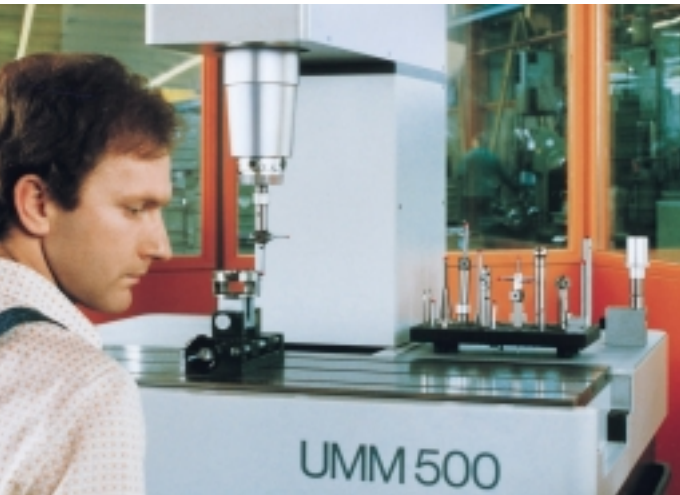


# Scanning. The Revolution in Measuring Technology.



SIMPLY MEASURE

# Carl Zeiss - the market leader in multi-point metrology



**Fast! Accurate! Complex!  
Faster! Even more accurate! Even more complex!  
The demands made on measuring technology by modern production are high. And only those who meet them can keep pace. As a technology leader, Carl Zeiss has always played a pioneering role in the development of innovative measuring technology. With its legendary universal 3D probe system, Carl Zeiss has revolutionized quality engineering and benefited modern production.**

**The revolutionary idea of multi-point measurement.**

As far back as 1973, when it launched the now legendary UMM 500, Carl Zeiss was the first supplier on the market with a 3D coordinate measuring machine. One year later, the CMM was already offering CNC capability. This completely new feature made it possible

to capture measuring points located anywhere on the workpiece with utmost precision. But that was not enough for Carl Zeiss. It also developed a sensor system capable of measuring not only dimensions, but also form errors with very high point quantities: the universal 3D probe system.

**Carl Zeiss technology becomes the industry standard.**

In the years to follow, multi-point measurement underwent continuous further development. And again it was Carl Zeiss who developed a unique solution for all price and performance categories. Simple measurement for everyone, regardless of the company size, order volume or measuring task. 75% of all scanning systems installed worldwide are Carl Zeiss systems. In this brochure, we would like to show you the benefits afforded by VAST® scanning. To show you how scanning will solve your routine measuring applications faster, more flexibly and more economically.

**Simply measure. We'll show you how.  
Carl Zeiss Measuring Technology.**



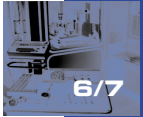


## CONTENTS

**VAST®. Multi-point measurement  
for everyone.**



**VAST®. Today's investment sees  
returns in no time at all.**



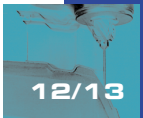
**VAST®. Reduces rejects and  
increases productivity.**



**VAST®. Unbeatable in accuracy  
and reproducibility.**



**VAST®. Minimum measuring times,  
maximum information content.**



**VAST®. A system for any  
measuring task.**



**VAST®. Easy to operate.**



**VAST®. Reliable results -  
easy to interpret.**



**Zeiss scanning technology  
right in the center of  
production.**



**Scanning. For any application.  
For any budget.**





# VAST®. Multi-point measurement for everyone.

**The demands on quality management have changed drastically over the last few years. Massive cost pressures and increasingly shorter development intervals compel more and more manufacturers to outsource their production to medium-sized companies and subcontractors. The technical feasibilities in automatic production have contributed further to increasing the demand on quality engineering. The solution: scanning. Using Carl Zeiss VAST® technology.**

## **Scanning. How it works.**

In scanning operation, the probe system captures a sequence of closely adjacent points by following a contour in one single, uninterrupted measuring process. By covering the workpiece surface as completely as possible, the actual shape of the part can be very precisely illustrated. To what purpose? Only if form errors are exactly known will you be on the safe side with your quality assurance of complex, tightly toleranced parts. Particularly when function-related, mounting and connecting dimensions are involved.

## **VAST®. Scanning across the board.**

In the past, scanning systems were available for ultra high accuracy machines only. The costs for machines and control systems were considerable, investment accordingly high, operation possible by specialists only.

With VAST®, Carl Zeiss makes scanning technology available to small and medium-sized companies. All VAST® machines are designed for shop floor use. To allow you to measure right in the middle of your

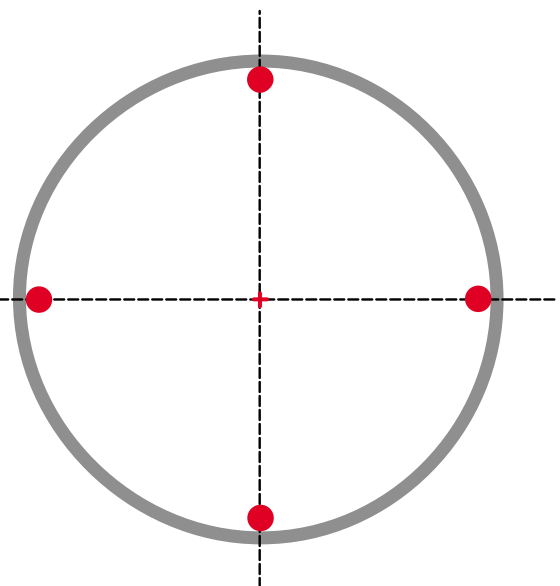
production and make use of all application benefits, which will also enhance the competitiveness of sub-suppliers.

## **VAST®. A sensor for dimension, form and position.**

Your customers expect high-precision results in the shortest possible time at a low price and with maximum flexibility. But at the same time you must keep your costs in mind. Today, form measurement can only be performed at acceptable costs in the scanning mode. With VAST®, you measure dimension, form and position instantly in one single measuring process. No need for mechanical alignment, no refixturing, no inaccuracies. VAST® gives you all it takes to keep you ahead of your competitors in the long term.

VAST® is also suitable for all applications in curve and free-form metrology and reverse engineering.

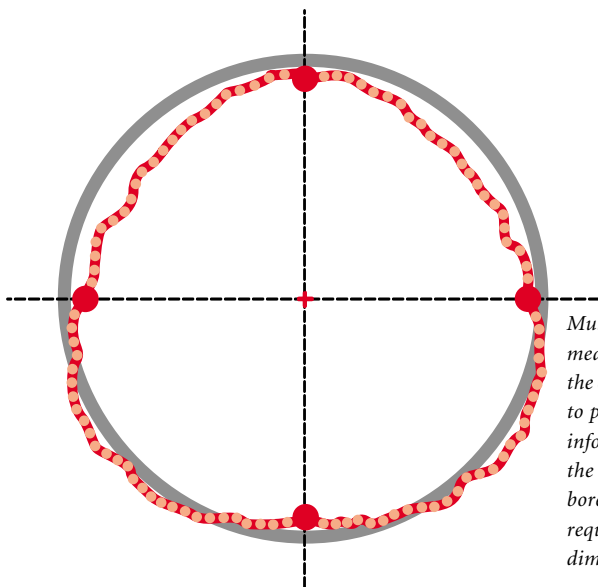
*Conventional measuring technology only permits single-point probing – fewer measuring points are obtained. However, for many functions the nature of the form deviation is more important than the actual absolute value.*



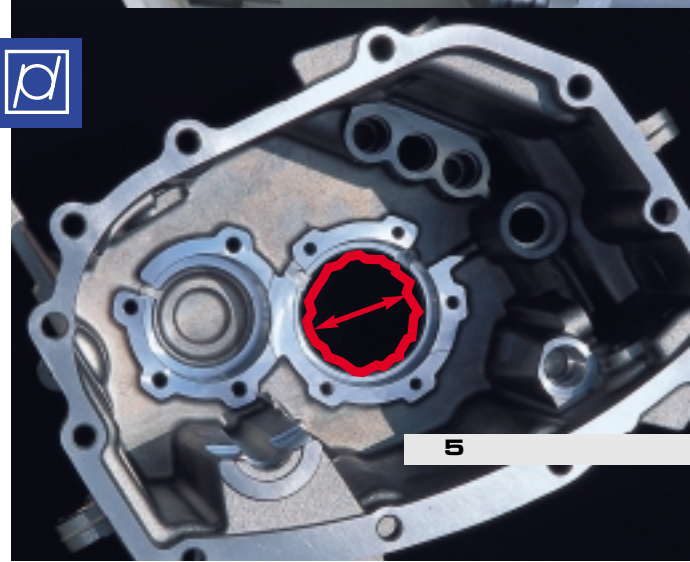
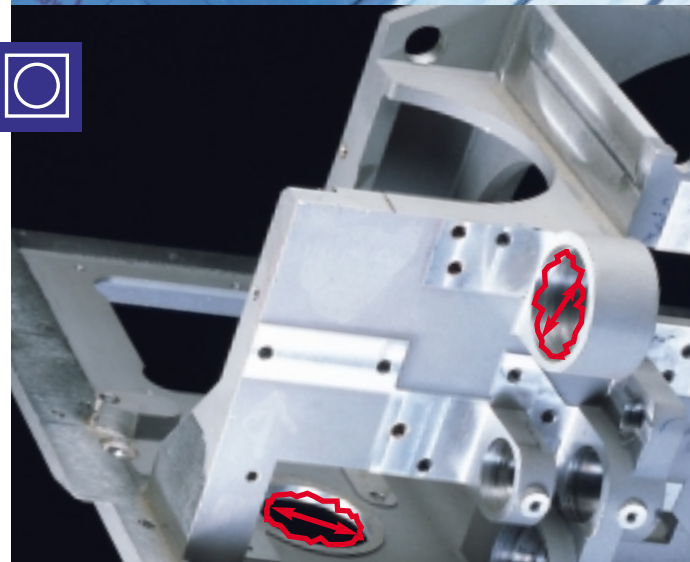


“For the very first time, the VAST® scanning probe head allows form evaluation to be performed in the production area.”

*Workpiece shapes can be illustrated through multi-point measurement using the VAST® technology. This permits you to precisely monitor your production process easily and directly for form errors, even if complex workpieces are involved.*



*Multi-point measurement is the only technique to provide exact information on the shape of this borehole and the required mating dimensions.*





# VAST®. Today's investment sees returns in no time at all.

**Your customers expect the same flexibility from you that they themselves must show. Conventional measuring equipment has problems keeping up with on-going changes. Once you have invested in VAST®, you can rely on a system which provides simple and quick solutions to virtually all your measuring tasks.**

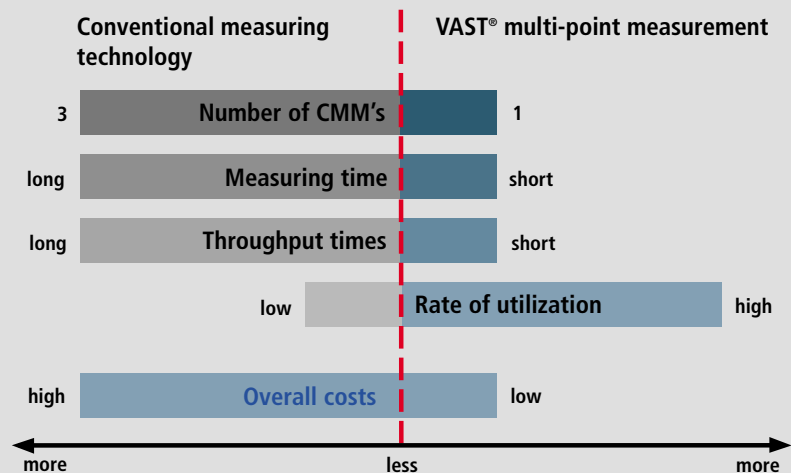
*Conventional measuring technology is time-consuming and requires a host of different measuring devices and test fixtures.*

**Conventional measurement is inefficient.**

Fast coordinate measuring machines with conventional single-point probing operate according to the "woodpecker" principle: each point is picked up discretely. Only a relatively small number of measuring points is obtained with reduced accuracy within an acceptable period of time. This means that you are running the risk, particularly in form measurement, of picking up results which differ from your customer's. Such a discrepancy is intolerable for customers who have adopted the Total Quality Management principle. Special form testers or dedicated gages and fixtures would of course help you to eliminate these differences. But this costs time, money and space and will only pay off if your throughput is very high.

**VAST® fits the bill through flexibility.**

Carl Zeiss coordinate measuring technology in conjunction with the VAST® sensor system helps you to meet any measuring challenge. You will be able to react flexibly to changes in your measuring tasks or parts spectrum and deliver utmost, just-in-time precision. You can work at full machine capacity, employ less personnel and get along without additional measuring rooms.



**“The high machine up-times and reliability of the Zeiss CMM have eliminated the need for additional doghouse gages.”**

**VAST® fits the bill through high-quality measuring results.**

There can be no doubt that the number of measuring points and the measuring uncertainty are directly related to the reproducibility of results. The required level of quality can only be guaranteed by high point densities, particularly where form measurement is concerned. Suppliers must give customers proof of this if they want to meet the stringent requirements of modern quality management.

**VAST® fits the bill through minimum floor-to-floor times.**

A performance comparison between conventional single-point probing and VAST® scanning clearly shows that VAST® not only features shorter measuring times (see also pp. 12/13), but automatically supplies the results for dimension and position together with the form measurement. This means VAST® provides all tolerated parameters in one measuring process.

*In form inspection more than anywhere else, the desired results can only be obtained with high point densities.*

**VAST® saves additional investment.**

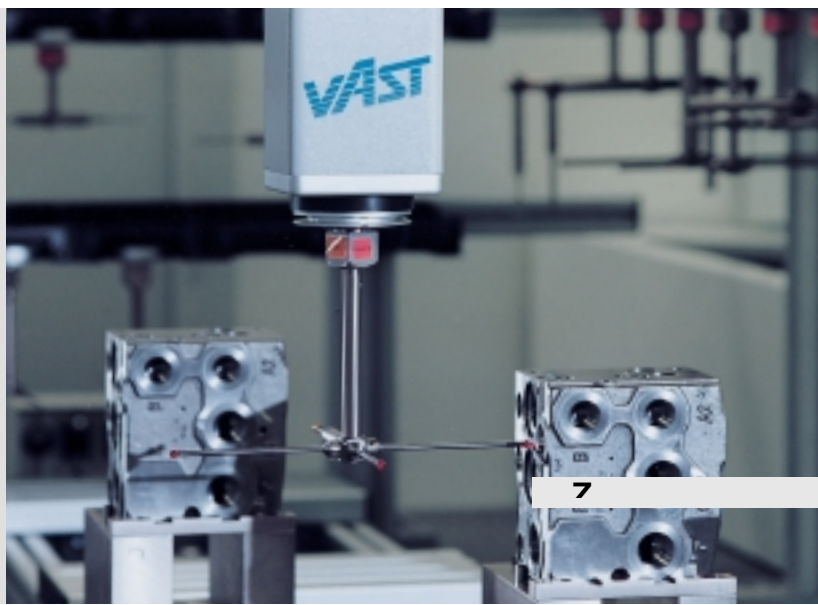
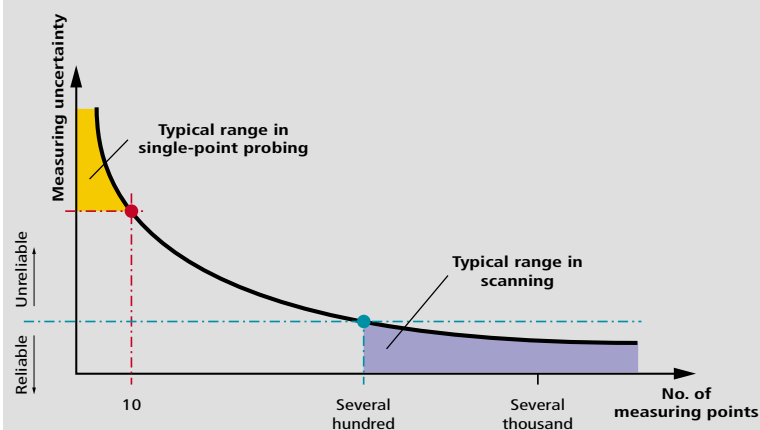
From now on you can save the money for form testers, dedicated gages and fixtures. Simple, single-purpose plug gages alone will cost between \$ 5,000 to \$ 12,000, complex gages well over \$ 60,000. Add to this the costs for fixtures, form testers for roundness, straightness, etc., for personnel and longer throughput times. Just calculate for yourself – in most cases VAST® pays for itself within two years.

**PRISMO® VAST® at the right price.**

Continuous optimization, increased productivity and the demand for high-tech components now required from medium sized suppliers were the requisites for achieving noticeably better performance and prices, from which our customers will also benefit.

*In most cases PRISMO® VAST® pays for itself within two years.*

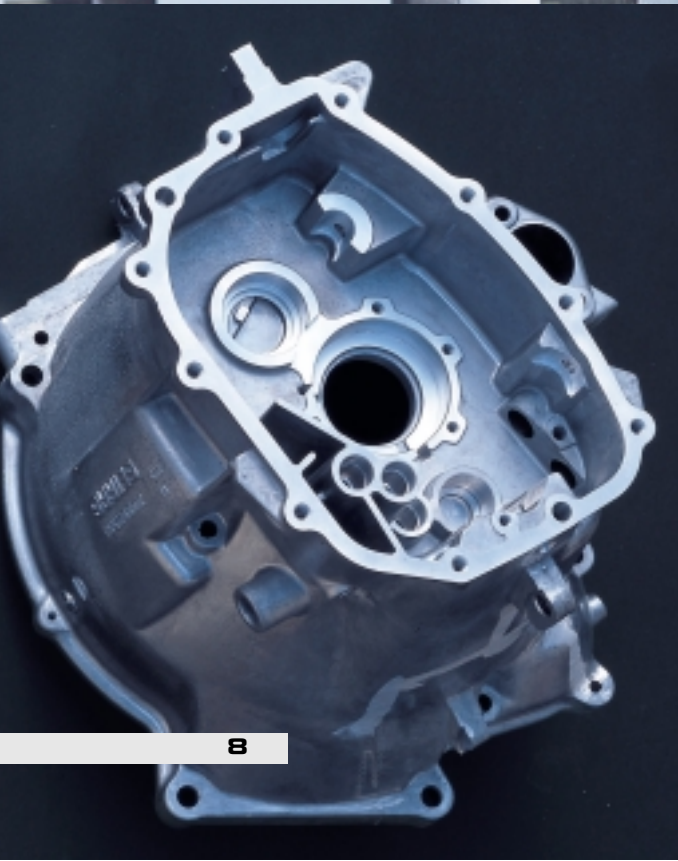
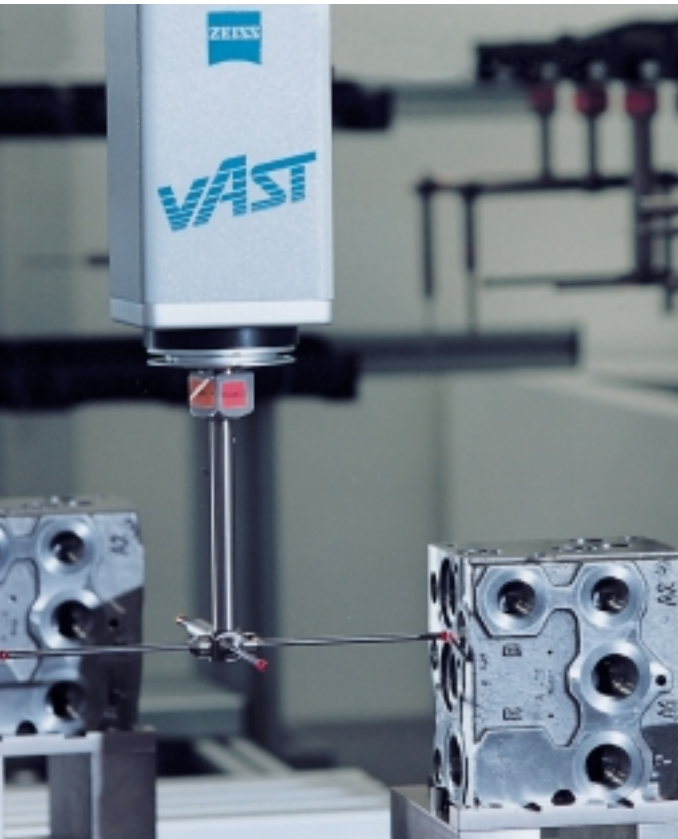
**Reduction of measuring uncertainty through high point number**







# VAST®. Reduces rejects and increases productivity.



**Multi-point measurement with VAST® permits form inspection to be performed at maximum speed and with high data quality. This allows computer-controlled use of the tolerances. Very narrow tolerances can be relaxed, mating dimensions are determined automatically. VAST® helps you to reduce rejects to an absolute minimum.**

**Shortest measuring times - more inspection parameters.**

Rapid scanning speeds with short measuring times (see also pp. 12/13) increase the inspection frequency and the number of inspection parameters. In the hydraulic casing shown at the top left, up to 280 different features must be captured in one complete measurement on each component. Such a large quantity of measuring points will give you detailed information on your current manufacturing process. Even minute inaccuracies can be detected at an early stage, more or less excluding the possibility of significant process changes which could lead to rejects being produced. Your manufacturing quality is stable, and this really pays off.

**Function-oriented measurement safeguards your assembly.**

The shaft bearing seat of the casing on the left was inspected and approved using conventional measuring technology, but it can still not be pressed into the bore when being assembled. The reason is that a mean value based on only a few discrete measuring points was used to calculate an ideal circle, but this circle still fails to display the functionally relevant dimensions. For workpieces whose function or mating capability is vital, other computation methods must be adopted.



“Complete and precise measurement puts us in the position of adapting our tolerances to manufacturing requirements and thereby giving our production greater leeway.”

**High point density for high data quality.**

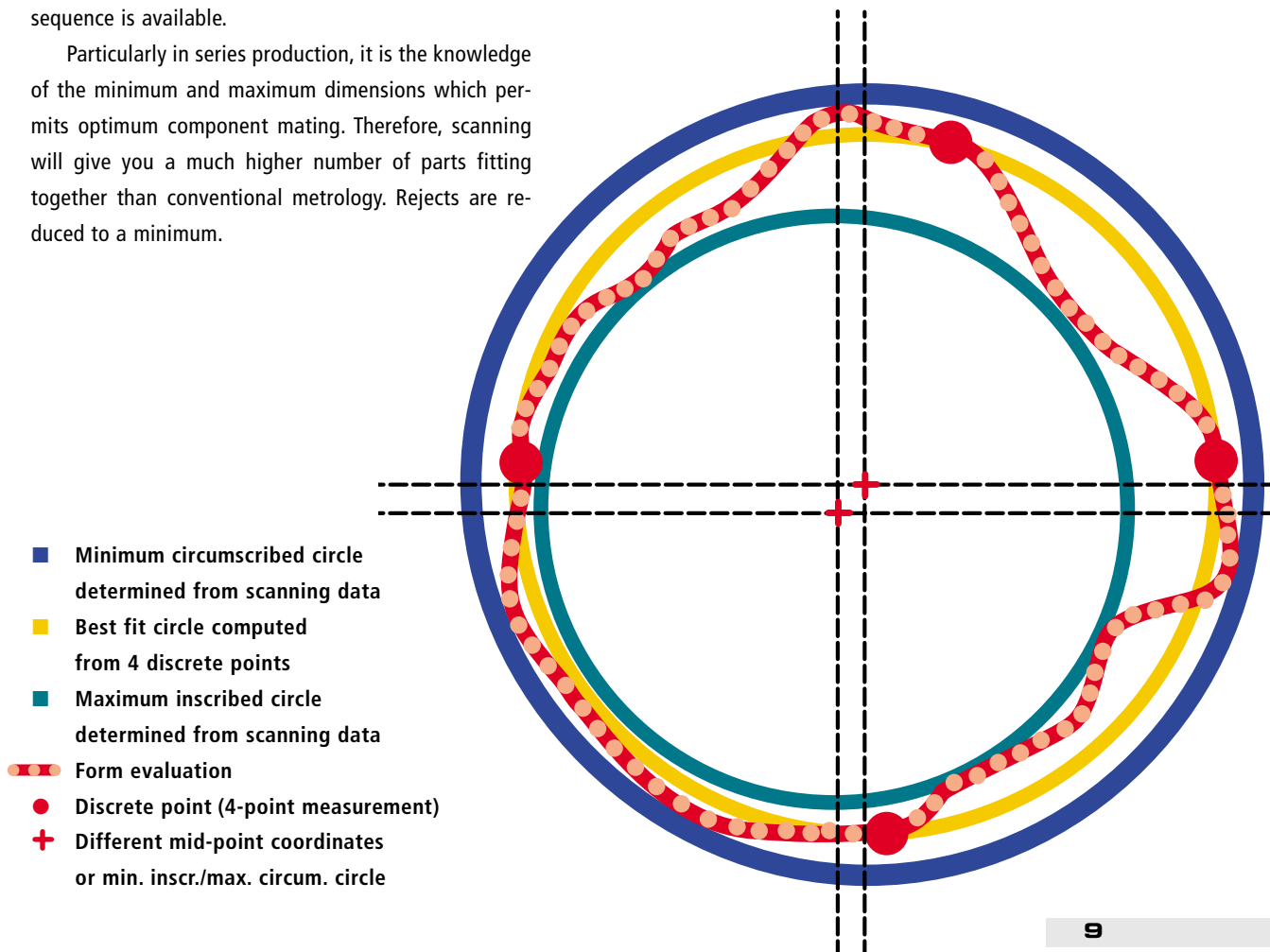
- **Maximum inscribed circle:** smallest possible borehole diameter
- **Minimum circumscribed circle:** largest possible shaft diameter
- **Chebyshev:** mean diameter for best fit according to least change of form

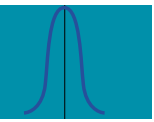
To ensure high data quality, it is absolutely essential to base all computation methods on a high number of measuring points, because the accuracy of reproducible results increases with the number of points. The maximum inscribed circle which is vital for the mating behavior can only be determined if a very dense point sequence is available.

Particularly in series production, it is the knowledge of the minimum and maximum dimensions which permits optimum component mating. Therefore, scanning will give you a much higher number of parts fitting together than conventional metrology. Rejects are reduced to a minimum.

**Scanning on the shop floor allows statistical process control.**

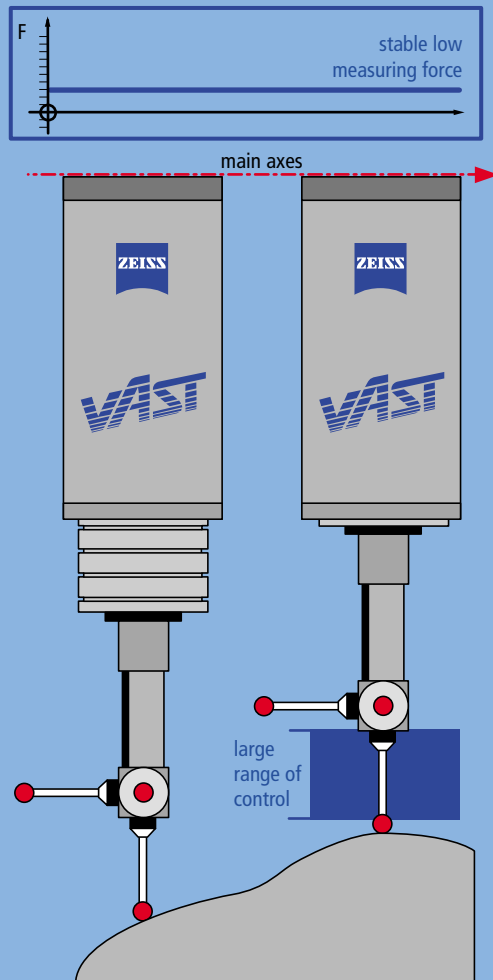
With PRISMO® VAST® and the Accept enclosure, form evaluations can be performed for the very first time directly in the manufacturing environment. Ideally, PRISMO® will be set up next to the machine tool where it monitors the on-going production process. Results are fed back to the machine tool as directly and quickly as possible.



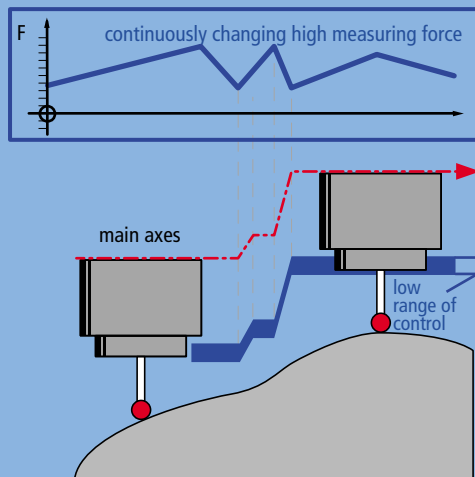


# VAST®. Unbeatable in accuracy and reproducibility.

## VAST®-technology



## Conventional systems



**VAST® technology provides maximum accuracy and reproducibility of measured data. Particularly during in-process quality control, VAST® paves the way for consistent product quality, because you can rely on being able to identify production variation. Only process-related interventions will be necessary.**

**Actively measuring scanning systems provide reliable measurement.**

Carl Zeiss had good reasons for developing its own probe systems. Our active scanning systems are constantly monitoring their own probe head deflections. The consistently low measuring force is generated, controlled and applied inductively via "electronic springs". In roundness measurement, the low measuring force is generated in each point with a constant value perpendicular to the workpiece surface. Dynamic influences on the result, inevitable in conventional systems, are completely eliminated with VAST®.

The large scanning control range permits fast data acquisition true to contour and free from lag errors. VAST® operates with superb speed and stability and with utmost precision.

*VAST® provides higher accuracy and reproducibility of measured data.*

*With conventional systems the dynamic influences result in high scanning uncertainties and widely scattered measuring results.*

**“The VAST® probe head has doubled the already good reproducibility of Zeiss touch trigger machines and further enhanced process reliability.”**

**Need to polish up measuring results? Not with Carl Zeiss.**

**Conventional systems:**

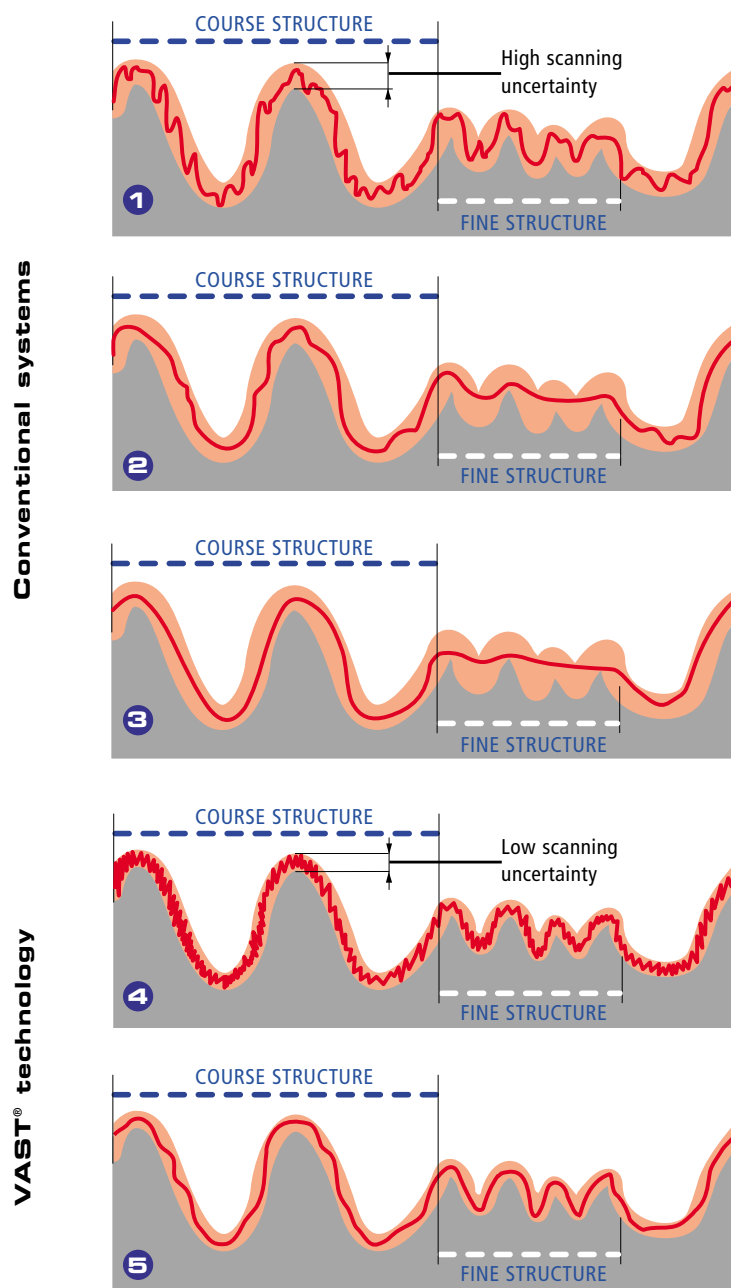
- 1 Systems consisting of individually purchased components (probe head, dimensional standard, control, software, ...) are insufficiently matched and may therefore be subject to a pronounced scanning uncertainty. The unfiltered result displays marked scatter.
- 2 Although weak filtering will smooth the measured contour, it is generally too erratic. Due to the high probing uncertainty, the contours of fine structures are blurred already.
- 3 Strong filtering smoothes the measured contour satisfactorily, but the contours of the fine structures have disappeared altogether.

**VAST® technology:**

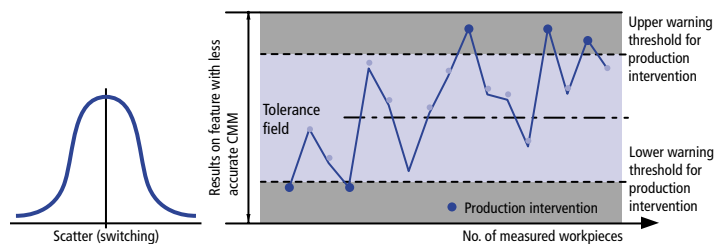
- 4 Suppliers of complete systems, such as Carl Zeiss, develop all components themselves. These are in perfect harmony and therefore feature low scanning uncertainties. The unfiltered result only displays slight scatter.
- 5 Weak filtering smoothes the measured contour satisfactorily. Due to the low probing uncertainty, the contours of the fine structures are well discernible.

**A** The high scatter of the less accurate measuring machine gives no clear indication of the production deviations and therefore calls for frequent, unnecessary and costly intervention.

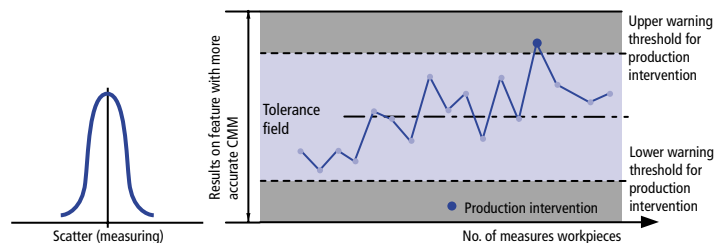
**B** The inherent errors of the more accurate measuring machine are negligible. The actual production deviation becomes visible. Only process-related interventions will be necessary.



**A Conventional systems, few points**



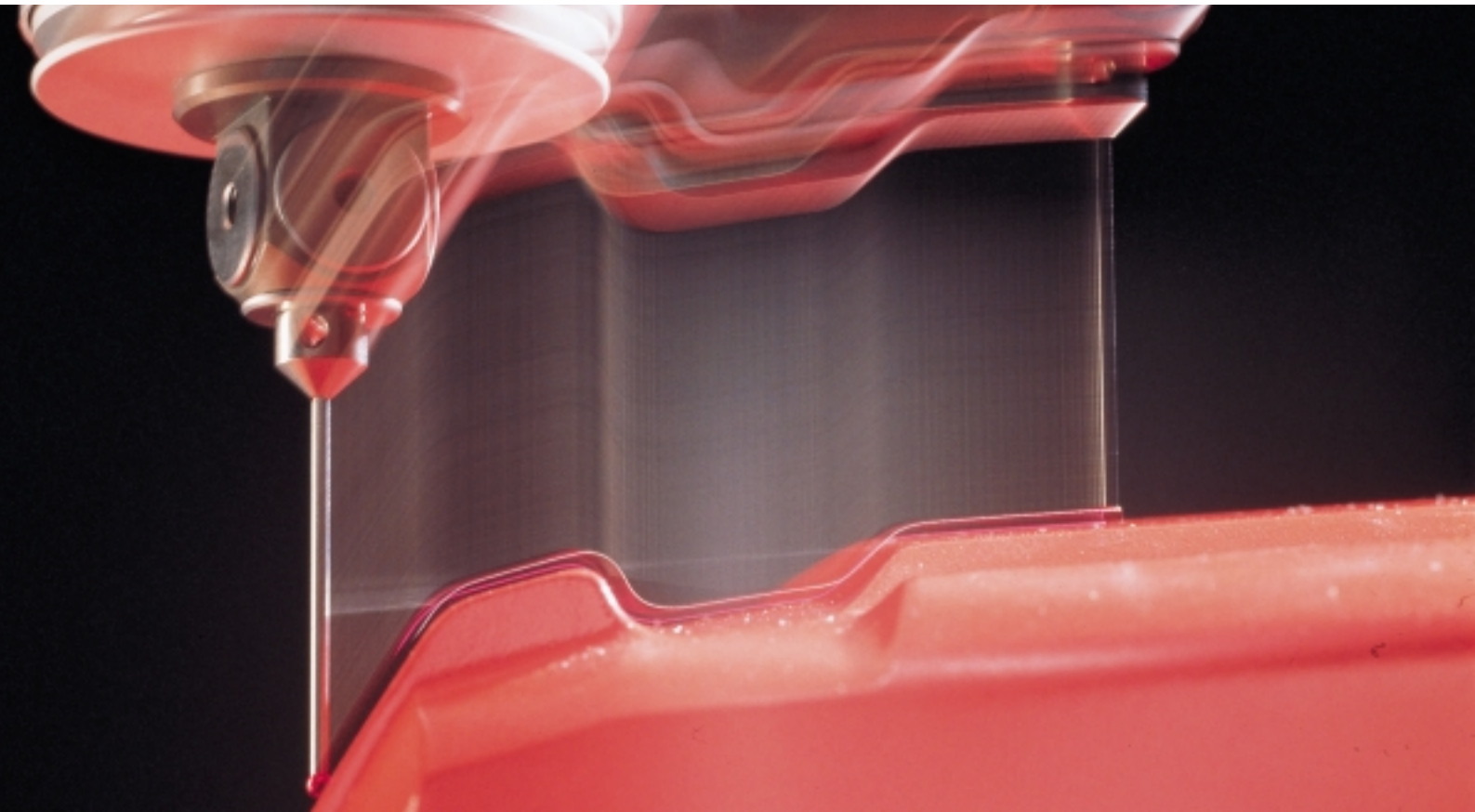
**B VAST® technology, many points**







# **VAST®. Minimum measuring times, maximum information content.**



**VAST® permits you to select the optimum combination of accuracy and tolerance as a function of the measuring task and the required tolerance. For this, preselectable stages are available. The system performs the optimization automatically in accordance with the selected speed and accuracy stages.**

## **Speed comparison of scanning and single-point probing.**

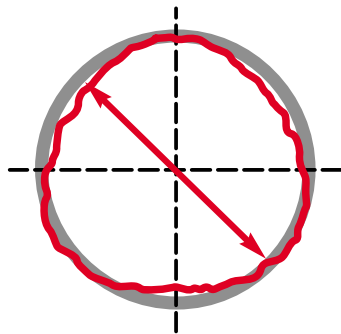
Form inspection with a high number of measuring points can be executed with VAST® in the same time as single-point measurement which only yields dimension and position results. The measuring times are extremely short even on very complex geometries.

Contrary to this, a fast bridge-type CMM with conventional single-point probing needs an unacceptable two seconds per measuring point. The point rates in the scanning mode presently lie between 60 and more processed and evaluated points per second.



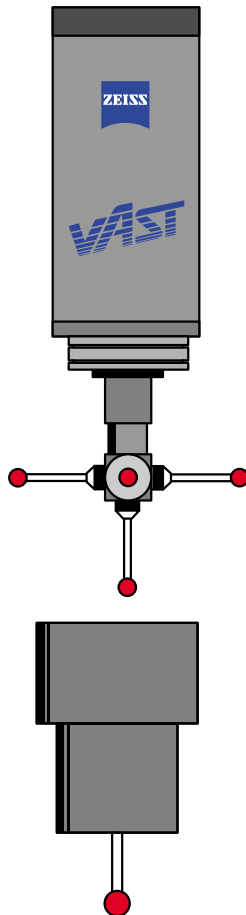
**“We have made an effort to obtain an objective assessment of coordinate measuring technology. Zeiss offers us the fastest coordinate measuring machine by far.”**

**VAST® scanning:  
600 evaluated  
points in  
10 sec.**



**Conventional mea-  
suring technology:**

**600 points in  
1200 sec.**



**High-speed scanning.**

You need to know the spacing between two bores right away? High-speed scanning gives you precise information in the shortest possible time.

**VAST® “thinks” like the cutting tool.**

For roughing, finishing and grinding in the metal removal, VAST® insures that your quality control work is performed time-optimized and with the required precision (see also pp. 16/17).

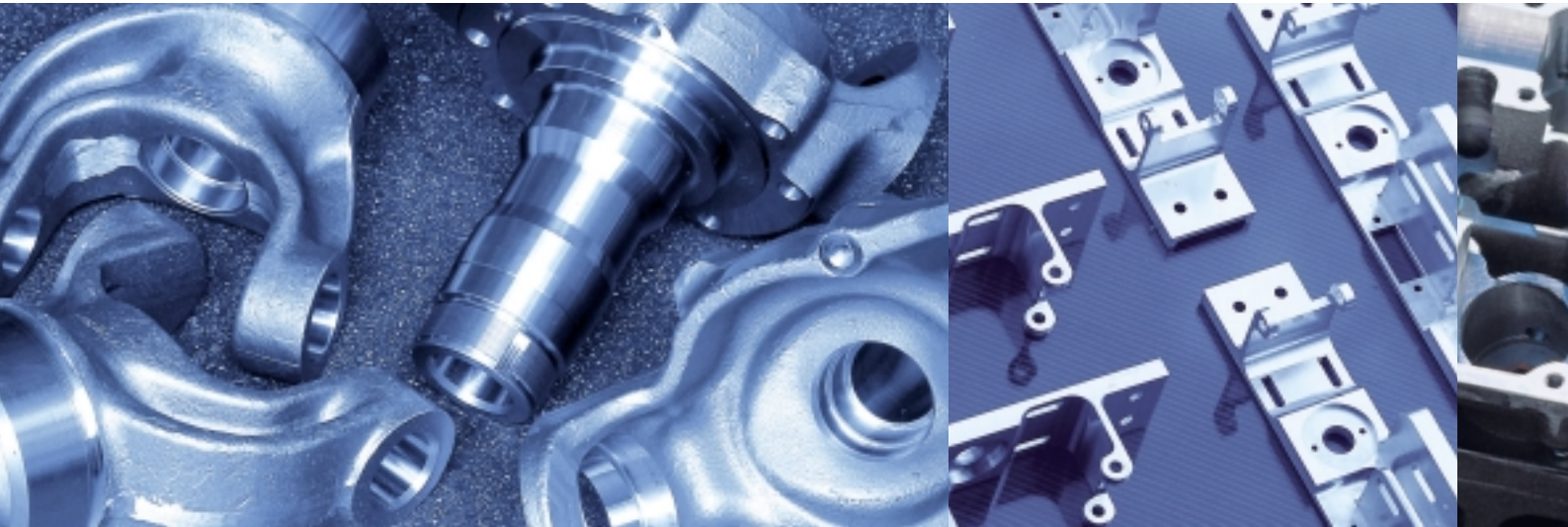
**VAST® stages for optimum  
process control.**

The operator selects the combination of accuracy and speed ideally suited for scanning operation in 4 stages as a function of the measuring task and the tolerance.

	<b>Conventional single-point probing</b>			<b>VAST® multi-point scanning</b>		
	No. of features	No. of points	Meas. time	No. of features	No. of points	Meas. time
Clutch case	16	76	3' 32"	18	3472	2' 28"
	Only dimension, position. Diameter with 8 points.			Dimension, position, 2 form measurements. Each diameter with approx. 200 points.		
Gear case	25	74	3' 6"	27	3583	3' 42"
	Only dimension, position. Diameter with 4 points.			Dimension, position, 2 form measurements. Each diameter with approx. 200 points.		
Engine block	27	128	5' 16"			
	In addition, 2x roundness with approx. 32 points each.					
Engine block	71	584	Bridge type CMM: 25' 12"	146	84062	35' 25"
	Measuring robot: 15' 04"			Dimension, position. All required form measurements (75x roundness and straightness).		
	71	584	Only dimension, position. Diameter with 8 points.			



# VAST®. A system for all measurements.



**The flexible production of increasingly complex parts requires quality engineering that is just as flexible. VAST® technology gives you the high data quality required for in-process quality assurance for a multitude of workpieces, applications and tolerances.**

## **Flexible measuring techniques stand up to all measuring tasks.**

VAST® scanning technology and powerful Carl Zeiss software will cope with virtually any measuring task:

- Classical applications such as distances and sections
- Form inspection of standard geometries on prismatic workpieces
- Scanning of curves, gears, free-form surfaces on the basis of nominal data

- Digitization of free-form surfaces, reverse engineering
- Self-centering scanning of grooves, edges, threaded bores

## **Easy probing in hard-to-access locations.**

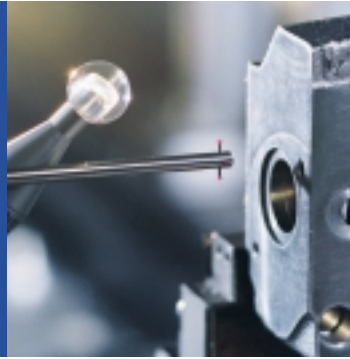
VAST® permits flexible use of complex stylus configurations.

### **1. Heavy stylus weight**

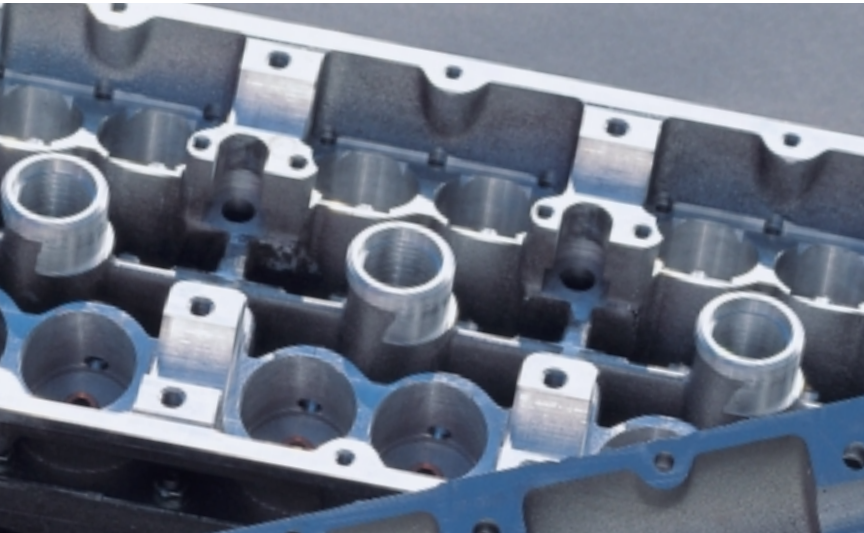
With VAST®, heavy stylus weights can be mounted. Even one-sided stylus loads present no problem. The system performs an automatic weight balance. To give you the figures: VAST® can carry loads of up to 600 g including the adapter plate.



**“Using VAST® scanning technology we simply measure more flexibly.”**



*With VAST® you can solve practically all your measuring problems – flexibly, quickly and precisely.*



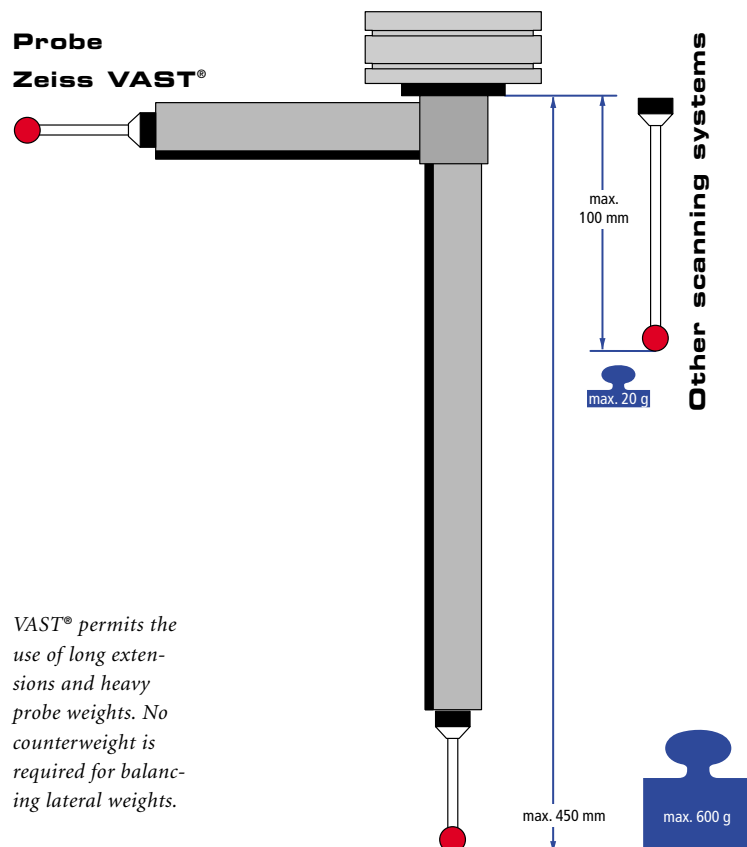
For your work, this means that VAST® gives you maximum flexibility due to the possibility of mounting greatly diversified stylus combinations for complex or difficult-to-reach geometries. This saves nonproductive time caused by probe changes, set-up and calibration times.

### 2. Long stylus extensions

Stylus extensions of up to 450 mm in length allow you to probe very deep boreholes. With other systems you have to limit yourself to 100 mm, with the result that you are unable to reach very deep measuring points altogether, or only by refixturing the workpiece.

### 3. Extremely small stylus tip diameters

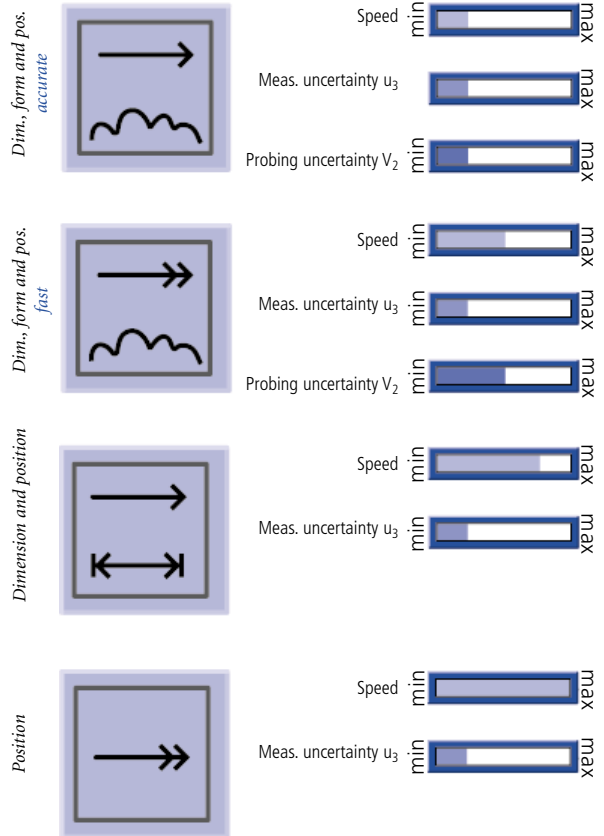
A more frequent application than expected. With VAST® you can scan even minute elements such as the gear flanks on the inside of the illustrated borehole (Fig. top right). Because you use a tip diameter of only 0.3 mm.



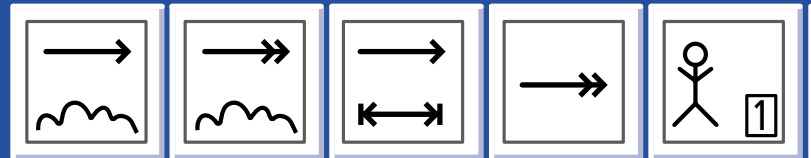
# VAST®. Easy to operate.

In the past, it took specialists to operate a scanning system and perform reliable measurements - and their qualification cost a lot of time and money. The graphics-based, self-explanatory operational concept of VAST® puts scanning technology at the fingertips of all operators.

VAST® stages for optimum process control. From 4 stages, the operator can select the optimum combination of speed and accuracy to suit the measuring task and tolerance involved.



Maß, Form und Lage, genau



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Fertig      Einstellwerte

**“Now production staff can perform their own in-process quality control.”**

**The VAST® expert system reduces programming times by up to 30%.**

An “expert system” in the software requires only a few values, such as diameter and tolerance, to compute the optimum scanning speed, the optimum number of measuring points, ideal filtering etc. You thereby save measuring times and always apply the necessary precision.

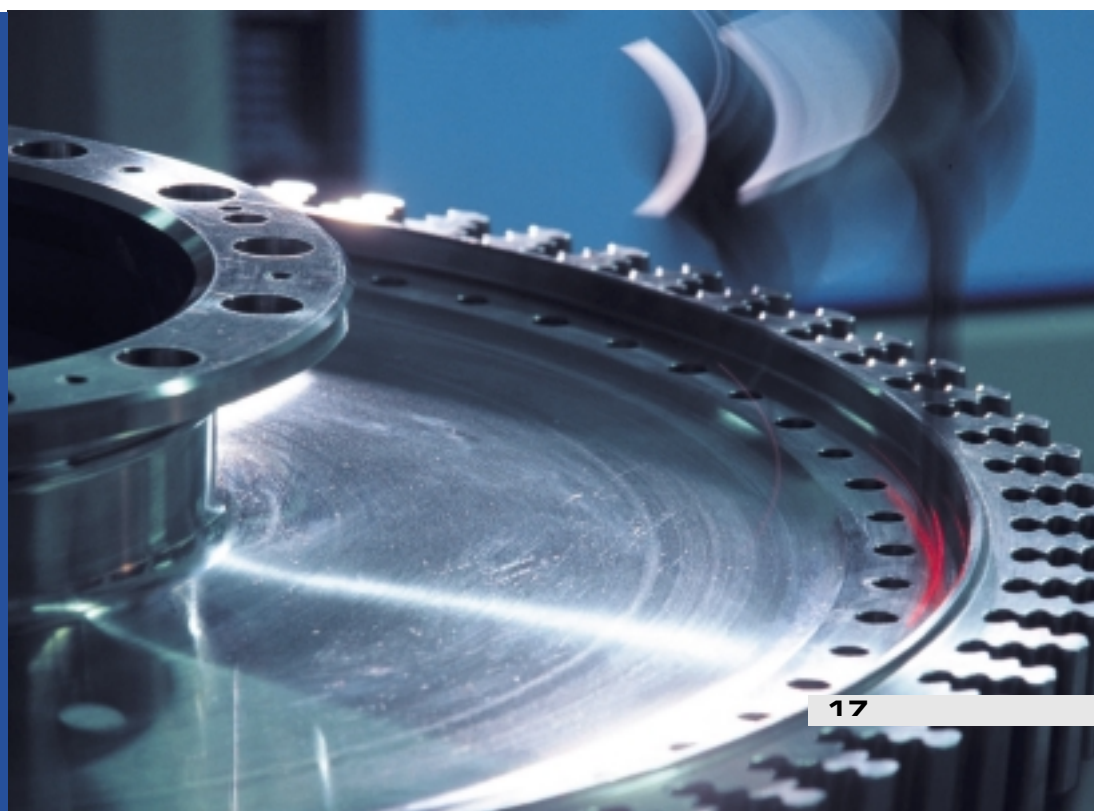
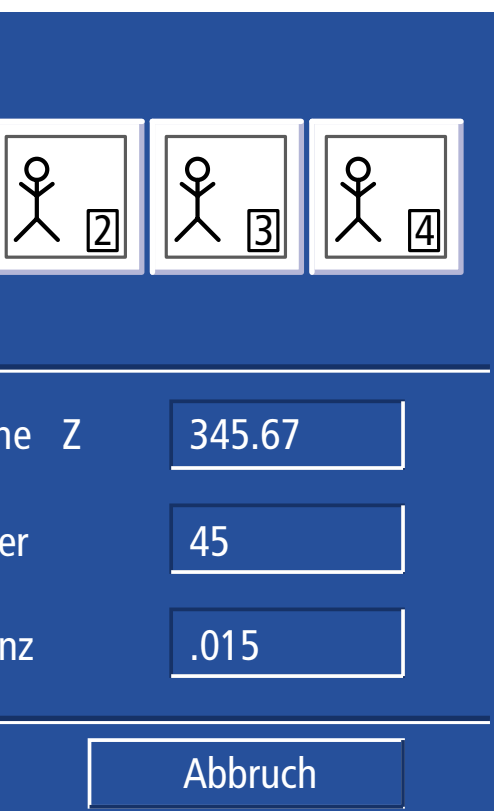
A time comparison has shown that the VAST® programming times over the entire range of applications are about 30% below those of conventional scanning systems.

**Easy to operate over the entire function range.**

Workshop personnel are no longer restricted to production, but can take care of quality assurance as well. Interactive, graphic, menu-driven operation with defaults prompts the operator safely through the complex measuring run with only a minimum of inputs.

**VAST® expert system reduces training costs.**

Operators are able to perform measurements and compile CNC programs after a brief familiarization period. Training requirements have been reduced to a minimum or – thanks to self-explanatory documentation – been eliminated altogether. This saves costs and time.







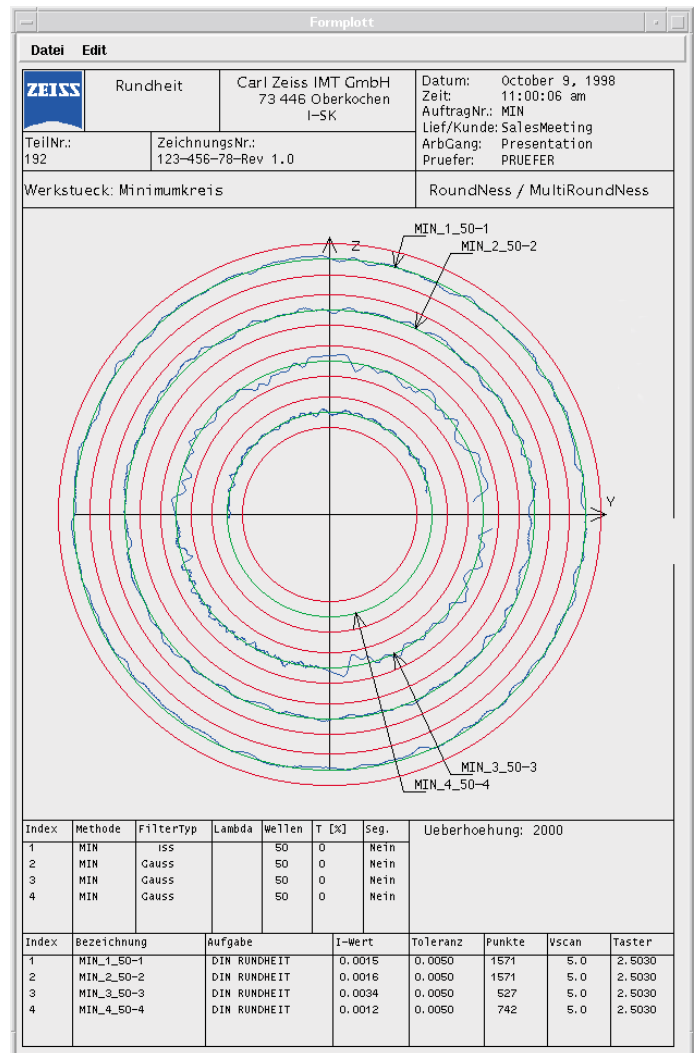
# VAST®. Reliable results - easy to interpret.

VAST®. Reliable results - easy to interpret.

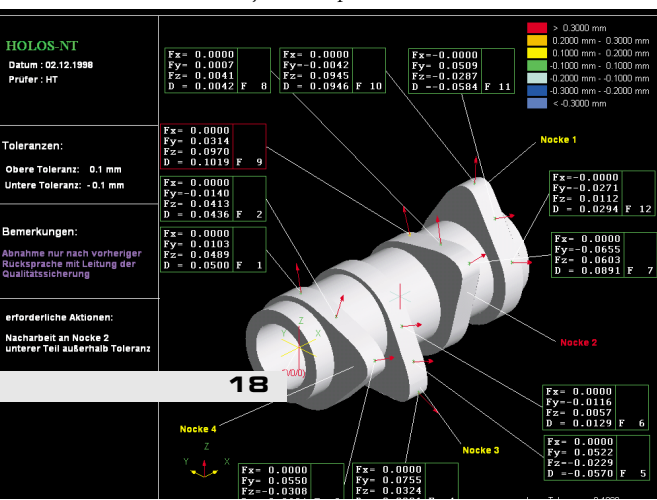
Quality management using Zeiss solutions means that you are working with powerful computer graphics, workpiece illustrations and self-explanatory protocols. This permits shop floor personnel to assess the workpiece quality directly from the measured data and to immediately take corrective measures, if necessary.

With solutions from Carl Zeiss you are always at the leading edge of technology.

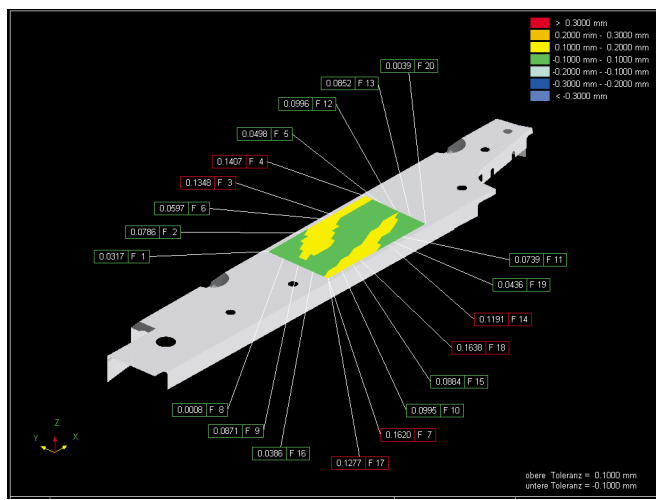
Carl Zeiss offers solutions for all standard systems. The examples show that all software packages were designed with simplicity and functionality in mind. Even complicated programming processes have been simplified to suit the application. Results are easy to interpret.



Self-explanatory measuring protocols for easy-to-interpret results.



Example: HOLOS screen illustration in chromatic coordinates.



**“For us, it was vital to obtain a measuring protocol where measured data can be used directly for implementing corrective production measures.”**

**Simple to operate.**

Carl Zeiss measuring software assists you during the entire measuring run and monitors the complete and correct evaluation of all operational steps. If an operation is left unfinished, our programs will help you with its completion. There will be no more time-consuming troubleshooting if the measuring process stops because of a fault.

**Powerful computer graphics.**

The illustration of workpieces and form errors on screen provides instant and comprehensive assessment of your results. In all Carl Zeiss software solutions you select the error illustration mode suited best to the task.

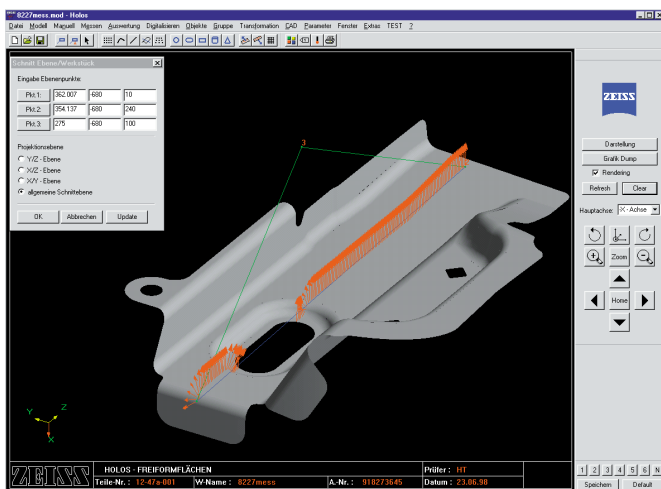
**Self-explanatory measuring protocols.**

Inspection protocols can be easily designed to meet the specific requirements of your customers.

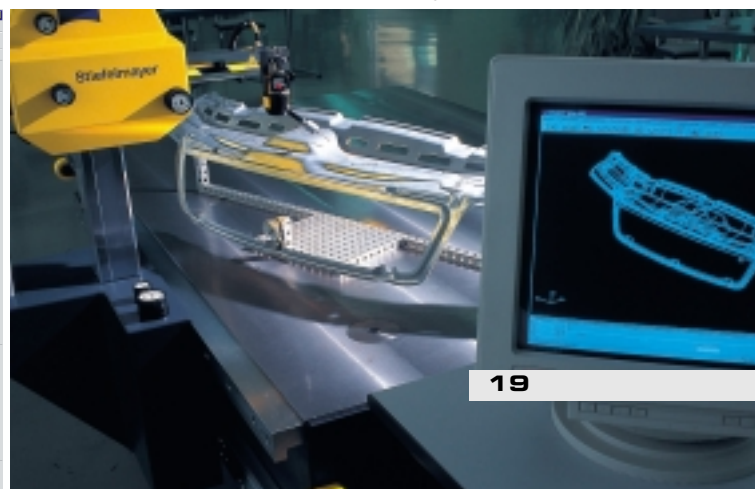
**Direct feedback of results to production.**

From the self-explanatory measuring protocols, your production staff obtains direct information on the workpiece quality. Deviations become visible, tool wear can be identified. The necessary corrective measures can be implemented long before a machine starts producing rejects. The measuring machine has become a manufacturing facility.

*Measured data along a surface profile can be shown as a vectorial view on the workpiece illustration along a scanned line, or as a two-dimensional curve along the nominal line.*



*With HOLOS, existing CAD component descriptions can be supplemented by standard geometries.*





# Carl Zeiss scanning technology right in the center of production.

**The number one priority is to measure where you manufacture. With the PRISMO® VAST® coordinate measuring machine, Carl Zeiss is taking coordinate measuring technology into small and medium-sized companies. All machines are shop-hardened - so that you can measure where you manufacture.**

## **Costs saved by integration in production.**

Quality assurance integrated in production makes exacting demands on a coordinate measuring machine. Measurement results must withstand floor vibrations, dust, temperature fluctuations and other ambient con-

ditions. PRISMO® in its protective Accept enclosure operates in the center of production without the need for a climatized measuring room. It is therefore more or less portable and can be set up where it is needed most.

This gives you maximum flexibility for your in-process quality engineering. It also saves the costs for a climatized room.

## **Low measuring uncertainty despite high temperature fluctuations.**

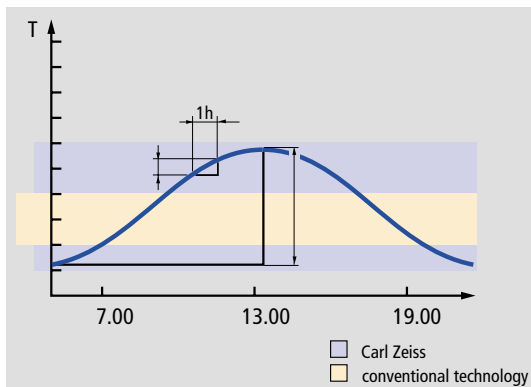
An analysis of the length measurements taken under marked temperature fluctuations in the area most removed from the scale (Y-axis left down) proves that all measurements remain within the specified tolerance even if the specified temperature range is exceeded.





**“Periodical inspection with ball plates showed that the quality of the system remains unaffected even in temperatures of up to 32 °C in summer.”**

**In-process scanning without additional costs for climatization. Carl Zeiss coordinate measuring machines can be employed like real manufacturing facilities.**



**Quality control throughout your production process eliminates errors instead of identifying rejects.**

Measurements are normally taken in series production at the beginning of a shift and then again after a few chucking cycles of the production machine. Individual analyses of setting measurements should be carried out within a few minutes. For this, it is necessary for the measuring machine to be set up on the shop floor. In addition to measuring protocols of high information content, relevant SPS parameters can be called up directly after each measuring run. Deviations can be dealt with immediately. Tool wear, thermal deformations of the machine quill or bed and changes in the material properties – changes which are virtually impossible to verify using gages – are identified long before rejects are produced.





# Scanning. For any application. For any budget.

**We have acquainted you with multi-point measurement and the benefits it provides, using VAST® as an example.**

**The advantages of Carl Zeiss scanning are available for any task, any application and any budget.**

## **PRISMO® VAST®**

Today, measuring equipment is production equipment. With PRISMO® VAST®, Carl Zeiss brings the benefits of scanning from the metrology lab into the workshop, to allow you to measure where you manufacture.

## **ScanMax®**

This is a manually operated measuring machine with scanning capability for verifying individual features during the production process. ScanMax® replaces all conventional, dedicated measuring devices. ScanMax® supplies results of the highest quality for dimension, form and position – and all this directly on the shop floor.



### **UPMC CARAT**

Precision measuring machine with a universal 3D high-speed scanning probe head. For measuring with leading-edge accuracy in research, development and quality engineering and for the calibration of gages and fixtures.

### **SMC with LTP 60**

CNC horizontal-arm CMM with the LTP laser probe for non-contact scanning of contours. For use in measuring car bodies and plastic parts in car production.





**Carl Zeiss**

**IMT Corporation**

7008 Northland Drive

Minneapolis, MN 55428

Phone: (6 12) 5 33-99 90

Fax: (6 12) 5 33-02 19

E-mail: [imt@zeiss.com](mailto:imt@zeiss.com)

Internet: <http://www.zeiss.com/imt>

**Carl Zeiss**

**Unternehmensbereich**

**Industrielle Meßtechnik**

D-73446 Oberkochen

Vertrieb: (0180) 3 33 63 36

Service: (0180) 3 33 63 37

Fax: (0 73 64) 20-38 70

E-Mail: [imt@zeiss.de](mailto:imt@zeiss.de)

Internet: <http://www.zeiss.de>

For advice, please contact: