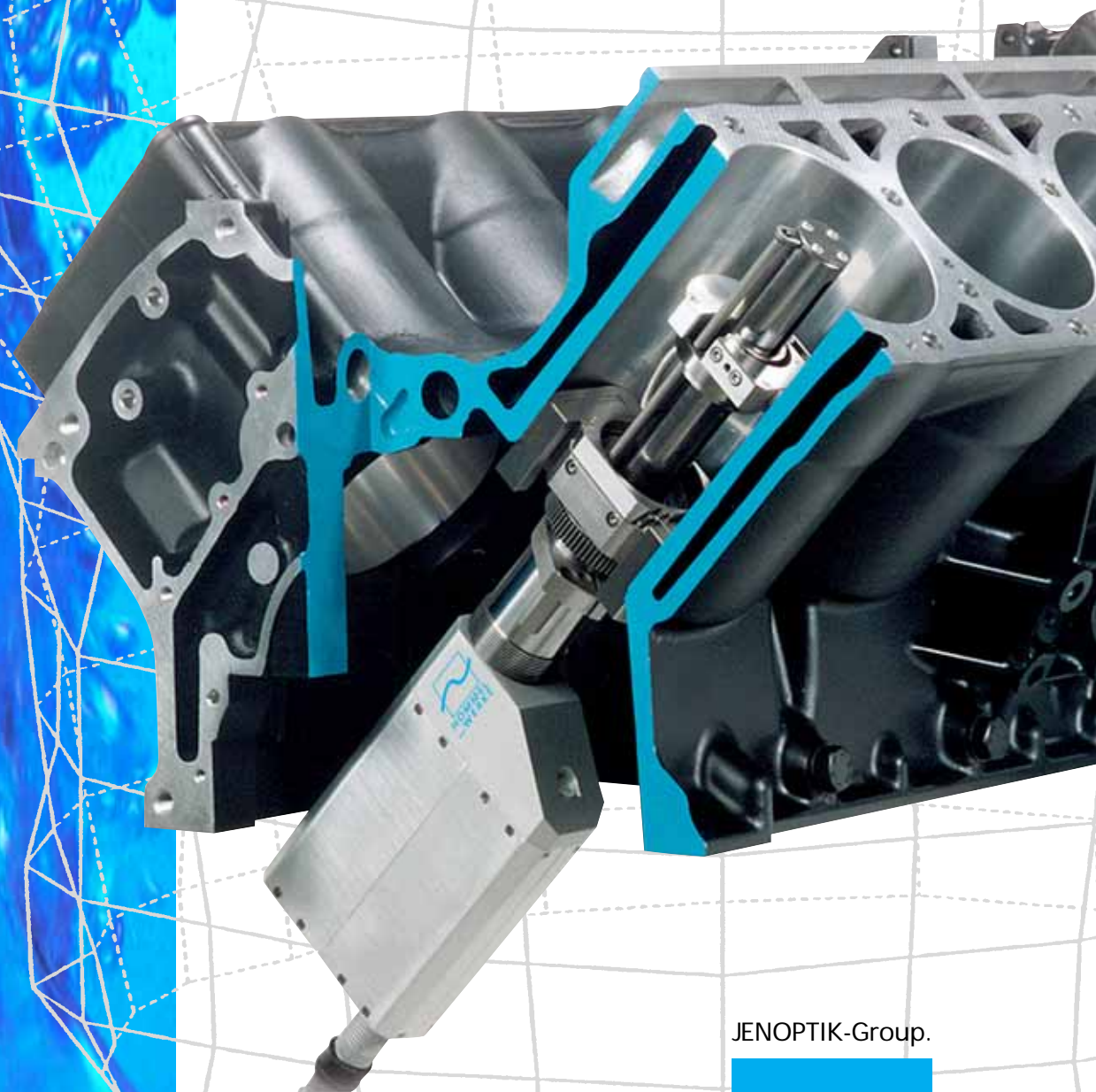


Precision is our business.



HOMMEL INCOLINE

Dynamic systems for the measurement of surfaces and form in the development and manufacturing of engines



Precise measurement in the development and manufacture of engines

HOMMEL INCOLINE

The **INCOLINE** products are systems for highly precise roundness and cylinder form measuring for cylinder bores, crankshaft and camshaft bearing seats. The systems are also available to measure valve stem guides and seats, piston and connecting rod bores plus many other applications.

In the 1970's isometric cylinder form with a $1\mu\text{m}$ precision had been created using the **INCOMETER** precision measuring system. The term **INCOMETER** is derived from the words **IN**ner **CO**ntour measuring system. A second product range was developed in parallel to the **Incometer** in the 1980's. This being the optical and tactile surface inspection systems for cylinder bores, the **TOPO-METER**. Hommelwerke has a product range that can be used in research and development to assess results and also in quality control in the manufacture of internal combustion engines. Hommelwerke's ongoing development of measuring technology creates systems that are more and more precise in actively supporting our customers in their daily work.

The list of customers demonstrates that, for more than 25 years, **INCOMETER** and **TOPOMETER** products have been accepted worldwide and used by most engine manufacturers. A highly motivated and experienced team satisfies our customers and guarantees the quality of our products.

Measuring philosophy

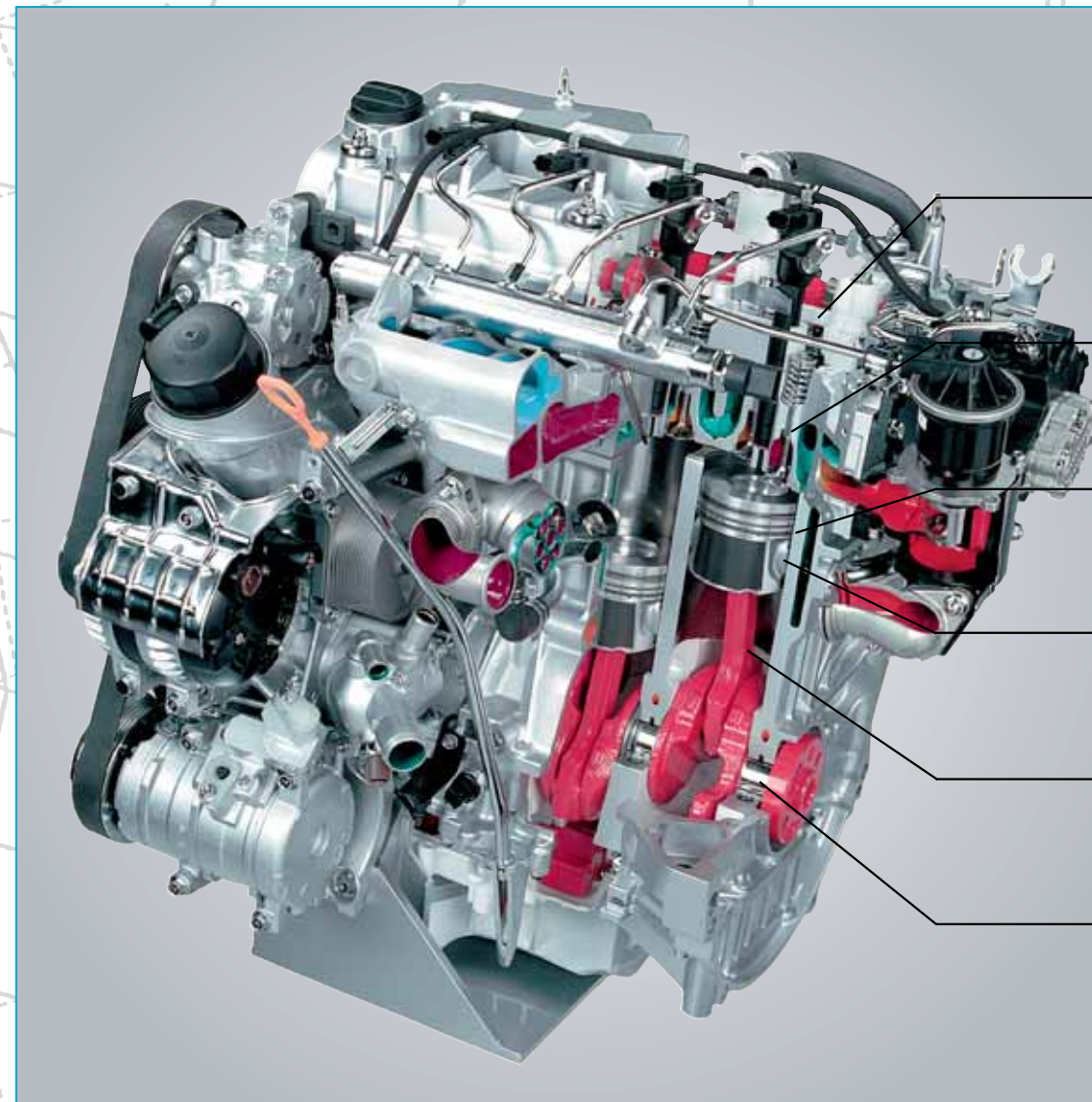
The **INCOMETER** system allows highly precise measurement of form and roundness in cylindrical bores within seconds. The measuring systems are small and compact in their construction. Thereby it is possible to use the systems stationary in the measuring room or mobile on the production line. The consequent application of the measuring principle to further applications as well as the construction of the measuring systems with their uncompromising precision has made them very successful. The **INCOLINE** products have become a quasi standard for the measuring of cylinder bores, crankshaft and camshaft bearings, valve seats and the geometry of valve stem guides.

Measurement of distortion

The piston ring and cylinder bore system has an essential influence on the quality characteristics of modern internal combustion engines. Insufficient sealing of the combustion chamber towards the crankcase results in poor waste gas values, increased oil consumption and finally to increased wear. If the form of the cylinder bore deviates from its nominal shape, the piston ring can only seal within the frame of its limited filling capacity. The filling capacity of the piston ring reduces with the increasing form error of the cylinder bore.

From the beginning of the development until the final series production, appropriate measurements and corresponding tests concerning the shape deviation of the cylinder bore are necessary in order to guarantee the function of the piston ring and cylinder wall system.

Our measuring systems from the **INCOMETER** family rapidly create highly reliable and precise measurement data for the analysis of the cylinder / piston configuration.



Camshaft bearings

Valve guide and valve seat

Cylinder bores

Connecting rod bores

Connecting rods







Crankshaft bearings

Flexible measuring system for form and roundness in cylinder bores

Measurement and analysis of

- cylinder distortion
- cylinder wear
- temperature influence
- piston ring dimensioning

for engine development and production

-  Roundness
-  Straightness
-  Cylindricity
-  Parallelism
-  Inner diameter
-  Concentricity



V-INCOMETER
Probe V-200 with electronics

V-INCOMETER

Quick, reliable, high precision measurement for analytic examination of cylinder piston configuration in engine block development.

Flexible and mobile

The use of different clamping jaws and measuring tips gives the INCOMETER the flexibility to measure the various cylinder diameters often required in development and laboratory applications. The compact design and easy clamping within the cylinder allow the system to be used directly on site. Furthermore, this system can be used for spot-check examinations in production areas.

Special features

The V-INCOMETER captures the efficiency and performance of a stationary measuring machine in a compact, rugged design. Self-adjustment within the measuring object eliminates the need for additional axes or time consuming adjustment work while the software eliminates any eccentricity or inclination of the cylinder to the measuring probe.

Simple operation and handling

The PC-driven system is controlled via the easy to learn Windows Software **INCOWIN**. Measuring routines are pre-defined so that only the appropriate values must be chosen and entered. This eliminates time consuming programming. By changing the appropriate parts (measuring tips and clamping jaws), the probe easily adapts to different diameters.

Applications

With its over 200 installations worldwide the **V-INCOMETER** is designed for the measurement and analysis of cylinder distortions and is mainly used in engine block development and laboratory areas.

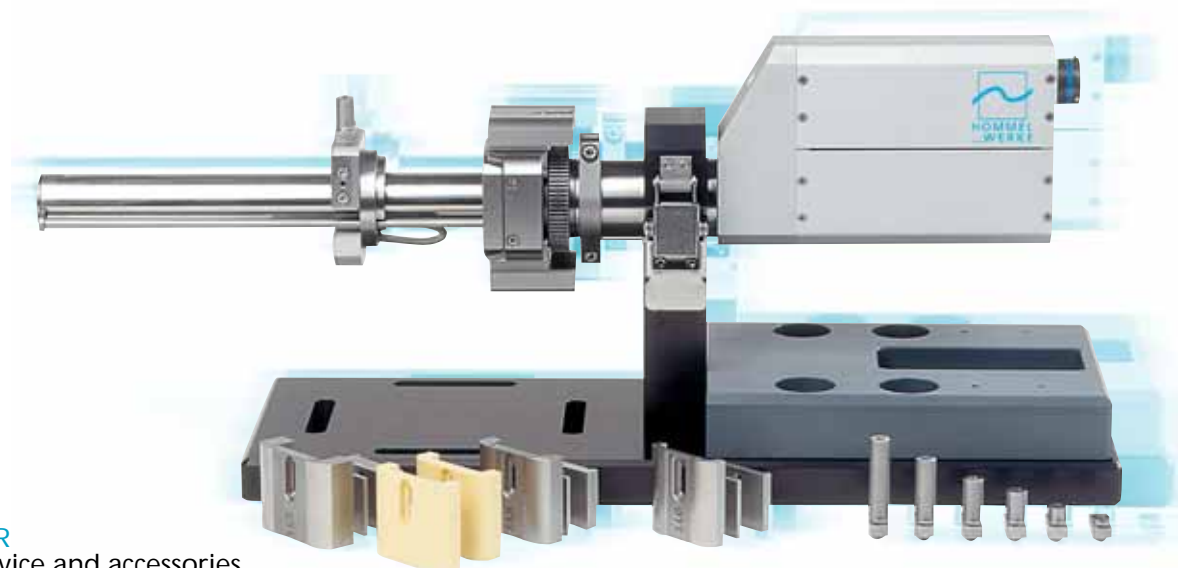
It is especially well-suited for measuring and evaluating the influence of cylinder heads and gaskets on bore distortion in combustion engines. During long-period tests, the wear rate and deformation of the cylinder can be observed. Simple fixturing and quick measurement allow for engine blocks even under high temperature conditions to be measured. This makes it possible to analyze the critical warm-up phase where there are extreme temperature differences between cylinder head and engine block. Theoretical results/models of finite element evaluation can be corrected or confirmed by the measured values.



External plate for fixing the probe



Mobile measuring station



V-INCOMETER
Mounting device and accessories

Software options for research and development

Wear measurement

This module enables the determination of cylinder bore wear. The cylinder bore is measured with high precision, with equally distributed axial scans. Extensive possibilities for the presentation of the measuring results are available.

Distortion measurement due to temperature

The INCOMETER requires only a few minutes to completely measure a cylinder bore. This speed of operation enables hot engine components (in excess of 100° C) to be measured. The distortion due to temperature can therefore be measured, without relying on simulation methods.

Mask-off

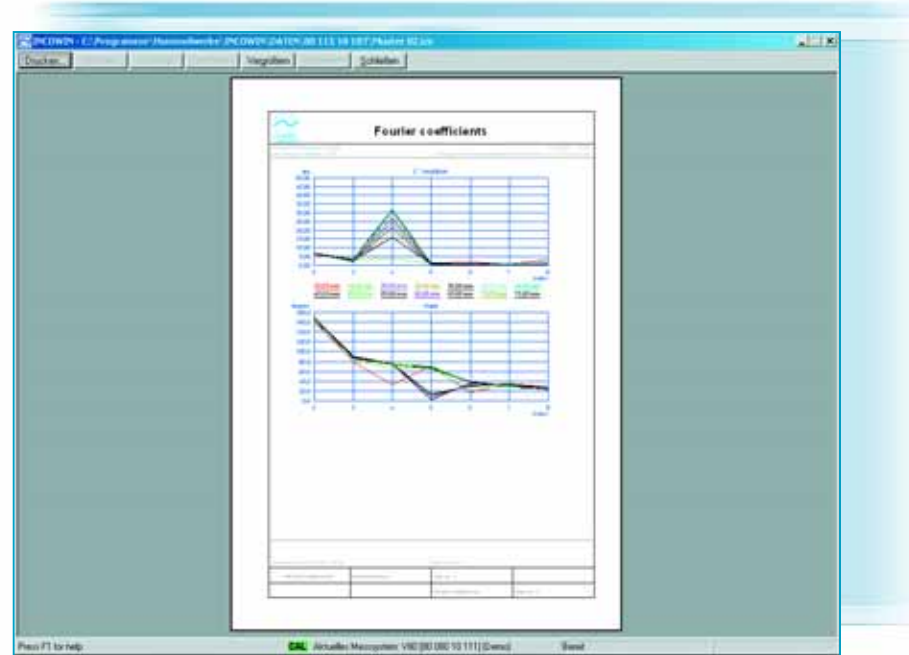
It is important to mask-off certain areas when measuring and evaluating interrupted surfaces, as for example in case of the two-stroke engines.

Fourier coefficients

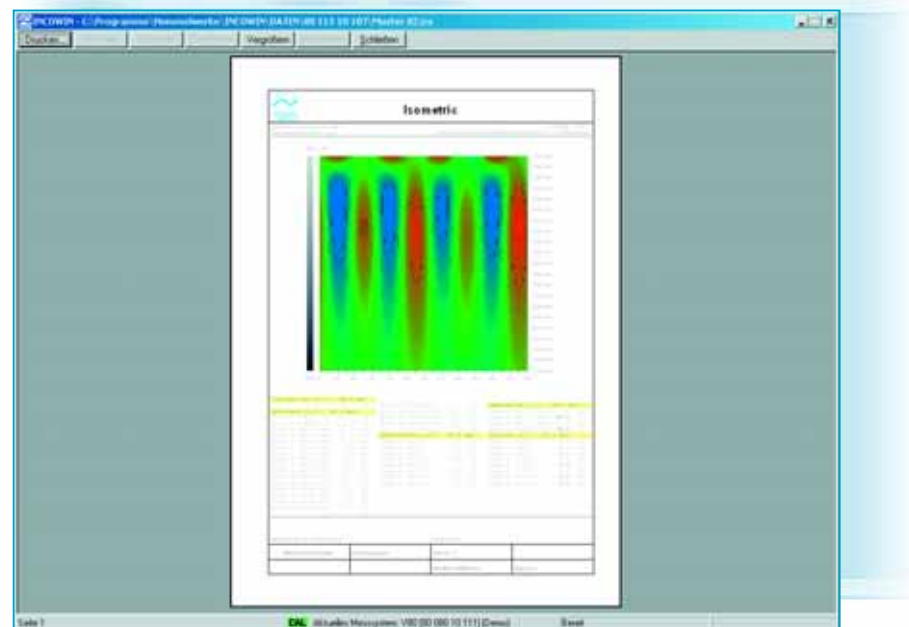
Fourier coefficients in cylinders of internal combustion engines are generally important up to a level of 8. To illustrate the Fourier coefficients better they can be presented graphically.

Output of data

The INCOWIN software supports you with copying (copy & paste) or exporting (creation of JPG or TXT files for example) your measuring results to other Windows applications.



Graphical presentation of fourier coefficients



Relief map of a distorted cylinder liner

Software options for manufacturing

Data transmission to q5-STAT®

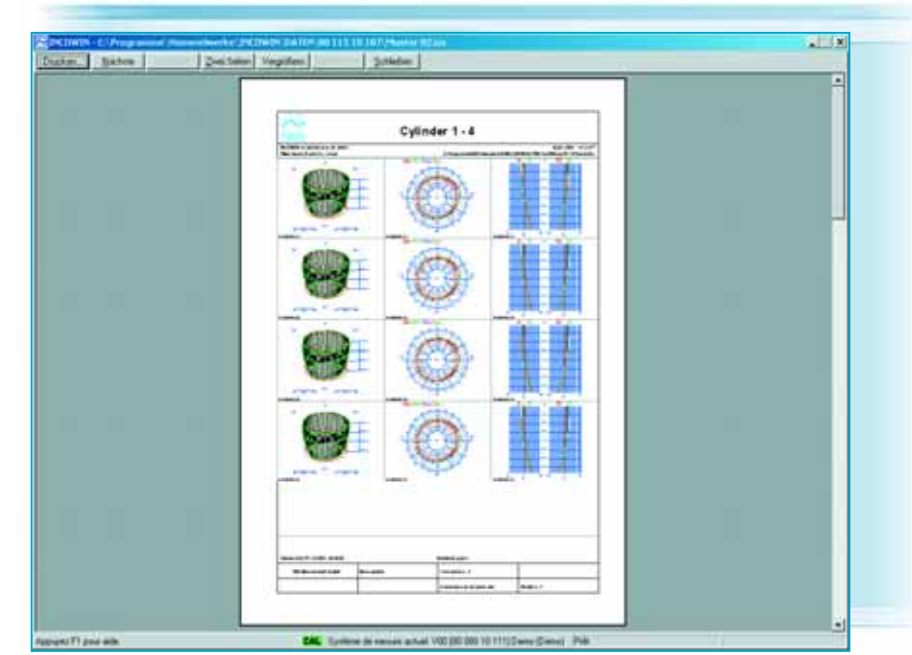
This software package creates files from standard results which can be processed by the SPC package q5-STAT®. The measurement files can be read by other external packages for subsequent statistical evaluation.

Engine measurement and evaluation

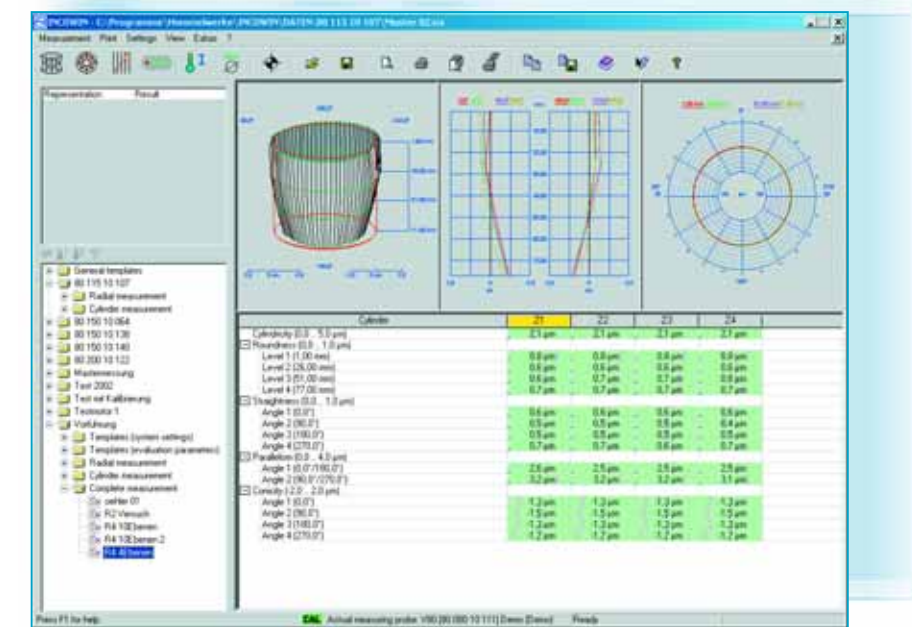
Once all the specification data has been entered into the software, it will enable the measurement of a complete crankcase. The software guides the operator through the measuring procedure. All the measurements for each cylinder are stored in a single file. Evaluation options include the display of the form of each cylinder in a tabular format and also as radial, axial and isometric plots. Multiple plots can be displayed on one page, which can be preset by the operator. Up to 20 graphics are definable on one page.

Measuring the absolute diameter

This software extension permits the measurement of the absolute diameter of the cylinders in the crankcase. Before each measurement the INCOMETER is calibrated to the nominal dimension of the cylinder diameter. This calibration is performed in a special fixture equipped either with integrated calibration rings or with a fixture plate with built-in calibration rings to be mounted on the cylinder head gasket. A third possibility is to manufacture a calibration cylinder with the nominal dimensions of the cylinder bore.



Complete evaluation of a motor unit








All measuring results at a glance

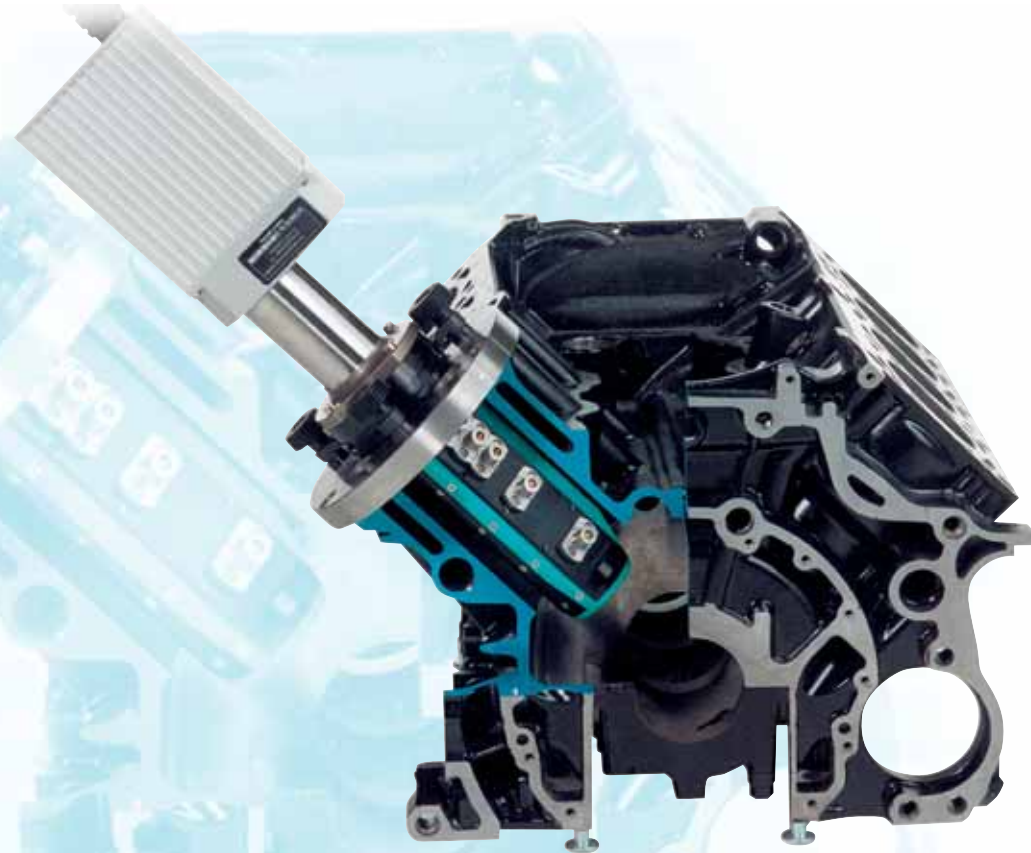
Quick measurement of form in cylinder bores

Precision measurement in seconds of

- roundness
- form
- diameter

in production areas

-  Roundness
-  Straightness
-  Cylindricity
-  Parallelism
-  Inner diameter



P-INCOMETER
Probe TK-5 with electronics

P-INCOMETER

Quick and reliable generation of cylinder bore data accurate to microns, directly in the production area.

Rugged and highly precise

The P-INCOMETER was conceptualized after the long established V-INCOMETER in order to utilize proven technical features, i.e. the connection of the measuring head to the engine block to safeguard against vibration. Also, the "self-adjusting" principle is integrated so that the manual adjustment of the probe to the bore is not necessary. These fundamental features give the system high accuracy even in harsh production environments.

High flexibility

The modular design of the measuring system enables quick and simple adaptation to different bore sizes. By simply exchanging the measuring probe and fixing plates, different engines can be measured without the need for special installation tools. The measuring head is equipped with up to 7 sensors positioned according to customers specifications.

Simple operation

The clearly structured menus of the control and evaluation software INCOWIN enable easy, error-free operation without requiring extensive training. Measurement results can be printed at the end of each cycle.

Mobile use

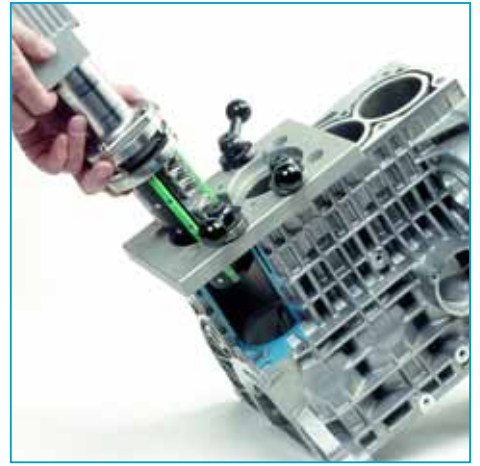
Due to the small size and light weight of the P-INCOMETER, the system is ideal for use on different production lines around the plant.

Easy handling

To take a measurement the P-INCOMETER is inserted into the cylinder bore.

Plastic guide rails are integrated into the measuring head to avoid damage to the cylinder wall. A centering collar on the P-Incometer unit and a fixture plate mounted on the engine block are coupled together by the use of a clamping lever. This ensures that the P-INCOMETER is in the correct measuring position on the engine block.

After starting a measurement, the measuring head begins a scanning rotation of 360°. Measurement values from each sensor are taken simultaneously at a constant speed. After the measurement, which only takes a few seconds, the calculations are computed and the results are printed.



Inserting of the probe



Fixing of the probe

PROTOCOL OF A CYLINDER MEASUREMENT

ROUNDNESS (0...6 µm)

Level 1,	10 mm	: 5.8 µm	-----x-
Level 2,	30 mm	: 4.4 µm	-----x-
Level 3,	50 mm	: 4.3 µm	-----x-
Level 4,	70 mm	: 4.2 µm	-----x-
Level 5,	90 mm	: 5.1 µm	-----x-

STRAIGHTNESS (0...6 µm)

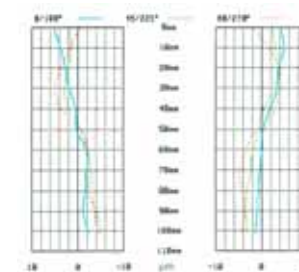
Angle 0°	: 2.3 µm	-----x-
Angle 90°	: 5.5 µm	-----x-
Angle 180°	: 1.7 µm	-----x-
Angle 270°	: 4.9 µm	-----x-

PARALLELISM (0...12 µm)

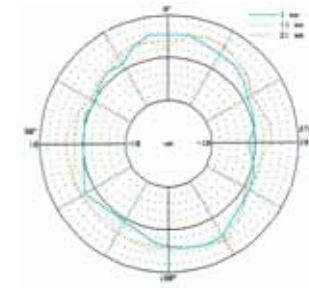
Angle 0 / 180°	: 8.8 µm	-----x-
Angle 90 / 270°	: 13.5 µm	-----x-

CYLINDER FORM (0...12 µm)

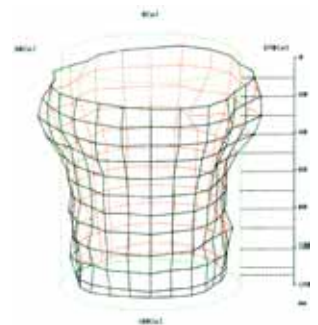
	: 11.9 µm	-----x-
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Axial plot of a cylinder bore



Radial plot of chosen levels









Isometric plot of cylinder bore

Form measuring system for crank- and camshaft bearings

Measurement and analysis of

- roundness
- form
- alignment

of parallel bores and bearings in development and production areas

-  Roundness
-  Straightness
-  Cylindricity
-  Parallelism
-  Inner diameter
-  Concentricity

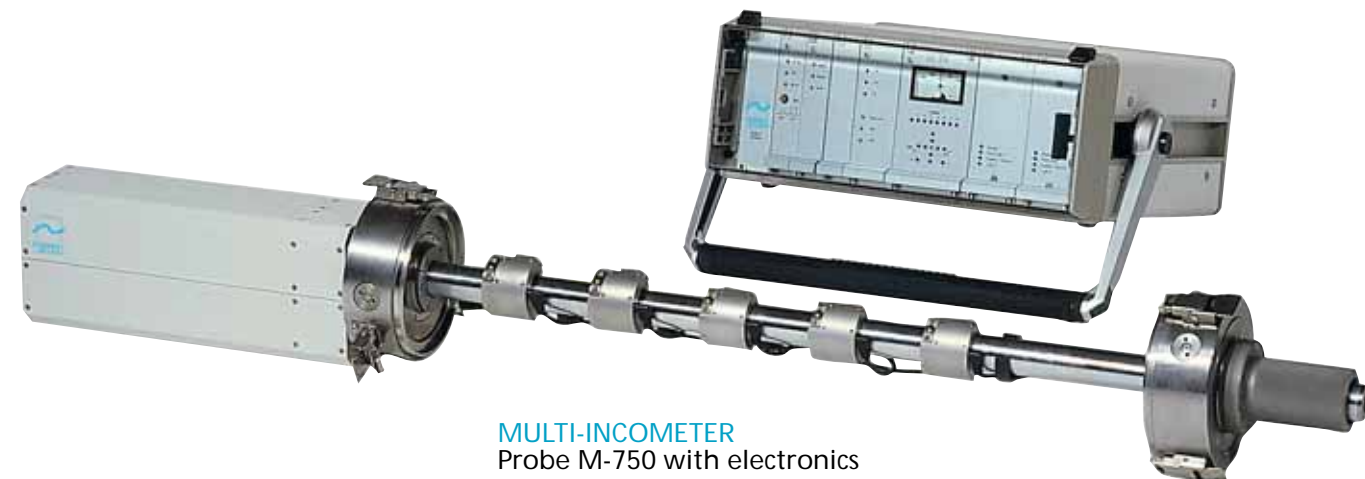
MULTI-INCOMETER

Quick and reliable documentation of roundness, form and alignment of parallel bores and bearings in development and production areas.

Economical measurement

Unlike conventional form measurement machines, the size of this machine is not determined by the object to be measured. Thanks to the design of the

MULTI-INCOMETER with exchangeable measuring heads and/or measuring shafts, simple adaptation of the probe to different engine block dimensions is made possible. The simultaneous measurement of up to eight measuring locations allow for shortened measuring times. The software activates appropriate control and evaluation programs, eliminating time consuming programming. The results are available immediately after the measurement, therefore enabling quick, on-site analysis.



MULTI-INCOMETER
Probe M-750 with electronics

High flexibility

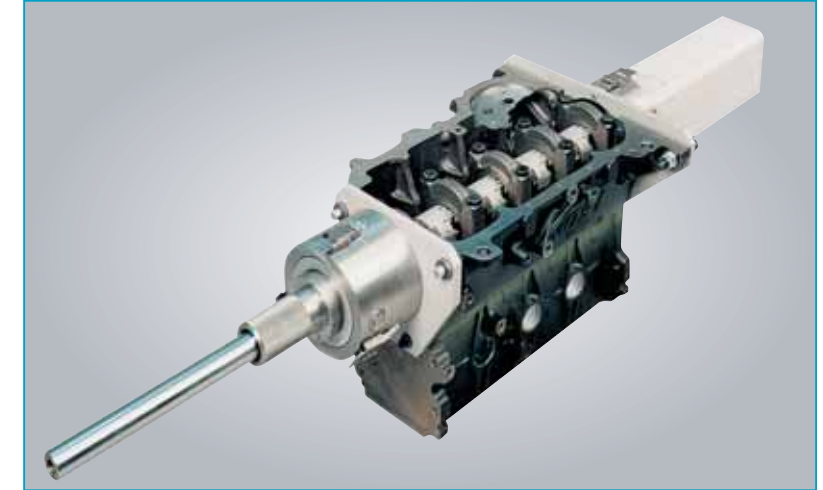
Due to the modular design with exchangeable measuring shafts and adjustable measuring heads various types of objects can be inspected (i.e. crankshaft and camshaft bearings, gear boxes, etc.).

Simple operation and handling

The probe is inserted into the bearing line, mounted on the drive side and the shaft end and fixed within the object to be measured. This installation is done with simple, appropriately adapted flanges. These flanges are pre-aligned and fixed to the object with a centering unit before the probe is inserted. For production areas where different measurements are frequently taken, fixtures are used which do not require pre-centering. This makes it possible to start a measurement immediately after inserting the probe. Through use of the function keys, the connected computer and the clear menu-guided software INCOWIN, the MULTI-INCOMETER measuring system can be operated without extensive training.

Mobile use

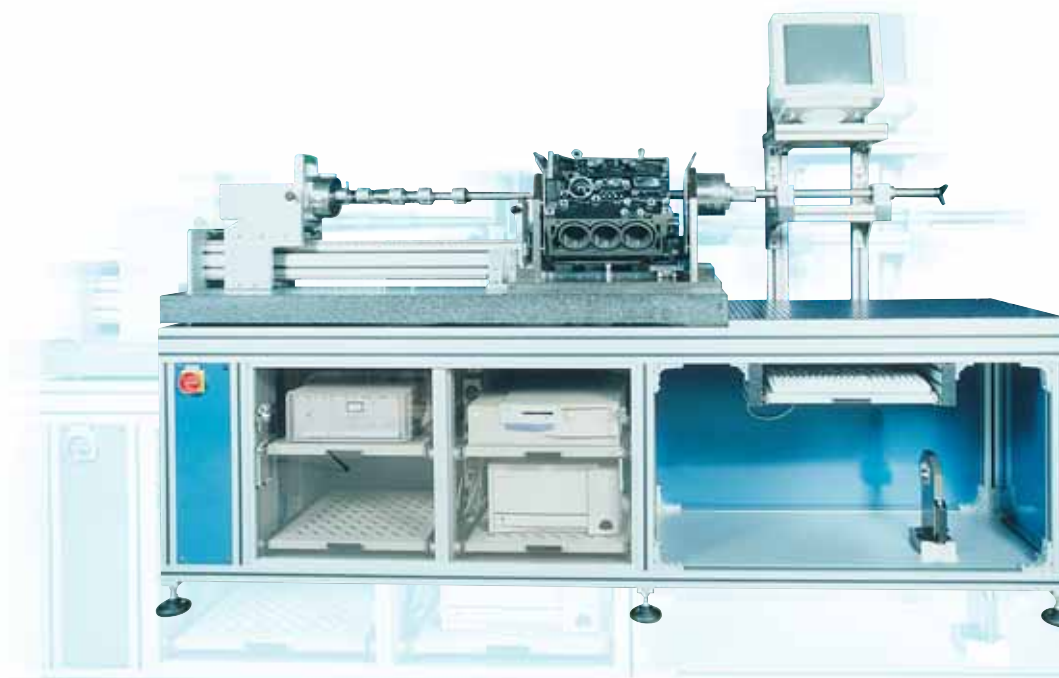
The MULTI-INCOMETER system is quickly ready for use and measurement. It is especially well-suited for on-site measurements because of its small dimensions and portability. This makes the MULTI-INCOMETER very practical for use in different areas such as development, laboratory, inspection and also in production.



Measurement of crankshaft bearings



Fixture for cylinder head



Mounting device for the crankshaft bearing line. Measurement directly after inserting the probe into the engine block without pre-alignment

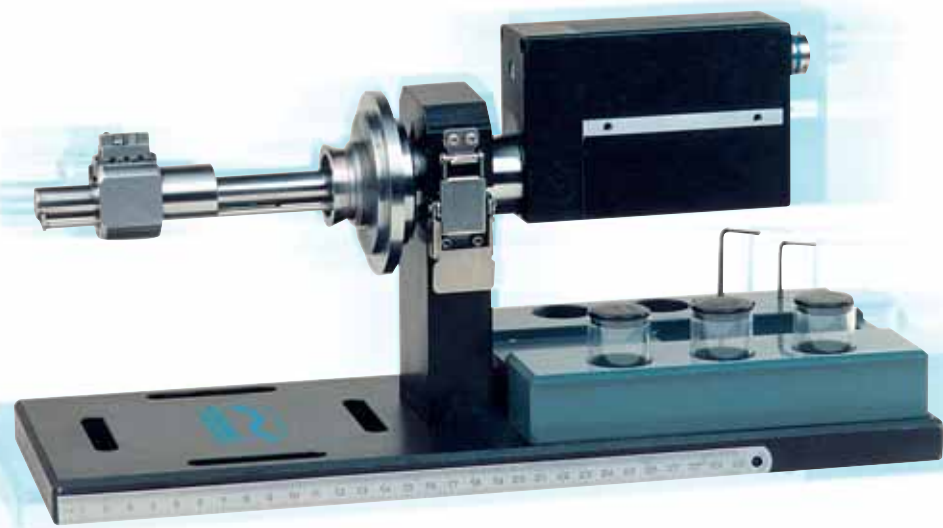








Form measuring system for small cylinder bores

Measuring of

- Cylinder distortion
- Cylinder wear
- Influence of temperature
- Dimensions of piston rings

In the development and manufacture of engines



-  Roundness
-  Straightness
-  Cylinder form
-  Parallelism
-  Interior diameter
-  Concentricity

Applications

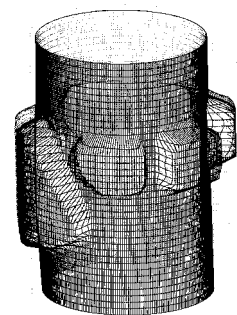
The VS-INCOMETER has been specially designed for the measurement and analyse of cylinder distortions of small diesel engines, together with two-stroke and four-stroke engines. These engines are used mainly in small agricultural and forestry appliances. The system is predominately used in measuring rooms for research and development, though the robust and compact design also enables its use on the shop floor.

Simple and rapid use

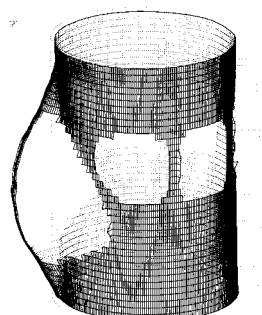
The Windows Software INCOWIN allows an easy adaptation and programming of the system through a menu in order to minimise operator training and enable its simple and effective use. The transmission of all measurement data to a server enables external evaluations and SPC analysis.

Abstract

The use of this special measuring system is of major benefit to the manufacturer of engines, considering the strict regulations regarding fuel consumption, higher power and lower emissions. The investment in an Incometer system will quickly repay itself.



Isometric Form with 40 levels



Isometric Form with automatic masking-off

VS-INCOMETER

A Rapid and reliable measuring system with maximum precision for detailed testing of cylinder bores on small engines.

Special advantages

The VS-INCOMETER has been developed from the worldwide renowned V-INCOMETER. The large range of diameters from 39 – 100 mm enables its use in many different engine types. The measurement method scans with up to 14.400 data points per revolution and up to 40 levels. This method reduces the total measuring time to an absolute minimum. This fact and the automatic adjustment of inclination and eccentricity of the sensor relative to the bore are unique.









Form measuring system for internal and external contours

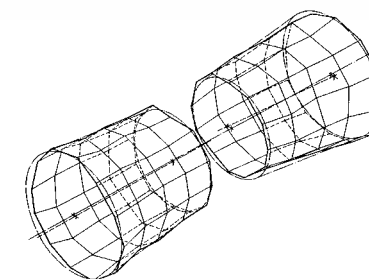
Measuring of

- Cylinder distortion
- Cylinder wear
- Temperature influence
- Piston ring dimension

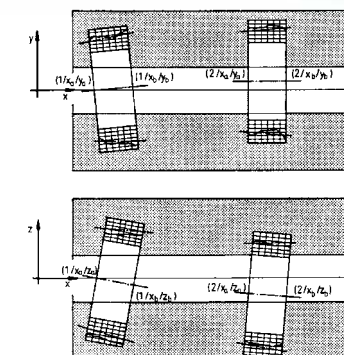
In the development and manufacture of engines



-  Roundness
-  Straightness
-  Cylinder form
-  Parallelism
-  Interior diameter
-  Concentricity



Isometry of two bearing shells



Alignment of two bearings

Simple handling

Due to the well-structured and easy to use Windows Software INCOWIN the system can be operated with ease, using the menu structure of the control and evaluation unit and the clear user interface. The measured values can be used for determining the form of small bores and shafts. The measuring sensor has the same advantages as all devices of the INCOMETER family: high precision, rapid and flexible use and extensive programs for command, adjustment and evaluation of measured data.

Application

The MINI-INCOMETER is used worldwide especially in the area of engine development and experimental manufacturing. The system is particularly useful for the measurement of bearings with small diameters in previously inaccessible places.

A special application of the MINI-INCOMETER is the measuring of piston pin bosses relating to form, alignment and the precise measurement of small shafts or the measurement of external or internal contours.

MINI-INCOMETER

Rapid, reliable and highly precise measurement for the analysis of small bores and shafts.

Flexible and mobile

Due to its simple operation the INCOMETER can be adapted to suit different diameters within seconds. This meets one of the main requirements for the use in development and testing departments.

Due to its light weight and compact design the INCOMETER can be easily used in many different areas within the shop floor.





Surface inspection system for cylinder bores

Measurement and assessment of surface features as

- Crosshatch-angles
- Dimension of surface structure
- Area of blowholes
- Stroke reversal radius
- Roughness

of cylinder bores in development, research and production areas



TOPOMETER

Quick and accurate inspection of cylinder bore surfaces directly on the production floor. Visual inspection of surface features and contact inspection of surface finish are uniquely combined in one compact measuring probe.

Highly flexible

The TOPOMETER TM 111 inspection unit is available in two versions. A base model serving solely as a visual inspection unit, and an extended model combined with roughness measuring capabilities. Visual kits can be upgraded or retrofit to full feature models. The probes are available in operating length of 150 mm and can be used in bores all the way down to 60mm in diameter. Different bore diameters are adapted by simply exchanging the locators used for radial pivoting and centering of the probe.

Easy handling

The entire system control is centrally located in the compact industrial PC with extension boards for live video display, image processing and the roughness testing unit. The systems software menus are clearly structured and guide the operator through the individual steps of operation. The software is operated using the keyboard function keys,

the mouse or the track ball. In addition, the functions needed most frequently during operation, such as motorized axial positioning, motorized zoom and focus adjustment and illumination adjustment are ergonomically located directly on the probe itself or can be adjusted by using the keyboard. Within seconds of inserting the high resolution optical probe in the cylinder bore, the inspector sees a magnified image of the surface on the PC system.

Complete bore assessment

The system enables the complete assessment of the inspected cylinder bore. This complete assessment includes fast axial scanning, a full range of possible visual measurements at any location within the bore and the capability to evaluate these areas within the bore in terms of all standard DIN and ISO roughness parameters. The individual, adjustable light sources enable optimum illumination of any particular bore surface to be measured.

Wide range of functions

The user-friendly menus allow the inspector to quickly measure the cross-hatch pattern, including angles in degrees, grooves width or other dimensions in inch or metric, areas of defects and stroke reversal radius. An easy-to-use control panel lets the inspector select the measuring mode and complete the measuring in a matter of seconds. The data is displayed on the screen in the desired unit.

High sampling rates

For rapid angular check, a tolerance mode overlays a "reference" angle in the middle of the screen with angular limits set to correspond with the specified tolerances selected. The operator positions the tolerance image over the cross-hatch angle to be checked and visually verifies the fit.

Documentation guaranteed

The optical video printer supplies immediate hard copy photographic documentation of the image and data on the video screen. A laser-printer can be connected for numerical and graphical printouts of the roughness parameters and profiles. Optical discs are available for video image storing and archiving.

Mobile use

Due to the compact design and the low weight of the probe of the measuring system can be comfortably moved to different locations throughout the plant floor.

TOPOMETER

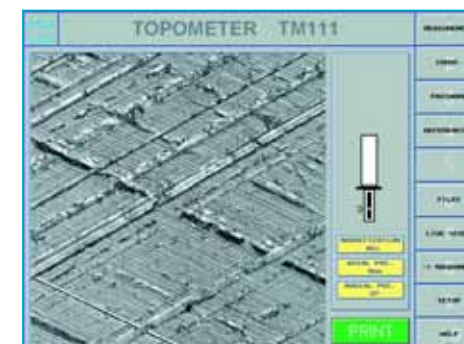
The ideal inspection unit for quick and accurate inspection of cylinder bores directly in production areas.



Evaluation of the cross-hatch angles



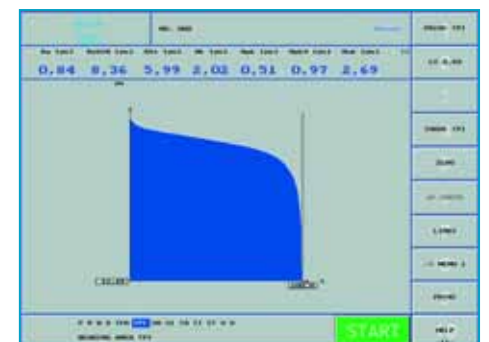
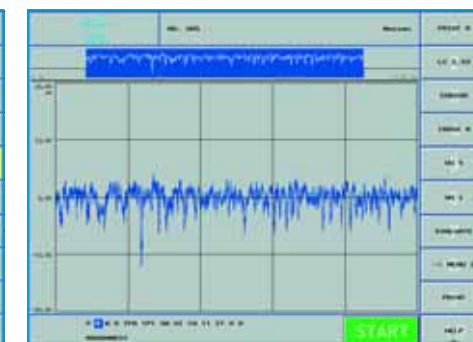
Industrial housing for use in production environments



Display of a bore surface



Display of roughness profiles



SAM – Semi-automatic measuring system

Precision measurement of

- roundness and form
- surface structure
- roughness

of cylinder bores in production areas

SAM

Quick generation of data directly in the production area.

Rugged and highly precise

For measurement in production areas, high demands are made on the design integrity, especially on the measuring probes used. By the use of proven rugged, standard measuring probes i.e. the INCOMETER MR100 with its self-adjusting principle, high accuracies are guaranteed even in harsh production environments.

High flexibility

The modular design of the SAM enables easy adaptation for different measuring tasks. This is achieved by the combination of different measuring probes. An additional extension for other measuring probes is possible for more measuring applications. Due to the integrated NC-axis varying bore pitches can be handled on one machine.

Compact design

The measuring machine type SAM is built using aluminium profiles. The sturdy carriers of the machine base are set on the floor with vibration pads removing frequencies from surrounding machinery.

The riser assembly for the measuring probes mounted to the machine base, is build of profiles with foamed cores and is additionally supported by diagonal struts. This makes the assembly extremely stiff and insensitive to external vibrations.

Simple operation

External function keys and a clear structured control software guarantee the simple operation of the system without a great deal of training. The machine requires only one terminal for the entire system control and evaluation. The fully automatic measuring sequence relieves personnel operation.

Automatic measuring sequence

After the loading of the SAM and starting the measuring cycle, the engine block is positioned below the probes and the bores are measured sequentially. Upon completion of the measurement the engine block is automatically transferred back to the loading position.

Modern control design

By the combination of an IBM-compatible work station with a fieldbus system, the control signals and the measured data are transferred and calculated together so that short measuring times

are achieved. The whole electrical section of the machine, including control and evaluation computer, is installed in a double cabinet. All standard safety procedures are considered in the mechanical and electrical design. The design enables a simple diagnostics and repair in the case of a breakdown.

SAM

The measuring station offers the possibility to monitor the quality of the production process with the accuracy of laboratory equipment. Quality control can be achieved directly at the production line.



Probe MR 100
Roundness and form

- Roundness
- Straightness
- Cylindricity
- Parallelism
- Inner diameter

Probe H 100
Surface finish

- Structure
- Cross-hatch angle
- Width of grooves
- Hone quality

Probe R 100
Roughness








- Depth of roughness
- Average roughness value
- Average peak to valley height
- Mean peak height

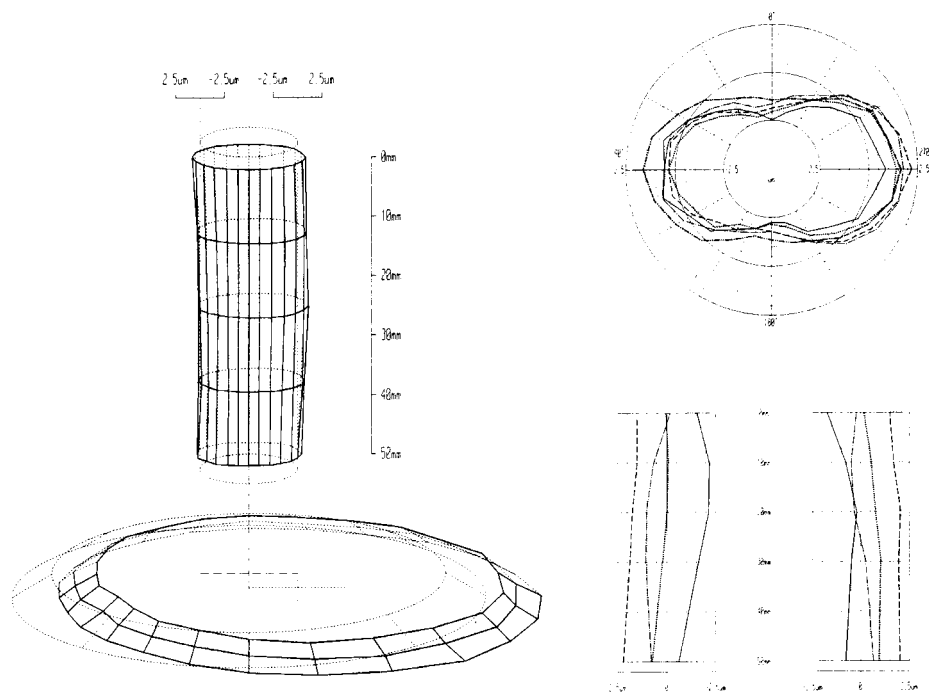
Measuring system for valve guide and valve seat

Measuring system for valve guide and valve seat

- Roundness
- Form
- Run-out
- Angle
- Width

of valve guide and seat

-  Roundness
-  Cylindricity
-  Run-out
-  Diameter
-  Straightness
-  Parallelism
-  Seat angle
Seat width



VALVE guide / seat measuring station

Quality data for roundness, form, run-out, angle and width directly in the production area.

Highly precise and rugged

For measurement in production areas, high demands are made on design integrity. By the use of proven rugged standard measurement probes, i.e. the INCOMETER MV 100, accuracies within 1 micron are reached even in harsh production environments.

High flexibility

The modular design of the measuring head enables easy set-up to different geometric configurations, e.g. different valve seat diameter ranges for intake and exhaust ports. Different head types can be measured on one machine by changing fixture plates and choosing the appropriate software programs.

Compact design

The measuring station is built using sturdy aluminium profiles. The station is mounted on anti-vibration pads to eliminate low frequencies from surrounding machinery. The complete electrical section of the machine, including the PC-based control, evaluation computer and EC 110 electronics unit is integrated into the base machine. All standard safety procedures are considered in the electrical and mechanical design. This design facilitates simple diagnosis and repair in the event of a breakdown.

Simple operation

Due to the systems automatic valve recognition, operator errors are reduced to a minimum. The clearly structured software guarantees the simple operation of the system without a great deal of training. The entire system control and evaluation is operated through the PC-keyboard.

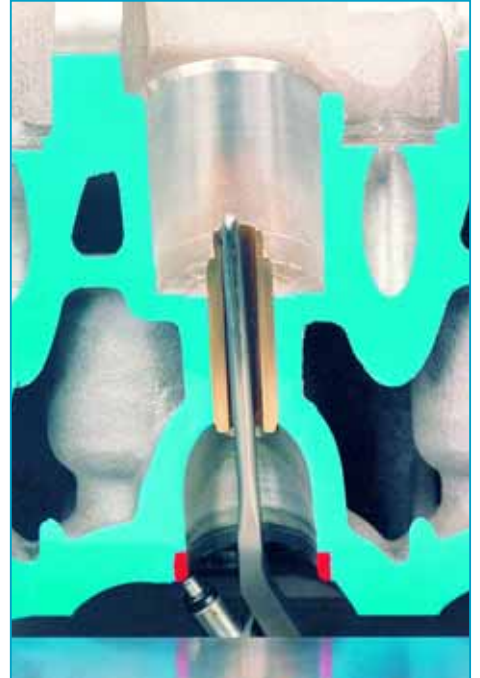
Automatic measurement sequence

After manually loading and located the cylinder head onto the fixture and positioning it into the measuring location, the operator begins the automatic measuring sequence for the relevant guide / seat.

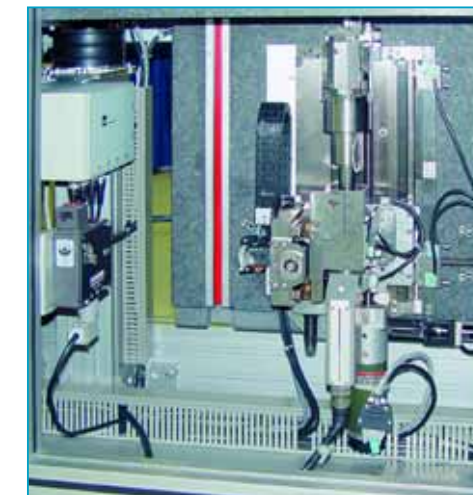
The system then automatically corrects any inherent misalignment of the measuring probe to the guide / seat using the x-y compensation unit required, and then completes the measurement sequence. Upon completion, the next valve location is positioned and the measuring cycle re-started. Fully automatic versions with automated part movement reduce the operator handling to loading and unloading.

Valve guide / seat measuring station

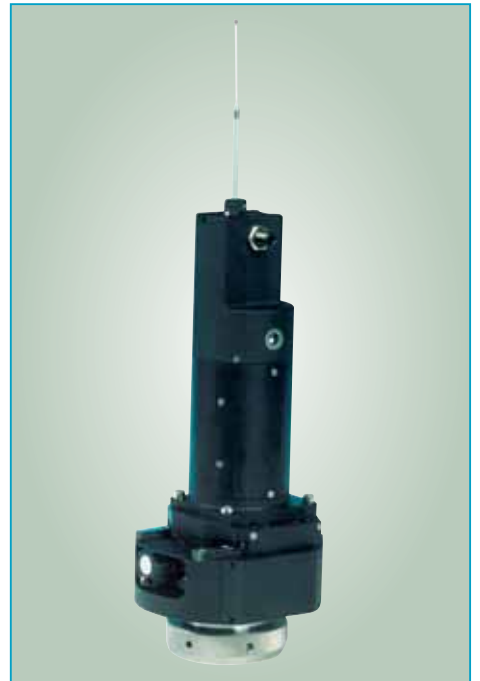
The measuring station VMM offers the possibility to monitor the quality of production procedures with the accuracy of laboratory equipment. Quality control can now be achieved directly also on the production line.



Measuring sensor in contact with valve guide and seat



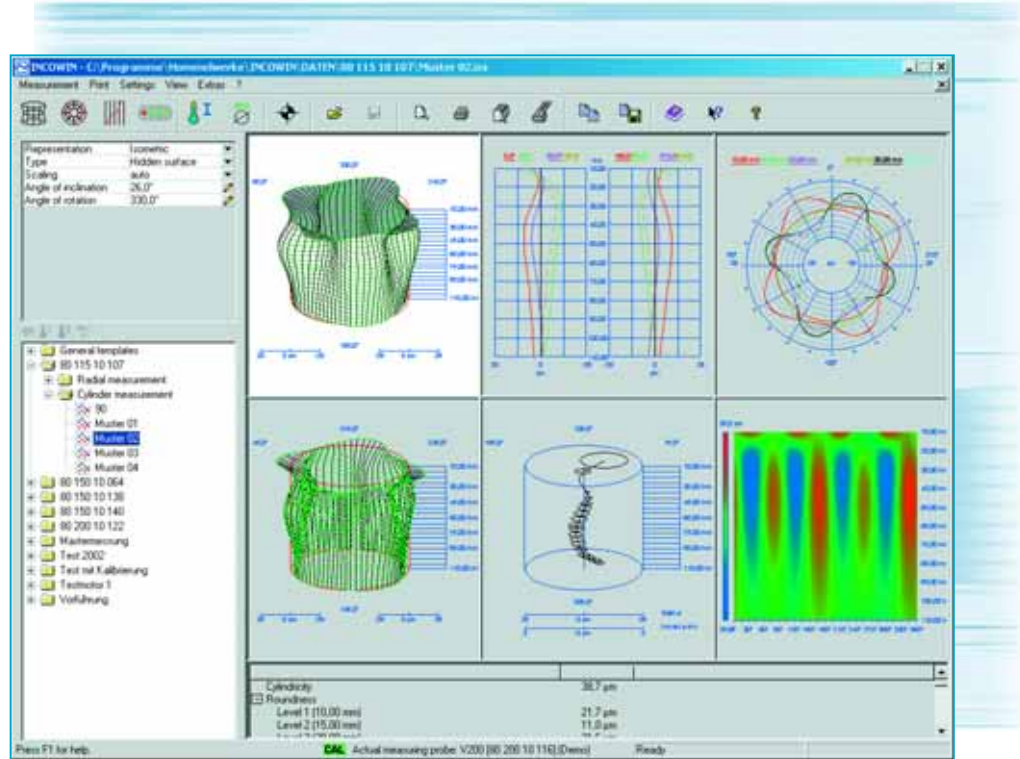
y-z compensation unit with tilting unit



Measuring head unit

Windows control and evaluation software for INCOMETER

- Scanning measurements as a standard feature
- Upgrade capability for earlier systems
- Multi-tasking Windows application
- Rapid setup of all customer specific requirements
- Optimum system portability with notebook PC



Clearly arranged out desktop with 100% context sensitive online help function

INCOWIN

The new Windows software, **INCOWIN**, enables the usage of the **V-INCOMETER** system with latest operating systems such as Windows NT, Windows 2000 and Windows XP. The intuitive operation of the measuring system, straight forward editing of new measurement protocols and the networking capability for centralized data storage are just some of these advantages.

Multi-Tasking

A new interface board has been developed to handle timing critical functions. The entire logic is generated in the microprocessor based INCO2 interface board, which is integrated in the EC110 electronics unit. The connection between the PC and the electronics unit is merely a standard interface cable. This feature enables the operation of the **INCOMETER** system with a notebook PC creating a new dimension of portability.

Copy & paste function

The **INCOWIN** software supports the "copy & paste function" of Windows. In this way both the graphics and the parameter list can be copied to other Windows applications by Ctrl-C and Ctrl-V. This provides a further powerful tool for creating reports and documentations in addition to the extensive printing functions of the **INCOWIN** software.

Dynamic measurement

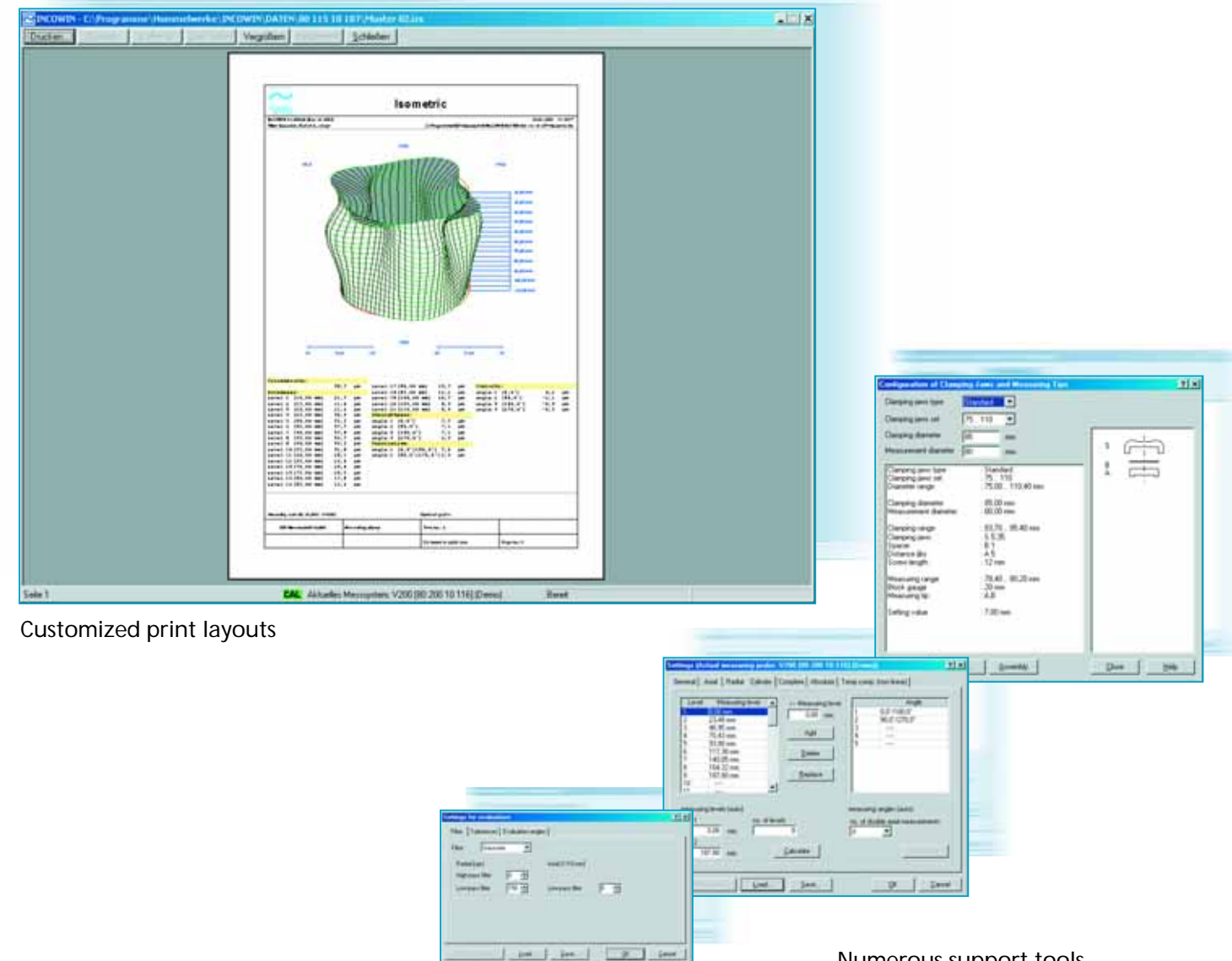
The Windows based system now includes high resolution scanning capability. The standard measurement of cylinder bores is done with a high resolution scanning and evaluation of each level with 14.400 steps or 1.024 points per level. Axial measurements are carried through as scans with the max. possible steps of 600 measured points per millimeter. The greatest advantage of this new scanning capability is the high resolution representation of the actual bore geometry reflecting the true quality of manufacturing precision. The higher data density allows for the use of stan-

standard filtering routines with a wide range of settings. Fourier, gaussian and median filters with settings from 0-500 upr are possible. Additionally this advanced „continuous scanning“ operation reduces the actual measuring time to approx. 10 seconds per level regardless of the number of points (24, 72, 144, 180, 360, 720 or 1.024) chosen for the final evaluation.

Upgrade

The described changes require certain hardware pre-requisites. Due to this an upgrade of the system to the new Windows control and evaluation software may require different degrees of alter-

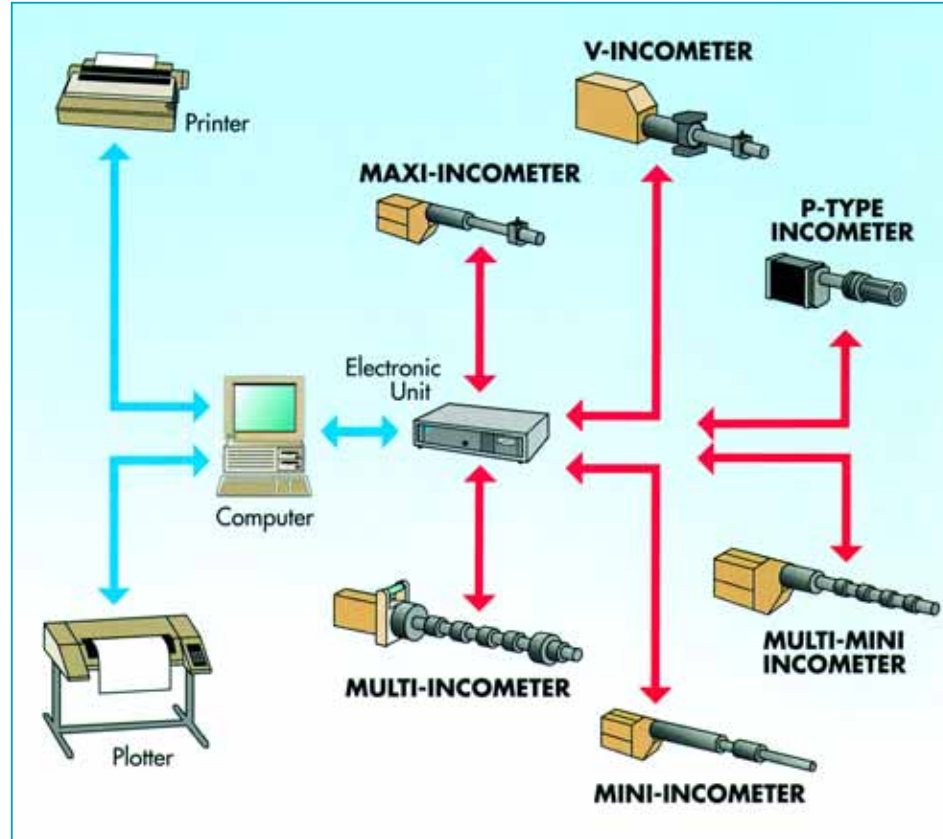
ations depending on the age and accordingly the technological status of the system. Older systems that still operate with the electronics unit type EC100M are neither capable to operate in the high resolution scanning method nor functionable with the new **INCOWIN** software. Therefore, they will need to be converted to the electronics unit type EC110. The communication between the PC and the electronics unit is carried through by a standard serial interface in conjunction with the new INCO2 interface board which replaces the previous interface.



Customized print layouts

Numerous support tools

Product family



INCOMETER family

The modular structure of the measuring systems permits the operation of different measuring sensors with one single electronic and computer unit. This saves money and increases the mobility of the systems.

Product range

Dimensions in mm

	Ø min/max	Height/Depth	Width of parts	Length of parts	Weight	Laboratory	off-line
with INCOTEC products	≤	≤	≤	≤	≤		
Cylinder bore	36 – 350	500	500	700	60	VS-INCOMETER V-INCOMETER MAXI-INCOMETER	P-INCOMETER SAM
Cylinder liners	30 – 350	600	Ø 320	620	30	VS-INCOMETER V-INCOMETER MAXI-INCOMETER	P-INCOMETER SAM
Camshaft bearing bore	22 – 100	60	325	600	30	MULTI -(MINI)- INCOMETER	MULTI -(MINI)- V-INCOMETER
Crankshaft bearing	50 – 120	60	500	700	60	MULTI (MINI) INCOMETER	MULTI (MINI) INCOMETER
Valve guide bore	5 – 10	50	325	600	30	VMM	VMM
Valve seat	25 – 45	2,5	325	600	30	VMM	VMM

FORM MEASUREMENT

	V-INCOMETER				Mini-INCOMETER	VS-INCOMETER	Maxi-INCOMETER		Multi-INCOMETER			Multi-Mini-INCOMETER	P-INCOMETER	SAM
	V 80	V 115	V 150	V 200	K 100	VS 100	L 275	L 400	M 600	M 750	M 1000	C 500	P 100	MR 100
Diameter of the cylinder *	65 – 155 mm				16 – 65 mm	39 – 100 mm	110 – 305 mm		50 – 75 mm	55 – 85 mm	60 – 100 mm	22 – 55 mm	60 – 110 mm	65 – 150 mm
Clamping length min.	20 mm	20 mm	25 mm	30 mm	ext. fixture									
Axial measuring range	80 mm	115 mm	150 mm	200 mm	100 mm	100 mm	275 mm	400 mm	60 mm			60 mm	max. 300 mm	max. 300 mm
Measuring path on the circumference	360°													
Radial measuring range	± 400 µm				± 700 µm	± 500 µm	± 700 µm		± 700 µm			± 700 µm	***± 500 / 1000 µm	± 1000 µm
Resolution	0,1 µm													
Number of measured values per rotation	14.400 / 1.024				4.096	4.096	4.096		4.096			4.096	14.400 / 1.024	14.400 / 1.024
Number of sensors	1				1	1	1		max. 8			max. 8	max. 7	max. 8
Repeating accuracy														
Roundness	≤ 1,0 µm				≤ 1,0 µm	≤ 1,0 µm	≤ 1,0 µm	≤ 1,5 µm	≤ 1,0 µm			≤ 1,0 µm	≤ 1,0 µm	≤ 1,0 µm
Cylinder form	≤ 1,5 µm				≤ 1,5 µm	≤ 1,5 µm	≤ 1,5 µm	≤ 1,5 µm	≤ 1,5 µm			≤ 1,0 µm	≤ 1,0 µm	≤ 1,0 µm
Parallelism	≤ 1,5 µm				≤ 1,5 µm	≤ 1,5 µm	≤ 1,5 µm	≤ 1,5 µm	≤ 1,5 µm			≤ 1,0 µm	-	-
Measuring accuracy														
Roundness	≤ 1,0 µm				≤ 2,0 µm	≤ 2,0 µm	≤ 2,0 µm	≤ 3,0 µm	≤ 1,0 µm			≤ 2,0 µm	≤ 1,0 µm	≤ 1,0 µm
Cylinder form	≤ 1,5 µm				≤ 2,0 µm	≤ 2,0 µm	≤ 2,0 µm	≤ 3,0 µm	≤ 1,5 µm			≤ 2,0 µm	≤ 1,5 µm	≤ 1,5 µm
Parallelism	≤ 1,5 µm				≤ 2,0 µm	≤ 2,0 µm	≤ 2,0 µm	≤ 3,0 µm	≤ 1,5 µm			≤ 2,0 µm	-	-
Temperature range of use **	20 – 40 °C													
Power supply	230 V / 50 Hz 115 V / 60 Hz													
Power consumption	150 W				150 W	150 W	150 W		150 W			150 W	150 W	
Weight of the sensor	2,9 kg				2,5 kg	1,9 kg	14 kg	21 kg	15 kg	17 kg	21 kg	16 kg	8 kg	

* Further diameters on demand **Measuring of the warm distortion on demand ***Dependant on the diameter

OPTIC AND ROUGHNESS

	Topometer		SAM	
	O 150	OR 150	H 100	R 100
Diameter*	60 - 110 mm		65 - 150 mm	
Axial measurement length	150 mm		300 mm	
Zoom optic	30 - 160 times (on the screen)		ca. 100 times (on the screen)	
Test zone	40 fach: 4,0 x 4,0 mm		100 fach: 1,6 x 1,6 mm	
	100 fach: 1,0 x 1,0 mm			
	160 fach: 1,0 x 1,0 mm			
Resolution 1/2" CCD camera	752 (H) x 582 (V)		752 (H) x 582 (V)	
Presentation on the screen	512 (H) x 512 (V)		512 (H) x 512 (V)	
Illumination	direct / indirect		direct / indirect	
Axial position	Motor-driven		Motor-driven	
Radial position	Manual		Motor-driven	
Focus adjustment	Motor-driven		Motor-driven	
Power supply	230 V / 50 Hz 115 V / 60 Hz			
Power consumption	200 W			
Operating modes	Scanning mode			
	Measuring mode			
Evaluation (Optic)	-		Roughness measuring	
	Hone angle		Hone angle	
	Stroke reversal radius		Stroke reversal radius	
	Spaces / width of grooves		Spaces / width of grooves	
	Detection of porous spots		Detection of porous spots	
	Tolerance zone (angle)		Tolerance zone (angle)	
	Meter / inch		Meter / inch	
	Laser structure (optional)		Laser structure (optional)	
Evaluation (Roughness)	All standard parameters according to DIN and ISO Ra, Rpk, Rvk, Tpi, etc.		All standard parameters according to DIN and ISO Ra, Rpk, Rvk, Tpi, etc.	
Documentation	Axial height of view		Axial height of view	
	Set magnification		Set magnification	
	Date / time		Date / time	
	Parts identification		Parts identification	

* Further diameters on demand

VMM

Valve guide diameter	≥ 5 mm
Valve guide length	50 mm
Valve seat diameter *	21 - 42 mm
Number of measuring points per level	14.400 / 1.024
Measuring range of the sensors	± 500 µm
Resolution	0,1 µm
Number of sensors	1 / 2
Repeating accuracy **	
Roundness	≤ 1,0 µm
Form	≤ 1,5 µm
Concentricity between valve guide and seat	≤ 3,0 µm
Seat angle	≤ 0,1°
Seat width	≤ 10 µm
Measuring accuracy **	
Roundness	≤ 1,2 µm
Form	≤ 1,8 µm
Concentricity between valve guide and seat	≤ 5,0 µm
Seat angle	≤ 0,2°
Seat width	≤ 15 µm
Temperature range of use	20 - 40 °C
Power supply	230 V / 50 Hz 115 V / 60 Hz
Power consumption	400 W
Dimensions	2300 x 600 x 1600 mm
Weight	app. 400 kg

* Further diameters on demand ** Dependant on the measured object

SAM

Available sensors	
Form measurement	MR 100
Surface inspection	H 100
Roughness measurement	R 100
Temperature range of use	20 - 40 °C
Power supply	3 x 380 V / 50 Hz 3 x 460 V / 60 Hz
Power consumption	3500 W
Measuring machine dimension	
Without protective grating	3000 x 1200 x 1900 mm
With protective grating	3100 x 1300 x 1900 mm
Control cabinet dimension	
Without air conditioning	1400 x 600 x 2000 mm
With air conditioning	1400 x 600 x 2400 mm
Weight	
Measuring machine	1000 kg
Control cabinet	450 kg

Precision is our business.



Product Programme

ROUGHNESS MEASURING
CONTOUR MEASURING
OPTICAL SHAFT MEASURING
FORM MEASURING
GEAR MEASURING
CRANKSHAFT AND CAMSHAFT MEASURING
OPTICAL SURFACE INSPECTION
DIMENSIONAL MEASURING MACHINES
STANDARD COMPONENTS
MEASURING SOLUTIONS
DKD CALIBRATION SERVICE
CONSULTATION, TRAINING AND SERVICE

Precision – worldwide

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