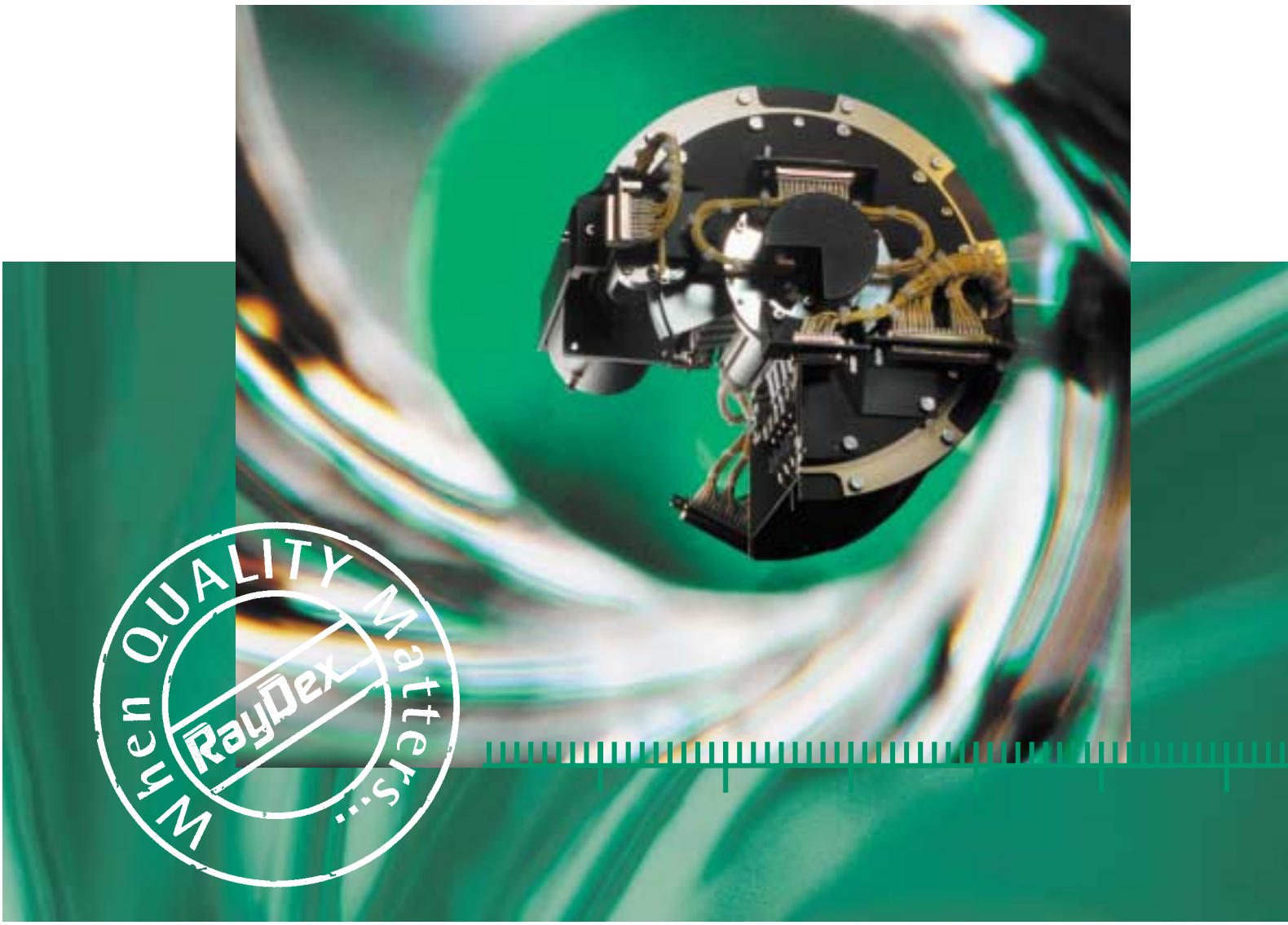
ISIS
sentronics

RayDex

Focus on Quality

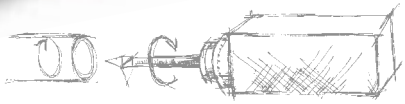


RayDex

the contactless alternative to mechanical tactile sensors

The RayDex c and RayDex h sensor series

comprise of 2 different optical Sensor heads with various degrees of mechanical axes and a Control Unit (shown on last double page). Optical measuring rods for contactless distance measurements at several working ranges can be swapped in a simple manner.



RayDex ca

contains 3 mechanical axes to conduct the following features:

a) autofocus, b) rotation and c) axial motions. This permits the precise and rapid contour evaluation of freeform objects, particularly within interior spaces (e. g. diameter). The autofocus covers a range of max. 7 mm and – dependent on the measuring rod – an object diameter range from less than 1 mm up to 70 mm.

In the standard version axial penetration depths (e.g. into a cylinder) of up to nearly 50 mm can be achieved.

RayDex cr

contains 2 mechanical axes to conduct the following features: a) autofocus, and b) rotation. The axial direction has to be covered by an external stage. With this sensor and the **RayDex ca** the measurement ray can rotate at a frequency of up to 5 Hz or it can be positioned with high precision at a predetermined angle.

Using the next optical sensor generation RayDex c and RayDex h accuracies of 200 nm, respectively 100 nm, can be achieved across a large working range (several mm) with very high acquisition rates up to 4 kHz using only one set of optics. It can evaluate topograhy, roughness, freeforms or very small interior spaces during process control with our patented SCI (Spectral Coherence Interferometry) technology. This offers a true alternative to mechanical tactile systems, particularly in very dynamic production processes.
Try us! RayDex – Focus on Quality.

RayDex hr

is anagolous in design to the **RayDex cr**, allows however through the lager rotor diameter even higher repeatabilities. With this sensor and the **RayDex ha** the measurement ray can rotate at a frequency of up to 2.5 Hz or it can be positioned with high precision at a predetermined angle.

RayDex ha

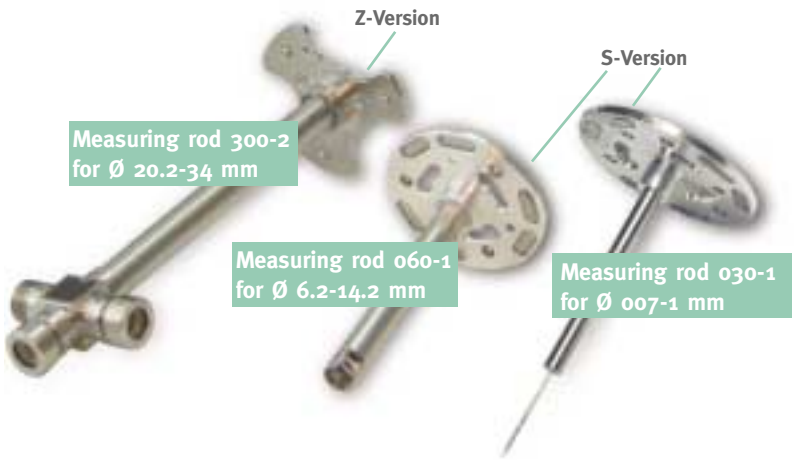
is anagolous in design to the **RayDex cr**, allows however though the lager rotor diameter even higher repeatabilities.

This version allows axial penetration depths (e.g. into a cylinder) of nearly 150 mm.

Applications of all RayDex Sensors:

- **Within measurement stations for individual objects in production and/or in a laboratory**
- **Attached to a robot, to conduct interior measurements for e.g.**
- **Mounted to a Coordinate Measurement Machine (CMM), once accuracy and speed are crucial factors**

Currently measuring rods between 0.7 mm and 10 mm diameter are available. Special versions have increased diameter at the tip of the measuring rod allowing diamater measurements of close to 70 mm. The standard length is 1 pitch (› 40 mm) and it can optionally be expanded up to 3 pitches. Measurement rods are magnetically attached to the sensor either though the standard mount (s-version) or the axial crash absorption mount (z-version).



Your Benefits:

- 100 nm repeatability (RayDex h series), 200 nm repeatability (RayDex c series)
- Acquisition rates up to 4 kHz
- 3D topography, diameter, roughness and other features within one scan
- Smallest interior spaces and not limited to rotationally symmetric objects
- High lateral resolution by small spot size (diameter: 5 µm)
- Axial and radial scan directions can be combined
- Easy to swap measuring rods
- Length / diameter ratio up to 30 x D
- Precise surface data even with (partly) transparent objects
- Thin layers (e. g. coatings, oil film) do not affect the measurement
- Thin layers (up to 30 µm) can be measured in the same scan

Applications:

- Freeform objects (e.g. micro parts), (small) radii and undercuts
- Complex objects (e.g. injection nozzles, pneumatic cylinders) with (small and) deep inner diameters
- Flat objects with small inherent stability (e. g. wax, soft plastics) and/or critical surface (e. g. glass)
- 2D objects with inner diameters and cutouts
- Layer thicknesses with special coatings

Object materials:

- Metal
- Ceramic
- Polymer
- Glass
- Diamond and other coatings

RayDex

the ideal solution for complex functions

Roboter

Various options for very flexible applications at a production assembly line are offered with dedicated RayDex sensor heads mounted to an industrial robot. With up to 9 degrees of freedom in the entire system almost any point in an object can be reached. Applications with highly accurate evaluation of diameters or 3D contours of interiour spaces can be performed with **RayDex ca** or **RayDex cr** because robot positions are not altered during the measurement. For those applications, inevitable positioning errors during robot movements are compensated by the measurement principle and the operating software »TopoSpect« and »TopoLine« respectively.
In addition, roughness data and other surface parameters can be extracted.

Coordinate Measurement Maschine (CMM)

For applications close to production or in a measurement laboratory, all RayDex sensors can be mounted in a coordinate measurement machine like the IBTL Cono Portal. With previously unknown acquisition speeds topographies can be measured with 0° and 90° scan directions (45° upon request).

The rotational direction of the measurement beam can be set in any direction. With measuring rods of up to 130 mm previously concealed characteristics can be determined.

Production software »TopoLine«:

- For direct use in production
- Online evaluation of individual measurement features such as circle, shape etc.
- Position/time charts
- SPS trigger for certain events
- Triggering of external special machines/robots possible
- Simple and very flexible configuration by scripts
- Direct output by RS-232
- Network capabilities via LAN

Application software »TopoSpect«:

- For various applications in the measurement laboratory
- Features such as circle, angle, contours, roughness etc.
- Triggering of standard coordinate measurement machines
- 1D, 2D and 3D visualization options
- ASCII, Excel and Mountains Map data export
- Easy configuration of an operation recipe via »Wizzard«
- Network capabilities via LAN

RayDex can be applied in various production environments

In the automotive sector, the critical mechanical processing steps within motor blocks or pneumatic cylinders can be evaluated very precisely in a production line. The evaluation of individual parts for nearly all 3D contours is applicable in specialized systems or coordinate measurement machines (CMM). Besides metal, semitransparent objects, like glass tubes, can be verified for its specifications as well.

Applications / Interior

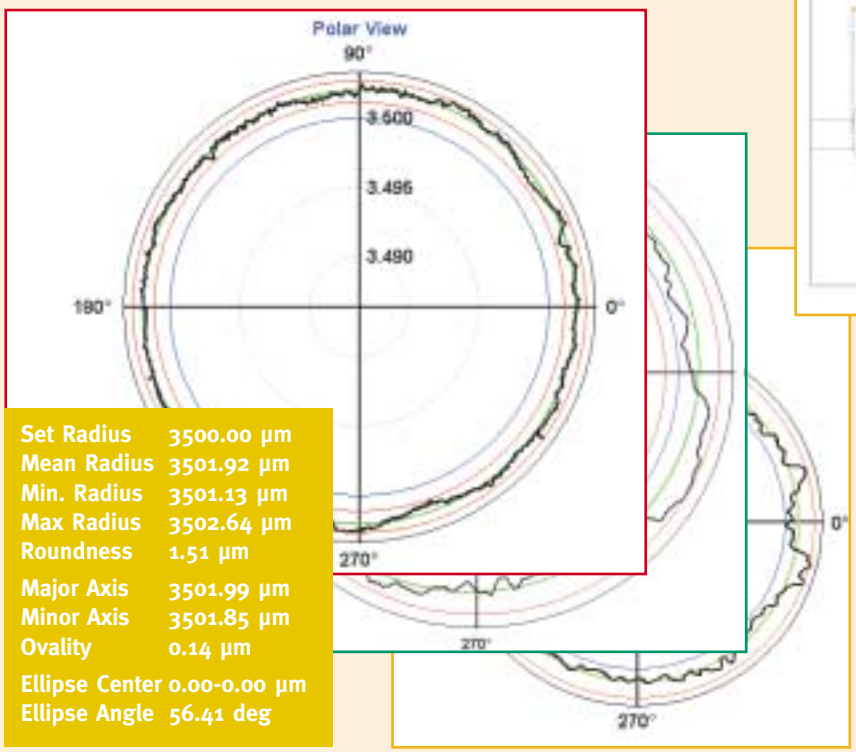
Highly precise diameter and freeform evaluation

Due to the flexible adaption of the system, numerous features can be evaluated and measured which are typically applicable to interior spaces. Further parameters can be extracted in other application programs based on data point clouds originating from »TopoSpect« or »Topoline«.

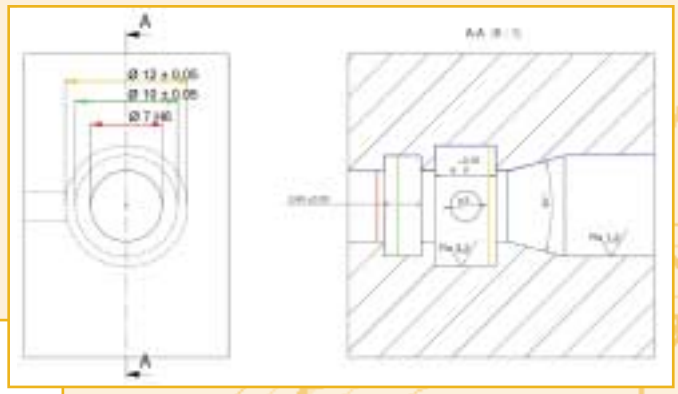
For example at a control valve, all important features can be measured with µm-precision and very fast, owing to the contact-less measurement principle. General purpose measuring tasks as described in the following can be solved within less than 30 seconds.

Measurements with integrated rotational axis (RayDex cr and ca)

D = 7 H6 **D = 10 ± 0,05** **D = 12 ± 0,05**

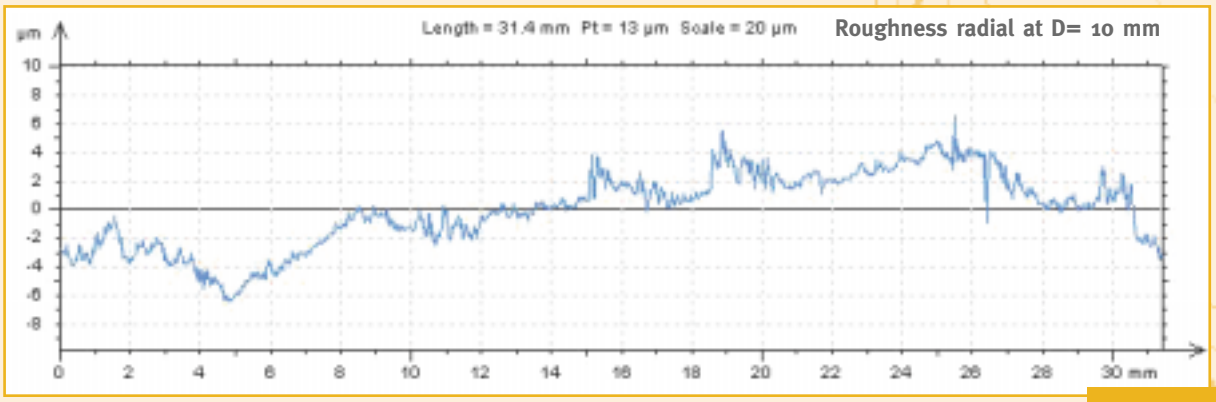


Set Radius	3500.00 µm
Mean Radius	3501.92 µm
Min. Radius	3501.13 µm
Max Radius	3502.64 µm
Roundness	1.51 µm
Major Axis	3501.99 µm
Minor Axis	3501.85 µm
Ovality	0.14 µm
Ellipse Center	0.00-0.00 µm
Ellipse Angle	56.41 deg



Measurements with integrated rotational axis (RayDex cr and ca)

Diameter and freeform evaluation at various axial positions.



R_a= 0.27 µm
R_q= 0.348 µm
R_t= 5.35 µm
R_z= 1.47 µm

Unwinded profile and results of a roughness computation

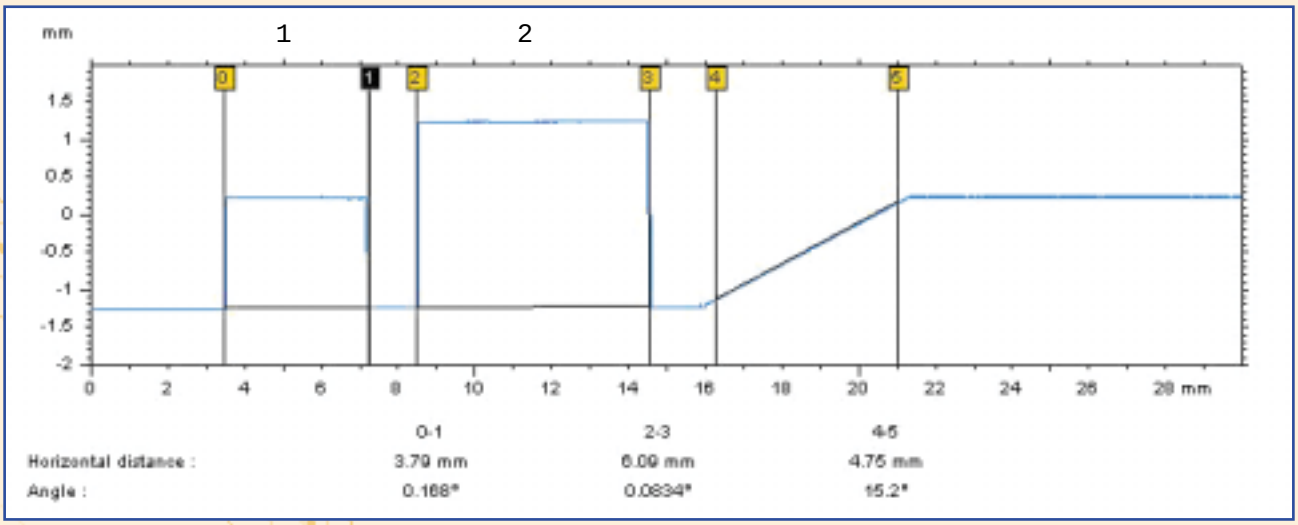
The unwinded data profiles from a complete circle can be evaluated in a simple manner regarding the features roughness, waviness and chatter marks.

Results: Features

Measurements with integrated axial motion (RayDex ca)

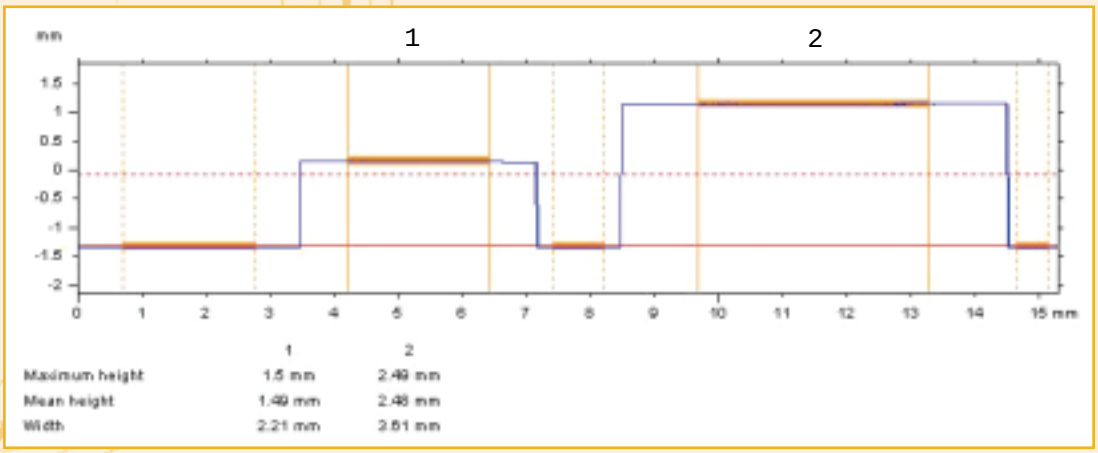
RayDex ca permits the evaluation of a profile analogous to a standard mechanical profiler by fixing the rotation angle with high precision (0.001°). Based on those data the following measurements were conducted. Here a crucial advantage of the RayDex sensors shows up: the high acquisition speed.

The measurement time for the plot shown was 10 seconds. Due to the contactless optical principle the measuring rod exhibits no wear. In addition the flexible and large working range ensures a high level of collision protection for the rod.



Distance- and angle evaluation

Distances and angles can easily be evaluated within the production software »TopoLine« by automated scripts.



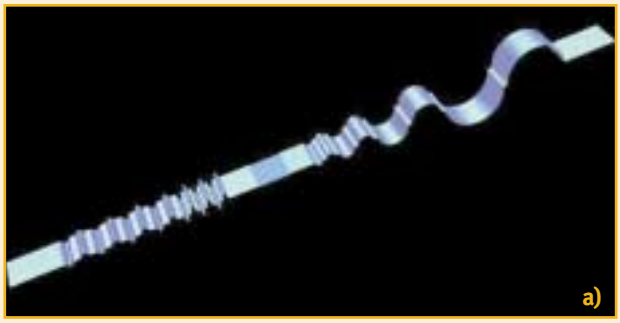
Evaluation of steps heights

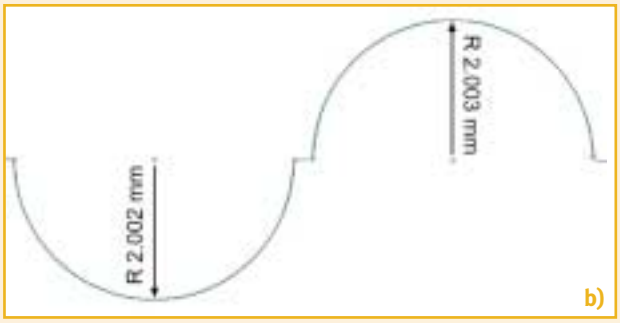
Just as simple and nearly fully automatic, step heights and widths can be evaluated. The same holds for concentricities and asymmetries.

Features:

- Point
- Circle
- Form of a circle
- Distance
- Angle
- Waviness
- Straightness
- Roughness

Applications: Freeform/Contours

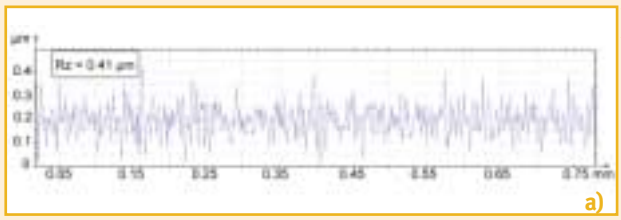


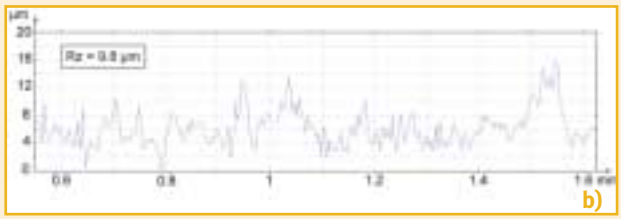


Accuracy analysis of topographical parameters from a calibrated probe

The topographic parameters of a calibrated probe from the PTB (»Physikalisch Technische Bundesanstalt«, Germany). Measured with **RayDex cr** with fixed angle position and axial movement provided by an external stage.

a) 3D Topographie
b) Radius, nominal: 2 - 2.002 mm



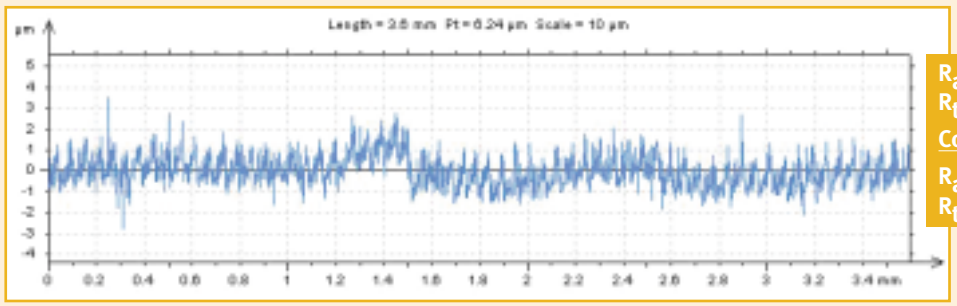


Roughness at various calibrated surfaces

Roughness with different nominal values. The axial object velocity was 20 mm/s. Measured in axial direction with the integrated axis in **RayDex ca**.

a) Nominal: R_z = 0.4 µm, measured: R_z = 0.41 µm

b) Nominal: R_z = 10 µm, measured: R_z = 9.8 µm



R_a = 0.543 µm R_q = 0.66 µm
R_t = 4.39 µm R_z = 3.69 µm

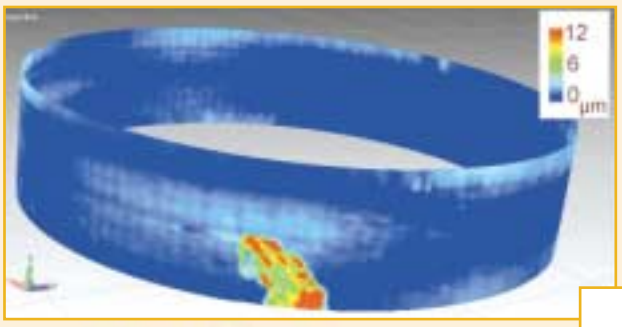
Compared with tactile measurement:

R_a = 0.498 µm R_q = 0.63 µm
R_t = 4.16 µm R_z = 3.54 µm

Roughness evaluation

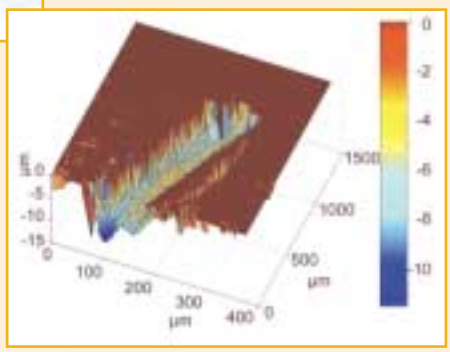
Besides roughness evaluation in radial direction it is easily possible to extract further information like roughness, waviness and chatter marks in axial direction. Measured in axial direction with the integrated axis in **RayDex ca**.

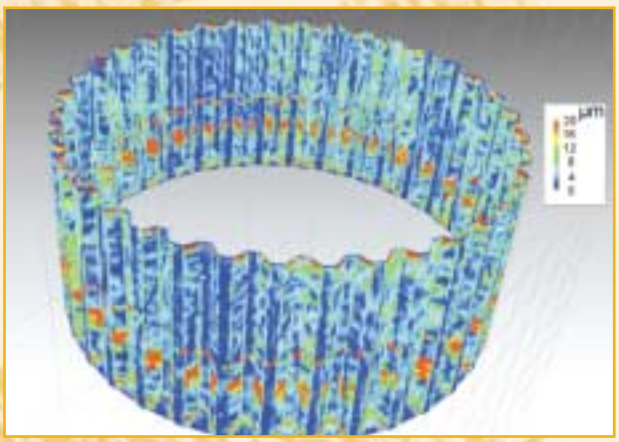
Applications: Interior / Contours



3D topography and actual target-shape comparison from a small cylinder with scratch

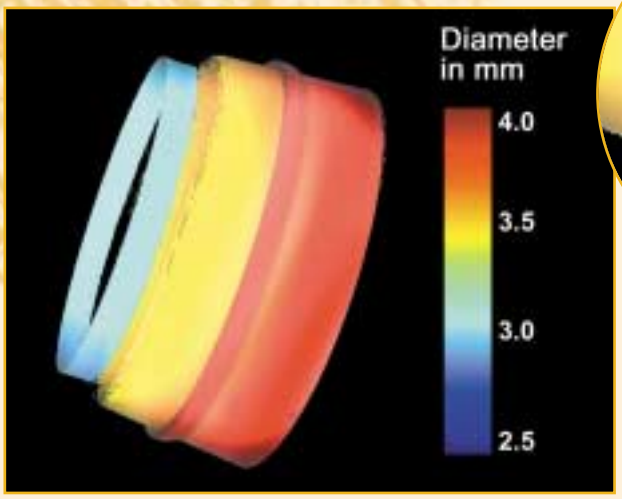
Detail 3D topography of the surface from a small cylinder (diameter: 3 mm) including a scratch. The maximum discrepancy from the ideal cylinder is 12 µm (at the scratch) as shown by the false color bar. The zoomed 3D representation exhibits further details. Measured with **RayDex ca**.

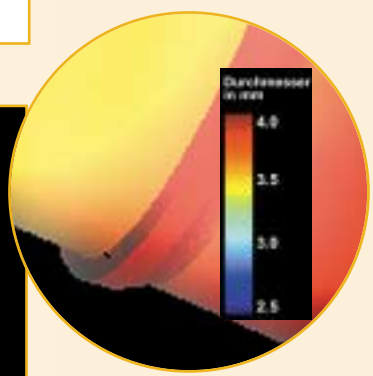




Actual target-shape comparison and 3D topography from an inner crank

Actual target-shape comparison of the surface from an inner crank (diameter: 25 mm).
According to the false color bar, the maximum deviation from the ideal shape amounts to 20 µm. The heights of the individual teeth are 1 mm. Measured with **RayDex ca**.





3D topography of a staircase cylinder

with various diameters (in parts slightly conical) in the range between 3.0 mm and 4.0 mm. Additionally, an undercut could be measured without problems (see detail). The inaccuracy of the diameter evaluation is less than about 200 nm.
Measured with **RayDex ca**.

Specifications Sensorhead (with Control Unit)	Model			
	RayDex ca	RayDex cr	RayDex ha	RayDex hr
Focus:				
Spot Size	5 µm			
Max. acquisition rate	4 kHz			
Repeatability static*	0.1 µm		0.1 µm	
Repeatability dynamic[1],*	0.2 µm		0.2 µm	
Measurement accuracy*	‹ 1 µm		‹ 0.5 µm	
Max. speed of refocusing	200 µm / ms		200 µm / ms	
Rotation:				
Repeatability in diameter (static)[2]*	0.2 µm		0.1 µm	
Repeatability in angular position*	0.001 °		0.0005 °	
Max. rotation frequency	5 Hz		2.5 Hz	
Axial directon:				
Axial range	48 mm		148 mm	
Repeatability in diameter (dynam.)[3]*	0.3 µm		0.2 µm	
Repeatability of an axial position[4]*	‹ 1 µm		‹ 1 µm	
Max. axial speed	200 mm/s		150 mm/s	

* *Accuracy and repeatability under the following constraints:*
- *Tolerance interval: 3 sigma*
- *25 repetitions, acquisition rate: 250 Hz*
- *Vibration damping (e.g. granite plate)*
- *Fluctuations in temperature: ‹ 0.5 K/h*
- *Variations in pressure: ‹ 0.01 bar/h, fine-filtered, 30l/min*

1 *Starting position 2 mm out of focus, refocussing at maximum speed, settling time of 50 ms.*

2 *Calibrated ring of 12 mm diameter; measuring rod of 1 pitch length and 6 mm diameter; rotational frequency is 3 Hz; axial position is static.*

3 *Calibrated ring of 12 mm diameter; measuring rod of 1 pitch length and 6 mm diameter; rotational frequency is 3 Hz; axial position is dynamic as described under[5].*

4 *Starting position 20 mm out of target position, axial motion with max. speed; settling time of 50 ms; Readout from axial position to an accuracy of ‹ 0.5 µm.*

Details Sensorhead	Model			
	RayDex ca	RayDex cr	RayDex ha	RayDex hr
Dimensions (wihout rod and flange)	Ø 89 mm x 210 mm	Ø 68 mm x 135 mm	140 x 130 x 375 mm³	Ø 108 mm x 230 mm
Weight	900 g	860 g	6.4 kg	2.8 kg
Air consumption	‹ 30 NLpm	‹ 12 NLpm	‹ 20 NLpm	‹ 12 NLpm
Air pressure	5 – 5.5 bar			

Details Control Unit	
Operating wavelength	830 / 1300 nm
Lightpower at optical exit	‹ 1 mW
Weight	13 kg
Dimensions	19“, 3HE, 375 mm tief
Electrical supply voltage	100 – 240 V
Cable length to sensorhead	max. 10 m

KMG

Roboter

	KMG	Roboter	
	*due to ISO 10360-2	Repeatability at repositioning	‹ 200 µm
Measurement accuracy	0.9 + (L/400) µm*	Repeatability in hold position	‹ 1 µm
Max. travel speed	300 mm/s	200°/s	
Dimensions	1.300 x 1.700 x 2.800 mm³	~ 1000 x 1000 x 1000 mm³	
Max. weight	2800 kg	› 80 kg	

Specifications Measuring rods (all data in mm)

Diameter

Code Diameter	Effective Diameter D	Diameter (Extension) D_E	Measurement range, Object-Diameter D_{min} ... D_{max}	Measurement range, axial A_{min} ... A_{max}
007	0.7	3.0	0.9 ... 1.7	0.1 ... 0.5
014 [1]	1.4	3.0	1.6 ... 3.5	0.1 ... 1.1
030	3.0		3.2 ... 7.2	0.1 ... 2.1
060 [2]	5.5		6.2 ... 14.2	0.1 ... 4.1
100 [2]	10.0		10.2 ... 24.0	0.1 ... 7.0
200 [2]	18.8	7.0	20.2 ... 34.0	1.5 ... 8.5
300 [2]	28.8	7.0	30.2 ... 44.0	1.2 ... 8.2
400 [2]	38.5	7.0	40.2 ... 54.0	1.2 ... 8.2

Length of the measuring rod (pitch) *(see figures 1 to 3)*

Code Diameter and Pitch	Pitch	Effective Length L	Code Diameter and Pitch	Pitch	Effective Length L
007-1	1	› 12.9	100-2 [2]	2	› 90.3
014-1	1	› 15	100-3 [2,3]	3	› 139.8
030-1	1	› 45.5	200-1 [2]	1	› 36.1
030-2 [2]	2	› 94.9	200-2 [2]	2	› 85.6
060-1 [2]	1	› 41.7	300-1 [2]	1	› 31.1
060-2	2	› 87.1	300-2 [2]	2	› 80.1
060-3 [2,3]	3	› 132.3	400-1 [2]	1	› 26.1
100-1 [2]	1	› 40.9	400-2 [2]	2	› 75.6

Orientation Measuring Ray

Code Orientation	Orientation	Rel. Measurement range Object-Diameter D_{max} - D_{min}	Rel. Measurement range, axial A_{max} - A_{min}
0	0°	–	0.65 D
90	90°	1.3 D	–
45 [4]	45°	~ 4.5	–
090 [3]	0° / 90°	1.3 D	0.65 D
045 [4]	0° / 45°	~ 4.5	~ 3.5

All measuring rods can be swapped from a standard flange under the specifications listed (except of absolute accuracy). Upon customer request, a flange with collision damage can be mounted.

1 *On customer request*

2 *On customer request the measurement range Dmin/Dmax or Amin/Amax can be enlarged at the expense of the pitch length.*

3 *Customer request; small compromises at the specificatios may have to be made.*

4 *The minimal effective diameter D has to be designed › 18 mm.*

All specifications are subject to change at any time without prior notice.

Product code for the measuring rods
The measurement rods will be identified according to a product code as listed below:

Code Diameter - **Code Pitch** - **Code Orientation** - **Code Flange**

In an example below is a measuring rod with 6 mm effective diameter, 2 pitch, a ray orientation angle of 90° and a standard flange:

060 - 2 - 90 - S

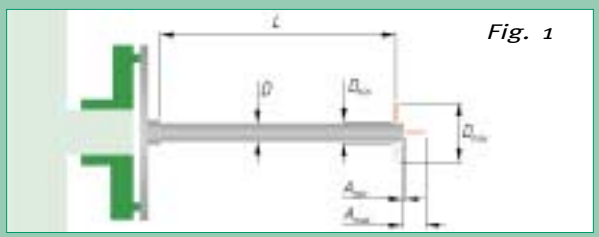


Fig. 1

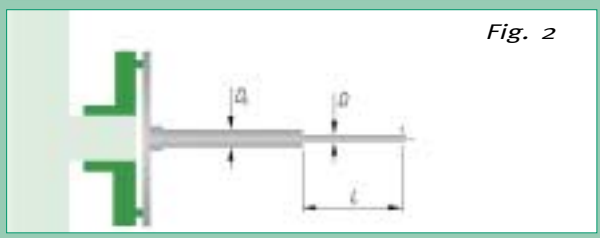


Fig. 2

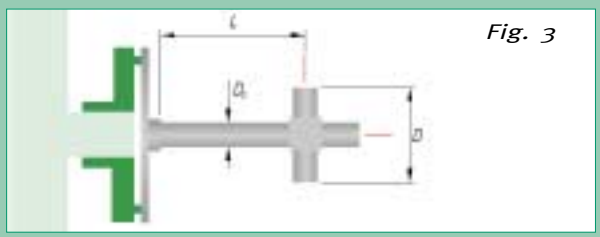
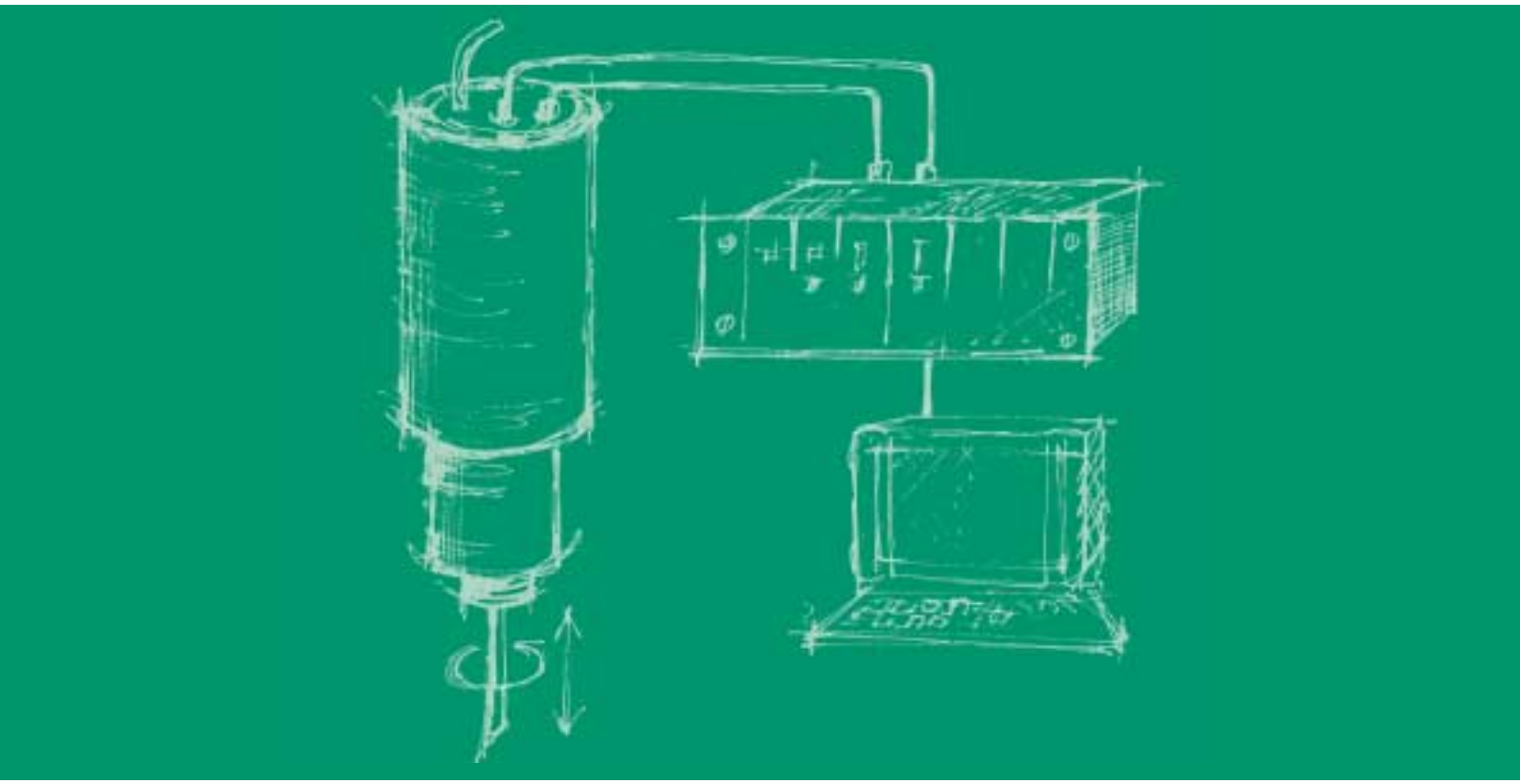


Fig. 3

Length-, diameter and workingrange (–) of the pitch rods

In general: (Fig. 1)
Measuring rods with D ‹ 3 mm (Fig. 2),
Measuring rods with D › 10 mm (Fig. 3)

April 2008



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