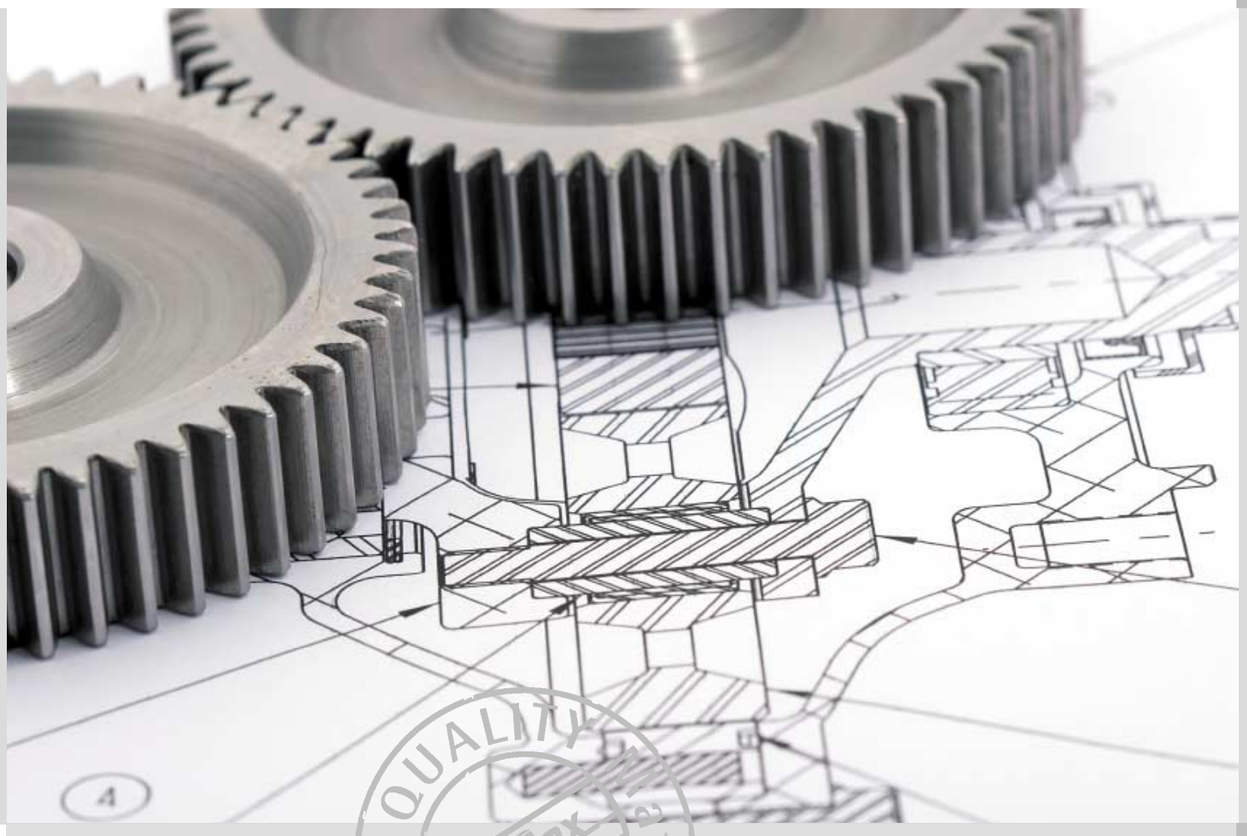
MECHANICAL ENGIN. / AUTOMOTIVE



March 2010

Applications and Products

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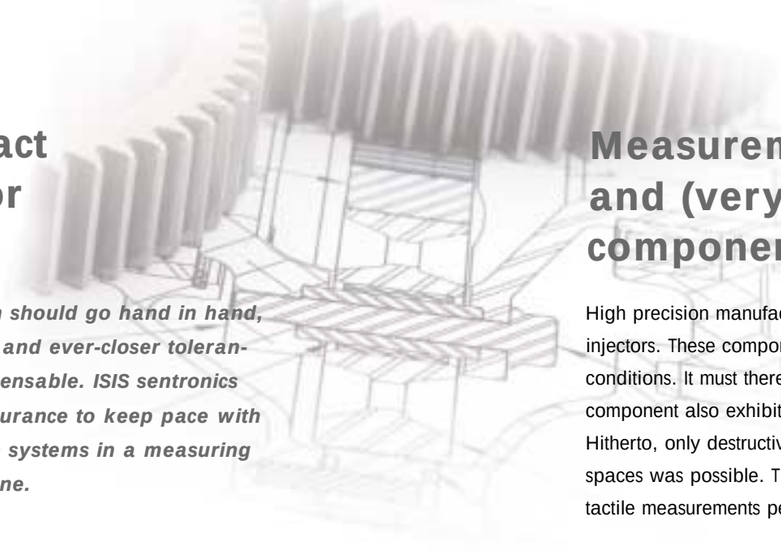
Applications of Modern, Non-contact Metrology in the Automotive Sector



Modern manufacturing and modern metrology – two concepts which should go hand in hand, particularly in the automotive sector. Increasing production volumes and ever-closer tolerances make the use of fast non-contact measurement practically indispensable. ISIS sentronics GmbH offers a selection of appropriate sensors allowing quality assurance to keep pace with constantly improving production processes – whether as stand-alone systems in a measuring room or as in-line solutions incorporated directly into a production line.

In addition, 100% testing of the geometries of complex components is becoming increasingly important – with regard to both the outer contours and above all the internal geometries of parts such as fuel injectors, valves, piston guides, or bearings. Precisely for applications in this area, **ISIS sentronics**' globally unique **RayDex** sensors embody many years of experience. These sensors have been incorporated in the new **i-Dex** product line where, in a variety of ways, they facilitate or accelerate the measuring processes involved in quality assurance. Whether metal, plastic, ceramic or glass, whether rough, smooth, or transparent surfaces – whatever material your test piece may consist of – the sensors can measure almost any surface.

Materials:

- Metals
- Plastics
- Ceramics
- Glass
- Smooth, rough, transparent surfaces

No matter which system is appropriate for your particular application, **ISIScript** permits straightforward and intuitive automation of all measurements. This requires no programming skills since automation can be accomplished in just a few mouse clicks. Moreover, circular, profile, and spiral measurements, as well as interior and exterior measurements (depending upon the instrument), can be combined at will in a single measuring procedure, permitting individual adaptation of measurement to your components. Nor are any extensive user training programmes necessary, and the influence of the operator is minimised through automation of the measuring protocol.

Your advantages at a glance:

- Non-contact optical measurement of interior geometries in freeform objects
- Non-contact optical measurement of interior and exterior geometries
- Diameters from 0.9 mm to almost 100 mm
- Repeatability of about 0.2 µm
- Measurement of coatings up to 50 µm thickness
- Measurements on various materials (metals, plastics, ceramics, rubber, etc.)
- **i-Dex** series now displays a very high degree of flexibility in its applications
- **ISIScript** software is easy to use and intuitive in nature

Measurement of interior spaces in fuel injectors and (very small) precision drill holes in freeform components

High precision manufacturing is extremely important for fuel injectors. These components are often exposed to very severe conditions. It must therefore be assured that the interior of the component also exhibits appropriate quality characteristics. Hitherto, only destructive inspection of such small interior spaces was possible. The component was cut open and tactile measurements performed.

Only an optical method can offer immediately obvious advantages:

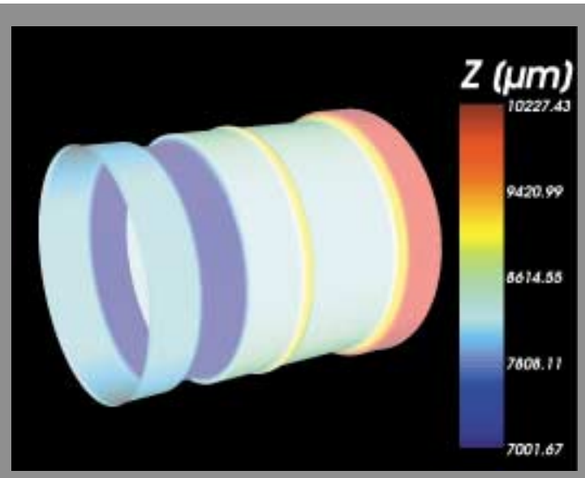
- no scratching of the surface by tactile measuring probes
- significantly greater accuracy

Moreover, owing to the possibilities of entering very small interior spaces with the ISIS metrology system, non-destructive inspection becomes feasible. This advantage quickly pays dividends, particularly in the case of such expensive components.

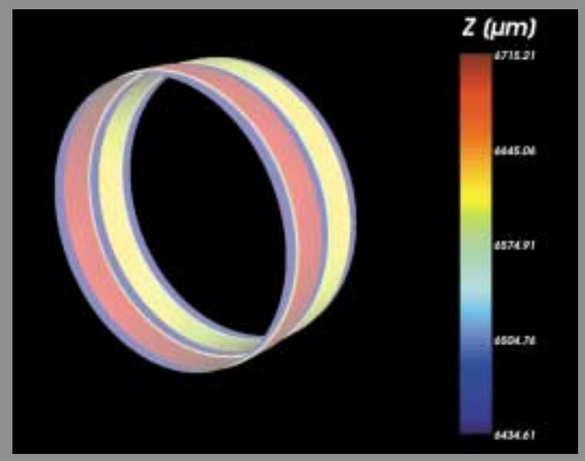
The **RayDex** sensor integrated into an **i-Dex f** stand-alone system can inspect the interior spaces of any test piece and measure and record, for example, their diameter, ovality, roundness, and conicity, as well as various linear dimensions.

Even complex geometries can be determined in this way and compared with the nominal CAD data. Roughness information can also be obtained down to a value of Rz > 0.5 µm.
The range of test pieces extends from drill holes of diameters from a minimal 0.9 mm all the way to almost 100 mm and lengths of 200 mm. This is made possible by the use of optical probes of unique design: The light ray which scans the components is guided through the optical probe and deflected through 90° by ultra-fine optics at its tip, with other angles also available as options.

Since light sources of two different wavelengths may be used, two different exit angles are simultaneously possible, e.g. 0° and 90°, so that information can also be obtained about the depth of drill holes. The autofocus system adjusts to the geometry of the test piece during scanning and ensures that even the slightest unevenness and microcracks can be detected with the small measuring spot of just 5 µm. The **RayDex** sensor in the **i-Dex f** provides the rotation of the probe necessary to continuously scan the interior of the component while the precision linear stage provides the necessary linear motion to insert the probe into the interior space.



Topography of a rotatational symmetrical swivel *measured with* ***i-Dex f****.*



Topography of a rotatational symmetrical swivel *measured with* ***i-Dex f****.*

Measurement of plain bearings and (quasi-) rotationally symmetrical turned parts

If it should be necessary to measure radii within seconds (for example for plain bearings, turned parts, etc.), the sensor travels to the desired position where a circular measurement is then performed. Several radii of the rotating object can be examined within a few seconds and the need for tedious tactile measurement is obviated.

With the rotation switched off, profiles can be recorded along the length of the components and in this way surface roughnesses or linear dimensions can be examined in the interior or on the exterior of the components.

The combination of rotational and linear motion offered by the **i-Dex r** permits spiral measurement of a component and hence up to 100% examination of its interior and its exterior geometry. Even complex (quasi-) rotationally symmetrical geometries can be recorded in this way and compared with the nominal CAD data.

Measurable parameters include:

- Diameter
- Roundness
- Cylindricity
- Topography
- Roughness

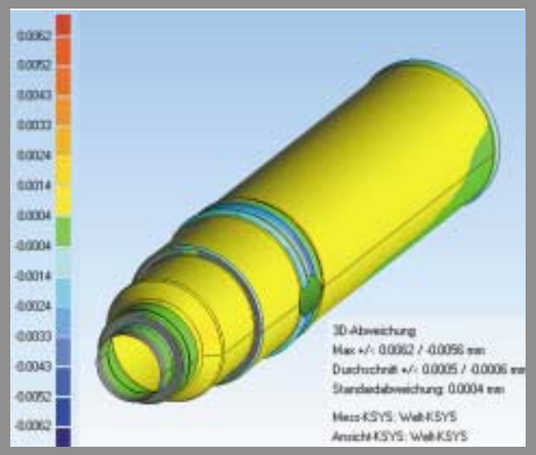
Measurement of brake discs and (quasi-) planar turned parts

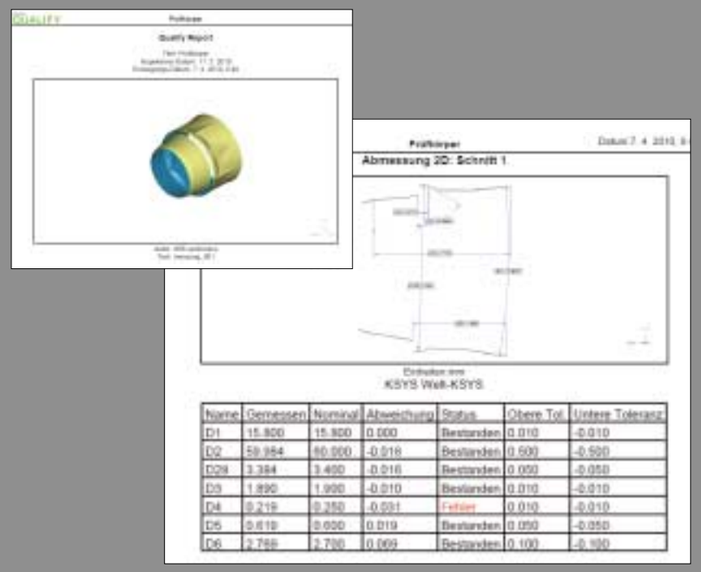
Brake discs and clutches, for example, are subject to considerable wear during use. Surface defects or signs of wear have to be determined quantitatively and hence often in three dimensions. This also includes the quantitative determination of material abrasion by before-and-after volume comparison at certain points on the rotationally symmetrical and (quasi-) planar component. Roughness values down to Rz > 0.5 µm can be readily determined.

Measurable parameters include:

- Surface planarity
- Conicity
- Topography
- Abrasion volume
- Roughness

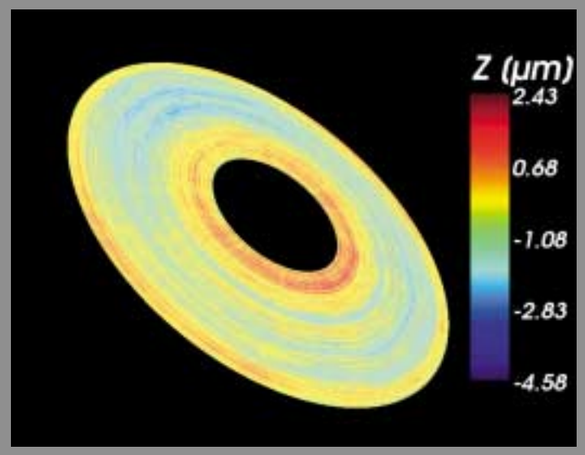
The **i-Dex p** series can execute spiral scanning of (quasi-) planar objects and thus determine their surface planarity or conicity. By comparing target and actual data, rates of abrasion can be calculated from volume differences. Comparison can, of course, also be performed in a radial direction without rotation.



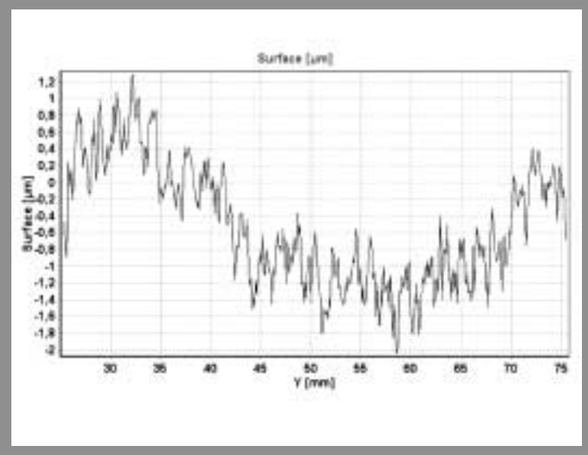


Name	Gemessen	Nominal	Abweichung	Status	Obere Tol.	Untere Toleranz
D1	15.800	15.800	0.000	Bestanden	0.010	-0.010
D2	59.964	60.000	-0.016	Bestanden	0.500	-0.500
D29	3.384	3.400	-0.016	Bestanden	0.050	-0.050
D3	1.890	1.900	-0.010	Bestanden	0.010	-0.010
D4	0.219	0.250	-0.031	Fehler	0.010	-0.010
D5	0.019	0.000	0.019	Bestanden	0.050	-0.050
D6	2.799	2.700	0.099	Bestanden	0.100	-0.100

Generation of a quality report *with the aid of evaluation software. Measured with* ***i-Dex r****. Various display options are possible (right).*



3D surface of a disc *measured with an* ***i-Dex p****.*



1D surface profile *averaged over the angles.*

Automatic measurement in a production line – the ISIS i-Dex programme

Measurement during production – a topic of increasing importance, particularly when pressure on the measuring room is to be relieved or information about the quality of a component is required fast and directly in the production line.
The **i-Dex** product range from the **ISIS** company can measure components fast and completely automatically.
During the measuring process, the test pieces are placed in the field of measurement of the sensor, either individually or on pallets, and measurement is started by pushing a button. The system is completely self-calibrating.

The system produces a high-resolution point cloud as result of measurement with point spacings of down to 1 µm. This can be sent automatically to the evaluation software (for example Geomagic Qualify) and the subsequent evaluation process can also proceed automatically. The user receives an individual measurement report showing all important values at a glance – whether you only want to know if the parts are rejects or you desire a complete target-nominal value comparison with your CAD data.

The **i-Dex f** system from **ISIS sentronics** can scan the interior spaces of any test piece and check and document, for example, diameter, ovality, roundness, and conicity as well as various linear dimensions. Moreover, information about surface roughness down to a value of Rz > 0.5 µm can also be obtained.

The test piece is placed on a high-precision air-bearing rotary table and rotates about its own axis. The two coordinated sensors can thus perform measurements both in the interior and on the exterior of the components, also providing information about the wall thickness. Since the probe responsible for the interior measurements is fixed and only requires a limited autofocus range, measurements can also be performed on eccentric or very large drill holes.

If the test pieces also have to be examined with regard to their exterior geometry or also exhibit quasi centric drill holes, **ISIS sentronics** offers the **i-Dex r** as a suitable measuring system. In addition to its **RayDex** Sensor, this system also incorporates a further sensor which scans the exterior geometry of the test body.

ISIS sentronics' **i-Dex p** is ideally suited for measurement of flat objects such as brake discs. The stand-alone system can capture data for flat, rotationally symmetrical objects and examine them for planarity, conicity, or roughness. The test piece is placed on an air-bearing rotary table and scanned with a **StraDex p** sensor.

i-Dex Stand-alone system

Specifications at a glance:

i-Dex f

Sensors for internal measurements	RayDex cr / hr
Internal diameter range	0.9 mm – 54 mm standard, optionally < 100 mm
Max. internal measuring depth	130 mm (depending upon probe)
xy and z traversing range	200 x 200 mm^2 und 200 mm
Max. rotational frequency of probe	3 Hz
Repeatability of internal profile measurement	200 nm
Max. acquisition rate	4 kHz
Dimensions of stand-alone system	785 x 1844 x 1020 mm^3

i-Dex r

Sensors for internal and external measurements	RayDex cr (only with autofocus)
Internal diameter range	0.9 mm – 150 mm
Max. internal measuring depth	180 mm (depending upon probe)
Max. rotational frequency of object	2 Hz
Repeatability per sensor	200 nm
Max. acquisition rate	4 kHz
Dimensions of stand-alone system	785 x 1844 x 1020 mm^3

i-Dex p

Sensors for internal and external measurements	StraDex p / f
Max. diameter of object	220 mm
Max. rotational frequency of object	1 Hz
Max. radial velocity of sensor	50 mm/s
Repeatability	200 nm
Max. Abtastrate	4 kHz
Dimensions of stand-alone system	785 x 1844 x 1020 mm^3