MACHINE TOOL INSPECTION & ANALYZER SOLUTIONS
DESIDERIUS ERASMUS
DUTCH HUMANIST (1469 – 1536)
Desiderius was the greatest humanist scholar of his age. He developed a biblical-humanist approach to theology that attached little value to dogma and to ecclesiastical ceremony.

INTRODUCTION
IBS Precision Engineering machine tool inspection series offers a range of products to provide peace of mind and control to machine operators by guaranteeing your machine is within specification. Machine-integrated, workshop robust INSPECTOR systems provide rapid qualification of cutting position, rotary table characteristics or spindle behaviour.

Simple go/no-go testing supports machine management and reduces out-of-tolerance products; data tracking makes essential maintenance planning easy.

For machine tool builders, maintenance providers and other advanced users ANALYZER systems offer fully calibrated, in-depth measurement and feedback capability. Machine acceptance qualification, compensation and diagnostics are at your fingertips.
Machine Tool Calibration and Inspection Solutions

Position Inspector
Quick health check of your machine tool linear axis

Position Analyzer
In-depth analysis & diagnostics of your machine tool linear axis

Rotary Axis Inspector
Quick health check of your machine tool rotary axis

Rotary Axis Analyzer
In-depth analysis & diagnostics of your machine tool rotary axis

Spindle Inspector
Quick health check of your spindle accuracy & performance

Spindle Analyzer
In-depth analysis & diagnostics of your spindle accuracy & performance
The positioning accuracy of any machine tool is of vital importance. It governs how and when your end product is within tolerance and defines your productivity. Over time accuracy falls off and with it your effective output.

The position INSPECTOR delivers rapid and reliable measurement of the positioning accuracy of your machine. Designed to integrate into the machine, it puts an instant ‘health check’ at hand during normal production.

The position INSPECTOR measures X-, Y- and Z- errors simultaneously, speeding the assessment process.

The Position Inspector will measure when the machine positioning accuracy exceeds a certain threshold and (if required) stop production to avoid scrap.

**UNIQUE STRENGTHS OF THE POSITION INSPECTOR:**

- Instantaneous qualification of tool positioning accuracy (for end product conformity)
- High performance measurement with 0,2 μm resolution
- Machine check with 10 positions within 1 minute
- Data tracking for predictive maintenance scheduling
- Automated process including simple go/no go options

The position INSPECTOR comes with the wireless (Trinity) probe. For specifications see pages 8 & 9.

All tests in compliance with the ISO 230 standard. All sensors are calibrated and supplied with a traceable certificate.
For machine tool builders, maintenance providers and other advanced users the position ANALYZER meets the need for more comprehensive diagnostic capability, absolute calibration and data feedback for on-line compensation.

Absolute geometric conformity measurements are achieved using a calibrated ball beam. A large probe range enables simple set-up without the need for complex alignment procedures. Ball beam measurement is completed in minutes and shows the positioning accuracy and straightness deviations directly.

**UNIQUE STRENGTHS OF OUR POSITION ANALYZER:**

- Rapid and comprehensive machine volumetric positioning accuracy determination
- Simultaneous measurement of position and straightness errors
- Absolute measurements for machine acceptance test qualification
- In-depth machine characterization (e.g. reversal error, backlash assessment)
- Simple automated set-up delivers accuracy comparable to a laser interferometer
- Measurement according to ISO 230 standards

**POSITION ANALYZER BALL BEAM**

The ball beam provides a reference object allowing absolute calibration of your machine tool. Constructed from 22 mm diameter precision balls, the relative position of the ball centre points are calibrated in X, Y and Z and may be compared to the coordinate system of the machine tool.

The number and spacing of the precision balls can be chosen according to the application.

<table>
<thead>
<tr>
<th>Ball beam</th>
<th>Nominal length</th>
<th>Nr. of balls</th>
<th>Ball distance</th>
<th>Beam material</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTB-500SC</td>
<td>500 mm</td>
<td>11</td>
<td>50 mm</td>
<td>Silicon Carbide</td>
</tr>
<tr>
<td>MTB-1000SC</td>
<td>1000 mm</td>
<td>21</td>
<td>50 mm</td>
<td>Silicon Carbide</td>
</tr>
<tr>
<td>MTB-1500SC</td>
<td>1500 mm</td>
<td>16</td>
<td>100 mm</td>
<td>Silicon Carbide</td>
</tr>
</tbody>
</table>

* Silicon carbide (carbon fibre available on request)

The position ANALYZER is available incorporating a wireless (TRINITY) or wired (TRITON) probe format. See pages 8 & 9.
Providing rapid confirmation of current performance against desired specification, the rotary axis INSPECTOR provides a key part of your maintenance routine. Ideally your rotary axis should be centred about a precisely known point; in reality offsets occur as a result of normal operation that lead to distortion in cutting tool paths which superimpose onto the final product form. As product tolerances increase, the impact of such errors becomes critical.

The rotary axis INSPECTOR provides instant confirmation of the conformity of your machines rotary axes to guarantee product quality. Measurements can be conducted against a fixed protocol for go/no go operation control. Data is provided in an easily accessible form for quantifiable error correction and maintenance.
For users who require more comprehensive analysis and diagnostics, the rotary axis ANALYZER, places full capability in your hands. Machine tool developers and professional maintenance providers can quantify machine performance in real time with both static and dynamic measurement possible.

Unique probe configuration allows high accuracy 3D measurement to determine both the location and the squareness of the rotary table.

**MACHINE ACCEPTANCE TESTS**
Multi axis operations can be completed in minutes. Rapid verification of the rotary axis correctness can be confirmed on all machine configurations: swivel head, rotating table, trunnion or combined configurations. Meets all ISO 10791-6 requirements.

**DYNAMIC ANALYSIS**
Users can measure the true tool path under two or more linear and rotary axis movements.

**EXACT ERROR CORRECTION AND COMPENSATION**
No more guesswork based on static measurements - with real dynamic data at hand

The rotary axis ANALYZER is available with both wireless (Trinity) and wired (Triton) probe configurations. See pages 8 & 9.

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**Static measurement**
C-Axis position before and after compensation

<table>
<thead>
<tr>
<th>C-Axis Position</th>
<th>Before Compensation</th>
<th>After Compensation</th>
</tr>
</thead>
<tbody>
<tr>
<td>XOC mm (ctx)</td>
<td>0.1391</td>
<td>-0.0017</td>
</tr>
<tr>
<td>YOC mm (cty)</td>
<td>0.0137</td>
<td>-0.0003</td>
</tr>
<tr>
<td>AOC° mm (cw)</td>
<td>0.0020</td>
<td>0.0027</td>
</tr>
<tr>
<td>BOC° mm (cw)</td>
<td>0.0036</td>
<td>0.0031</td>
</tr>
</tbody>
</table>
The position and rotary INSPECTOR and ANALYZER series employ IBS Precision Engineering’s patented probe systems. Unlike other systems, their unique design means that X, Y and Z measurements are made simultaneously and with equal precision—so exceptional measurement speed and accuracy are delivered hand in hand.

Measurements are based on master ball(s) mounted on the machine tool. Moving the probe on to the master ball, three highly accurate sensors in the probe head are used to determine its centre point position with sub-micron accuracy.

Available in two configurations: the TRITON wired probe delivers a smaller measurement range with higher precision whilst the TRINITY probe provides the flexibility of wireless.
**Measuring range** 3.50 mm
**Resolution** 0.2 µm
**Sampling rate** 2 kHz
**Measuring uncertainty** U1 < 1.0 µm (within 1 mm range)
**Power consumption**
- 1.3 W (=17 hrs) when measuring
- 0.52 W (=42 hrs) when in sleep mode
**Wireless details PSK**
- 2.4 GHz frequency, 802.11b/g/n standard, WPA2 - security
**Probe mounting shaft** Ø = 16 mm
**Dimensions**
- **Length:** 135 mm
- **Diameter:** 80 mm
- **Weight:** 770 grams

**Roundness error** < 0.6 µm
**Diameter (nominal)** 22 mm
**Length** 75 mm

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**Wireless Probe: Trinity**

The Trinity probe system consists of:
- Calibrated Trinity probe
- Wireless access point
- Wireless USB receiver
- 22mm diameter masterball
- Mounting accessories
- Travel case (optional)
- Manual
- 4 batteries (3100 mAh), including charger & adapter

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**Wired Probe: Triton**

**Specifications Probe**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring range</td>
<td>1 mm</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.1 µm</td>
</tr>
<tr>
<td>Sampling rate</td>
<td>6.5 kHz</td>
</tr>
<tr>
<td>Measuring uncertainty</td>
<td>U1 &lt; 0.6 µm (k=2)</td>
</tr>
<tr>
<td>Probe mounting shaft</td>
<td>Ø = 16 mm</td>
</tr>
<tr>
<td>Dimensions</td>
<td></td>
</tr>
<tr>
<td>- Length</td>
<td>56 mm</td>
</tr>
<tr>
<td>- Diameter</td>
<td>75 mm</td>
</tr>
<tr>
<td>- Weight</td>
<td>375 grams</td>
</tr>
</tbody>
</table>

**Specifications Masterball**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roundness error</td>
<td>&lt; 0.25 µm</td>
</tr>
<tr>
<td>Diameter (nominal)</td>
<td>22 mm</td>
</tr>
<tr>
<td>Length</td>
<td>75 mm</td>
</tr>
</tbody>
</table>
Spindles represent a key part of any machine tool. Not only does their performance represent a key parameter in product quality, they can represent a significant fraction of the machine cost.

The IBS Precision Engineering spindle INSPECTOR delivers a simple but highly accurate system which may be integrated seamlessly into production systems. Automated measurement at a range of user defined speeds reduces spindle performance to a set of simple parameters with definable tolerances*. A ‘green light’ system allows your machines to continue performing uninterrupted until a tolerance run out is spotted; system interface options cease operation when tolerance is exceeded. Spindle replacement can be precisely predicted; product failure and sampling reduced.

**Unique strengths of the spindle INSPECTOR**
- High performance non-contact measurement at 75 nm resolution
- Measurement of dynamic spindle performance from 250 to 40,000 rpm
- In process axis shift measurement
- Data logging for spindle performance monitoring over time

**List of parameters**
- Synchronous radial error in X
- Asynchronous radial error in X
- Synchronous radial error in Y
- Asynchronous radial error in Y
- Synchronous rotating radial error
- Asynchronous rotating radial error
- Fundamental axial error in Z
- Residual axial error in Z
- Asynchronous axial error in Z
- Axis shift in X
- Axis shift in Y
- Axis shift in Z

*Tolerance values can be predefined by IBS Precision Engineering based on product specifications.*
Measurement takes place in a probe nest permanently positioned in the machine. The target is a high precision cylinder with a maximum roundness error of 1 μm, accommodated in the tool magazine. Three sensors in the probe nest measure simultaneously allowing a real-time dynamic radial and axial measurement.

All data is acquired by an industrial real-time system and stored locally. The spindle INSPECTOR is supplied with Windows software to analyse and present the data. Multiple inspectors can be networked remotely for total factory control.

<table>
<thead>
<tr>
<th>SPECIFICATIONS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>625 μm</td>
</tr>
<tr>
<td>Resolution</td>
<td>&lt; 0.075 μm</td>
</tr>
<tr>
<td>Input</td>
<td>110-230 VAC</td>
</tr>
<tr>
<td>Output</td>
<td>TCP/IP network communication / 24 V output to machine tool</td>
</tr>
<tr>
<td>Measurement time</td>
<td>30 seconds per rpm test</td>
</tr>
<tr>
<td>RPM range</td>
<td>250 - 40,000 rpm</td>
</tr>
<tr>
<td>Software</td>
<td>Monitor spindle performance over time with up to 500 measurements in log file</td>
</tr>
<tr>
<td>Target roundness</td>
<td>&lt; 1 μm (calibrated)</td>
</tr>
</tbody>
</table>

For spindle producers, machine tool builders and research users, IBS Precision Engineering offers the spindle ANALYZER. With all the advantages of a spindle INSPECTOR plus advanced functionality (such as tilt measurement, polar and FFT analysis) and higher accuracy, it provides the ultimate system for advanced professionals. Please contact us or visit our website www.ibspe.com for more information.
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