Roundtest RA-120 / 120P
SERIES 211 — Roundness Measuring Instruments

The Roundtest RA-120 / 120P are a compact, affordable, and simple-to-use device for measuring part geometry on the shop floor. It also provides such superb data analysis capabilities as required with laboratory roundness measuring instruments and has a ±1000µm wide range detector and precision turntable with excellent rotation accuracy.

The RA-120 is a dedicated processor-based model which controls all operations via the control panel incorporated in the main unit.

The RA-120P is a PC-based model which controls all operations via ROUNDPAK software (optional).

Large color LCD display for RA-120 models

Optional X-axis stop

**SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Model No.</th>
<th>RA-120*</th>
<th>RA-120D</th>
<th>RA-120P</th>
<th>RA-120PD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order No.</td>
<td>211-544A</td>
<td>211-543A</td>
<td>211-547A</td>
<td>211-546A</td>
</tr>
</tbody>
</table>

* Does not include Z-axis scale unit.
Roundtest RA-120 / 120P
SERIES 211 — Roundness Measuring Instruments

DAT (Digital Adjustment Table) function
The turntable digitally displays the centering and leveling adjustments, turning what used to be a difficult task into one that is simple enough for even new operators to perform.

1. Preliminary measurement of two cross-sections: A and B.

2. Following preliminary measurement, the centering and leveling adjustment values are displayed on the monitor.

3. Manipulate the digital micrometer heads of the rotary table so that the adjustment values displayed on the monitor are realized.

4. Centering and leveling are complete.
   Centering range: ±3mm
   Leveling (inclination) range: ±1°

DIMENSIONS

CONSUMABLE PARTS

12AAH181: Printer paper 10 rolls/set
358592: Element for air filter 1 pc/set
358593: Element for air regulator 10 pcs/set

Optional Accessories
211-032: Quick chuck (OD: 1 - 79mm, ID: 16 - 69mm)
211-014: Three-Jaw chuck (OD: 2 - 78mm, ID: 25 - 68mm)
211-031: Micro-chuck (OD: 1.5mm max.)
356038: Auxiliary stage for a low-height workpiece
211-016: Reference hemisphere
211-045: Magnification checking gage
997090: Gage block set for calibration
12AAH320: X-axis stop
211-013: Vibration damping stand
12AAH433: 2-axis scale unit for RA-120

Roundtest RA-120 / 120P SERIES 211 — Roundness Measuring Instruments
## Technical Data

### Turntable
- Rotational accuracy (radial): (0.02+6H/10000)µm (RA-1600)
- Rotational accuracy (axial): (0.024+6Y/10000)µm (RA-1600)
- Rotational accuracy (radial): (0.03+6H/10000)µm (RA-1600M)
- Rotational accuracy (axial): (0.036+6Y/10000)µm (RA-1600M)

### Rotational speed:
- 4, 6, 10rpm

### Table top diameter:
- ø5.9"(150mm)

### Centering range:
- ±3mm (with DAT function)

### Leveling range:
- ±1° (with DAT function)

### Maximum probing diameter:
- ø11"(ø280mm)

### Maximum workpiece diameter:
- ø22"(ø560mm)

### Maximum table loading:
- 55lbs (25kg)

### Vertical column (Z-axis)
- Vertical travel: 11.8"(300mm)
- Straightness (in narrow range): 0.20µm / 100mm (RA-1600)
- Straightness (in entire range): 0.30µm / 300mm (RA-1600)
- Straightness (in narrow range): 0.40µm / 100mm (RA-1600M)
- Straightness (in entire range): 0.80µm / 300mm (RA-1600M)

### Parallelism with turntable axis:
- 1.5µm / 300mm

### Positioning speed:
- Max. 15mm/s

### Measuring speed:
- 0.5, 1, 2, 5mm/s

### Maximum probing depth:
- 11.8"(300mm)*1
- 91mm (over ø32)
- 3.6"(over ø1.26") (91mm (over ø32))
- 1.97"(over ø0.27") (50mm (over ø7))

### Horizontal arm (X-axis)
- Horizontal travel: 6.5"(165mm) (From table axis -1±5.5")
- 6.5"(165mm) (From table axis, ±25mm – ±140mm)

### Positioning speed:
- Max. 15mm/s

### Measuring speed:
- 0.5, 1, 2, 5mm/s

### X-axis straightness:
- 2.7µm/140mm (RA-1600)

### Parallelism to turntable axis:
- 1.6µm/140mm (RA-1600)

### Probe and stylus
- Measuring range: ±400µm / ±40µm / ±4µm
- Measuring force: 10–50mN (5 level switching)
- Standard stylus: 12AAL021, carbide ball, ø1.6mm
- Measuring direction: Bi-directional
- Stylus angle adjustment: ±45° (with graduations)

### Air supply
- Air pressure: 0.35MPa (4kgf/cm²)
- Air consumption: 22L/min.
- Power supply: 100V AC – 240V AC, 50/60Hz
- Dimensions (W x D x H): 35 x 19.3 x 33" (890 x 490 x 840mm)
- Mass: 375lbs (170kg)

### Additional Features
- Safety mechanism provided as a standard feature
- Spiral Measurement/Analysis
- Measurement Through X-axis Tracking
- Continuous Internal/External Diameter Measurement

### Spiral Measurement/Analysis
The spiral-mode measurement function combines table rotation and rectilinear action allowing cylindricity, coaxiality, and other measurement data to be loaded as a continuous data set.

### Measurement Through X-axis Tracking
Measurement while tracing is possible through a built-in linear scale in the X-axis. This type of measurement is useful when displacement due to form variation exceeds the measuring range of the detector, and X-axis motion is necessary to maintain contact with the workpiece surface.

### Continuous Internal/External Diameter Measurement
Continuous internal/external diameter measurement is possible without changing the detector position.

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**ROUNDPAK**

The latest roundness/cylindrical form analysis program

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**MiCAT**

the standard in world metrology software

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**FORM**

A PC-compliant roundness and cylindrical-form measuring instrument with extensive analysis features to enable measurement of a wide variety of workpieces.
**Roundtest RA-1600 / RA-1600M**

**SERIES 211 — Roundness/Cylindricity Measuring System**

**Centering and Leveling Function**
The turntable displays centering and leveling adjustments digitally, making this challenging task simple enough for even a new operator to perform.
1. Preliminary measurement of two cross sections: A and B.
2. Following preliminary measurement, the centering and leveling adjustment values are displayed on the monitor.
3. By adjusting the micrometer heads for the rotary table, the adjustment values or level meter displayed on the monitor can be achieved.
4. Centering and leveling are complete.
   Centering range: ±3mm
   Leveling (inclination) range: ±1°

**SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Model No.</th>
<th>RA-1600</th>
<th>RA-1600M</th>
</tr>
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<tbody>
<tr>
<td>Order No. (inch/mm)</td>
<td>211-733A</td>
<td>211-724A</td>
</tr>
<tr>
<td>Mic Heads</td>
<td>Digimatic</td>
<td>Mechanical</td>
</tr>
</tbody>
</table>

**DIMENSIONS**

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**Optional Accessories**

- 350850: Cylindrical square
- 356038: Auxiliary stage for a low-height workpiece
- 12AAF203: 2x extension detector holder
- 12AAF204: Auxiliary detector holder for a large-diameter workpiece
- 12AAL090: Sliding detector holder
- 211-045: Magnification checking gage
- 211-014: Chuck (OD: ø2 - 78mm, ID: ø25 - 68mm)
- 211-032: Quick chuck (OD: ø1 - 78mm, ID: 16 - 69mm)
- 211-031: Micro-chuck (OD: ø0.1 - 1.5mm max.)
- 178-025: Vibration isolator (Desktop type)
- 64AAB213: Vibration isolation workstation
- 12AAL019: Side table for PC

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**Sliding detector-unit holder (Option) 12AAL090**
The detector-unit holder is equipped with a sliding mechanism, enabling one-touch measurement of a workpiece with a deep hole having a thick wall, which has been difficult with the conventional standard arm.

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* See page 41 for details about the continuous ID and OD measuring function.*
The RA-2200 provides high accuracy, high speed and high performance in roundness measurement. The fully-automatic, or DAT (Digital Adjustment Table), function-aided manual workpiece centering and leveling turns what used to be a difficult task into one that is simple enough for even new users to perform. This facilitates substantial reductions in overall measurement time. The RA-2200 system comes complete with powerful data analysis software ROUNDPAK, which requires only simple manipulation using a mouse and icons, achieving enhanced functionality and ease of operation.

Highly accurate and easy-to-use turntable

With extremely high rotational accuracy, both in the radial and axial directions, the turntable allows high accuracy flatness testing to be performed in addition to roundness and cylindricity measurements.

Incorporating an automatic centering/leveling turntable (A.A.T.), the top-of-the-line RA-2200AS/AH models relieve the operator of the bothersome task of workpiece centering and leveling.

A guidance system (D.A.T.) is incorporated into the turntables on the RA-2200DS/DH models to help the operator perform manual centering and leveling smoothly and simply.

Roundtest RA-2200AS / DS / AH / DH
SERIES 211 — Roundness / Cylindricity Measuring System
Roundtest RA-2200AS / DS / AH / DH
SERIES 211 — Roundness / Cylindricity Measuring System

Greater productivity by continuous measurement
Both the OD and ID of a workpiece* can be measured in succession without the need for changing the traverse direction of the stylus.
*Inside diameter up to 50 mm.

Continuous measurement is possible as shown in steps (1) through (3) on the figure at the left, without having to switch the probe direction.

1) and 2): OD measurement
3): ID measurement
Movement

Highly repeatable measurements with high-accuracy scales Mitutoyo linear scales are used in the X/Z drive unit to guarantee the high precision positioning so vital for repetitive measurement.

SPECIFICATIONS

<table>
<thead>
<tr>
<th>Model No.</th>
<th>RA-2200AS</th>
<th>RA-2200DS</th>
<th>RA-2200AH</th>
<th>RA-2200DH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order No.</td>
<td>211-511A (mm/inch)</td>
<td>211-514A (inch)</td>
<td>211-512A (mm/inch)</td>
<td>211-516A (inch)</td>
</tr>
<tr>
<td>Effective table diameter</td>
<td>9.25” (235mm)</td>
<td>8” (200mm)</td>
<td>9.25” (235mm)</td>
<td>8” (200mm)</td>
</tr>
<tr>
<td>Centering range</td>
<td>±0.118” (±3mm)</td>
<td>±0.197” (±5mm)</td>
<td>±0.118” (±3mm)</td>
<td>±0.197” (±5mm)</td>
</tr>
<tr>
<td>Column travel</td>
<td>12” (300mm) (standard column)</td>
<td>20” (500mm) (high column)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic unit mass</td>
<td>396 lbs. (180kg)</td>
<td>440 lbs. (200kg)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

DIMENSIONS

Sliding detector-unit holder (Standard) 12AAL090
The detector-unit holder is equipped with a sliding mechanism, enabling one-touch measurement of a workpiece with a deep hole having a thick wall, which has been difficult with the conventional standard arm.

Sliding distance: 4.4”(112mm)
The detector-unit holder can be stopped at a position sufficiently higher than the workpiece along the Z-axis, and then lowered and positioned to make measurements. Furthermore, internal/external diameters can be easily measured with the continuous internal/external diameter measurement function*.

* See page 41 for details about the continuous ID and OD measuring function.
Continuous measurement is possible as shown in steps (1) through (3) on the figure at the left, without having to switch the probe direction.

1) and 2) OD measurement
3) ID measurement

Movement

**Roundtest RA-H5200AS / AH**

**SERIES 211 — Roundness / Cylindricity Measuring System**

RA-H5200AS / AH, a roundness/cylindricity measuring system developed to combine world-class accuracy with maneuverability/high-analysis capability.

**Enhanced detector safety functions, such as accidental touch and collision detection, is installed to minimize damage to both machine and workpieces.**

**Technical Data**

**Turntable**
- Rotational accuracy (radial): (0.02±3.5H/10000)µm
- Rotational accuracy (axial): (0.02±3.5V/10000)µm

**H: Probing height (mm), V: Distance from the turntable axis (mm)**

- Rotating speed: 2, 4, 6, 10rpm (20rpm: auto-centering)
- Table top diameter: ø 11.8" (300mm)
- Centering range: ±5mm
- Leveling range: ±1°
- Maximum probing diameter: ø 15.7" (400mm)
- Maximum workpiece diameter: ø 26.8" (680mm)
- Maximum workpiece weight: 176 lbs (80kg)

**Vertical column (Z-axis)**
- Vertical travel: 13.8" (350mm), (21.7" (550mm): AH model)
- Straightness (µ=2.5): 0.05µm / 100mm, 0.14µm / 350mm
- Parallelism with rotating axis: 0.2µm / 350mm
- Positioning speed: Max. 60mm/s
- Measuring speed: 0.5, 1, 2, 5mm/s
- Maximum probing height: 13.8" (350mm) (OD / ID)
- Maximum probing depth: over ø32: 85mm (w/standard stylus)
- Centering range: ±5mm (w/standard stylus)

**Horizontal arm (X-axis)**
- Horizontal travel: 8.9" (225mm)
- Straightness (µ=2.5): 0.4µm / 200mm
- Squaredness with rotating axis: Ø 0.5µm / 200mm
- Positioning speed: Max. 50mm/s
- Measuring speed: 0.5, 1, 2, 5mm/s

**Probe and stylus**
- Measuring range: ±400µm (±5mm: tracking range)
- Measuring force: 10mN – 50mN (in 5 steps)
- Standard stylus: 12AAL021, carbide ball, ø1.6mm
- Measuring direction: Two directional
- Stylus angle adjustment: ±45° (with graduations)

**Data analysis system**
- Analysis software: Roundpak
- Filter type:
  - 2CRPC-75%, 2CRPC-50%, 2CR-75% (non-phase corrected), 2CR-50% (non-phase corrected), Gaussian, filter OFF
- Cutoff value:
  - 15upr, 50upr, 150upr, 500upr, 1500upr
- Reference circles for roundness evaluation:
  - LSC, Mzc, Mcc

**Air supply**
- Air pressure: 390kPa (4kgf/cm²)
- Power supply: 100V AC – 240V AC, 50/60Hz
- Dimensions (W x D x H): 49.6 x 28.0 x 74.8" (1260 x 710 x 1900mm: AH model)
- Mass: Main unit: 1433 lbs. (650kg)
- Vibration isolator: 375 lbs (170kg)

**High-accuracy automatic centering/leveling turntable**

A highly accurate, highly rigid turntable has been achieved through exceptional manufacturing accuracy of the critical components, such as the rotor and stator, in addition to an air-bearing incorporating a complex aperture that provides superior rigidity and uniform pressure distribution. As a result, the rotational accuracy (radial), which is the heart of the roundness/cylindricity measuring system, is a world-class (0.02±3.5H/10000)µm.

**Automatic continuous OD/ID measurement**

Automatic measurement can be performed continuously from external diameter to internal diameter without having to change the probe position. This not only reduces measurement time, but eliminates the error factors otherwise involved in changing the probe position, greatly facilitating high-accuracy measurement.

The automatic centering/leveling mechanism incorporates a high-precision glass scale on each axis of the turntable. This allows feedback to be generated that prevents positioning errors from affecting centering/leveling adjustments. The high-speed, automatic, centering/leveling capability achieved greatly contributes to reducing the total measurement time from workpiece setting to workpiece measurement.

* Shown with optional side table for PC.
Roundtest RA-H5200AS / AH
SERIES 211 — Roundness / Cylindricity Measuring System

X-axis tracking measurement
Because of the linear scale incorporated into the X-axis, measurement can be performed by tracking the workpiece surface (tracking range: ±5mm). This function is effective for measuring a workpiece with a displacement that exceeds the detection range of the probe in measuring roundness/cylindricity or a taper that is determined with slider/column movement.

Surface roughness measurement function
(Surface roughness unit: option)
A surface roughness detector, compliant with the relevant international standards, can be mounted in place of the roundness measuring detector. This creates a multiple sensor system that can not only test the geometrical roundness/cylindricity of a surface, but also the roughness of that surface.

Optional Accessories
- 350850: Cylindrical square
- 12AAF203: Extension probe holder (2X higher)
- 12AAF205: Extension probe holder (3X higher)
- 12AAF204: Auxiliary probe holder for a large diameter workpiece
- 211-045: Magnification calibration gage
- 211-014: Chuck (OD: 2 - 78mm, ID: 25 - 68mm)
- 211-032: Quick chuck (OD: 1 - 79mm, ID: 16 - 69mm)
- 211-031: Micro-chuck (OD: 0.1~1.5mm max.)
- 12AAB598: Protective shield
- 12AAL019: Side table for PC

SPECIFICATIONS

<table>
<thead>
<tr>
<th>Model No.</th>
<th>RA-H5200AS</th>
<th>RA-H5200AH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order No. *</td>
<td>211-531A</td>
<td>211-532A</td>
</tr>
<tr>
<td>Column travel</td>
<td>13.77&quot; (350mm) (standard column)</td>
<td>21.65&quot; (550mm) (high column)</td>
</tr>
</tbody>
</table>

DIMENSIONS

Unit: mm

Sliding detector-unit holder (Standard) 12AAL090
The detector-unit holder is equipped with a sliding mechanism, enabling one-touch measurement of a workpiece with a deep hole having a thick wall, which has been difficult with the conventional standard arm.

Sliding distance: 4.4" (112mm)
The detector-unit holder can be stopped at a position sufficiently higher than the workpiece along the Z-axis, and then lowered and positioned to make measurements. Furthermore, internal/external diameters can be easily measured with the continuous internal/external diameter measurement function*.

* See page 41 for details about the continuous ID and OD measuring function.

J-46
**Roundtest Extreme RA-2200CNC / RA-H5200CNC**

**SERIES 211 — CNC Roundness, Cylindricity and Surface Roughness Measuring System**

Mitutoyo offers innovative roundness/cylindricity measuring systems capable of automated measurement with independent/simultaneous multi-axis CNC control. In addition to high measuring accuracy and reliability, these CNC models provide excellent inspection productivity. Roundness and surface roughness measurements are both available from a single measuring system so workpiece resetting for roughness measurement is not required. Roughness measurement is possible in the axial and circumferential directions.

### Technical Data: RA-2200CNC

**Turntable**
- Rotational accuracy (radial): 0.02+3.5H/10000μm
- Rotational accuracy (axial): 0.02+3.5X/10000μm
  - H: Probing height (mm), X: Distance from the turntable axis (mm)
- Rotating speed: 2, 4, 6, 10rpm
- Tabletop diameter: ø235mm
- Centering range: ±3mm
- Leveling range: ±1°
- Maximum probing diameter: ø10.4” (260mm)
- Maximum workpiece diameter: ø22.8” (580mm)
- Maximum workpiece weight: 66 lbs (30kg)

**Vertical column (Z-axis)**
- Vertical travel: 11.8” (300mm) 9.7” (250mm)
- Straightness (c2.5): 0.10μm / 100mm, 0.15μm / 300mm (0.25μm / 500mm: 2200H model)
- Parallelism with rotating axis: 0.7μm / 300mm (2200H model)
- Positioning speed: Max. 50mm/s
- Measuring speed: 0.5, 1.2, 5mm/s
- Maximum probing height: 11.8” (300mm) (OD / ID)
- Maximum probing depth: over ø32: 104mm (w/standard stylus)
  - ø12.7: 26mm (w/standard stylus)

**Horizontal arm (X-axis)**
- Horizontal travel: 6.9” (175mm) (Including a protrusion of 1” (25mm) the turntable rotation center)
- Straightness (c2.5): 0.7μm / 150mm
- Squareness with rotating axis: 1μm / 150mm
- Positioning speed: Max. 50mm/s
- Measuring speed: 0.5, 1.2, 5mm/s
- Probe and stylus
  - Measuring range: ±400μm / ±40μm / ±4μm (±5mm: tracking range)
  - Measuring force: 40mN (not adjustable)
  - Standard stylus: 12AAE301, carbide ball, ø1.6mm
  - Measuring direction: one direction
  - Stylus angle adjustment: ±45° (with graduations)

**Air supply**
- Air pressure: 390kPa (4kgf/cm²)
- Air consumption: 30L/min.
- Power supply: 100V AC – 240V AC, 50/60Hz
- Dimensions (W x D x H): 26.3 x 20 x 35.4” (667 x 510 x 900mm)
- Mass: 397 lbs (180kg) (441 lbs (200kg): 2200H model)

### Technical Data: RA-H5200CNC

**Turntable**
- Rotational accuracy (radial): 0.8+(0.35X/10000)μm
- Rotational accuracy (axial): 0.8+(0.35H/10000)μm
  - H: Probing height (mm), X: Distance from the turntable axis (mm)
- Rotating speed: 2, 4, 6, 10rpm (20rpm: auto-centering)
- Tabletop diameter: ø300mm
- Centering range: ±5mm
- Leveling range: ±1°
- Maximum probing diameter: ø14” (356mm)
- Maximum workpiece diameter: ø26.8” (680mm)
- Maximum workpiece weight: 176 lbs (80kg)
- 143 lbs (65kg): auto-centering

**Vertical column (Z-axis)**
- Vertical travel: 13.7” (350mm) 21.7” (550mm)
- Straightness (c2.5): 0.05μm / 100mm, 0.14μm / 350mm (0.2μm / 550mm: H5200H model)
- Parallelism with rotating axis: 0.2μm / 350mm (0.32μm / 550mm: H5200H model)
- Positioning speed: Max. 60mm/s
- Measuring speed: 0.5, 1, 2, 5mm/s
- Maximum probing height: 13.7” (350mm) (OD / ID)
- Maximum probing depth: over ø32: 104mm (w/standard stylus)
  - ø12.7: 26mm (w/standard stylus)

**Horizontal arm (X-axis)**
- Horizontal travel: 8.8” (225mm)
- Straightness (Ax:X): 0.4μm / 200mm
- Squareness with rotating axis: 0.5μm / 200mm
- Positioning speed: Max. 50mm/s
- Measuring speed: 0.5, 1, 2, 5mm/s
- Probe and stylus
  - Measuring range: ±400μm (±5mm: tracking range)
  - Measuring force: 40mN (not adjustable)
  - Standard stylus: 12AAE301, carbide ball, ø1.6mm
  - Measuring direction: one direction
  - Stylus angle adjustment: ±45° (with graduations)

**Air supply**
- Air pressure: 390kPa (4kgf/cm²)
- Air consumption: 45L/min.
- Power supply: 100V AC – 240V AC, 50/60Hz
- Dimensions (W x D x H): 49.6 x 28.0 x 66.9” (1260 x 710 x 1700mm)
- Mass: 1433 lbs (650kg)
- Vibration isolator: 375 lbs (170kg)

* Shown with optional vibration isolator and side table for PC.
Roundtest Extreme
RA-2200CNC / RA-H5200CNC

SERIES 211 — CNC Roundness, Cylindricity and Surface Roughness Measuring System

ROUNDPAK
Off-line measurement procedure programming function
On-screen virtual 3D simulation measurements can be performed with the incorporated off-line teaching function that allows a part program (measurement procedure) to be created without an objective workpiece. The probe and the holder unit of the Roundtest Extreme can be precisely represented and an alarm can be raised to indicate that there is a collision risk predicted by the simulation.

3D simulation screens (work-view windows) can be generated after entering CAD data (in IGES, DXF form) and text data.

SPECIFICATIONS

<table>
<thead>
<tr>
<th>Model No.</th>
<th>EXTREME RA-2200S CNC</th>
<th>EXTREME RA-2200H CNC</th>
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<tbody>
<tr>
<td>Order No.</td>
<td>211-517A</td>
<td>211-518A</td>
</tr>
<tr>
<td>Column travel</td>
<td>11.8” (300mm) (standard column)</td>
<td>19.7” (500mm) (high column)</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Model No.</th>
<th>EXTREME RA-H5200S CNC</th>
<th>EXTREME RA-H5200H CNC</th>
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</thead>
<tbody>
<tr>
<td>Order No. with vibration isolating stand</td>
<td>211-533A</td>
<td>211-534A</td>
</tr>
<tr>
<td>Column travel</td>
<td>15.77” (350mm) (standard column)</td>
<td>21.65” (550mm) (high column)</td>
</tr>
</tbody>
</table>

DIMENSIONS

<table>
<thead>
<tr>
<th>Unit: mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>RA-H5200S CNC / RA-H5200H CNC</td>
</tr>
<tr>
<td>980</td>
</tr>
<tr>
<td>710</td>
</tr>
<tr>
<td>420</td>
</tr>
<tr>
<td>max. 1240</td>
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<tr>
<td>221</td>
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<tr>
<td>RA-2200S CNC / RA-2200H CNC</td>
</tr>
<tr>
<td>425</td>
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<tr>
<td>667</td>
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<tr>
<td>Max. 940</td>
</tr>
<tr>
<td>64AAB524 Workstation</td>
</tr>
</tbody>
</table>

Optional Accessories

| 350850: Cylindrical square |
| 211-045: Magnification calibration gage |
| 211-014: Chuck (OD: 1 - 78mm, ID: 25 - 68mm) |
| 211-032: Quick chuck (OD: 1 - 79mm, ID: 16 - 69mm) |
| 211-031: Micro-chuck (OD: 0.1~1.5mm max.) |
| 12AAAB598: Protective shield (RA-H5200 only) |
| Interchangeable stylus (See page J-49.) |
| 12AAK110: Vibration isolator (RA-2200 only) |
| 12AAK120: Monitor arm (RA-2200 only) |
| 12AAL019: Side table for PC |
| 12AAG419: Surface roughness detector for RA-CNC |

Dimensions

Overall: 36 x 30 x 24-32” (W x D x H)
Cord Bin: 4”h x 5-3/8”d (width is 10” less than table width)
Distance From Front Edge to Cord Bin: 30”d table – 15-1/2”d
Distance Between Legs: 10” less than the overall table width

Work surface feature a 1”, 45 lb density, furniture board substrate with attractive Gray laminate tabletop brimmed with bullnose edge band in Quartz gray color. Work surface is height adjustable in one inch increments from 24” to 32”.

Tabletop incorporates metal threaded inserts on the underside to affix the leg assemblies for added strength and durability. Table comes with 4” casters with two as locking type for stationary placement.

*Laptop PC not included with table.
## Optional Styli for Roundtest

### Interchangeable Styli for RA-120, RA-120P, RA-1600/M, RA-2200, RA-H5200

<table>
<thead>
<tr>
<th>Application/Type</th>
<th>Standard (Standard accessory)</th>
<th>Notch</th>
<th>Deep groove</th>
<th>Corner</th>
<th>Cutter mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order No.</td>
<td>12AAL021*</td>
<td>12AAL022</td>
<td>12AAL023</td>
<td>12AAL024</td>
<td>12AAL025</td>
</tr>
<tr>
<td>Stylist tip</td>
<td>ø1.6 mm tungsten carbide</td>
<td>ø3 mm tungsten carbide</td>
<td>5R0.5 2.5mm sapphire</td>
<td>5R0.5 2.5mm sapphire</td>
<td>tungsten carbide</td>
</tr>
<tr>
<td>Dimensions (mm)</td>
<td>ø1.6 tungsten carbide</td>
<td>ø3 tungsten carbide</td>
<td>5R0.5 2.5mm sapphire</td>
<td>5R0.5 2.5mm sapphire</td>
<td></td>
</tr>
</tbody>
</table>

- Included in 5-pcs. styli set No. 12AAL020

### Application/Type

<table>
<thead>
<tr>
<th>Small hole (ø0.8)</th>
<th>Small hole (ø1.0)</th>
<th>Small hole (ø1.6)</th>
<th>Extra small hole (Depth 3mm)</th>
<th>ø1.6 mm ball</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order No.</td>
<td>12AAL026</td>
<td>12AAL027</td>
<td>12AAL028</td>
<td>12AAL029</td>
</tr>
<tr>
<td>Stylist tip</td>
<td>ø0.8 mm tungsten carbide</td>
<td>ø1.0 mm tungsten carbide</td>
<td>ø1.6 mm tungsten carbide</td>
<td>ø1.6 mm tungsten carbide</td>
</tr>
<tr>
<td>Dimensions (mm)</td>
<td>ø0.8 mm tungsten carbide</td>
<td>ø1.0 mm tungsten carbide</td>
<td>ø1.6 mm tungsten carbide</td>
<td>ø1.6 mm tungsten carbide</td>
</tr>
</tbody>
</table>

### Application/Type

<table>
<thead>
<tr>
<th>Disk</th>
<th>Crank (ø0.5)</th>
<th>Crank (ø1.0)</th>
<th>Flat surface</th>
<th>2X-long type**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order No.</td>
<td>12AAL031</td>
<td>12AAL032</td>
<td>12AAL033</td>
<td>12AAL034</td>
</tr>
<tr>
<td>Stylist tip</td>
<td>ø12 mm tungsten carbide</td>
<td>ø0.5 mm tungsten carbide (Depth 2.5 mm)</td>
<td>ø1.0 mm tungsten carbide (Depth 5.5 mm)</td>
<td>tungsten carbide</td>
</tr>
<tr>
<td>Dimensions (mm)</td>
<td>ø12 mm tungsten carbide</td>
<td>ø0.5 mm tungsten carbide (Depth 2.5 mm)</td>
<td>ø1.0 mm tungsten carbide (Depth 5.5 mm)</td>
<td>tungsten carbide</td>
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</table>

### Application/Type

<table>
<thead>
<tr>
<th>2X-long type notch**</th>
<th>2X-long type deep groove**</th>
<th>2X-long type corner**</th>
<th>2X-long type cutter mark**</th>
<th>2X-long type Small hole**</th>
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<tbody>
<tr>
<td>Order No.</td>
<td>12AAL036</td>
<td>12AAL037</td>
<td>12AAL038</td>
<td>12AAL039</td>
</tr>
<tr>
<td>Stylist tip</td>
<td>ø3 mm tungsten carbide</td>
<td>5R0.25 mm sapphire</td>
<td>5R0.25 mm sapphire</td>
<td>tungsten carbide</td>
</tr>
<tr>
<td>Dimensions (mm)</td>
<td>ø3 mm tungsten carbide</td>
<td>5R0.25 mm sapphire</td>
<td>5R0.25 mm sapphire</td>
<td>tungsten carbide</td>
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</tbody>
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### Application/Type

<table>
<thead>
<tr>
<th>3X-long type***</th>
<th>3X-long type deep groove***</th>
<th>Stylus Shank</th>
<th>Stylus Shank (Standard groove)</th>
<th>Stylus Shank (2X-long groove)***</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order No.</td>
<td>12AAL041</td>
<td>12AAL042</td>
<td>12AAL043</td>
<td>12AAL044</td>
</tr>
<tr>
<td>Stylist tip</td>
<td>ø1.6 mm tungsten carbide</td>
<td>5R0.25 mm sapphire</td>
<td>For mounting CMM stylus (mounting thread M2)</td>
<td>For mounting CMM stylus (mounting thread M2)</td>
</tr>
<tr>
<td>Dimensions (mm)</td>
<td>ø1.6 mm tungsten carbide</td>
<td>5R0.25 mm sapphire</td>
<td>For mounting CMM stylus (mounting thread M2)</td>
<td>For mounting CMM stylus (mounting thread M2)</td>
</tr>
</tbody>
</table>

* 12AAL021 is a standard accessory for all Roundtest models.
* 2X-long type for deep groove 0.25mm

** Not available for RA-10, RA-120P and RA-220

** 3X–long type for deep groove 0.25mm

Customized special interchangeable styli are available on request. Please contact any Mitutoyo office for more information.

New styli for RA-2200 / HS5200 are compatible with old RA-2100 / HS100 detectors.

Old styli for RA-2100 / HS100 are NOT compatible with new RA-2200 / HS5200 detectors.

---

### Optional M2 CMM stylus with ruby ball tip

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
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<tbody>
<tr>
<td>12AAL022</td>
<td>Stylus for notched workpiece</td>
</tr>
<tr>
<td>12AAL023</td>
<td>Stylus for deep groove</td>
</tr>
<tr>
<td>12AAL027</td>
<td>Stylus for small hole (1.0mm)</td>
</tr>
<tr>
<td>12AAL030</td>
<td>1.6mm ball stylus</td>
</tr>
<tr>
<td>12AAL035</td>
<td>2X-long type stylus</td>
</tr>
</tbody>
</table>

---

**K551013**:  D = ø1.5, d = ø0.7, l = 4.5, Mass = 0.3g
**K551014**:  D = ø2.0, d = ø1.0, l = 6.0, Mass = 0.3g
**K551016**:  D = ø3.0, d = ø1.5, l = 7.5, Mass = 0.4g
**K551017**:  D = ø4.0, d = ø1.5, l = 10.0, Mass = 0.4g

---

**K651025**:  D = ø6.0, d = ø2.5, R = 11.0, Mass = 1.5g
Optional Styli for Roundtest

Interchangeable Styli for RA-2200 CNC, RA-H5200 CNC

<table>
<thead>
<tr>
<th>Application/Type</th>
<th>Order No.</th>
<th>Groove</th>
<th>Flat surface</th>
<th>General purpose</th>
<th>Notch</th>
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<tr>
<td>Stylus tip</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ø1.6 mm tungsten</td>
<td>12AAE310</td>
<td>Ø1.6 mm tungsten carbide</td>
<td>Ø1.6 mm tungsten carbide</td>
<td>Ø1.6 mm tungsten carbide</td>
<td>Ø3 mm tungsten carbide</td>
</tr>
<tr>
<td>Ø1.6 mm tungsten</td>
<td>12AAE302</td>
<td>Ø1.6 mm tungsten carbide</td>
<td>Ø1.6 mm tungsten carbide</td>
<td>Ø1.6 mm tungsten carbide</td>
<td>Ø3 mm tungsten carbide</td>
</tr>
<tr>
<td>Ø1.6 mm tungsten</td>
<td>12AAE301</td>
<td>Ø1.6 mm tungsten carbide</td>
<td>Ø1.6 mm tungsten carbide</td>
<td>Ø1.6 mm tungsten carbide</td>
<td>Ø3 mm tungsten carbide</td>
</tr>
<tr>
<td>Ø1.6 mm tungsten</td>
<td>12AAE309</td>
<td>Ø1.6 mm tungsten carbide</td>
<td>Ø1.6 mm tungsten carbide</td>
<td>Ø1.6 mm tungsten carbide</td>
<td>Ø3 mm tungsten carbide</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Application/Type</th>
<th>Order No.</th>
<th>Deep hole A</th>
<th>Deep hole B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stylus tip</td>
<td></td>
<td>Ø1.6 mm tungsten carbide</td>
<td>Ø1.6 mm tungsten carbide</td>
</tr>
<tr>
<td>Dimensions (mm)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>69.7cm</td>
<td>69.6cm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>58cm</td>
<td>58cm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>33mm</td>
<td>33mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.4mm</td>
<td>2.4mm</td>
</tr>
</tbody>
</table>

Usage examples of styli

- Cutter mark
- Corner
- Flatness measurement
- Notched workpiece measurement
- ID measurement
- Full measurement capability
- Limited measurement capability; R-Axis must be stationary.
Optional Accessories for Roundtest

Centering chuck (ring operated) 211-032
Suitable for holding small parts with easy-to-operate knurled-ring clamping.
• Holding capacity:
  - Internal jaws: OD = 1-36 mm, ID = 14-70 mm.
  - External jaws: OD = 30-80 mm.
• External dimensions: ø157 x 76 mm
• Mass: 1.2kg

Centering chuck (key operated) 211-014
Suitable for holding longer parts and those requiring a relatively powerful clamp.
• Holding capacity:
  - Internal jaws: OD = 1-35 mm, ID = 33 - 85 mm.
  - External jaws: OD = 30-80 mm.
• External dimensions: ø157 x 76 mm
• Mass: 3.8kg

Micro-chuck 211-031
Used for clamping a workpiece (less than ø1 mm dia.) that the centering chuck cannot handle.
• Holding capacity: up to ø1.5 mm
• External dimensions: ø118x48.5 mm
• Mass: 0.8kg

Magnification calibration gage 211-045
Used for normalizing detector magnification by calibrating detector travel against displacement of a micrometer spindle.
• Maximum calibration range: 400µm
• Graduation: 0.2µm
• Mass: 4kg

Vibration Isolated frame with work surface

Auxiliary workpiece stand 356038
• Used for measuring a workpiece whose diameter is 20mm or shorter and whose height is 20mm or lower.

Cylindrical square 350850
• Used for checking and aligning table rotation axis parallel to the Z-axis column.
• Squareness: 3µm
• Straightness: 1µm
• Cylindricity: 2µm
• Roundness: 0.5µm
• Mass: 7.5kg

Magnification checking kit* 997090
• A combination of gage blocks and an optical flat.
  * Standard accessory for RA-2200, RA-2200CNC, RA-H5200 and RA-H5200CNC

Origin-point gage* 998382
• A gage for zero setting of the R-axis and Z-axis.
  * Standard accessory for RA-2200 and RA-H5200

Reference Hemisphere Code No. 211-016
Dimensions 30 x 48 x 30" Load Capacity 1300 lbs

Code No. Dimensions Load Capacity
64AA8357 30 x 48 x 30" 1300 lbs
### Eco-Fix Kit Form-S

**Mitutoyo ECO-FIX Kit Fixture Systems**

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Qty.</th>
<th>Part name</th>
<th>Part No.</th>
<th>Qty.</th>
<th>Part name</th>
</tr>
</thead>
<tbody>
<tr>
<td>K551038</td>
<td>1</td>
<td>Adaptor plate ø 150mm</td>
<td>K551069</td>
<td>1</td>
<td>Flat top ø 12mm</td>
</tr>
<tr>
<td>K551024</td>
<td>1</td>
<td>Location pin ø 12 X 13mm</td>
<td>K550262</td>
<td>1</td>
<td>V-block mini</td>
</tr>
<tr>
<td>K551025</td>
<td>1</td>
<td>Location pin ø 12 X 25mm</td>
<td>K550261</td>
<td>2</td>
<td>Cone receiver mini</td>
</tr>
<tr>
<td>K551026</td>
<td>1</td>
<td>Location pin ø 12 X 50mm</td>
<td>K550250</td>
<td>1</td>
<td>Stopper element mini</td>
</tr>
<tr>
<td>K551027</td>
<td>1</td>
<td>Location pin ø 12 X 100mm</td>
<td>K550247</td>
<td>1</td>
<td>Back square mini</td>
</tr>
<tr>
<td>K551028</td>
<td>1</td>
<td>Location pin ø 20 X 13mm</td>
<td>K550888</td>
<td>2</td>
<td>Straight pin Ø 6mm x 20mm</td>
</tr>
<tr>
<td>K551029</td>
<td>1</td>
<td>Location pin ø 20 X 25mm</td>
<td>K550889</td>
<td>2</td>
<td>Straight pin Ø 6mm x 30mm</td>
</tr>
<tr>
<td>K551030</td>
<td>1</td>
<td>Location pin ø 20 X 50mm</td>
<td>K550890</td>
<td>2</td>
<td>Straight pin Ø 6mm x 40mm</td>
</tr>
<tr>
<td>K551031</td>
<td>1</td>
<td>Location pin ø 20 X 100mm</td>
<td>K551046</td>
<td>1</td>
<td>Slotted nut for receiver bracket h=12mm</td>
</tr>
<tr>
<td>K551035</td>
<td>1</td>
<td>Receiver bracket small</td>
<td>K551050</td>
<td>1</td>
<td>Allen key 2mm</td>
</tr>
<tr>
<td>K551036</td>
<td>1</td>
<td>Receiver bracket large</td>
<td>K551051</td>
<td>1</td>
<td>Allen key 3mm</td>
</tr>
<tr>
<td>K551040</td>
<td>1</td>
<td>Adjustable location pin ø 20mm</td>
<td>K551052</td>
<td>1</td>
<td>Allen key 4mm</td>
</tr>
<tr>
<td>K551041</td>
<td>1</td>
<td>Adjustable location pin ø 12mm</td>
<td>K551053</td>
<td>1</td>
<td>Allen key 5mm</td>
</tr>
<tr>
<td>K551042</td>
<td>3</td>
<td>Location pin ø 12mm with bore Ø 6mm</td>
<td>K551054</td>
<td>1</td>
<td>Double open ended spanner 10-17</td>
</tr>
<tr>
<td>K551044</td>
<td>1</td>
<td>Receiver bracket L=90, ø 12mm</td>
<td>K550591</td>
<td>1</td>
<td>Washer ø 6,4mm / ø 17mm</td>
</tr>
<tr>
<td>K550716</td>
<td>1</td>
<td>Straight pin with thread</td>
<td>K550110</td>
<td>8</td>
<td>Cylinder head screw M6 x 20mm</td>
</tr>
<tr>
<td>K550279</td>
<td>1</td>
<td>Spring clip, d=8mm, L=60mm</td>
<td>K550563</td>
<td>6</td>
<td>Cylinder head screw M6 x 25mm</td>
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<tr>
<td><strong>Kit Part No.</strong></td>
<td></td>
<td></td>
<td>K551133</td>
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</table>

### Eco-Fix Kit Form-L

<table>
<thead>
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<th>Part No.</th>
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<th>Part name</th>
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<td>V-block</td>
</tr>
<tr>
<td>K551025</td>
<td>1</td>
<td>Location pin ø 12 X 25mm</td>
<td>K550365</td>
<td>2</td>
<td>Cone receiver</td>
</tr>
<tr>
<td>K551026</td>
<td>1</td>
<td>Location pin ø 12 X 50mm</td>
<td>K550982</td>
<td>1</td>
<td>Stopper element</td>
</tr>
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<td>K551027</td>
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<td>Location pin ø 12 X 100mm</td>
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<td>Back square</td>
</tr>
<tr>
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<td>Straight pin Ø 6mm x 20mm</td>
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<td>2</td>
<td>Location pin ø 20 X 25mm</td>
<td>K550889</td>
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<td>Straight pin Ø 6mm x 30mm</td>
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<td>K551052</td>
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</tr>
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<td><strong>Kit Part No.</strong></td>
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<td>K551133</td>
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</tbody>
</table>
Quick Guide to Precision Measuring Instruments

Roundtest (Roundform Measuring Instruments)

- JIS B 7451-1997: Roundness measuring instruments
- JIS B 0621-1984: Definition and notation of geometric deviations

Roundness
Any circumferential line must be contained within the tolerance zone formed between two coplanar circles with a difference in radii of t.

Straightness
Any line on the surface must lie within the tolerance zone formed between two parallel straight lines a distance t apart and in the direction specified.

Flatness
The surface must be contained within the tolerance zone formed between two parallel planes a distance t apart.

Cylindricity
The surface must be contained within the tolerance zone formed between two coaxial cylinders with a difference in radii of t.

Concentricity
The center point must be contained within the tolerance zone formed by a circle of diameter t concentric with the datum.

Coaxiality
The axis must be contained within the tolerance zone formed by a cylinder of diameter t concentric with the datum.

Perpendicularity
The line or surface must be contained within the tolerance zone formed between two planes a distance t apart and perpendicular to the datum.

Total Runout
The surface must be contained within the tolerance zone formed between two coaxial cylinders with a difference in radii of t, or plans a distance t apart, concentric with or perpendicular to the datum.

Circular Runout
The line must be contained within the tolerance zone formed between two coplanar and/or concentric circles a distance t apart concentric with or perpendicular to the datum.

Adjustment prior to Measurement

Centering
A displacement offset (eccentricity) between the Roundtest’s rotary table axis and that of the workpiece results in distortion of the measured form (limaçon error) and consequently produces an error in the calculated roundness value. The larger the eccentricity, the larger is the error in calculated roundness. Therefore the workpiece should be centered (axes made coincident) before measurement. Some roundness testers support accurate measurement with a limaçon error correction function. The effectiveness of this function can be seen in the graph below.

Effect of eccentricity compensation function

Leveling
Any inclination of the axis of a workpiece with respect to the rotational axis of the measuring instrument will cause an elliptic error. Leveling must be performed so that these axes are sufficiently parallel.
**Effect of Filter Settings on the Measured Profile**

Roundness values as measured are greatly affected by variation of filter cutoff value. It is necessary to set the filter appropriately for the evaluation required.

- **No filter**
- **Low-pass filter**
- **Band-pass filter**

**Evaluating the Measured Profile Roundness**

Roundness testers use the measurement data to generate reference circles whose dimensions define the roundness value. There are four methods of generating these circles, as shown below, and each method has individual characteristics so the method that best matches the function of the workpiece should be chosen.

- **Least Square Circle (LSC) Method**
  - A circle is fitted to the measured profile such that the sum of the squares of the departure of the profile data from this circle is a minimum. The roundness figure is then defined as the difference between the maximum departures of the profile from this circle (highest peak to the lowest valley).

- **Minimum Zone Circles (MZC) Method**
  - Two concentric circles are positioned to enclose the measured profile such that their radial difference is a minimum. The roundness figure is then defined as the radial separation of these two circles.

- **Minimum Circumscribed Circle (MCC) Method**
  - The smallest circle that can enclose the measured profile is created. The roundness figure is then defined as the maximum departure of the profile from this circle. This circle is sometimes referred to as the 'ring gage' circle.

- **Maximum Inscribed Circle (MIC) Method**
  - The largest circle that can be enclosed by the profile data is created. The roundness figure is then defined as the maximum departure of the profile from this circle. This circle is sometimes referred to as the 'plug gage' circle.

**Undulations Per Revolution (UPR) data in the roundness graphs**

Measurement result graphs

A 1 UPR condition indicates eccentricity of the workpiece relative to the rotational axis of the measuring instrument. The amplitude of undulation components depends on the leveling adjustment.

A 2 UPR condition may indicate: (1) insufficient leveling adjustment on the measuring instrument; (2) circular runout due to incorrect mounting of the workpiece on the machine tool that created its shape; (3) the form of the workpiece is elliptical by design as in, for example, an IC-engine piston.

A 3 to 5 UPR condition may indicate: (1) Deformation due to over-tightening of the holding chuck on the measuring instrument; (2) Relaxation deformation due to stress release after unloading from the holding chuck on the machine tool that created its shape.

- **Low-pass Filter**
- **Band-pass Filter**
- **No Filter**

A circle is fitted to the measured profile such that the sum of the squares of the departure of the profile data from this circle is a minimum. The roundness figure is then defined as the difference between the maximum departures of the profile from this circle (highest peak to the lowest valley).

Two concentric circles are positioned to enclose the measured profile such that their radial difference is a minimum. The roundness figure is then defined as the radial separation of these two circles.

The smallest circle that can enclose the measured profile is created. The roundness figure is then defined as the maximum departure of the profile from this circle. This circle is sometimes referred to as the 'ring gage' circle.

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