

Roundtest RA-120 / 120P

SERIES 211 — Roundness Measuring Instruments

Technical Data

Turntable
 Rotational accuracy: (0.04+6H/10000) μ m
 H: Probing height (mm)
 Rotating speed: 6rpm
 Table top diameter: \varnothing 1.96" (150mm)
 Centering range: \pm 12" (3mm)
 Leveling range: \pm 1°
 Maximum probing diameter: \varnothing 11" (280mm)
 Maximum workpiece diameter: \varnothing 17.3" (440mm)
 Maximum workpiece weight: 55 lbs (25kg)

Vertical column (Z-axis)
 Vertical travel: 11" (280mm)
 Feeding: 1.18" (30mm)/rev. (coarse),
 0.039" (1mm)/rev. (fine)

Maximum probing height: 11" (280mm) from the turntable top
 Maximum probing depth: 3.94" (100mm) (min. ID: 1.18" (30mm))

Horizontal arm (X-axis)
 Horizontal travel: 65" (165mm) (Including a protrusion of 1" (25mm) the turntable rotation center)

Probe and stylus
 Measuring range: \pm 1000 μ m
 Measuring force: 100mN \pm 30mN
 Standard stylus: 12AAL021, carbide ball, \varnothing 1.6mm
 Measuring direction: Two directional
 Stylus angle adjustment: \pm 45° (with graduations)

Data analysis unit:
 Processing unit: Built-in (PC with Roundpak)*
 Data sampling points: 3,600 points/rotation
 Data analysis items:
 Roundness, Coaxiality, Concentricity, Flatness, Circular runout (radial), Circular runout (axial), Squareness (against axis), Squareness (against plane), Thickness deviation, Parallelism

Reference circles for roundness evaluation:
 LSC, MZC, MIC, MCC

Recording device:
 Built-in thermal line printer (optional external printer)*

Recording magnification:
 X5 to X200,000, Auto (X1 to X500,000)*

Roughness component reduction:
 Low pass filter, band pass filter

Filter type:
 2CR-75%, 2CR-50%, 2CRPC-75% (phase corrected),
 2CRPC-50% (phase corrected), Gaussian, filter OFF

Cutoff value:
 15 μ r, 50 μ r, 150 μ r, 500 μ r, 15-150 μ r, 15-500 μ r,
 50-500 μ r, Manual setting*

Number of measuring sections
 Max. 5-section (100-section)*

*RA-120P

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 \pm 1000 μ m wide range detector and precision turn table 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.



Z-axis scale unit



Optional X-axis stop



RA-120

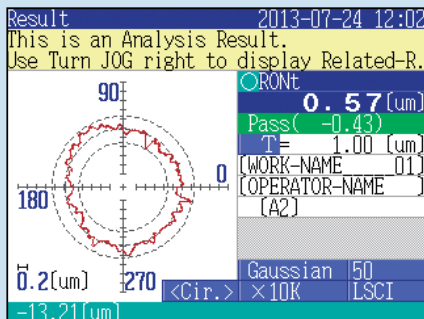
Order No.: 211-544A (with mechanical table)

Order No.: 211-543A (with DAT function, inch/mm)

SPECIFICATIONS

Model No.	RA-120	RA-120D	RA-120P	RA-120PD
Order No.	211-544A	211-543A	211-547A	211-546A

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



Large color LCD display for RA-120 models



RA-120P

Order No.: 211-547A (with mechanical table)

Order No.: 211-546A (with DAT function, inch/mm)

MiCAT

Mitutoyo Intelligent Computer Aided Technology

the standard in world metrology software

FORM

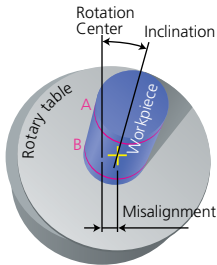
Roundtest RA-120 / 120P

SERIES 211 — Roundness Measuring Instruments

DAT (Digital Adjustment Table) function

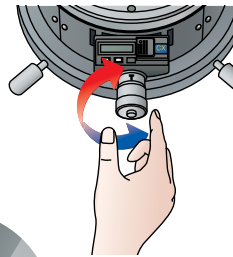
The turntable digitally displays the centering and leveling adjustments, turning what used to be a difficult and finicky task into one that is simple enough for even untrained operator to perform.

1. Preliminary measurement of two cross sections "A" and "B".

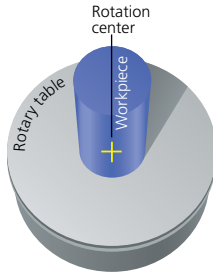


2. Following preliminary measurement, the centering and leveling adjustment values are displayed on the monitor.

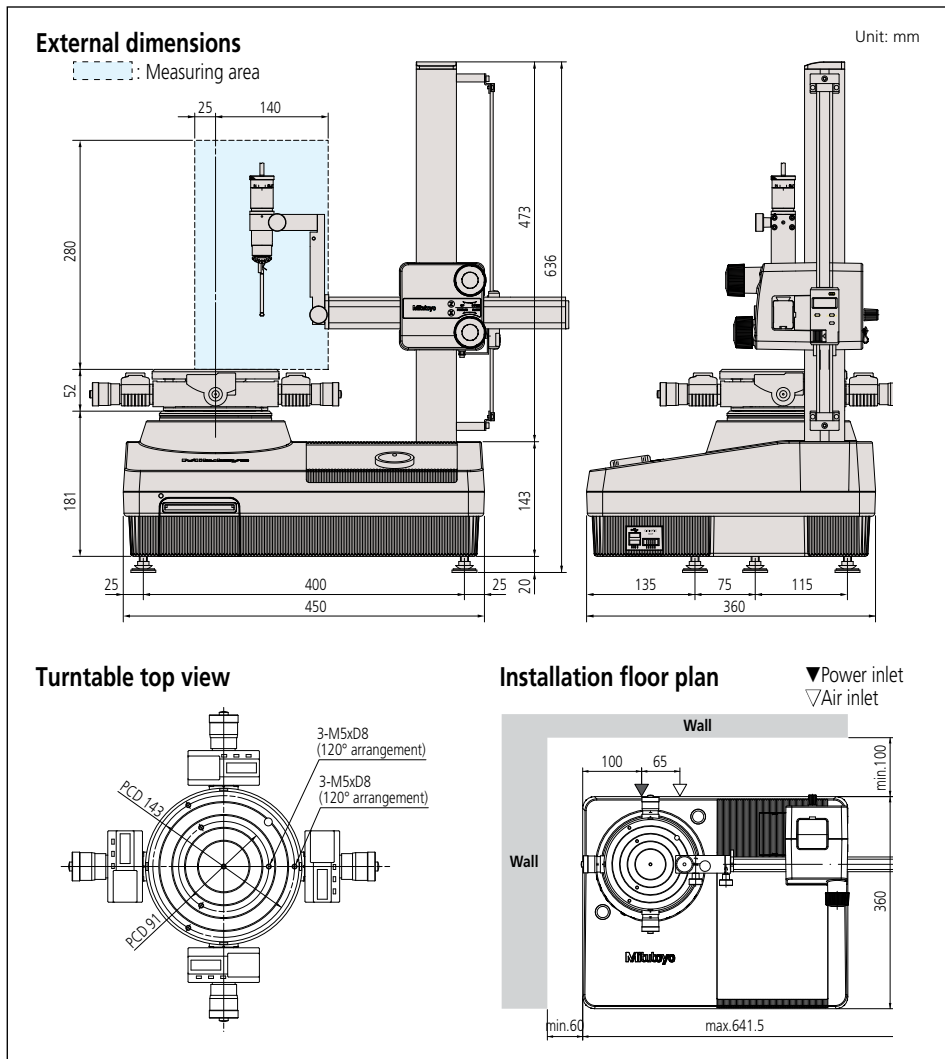
3. Manipulate the digital micrometer heads of the rotary table so that the adjustment values displayed on the monitor are realized.



4. Centering and leveling are complete. Centering range: $\pm 3\text{mm}$ Leveling (inclination) range: $\pm 1^\circ$



DIMENSIONS



Functions

- Notched workpiece measurement
- Recalculation of datum/measured data
- Limaçon function compensates for eccentricity
- Rotation of 3D display**
- Real-time display**
- Simplified layout (divided layout)**
- Hair line, auxiliary line, hidden line, fill line**
- Color setting of measured data**
- Offsetting of recorded profile generation**
- Zooming of recorded profile**
- Data deletion**
- Graph analysis (displacement/angle between measured points)**
- Power spectrum analysis**
- Gear tooth analysis**
- Harmonic analysis**
- Text data output (via CSV format)**

**Function of ROUNDPAK software

Air supply

- Air pressure: 390kPa
- Air consumption: 30L/min.
- Power supply: 100V AC – 240V AC, 50/60Hz
- Dimensions (W x D x H): 17.7" x 14.2" x 25" (450 x 360 x 636mm)
- Mass: 70.5 lbs (32kg) (main unit), 4.4 lbs (2kg) (air regulator)

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

—: Interchangeable styli (See page J-49.)



CONSUMABLE PARTS

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

Roundtest RA-1600 / RA-1600M

SERIES 211 — Roundness/Cylindricity Measuring System

Technical Data

Turntable
 Rotational accuracy (radial): $(0.02+6H/10000)\mu\text{m}$ (RA-1600)
 Rotational accuracy (axial): $(0.02+6X/10000)\mu\text{m}$ (RA-1600)
 Rotational accuracy (radial): $(0.03+6H/10000)\mu\text{m}$ (RA-1600M)
 Rotational accuracy (axial): $(0.03+6X/10000)\mu\text{m}$ (RA-1600M)
 H: Probing height (mm), X: Probing radius (mm)

Rotational speed: 4, 6, 10rpm
 Table top diameter: $\phi 5.9"$ (150mm)
 Centering range: $\pm 3\text{mm}$ (with DAT function)
 Leveling range: $\pm 1^\circ$ (with DAT function)
 Maximum probing diameter: $\phi 11"$ ($\phi 280\text{mm}$)
 Maximum workpiece diameter: $\phi 22"$ ($\phi 560\text{mm}$)
 Maximum table loading: 55lbs (25kg)

Vertical column (Z-axis)
 Vertical travel: 11.8" (300mm)
 Straightness (in narrow range): $0.20\mu\text{m} / 100\text{mm}$ (RA-1600)
 Straightness (in entire range): $0.30\mu\text{m} / 300\text{mm}$ (RA-1600)
 Straightness (in narrow range): $0.40\mu\text{m} / 100\text{mm}$ (RA-1600M)
 Straightness (in entire range): $0.80\mu\text{m} / 100\text{mm}$ (RA-1600M)
 Parallelism with turntable axis: $1.5\mu\text{m} / 300\text{mm}$
 Positioning speed: Max. 15mm/s
 Measuring speed: 0.5, 1, 2, 5mm/s
 Maximum probing height (ID/OD): 11.8" (300mm)*1
 Maximum probing depth: 91mm (over $\phi 32$)
 3.6" (over $\phi 1.26"$) ($\phi 91\text{mm}$ (over $\phi 32$))
 1.97" (over $\phi 0.27"$) ($\phi 50\text{mm}$ (over $\phi 7$))

Horizontal arm (X-axis)
 Horizontal travel: 6.5" (165mm) (From table axis $-1 \sim \pm 5.5"$
 ($-25\text{mm} \sim \pm 140\text{mm}$)
 Positioning speed: Max. 15mm/s
 Measuring speed: 0.5, 1, 2, 5mm/s
 X-axis straightness: $2.7\mu\text{m} / 140\text{mm}$ (RA-1600)
 X-axis parallelism to turntable axis:
 1.6 $\mu\text{m} / 140\text{mm}$ (RA-1600)

Probe and stylus
 Measuring range: $\pm 400\mu\text{m} / \pm 40\mu\text{m} / \pm 4\mu\text{m}$
 Measuring force: 10–50mN (5 level switching)
 Standard stylus: **12AAL021**, carbide ball, $\phi 1.6\text{mm}$
 Measuring direction: Bi-directional
 Stylus angle adjustment: $\pm 45^\circ$ (with graduations)

Air supply
 Air pressure: 0.39MPa (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)

*1 Use an optional auxiliary stage for measuring a workpiece whose height is 20mm or less.

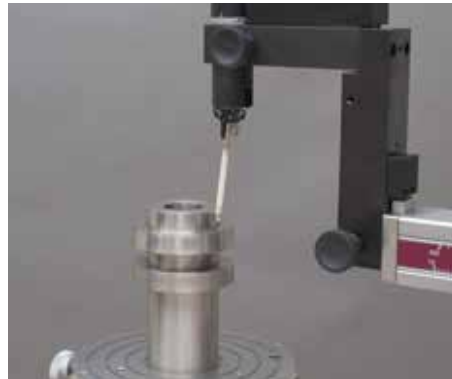


RA-1600 / RA-1600M
with personal computer system and software

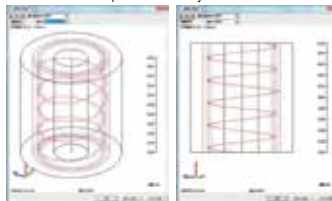
A new PC-compliant roundness and cylindrical-form measuring instrument with extensive analysis features to enable measurement of a wide variety of workpieces

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.



Spiral-mode cylinder measurement



Safety mechanism provided as a standard feature

A collision-sensing function has been added to the detector unit (when it is in the vertical orientation) to prevent collision in the Z-axis direction. Additionally, an accidental collision prevention function, which stops the system when the detector displacement exceeds its range, has been added. When an accidental touch is detected, the dedicated analysis software (ROUNDPAK) senses the error and automatically stops the system.



Measurement through X-axis tracking

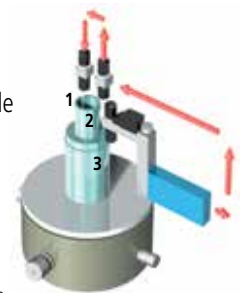
Measurement while tracing is possible through a built-in linear scale in the X-axis. This type of measurement is useful when displacement due to form variation exceeds the measuring range of the detector, and X-axis motion is necessary to maintain contact with the workpiece surface.



Continuous internal/external diameter measurement

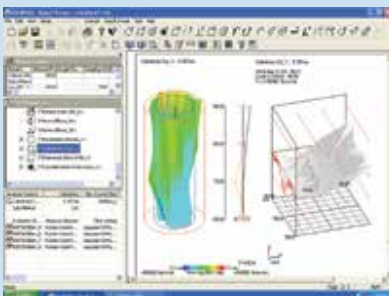
Continuous internal/external diameter measurement is possible without changing the detector position.

- 1), 2) : External diameter measurement
- 3) : Internal diameter measurement
- ➔ : Displacement
- 3) = inner diameter: Up to $\phi 50\text{mm}$



ROUNDPAK

The latest roundness/cylindrical form analysis program



MiCAT

Mitutoyo Intelligent Computer Aided Technology

the standard in world metrology software
FORM

Mitutoyo

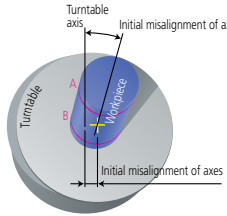
Roundtest RA-1600 / RA-1600M

SERIES 211 — Roundness/Cylindricity Measuring System

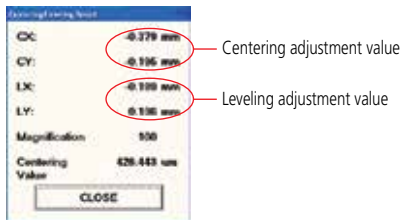
* Centering and Leveling function

The turntable displays centering and leveling adjustments digitally, making this challenging task simple enough for even an untrained 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.



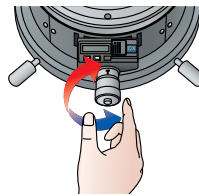
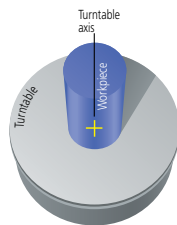
For RA-1600



For RA-1600M



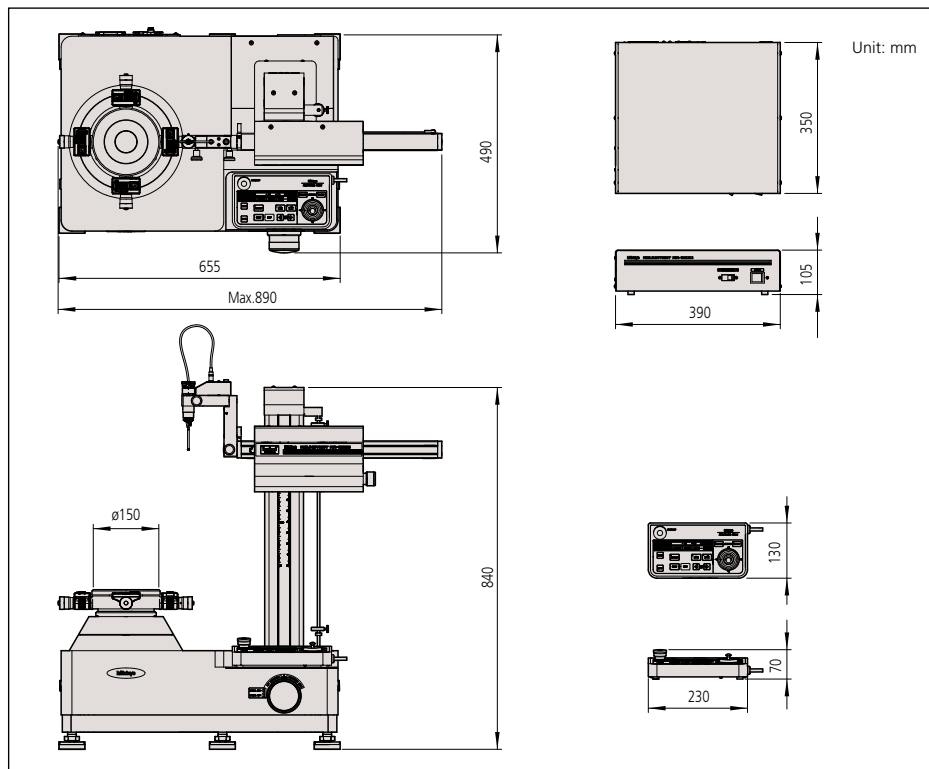
3. By adjusting the micrometer heads for the rotary table, the adjustment values or level meter displayed on the monitor can be achieved.
4. Centering and leveling are complete.
Centering range: $\pm 3\text{mm}$
Leveling (inclination) range: $\pm 1^\circ$



SPECIFICATIONS

Model No.	RA-1600	RA-1600M
Order No. (inch/mm)	211-733A	211-724A
Mic Heads	Digimatic	Mechanical

DIMENSIONS



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: $\varnothing 2 - 78\text{mm}$, ID: $\varnothing 25 - 68\text{mm}$)
- 211-032:** Quick chuck (OD: $\varnothing 1 - 79\text{mm}$, ID: $16 - 69\text{mm}$)
- 211-031:** Micro-chuck (OD: $\varnothing 0.1 - 1.5\text{mm}$ max.)
- 178-025:** Vibration isolator (Desk top type)
- 64AAB213:** Vibration isolation workstation
- 12AAL019:** Side table for PC
- : Interchangeable styli (See page J-49.)



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.



Sliding distance: 4.4" (112mm)

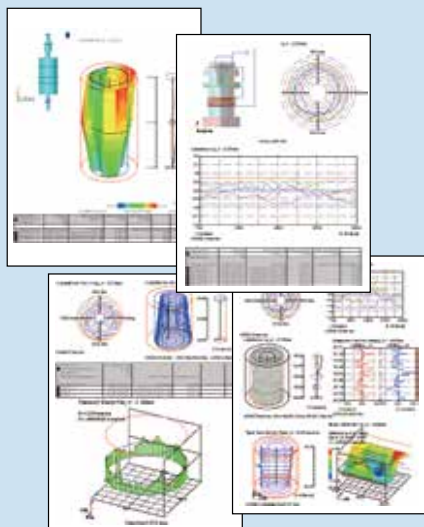
The detector-unit holder can be stopped at a position sufficiently higher than the workpiece along the Z-axis, and then lowered and positioned to make measurements. Furthermore, internal/external diameters can be easily measured with the continuous internal/external diameter measurement function*.

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

Technical Data

Turntable
 Rotational accuracy (radial): $(.8+.35H)\mu\text{in}$ $\{(0.02+3.5H/10000)\mu\text{m}\}$
 Rotational accuracy (axial): $(.8+.35R)\mu\text{in}$ $\{(0.02+3.5R/10000)\mu\text{m}\}$
H: Probing height (mm), R: Probing radius (mm)
 Rotating speed: 2, 4, 6, 10rpm
 Table top diameter: $\varnothing 9.2"$ (235mm) AS / AH models
 $\varnothing 7.9"$ (200mm) DS / DH models
 Centering range: $\pm 3\text{mm}$ ($\pm 5\text{mm}$: DS / DH models)
 Leveling range: $\pm 1^\circ$
 Maximum probing diameter: $\varnothing 11.8"$ (300mm)
 Maximum workpiece diameter: $\varnothing 22.8"$ (580mm)
 Maximum workpiece weight: 66 lbs (30kg)
 Vertical column (Z-axis)
 Vertical travel: 11.8" (300mm) (22.8" (500mm): AH/DH models)
 Straightness ($\lambda c 2.5$): 0.10 μm / 100mm, 0.15 μm / 300mm
 (0.25 μm / 500mm: AH / DH models)
 Parallelism with rotating axis: 0.7 μm / 300mm
 (1.2 μm / 500mm: AH / DH models)
 Positioning speed: Max. 50mm/s
 Measuring speed: 0.5, 1, 2, 5mm/s
 Maximum probing height: 11.8" (300mm) (OD / ID)
 [22.8" (500mm): AH / DH models]
 Maximum probing depth: over $\varnothing 32$: 85mm (w/standard stylus)
 over $\varnothing 7$: 50mm (w/standard stylus)
 Horizontal arm (X-axis)
 Horizontal travel: 6.9" (175mm) (Including a protrusion of
 1" (25mm) the turntable rotation center)
 Straightness ($\lambda c 2.5$): 0.7 μm / 150mm
 Squareness with rotating axis: 1.0 μm / 150mm
 Positioning speed: Max. 30mm/s with joystick operation
 Measuring speed: 0.5, 1, 2, 5mm/s
 Probe and stylus
 Measuring range: $\pm 400\mu\text{m}/\pm 40\text{mm}/\pm 4\text{mm}$
 ($\pm 5\text{mm}$: tracking range)
 Measuring force: 10mN–50mN (in 5 steps)
 Standard stylus: **12AAL021**, carbide ball, $\varnothing 1.6\text{mm}$
 Measuring direction: Two directional
 Stylus angle adjustment: $\pm 45^\circ$ (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,
 15-150upr, 15-500upr, 15-1500upr, 50-500upr,
 50-1500upr, 150-1500upr, Manual setting
 Reference circles for roundness evaluation:
 LSC, MZC, MIC, MCC
 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)
 (667 x 20 x 43.3"
 (667 x 510 x 1100mm: AH / DH models)
 Mass:
 396 lbs (180kg)
 440 lbs (200kg) AH / DH models

Printout



Roundtest RA-2200AS / DS / AH / DH

SERIES 211 — Roundness / Cylindricity Measuring System

The RA-2200 provides a high accuracy, high speed and high performance in roundness measurement. The fully-automatic or a DAT (Digital Adjustment Table) function aided manual workpiece centering and leveling turns what used to be a difficult and finicky task into one that is simple enough for even untrained

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 icon, achieving enhanced functionality and ease of operation.

RA-2200AS with personal computer system and software

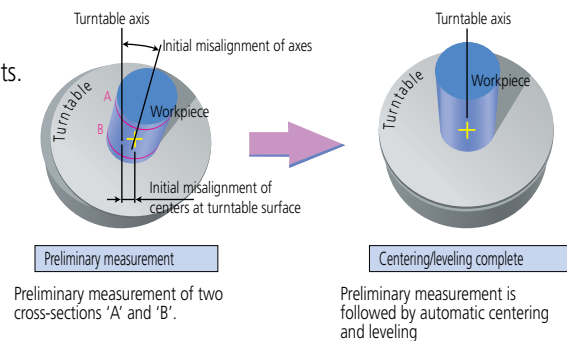
* Shown with optional
vibration isolator and side
table for PC



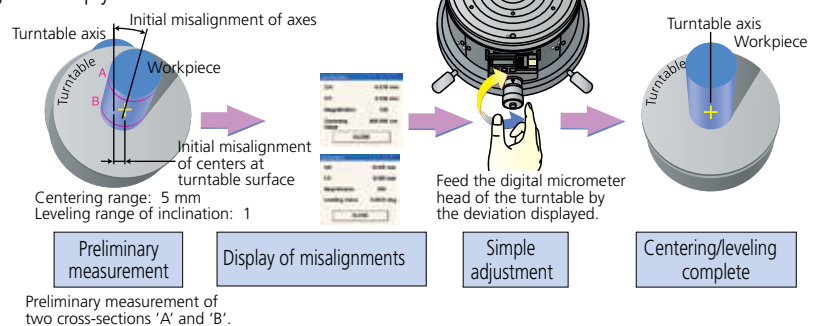
Highly accurate and easy-to-use turntable

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.



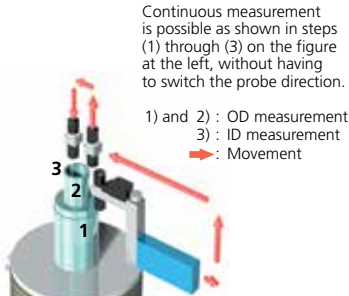
Roundtest RA-2200AS / DS / AH / DH

SERIES 211 — Roundness / Cylindricity Measuring System

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.



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.

Unique design allows system upgrading

The system can be upgraded to CNC operation by replacing and adjusting the detector unit. (This task should be performed by a Mitutoyo technician.)

Surface roughness measurement function (Surface roughness unit: option)

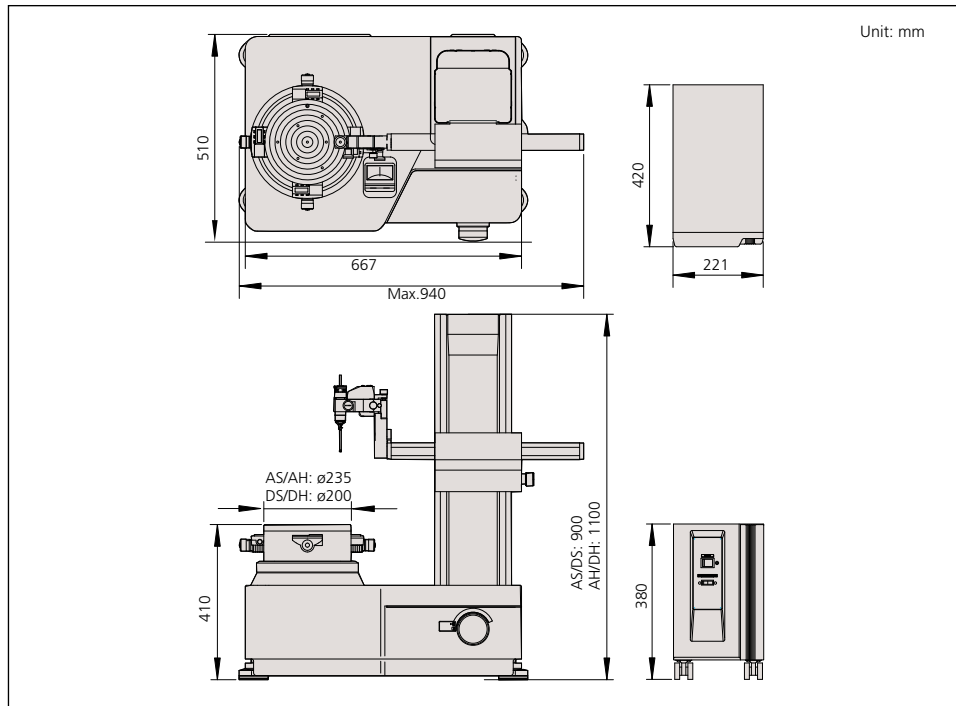
A surface roughness detector, compliant with the relevant International Standards, can be mounted in place of the roundness measuring detector. This creates a multiple sensor system that can not only test the geometrical roundness/cylindricity of a surface but also the roughness of that surface as well.



SPECIFICATIONS

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

DIMENSIONS



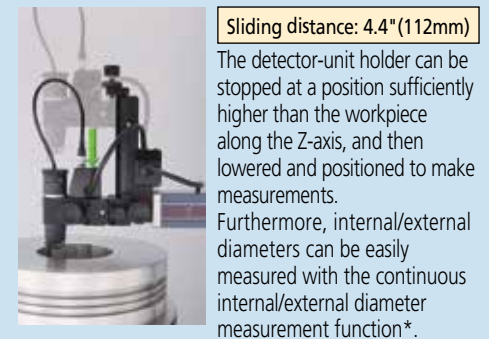
Optional Accessories

- 350850: Cylindrical square
- 356038: Auxiliary stage for a low-height workpiece
- 12AAF203: Extension probe holder (2X higher)
- 12AAF204: Auxiliary probe holder for a large diameter workpiece
- 211-045: Magnification checking gage
- 211-014: Chuck (OD: 1 - 85mm, ID: 33 - 85mm)
- 211-032: Quick chuck (OD: 1 - 75mm, ID: 14 - 70mm)
- 211-031: Micro-chuck (OD: 1.5mm max.)
- 178-025: Vibration isolator
- 178-024: Stand for vibration isolator
- : Interchangeable styli (See page J-49.)
- 12AAK110: Vibration isolator
- 12AAK120: Monitor arm
- 12AAL019: Side table for PC

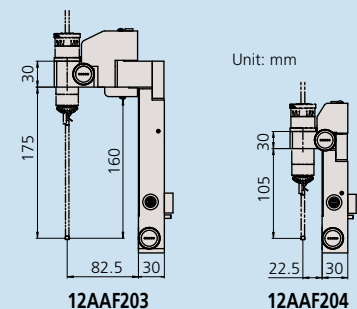


Sliding detector-unit holder (Standard) 12AAL090

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.



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



Roundtest RA-H5200AS / AH

SERIES 211 — Roundness / Cylindricity Measuring System

Technical Data

Turntable
 Rotational accuracy (radial): $(.8+.35H)\mu\text{in}$ $\{(0.02+3.5H/10000)\mu\text{m}\}$
 Rotational accuracy (axial): $(.8+.35X)\mu\text{in}$ $\{(0.02+3.5X/10000)\mu\text{m}\}$
H: Probing height (mm), X: Distance from the turntable axis (mm)
 Rotating speed: 2, 4, 6, 10rpm (20rpm: auto-centering)
 Table top diameter: \varnothing 11.8" (300mm)
 Centering range: $\pm 5\text{mm}$
 Leveling range: $\pm 1^\circ$
 Maximum probing diameter: \varnothing 15.7" (400mm)
 Maximum workpiece diameter: \varnothing 26.8" (680mm)
 Maximum workpiece weight: 176 lbs (80kg)
 143 lbs (65kg): auto-centering

Vertical column (Z-axis)
 Vertical travel: 13.8" (350mm), (21.7" (550mm): AH model)
 Straightness ($\lambda c2.5$): $0.05\mu\text{m} / 100\text{mm}$, $0.14\mu\text{m} / 350\text{mm}$
 ($0.2\mu\text{m} / 550\text{mm}$: AH model)
 Parallelism with rotating axis: $0.2\mu\text{m} / 350\text{mm}$
 ($0.32\mu\text{m} / 550\text{mm}$: AH model)
 Positioning speed: Max. 60mm/s
 Measuring speed: 0.5, 1, 2, 5mm/s
 Maximum probing height: 13.8" (350mm) (OD / ID)
 [21.7" (550mm) (OD / ID): AH model]
 Maximum probing depth: over $\varnothing 32$: 85mm (w/standard stylus)
 over $\varnothing 7$: 50mm (w/standard stylus)

Horizontal arm (X-axis)
 Horizontal travel: 8.9" (225mm)
 Straightness ($\lambda c2.5$): $0.4\mu\text{m} / 200\text{mm}$
 Squareness with rotating axis: $0.5\mu\text{m} / 200\text{mm}$
 Positioning speed: Max. 50mm/s
 Measuring speed: 0.5, 1, 2, 5mm/s

Probe and stylus
 Measuring range: $\pm 400\mu\text{m}$ ($\pm 5\text{mm}$: tracking range)
 Measuring force: 10mN~50mN (in 5 steps)
 Standard stylus: **12AAL021**, carbide ball, $\varnothing 1.6\text{mm}$
 Measuring direction: Two directional
 Stylus angle adjustment: $\pm 45^\circ$ (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,
 15-150upr, 15-500upr, 15-1500upr, 50-500upr, 50-1500upr, 150-1500upr, Manual setting
 Reference circles for roundness evaluation:
 LSC, MZC, MIC, MCC

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)
 49.6 x 28.0 x 74.8"
 (1260 x 710 x 1900mm: AH model)

Mass: Main unit: 1433lbs. (650kg)
 1477lbs. (670kg): AH model
 Vibration isolator: 375 lbs (170kg)

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.



RA-H5200AS with personal computer system and software

* Shown with optional side table for PC.

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 .

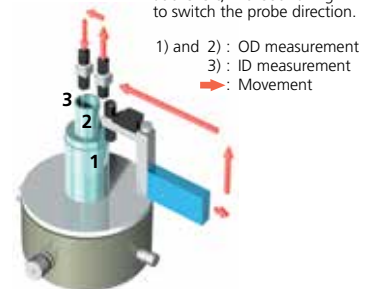
Automatic continuous OD/ID measurement

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.



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



Roundtest RA-H5200AS / AH

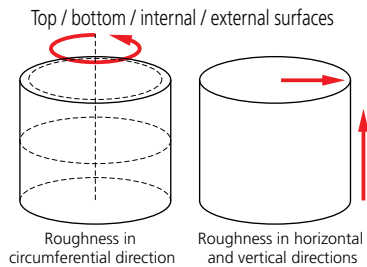
SERIES 211 — Roundness / Cylindricity Measuring System

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: $\pm 5\text{mm}$). 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)

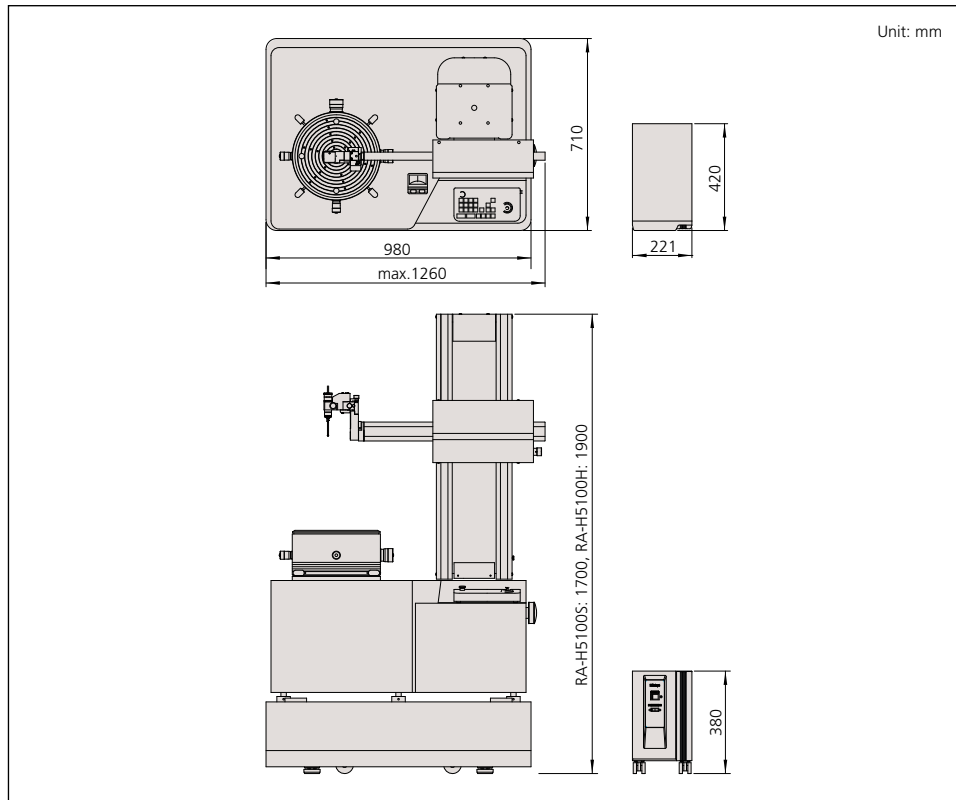
A surface roughness detector, compliant with the relevant International Standards, can be mounted in place of the roundness measuring detector. This creates a multiple sensor system that can not only test the geometrical roundness/cylindricity of a surface but also the roughness of that surface as well.



SPECIFICATIONS

Model No.	RA-H5200AS	RA-H5200AH
Order No. * with vibration isolating stand	211-531A	211-532A
Column travel	13.77" (350mm) (standard column)	21.65" (550mm) (high column)

DIMENSIONS



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
- Interchangeable styli (See page J-49.)
- 12AAL019: Side table for PC



Sliding detector-unit holder(Standard) 12AAL090

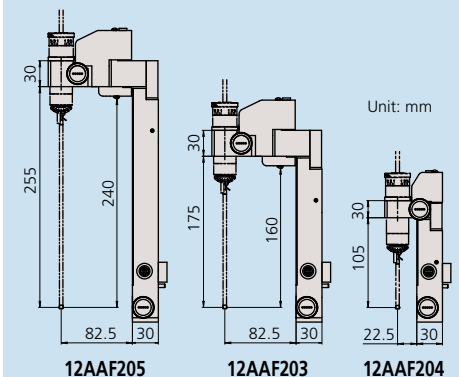
The detector-unit holder is equipped with a sliding mechanism, enabling one-touch measurement of a workpiece with a deep hole having a thick wall, which has been difficult with the conventional standard arm.



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 this page for details about the continuous ID and OD measuring function.



Technical Data: RA-2200CNC

Turntable
 Rotational accuracy (radial): (.8+.35H) μ m {(0.02+3.5H/10000) μ m}
 Rotational accuracy (axial): (.8+.35X) μ m {(0.02+3.5X/10000) μ m}
H: Probing height (mm), X: Distance from the turntable axis (mm)
 Rotating speed: 2, 4, 6, 10rpm
 Table top diameter: \varnothing 9.25" (235mm)
 Centering range: \pm 3mm
 Leveling range: \pm 1°
 Maximum probing diameter: \varnothing 10.1" (256mm)
 Maximum workpiece diameter: \varnothing 22.8" (580mm)
 Maximum workpiece weight: 66 lbs (30kg)

Vertical column (Z-axis)
 Vertical travel: 11.8" (300mm) 19.7" (500mm): 2200H model)
 Straightness (λ c2.5): 0.10 μ m / 100mm, 0.15 μ m / 300mm
 (0.25 μ m / 500mm: 2200H model)
 Parallelism with rotating axis: 0.7 μ m / 300mm
 (1.2 μ m / 500mm: 2200H model)
 Positioning speed: Max. 50mm/s
 Measuring speed: 0.5, 1, 2, 5mm/s
 Maximum probing height: 11.8" (300mm) (OD / ID)
 [19.7" (500mm) (OD / ID): 2200H model]
 Maximum probing depth: over \varnothing 32: 104mm (w/standard stylus)
 over \varnothing 12.7: 26mm (w/standard stylus)

Horizontal arm (X-axis)
 Horizontal travel: 6.9" (175mm) (Including a protrusion of
 1" (25mm) the turntable rotation center)
 Straightness (λ c2.5): 0.7 μ m / 150mm
 Squareness with rotating axis: 1.0 μ m / 150mm
 Positioning speed: Max. 30mm/s
 Measuring speed: 0.5, 1, 2, 5mm/s

Probe and stylus
 Measuring range: \pm 400 μ m/ \pm 40 μ m/ \pm 4 μ m (\pm 5mm: tracking range)
 Measuring force: 40mN
 Standard stylus: **12AAE301**, carbide ball, \varnothing 1.6mm
 Measuring direction: one direction
 Stylus angle adjustment: \pm 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)
 (26.3 x 20 x 43.3"
 (667 x 510 x 1100mm): 2200H model)

Mass: 397 lbs (180kg) (441 lbs (200kg): 2200H model)

Technical Data: RA-H5200CNC

Turntable
 Rotational accuracy (radial): (.8+.35H) μ m {(0.02+3.5H/10000) μ m}
 Rotational accuracy (axial): (.8+.35X) μ m {(0.02+3.5X/10000) μ m}
H: Probing height (mm), X: Distance from the turntable axis (mm)
 Rotating speed: 2, 4, 6, 10rpm (20rpm: auto-centering)
 Table top diameter: \varnothing 300mm
 Centering range: \pm 5mm
 Leveling range: \pm 1°
 Maximum probing diameter: \varnothing 14" (356mm)
 Maximum workpiece diameter: \varnothing 26.8" (680mm)
 Maximum workpiece weight: 176 lbs (80kg)
 143 lbs (65kg): auto-centering

Vertical column (Z-axis)
 Vertical travel: 13.7" (350mm) 21.7" (550mm): H5200H model)
 Straightness (λ c2.5): 0.05 μ m / 100mm, 0.14 μ m / 350mm
 (0.2 μ m / 550mm: H5200H model)
 Parallelism with rotating axis: 0.2 μ m / 350mm
 (0.32 μ m / 550mm: H5200H model)
 Positioning speed: Max. 60mm/s
 Measuring speed: 0.5, 1, 2, 5mm/s
 Maximum probing height: 13.7" (350mm) (OD / ID)
 [21.7" (550mm) (OD / ID): H5200H model]
 Maximum probing depth: over \varnothing 32: 104mm (w/standard stylus)
 over \varnothing 12.7: 26mm (w/standard stylus)

Horizontal arm (X-axis)
 Horizontal travel: 8.8" (225mm)
 Straightness (λ c2.5): 0.4 μ m / 200mm
 Squareness with rotating axis: 0.5 μ m / 200mm
 Positioning speed: Max. 50mm/s
 Measuring speed: 0.5, 1, 2, 5mm/s

Probe and stylus
 Measuring range: \pm 400 μ m (\pm 5mm: tracking range)
 Measuring force: 40mN (in 5 steps)
 Standard stylus: **12AAE301**, carbide ball, \varnothing 1.6mm
 Measuring direction: one direction
 Stylus angle adjustment: \pm 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)
 49.6 x 28.0 x 74.8"
 (1260 x 710 x 1900mm: H5200H model)

Mass: Main unit: 1433 lbs (650kg)
 1477 lbs (670kg): H5200H (model)
 Vibration isolator: 375 lbs (170kg)

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.



Holder-arm orientation switching (vertical position - horizontal position)



Detector rotation mechanism (0 to 290°, in increments of 1°)



RA-2200H CNC
with personal computer system and software

* Shown with optional vibration isolator and side table for PC.



RA-H5200H CNC
with personal computer system and software

* Shown with optional side table for PC.

Mitutoyo

Roundtest Extreme RA-2200CNC / RA-H5200CNC

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

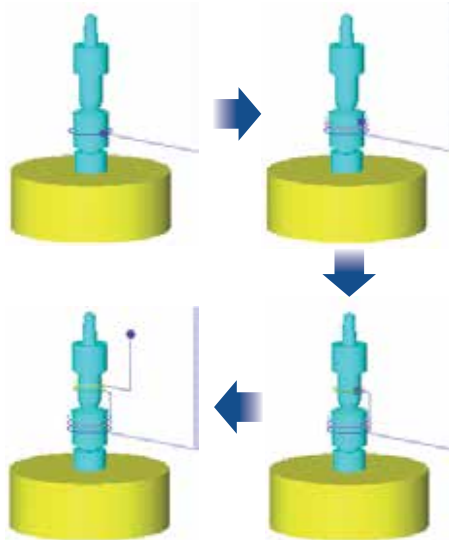
ROUNDPAK

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.



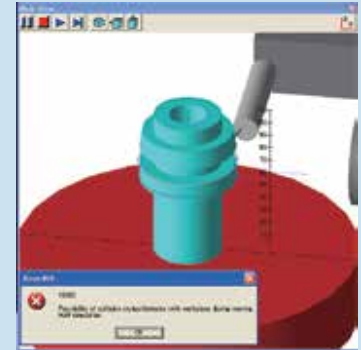
3D simulation screens (work-view windows) can be generated after entering CAD data (in IGES, DXF form) and text data.



MiCAT

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the standard in world
metrology software
FORM



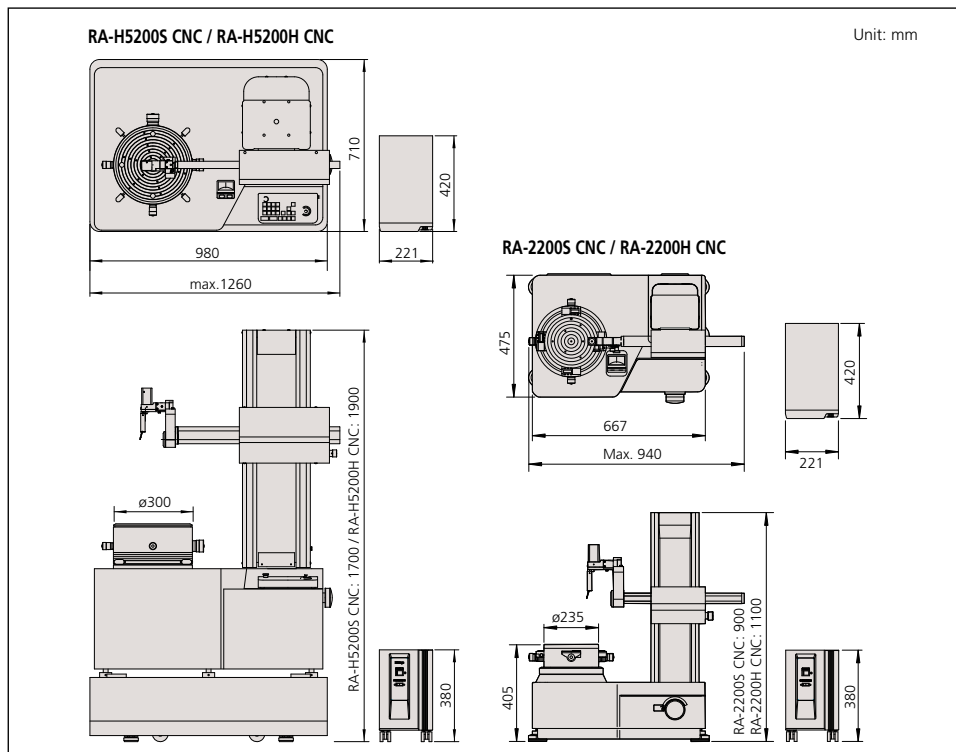
Optional Accessories

- 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.)
- 12AAB598:** Protective shield (RA-H5200 only)
- : Interchangeable styli (See page J-54.)
- 12AAK110:** Vibration isolator (RA-2200 only)
- 12AAK120:** Monitor arm (RA-2200 only)
- 12AAL019:** Side table for PC
- 12AAG419:** Surface roughness detector for RA-CNC

SPECIFICATIONS

Model No.	EXTREME RA-2200S CNC	EXTREME RA-2200H CNC
Order No.	211-517A	211-518A
Column travel	11.8" (300mm) (standard column)	19.7" (500mm) (high column)
Model No.	EXTREME RA-H5200S CNC	EXTREME RA-H5200H CNC
Order No. with vibration isolating stand	211-533A	211-534A
Column travel	13.77" (350mm) (standard column)	21.65" (550mm) (high column)

DIMENSIONS



050165B Workstation

Dimensions

- Overall: 32" w x 24" d x 33" h
- CPU Holder: Adjusts from 6- 1/2" – 11- 3/4" w
- CPU Tower Height: 16" when keyboard tray is set at 25" h
- 18" when keyboard tray is set at 27" h
- 20" when keyboard tray is set at 29" h
- Cord Bin: 4-1/2" d x 10" h x 30" w
- Keyboard Tray: 30" w x 22-3/4" d, pulls out 9"

Cart is constructed of steel and rolls easily on casters. A keyboard drawer can be placed at the perfect height for nearly any user. A CPU tower can be placed on the lower shelf.

Optional Styli for Roundtest

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

Application/Type	Standard (Standard accessory)	Notch	Deep groove	Corner	Cutter mark
Order No.	12AAL021*	12AAL022	12AAL023	12AAL024	12AAL025
Stylus tip	ø1.6 mm tungsten carbide	ø3 mm tungsten carbide	SR0.25mm sapphire	SR0.25mm sapphire	tungsten carbide
Dimensions (mm)					
Application/Type	Small hole (ø0.8)	Small hole (ø1.0)	Small hole (ø1.6)	Extra small hole (Depth 3mm)	ø1.6 mm ball
Order No.	12AAL026	12AAL027	12AAL028	12AAL029	12AAL030
Stylus tip	ø0.8 mm tungsten carbide	ø1 mm tungsten carbide	ø1.6 mm tungsten carbide	ø0.5 mm tungsten carbide	ø1.6 mm tungsten carbide
Dimensions (mm)					
Application/Type	Disk	Crank (ø0.5)	Crank (ø1.0)	Flat surface	2X-long type**
Order No.	12AAL031	12AAL032	12AAL033	12AAL034	12AAL035
Stylus tip	ø12 mm tungsten carbide	ø0.5 mm tungsten carbide (Depth 2.5 mm)	ø1 mm tungsten carbide (Depth 5.5 mm)	tungsten carbide	ø1.6 mm tungsten carbide
Dimensions (mm)					
Application/Type	2X-long type notch**	2X-long type deep groove**	2X-long type corner**	2X-long type cutter mark**	2X-long type Small hole**
Order No.	12AAL036	12AAL037	12AAL038	12AAL039	12AAL040
Stylus tip	ø3 mm tungsten carbide	SR0.25 mm sapphire	SR0.25 mm sapphire	tungsten carbide	ø1 mm tungsten carbide
Dimensions (mm)					
Application/Type	3X-long type**	3X-long type deep groove**	Stylus shank	Stylus shank(standard groove)	Stylus shank(2X-long groove)**
Order No.	12AAL041	12AAL042	12AAL043	12AAL044	12AAL045
Stylus tip	ø1.6 mm tungsten carbide	SR0.25 mm sapphire	For mounting CMM stylus (mounting thread M2)	For mounting CMM stylus (mounting thread M2)	For mounting CMM stylus (mounting thread M2)
Dimensions (mm)					

* **12AAL021** is a standard accessory for all Roundtest models.

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

Measuring is only in the vertical direction. Measuring magnification of 20000X is available using the 2X-long stylus.

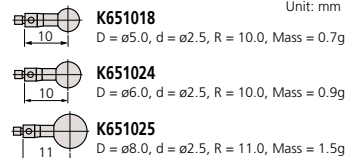
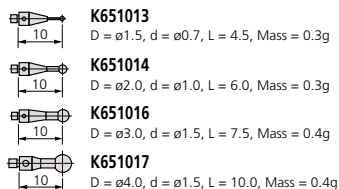
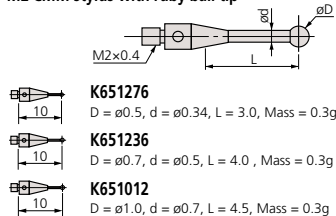
Customized special interchangeable styli are available on request. Please contact any Mitutoyo office for more information.

† New design for holding styli is not shown in above illustrations.

New styli for RA-2200 / H5200 are compatible with old RA-2100 / H5100 detectors.

Old styli for RA-2100 / H5100 are NOT compatible with new RA-2200 / H5200 detectors.

M2 CMM stylus with ruby ball tip



Unit: mm

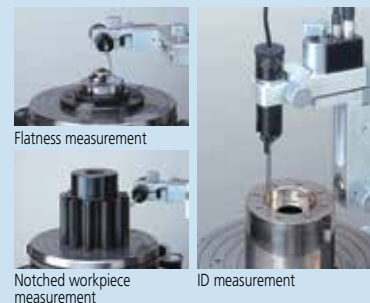
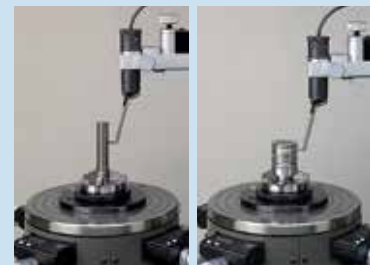
Optional Styli for Roundtest

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

Application/Type	Groove	Flat surface	General purpose	Notch
Order No.	12AAE310	12AAE302	12AAE301	12AAE309
Stylus tip	ø1.6 mm tungsten carbide	ø1.6 mm tungsten carbide	ø1.6 mm tungsten carbide	ø3 mm tungsten carbide
Dimensions (mm)				
Application/Type	ø1.6 mm ball	ø0.8 mm ball	ø0.5 mm ball	Deep groove
Order No.	12AAE303	12AAE304	12AAE305	12AAE308
Stylus tip	ø1.6 mm tungsten carbide	ø0.8 mm tungsten carbide	ø0.5 mm tungsten carbide	ø1.6 mm tungsten carbide
Dimensions (mm)				
Application/Type	Deep hole A		Deep hole B	
Order No.	12AAE306		12AAE307	
Stylus tip	ø1.6 mm tungsten carbide		ø1.6 mm tungsten carbide	
Dimensions (mm)				

Analyzing items		Models	RA-H5200CNC/ RA-H5200	RA-2200CNC/ RA-2200	RA-1600	RA-1600M	RA-120P	RA-120
		Models	RA-H5200CNC/ RA-H5200	RA-2200CNC/ RA-2200	RA-1600	RA-1600M	RA-120P	RA-120
Roundness	○		●	●	●	●	●	●
Cylindricity	∩		●	●	●	●	—	—
Concentricity	◎		●	●	●	●	●	●
Coaxiality	axis-element	◎	●	●	●	●	●	●
	Axis-axis	◎	●	●	●	●	●	—
Flatness	□		●	●	●	▲	●	●
Parallelism	//		●	●	●	▲	●	●
Perpendicularity	⊥		●	●	●	●	●	●
Runout	↗		●	●	●	●	●	●
Total runout	↗↖		●	●	●	▲	—	—
Straightness	—		●	●	●	▲	—	—
Inclination	∠		●	●	●	▲	—	—
Taper	∧		●	●	●	▲	—	—

Usage examples of styli



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 = 1-75 mm.
- External dimensions: $\phi 118 \times 34$ 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 - 35mm, ID = 33 - 85mm
External jaws: OD = 30-80mm.
- External dimensions: $\phi 157 \times 76$ mm
- Mass: 3.8kg

Vibration Isolated frame with work surface



Code No.	Dimensions	Load Capacity
64AAB357	30 x 48 x 30"	1300 lbs



211-016
Reference Hemisphere



Cylindrical square

350850

- Used for checking and aligning table rotation axis parallel to the Z-axis column.
- Squareness: $3\mu\text{m}$
- Straightness: $1\mu\text{m}$
- Cylindricity: $2\mu\text{m}$
- Roundness: $0.5\mu\text{m}$
- Mass: 7.5kg



Micro-chuck

211-031

Used for clamping a workpiece (less than $\phi 1$ mm dia.) that the centering chuck cannot handle.

- Holding capacity: up to $\phi 1.5$ mm
- External dimensions: $\phi 118 \times 48.5$ mm
- Mass: 0.8kg

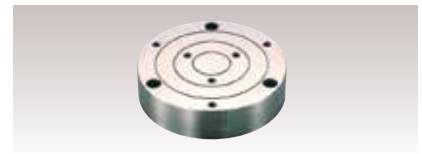


Magnification calibration gage

211-045

Used for normalizing detector magnification by calibrating detector travel against displacement of a micrometer spindle.

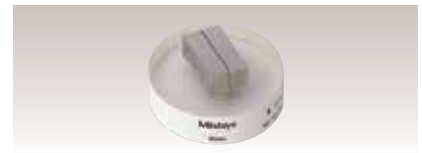
- Maximum calibration range: $400\mu\text{m}$
- Graduation: $0.2\mu\text{m}$
- Mass: 4kg



Auxiliary workpiece stand

356038

- Used for measuring a workpiece whose diameter is 20mm or shorter and whose height is 20mm or lower.



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

Eco-Fix Kit Form-S

Mitutoyo ECO-FIX Kit Fixture Systems



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



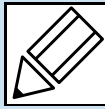
Eco-Fix Kit Form-L



Part No.	Qty.	Part name	Part No.	Qty.	Part name
K551039	1	Adaptor plate ø 200mm	K550247	1	Back square mini
K551024	1	Location pin ø 12 X 13mm	K550058	1	V-block
K551025	1	Location pin ø 12 X 25mm	K550365	2	Cone receiver
K551026	1	Location pin ø 12 X 50mm	K550982	1	Stopper element
K551027	2	Location pin ø 12 X 100mm	K550248	1	Back square
K551028	2	Location pin ø 20 X 13mm	K550888	2	Straight pin Ø 6mm x 20mm
K551029	2	Location pin ø 20 X 25mm	K550889	2	Straight pin Ø 6mm x 30mm
K551030	2	Location pin ø 20 X 50mm	K550890	2	Straight pin Ø 6mm x 40mm
K551031	1	Location pin ø 20 X 100mm	K550000	2	Straight pin Ø 8mm x 30mm
K551035	1	Receiver bracket small	K550001	2	Straight pin Ø 8mm x 50mm
K551036	1	Receiver bracket large	K550002	2	Straight pin Ø 8mm x 95mm
K551040	2	Adjustable location pin ø 20mm	K551046	1	Slotted Nut for receiver bracket h= 12mm
K551041	1	Adjustable location pin ø 12mm	K551047	1	Slotted Nut for receiver bracket h= 15mm
K551042	2	Location pin ø 12mm with bore ø 6mm	K551050	1	Allen key 2mm
K551043	3	Location pin ø 20mm with bore ø 8mm	K551051	1	Allen key 3mm
K551044	1	Receiver bracket L=90; ø 12mm	K551052	1	Allen key 4mm
K551045	1	Receiver bracket L=120; ø 20mm	K551053	1	Allen key 5mm
K550279	2	Spring clip, d= 8mm, L= 60mm	K550591	1	Washer ø 6,4mm / ø 17mm
K550262	1	V-block mini	K550110	12	Cylinder head screw M6 x 20mm
K550261	2	Cone receiver mini	K550563	6	Cylinder head screw M6 x 25mm
K550250	1	Stopper element mini			
Kit Part No.			K551134		



Quick Guide to Precision Measuring Instruments

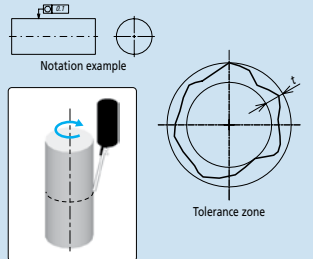


Roundtest (Roundform Measuring Instruments)

- JIS B 7451-1997: Roundness measuring instruments
- JIS B 0621-1984: Definition and notation of geometric deviations
- JIS B 0021-1998: Geometric property specifications (GPS) of products – Geometric tolerance Roundness Testing

○ Roundness

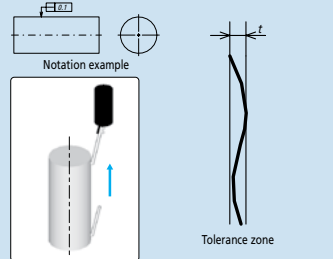
Any circumferential line must be contained within the tolerance zone formed between two coplanar circles with a difference in radii of t



Verification example using a roundness measuring instrument

— Straightness

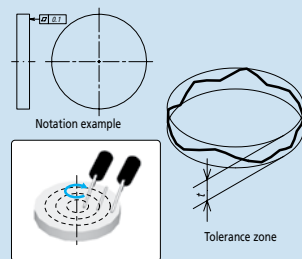
Any line on the surface must lie within the tolerance zone formed between two parallel straight lines a distance t apart and in the direction specified



Verification example using a roundness measuring instrument

□ Flatness

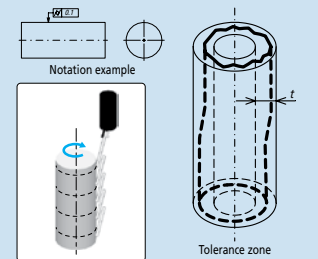
The surface must be contained within the tolerance zone formed between two parallel planes a distance t apart



Verification example using a roundness measuring instrument

∅ Cylindricity

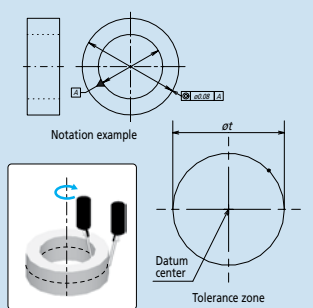
The surface must be contained within the tolerance zone formed between two coaxial cylinders with a difference in radii of t



Verification example using a roundness measuring instrument

◎ Concentricity

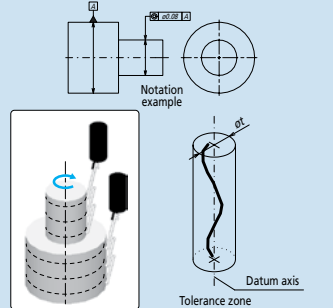
The center point must be contained within the tolerance zone formed by a circle of diameter t concentric with the datum



Verification example using a roundness measuring instrument

◎ Coaxiality

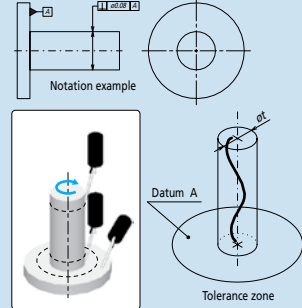
The axis must be contained within the tolerance zone formed by a cylinder of diameter t concentric with the datum



Verification example using a roundness measuring instrument

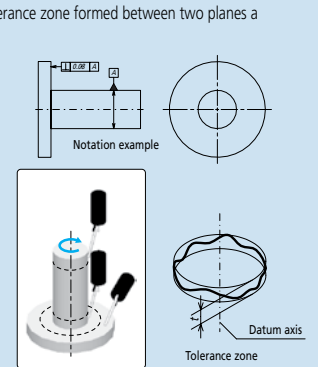
⊥ Perpendicularity

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



Verification example using a roundness measuring instrument

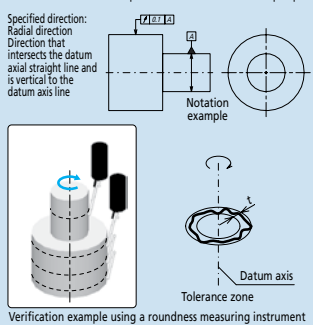
⊥ Perpendicularity



Verification example using a roundness measuring instrument

↗ Circular Runout

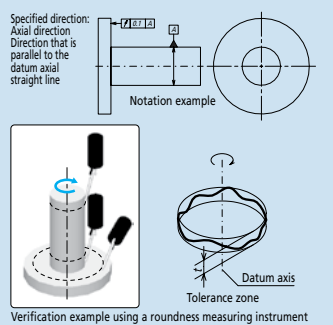
The line must be contained within the tolerance zone formed between two coplanar and/or concentric circles a distance t apart concentric with or perpendicular to the datum



Verification example using a roundness measuring instrument

↗ Total Runout

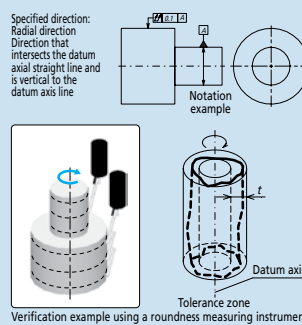
The surface must be contained within the tolerance zone formed between two coaxial cylinders with a difference in radii of t , or planes a distance t apart, concentric with or perpendicular to the datum



Verification example using a roundness measuring instrument

↗ Total Runout

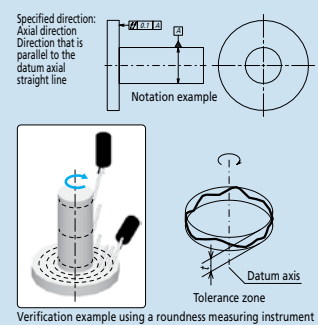
The surface must be contained within the tolerance zone formed between two coaxial cylinders with a difference in radii of t , or planes a distance t apart, concentric with or perpendicular to the datum



Verification example using a roundness measuring instrument

↗ Total Runout

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

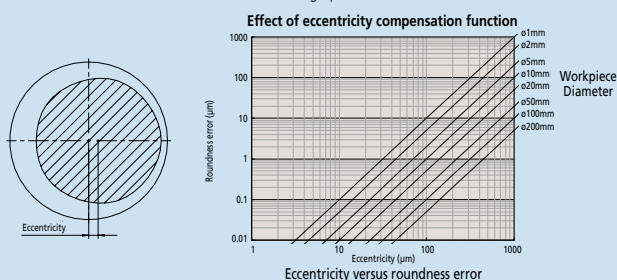


Verification example using a roundness measuring instrument

■ Adjustment prior to Measurement

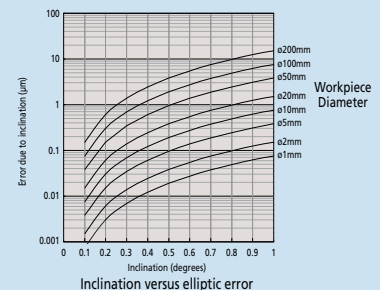
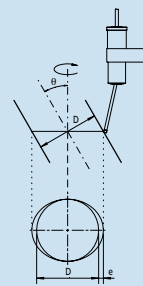
Centering

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.



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.

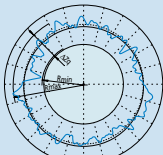


Evaluating the Measured Profile Roundness

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.

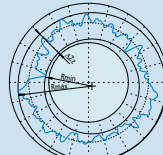
Least Square Circle (LSC) Method

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).



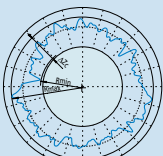
Minimum Zone Circles (MZC) Method

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.



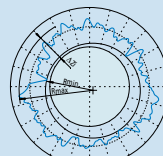
Minimum Circumscribed Circle (MCC) Method

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.



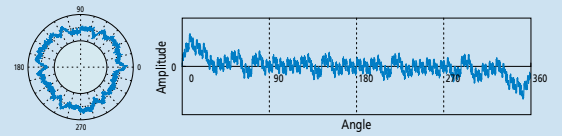
Maximum inscribed Circle (MIC) Method

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.

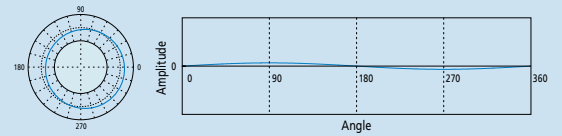


Undulations Per Revolution (UPR) data in the roundness graphs

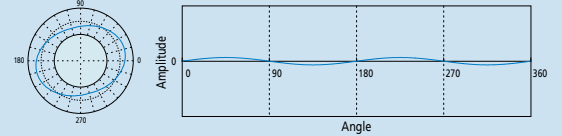
Measurement result graphs



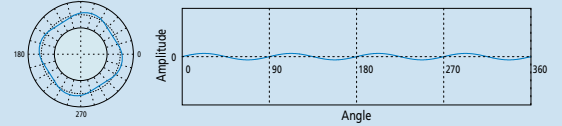
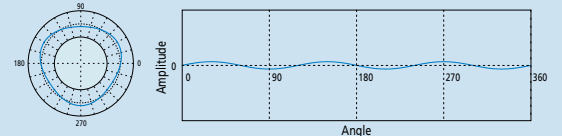
A 1 UPR condition indicates eccentricity of the workpiece relative to the rotational axis of the measuring instrument. The amplitude of undulation components depends on the leveling adjustment.



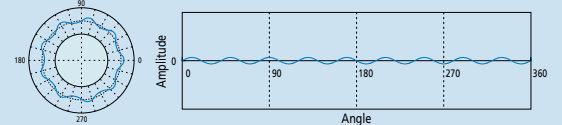
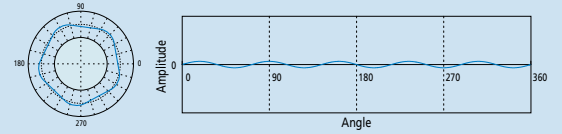
A 2 UPR condition may indicate: (1) insufficient leveling adjustment on the measuring instrument; (2) circular runout due to incorrect mounting of the workpiece on the machine tool that created its shape; (3) the form of the workpiece is elliptical by design as in, for example, an IC-engine piston.



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.



A 5 to 15 UPR condition often indicates unbalance factors in the machining method or processes used to produce the workpiece.



A 15 (or more) UPR condition is usually caused by tool chatter, machine vibration, coolant delivery effects, material non-homogeneity, etc., and is generally more important to the function than to the fit of a workpiece.

