Form Measurement

ROUNDTEST RA-2100 SERIES

Bulletin No. 1901

Best in class roundness/cylindricity measuring system for the ultimate in accuracy and ease-of-use

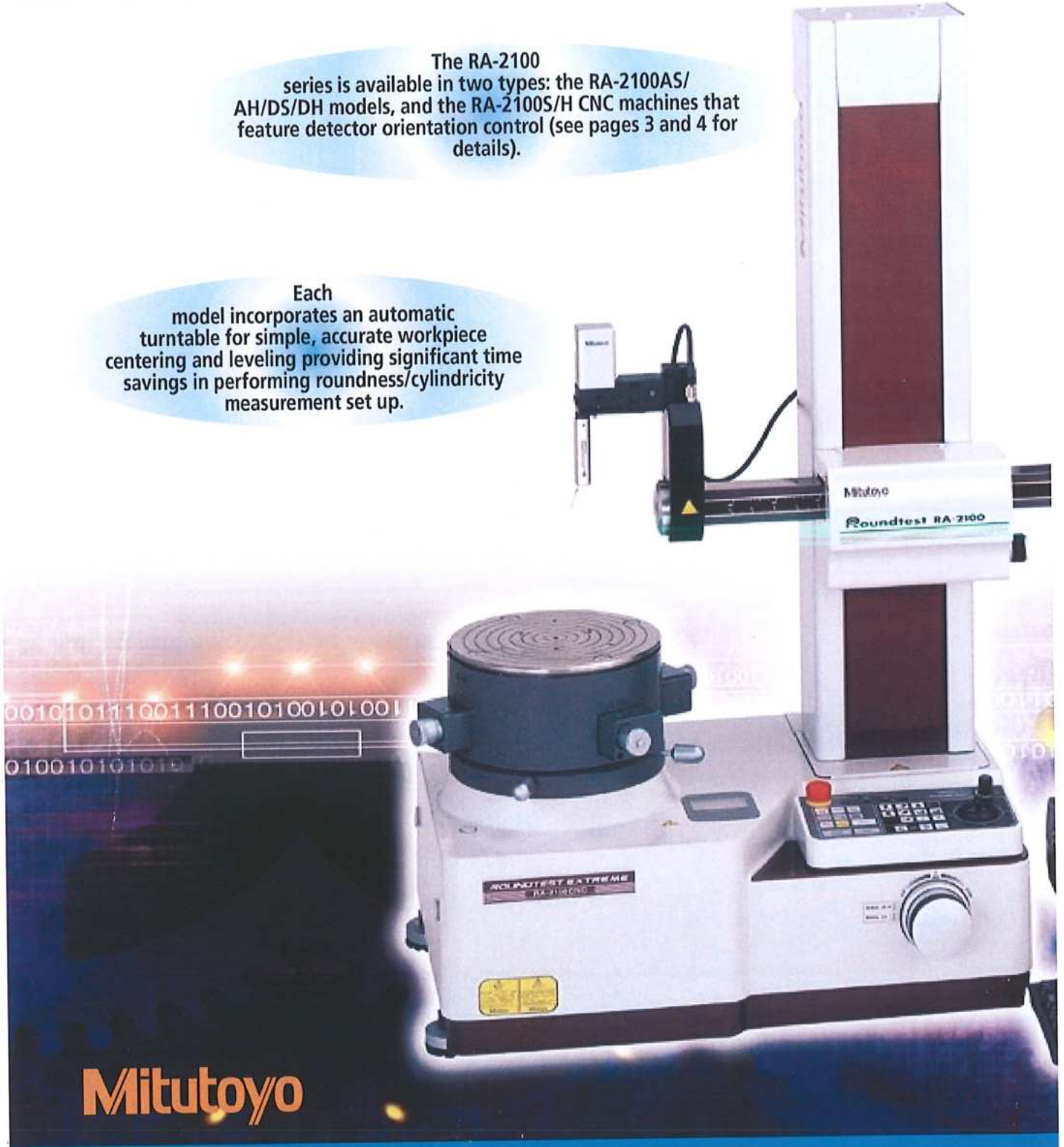
Mitutoyo

Pos. 420

ROUNDTEST/ROUNDTEST EXTREME — Best in class roundness/cylindricity measuring system for the ultimate in accuracy and ease-of-use

The RA-2100 series is available in two types: the RA-2100AS/AH/DS/DH models, and the RA-2100S/H CNC machines that feature detector orientation control (see pages 3 and 4 for details).

Each model incorporates an automatic turntable for simple, accurate workpiece centering and leveling providing significant time savings in performing roundness/cylindricity measurement set up.



Detector orientation control in 1° increments (unique to RA-2100CNC)

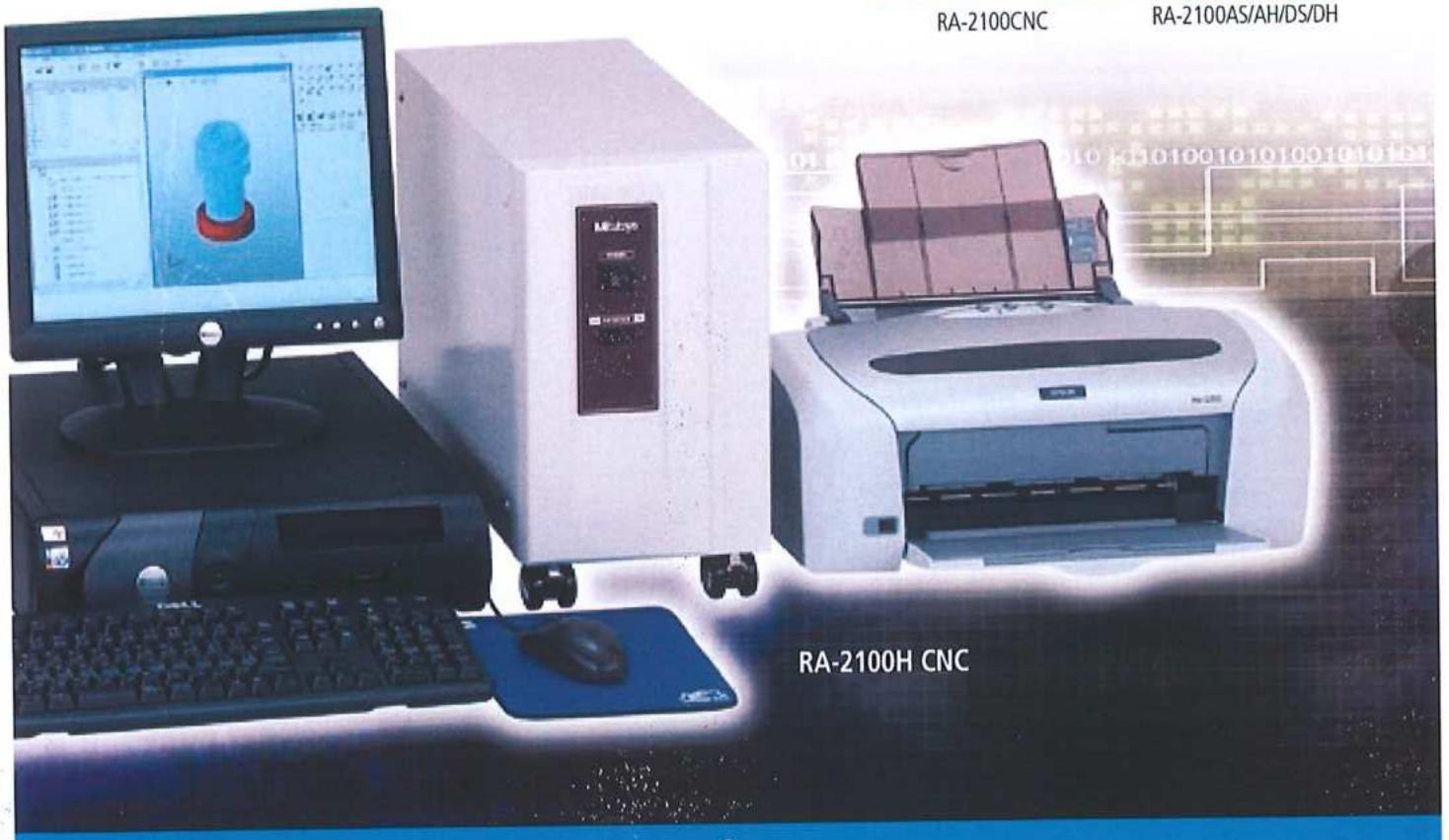
Many optional accessories, such as styli, chucks and calibration standards, are available to make it easy to measure a wide variety of workpieces (see pages 10 and 11 for details).

ROUNDPAK data analysis software allows a wide range of analyses to be performed easily (see pages 8 and 9 for details).

Surface roughness measurement (Optional)

RA-2100CNC

RA-2100AS/AH/DS/DH



RA-2100H CNC

ROUNDTEST EXTREME RA-2100S/H CNC —

CNC Roundness/Cylindricity Measuring Systems... For Greatly Enhanced Productivity and Efficiency

Turntable features high accuracy and ease-of-use

High turntable rotational accuracy, in both the radial (0.02 + 3.8H/10000 µm) and axial (0.02 + 3.8X/10000 µm) directions, allows high accuracy flatness testing to be performed in addition to roundness and cylindricity measurements. The automatic alignment feature of the turntable enhances productivity by eliminating time-consuming workpiece centering and leveling operations.

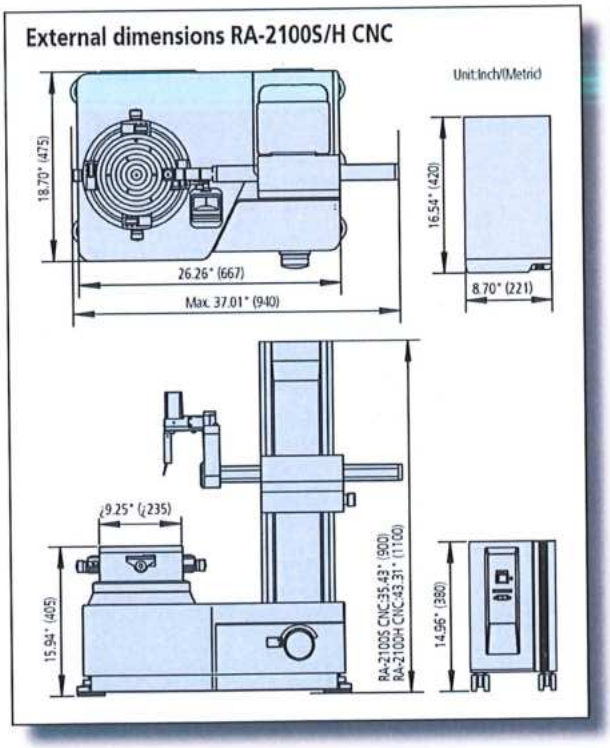
Detector orientation control in 1° increments supports CNC automatic measurement

Detector holder arm orientation (vertical/horizontal) and detector rotation (within a range between 0 to 270°, in increments of 1°) are automatically controlled to provide automatic and continuous measurement of OD, ID, and top and bottom surfaces. Also, the powerful off-line teaching function allows a part program to be created with ease.

Mitutoyo linear scales ensure high accuracy CNC measurements

Mitutoyo linear scales are used in the X/Z drive unit to guarantee high precision positioning vital for automatic CNC operation.

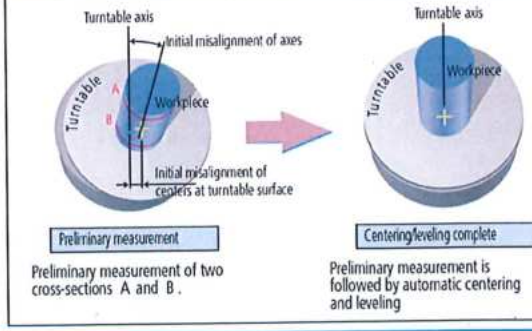
External dimensions RA-2100S/H CNC



Detector rotation mechanism (0 to 270°, increments of 1°)

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

AAT (Automatic Adjustment Table): Automatic workpiece centering/leveling



Preliminary measurement of two cross-sections A and B.

Preliminary measurement is followed by automatic centering and leveling

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Standard accessories (RA-2100S/H CNC)

Magnification calibration kit
No.997090
A combination of gage blocks and an optical flat.

Thin workpiece stage
No.12AAE404

Origin point gage for CNC
No.12AAD877

Reference hemisphere
No.211-016

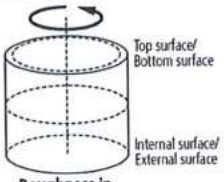
* See page 10 and 11 for optional accessories including interchangeable styli

Surface roughness measurement function

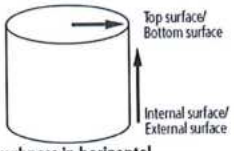
(Roughness measurement unit: optional)

This is a multi-sensor compatible system that is capable of accepting not only the roundness measuring system standard probe but also a surface roughness measuring detector. It permits verification of both geometric tolerancing on roundness or cylindricity and surface roughness to be performed with a single system.

Measuring direction



Roughness in circumferential direction



Roughness in horizontal and vertical directions

Specification

Item		Model No.	RA-2100S CNC	RA-2100H CNC
		Order No.	211-847-1 * Inch/(Metric)	211-848-1* Inch/(Metric)
Turntable	Rotational accuracy	Radial direction	0.8+0.38H µinch ((0.02 + 3.8H/10000)µm); H = probing height above turntable	
		Axial direction	0.8+0.38X µinch ((0.02 + 3.8X/10000)µm); X = distance from the turntable axis	
	Rotational speed		2, 4, 6, 10rpm	
	Effective table diameter		9.25" (235mm)	
	Centering/leveling adjustment		Automatic	
	Centering range		±0.11" (±3mm)	
	Leveling range		±1°	
	Maximum table loading		30kgf	
	Maximum measuring diameter		10.07" (256mm)	
	Maximum workpiece diameter		22.83" (580mm)	
Vertical drive unit (Z-axis column unit)	Traverse straightness		4.7µinch/3.93" (0.12µm/100mm) (λc2.5) 7.1µinch/11.81" (0.18µm/300mm) (λc2.5)	4.7µinch/3.93" (0.12µm/100mm) (λc2.5) 11.8µinch/19.68" (0.3µm/500mm) (λc2.5)
	Parallelism with turntable axis		28µinch/11.81" (0.7µm/300mm) (generatrix basis)	47µinch/19.68" (1.2µm/500mm) (generatrix base)
	Traverse speed		1.37"/s (35mm/s) maximum for positioning; 0.02, 0.04, 0.08, 0.20"/s (0.5, 1, 2, 5mm/s) for measuring	
	Maximum probing height	for measuring OD	11.81" (300mm)	19.68" (500mm)
		for measuring ID	11.81" (300mm)	19.68" (500mm)
	Maximum probing depth		1.02" (26mm) for ø0.50" (ø12.7mm) or more 4.09" (104mm) for ø1.27" (ø32mm) or more (using the standard stylus)	
Radial drive unit	Arm straightness		28µinch/5.90" (0.7µm/150mm) (λc2.5)	
	Perpendicularity to turntable axis		40µinch/5.90" (1.0µm/150mm) (generatrix basis)	
	Traverse range		6.88" (175mm) (±25mm from the turntable center)	
	Traverse speed		0.78"/s (20 mm/s) maximum for positioning; (0.02, 0.04, 0.20"/s (0.5, 1, 5mm/s) for measuring	
Detector	Measuring force		7–40mN	
	Stylus tip shape/material		ø0.06" (ø1.6mm) tungsten carbide ball	
	Range	Detecting range	±0.015" (±400µm)	
		Tracking range	±0.19" (±5mm)	
	Other		Rotation (within the range 0 to 270°, in increments of 1°)	
Others	Line voltage		100–240V	
	Air pressure		0.39MPa	
	Air consumption		30 L/min in standard condition (Air supply of 80 L/min or more)	
	Mass of the main unit		396lb (180kg)	440lb (200kg)

* To specify the power line connector required add the following suffixes (e.g.211-847-1A):
A for UL/CSA type, C for JIS type, D for CEE type, E for BS type, DC for CCC type K for EK type.

ROUNDTEST RA-2100AS/AH/DS/DH —

Roundness/Cylindricity Measuring System... A Fusion of the Highest Level of Accuracy and Ease-of-Use

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, the top-of-the-line RA-2100AS/AH models relieve the operator of the bothersome task of workpiece centering and leveling. A guidance system is incorporated into the turntables on the RA-2100DS/DH models to help the operator perform manual centering and leveling smoothly and simply.

Continuous measurement improves productivity

Measurement/analysis of outside and inside diameters*1 on a hybrid workpiece (as in concentricity measurement) can be performed continuously without the need to change the traverse direction of the detector.

*1: 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.

Readily upgraded to CNC operation

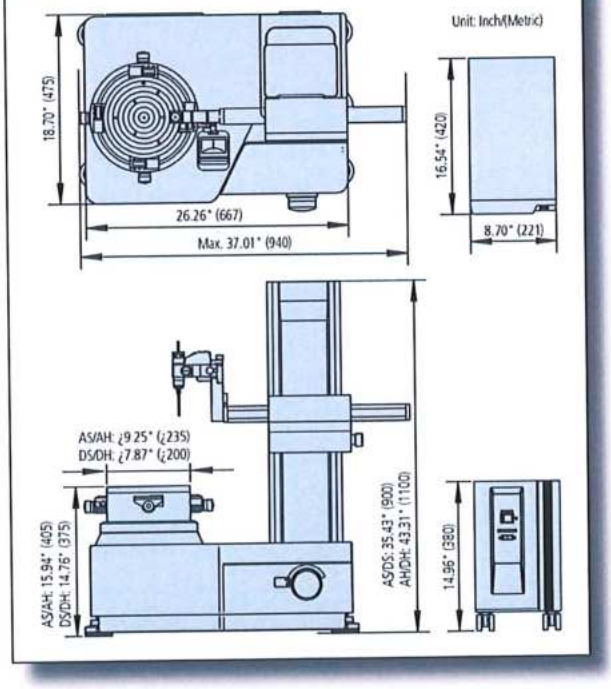
The system can be upgraded to CNC operation by replacing and adjusting the detector unit. (This task should be performed by a Mitutoyo technician.)

Surface roughness measurement function (Surface roughness unit: option)

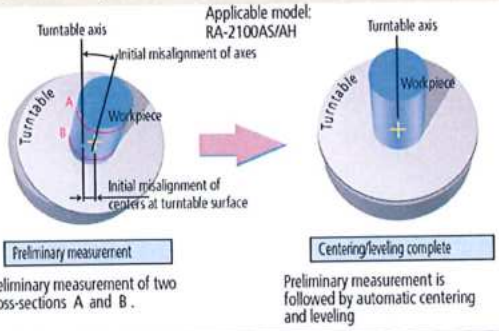
A surface roughness detector, compliant with the relevant International Standards, can be mounted in place of the roundness measuring detector. This creates a multiple sensor system that can not only test the geometrical roundness/cylindricity of a surface but also the roughness of that surface as well.

* Please contact Mitutoyo for further information.

External dimensions RA-2100AS/AH/DS/DH



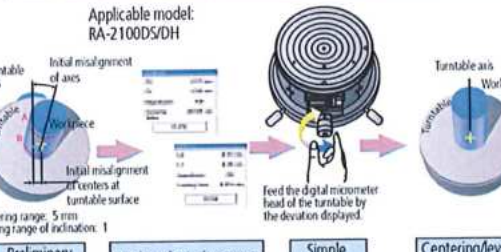
AAT (Automatic Adjustment Table): Automatic workpiece centering/leveling



Preliminary measurement of two cross-sections A and B.

Preliminary measurement is followed by automatic centering and leveling

DAT (Digital Adjustment Table):
Workpiece centering/leveling with Digimatic micrometer heads



Preliminary measurement of two cross-sections A and B.

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Accessories

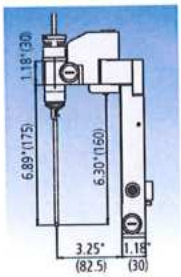
Standard

Magnification calibration kit
No. 997090
A combination of gage blocks and an optical flat.

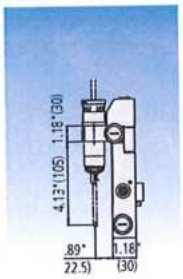
Origin-point gage
No. 998382
A gage for zero setting of the R-axis and Z-axis.

Reference hemisphere
No. 211-016

Optional



Double length holder
No. 12AAF203
For extra-deep holes.



Large diameter holder
No. 12AAF204
For measuring a larger OD 2.76" to 16.54" (70 to 420 mm).

Thin workpiece stage
No. 356038
Loading diameter: 3.94" (100 mm)
Dimensions (D x H): 4.13"x.98" (105 x 25 mm)
Mass: 3.75 lbs. (1.7kg)

* See page 10 for optional accessories common to the RA-2100 series. See page 11 for interchangeable styli for use with the RA-2100AS/AH/DS/DH.

Specification

Inch/(Metric)

Item		Model No.	RA-2100AS	RA-2100DS	RA-2100AH	RA-2100DH
		Order No.	**211-843 * -1** Inch/(Metric)	**211-863 * -1** (Metric) **211-873 * -1** inch	**211-844 * -1** Inch/(Metric)	**211-864 * -1** (Metric) **211-874 * -1** inch
Turntable	Rotational accuracy	Radial direction	(0.8+0.38H)µinch ((0.02 + 3.8H/10000)µm); H = probing height above turntable			
		Axial direction	(0.8+0.38X)µinch ((0.02 + 3.8X/10000)µm); X = distance from the turntable axis			
	Rotational speed		2, 4, 6, 10rpm			
	Effective table diameter		9.25" (235mm)	7.87" (200mm)	9.25" (235mm)	7.87" (200mm)
	Centering/leveling adjustment		AAT	DAT	AAT	DAT
	Centering range		±0.11" (±3mm)	±0.19" (±5mm)	±0.11" (±3mm)	±0.19" (±5mm)
	Leveling range		±1°			
	Maximum table loading		30kg			
	Maximum measuring diameter		11.81" (300mm)			
	Maximum workpiece diameter		22.83" (580mm)			
Vertical drive unit (Z-axis column unit)	Traverse straightness (λc2.5)		4.7µinch/3.93" (0.12µm/100mm) 7.1µinch/11.81" (0.18µm/300mm)		4.7µinch/3.93" (0.12µm/100mm) 11.8µinch/19.68" (0.3µm/500mm)	
	Parallelism with turntable axis		28µinch/11.81" (0.7µm/300mm) generatrix basis		47µinch/19.68" (1.2µm/500mm) generatrix base	
	Traverse speed		1.37"/s (35mm/s) maximum for positioning; 0.02, 0.04, 0.08, 0.20"/s (0.5, 1, 2, 5mm/s) for measuring			
	Maximum probing height	for measuring OD	11.81" (300mm)		19.68" (500mm)	
		for measuring ID	11.81" (300mm)		19.68" (500mm)	
	Maximum probing depth		3.93" (100mm) (using the standard stylus)			
Radial drive unit	Arm straightness		28µinch/5.90" (0.7µm/150mm) (λc2.5)			
	Perpendicularity to turntable axis		40µinch/5.90" (1.0µm/150mm) (generatrix basis)			
	Traverse range		6.88" (175mm) (±25mm from the turntable center)			
	Traverse speed		0.78"/s (20 mm/s) maximum for positioning; (0.02, 0.04, 0.20"/s (0.5, 1, 5mm/s) for measuring			
Detector	Measuring force		7–10mN (changeable in 5 steps)			
	Stylus tip shape/material		ø0.06" (ø1.6mm) tungsten carbide ball			
	Range	Detecting range	±0.015" (±400µm)			
		Tracking range	±0.19" (±5mm)			
	Other		IN/OUT switching mechanism, measuring force changeable (in 5 steps)			
Others	Line voltage		100–240V			
	Air pressure		0.39MPa			
	Air consumption		30 L/min in standard condition (air supply of 80 L/min or more)			
	Basic unit mass		396lb (180kg)		440lb (200kg)	

*To specify the power line connector required add the following suffixes (e.g.211-843-1A):
A for UL/CSA type, C for JIS type, D for CEE type, E for BS type, DC for CCC type K for EK type.

Roundness/cylindricity measurement/analysis software

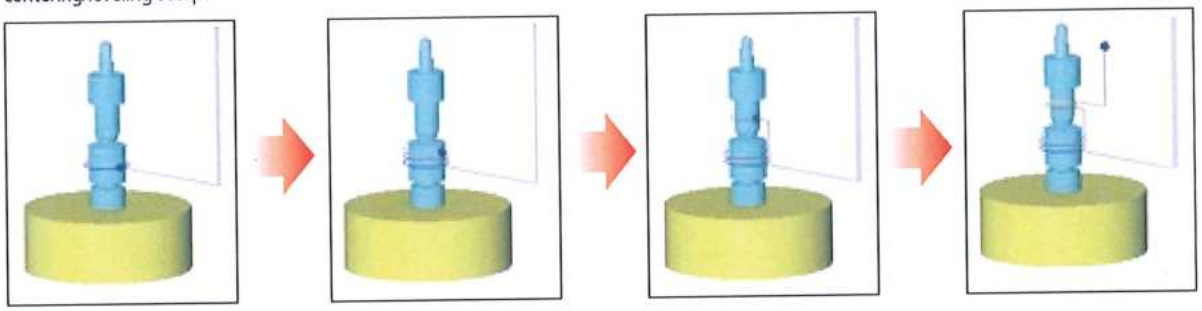
ROUNDPAK®

Software for easy control of preliminary setup, measurement, analysis, and result output

Preliminary setup

Centering/leveling the workpiece

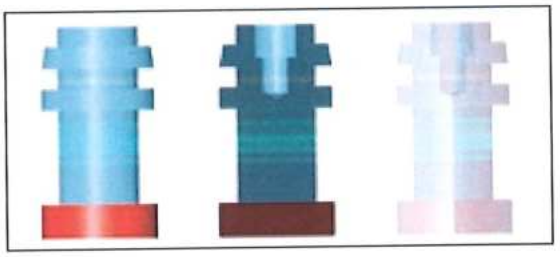
Mitutoyo's unique AAT functionality (which measures initial misalignment and automatically centers and levels the workpiece) and DAT functionality (which measures and displays the amount of adjustment needed to center and level the workpiece) have been commended by customers as superb solutions for preliminary centering/leveling setup.



Simulating part programs

The part program (automatic measurement procedure) can be simulated in 3D form on screen displays generated by the design data generation function.

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



Measurement

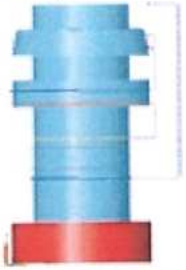
Measurement mode

Two modes are available for selective use: 'Simple mode' to simply measure and 'Part program mode' for measurement and analysis of multiple items.

Convenient measuring functions

(1) Edge detection function

A coordinate system can be set up for a workpiece. This allows measurements to be repeated easily on identical workpieces.

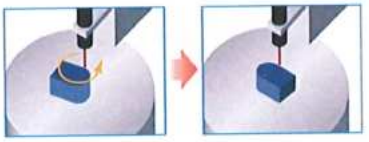


(2) Continuous OD/ID measuring function

Both the OD and ID of a workpiece can be measured in succession without the need for changing the traverse direction of the stylus.

(3) Partial arc measuring function

This enables measurements to be performed on a workpiece having a projected section or incomplete circumference.



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Analysis, results output

A variety of parameters and analysis functions

A variety of parameters, not only for roundness and cylindricity, but also for flatness and parallelism, can be handled. Also included are functions for design data best-fit analysis, harmonic analysis and circumferential peak-bottom detection, etc.

*1: For further information about parameters, refer to the ROUNDPAK catalog.

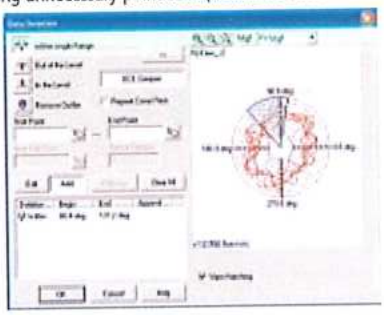
Measurement data utilization

(1) Re-calculation function

It is possible to re-calculate an analysis using measurement data previously obtained but using changed measurement conditions (filter-cutoff values, etc.), or different analysis parameters.

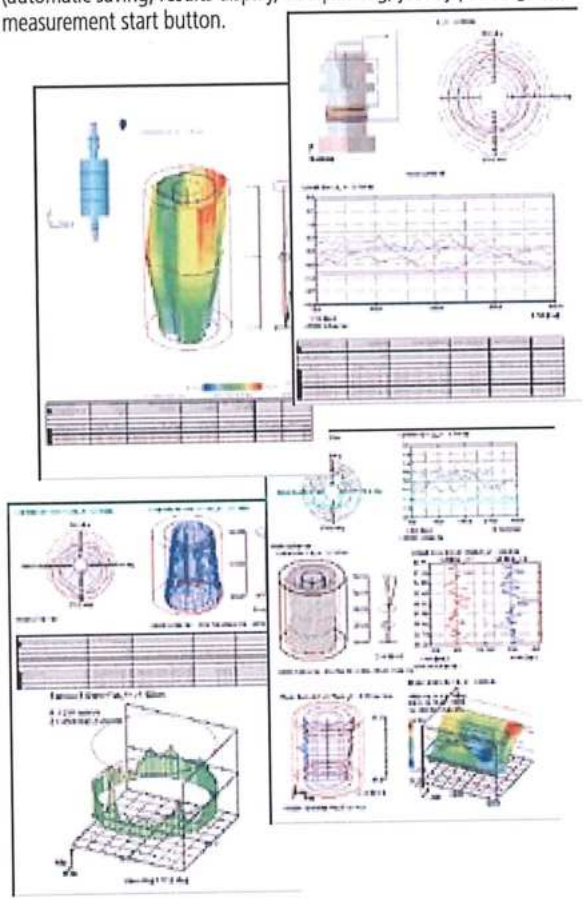
(2) Data deletion function

This function allows calculation/analysis to be performed with only the remaining data after deleting unnecessary point data (from a notched section, or from an area outside the target area on the workpiece) from that obtained by measurement.



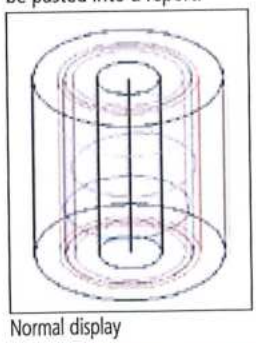
Result output

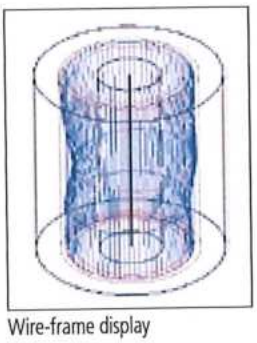
Result output is possible in the customer's original format according to the layout prescribed for the location, size, etc., of the analysis results including graphics and drawings. The original layout, if saved, allows automatic operation from measurement to calculation (automatic saving, results display, and printing) just by pressing the measurement start button.

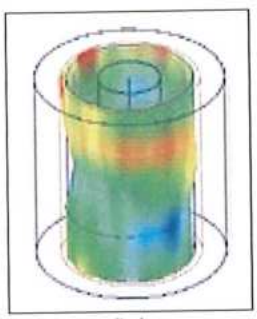


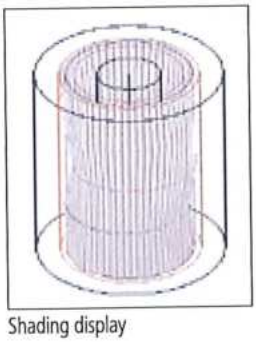
Graphical display of results

Results of analyses, such as for cylindricity or coaxiality, can be visually represented by a 3D graphical display. This 3D graphic can be pasted into a report.


Normal display

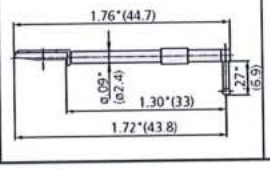
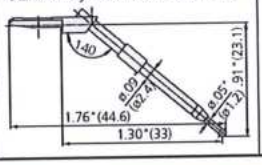
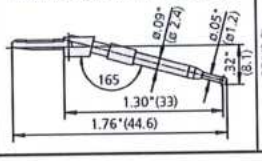
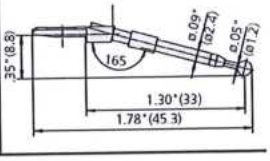

Wire-frame display

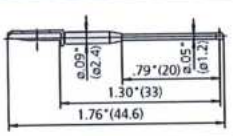
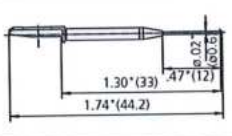
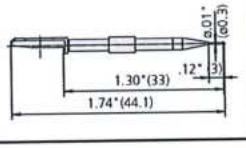
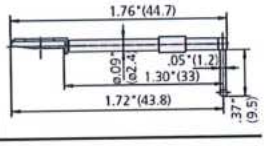

Surface map display

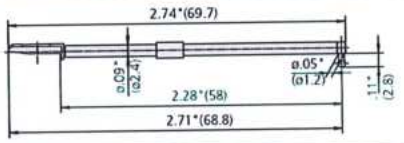
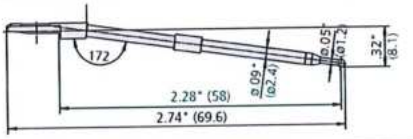

Shading display

OPTIONAL ACCESSORIES

Interchangeable Styli for RA-2100S/H CNC

Application/Type	Groove	Flat surface	General purpose	Notch
Order No.	**12AAE310**	**12AAE302**	**12AAF150**	**12AAE309**
Stylus tip	ø.06"(ø1.6 mm) tungsten carbide	ø.06"(ø1.6 mm) tungsten carbide	ø.06"(ø1.6 mm) tungsten carbide	ø.06"(ø1.6 mm) tungsten carbide
Dimensions inch(mm)		Standard stylus for RA-2100S/H CNC 	Standard stylus for RA-2100S/H CNC 	

Application/Type	ø.06"(ø1.6 mm) ball	ø.03"(ø0.8 mm) ball	ø.02"(ø0.5 mm) ball	Deep groove
Order No.	**12AAE303**	**12AAE304**	**12AAE305**	**12AAE308**
Stylus tip	ø.06"(ø1.6 mm) tungsten carbide	ø.03"(ø0.8 mm) tungsten carbide	ø.02"(ø0.5 mm) tungsten carbide	ø.06"(ø1.6 mm) tungsten carbide
Dimensions inch(mm)				

Application/Type	Deep hole A	Deep hole B
Order No.	**12AAE306**	**12AAE307**
Stylus tip	ø.06"(ø1.6 mm) tungsten carbide	ø.06"(ø1.6 mm) tungsten carbide
Dimensions inch(mm)		

Options common to the RA-2100S/H CNC, RA-2100AS/AH/DS/DH

Centering chuck
(key operated)
No.211-014
Suitable for holding longer parts and those requiring a relatively powerful clamp.

- Holding capacity: Internal jaws, OD: .04"-1.38" (1-35 mm) Internal jaws, ID: 1.30"-3.35" (33-85 mm) External jaws, OD: 1.18"-3.15" (30-80 mm)
- External dimensions: ø6.18"x2.99" (ø157x76 mm)
- Mass: 8.38 lbs. (3.8 kg)

Centering chuck
(ring operated)
No.211-032
Suitable for holding small parts with easy-to-operate knurled-ring clamping.

- Holding capacity: Internal jaws, OD: .04"-1.42" (1-36 mm) Internal jaws, ID: .55"-2.76" (14-70 mm) External jaws, OD: .04"-2.95" (1-75 mm)
- External dimensions: ø4.65"x1.34" (ø118x34 mm)
- Mass: 2.65 lbs. (1.2kg)

Micro-chuck
No.211-031
Used for clamping a workpiece with a diameter less than .04" (1 mm) that the centering chuck cannot handle.

- Holding capacity: up to ø.06" (ø1.5 mm)
- External dimensions: ø4.65"x1.91" (ø118x48.5 mm)
- Mass: 1.77 lbs. (0.8kg)

Magnification calibration gage
No.211-045
Used for normalizing detector magnification by calibrating detector travel against displacement of a micrometer spindle.

- Maximum calibration range: 400µm
- Graduation: 0.2µm
- External dimensions (WxDxH): 9.25"(max)x7.28"x2.76" (235(max)x185x70 mm)
- Mass: 8.82 lbs. (4kg)

Vibration isolator
No.178-025

- Vibration isolation method: Air suspended, diaphragm isolation system.
- External dimensions: ø2.76"x9.84" (ø70x250 mm)

Vibration isolator stand
No.178-024

Cylindrical square
No.350850

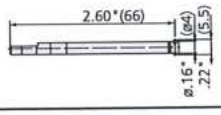
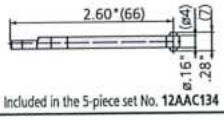
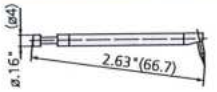
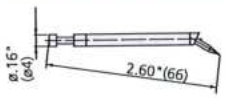
- Straightness: 0.5µm
- Cylindricity: 2µm
- External dimensions: ø2.76"x9.84" (ø70x250 mm)
- Mass: 16.53 lbs. (7.5kg)

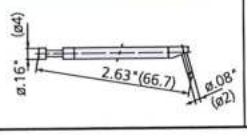
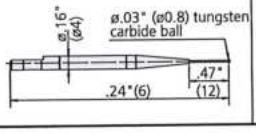
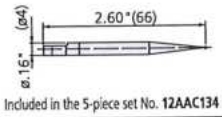
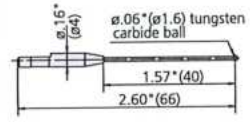
Protective shield
No.12AAB949

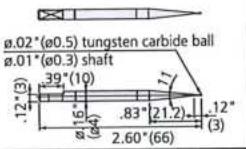
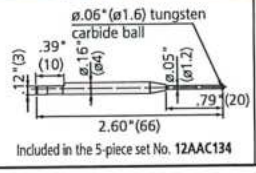
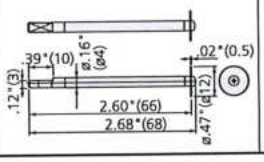
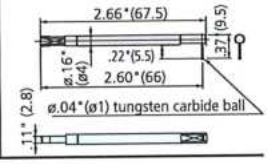
Mitutoyo

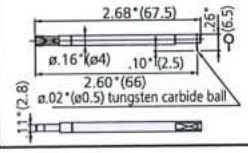
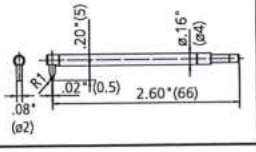
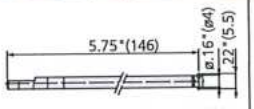
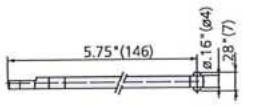
Interchangeable Styli for RA-2100AS/AH/DS/DH

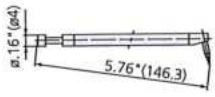
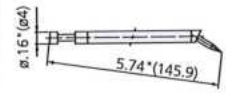
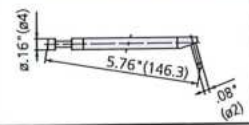
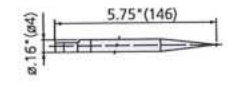
Inch (Metric)

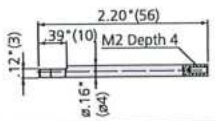
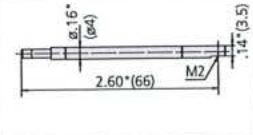
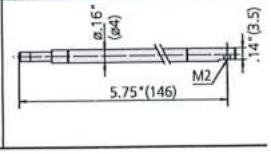
Application/Type	Standard type (supplied)	Notch	Deep groove	Corner
Order No.	**12AAB681**	**12AAB682**	**12AAB683**	**12AAB684**
Stylus tip	ø.06"(ø1.6) tungsten carbide	ø.12"(ø3) tungsten carbide	ø.01"(0.25) radius sapphire	ø.01"(0.25) radius sapphire
Dimensions inch (mm)		 Included in the 5-piece set No. **12AAC134**	 Included in the 5-piece set No. **12AAC134**	

Application/Type	Cutter mark	Small hole ø.03"(ø0.8)	Small hole	Small hole ø.06"(ø1.6)
Order No.	**12AAB685**	**12AAE859**	**12AAB686**	**12AAE855**
Stylus tip	.59"(15) radius tungsten carbide	ø.03"(ø0.8) tungsten carbide	ø.04"(ø1) tungsten carbide	ø.06"(ø1.6) tungsten carbide
Dimensions inch (mm)			 Included in the 5-piece set No. **12AAC134**	

Application/Type	Extra small hole Depth: .12"(3)	ø.06"(ø1.6) ball	Disk	Crank tip: ø.02"(ø0.5)
Order No.	**12AAB687**	**12AAB674**	**12AAB694**	**12AAB696**
Stylus tip	ø.02"(ø0.5) tungsten carbide	ø.06"(ø1.6) tungsten carbide	ø.47"(ø12)	ø.06"(ø1.6) tungsten carbide Depth: .10"(2.5)
Dimensions inch (mm)		 Included in the 5-piece set No. **12AAC134**		

Application/Type	Crank (tip:ø1 mm)	Flat surface	2X-long type*	2X-long type notch*
Order No.	**12AAB695**	**12AAE856**	**12AAB688**	**12AAB689**
Stylus tip	.04"(ø1) tungsten carbide Depth: .22"(5.5)	Tungsten carbide	ø.06"(ø1.6) tungsten carbide	ø.12"(ø3) tungsten carbide
Dimensions inch (mm)			 Included in the 5-piece set No. **12AAC134**	

Application/Type	2X-long type deep groove*	2X-long type corner*	2X-long type cutter mark*	2X-long type small hole*
Order No.	**12AAB690**	**12AAE691**	**12AAB692**	**12AAB693**
Stylus tip	.01"(0.25) radius sapphire	ø.04"(ø1) tungsten carbide Sapphire	.59"(15) radius tungsten carbide	ø.04"(ø1) tungsten carbide
Dimensions inch (mm)				

Application/Type	Stylus shank	Stylus shank (standard groove)	Stylus shank (2X-long groove)
Order No.	**12AAB676**	**12AAE857**	**12AAE858**
Stylus tip	For mounting CMM stylus (mounting thread M2)		
Dimensions inch (mm)			

* Measuring is only in the vertical direction.

Measuring magnification of 20000X is available using the 2X-long stylus.
A set of five optional interchangeable styli is available including the most commonly used ones.
Customized special interchangeable styli are available on request. Please contact any Mitutoyo office for more information.

Specifications are subject to change without notice.

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