

Compact Roundness Measurement **ROUNDTEST RA-10**

Bulletin No. 1951



Compact new roundness tester combines outstanding cost/performance ratio with full measurement capabilities

Mitutoyo

Improve quality and lower costs with roundness verification.

Verification of geometrical tolerances, including roundness, is a must in today's quality-conscious environment.

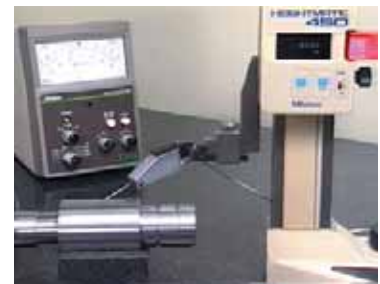
Roundness measuring machines with the ability to perform product verification in conformity with ISO, JIS and other standards are indispensable to any quality control system that aspires to implementing high-grade quality assurance. Heightened awareness of production quality and higher quality goods will help enhance your corporate image with the buying public.

Roundness verification attempted using basic measuring tools involves the following drawbacks:

- Measurement is not conducted by a radius method conforming to the standards, for which a reference axis is necessary.
- Measurement verification that meets the accuracy required by the drawings cannot be performed.
- Recorded profiles cannot be obtained.



Diameter measurement using a micrometer cannot detect an odd-number lobing condition and resolution is marginal.



Three-point method using an indicator and V-block has better resolution but is not sensitive to common lobing conditions.

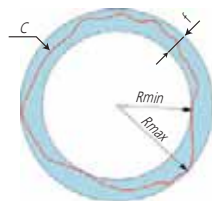
Once roundness measuring machines are introduced into quality control:

- Reduction of nonconforming parts will translate into lower overall cost of manufacture.
- Product quality will improve and the time-to-market for new product will be reduced.
- Corporate image will be enhanced.



Definition of Roundness

Roundness of a profile or contour (C) is the difference in radius (f) of two concentric circles that enclose C when the separation of these circles is a minimum, and is indicated as 'roundness xx mm' or 'roundness xx μm '.



High-Precision Roundness Measurement

Simple, beginner-friendly operation

- The key layout is large and simple making it easy to view and easy to understand.
- One-time setup recall function: Complex setups are stored in advance, ready for recall when required by one-key operation.
- Zero-setting function: The detector's level can be set to zero (0) with one single key press. This relieves the user from the chore of meticulously positioning the detector.
- The adjustment knobs for vertical direction (Z-axis) and radial direction (X-axis) travel have been positioned on the slider for best operability.
- Because setups can only be altered in administrator mode, the machine operator can be prevented from inadvertently changing settings.

High accuracy even though it is a low-end machine

Despite being a low-priced model, the rotary table with air bearing offers rotational accuracy as high as $(0.04+6H/10000)\mu\text{m}$, thus assuring a precision that compares well to that of high-end models.

Large LCD panel displays measurement results and recorded profiles in an easy-to-view fashion

The built-in high-grade thermal printer prints out measurement results and recorded profiles on demand

Compact design means small installation space

The machine calls for only a small installation space as its compact body integrates the measuring unit, electronics and printer.

Options that further enhance usability

Use of a part setting jig exactly fitting the object being measured eliminates the need for the centering and leveling adjustments which would otherwise be required prior to measurement. An X-axis stop in the radial direction allows the detector to be positioned easily according to the object to be measured, eliminating the task of fine positioning when measurement is repeated.

* For details on the options, see pages 3 and 8.



Four easy steps to measurement



Clamp the workpiece to the jig.



Bring the detector into contact with the workpiece.

* Combined use of the zero-setting function and X-axis stop (Optional) will result in securing even higher efficiency when identical workpieces are measured repetitively.



Press the [CONDITION (setup recall)] button, as needed.

* If measurement is always conducted using the last setup, there is no need to recall this because the machine always starts up with the same settings that were effective immediately before the machine was powered down last time.



Press the [START] button.

Main Measuring Unit

Detector

Allows simple positioning of the workpiece due to its wide measuring range of $\pm 1000\mu\text{m}$.

Part setting jig (Optional)

Can be selected to best suit the workpiece, which can be clamped/released in a single action. High re-gripping accuracy eliminates the need for centering and leveling.

High-precision air bearings

The highest accuracy in its class, $(0.04+6H/10000)\mu\text{m}$, has been achieved.

Built-in printer

Prints measurement results.

Space-saving design

The compact body integrating the measuring unit, electronics and printer poses no problem in installing the machine.

Z-axis ABS scale (Optional)

When the ABS scale is fitted, positioning in the Z-axis (vertical) direction is performed with higher accuracy.

X-axis stop (Optional)

Allows fast positioning of the stylus after the workpiece is clamped so that measurement can be started immediately without the need for a delicate positioning operation. This greatly increases work efficiency on batch work.

Slider

Carries the manual operation knobs positioned together for convenient X- and Z-axis stylus position adjustment.

Large LCD panel

Clearly displays measurement results and recorded profiles.

Simple operation panel

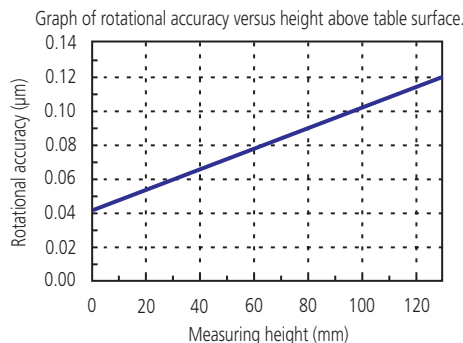
Large-sized buttons allow easy recall of stored measurement setups and help prevent input errors.



High-precision air bearings provide highly accurate measurement

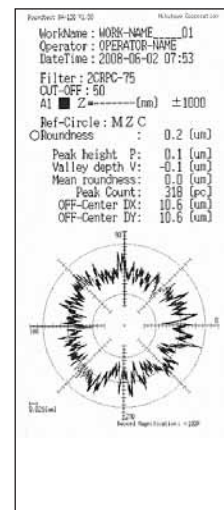
Rotary table axis stability is the most critical specification of a roundness measuring machine since this axis provides the datum from which the stylus deflection is measured for every type of analysis. For this reason the RA-10 is equipped with specially designed air bearings that assure high rotational accuracy to guarantee high-precision measurements.

As these bearings are inherently non-contacting they are free of any degradation arising from normal use, so the machine retains high accuracy even when used for an extended period of time.



Measurement results can be sent to the built-in printer or exported for external processing and storage

Measurement results and recorded profiles can be sent to the high-grade built-in thermal printer or exported via the SPC and RS-232C output functions or text file output function to USB memory.



Sample print by built-in printer

Control Panel

Measurement screen/result screen switching

Switches between measurement screen and analysis screen at one touch of a button.

Printer control

While automatic print is available, setting can also be made to print desired results only, thus resulting in the saving of paper resources.

Zero Set button

A potent tool for establishing optimum positioning of the detector.

Setup button



Large LCD screen

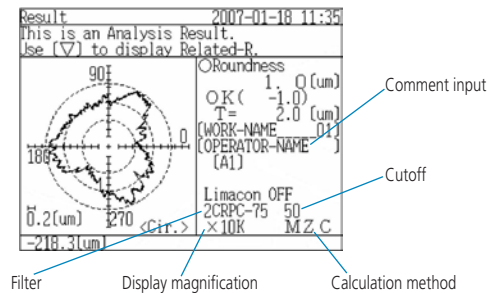
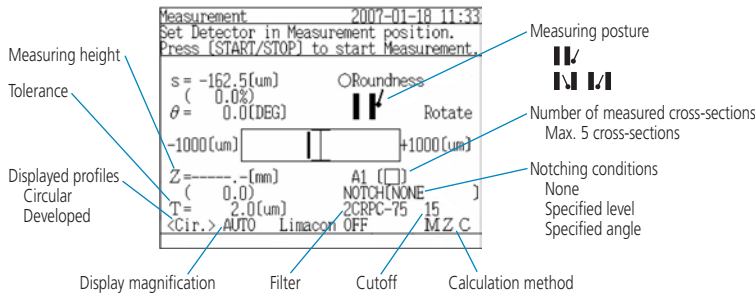
Displays measurement results and recorded profiles in an easy-to-understand manner.

Setup Recall

Frequently used measurement setups can be stored in advance, ready to be called up by one touch of a key.

Setup definition

Measuring range switching



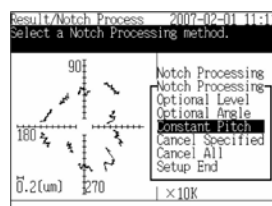
Sample Result Screen (Roundness)

Useful functions help setting up prior to measurement

When a high-resolution range measurement is needed, for which accurate positioning is required, the Zero Set button allows the detector to be set at the optimum position. The machine delivers the measurement results for a workpiece after automatically correcting for eccentricity and inclination.

Measurement data editing function

Any part of a profile that is not to be included in the calculation can automatically be excluded from the measurement data. Therefore notches in the profile can be ignored, or data produced by scratches can be deleted while observing recorded profiles on the screen.



Limaçon function compensates for eccentricity

A displacement offset between the rotary table axis and that of the part under measurement results in distortion of the measured form (limaçon error) and consequentially produces an error in the calculated roundness value. The larger the eccentricity, the larger is the error in calculated roundness. The RA-10 supports accurate measurement with a limaçon error correction function, which is provided to correct such errors arising from eccentricity.

- The limaçon error correction yields the effect of error reduction only when measuring a workpiece of larger diameter than that of the tip of the probe.
- If the effect obtained with the limaçon error correction function is not sufficient, use the optional alignment table (purchase separately) to establish precise centering of the workpiece.

Types of Analysis

Type of Tolerance	Characteristic/Symbol	Measurement Method	Sample Result Screen	Explanation
Form	Roundness 			<p>The radial difference between an inscribed circle and a circumscribed circle that are concentric with the center found by each calculation method is evaluated as "Roundness."</p>
	Flatness 			<p>When the surface under measurement is contained between two planes that are parallel to the reference plane found by a calculation method, the separation of these two planes is evaluated as "Flatness."</p>
Location	Concentricity 			<p>Using the measurement data for two elements, double the deviation of the center of the element under evaluation from that of the reference element is evaluated as "Concentricity."</p>
	Coaxiality 			<p>Of the centers of various elements under evaluation, double the largest deviation from the reference axis is evaluated as "Coaxiality."</p>
Runout	Circular runout 			<p>When the element under evaluation is contained between two cylinders that are coaxial with the reference axis, the separation of these two cylinders is evaluated as "Runout (In radial direction)."</p>

Specifications

Main unit

Model		RA-10
Order No.		211-601A
Turntable	Bearing type	Air bearing
	Rotational accuracy (radial)	(0.04+6H/10000)μm H: Probing height (mm) JISB7451-1997
	Rotational accuracy (axial)	(0.04+6X/10000)μm X: Probing radius (mm)
	Rotation speed	6rpm
	Effective table diameter	ø 6" (150mm)
	Maximum turntable loading	22 lbs (10kg)
	Maximum probing diameter	ø 3.94" (100mm)
Vertical column (Z axis)	Maximum workpiece diameter	ø 12.6" (320mm)
	Vertical travel	4.6" (117mm) ·Bottom position: Approx 1.38"(35mm) from the turntable top*2 ·Top position: Approx. 5.98"(152mm)*1 from the turntable top*2
	Maximum probing height	5.98"(152mm) from the turntable top
Horizontal arm (X axis)	Maximum probing depth	3.94"(100mm) [(minimum ID: ø 1.18"(30mm) using the standard stylus)]
	Horizontal travel	-.98" (-25mm) to 1.97"(50mm)
Detector	Measuring force	70mN to 100mN
	Standard stylus (12AAB681)	Stylus tip: ø1.6mm carbide ball (Refer to page 7 for detailed information.)
	Measuring range	±1000μm
Electronic unit	Measuring direction	Two directional (IN/OUT switchable)
	Measuring range	±1000μm, ±100μm, ±10μm
	Magnification	×5, ×10, ×20, ×50, ×100, ×200, ×500, ×1,000, ×2,000, ×5,000, ×10,000, ×20,000, ×50,000, ×100,000, ×200,000
	Filter type	Phase corrected: 2CRPC75, 2CRPC50 Not phase corrected: 2CR75, 2CR50 Gaussian, filter OFF
	Cutoff value	15upr, 50upr, 150upr, 500upr 15-150upr, 15-500upr, 50-500upr
	Number of measuring sections	1-section to 5-section: Roundness, Coaxiality, Flatness 1-section to 3-section: Circular runout (radial) 2-section: Concentricity
	Reference circle for evaluation	LSC, MZC, MIC, MCC
	Evaluation item	Roundness, Coaxiality, Concentricity, Flatness, Circular runout (radial)
	Data output	RS-232C I/F, SPC, USB stick memory
	Display	LCD 4.6" x 3.48" (117.2 x 88.4mm)
	Printer	Thermal line printer, optional external printer
Others	Power supply	AC100 to 240V
	Power consumption	33W
	Air pressure	0.39MPa
	Air consumption	30L/min (minimum)
	Mass	57 lbs (26kg)

*1: Top position will vary depending on any attachments installed.

*2: No attachments installed.

Standard accessories

Order No.	Name	Quantity
350366	Magnification adjusting film	2
611755-04	Gauge block (35mm, JIS 2-grade)	1
11BAB941	Level	1
12AAB681	Standard stylus	1
12BAJ340	Printer paper	2
—	Receptacle	1
—	Hose band	1
—	Power cable	1
—	Leveling spanner	1
—	Philips screwdriver	1
—	Key wrench 0.9	1
—	Key wrench 2	2
—	Key wrench 4	1
—	Machine cover	1
—	User's manual	1

Optional accessories

211-016: Reference hemisphere*
* Optional spacer
(**12AAH420**) is required



211-045: Magnification checking gage



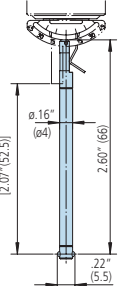
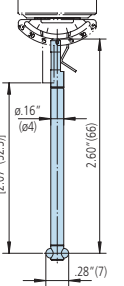
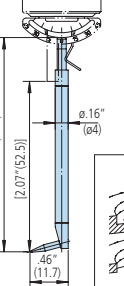
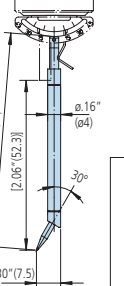
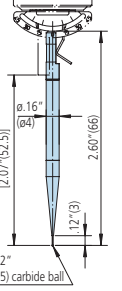
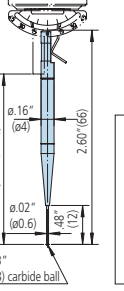
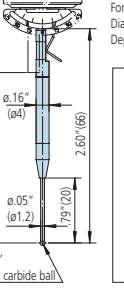
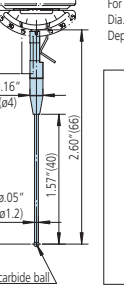
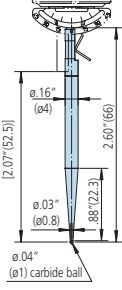
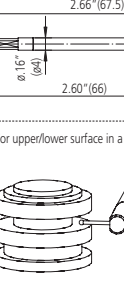
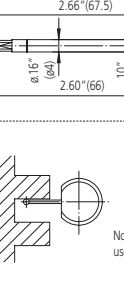
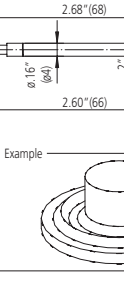
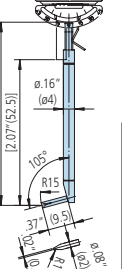
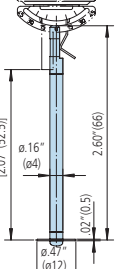
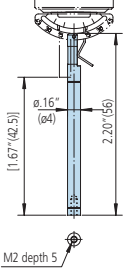
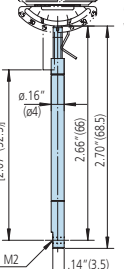
997090: Gage block set for calibration



358592: Replacement element for filter
358593: Replacement element filter regulator

Optional Accessories

Unit: inch (mm)

12AAB681 Standard stylus (*Standard accessory) (stylus tip: $\phi 0.06$ "($\phi 1.6$ mm) carbide ball)	12AAB682 Stylus for notched workpieces (stylus tip: $\phi 0.12$ "($\phi 3$ mm) carbide ball)	12AAB683 Stylus for grooves (stylus tip: R0.01"($\phi 0.25$ mm) sapphire)	12AAB684 Stylus for corners (stylus tip: R0.01"($\phi 0.25$ mm) sapphire)
 <p>For standard applications</p> <p>In ID measurement Dia.: ≥ 0.30"(7.5mm), Depth: ≤ 1.97"(50mm)</p> <p>$\phi 0.16$"($\phi 4$)</p> <p>2.60"(66)</p> <p>2.07"(52.5)</p> <p>22"(5.5)</p>	 <p>Useful for notched workpieces</p> <p>Example</p> <p>$\phi 0.16$"($\phi 4$)</p> <p>2.60"(66)</p> <p>2.07"(52.5)</p> <p>28"(7)</p>	 <p>For stepped applications</p> <p>Example</p> <p>2.63"(66.7)</p> <p>$\phi 0.16$"($\phi 4$)</p> <p>2.07"(52.5)</p> <p>46"(11.7)</p>	 <p>For inside-corner applications</p> <p>Example</p> <p>2.60"(66)</p> <p>2.06"(52.3)</p> <p>$\phi 0.16$"($\phi 4$)</p> <p>30°</p> <p>30"(7.5)</p>
12AAB687 Stylus for extra small holes (stylus tip: $\phi 0.02$ "($\phi 0.5$ mm) carbide ball)	12AAE859 Stylus for small holes (stylus tip: $\phi 0.03$ "($\phi 0.8$ mm) carbide ball)	12AAB674 Stylus for small and deep holes (stylus tip: $\phi 0.06$ "($\phi 1.6$ mm) carbide ball)	12AAE855 Stylus for small and deep holes (stylus tip: $\phi 0.06$ "($\phi 1.6$ mm) carbide ball)
 <p>For extra small hole applications Dia.: ≥ 0.04"(1mm), Depth: ≤ 1.0"(2.5mm)</p> <p>Enlarged image</p> <p>$\phi 0.16$"($\phi 4$)</p> <p>2.60"(66)</p> <p>2.07"(52.5)</p> <p>12"(3)</p> <p>$\phi 0.02$"($\phi 0.5$) carbide ball</p> <p>$\phi 0.04$"($\phi 1$)</p>	 <p>For small hole applications Dia.: ≥ 0.06"(1.5mm), Depth: ≤ 0.39"(10mm)</p> <p>Enlarged image</p> <p>$\phi 0.16$"($\phi 4$)</p> <p>2.60"(66)</p> <p>2.07"(52.5)</p> <p>48"(12)</p> <p>$\phi 0.03$"($\phi 0.8$) carbide ball</p> <p>39"(10)</p> <p>$\phi 0.06$"($\phi 1.5$)</p>	 <p>For small and deep hole application Dia.: ≥ 0.12"(3mm), Depth: ≤ 0.71"(18mm)</p> <p>Enlarged image</p> <p>$\phi 0.16$"($\phi 4$)</p> <p>2.60"(66)</p> <p>2.07"(52.5)</p> <p>$\phi 0.05$"($\phi 1.2$)</p> <p>79"(20)</p> <p>71"(18)</p> <p>$\phi 0.12$"($\phi 3$)</p>	 <p>For small and deep hole application Dia.: ≥ 0.12"(3mm), Depth: ≤ 1.50"(38mm)</p> <p>Enlarged image</p> <p>$\phi 0.16$"($\phi 4$)</p> <p>2.60"(66)</p> <p>2.07"(52.5)</p> <p>$\phi 0.05$"($\phi 1.2$)</p> <p>1.57"(40)</p> <p>1.50"(38)</p> <p>$\phi 0.12$"($\phi 3$)</p>
12AAB686 Stylus for small holes (stylus tip: $\phi 0.04$ "($\phi 1$ mm) carbide ball)	12AAB696 Cranked stylus (stylus tip: $\phi 0.02$ "($\phi 0.5$ mm) carbide ball)	12AAB695 Cranked stylus (stylus tip: $\phi 0.04$ "($\phi 1$ mm) carbide ball)	12AAE856 Stylus for flat surface
 <p>For small hole applications</p> <p>Example</p> <p>$\phi 0.16$"($\phi 4$)</p> <p>2.60"(66)</p> <p>2.07"(52.5)</p> <p>88"(22.3)</p> <p>$\phi 0.04$"($\phi 1$) carbide ball</p>	 <p>For upper/lower surface in a narrow groove</p> <p>Example</p> <p>2.66"(67.5)</p> <p>$\phi 0.16$"($\phi 4$)</p> <p>2.60"(66)</p> <p>22"(5.5)</p> <p>$\phi 0.04$"($\phi 1$) carbide ball</p> <p>Note: This stylus cannot be used for OD/ID measurement.</p>	 <p>2.66"(67.5)</p> <p>$\phi 0.16$"($\phi 4$)</p> <p>2.60"(66)</p> <p>10"(2.5)</p> <p>$\phi 0.02$"($\phi 0.5$) carbide ball</p>	 <p>2.68"(68)</p> <p>$\phi 0.16$"($\phi 4$)</p> <p>2.60"(66)</p> <p>22"(5.5)</p> <p>$\phi 0.02$"($\phi 0.5$) carbide ball</p> <p>Example</p>
12AAB685 Stylus for filtering asperities (cutter mark)	12AAB694 Disk stylus	12AAB676 M2 tapped shank for CMM styli	12AAE857 M2 tapped shank for CMM styli
 <p>Filtering out the effects of asperities by tracing with R15 tipped stylus</p> <p>Example</p> <p>Cutter mark</p> <p>2.60"(66)</p> <p>2.07"(52.5)</p> <p>$\phi 0.16$"($\phi 4$)</p> <p>105°</p> <p>R15</p> <p>37"(9.5)</p> <p>20"(5)</p> <p>180°</p>	 <p>Example</p> <p>For narrow groove applications</p> <p>2.07"(52.5)</p> <p>$\phi 0.16$"($\phi 4$)</p> <p>2.60"(66)</p> <p>$\phi 0.47$"($\phi 12$)</p> <p>0.02"(0.5)</p>	 <p>Compatible with CMM styli with M2 threaded shank</p> <p>M2 depth 5</p> <p>1.67"(42.5)</p> <p>$\phi 0.16$"($\phi 4$)</p> <p>2.20"(56)</p>	 <p>Compatible with CMM styli with M2 threaded shank</p> <p>2.07"(52.5)</p> <p>$\phi 0.16$"($\phi 4$)</p> <p>2.66"(66)</p> <p>2.70"(68.5)</p> <p>M2</p> <p>1.4"(3.5)</p>

* portion shows stylus except for the cranked stylus and stylus for flat surface.

* [] dimension shows a distance from the tip end of stylus or the center of tip ball to the connecting surface of detector.

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

•Various Types of Part-Setting Jigs Directly mounted on the rotary table for use

Centering chuck

When measuring a small-sized workpiece, the chuck provides good operability and the knurled ring allows the workpiece to be clamped easily.



Order No.	211-052
Part holding range	O.D. (Internal jaws) 1–36mm O.D. (External jaws) 25–79mm I.D. (Internal jaws) 16–69mm
Centering error	Within 150µm*1
Mass	5.5 lbs (2.5kg)

*1: When measured with 10 mm pin gauge at measuring height of 30 mm.

Collecting Chuck

Provides high clamping repeatability due to the use of optional precision collets. (See table at right.)



Order No.	211-051
Part holding range	O.D. \varnothing 0.5–10mm*2
Centering error	Within 50µm*3
Mass	3.1 lbs (1.4kg)

*2: Collets to match the workpiece size range are required for use with this chuck.

*3: When measured with \varnothing 5 mm pin gauge at measuring height of 30 mm.

V-block jig A [Semi-custom product]

The cylindrical surface of the workpiece is held against the V-block and secured with the screw-type clamp. This is a semi-custom-made product that is shipped out after adjusting the position of the V-block according to the workpiece size. This jig allows workpieces of the same size to be measured without having to center each one.

211-053: for \varnothing 1.96" (50mm)



V-block jig B [Semi-custom product]

The cylindrical surface of the workpiece is held against the V-block and secured with the screw-type clamp. This is a semi-custom-made product that is shipped out after adjusting the position of the V-block according to the workpiece size. This jig allows workpieces of the same size to be measured without having to center each one.

211-054: for \varnothing 1.96" (50mm)



OD/ID mating jig [Semi-custom product]

These jigs are specially made to locate plain sections of a workpiece so that loading/unloading is very quick. Workpiece centering is automatically provided by just one initial centering operation on the jig, when first installed, so measurement can be started as soon as the jig is loaded with a workpiece. No clamping is used so the workpiece must be heavy enough to remain stable during measurement.

* An OD/ID master mating part to match the workpiece diameter is required separately (available to special order).



211-055: for \varnothing .39" (10mm)

Individual Collets*4

These collets are for use with the collet chuck shown at left and are acquired to match the workpiece diameter range required.

Order No.	Part Holding Range (O.D.)
12AAH402	\varnothing 0.02"–0.04" (0.5–1.0mm)
12AAH403	\varnothing 0.04"–0.06" (1.0–1.5mm)
12AAH404	\varnothing 0.06"–0.08" (1.5–2.0mm)
12AAH405	\varnothing 0.08"–0.1" (2.0–2.5mm)
12AAH406	\varnothing 0.1"–0.12" (2.5–3.0mm)
12AAH407	\varnothing 0.12"–0.138" (3.0–3.5mm)
12AAH408	\varnothing 0.138"–0.157" (3.5–4.0mm)
12AAH409	\varnothing 0.157"–0.197" (4.0–5.0mm)
12AAH410	\varnothing 0.197"–0.236" (5.0–6.0mm)
12AAH411	\varnothing 0.236"–0.275" (6.0–7.0mm)
12AAH412	\varnothing 0.275"–0.315" (7.0–8.0mm)
12AAH413	\varnothing 0.315"–0.354" (8.0–9.0mm)
12AAH414	\varnothing 0.354"–0.394" (9.0–10.0mm)

*4: A collet cannot be mounted on the rotary table without a collet chuck.

*4: YCC10-** Class AA, made by Yukiwa Seiko Inc. or its equivalent.

• Alignment table

When installed on the rotary table, this accessory enables the user to efficiently perform centering and leveling adjustments in synchronization with the adjustment Navi DAT.



Order No.	12AAH426
Centering adjustment range	\pm .12" (3mm)
Leveling adjustment range	\pm 1°
Maximum loading mass	6.6 lbs (3kg)
Mass	15.4 lbs (7kg)

Options that can be installed on the alignment table

When measuring a small-diameter workpiece, the chuck provides good operability and the knurled ring allows the workpiece to be clamped easily.



Order No.	211-032
Holding range	O.D. with internal jaws \varnothing 11– \varnothing 36mm I.D. with internal jaws \varnothing 16– \varnothing 69mm O.D. with internal jaws \varnothing 25– \varnothing 79mm
External size (D x H)	\varnothing 4.65x1.6" (118 x 41mm)
Mass	2.6 lbs (1.2kg)

For clamping a small workpiece, 1 mm or less in diameter, that cannot be held in the centering chuck.



Order No.	211-031
Holding range	O.D.: up to \varnothing 1.5mm
External size (D x H)	\varnothing 4.65"x1.9" (118 x 48.5mm)
Mass	1.32 lbs (0.6kg)

X-axis stop

Allows the user to return the detector rapidly and easily to a fixed position in the X axis.



Order No.	12AAH320
Mass	.14 lbs (65g)

SD scale for Z axis*

Scale unit for accurate positioning of the slider in the Z-axis direction (ABS scale used).



Order No.	12AAH318
Mass	.99 lbs (450g)

* Shipped out attached to the RA-10 machine, or will be installed on site by Mitutoyo service personnel.

Vibration damping stand



Order No.	950-990
Vibration damping system	Pneumatic type w/self-leveling
External size	24"x20"x2" (615x515x51mm)
Max. loading mass	175 lbs (150kg)

Installation Environment

Temperature	This system has been assembled and adjusted in a temperature-controlled room controlled to 20°C. For the machine to be operated with the specified accuracy, it is essential that the temperature of the location where it is installed be in the neighborhood of 20°C, with little variation. (The ideal will be the Standard Temperature Status First Class, 20°C ±1°C, specified in the 'Standard for Precision Measurement Environment' of the Japanese Precision Measuring Machine Engineering Association Standard JMAS5011. Moreover, the machine is designed for a temperature change of not more than 2K in 8 hours.) The specified accuracy may not be realized if the machine is operated in an inadequate temperature environment. An accuracy adjustment performed in such an environment would no longer be a normal adjustment, since the machine would not be accurate at an ambient temperature of 20°C.
Humidity	Although humidity does not directly affect the accuracy of the measuring machine, a high degree of humidity tends to promote rust in the critical parts of the machine, with an adverse effect also on the electronic components. Try to maintain a humidity of 55% to 65%, as far as practicable.
Vibration	If the machine is subjected to excessive levels of vibration during measurement the results will be adversely affected. The recommended vibration limits are specified below: At a frequency of 10Hz or lower, the amplitude should be no more than 2µm p-p. At a frequency of 10–20Hz, the acceleration should be no more than 0.004m/s (0.4Gals). If the above conditions are surpassed, construct a proper foundation or use the dedicated vibration damping stand available as an optional purchase.
Dust	This machine should be operated in a dust-free environment to prevent damage to its precision components.

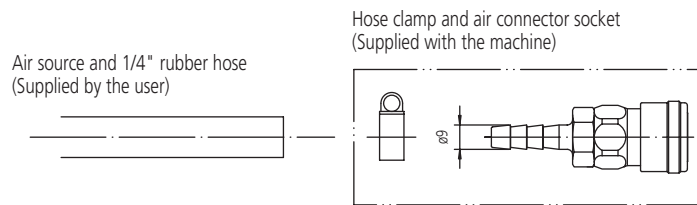
Power supply

This system requires the power supply specified in the table below. The power supply should possess some margin of capacity over the power required.

Distribution system	Single-phase two-wire system with ground connection.
Voltage	100VAC +10%, -5%
Frequency	50/60Hz
Grounding	Class D grounding connection or better.
Power consumption	Max. 60W
Type of plug socket x quantity	Grounded 2-pole socket x 1

Air supply capacity and connection details

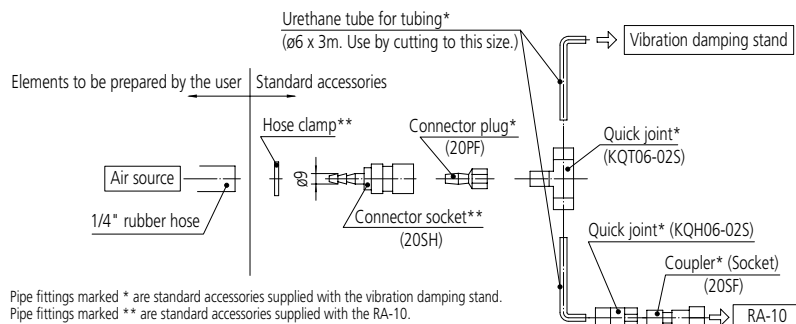
A 1/4" bore rubber hose is suitable for connecting the air supply to the machine.



The minimum requirements for pressure and flow rate of the air supply are specified below. The air supply should possess some margin of capacity in excess of these requirements.

- Required air pressure: 0.39MPa (Approx. 4kgf/cm²)
- Discharge air flow rate: 30L/min (Under standard conditions)

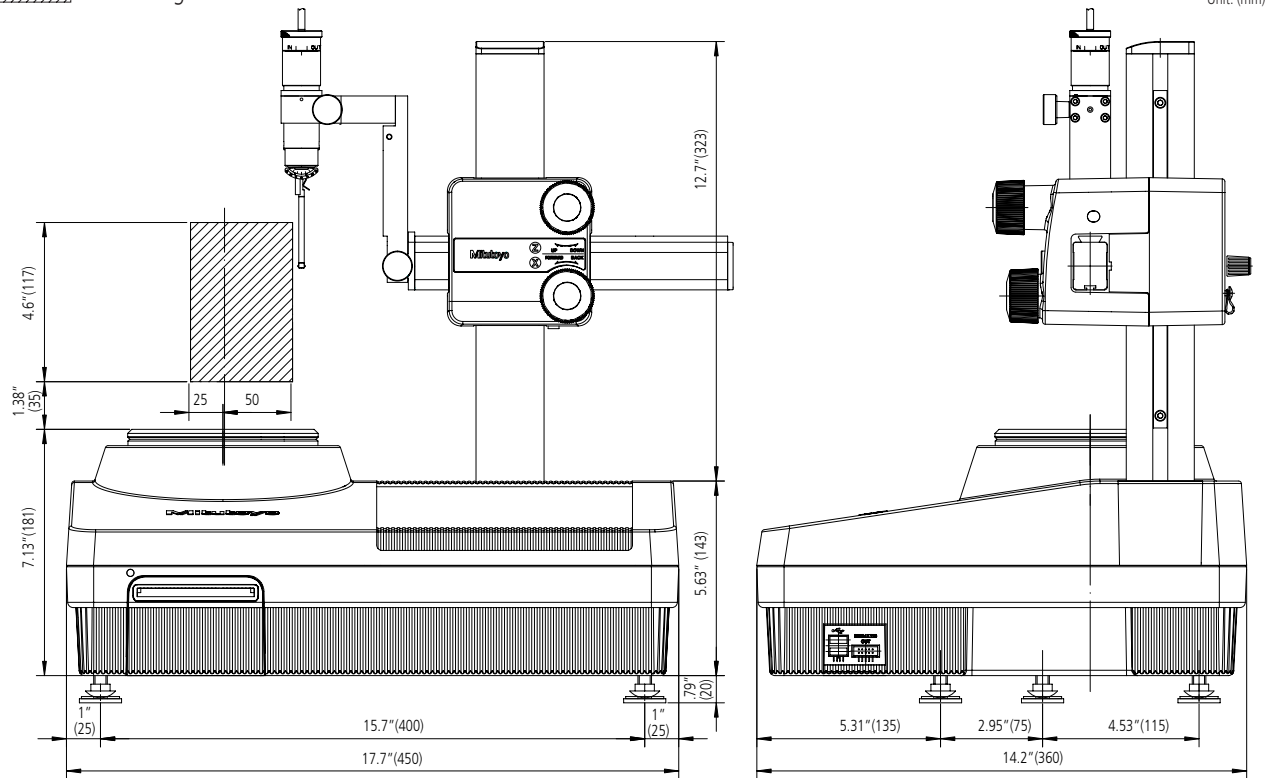
If the optional vibration damping stand is to be used with the RA-10 the recommended arrangement for the air supply tubing is shown below:



Dimensions

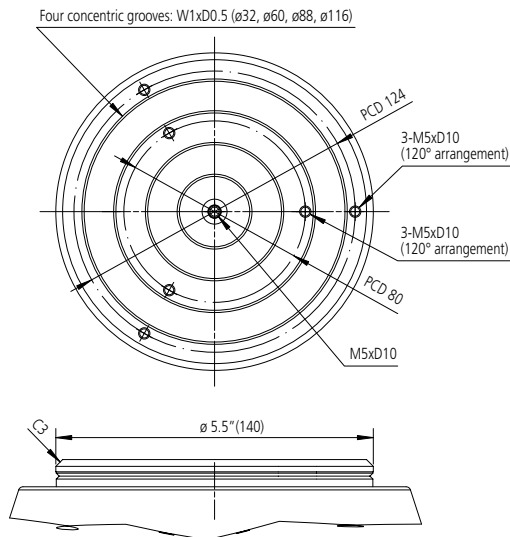
External dimensions

 : Measuring area



Turtable top view

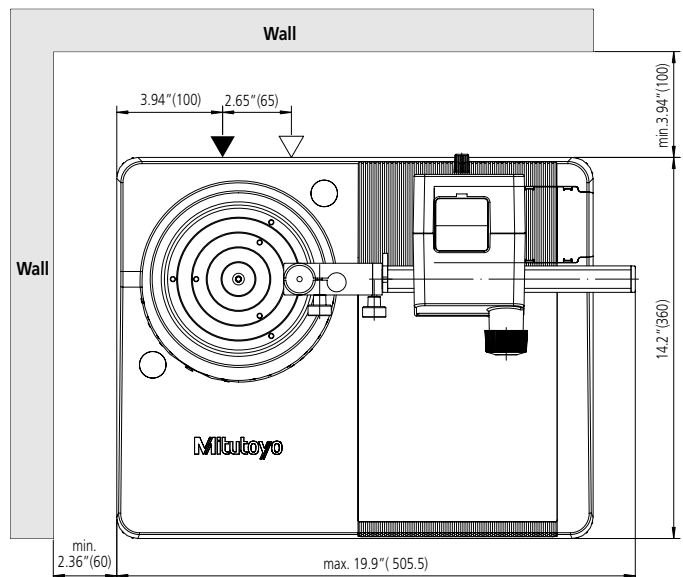
Unit: (mm)



Installation floor plan

▼: Power inlet
▽: Air inlet

Unit: (mm)





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