

ROUNDTEST RA-10

COMPACT ROUNDNESS MEASUREMENT

FORM MEASUREMENT



We have a reason for proposing you introduce roundness measuring machines to your business.

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

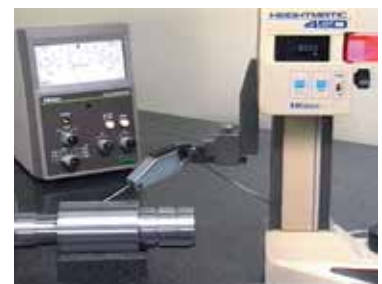
Roundness measuring machines with the ability to perform product verification in conformity with ISO, JIS and other standards are indispensable to any quality control system that aspires to implementing high-grade quality assurance. Heightened awareness of production quality and higher quality goods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

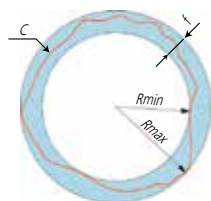


Once roundness measuring machines are introduced into quality control:

- 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 $R_{\text{ONT}} = xx \mu\text{m}$



High-Precision Roundness Measurement

Simple, beginner-friendly operation

- The key layout is large and simple so is easy to view and easy to understand.
- One-shot 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 operation handles for vertical direction (Z-axis) and radial direction (X-axis) adjustments 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 a low-end machine

Despite being a low-priced model, the turntable with air bearings offers rotational accuracy as high as $(0.04+0.0006H) \mu\text{m}$, 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 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.

High-precision air bearings

The highest accuracy in its class, ($0.04+0.0006H$) μm , 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

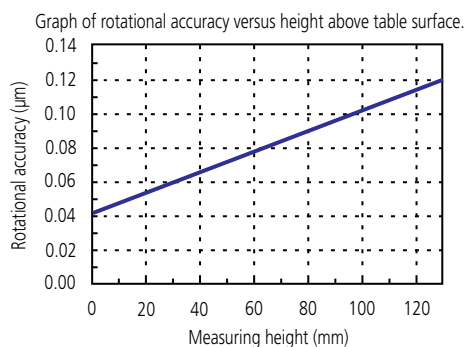
Large-sized buttons allow easy recall of stored measurement setups and help prevent input errors.



High-precision air bearings provide highly accurate measurement

Turntable 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.

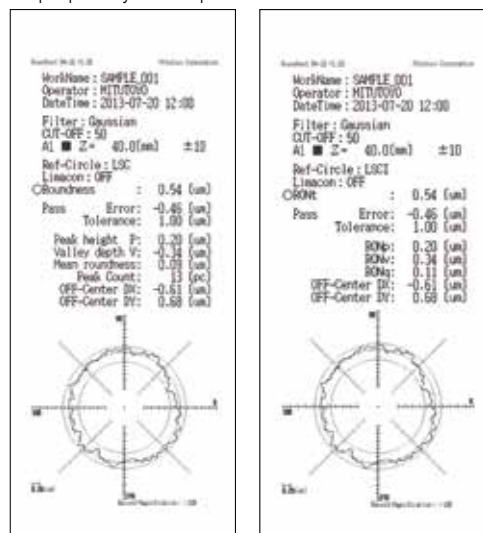
As these bearings are inherently non-contacting they are free of any degradation arising from normal use, so the machine retains high accuracy even when used for an extended period of time.



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 result screen at one touch of a button.

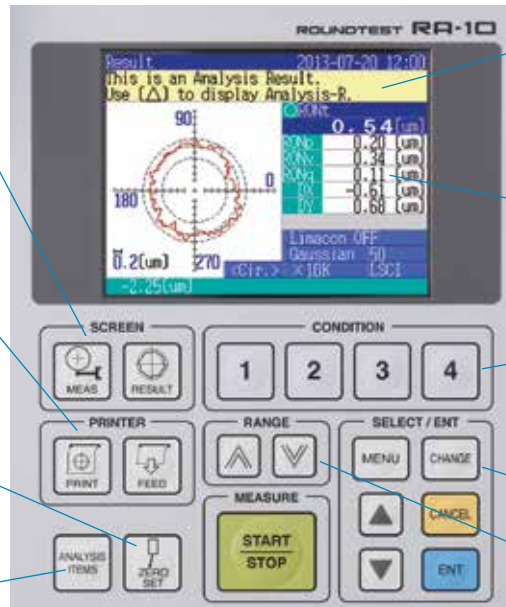
Printer control

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



Supports 16 languages

Japanese, English, German, French, Italian, Spanish, Portuguese, Korean, Traditional Chinese, Simplified Chinese, Czech, Polish, Hungarian, Turkish, Swedish, Dutch

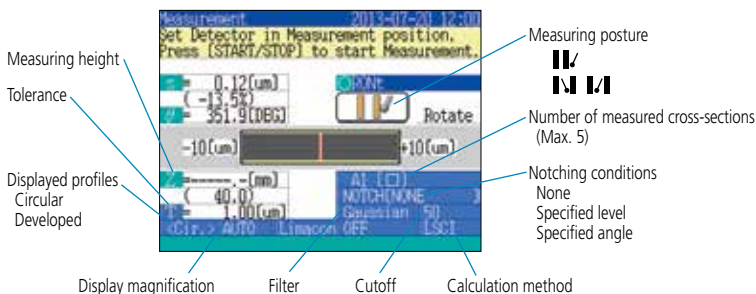
Displays measurement results and recorded profiles in an easy-to-understand manner.

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

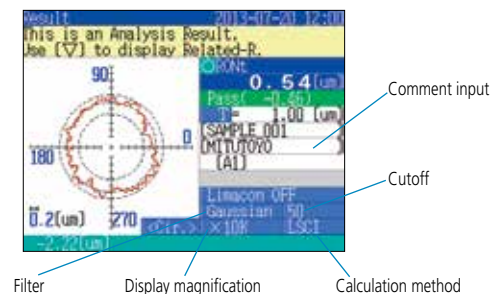
Setup definition

USB Communication Program for ROUNDTEST RA-10

The Roundtest RA-10 has a USB interface, enabling data to be transferred to a spreadsheet or other software.



Sample Measurement Screen



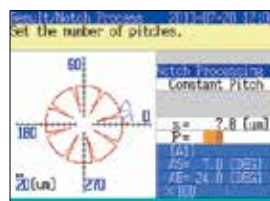
Sample Result Screen (Roundness)

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.

Measurement data editing function

Any part of a profile that is not to be included in the calculation can be automatically 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




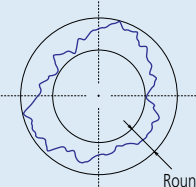

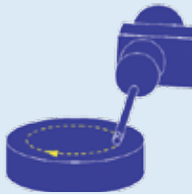

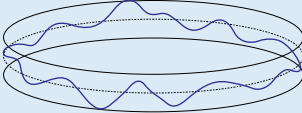

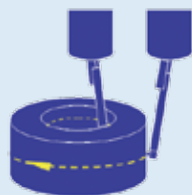

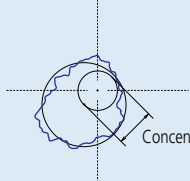

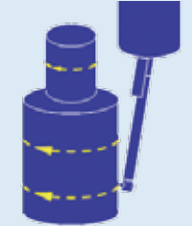

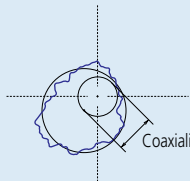

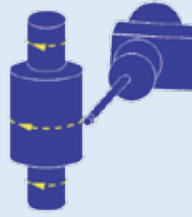
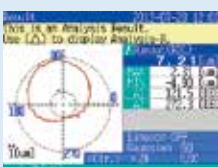
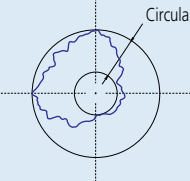
A displacement offset between the turntable axis and that of the part under measurement results in distortion of the measured form (limaçon error) and consequentially produces an error in the calculated roundness value. The larger the eccentricity, the larger is the error in calculated roundness.

The RA-10 supports accurate measurement with a limaçon error correction function, which is provided to correct such errors arising from eccentricity.

Notes:

1. The limaçon error correction is effective only when measuring a workpiece of larger diameter than that of the tip of the probe.
2. If the effect obtained with the limaçon error correction function is not sufficient, use the optional alignment table (to be purchased separately) to establish precise centering and leveling of the workpiece.

Types of Analysis with the RA-10

Feature Characteristic	Characteristic Symbol	Measurement Method	Sample Result Screen	Explanation
Form	Roundness 			 <p>Roundness (MZCI definition) of a profile is the difference in radius of two concentric circles that enclose the profile when the separation of these circles is a minimum.</p>
	Flatness 			 <p>Flatness of a profile is the distance between two planes enclosing the profile when this distance is a minimum.</p>
Location	Concentricity 			 <p>Concentricity of a profile is twice the shortest distance between the center of the profile and the datum.</p>
	Coaxiality 			 <p>Coaxiality of the axis of a profiled surface is twice the shortest radial distance between the axis and the datum at the measured positions.</p>
Runout	Circular runout (radial) 			 <p>Circular runout (radial) of a profile is the radial distance between two circles enclosing the profile and concentric with the datum when this distance is a minimum.</p>

Optional Accessories

Interchangeable Styli

Unit: mm

12AAL021 Standard accessory Standard stylus (stylus tip: $\phi 1.6$ carbide ball)	12AAL022 Stylus for notched workpieces (stylus tip: $\phi 3$ carbide ball)	12AAL023 Stylus for grooves (stylus tip: R0.25 sapphire) (stylus tip: $\phi 3$ carbide ball)	12AAL024 Stylus for corners (stylus tip: R0.25 sapphire)
<p>For standard applications</p> <p>In ID measurement Dia.: ≥ 7.5mm, Depth: ≤ 50mm</p>	<p>Useful for notched workpieces</p> <p>Example</p>	<p>For stepped applications</p> <p>Example</p>	<p>For inside-corner applications</p> <p>Example</p>
12AAL029 Stylus for extra small holes (stylus tip: $\phi 0.5$ carbide ball)	12AAL026 Stylus for small holes (stylus tip: $\phi 0.8$ carbide ball)	12AAL030 Stylus for small and deep holes (stylus tip: $\phi 1.6$ carbide ball)	12AAL028 Stylus for small and deep holes (stylus tip: $\phi 1.6$ carbide ball, L=40)
<p>For extra small hole applications Dia.: ≥ 1mm, Depth: ≤ 2.5mm</p> <p>Enlarged image</p> <p>$\phi 0.5$ carbide ball</p>	<p>For small hole applications Dia.: ≥ 1.5mm, Depth: ≤ 10mm</p> <p>Enlarged image</p> <p>$\phi 0.8$ carbide ball</p>	<p>For small and deep hole applications Dia.: ≥ 3mm, Depth: ≤ 18mm</p> <p>Enlarged image</p> <p>$\phi 1.6$ carbide ball</p>	<p>For small and deep hole applications Dia.: ≥ 3mm, Depth: ≤ 38mm</p> <p>Enlarged image</p> <p>$\phi 1.6$ carbide ball</p>
12AAL027 Stylus for small holes (stylus tip: $\phi 1$ carbide ball)	12AAL032 Cranked stylus (stylus tip: $\phi 0.5$ carbide ball)	12AAL033 Cranked stylus (stylus tip: $\phi 1$ carbide ball)	12AAL034 Stylus for flat surface
<p>For small hole applications</p> <p>Example</p> <p>$\phi 1$ carbide ball</p>	<p>For upper/lower surface in a narrow groove</p> <p>Note: This stylus cannot be used for OD/ID measurement.</p>	<p>Example</p>	<p>Example</p>
12AAL025 Stylus for filtering asperities (machining marks)	12AAL031 Disk stylus	12AAL043 M2 tapped shank for CMM styli	12AAL044 M2 tapped shank for CMM styli
<p>Filtering out the effects of asperities by tracing with R15 tipped stylus</p> <p>Example</p> <p>Machining marks</p>	<p>Example</p> <p>For narrow groove applications</p>	<p>Compatible with CMM styli with M2 threaded shank</p> <p>M2 depth 5</p>	<p>Compatible with CMM styli with M2 threaded shank</p> <p>M2</p>

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

Optional Accessories

Various Clamping Jigs

For direct mounting on the turntable

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) 1–36 mm O.D. (External jaws) 25–79 mm I.D. (Internal jaws) 16–69 mm
Centering error	Within 150 µm* ¹
Mass	2.5 kg

*1: When measured with ø10mm pin gauge at measuring height of 30 mm.

Collet 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. ø0.5–10 mm* ²
Centering error	Within 50 µm* ³
Mass	1.4 kg

*2: Optional collets to match the workpiece size range are required.

*3: When measured with ø5mm pin gauge at measuring height of 30mm.

Individual collets*⁴

These collets are acquired to match the workpiece diameter range required.

Order No.	Part Holding Range (O.D.)
12AAH402	ø0.5–1.0 mm
12AAH403	ø1.0–1.5 mm
12AAH404	ø1.5–2.0 mm
12AAH405	ø2.0–2.5 mm
12AAH406	ø2.5–3.0 mm
12AAH407	ø3.0–3.5 mm
12AAH408	ø3.5–4.0 mm
12AAH409	ø4.0–5.0 mm
12AAH410	ø5.0–6.0 mm
12AAH411	ø6.0–7.0 mm
12AAH412	ø7.0–8.0 mm
12AAH413	ø8.0–9.0 mm
12AAH414	ø9.0–10.0 mm

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

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 (ø10 to ø100mm) 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 ø50 mm

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 (ø10 to ø100mm) 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 ø50 mm

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 (max. ø30 mm)).



211-055: for ø10mm

Alignment table

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



Order No.	12AAH425	12AAH426
Centering adjustment range	±3 mm	±3 mm/.12"
Leveling adjustment range	±1°	±1°
Maximum loading	3 kg	3 kg
Mass	7 kg	7 kg

With mechanical micrometer head type (12AAH427) is available.

Options that can be installed on the alignment table

Centering chuck (knurled ring operated)

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 ø1–ø36 mm I.D. with internal jaws ø16–ø69 mm O.D. with internal jaws ø25–ø79 mm
External size (D x H)	ø118 x 41 mm
Mass	1.2 kg

Microchuck

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.: ø0.1–ø1.5 mm
External size (D x H)	ø107 x 48.5 mm
Mass	0.6 kg

Auxiliary stage for a low-height workpiece

Used for measuring a workpiece whose diameter is 20 mm or less and whose height is 20 mm or less.

Order No.: 356038



Other accessories

X-axis stop

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



Order No.	12AAH320
Mass	65 g

SD scale for Z-axis*

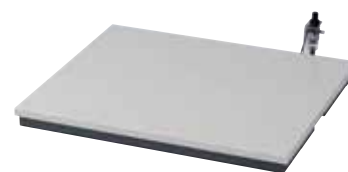
Scale unit for accurate positioning of the slider in the Z-axis direction (ABS scale used).



Order No.	12AAH318
Mass	450 g

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

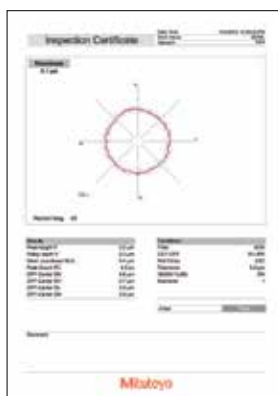
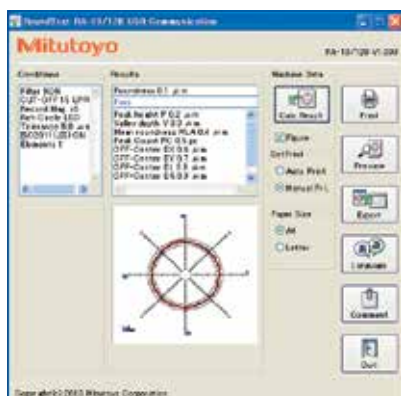
Vibration damping stand



Order No.	211-013
Vibration damping system	Diaphragm type air spring
External size	615 x 515 x 51 mm
Max. loading	150 kg

USB Communication Program for ROUNDTTEST RA-10

The Roundtest RA-10 has a USB interface, enabling data to be transferred to a spreadsheet or other software. We also provide a program that lets you create inspection record tables using a macro in Microsoft® Excel®.



Required environment:

- OS: Windows® XP-SP3
Windows® 7
- Spreadsheet software: Microsoft® Excel® 2010

The optional USB cable is also required.

- USB cable for RA-10 series
Order No. **12AAH490**

USB Communication Program as a free download on www.mitutoyo.eu!

Specifications

Main unit

Model		RA-10
Turntable	Bearing type	Air bearing
	Rotational accuracy (radial)	(0.04+0.0006H) μ m H: Probing height (mm) JISB7451-1997
	Rotational accuracy (axial)	(0.04+0.0006X) μ m X: Probing radius (mm)
	Rotational speed	6 rpm
	Effective table diameter	ϕ 150 mm
	Maximum turntable loading	10 kg
	Maximum probing diameter	ϕ 100 mm
	Maximum workpiece diameter	ϕ 320 mm
Vertical column (Z-axis)	Vertical travel	117mm ·Bottom position: Approx 35 mm from the turntable top* ² ·Top position: Approx. 152 mm* ¹ from the turntable top* ¹
	Maximum probing height	152 mm from the turntable top
	Maximum probing depth	100 mm (minimum ID: ϕ 30mm) using the standard stylus
Horizontal arm (X-axis)	Horizontal travel	-25 mm to 50 mm
Detector	Measuring force	100mN (\pm 30%)
	Standard stylus (12AAL021)	Stylus tip: ϕ 1.6 mm carbide ball (Refer to page 7 for detailed information.)
	Measuring range	\pm 1000 μ m
	Measuring direction	Two directional (IN/OUT switchable)
Electronic unit	Measuring range	\pm 1000 μ m, \pm 100 μ m, \pm 10 μ m
	Magnification	x5, x10, x20, x50, x100, x200, x500, x1000, x2000, x5000, x10000, x20000, x50000, x100000, x200000
	Filter type	Phase corrected: 2CRPC75, 2CRPC50, Gaussian Not phase corrected: 2CR75, 2CR50, filter OFF
	Cutoff value	15 μ m, 50 μ m, 150 μ m, 500 μ m 15-150 μ m, 15-500 μ m, 50-500 μ m
	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	LSCI, MZCI, MICI, MCCI
	Evaluation capability	Roundness, Coaxiality, Concentricity, Flatness, Circular runout (radial)
	Data output	RS-232C I/F, SPC, USB stick memory
	Display	LCD 117.2 x 88.4 mm
	Printer	Thermal line printer
	Display languages	Japanese, English, German, French, Italian, Spanish, Portuguese, Korean, Traditional Chinese, Simplified Chinese, Czech, Polish, Hungarian, Turkish, Swedish, Dutch
Others	Power supply	AC100 to 240V, 50/60Hz
	Power consumption	32-36W
	Air pressure	0.39MPa
	Air consumption	30L/min (minimum)
	Mass	26 kg

*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 pcs.
611755-04	Gauge block (35mm, JIS Grade 2)	1 pc.
11BAB941	Level	1 pc.
12AAL021	Standard stylus	1 pc.
12BAJ340	Printer paper*	2 rolls
—	Receptacle	1 pc.
—	Hose band	1 pc.
—	Power cable	1 pc.
—	Leveling spanner	1 pc.
—	Philips screwdriver	1 pc.
—	Key wrench 0.9, 2 and 4	1 pc. (0.9), 2 pcs. (2), 1 pc. (4)
—	Machine cover	1 pc.
—	User's manual	1 copy

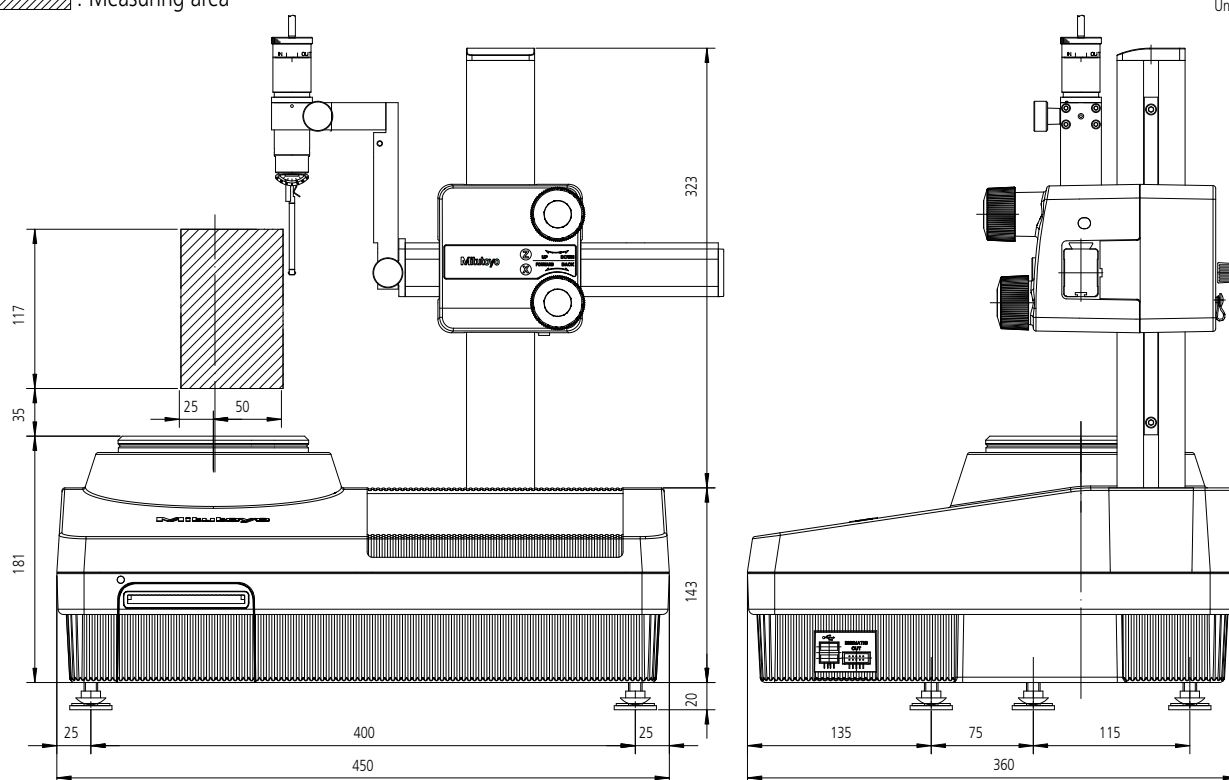
*12AAH181: Optional printer paper set (10 rolls)

Dimensions

External dimensions

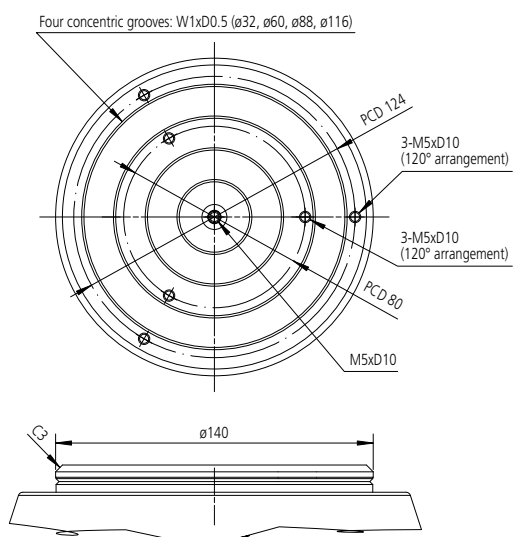
 : Measuring area

Unit: mm



Turntable top view

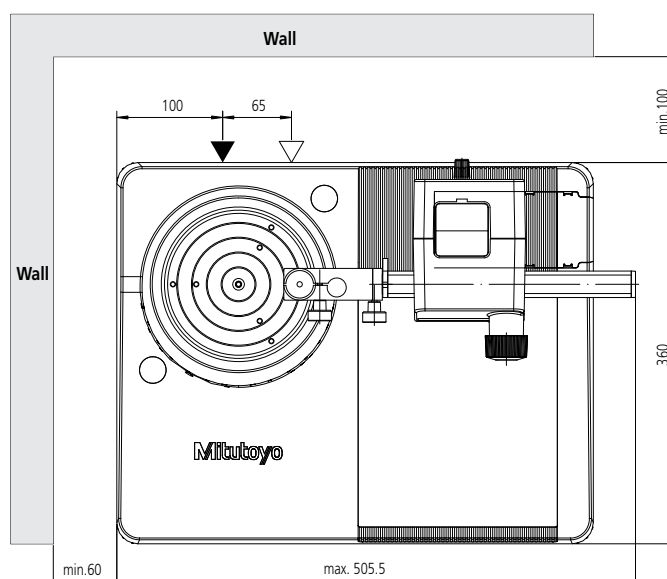
Unit: mm



Installation floor plan

▼: Power inlet
▽: Air inlet

Unit: mm





**Whatever your challenges are,
Mitutoyo supports you from start to finish.**

Mitutoyo is not only a manufacturer of top quality measuring products but one that also offers qualified support for the lifetime of the equipment, backed up by comprehensive services that ensure your staff can make the very best use of the investment.

Apart from the basics of calibration and repair, Mitutoyo offers product and metrology training, as well as IT support for the sophisticated software used in modern measuring technology. We can also design, build, test and deliver bespoke measuring solutions and even, if deemed cost-effective, take your critical measurement challenges in-house on a sub-contract basis.

Coordinate Measuring Machines

Vision Measuring Systems

Form Measurement

Optical Measuring

Sensor Systems

Test Equipment
and Seismometers

Digital Scale and DRO Systems

Small Tool Instruments
and Data Management



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