Compact Roundness Measurement

ROUNDTEST RA-10

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

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’. 

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.
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)um, 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 6.

Four easy steps to measurement

Clamp the workpiece to the jig.
Bring the detector into contact with the workpiece.
Press the [CONDITION (setup recall)] button, as needed.
Press the [START] button.

*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.

*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.
Main Measuring Unit

Detector
Allows simple positioning of the workpiece due to its wide measuring range of ±1000µm.

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)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
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**: Useful functions help setting up prior to measurement.

- **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.

- **Measuring range switching**: 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.

- **Sample Result Screen (Roundness)**: 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.

- **Limarçon function compensates for eccentricity**: The limaçon error correction function 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

<table>
<thead>
<tr>
<th>Type of Tolerance</th>
<th>Characteristic/ Symbol</th>
<th>Measurement Method</th>
<th>Sample Result Screen</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roundness</td>
<td>∅</td>
<td></td>
<td></td>
<td>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.”</td>
</tr>
<tr>
<td>Flatness</td>
<td>□</td>
<td></td>
<td></td>
<td>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.”</td>
</tr>
<tr>
<td>Concentricity</td>
<td>∅</td>
<td></td>
<td></td>
<td>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.”</td>
</tr>
<tr>
<td>Coaxiality</td>
<td>∅</td>
<td></td>
<td></td>
<td>Of the centers of various elements under evaluation, double the largest deviation from the reference axis is evaluated as “Coaxiality.”</td>
</tr>
<tr>
<td>Circular runout</td>
<td>∅</td>
<td></td>
<td></td>
<td>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).”</td>
</tr>
</tbody>
</table>
### Specifications

#### Main unit

<table>
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<tr>
<th>Model</th>
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</tr>
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<tr>
<td>Order No.</td>
<td>211-601A</td>
</tr>
</tbody>
</table>

#### Turntable

- **Bearing type**: Air bearing
- **Rotational accuracy (radial)**: 0.044μm/1000μm
- **Rotational accuracy (axial)**: 0.046μm/1000μm
- **Rotation speed**: 6rpm
- **Effective table diameter**: ø 6" (150mm)
- **Maximum turntable loading**: 22 lbs (10kg)
- **Maximum probing diameter**: ø 3.94" (100mm)
- **Maximum workpiece diameter**: ø 12.5" (320mm)

#### Vertical column (Z axis)

- **Vertical travel**
  - Bottom position: Approx. 1.38" (35mm) from the turntable top
  - Top position: Approx. 5.98" (152mm) from the turntable top
- **Maximum probing height**: 5.98" (152mm) from the turntable top
- **Maximum probing depth**: 3.94" (100mm) (minimum ID: ø 1.18" (30mm) using the standard stylus)

#### Horizontal arm (X axis)

- **Horizontal travel**: 1.96" (25mm) to 1.97" (50mm)

#### Detector

- **Measuring force**: 70mN to 100mN
- **Standard stylus (12AAB8681)**: Stylus type: ø 1.6mm carbide ball (Refer to page 7 for detailed information.)
- **Measuring range**: ±1000μm
- **Measuring direction**: Two directional (IN/OUT switchable)

#### Electronic unit

- **Measuring range**: ±1000μm, ±100μm, ±10μm
- **Magnification**: 5×, 10×, 20×, 50×, 100×, 200×, 500×, 1000×, 2000×, 5000×, 10000×, 20000×
- **Filter type**: Phase corrected: 2CRPC75, 2CRCS50
- **Gaussian, filter OFF**
- **Cutoff value**: 15, 50μupr, 150μupr, 500μupr
- **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, M2C, MIC, MCC
- **Evaluation item**: Roundness, Coaxiality, Concentricity, Flatness, Circular runout (radial)
- **Data output**: RS-232C, UR, SPC, USB stick memory
- **Display**: LCD 4.6" × 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

<table>
<thead>
<tr>
<th>Order No.</th>
<th>Name</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>350366</td>
<td>Magnification adjusting film</td>
<td>2</td>
</tr>
<tr>
<td>611755-04</td>
<td>Gage block (35mm, JIS 2-grade)</td>
<td>1</td>
</tr>
<tr>
<td>11BAB941</td>
<td>Level</td>
<td>1</td>
</tr>
<tr>
<td>12AAB8681</td>
<td>Standard stylus</td>
<td>1</td>
</tr>
<tr>
<td>12BAJ340</td>
<td>Printer paper</td>
<td>2</td>
</tr>
<tr>
<td>—</td>
<td>Receptacle</td>
<td>1</td>
</tr>
<tr>
<td>—</td>
<td>Hose band</td>
<td>1</td>
</tr>
<tr>
<td>—</td>
<td>Power cable</td>
<td>1</td>
</tr>
<tr>
<td>—</td>
<td>Leveling spanner</td>
<td>1</td>
</tr>
<tr>
<td>—</td>
<td>Philips screwdriver</td>
<td>1</td>
</tr>
<tr>
<td>—</td>
<td>Key wrench 0.9</td>
<td>1</td>
</tr>
<tr>
<td>—</td>
<td>Key wrench 2</td>
<td>2</td>
</tr>
<tr>
<td>—</td>
<td>Key wrench 4</td>
<td>1</td>
</tr>
<tr>
<td>—</td>
<td>Machine cover</td>
<td>1</td>
</tr>
<tr>
<td>—</td>
<td>User’s manual</td>
<td>1</td>
</tr>
</tbody>
</table>

### Optional accessories

<table>
<thead>
<tr>
<th>Order No.</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>211-016</td>
<td>Reference hemisphere*</td>
</tr>
<tr>
<td>211-045</td>
<td>Magnification checking gage</td>
</tr>
<tr>
<td>997090</td>
<td>Gage block set for calibration</td>
</tr>
<tr>
<td>358592</td>
<td>Replacement element for filter</td>
</tr>
<tr>
<td>358593</td>
<td>Replacement element filter regulator</td>
</tr>
</tbody>
</table>

* Optional spacer (12AAH420) is required
## Optional Accessories

### 12AAB681
**Standard stylus** (*Standard accessory*)
(stylus tip: ø0.06” (1.6mm) carbide ball)

<table>
<thead>
<tr>
<th>Spec</th>
<th>Image</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dia.: ø0.06” (1.6mm)</td>
<td><img src="image" alt="Standard stylus" /></td>
</tr>
<tr>
<td>Depth: 1.97” (50mm)</td>
<td><img src="image" alt="Standard stylus" /></td>
</tr>
</tbody>
</table>

*For standard applications*  

*In ID measurement*  
 Dia.: ø0.06” (1.6mm)  
 Depth: 1.97” (50mm)  

### 12AAB682
Stylus for notched workpieces
(stylus tip: ø0.12” (3.0mm) carbide ball)

<table>
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<tr>
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<th>Image</th>
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</thead>
<tbody>
<tr>
<td>Dia.: ø0.12” (3.0mm)</td>
<td><img src="image" alt="Notched workpieces stylus" /></td>
</tr>
<tr>
<td>Depth: 2.60” (66mm)</td>
<td><img src="image" alt="Notched workpieces stylus" /></td>
</tr>
</tbody>
</table>

*Useful for notched workpieces*  

### 12AAB683
Stylus for grooves
(stylus tip: ø0.06” (1.6mm) sapphire)

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<tbody>
<tr>
<td>Dia.: ø0.06” (1.6mm)</td>
<td><img src="image" alt="Grooves stylus" /></td>
</tr>
<tr>
<td>Depth: 2.60” (66mm)</td>
<td><img src="image" alt="Grooves stylus" /></td>
</tr>
</tbody>
</table>

*For stepped applications*  

### 12AAB684
Stylus for corners
(stylus tip: ø0.06” (1.6mm) carbide ball)

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<tr>
<th>Spec</th>
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<tbody>
<tr>
<td>Dia.: ø0.06” (1.6mm)</td>
<td><img src="image" alt="Corners stylus" /></td>
</tr>
<tr>
<td>Depth: 2.60” (66mm)</td>
<td><img src="image" alt="Corners stylus" /></td>
</tr>
</tbody>
</table>

*For inside-corner applications*  

### 12AAB685
Stylus for extra small holes  
(stylus tip: ø0.02” (0.5mm) carbide ball)

<table>
<thead>
<tr>
<th>Spec</th>
<th>Image</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dia.: ø0.02” (0.5mm)</td>
<td><img src="image" alt="Extra small holes stylus" /></td>
</tr>
<tr>
<td>Depth: 0.22” (5.5mm)</td>
<td><img src="image" alt="Extra small holes stylus" /></td>
</tr>
</tbody>
</table>

*For extra small hole applications*  

### 12AAB686
Stylus for small holes  
(stylus tip: ø0.04” (1.0mm) carbide ball)

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Dia.: ø0.04” (1.0mm)</td>
<td><img src="image" alt="Small holes stylus" /></td>
</tr>
<tr>
<td>Depth: 0.79” (20mm)</td>
<td><img src="image" alt="Small holes stylus" /></td>
</tr>
</tbody>
</table>

*For small hole applications*  

### 12AAB687
Stylus for small and deep holes  
(stylus tip: ø0.12” (3.0mm) carbide ball)

<table>
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<tr>
<td>Dia.: ø0.12” (3.0mm)</td>
<td><img src="image" alt="Small and deep holes stylus" /></td>
</tr>
<tr>
<td>Depth: 1.50” (38mm)</td>
<td><img src="image" alt="Small and deep holes stylus" /></td>
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</table>

*For small and deep hole applications*  

### 12AAB688
Stylus for filtering asperities  
(cutter mark)

<table>
<thead>
<tr>
<th>Spec</th>
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<tbody>
<tr>
<td>Dia.: ø0.16” (4.0mm)</td>
<td><img src="image" alt="Filtering asperities stylus" /></td>
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*filtering out the effects of asperities by tracing with R15 tipped stylus*  

### 12AAB689
Disk stylus

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*Compatible with CMM styli with M2 threaded shank*  

*Compatible with CMM styli with M2 threaded shank*  

### 12AAB690
Stylus for small and deep holes  
(stylus tip: ø0.06” (1.6mm) carbide ball)

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*For small and deep hole applications*  

### 12AAB691
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*filtering out the effects of asperities by tracing with R15 tipped stylus*  

### 12AAB692
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### 12AAB693
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*filtering out the effects of asperities by tracing with R15 tipped stylus*  

### 12AAB699
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*filtering out the effects of asperities by tracing with R15 tipped stylus*  

### 12AAB700
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</tr>
</tbody>
</table>

*filtering out the effects of asperities by tracing with R15 tipped stylus*  

### 12AAB701
Stylus for filtering asperities  
(cutter mark)

<table>
<thead>
<tr>
<th>Spec</th>
<th>Image</th>
</tr>
</thead>
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*filtering out the effects of asperities by tracing with R15 tipped stylus*  

### 12AAB702
Stylus for filtering asperities  
(cutter mark)

<table>
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*filtering out the effects of asperities by tracing with R15 tipped stylus*  

### 12AAB703
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(cutter mark)

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*filtering out the effects of asperities by tracing with R15 tipped stylus*  

# CUSTOMIZED SPECIAL INTERCHANGEABLE STYLUS 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.

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

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 75μm
Mass
5.5 lbs (2.5kg)

Note: 1. When measured with 10 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 ø1.96” (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 (unavailable to special order).

211-054: for ø1.96” (50mm)

Order No. 211-032
Order No. 211-031
Holding range
O.D. with internal jaws ø11–ø36mm
I.D. with internal jaws ø16–ø59mm
O.D. with internal jaws ø25–ø79mm
External size (O x H)
ø4.65 x 1.6” (118 x 41mm)
Mass
2.6 lbs (1.2kg)

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.

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

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

Vibration damping stand

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

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

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

Order No. 12AAH426
Centering adjustment range
ø1.2” (30mm)
Leveling adjustment range
ø1”
Maximum loading mass
1.6 lbs (3kg)
Mass
15.4 lbs (7kg)

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

Order No. 211-052
Part holding range
O.D. ø0.2”–ø0.4” (5.5–1.1mm)
O.D. ø0.4”–ø0.6” (1.0–1.5mm)
O.D. ø0.6”–ø0.8” (1.5–2.0mm)
O.D. ø0.8”–ø1” (2.0–2.5mm)
O.D. ø1”–ø1.2” (2.5–3.0mm)
O.D. ø1.2”–ø1.38” (3.0–3.5mm)
O.D. ø1.38”–ø1.57” (3.5–4.0mm)
O.D. ø1.57”–ø1.97” (4.0–5.0mm)
O.D. ø1.97”–ø2.23” (5.0–6.0mm)
O.D. ø2.23”–ø2.75” (6.0–7.0mm)
O.D. ø2.75”–ø3.15” (7.0–8.0mm)
O.D. ø3.15”–ø3.54” (8.0–9.0mm)
O.D. ø3.54”–ø3.94” (9.0–10.0mm)

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

** YC10-** Class AA, made by Yukiha 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.
Installation Environment

<table>
<thead>
<tr>
<th>Temperature</th>
<th>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 JMASS011. 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.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humidity</td>
<td>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.</td>
</tr>
<tr>
<td>Vibration</td>
<td>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/s² (0.4Gal). If the above conditions are surpassed, construct a proper foundation or use the dedicated vibration damping stand available as an optional purchase.</td>
</tr>
<tr>
<td>Dust</td>
<td>This machine should be operated in a dust-free environment to prevent damage to its precision components.</td>
</tr>
</tbody>
</table>

### 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.

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

### Air supply capacity and connection details

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

- Air source and 1/4” rubber hose (Supplied by the user)
- Hose clamp and air connector socket (Supplied with 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:

Pipe fittings marked * are standard accessories supplied with the vibration damping stand. Pipe fittings marked ** are standard accessories supplied with the RA-10.
Dimensions

External dimensions

![Diagram of External dimensions]

Turntable top view

![Diagram of Turntable top view]

Installation floor plan

![Diagram of Installation floor plan]