

CV-3200/4500 series, For SV-C3200/4500 series

Using the following optional accessories enables semi-automatic (simplified CNC) measurement.

Y-axis table

- Enables efficient, automatic measurement of multiple aligned workpieces and multiple points on a single table surface.



No.178-097

Travel range	200mm
Resolution	0.05 μm
Positioning accuracy	±3μm
Drive speed	80mm/s (max.)
Maximum loading	50kg
Mass	28kg

*Note: This Y-axis table cannot be used with CNC form measuring instruments.

θ1-axis table No.12AAD975

- Calculates the angle in advance when measuring the cross-sectional data in the orthogonal direction or at the specified angle pitch of a cylindrical or spherical workpiece.



No.12AAD975

Travel range	360°
Resolution	0.004°
Rotational speed	10°/sec (max.)
Table diameter	ø150mm
Maximum loading	12kg

θ2-axis unit

- Calculates the angle in advance when loading the sectional data at the specified angle pitch when measuring the multiple cross-sectional data of a rectangle workpiece or the axial direction of a cylindrical workpiece.



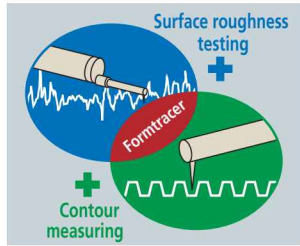
No.178-078

Travel range	360°
Resolution	0.0072°
Rotational speed	18°/sec (max.)
Table diameter	ø118mm
Maximum loading (loading moment)	4kg (343N·cm or less)

Formtracer

Hybrid machine with dual-role capability

Formtracer SV-C3200/4500 SERIES 525 — Surface Roughness and Contour Measuring Systems



SV-C3200S4

SPECIFICATIONS

Model No.	SV-C3200S4	SV-C3200H4	SV-C3200W4	SV-C3200L4	SV-C3200S8	SV-C3200H8	SV-C3200W8	SV-C3200L8
	SV-C4500S4	SV-C4500H4	SV-C4500W4	SV-C4500L4	SV-C4500S8	SV-C4500H8	SV-C4500W8	SV-C4500L8
• Surface roughness measurement								
Measuring range	X axis (drive unit)	100mm			200mm			
	Z1 axis (detector)	800µm/80µm						
Straightness		(0.05+L/1000) µm L: traverse length (mm)			(0.1+0.002L) µm L: traverse length (mm)			
Resolution	Z1 axis (detector)	0.01µm(800µm), 0.001µm(80µm), 0.0001µm(8µm)						
Measuring force		0.75mN (when the Code No. of the main unit ends with "-1") / 4mN (when the Code No. of the main unit ends with "-2")						
Stylus tip shape		60°, 2µmR (when the Code No. of the main unit ends with "-1") / 90°, 5µmR (when the Code No. of the main unit ends with "-2")						
Applicable standards		JIS1982/ JIS1994/ JIS2001/ ISO1997/ ANSI/ VDA						
Parameter		Pa, Pq, Psk, Pku, Pp, Pv, Pz, Pt, Pc, PSm, PΔq, Pmr(C), Pmr, Pδc, Ra, Rq, Rsk, Rku, Rp, Rv, Rz, Rt, Rc, RSm, RΔq, Rmr(C), Rmr, Rδc, Wa, Wq, Wsk, Wku, Wp, Wv, Wz, Wt, Wc, WSm, WΔq, Wmr(C), Wmr, Wδc, Rk, Rpk, Rvk, Mr1, Mr2, A1, A2, Rx, AR, R, Wx, AW, W, Wte, Ry, RyDIN, RzDIN, R3y, R3z, S, HSC, Lo, Ir, Δa, Δa, Δq, Vo, Htp, NR, NCRX, CPM, SR, SAR, NW, SW, SAW						
Assessed profile		Primary profile, Roughness profile, Filtered waviness profile, Waviness profile, Rolling circle waviness primary profile, Rolling circle waviness profile, Envelope residual profile, DF profile (DIN4776/ ISO13565-1), Roughness motif (Envelope waviness profile is displayed when evaluating the motif.)						
Analysis graph		Material ratio curve, Profile height amplitude distribution curve, Power spectrum chart, Auto-correlation chart, Walsh power spectrum chart, Walsh auto-correlation chart, Slope distribution chart, Local peak distribution chart, Parameter distribution chart (Contour analysis function can analyze the area of abrasion amount and overlay.)						
Data compensation functions		Least squares straight line, R-surface compensation, Ellipse compensation, Parabola compensation, Hyperbolic compensation, Conic compensation, Polynomial compensation (auto or arbitrary 2nd to 7th), No compensation						
Filter		Gaussian filter, 2CRPC75, 2CRPC50, 2CR75, 2CR50, Robust spline filter						
• Contour measurement								
Measuring range	X axis (drive unit)	100mm			200mm			
	Z1 axis (detector)	60mm (±30mm from the horizontal)						
Straightness		0.8µm/100mm			2µm/200mm			
Accuracy	X axis (drive unit)	±(0.8+0.01L)µm L: traverse length (mm)			±(0.8+0.02L)µm L = traverse length (mm)			
	Z1 axis (detector)	SV-C3200 series: ±(1.4+ 2H /100)µm, SV-C4500 series: ±(0.8+ 2H /100)µm H: Probing height from the horizontal (mm)						
Resolution	X axis (drive unit)	0.05 µm						
	Z1 axis (detector)	SV-C3200 series: 0.04µm, SV-C4500 series: 0.02µm						
	Z2 axis (column)	1 µm						
Measuring force		SV-C3200 series: 30mN (adjustment using weights) SV-C4500 series: 10, 20, 30, 40, 50mN (switching on the software)						
Face of stylus		SV-C3200 series: Vertical direction (up/down, single measurement) SV-C4500 series: Vertical direction (up/down, available for continuous measurement)						
• Common specification								
Z2-axis (column) moving range		300mm	500mm	700mm	300mm	500mm	700mm	
X axis Inclination range		±45°						
Drive speed	X axis	0 to 80mm/s or manual operation						
	Z2 axis (column)	0 to 30mm/s or manual operation						
Measuring speed		0.02, 0.05, 0.1, 0.2, 0.5, 1.0, 2.0, 5.0, 10, 20mm/s						

Note: While the appearance of the natural stone measuring table varies according to the source, the high stability for which this material is known can always be relied upon.



An inspection certificate is supplied as standard. Refer to page X for details.

- The combination of a surface roughness tester and contour measuring instrument saves installation space.

Surface roughness testing function

- Z1-axis detector provides highest resolution of 0.0001µm (when the measuring range is 8µm) is provided as standard.
- High-accuracy glass scales, built-in on the X axis, directly read the drive unit movement. Greatly facilitates spacing parameter evaluation while achieving high-accuracy positioning.
- Measuring force for the detector is selectable from 4mN or 0.75mN.

Contour measuring function

- The Z1 axis (detector) is equipped with a high-precision arc scale and newly designed arm. The high-precision arc scale can directly read the arc track of the stylus tip to achieve high accuracy and resolution. The new arm has extended the Z1-axis measuring range by 10 mm while reducing the chance of interference with workpieces compared to conventional models. The arm mount can be attached/detached with a single touch on the magnet joint for improved ease of operation.



Z1-axis measuring range has been extended by 10mm.

- The following two features have been added exclusively for the SV-C-4500 series as functions dedicated to contour measuring systems.

- (1) Continuous measurement in the vertical direction (up/down) is available in combination with a double-tipped stylus. Up/down continuous measurement data facilitates the analysis of the effective diameter of screw threads, which has been difficult to measure in the past.
- (2) The measuring force can be set in the **FORMTRACEPAK** software. Weight replacement and position adjustment are not required to adjust the measuring force.

Downward (Bottom plane) measurement



Upward/downward measurement direction is switchable in the software

Upward (Top plane) measurement



- The 700mm Z2-axis (column) range models are new to the lineup.

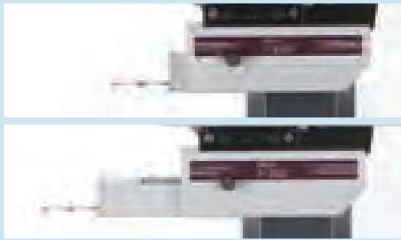


Refer to the Formtracer SV-C3200/4200 series (Catalog No.E15012) for more details.



An inspection certificate is supplied as standard.
Refer to page X for details.

- Equipped with a wide range and high resolution Z-axis detector.
- Measuring range
Z1 axis (detector): 5mm
(Resolution: 0.0008 μ m)
*Applicable when the measuring range is 0.05mm)
X axis: 100mm
(Resolution: 0.05 μ m)
- Overhang of the detector: Max. 70mm
(Fixable at a desired position)



- Uses the well-respected **FORMTRACEPAK** software to provide a rich variety of analysis functions to achieve excellent surface texture evaluation.

Formtracer CS-3200S4 SERIES 525 — Surface Roughness and Contour Measuring System



CS-3200S4

SPECIFICATIONS

Model No.		CS-3200S4		
Measuring range/ Resolution	X axis	100mm/0.05 μ m		
	Z1 axis (detector)	5mm/0.08 μ m		
		0.5mm/0.008 μ m		
	Z2 axis (column)	0.05mm/0.0008 μ m		
Accuracy (20°C)	X axis	300mm/1 μ m		
	Z1 axis (detector)	$\pm(0.8+0.01L)\mu\text{m}$ L= measuring length(mm)		
Drive unit	Straightness (X axis)	Under normal use	$\pm(1.5+2H/100)\mu\text{m}$ H= probing height from the horizontal (mm)	
		When protruding to the maximum extent	0.2 μ m/100mm	
	Measuring speed	Roughness measurement	0.4 μ m/100mm	
		Contour measurement	0.02, 0.05, 0.1, 0.2mm/s (4-step)	
	Drive speed	X axis (horizontal direction)	0.02, 0.05, 0.1, 0.2, 0.5, 1.0, 2.0mm/s (7-step)	
		Z2 axis (vertical direction)	0 to 80mm/s or manual operation	
	Up/down movement	0 to 20mm/s or manual operation		
Inclination range	300mm (motorized)			
Detector	Detection method	$\pm 45^\circ$		
	Measuring force	Differential inductance		
	Stylus	Standard stylus (for roughness/ contour measurement)	0.75mN	
		Cone stylus (for contour measurement)	Tip angle: 60° cone, Tip radius: 2 μ m, Diamond tip	
Stylus up/down	Tip angle: 30° cone, Tip radius: 25 μ m, Sapphire			
		Available (Stoppable at a mid-air position)		

Note1: While the appearance of the natural stone measuring table varies according to the source, the high stability for which this material is known can always be relied upon.

Note2: High column and 200mm X-axis drive-unit models are also available. Please consult your local Mitutoyo office for applicable specifications.



Refer to the Formtracer CS-3200
(Catalog No.E15025) for more details.

Formtracer

Hybrid machine with dual-role capability

Formtracer Extreme SV-C4500CNC SERIES 525 — CNC Surface Roughness and Contour Measuring Systems



SV-C4500CNC (Contour detector shown mounted together with the inclinable drive unit and Y-axis table)

SPECIFICATIONS

Model No.		SV-C4500CNC		
X1 axis (Drive unit)	Measuring range	200mm		
	Resolution	0.05 μm		
	Scale type	Reflective-type linear encoder		
	Drive speed	CNC mode	Max. 200mm/s	
		Joystick mode	0 to 50mm/s	
	Measuring speed	0.02, 0.05, 0.1, 0.2, 0.5, 1.0, 2.0mm/s		
	Contour	Measuring direction	Forward / backward	
		Straightness	2μm/200mm	
		Accuracy (20°C)	±(0.8+4L/200)μm L: Measuring length (mm)	
	Surface roughness	Measuring direction	Backward	
Straightness		0.5 μm/200mm		
Measuring range		60mm (±30mm from the horizontal)		
Z1 axis (Detector)	Resolution	0.02 μm		
	Contour	Measuring direction	Both forward and backward (Direction is changed by FORMTRACEPAK)	
		Vertical movement of the stylus	Arc motion	
		Scale type	Arc	
	Accuracy (20°C)	±(0.8+2H/100)μm H: Measuring height from horizontal position (mm)		
	Measuring force	10, 20, 30, 40, 50mN (setting measuring force Formtracepak)		
	Traceable angle	Ascent: 70°, Descent: 70°, (Depends on the surface texture.) ^{Note1}		
	Stylus tip	30° cone, Carbide		
	Surface roughness	Measuring range	800μm/80μm/8μm	
		Resolution	0.01μm/0.001μm/0.0001μm	
Measuring force		0.75mN		
Z2 axis (Column)	Drive range	Specification is selectable from 300mm or 500mm.		
	Resolution	0.05 μm		
	Scale type	Reflective-type linear encoder		
	Drive speed	CNC mode	Max. 200mm/s	
		Joystick mode	0 to 50mm/s	
	Accuracy (at 20°C)	Model without α axis	±(1.5+10H/1000)μm H: Z2 axis measuring height (mm)	
		Model with α axis	—	
Base size (WxD)	750x600mm			
Base material	Gabbro			

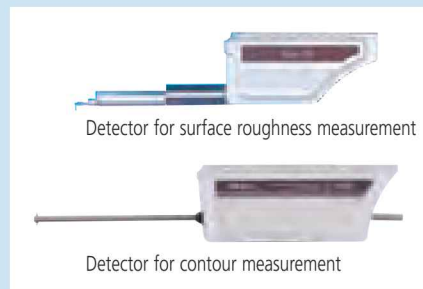
Note1: When measuring range is ±15mm and stylus SPH-76 and SPHW-56 are used.

Note2: While the appearance of the natural stone measuring table varies according to the source, the high stability for which this material is known can always be relied upon.



An inspection certificate is supplied as standard. Refer to page X for details.

- High-accuracy stylus type CNC Surface Roughness / Contour Measuring System that allows measurement of surface roughness and form/contour with one unit through detector replacement.
- The X1-, Y- and Z2-axes have a maximum drive speed of 200mm/s. This permits high-speed positioning that can potentially result in a large increase in the throughput of multiple-profile / multiple-workpiece measurement tasks.
- For models with the α axis, it is possible to perform continuous measurement over horizontal and inclined surfaces by power-tilting the X1 axis. In addition, automatic measuring force adjustment function of Z1-axis detector for contour measurement enables automatic measurement with constant measuring force even with the X1 axis tilted.
- For models with the Y-axis table, it is possible to expand the measuring range for multiple workpieces, etc., through positioning in the Y-axis direction.
- Detector for contour measuring systems (Z1 axis)
Accuracy ±(0.8+2H/100)μm
- For the model without an α axis, indication accuracy of the Z2-axis (column) is guaranteed. For this reason, it expands the measuring range of the Z1 axis (detector) in form/contour measurement by using the Z2-axis tracing function.
- 2-axis simultaneous control in the X- and Y-axis directions enables inclined plane measurements.
- When the Z1-axis detector for form/contour measurement is replaced with that for surface roughness measurement, or vice versa, it is a simple, one-touch replacement without rerouting of the connecting cables.
- Since the Z1-axis detector incorporates an anti-collision safety device, the machine will automatically stop if the detector touches a workpiece or jig.
- Optional external control function (Ext I/O) through bidirectional communication (RS-232C) with the PLC (programmable logic controller) is available.





An inspection certificate is supplied as standard. Refer to page X for details.

Formtracer Extreme CS-5000CNC/CS-H5000CNC SERIES 525 — CNC Surface Roughness and Contour Measuring Systems

- High-accuracy stylus type CNC Surface Measuring System that allows batch measurement of surface roughness and form/contour.
- The X1- and Z2-axes have maximum drive speeds of 40mm/s and 200mm/s, respectively. This permits high-speed positioning that can potentially result in a large increase in the throughput of multiple-profile / multiple-workpiece measurement tasks.
- A Mitutoyo Laser HoloScale is incorporated in the X1- and Z1-axes so that high resolution is achieved and batch measurement of form/contour and surface roughness can be made.
- The active control method is employed for the Z1-axis detector to implement a wide-range measurement capability wherein the variation in dynamic measuring force is restricted.
- Since the Z1-axis detector incorporates an anti-collision safety device, the machine will automatically stop if the detector touches a workpiece or jig.
- For models with the α axis, it is possible to perform continuous measurement over horizontal and inclined surfaces by power-tilting the X1 axis. (**CS-5000CNC** only)
- For models with the Y-axis table, it is possible to expand the measuring range for multiple workpieces, etc., through positioning in the Y-axis direction.
- Optional external control function (Ext I/O) through bidirectional communication (RS-232C) with the PLC (programmable logic controller) is available.



CS-H5000CNC
(with Y-axis table)



Wide range detector employing active control technology

SPECIFICATIONS

Model No.		CS-5000CNC	CS-H5000CNC	
X1 axis	Measuring range	200mm		
	Resolution	0.00625 μ m		
	Scale type	Laser HoloScale		
	Drive speed	CNC mode	Max. 40mm/s	
		Joystick mode	0 to 40mm/s	
	Measuring speed	0.02, 0.05, 0.1, 0.2mm/s (surface roughness), 0.02, 0.05, 0.1, 0.2, 0.5, 1.0, 2.0mm/s (form/contour)		
	Measuring direction	Forward / backward		
	Straightness	(with standard stylus)	(0.1+0.0015L) μ m L: traverse length (mm)	(0.05+0.0003L) μ m L: traverse length (mm)
(with 2X-long stylus)		(0.2+0.0015L) μ m L: traverse length (mm)	(0.1+0.0015L) μ m L: traverse length (mm)	
Accuracy (20°C)	$\pm(0.3+0.002L)\mu$ m L: traverse length (mm)		$\pm(0.16+0.001L)\mu$ m L: traverse length (mm)	
Z1 axis (Detector)	Measuring range	(with standard stylus)	12mm	
		(with 2X-long stylus)	24mm	
	Resolution	(with standard stylus)	0.0008 μ m	
		(with 2X-long stylus)	0.0016 μ m	
	Vertical movement of the stylus	Arc motion		
	Scale type	Transmission-type linear encoder		
	Accuracy (20°C)	$\pm(0.3+0.02H)\mu$ m H: probing height (mm)	$\pm(0.07+0.02H)\mu$ m H: probing height (mm)	
	Measuring force	(with standard stylus)	4mN (Fixed)	
		(with 2X-long stylus)	0.75mN (Fixed)	
	Traceable angle	Ascent: 60°, Descent: 60°, (Depends on the surface texture.)		
Stylus tip shape	Standard stylus	Tip angle: 40°, Tip radius: 5 μ m, Diamond tip		
	Standard ball stylus	Tip ball radius: 0.25mm, Sapphire		
	2X-long stylus	Tip angle: 40°, Tip radius: 5 μ m, Diamond tip		
	2X-long ball stylus	Tip angle: 60°, Tip radius: 2 μ m, Diamond tip		
Face of stylus	Downward			
Z2 axis (Column)	Travel range	Z2 axis (column, type S)	300mm	
		Z2 axis (column, type H)	500mm	
	Resolution	0.05 μ m		
	Scale type	Reflective-type linear encoder		
	Drive speed	CNC mode	Max. 200mm/s	
		Joystick mode	0 to 50mm/s	
Base size (width \times depth)	750 \times 600mm			
Base material	Gabbro			

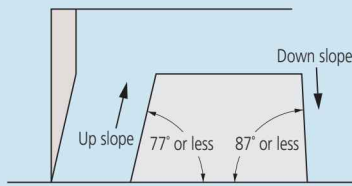
Note: While the appearance of the natural stone measuring table varies according to the source, the high stability for which this material is known can always be relied upon.

Quick Guide to Precision Measuring Instruments



Contracer (Contour Measuring Instruments)

Traceable Angle

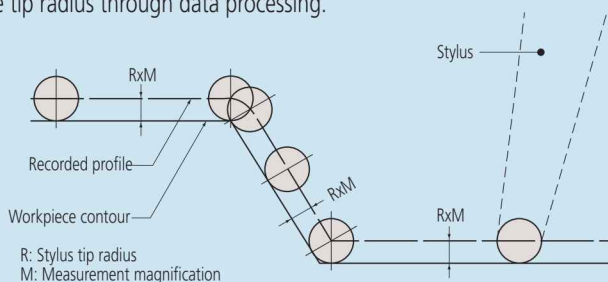


The maximum angle at which a stylus can trace upwards or downwards along the contour of a workpiece, in the stylus travel direction, is referred to as the traceable angle. A one-sided sharp stylus with a tip angle of 12° (as in the above figure) can trace a maximum 77° of up slope and a maximum 87° of down slope. For a conical stylus (30° cone), the traceable angle is smaller. An up slope with an angle of 77° or less overall may actually include an angle of more than 77° due to the effect of surface roughness. Surface roughness also affects the measuring force.

For model CV-3200/4500, the same type of stylus (SPH-71: one-sided sharp stylus with a tip angle of 12°) can trace a maximum 77° of up slope and a maximum 83° of down slope.

Compensating for Stylus Tip Radius

A recorded profile represents the locus of the center of the ball tip rolling on a workpiece surface. (A typical radius is 0.025mm.) Obviously this is not the same as the true surface profile so, in order to obtain an accurate profile record, it is necessary to compensate for the effect of the tip radius through data processing.

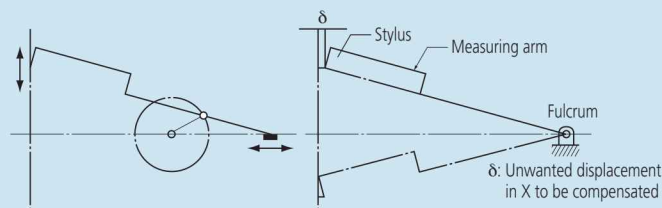


If a profile is read from the recorder through a template or scale, it is necessary to compensate for the stylus tip radius beforehand according to the applied measurement magnification.

Compensating for Arm Rotation

The stylus is carried on a pivoted arm so it rotates as the surface is traced and the contact tip does not track purely in the Z direction. Therefore it is necessary to apply compensation in the X direction to ensure accuracy. There are three methods of compensating for arm rotation.

- 1: Mechanical compensation
- 2: Electrical compensation



- 3: Software processing. To measure a workpiece contour that involves a large displacement in the vertical direction with high accuracy, one of these compensation methods needs to be implemented.

Accuracy

As the detector units of the X and Z axes incorporate scales, the magnification accuracy is displayed not as a percentage but as the linear displacement accuracy for each axis.

Overload Safety Cutout

If an excessive force (overload) is exerted on the stylus tip due, perhaps, to the tip encountering a too-steep slope on a workpiece feature, or a burr, etc., a safety device automatically stops operation and sounds an alarm buzzer. This type of instrument is commonly equipped with separate safety devices for the tracing direction (X axis) load and vertical direction (Y axis) load.

For model CV-3200/4500, a safety device functions if the arm comes off the detector mount.

Simple or Complex Arm Guidance

In the case of a simple pivoted arm, the locus that the stylus tip traces during vertical movement (Z direction) is a circular arc that results in an unwanted offset in X, for which compensation has to be made. The larger the arc movement, the larger is the unwanted X displacement (δ) that has to be compensated. (See figure, lower left.) The alternative is to use a complex mechanical linkage arrangement to obtain a linear translation locus in Z, and therefore avoid the need to compensate in X.

Z axis Measurement Methods

Though the X axis measurement method commonly adopted is by means of a digital scale, the Z axis measurement divides into analog methods (using a differential transformer, etc.) and digital scale methods.

Analog methods vary in Z axis resolution depending on the measurement magnification and measuring range. Digital scale methods have fixed resolution.

Generally, a digital scale method provides higher accuracy than an analog method.

■ Contour analysis methods

You can analyze the contour with one of the following two methods after completing the measurement operation.

Data processing section and analysis program

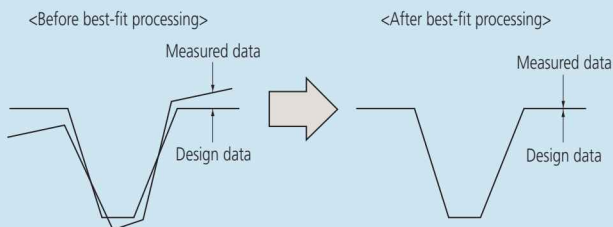
The measured contour is input into the data processing section in real time and a dedicated program performs the analysis using the mouse and/or keyboard. The angle, radius, step, pitch and other data are directly displayed as numerical values. Analysis combining coordinate systems can be easily performed. The graph that goes through stylus radius correction is output to the printer as the recorded profile.

■ Tolerancing with Design Data

Measured workpiece contour data can be compared with design data in terms of actual and designed shapes rather than just analysis of individual dimensions. In this technique each deviation of the measured contour from the intended contour is displayed and recorded. Also, data from one workpiece example can be processed so as to become the master design data to which other workpieces are compared. This function is particularly useful when the shape of a section greatly affects product performance, or when its shape has an influence on the relationship between mating or assembled parts.

■ Best-fitting

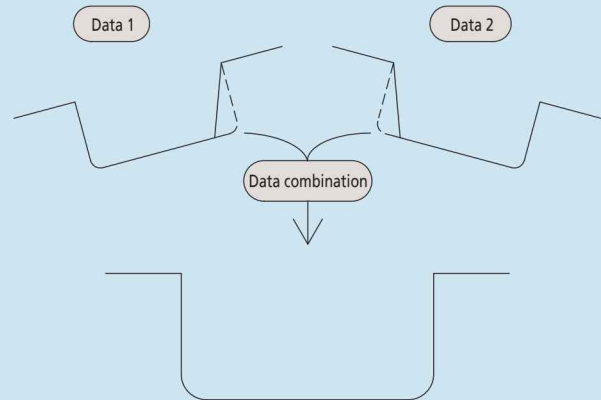
If there is a standard for surface profile data, tolerancing with design data is performed according to the standard. If there is no standard, or if tolerancing only with shape is desired, best-fitting between design data and measurement data can be performed.



The best-fit processing algorithm searches for deviations between both sets of data and derives a coordinate system in which the sum of squares of the deviations is a minimum when the measured data is overlaid on the design data.

■ Data Combination

Conventionally, if tracing a complete contour is prevented by stylus traceable-angle restrictions then it has to be divided into several sections that are then measured and evaluated separately. This function avoids this undesirable situation by combining the separate sections into one contour by overlaying common elements (lines, points) onto each other. With this function the complete contour can be displayed and various analyses performed in the usual way.



■ Measurement Examples



Aspheric lens contour



Inner/outer ring contour of a bearing



Internal gear teeth



Female thread form



Male thread form



Gage contour

Roundtest

To realize efficient centering and leveling combined with high-precision measurement

Roundtest RA-10 SERIES 211 — Roundness Measuring Instrument



RA-10

Simple measurement procedure

Mount the workpiece on the the holding fixture.

Position the detector in contact with the workpiece.
* If zero-set function or X-axis stop (optional) is used, repetitive measurement of identical workpieces can be performed efficiently.

Press the "Condition" button as required.
* If measuring with the same conditions as were used in the previous session before power was turned off, pressing the condition button is not required.

Press the "START/STOP" button.

SPECIFICATIONS

Model No.		RA-10	
Turntable	Rotational accuracy (JIS B 7451-1997)	Radial direction	(0.04+6H/10000) μ m H: Probing height (mm)
		Axial direction	(0.04+6X/10000) μ m X: distance from the center of rotation (mm)
	Rotational speed		6rpm
	Effective diameter of the table		ϕ 150mm
	Centering adjustment range		-
	Leveling adjustment range		-
	Maximum probing diameter		ϕ 100mm
Vertical movement	Maximum loading diameter		ϕ 320mm
	Maximum loading mass		10kg
	Vertical travel		117mm
X axis	Maximum probing height		152mm
	Maximum probing depth		ϕ 30x100mm (depth), ϕ 7x50mm (depth)
Detector*1	Travel range		75mm (-25mm to 50mm from the rotation center)
	Measuring range		\pm 1000 μ m
	Measuring force		100mN (\pm 30%)
	Stylus tip form		ϕ 1.6 Carbide

*1: Only the standard length stylus is applicable to this detector. The long type cannot be used.

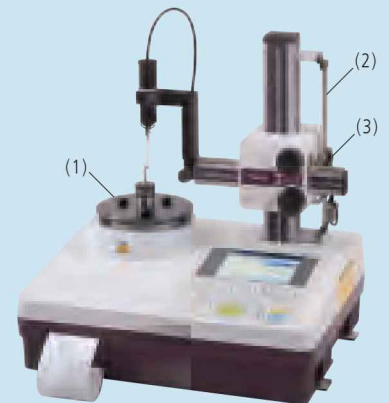


An inspection certificate is supplied as standard. Refer to page X for details.

It is a cost-effective compact machine that enables full-scale roundness evaluation.

- Offers easy operation for anyone
A large, simple key arrangement is used. Conveniently situated adjustment wheels for the vertical direction (Z axis) and the radial direction (X axis) are provided on the slider for excellent operability.
- High accuracy provided by a low-cost machine
This model uses an air bearing to guarantee best performance. Rotational accuracy as high as (0.04+6H/10000) μ m is offered, assuring a precision that is comparable to that of upper-grade models.

- User-friendly operation
Measurement results and recorded profiles are easy to view with the large LCD, and can then be printed by the built-in thermal line printer. The machine has a compact body to enable installation in congested inspection areas. Furthermore, optional functions to improve usability can be offered.



- (1) Collet chuck holder and collet chuck
- (2) Z axis ABS scale
- (3) X axis stop



Refer to the Roundtest RA-10 (Catalog No. E4319) for more details.

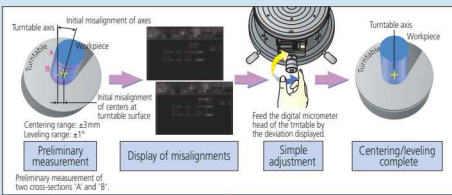


An inspection certificate is supplied as standard. Refer to page X for details.

Easy operation, compact and lightweight, designed for use on the shop-floor right beside the production line.

- D.A.T. (Digimatic Adjustment Table) function aids adjustments such as centering and leveling, and substantially reduces the time required for preliminary setup operations.

What is the D.A.T. (Digimatic Adjustment Table) function?



Dedicated analysis unit type (RA-120)

Data analysis by PC (RA-120P)

- Icons on the built-in operation panel in the main unit allows easy operation for anyone.
- Compact, lightweight design from incorporating electronic components inside the main unit.
- Icons representing geometric tolerances, such as roundness and coaxiality, are used. The measurement can be started just by pressing the desired icon and then the start button.
- Compact, lightweight design is realized by incorporating electronic components inside the main unit.
- Provides functions comparable to upper grade models, such as a Z axis equipped with digital scales, a wide range detector, and continuous inside/outside diameter measurement.
- ROUNDPAK, a data analysis program employs Windows OS and archived higher level of analysis.

Roundtest RA-120/120P SERIES 211 — Roundness Measuring Instruments



RA-120



RA-120P

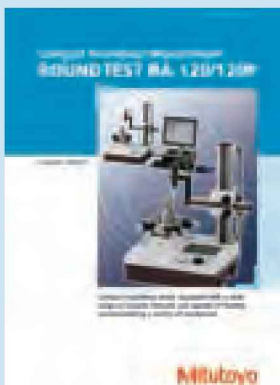
The analysis capabilities for the various models (RA-120/120P/10) vary. For details, refer to page L-41.

SPECIFICATIONS

Model No.		RA-120	RA-120P
Turntable	Rotational accuracy (JIS B 7451-1997)	Radial direction: (0.04+6H/10000)μm	Radial direction: (0.04+6H/10000)μm
		Axial direction: (0.04+6X/10000)μm	Axial direction: (0.04+6X/10000)μm
	Rotational speed	6rpm	
	Effective diameter of the table	ø150mm	
	Centering adjustment range	±3mm	
	Leveling adjustment range	±1°	
	Maximum probing diameter	ø280mm (ø380mm: for the vertical position when detector holder is installed reversely, the maximum probing height is up to 50mm from the table top.)	
Maximum loading diameter	ø440mm		
Maximum loading mass	25kg		
Vertical movement	Vertical travel	280mm from the table top	
	Maximum probing height	280mm from the table top (480mm: for the vertical position when detector holder is installed reversely)	
	Maximum probing depth	ø30×100mm (depth), ø7×50mm (depth)	
X axis	Travel range	165mm (-25mm to 140mm from the rotation center)	
Detector*1,*2	Measuring range	Standard: ±1000μm	
	Measuring force	100mN (± 30%)	
	Stylus tip form	ø1.6 Carbide	

*1: Auxiliary stage for a low-height workpiece (optional) is required for the measurement 20mm or less in the radial direction from the center point of the table and 20mm or less from the table top.

*2: Only the standard length stylus is applicable to this detector. The long type cannot be used.



Refer to the Roundtest RA-120/120P (Catalog No.E4323) for more details.

Roundtest

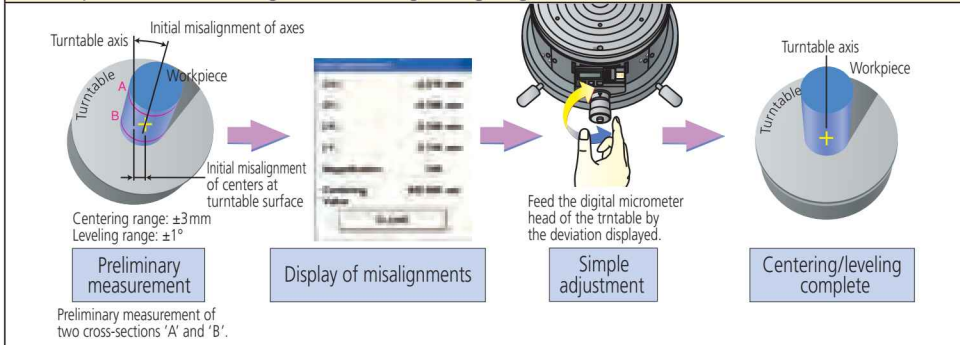
To realize efficient centering and leveling combined with high-precision measurement

Roundtest RA-1600 SERIES 211 — Roundness/Cylindricity Measuring System



211-723 RA-1600

D.A.T. (Digimatic Adjustment Table): Description of centering and leveling using Digimatic micrometer



SPECIFICATIONS

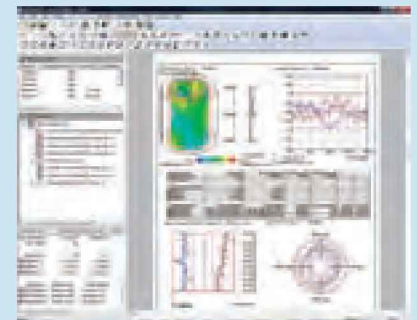
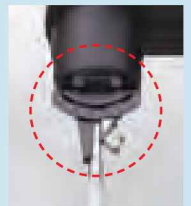
Model No.	RA-1600	
Turntable	Rotational accuracy (JIS B 7451-1997)	Radial direction: $(0.02+6H/10000)\mu\text{m}$ H: Probing height (mm) Axial direction: $(0.02+6X/10000)\mu\text{m}$ X: Distance from the center of rotation (mm)
	Rotational speed	4, 6, 10rpm
	Effective diameter of the table	$\phi 150\text{mm}$
	Centering/ leveling adjustment	D.A.T.
	Centering adjustment range	$\pm 3\text{mm}$
	Leveling adjustment range	$\pm 1^\circ$
	Maximum loading	25kg
	Maximum probing diameter	$\phi 280\text{mm}$
	Maximum workpiece diameter	$\phi 560\text{mm}$
	Vertical movement	Straightness of traverse ($\lambda c2.5$)
Parallelism to the rotation axis (with respect to the generating line)		$1.5\mu\text{m}/300\text{mm}$
Moving speed		Maximum: 15mm/s (at measurement: 0.5, 1.0, 2.0, 5.0 mm/s)
Vertical travel		300mm
Maximum probing height		300mm^*1
X axis	Maximum probing depth (when using a standard stylus)	$\phi 32 \times 91\text{mm}$ (depth), $\phi 7 \times 50\text{mm}$ (depth)
	Straightness ($\lambda c2.5$)	$2.7\mu\text{m}/140\text{mm}$
	Perpendicularity to the rotation axis (with respect to the generating line)	$1.6\mu\text{m}/140\text{mm}$
	Travel range	165mm (-25mm to $+140\text{mm}$ from the rotation center)
Detector	Drive speed	Maximum: 8mm/s (at measurement: 0.5, 1.0, 2.0, 5.0 mm/s)
	Measuring force	10 to 50mN, 1 to 5 steps
	Stylus tip form, material	$\phi 1.6\text{mm}$ Carbide
	Detection range	Standard: $\pm 400\mu\text{m}/\pm 40\mu\text{m}/\pm 4\mu\text{m}$ Tracking: $\pm 5\text{mm}$
Others	Others	In/out one-touch switching feature, Z-direction collision detection function, stylus angle graduations ($\pm 45^\circ$)
	Power supply	100-240VAC
	Power consumption	80W (PC and printer excluded)
	Required air pressure	0.39MPa
	Air consumption	22L/min in normal state (80L/min or more as air source)
Main unit mass	170kg	

*1: Auxiliary stage for a low-height workpiece is required for the measurement 20mm or less from the table top.



An inspection certificate is supplied as standard. Refer to page X for details.

- Compact body and a wide measuring range assures precision that compares well with that of higher-grade models.
Maximum probing diameter: $\phi 280\text{mm}$
Vertical travel: 300mm
Maximum table loading: 25kg
Rotational accuracy in the radial direction: $(0.02+6H/10000)\mu\text{m}$
Rotational accuracy in the axial direction: $(0.02+6X/10000)\mu\text{m}$
- D.A.T. (Digital Adjustment Table) function aids manual workpiece centering and leveling.
- Safety mechanism provided in the detection section as a standard feature. A collision-sensing function is equipped in the detector (when it is in the vertical orientation) to prevent a damaging collision in the Z direction. Additionally, an overrun prevention function is equipped, which stops the system when the detector displacement exceeds its range.
- A sliding mechanism (optional sliding detector holder) can be installed in the detector holder. It enables one-touch measurement of a workpiece with a deep hole having a thick wall, which has been difficult with the standard detector.
- The measurement results are shown graphically if using the roundness/cylindricity analysis software (ROUNDPAK).



Result screen

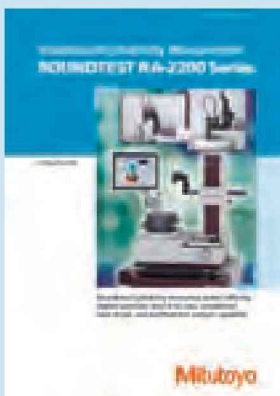


Refer to the Roundtest RA-1600 (Catalog No.E15000) for more details.



An inspection certificate is supplied as standard. Refer to page X for details.

- Highly accurate and easy-to-use turntable**
 The rotational accuracy in the radial direction is better than $0.02+3.5H/10000\mu\text{m}$, and in the axial direction $0.02+3.5X/10000\mu\text{m}$ is achieved. High accuracy measurement of not only roundness or cylindricity but also flatness is assured. A turntable with an automatic centering and leveling function is adopted for RA-2200AS/AH as a standard feature, which frees operators from manual centering and leveling operations. Furthermore, for the RA-2200DS/DH models, a guidance system is incorporated as a standard feature help untrained operators perform centering and leveling simply and smoothly.
- Greater productivity achieved by continuous inside/outside diameter measurement**
 Both the ID and OD of a workpiece*1 can be traced in succession without changing the detector traverse direction. *1: Up to ID $\varnothing 50\text{mm}$.
- Sliding detector holder is equipped as standard**
 A sliding mechanism is incorporated in the detector holder. It enables one-touch measurement of a workpiece with a deep hole having a thick wall, which has been difficult with the standard detector. To perform measurement, the contact point can be positioned higher than the workpiece, and then the detector holder is simply lowered. Furthermore, internal/outside diameters can be easily measured with the continuous ID/OD measurement function.
- Positioning sensor equipped to enable high accuracy repetitive measurement**
 A Mitutoyo linear scale is used in the X-axis drive unit to directly detect the position of the drive unit. It guarantees the highly precise positioning vital for repetitive measurement.
- Safety mechanism provided as a standard feature**
 A collision-sensing function is equipped in the detector unit (when it is in the vertical orientation) to prevent a damaging collision in the Z direction. Additionally, an overrun prevention function is equipped, which stops the system when the detector displacement exceeds its range.



Refer to the Roundtest RA-2200 series (Catalog No.E4385) for more details.

Roundtest RA-2200 SERIES 211 — Roundness/Cylindricity Measuring System



RA-2200 AS
System vibration isolator (with side table)

RA-2200 AS
System vibration isolator (monitor arm type)*
* Printer table (provided by the customer) not shown.

SPECIFICATIONS

Model No.			RA-2200AS	RA-2200DS	RA-2200AH	RA-2200DH	
Turntable	Rotational accuracy (JIS B 7451-1997)	Radial direction	$(0.02+3.5H/10000)\mu\text{m}$ H: Probing height (mm)				
		Axial direction	$(0.02+3.5X/10000)\mu\text{m}$ X: distance from the center of rotation (mm)				
	Rotational speed	2, 4, 6, 10 rpm					
	Effective diameter of the table	$\varnothing 235\text{mm}$	$\varnothing 200\text{mm}$	$\varnothing 235\text{mm}$	$\varnothing 200\text{mm}$		
	Centering/leveling mechanism	A.A.T	D.A.T	A.A.T	D.A.T		
	Centering adjustment range	$\pm 3\text{mm}$	$\pm 5\text{mm}$	$\pm 3\text{mm}$	$\pm 5\text{mm}$		
	Leveling adjustment range	$\pm 1^\circ$					
	Maximum loading mass	30kg					
	Maximum probing diameter	$\varnothing 300\text{mm}$					
	Maximum loading diameter	$\varnothing 580\text{mm}$					
Vertical movement (Z-axis column unit)	Straightness of traverse ($\lambda c2.5$)		$0.10\mu\text{m}/100\text{mm}$ $0.15\mu\text{m}/300\text{mm}$		$0.10\mu\text{m}/100\text{mm}$ $0.25\mu\text{m}/500\text{mm}$		
	Parallelism to the rotation axis (with respect to the generating line)		$0.7\mu\text{m}/300\text{mm}$		$1.2\mu\text{m}/500\text{mm}$		
	Moving speed		Maximum: 50mm/s (at measurement: 0.5, 1.0, 2.0, 5.0 mm/s)				
	Maximum probing height	At OD measurement	300mm		500mm		
		At ID measurement	300mm		500mm		
Maximum probing depth (when using a standard stylus)		$\varnothing 32 \times 85\text{mm}$ (depth), $\varnothing 7 \times 50\text{mm}$ (depth)					
X axis	Straightness ($\lambda c2.5$)		$0.7\mu\text{m}/150\text{mm}$				
	Perpendicularity to the rotation axis (with respect to the generating line)		$1.0\mu\text{m}/150\text{mm}$				
	Travel range		175mm (-25mm to +150mm from the rotation center)				
	Drive speed		Maximum: 30mm/s (at measurement: 0.5, 1.0, 2.0, 5.0 mm/s)				
Detector	Measuring force		Approx. 10 to 50mN, 1 to 5 steps				
	Stylus tip form, material		$\varnothing 1.6\text{mm}$ Carbide				
	Detection range	Standard	$\pm 400\mu\text{m}/\pm 40\mu\text{m}/\pm 4\mu\text{m}$				
		Tracking	$\pm 5\text{mm}$				
Others		In/out switching feature, Measuring force switching feature (5-step), Stylus angle graduations ($\pm 45^\circ$), Z direction collision detection function, sliding detector holder (3 positionings)					
Others	Power supply		100-240VAC				
	Required air pressure		0.39MPa				
	Air consumption (in normal state)		30L/min in normal state (80L/min or more as air source)				
Main unit weight		180kg		200kg			

*1: Auxiliary stage for a low-height workpiece is required for the measurement 20mm or less from the table top.

Roundtest

To realize efficient centering and leveling combined with high-precision measurement

Roundtest RA-H5200 SERIES 211 — Roundness/Cylindricity Measuring System



RA-H5200AH
with side table

SPECIFICATIONS

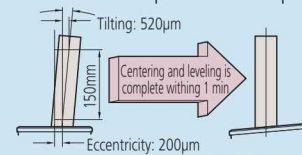
Model No.		RA-H5200AS	RA-H5200AH
Turntable	Rotational accuracy (JIS B 7451-1997)	(0.02+3.5H/10000)μm H: Probing height (mm)	
		(0.02+3.5X/10000)μm X: distance from the center of rotation (mm)	
	Rotational speed	2, 4, 6, 10rpm (On auto-centering: 20rpm)	
	Effective diameter of the table	ø300mm	
	Centering adjustment range	±5mm	
	Leveling adjustment range	±1°	
	Maximum loading mass	80kg (On auto-centering: 65kg)	
	Maximum probing diameter	ø400mm	
	Maximum loading diameter	ø680mm	
	Vertical movement	Straightness of traverse (λc2.5)	0.05μm/100mm
		Narrow range	0.14μm/350mm
		Wide range	0.2μm/550mm
Parallelism to the rotation axis (with respect to the generating line)		0.2μm/350mm	
Travel range (from the table top)		350mm	550mm
Moving speed		Maximum: 60mm/s (at measurement: 0.5, 1, 2, 5mm/s)	
X axis	Maximum probing height	350mm	550mm
	Maximum probing depth (when using a standard stylus)	ø32×85mm (depth) ø7×50mm (depth)	
	Straightness (λc2.5)	0.4μm/200mm	
	Perpendicularity to the rotation axis (with respect to the generating line)	0.5μm/200mm	
	Travel range	225mm (-25mm to +200mm from the rotation center)	
Detector	Moving speed	Maximum: 50mm/s (at measurement: 0.5, 1, 2, 5mm/s)	
	Measuring force	Approx. 10 to 50mN, 1 to 5 steps	
	Stylus tip form, material	ø1.6mm Carbide	
	Detection range	Standard	±400μm/±40μm/±4μm
		Tracking	±5mm
Others	Others	In/out switching feature, Measuring force switching feature (5-step), Stylus angle graduations (±45°), Z-direction collision detection function, sliding detector holder (3 positioning)	
	Required air pressure	0.39MPa	
	Air consumption (in normal state)	45L/min (120L/min or more as air source)	
	Mass	Measuring main unit	650kg
	Vibration isolator	170kg	



An inspection certificate is supplied as standard. Refer to page X for details.

A high-performance automatic model equipped with a high-speed automatic centering/leveling function achieves the world's highest-level of accuracy.

- A turntable with a highly rigid air bearing is incorporated to attain the industry leading rotational accuracy of (0.02+3.5H/10000)μm
- High-speed automatic centering/leveling function contributes to a significant reduction in the man-hours required for setups.



- The analysis program (ROUNDPAK) employs Windows OS to provide user-friendly screen and easy operation through the use of the mouse and icon selection.
- It is a full-automatic model which performs processing automatically from part program calling, centering/leveling, measurement, calculation, all the way through to printing.
- Capable of continuous inside/outside diameter measurement without changing the detector position. (up to ID ø50mm)
- The automatic positioning function of the turntable enables automatic measurement in combination with table rotation and slider/column movement.

- The measurement range is extended by the X-axis tracking measuring function. This function is useful when the roundness/cylindricity displacement or the taper obtained from the slider/column movement is too large and the detector's measuring range is exceeded.



(Tracking measurement range: 5mm)

- The spiral-mode measurement function combining table rotation and rectilinear action is enhanced.

It performs multiple-profile measurement in one cycle of measurement, and loads cylindricity or flatness data as a continuous data set.



- Advanced graphical analysis such as a power spectrum chart is available.
- A sliding mechanism is incorporated in the detector holder. It enables one-touch measurement of a workpiece with a deep hole having a thick wall, which has been difficult with the standard detector. To perform measurement, the contact point can be positioned higher than the workpiece, and then the detector holder is simply lowered. Furthermore, internal/outside diameters can be easily measured with the continuous ID/OD measurement function.



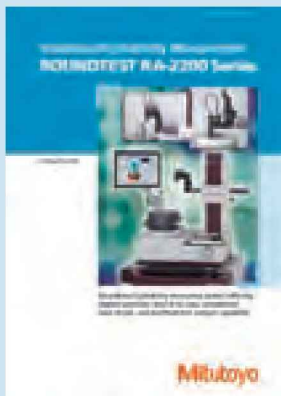


An inspection certificate is supplied as standard. Refer to page X for details.

- **Highly accurate and easy-to-use turntable**
The rotational accuracy in the radial direction is better than $0.02+3.5H/10000\mu\text{m}$, and in the axial direction $0.02+3.5X/10000\mu\text{m}$ is achieved. High accuracy measurement of not only roundness or cylindricity but also flatness is assured. Also, the turntable with automatic centering and leveling function is equipped as standard, which frees operators from manual centering and leveling operations.
- **A function to change the detector posture enables CNC automatic measurement.**
Automatic control of holder arm posture (vertical/horizontal) and the rotation feature of the detector (rotates in 1° increments in the range of 0 to 270°) enables continuous measurement of various feature combinations, such as OD/ID and/or top/bottom plane measurements. Also, an off-line teaching function allows easy part program creation.



- **A positioning sensor to achieve CNC high-accuracy automatic measurement.**
A Mitutoyo linear scale is used in the X-axis drive unit to directly detect the position of the drive unit. It guarantees the highly precise positioning vital for automatic measurement.
- **A roughness detector is supported**
An optional surface roughness detector enables measurements in the circumferential, radial and axial directions with the workpiece held stationary as required.



Refer to the Roundtest RA-2200 series (Catalog No.E4385) for more details.

Roundtest Extreme RA-2200 CNC SERIES 211 — CNC Roundness/Cylindricity Measuring System



RA-2200 CNC
System vibration isolator (with side table)

SPECIFICATIONS

Model No.		RA-2200 CNC	
Z-axis column unit		Standard column specification (Vertical travel: 300mm)	High column specification (Vertical travel: 500mm)
Turntable	Rotational accuracy (JIS B 7451-1997)	Radial direction $(0.02+3.5H/10000)\mu\text{m}$	H: Probing height (mm)
		Axial direction $(0.02+3.5X/10000)\mu\text{m}$	X: distance from the center of rotation (mm)
	Rotational speed	2, 4, 6, 10 rpm	
	Effective diameter of the table	ϕ 235mm	
	Centering/leveling mechanism	A.A.T	
	Centering adjustment range	\pm 3mm	
	Leveling adjustment range	\pm 1°	
	Maximum loading mass	30kg	
	Maximum probing diameter	ϕ 256mm	
Maximum loading diameter	ϕ 580mm		
Vertical movement (Z-axis column unit)	Straightness of traverse (λ c2.5)	Narrow range	0.10 $\mu\text{m}/100\text{mm}$
		Wide range	0.15 $\mu\text{m}/300\text{mm}$
	Parallelism to the rotation axis (with respect to the generating line)	0.7 $\mu\text{m}/300\text{mm}$	1.2 $\mu\text{m}/500\text{mm}$
	Travel range	300 mm	500 mm
	Moving speed	Maximum: 50mm/s (at measurement: 0.5, 1.0, 2.0, 5.0 mm/s)	
Maximum probing height	300 mm	500 mm	
Maximum probing depth (when using a standard stylus)	ϕ 12.7x26mm (depth), ϕ 32x104mm (depth)		
X axis	Straightness (λ c2.5)	0.7 $\mu\text{m}/150\text{mm}$	
		Perpendicularity to the rotation axis (with respect to the generating line)	1.0 $\mu\text{m}/150\text{mm}$
	Travel range	175mm (-25mm to +150mm from the rotation center)	
	Moving speed	Maximum: 30mm/s (at measurement: 0.5, 1.0, 2.0, 5.0 mm/s)	
Detector	Measuring force	Approx. 40mN	
	Stylus tip form, material	ϕ 1.6mm Carbide	
	Detection range	Standard	\pm 400 $\mu\text{m}/\pm$ 40 $\mu\text{m}/\pm$ 4 μm
		Tracking	\pm 5mm
	Others	Rotation mechanism (rotates in 1° increments in the range of 0 to 270°)	
Others	Power supply	100-240VAC	
	Required air pressure	0.39MPa	
	Air consumption	30L/min in normal state (80L/min or more as air source)	
	Main unit weight	180kg	200kg

Roundtest

To realize efficient centering and leveling combined with high-precision measurement

Roundtest Extreme RA-H5200 CNC SERIES 211 — CNC Roundness/Cylindricity Measuring System



RA-H5200 CNC
with side table

SPECIFICATIONS

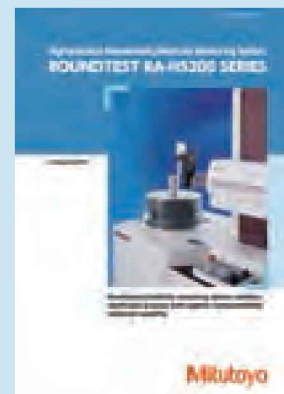
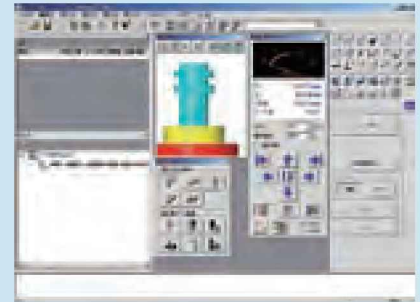
Model No.		RA-H5200 CNC	
Z-axis column unit		Standard column specification (Vertical travel: 350mm)	High column specification (Vertical travel: 550mm)
Turntable	Rotational accuracy (JIS B 7451-1997)	Radial direction (0.02+3.5H/10000) μ m	H: Probing height (mm)
		Axial direction (0.02+3.5X/10000) μ m	X: distance from the center of rotation (mm)
	Rotational speed	2, 4, 6, 10rpm (On auto-centering: 20rpm)	
	Effective diameter of the table	ϕ 300mm	
	Centering adjustment range	\pm 5mm	
	Leveling adjustment range	\pm 1°	
	Maximum loading mass	80kg (On auto-centering: 65kg)	
Vertical movement (Z-axis column unit)	Maximum probing diameter	ϕ 356mm	
	Maximum loading diameter	ϕ 680mm	
	Straightness of traverse (λ c2.5)	Narrow range 0.05 μ m/100mm	Wide range 0.2 μ m/550mm
	Parallelism to the rotation axis (with respect to the generating line)	0.2 μ m/350mm	0.32 μ m/550mm
	Travel range	350mm	550mm
	Moving speed	Maximum: 60mm/s (at measurement: 0.5, 1, 2, 5mm/s)	
	Maximum probing height	350mm	550mm
X axis	Maximum probing depth (when using a standard stylus)	ϕ 32 \times 104mm (depth), ϕ 12.7 \times 26mm (depth)	
	Straightness (λ c2.5)	0.4 μ m/200mm	
	Perpendicularity to the rotation axis (with respect to the generating line)	0.5 μ m/200mm	
	Travel range	225mm (-25mm to +200mm from the rotation center)	
Detector	Moving speed	Maximum: 50mm/s (at measurement: 0.5, 1, 2, 5mm/s)	
	Measuring force	Approx. 40mN	
	Stylus tip form, material	ϕ 1.6mm Carbide	
	Detection range	Standard	\pm 400 μ m/ \pm 40 μ m/ \pm 4 μ m
	Tracking	\pm 5mm	
Others	Others	Rotation mechanism (rotates in 1° increments in the range of 0 to 270°)	
	Required air pressure	0.39MPa	
	Air consumption (in normal state)	45L/min (120L/min or more as air source)	
Mass	Measuring main unit	650kg	670kg
	Vibration isolator	170kg	



An inspection certificate is supplied as standard.
Refer to page X for details.

Top productivity and performance from a CNC machine with highest-level accuracy.

- Automatic control of holder arm posture (vertical/horizontal) and the rotation feature of the detector enables continuous measurement of various feature combinations, such as OD/ID and/or top/bottom plane measurements.
- Off-line teaching function allows easy part program creation.
- External control function (Ext I/O) is available by establishing interactive communication (RS-232C) with PLC (Programmable Logic Controller).
- ROUNDPAK is a dedicated data analysis software package that provides enhanced functionality with easy operation through the use of mouse and icon selection.
- 3D part program simulation function enables part program editing and a visual check of performance.
- The measurement results report, including layout and size, can be flexibly customized.



Refer to the Roundtest RA-H5200
(Catalog No.E4392) for more details.

Optional Accessories SERIES 211 — Roundness/Cylindricity Measuring Systems

Styli for RA-H5200 and RA-2200/1600/120/120P/10

For RA-H5200CNC and RA-2200CNC, refer to page L-41.

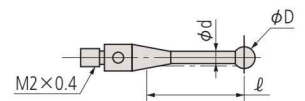
Item name	Standard stylus (standard accessory)	Stylus for notched workpiece	Stylus for groove	Stylus for corner	Stylus for removing asperity
Order No.	12AAL021	12AAL022	12AAL023	12AAL024	12AAL025
Tip shape	ø1.6mm Carbide	ø3mm Carbide	SR0.25mm Sapphire	SR0.25mm Sapphire	Carbide
Dimensions (mm)					
Item name	Stylus for small hole (ø0.8)	Stylus for small hole (ø1.0)	Stylus for small hole (ø1.6)	Stylus for extra small hole (depth 3mm)	ø1.6 ball stylus
Order No.	12AAL026	12AAL027	12AAL028	12AAL029	12AAL030
Tip shape	ø0.8mm Carbide	ø1mm Carbide	ø1.6mm Carbide	ø0.5mm Carbide	ø1.6mm Carbide
Dimensions (mm)					
Item name	Disk stylus	Crank stylus (ø0.5)	Crank stylus (ø1.0)	Stylus for flatness measurement	2X-long type stylus *1
Order No.	12AAL031	12AAL032	12AAL033	12AAL034	12AAL035
Tip shape	ø12mm Carbide	ø0.5mm Carbide (depth 2.5mm)	ø1mm Carbide (depth 5.5mm)	Carbide	ø1.6mm Carbide
Dimensions (mm)					
Item name	2X-long type for notch *1	2X-long type for deep groove *1	2X-long type for corner *1	2X-long type for removing cutter mark *1	2X-long type for small hole *1
Order No.	12AAL036	12AAL037	12AAL038	12AAL039	12AAL040
Tip shape	ø3mm Carbide	SR0.25mm Sapphire	SR0.25mm Sapphire	Carbide	ø1mm Carbide
Dimensions (mm)					
Item name	3X-long type *1	3X-long type for deep groove *1	M2 stylus shank	M2 stylus shank (standard groove)	M2 stylus shank (2X-long groove) *1
Order No.	12AAL041	12AAL042	12AAL043	12AAL044	12AAL045
Tip shape	ø1.6mm Carbide	SR0.25mm Sapphire	For mounting CMM stylus (mounting thread M2)	For mounting CMM stylus (mounting thread M2)	For mounting CMM stylus (mounting thread M2)
Dimensions (mm)					

*1: Measuring is only possible in the vertical direction. Not available for RA-10, RA-120, and RA-120P.

Note: The general-purpose 5 styli set (Order No. 12AAL020) is also available (for notched workpiece, for deep groove, small hole (ø1.0), ø1.6 ball, and 2X).

Stylus

This is a stylus for CMM which is equipped with the tip of the stylus shank (Order No. 12AAL043/12AAL044/12AAL045).



Ball stylus (ruby ball tip, M2 mounting thread)					
Form	D(mm)	d(mm)	ℓ(mm)	Mass (g)	Order No.
	ø0.5	ø0.34	3.0	0.3	06ABN752
	ø0.7	ø0.5	4.0	0.3	06ABN753
	ø1.0	ø0.7	4.5	0.3	06ABN754
	ø1.5	ø0.7	4.5	0.3	06ABN758
	ø2.0	ø1.0	6.0	0.3	06ABN761
	ø3.0	ø1.5	7.5	0.4	06ABN769
	ø4.0	ø1.5	10.0	0.4	06ABN774
	ø5.0	ø2.5	10.0	0.7	06ABN780
	ø6.0	ø2.5	10.0	0.9	06ABN786
	ø8.0	ø2.5	11.0	1.5	06ABN788

Roundtest

To realize efficient centering and leveling combined with high-precision measurement

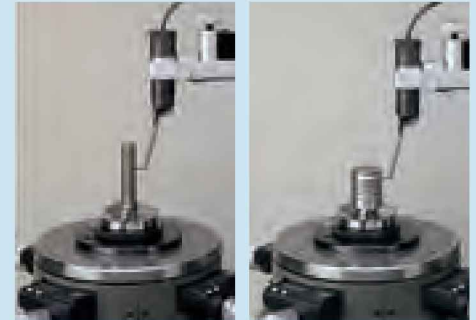
Optional Accessories SERIES 211 — Roundness/Cylindricity Measuring Systems

Stylus for RA-H5200CNC/RA-2200CNC

Item name	Groove stylus	Stylus for flatness measurement	Standard stylus	Stylus for notched workpiece	Deep-hole stylus A
Order No.	12AAE310	12AAE302	12AAE301	12AAE309	12AAE306
Tip shape	ø1.6mm Carbide	ø1.6mm Carbide	ø1.6mm Carbide	ø3mm Carbide	ø1.6mm Carbide
Dimensions (mm)					
Item name	ø1.6mm ball stylus	ø0.8mm ball stylus	ø0.5mm ball stylus	Stylus for groove	Deep-hole stylus B
Order No.	12AAE303	12AAE304	12AAE305	12AAE308	12AAE307
Tip shape	ø1.6mm Carbide	ø0.8mm Carbide	ø0.5mm Carbide	ø1.6mm Carbide	ø1.6mm Carbide
Dimensions (mm)					

		Model	RA-H5200CNC/ RA-H5200	RA-2200CNC/ RA-2200	RA-1600	RA-120P	RA-120	RA-10
Analysis type								
Roundness	○	●	●	●	●	●	●	●
Cylindricity	∅	●	●	●	—	—	—	—
Concentricity	◎	●	●	●	●	●	●	●
Coaxiality	Axis element	◎	●	●	●	●	●	●
	Axis	◎	●	●	●	—	—	—
Flatness	□	●	●	●	●	●	●	●
Parallelism	//	●	●	●	●	●	●	—
Perpendicularity	⊥	●	●	●	●	●	●	—
Radial deviation	▭	●	●	●	—	—	—	—
Thickness deviation	⊙	●	●	●	●	●	●	—
Radial runout	↗	●	●	●	●	●	●	●
Total runout	↗↘	●	●	●	—	—	—	—
Diameter measurement	∅	●	●	●	—	—	—	—
Straightness	—	●	●	●	—	—	—	—
Inclination	∟	●	●	●	—	—	—	—
Taper	∧	●	●	●	—	—	—	—
Diameter contour tolerancing	∅	●	●	●	—	—	—	—
Rectilinear contour tolerancing	∟	●	●	●	—	—	—	—
Width measurement (only CNC)	↔	● (only CNC)	● (only CNC)	—	—	—	—	—
Power spectrum	▒	●	●	●	—	—	—	—
Harmonic analysis	∅	●	●	●	●	—	—	—
Profile operation	±	●	●	●	●	—	—	—
Tapered surface analysis	∩	●	●	●	—	—	—	—

Usage examples of styli



Removing cutter mark

Corners



Small hole

Small hole



Flatness measurement

ID measurement

Collet chuck holder

- Used for holding parts with a collet (optional).



No.211-051

Code No.	211-051 (for RA-10)	211-061 (except RA-10)
Holding capacity	OD ϕ 0.5 to ϕ 10mm* ¹	
Centering error	50 μ m or less* ²	
Mass	1.4kg	

*1: Collets compatible with the workpiece are optional.

*2: When measured with a ϕ 5mm pin gage at the probing height of 30mm.

Collet chuck holder*³

- Individual collet for the collet chuck holder.

Order No.	Holding capacity (OD)
12AAH402	ϕ 0.5~ ϕ 1.0mm
12AAH403	ϕ 1.0~ ϕ 1.5mm
12AAH404	ϕ 1.5~ ϕ 2.0mm
12AAH405	ϕ 2.0~ ϕ 2.5mm
12AAH406	ϕ 2.5~ ϕ 3.0mm
12AAH407	ϕ 3.0~ ϕ 3.5mm
12AAH408	ϕ 3.5~ ϕ 4.0mm
12AAH409	ϕ 4.0~ ϕ 5.0mm
12AAH410	ϕ 5.0~ ϕ 6.0mm
12AAH411	ϕ 6.0~ ϕ 7.0mm
12AAH412	ϕ 7.0~ ϕ 8.0mm
12AAH413	ϕ 8.0~ ϕ 9.0mm
12AAH414	ϕ 9.0~ ϕ 10.0mm

*3: The collet chuck itself cannot be fixed to the turntable. A separate collet chuck holder is required. Equivalent to product of YUKIWA SEIKO, YCC10-**, AA.

Magnification calibration kit

- A combination of gage blocks and an optical flat.

Order No. 997090

* Supplied with RA-H5200/RA-H5200CNC/RA-2200/RA-2200CNC as standard.



Printer paper set (for thermal printer)

- 10 rolls (25m/roll)

Order No. 12AAH181 (for RA-120/10)

Optional Accessories

SERIES 211 — Roundness/Cylindricity Measuring Systems

Centering chuck (knurled ring operated)

- Suitable for holding small parts with easy-to-operate knurled-ring clamping.



Code No.	211-032
Holding capacity	OD with internal jaws ϕ 1- ϕ 36mm ID with internal jaws ϕ 16- ϕ 69mm OD with external jaws ϕ 25- ϕ 79mm
External dimensions (DxH)	ϕ 118x41mm
Mass	1.2kg

Three-jaw chuck (key operated)

- Suitable for holding longer parts and those requiring a relatively powerful clamp, including crankshafts and pin shafts.



Code No.	211-014
Holding capacity	OD with internal jaws 2-35mm ID with internal jaws 25-68mm OD with external jaws 35-78mm
External dimensions (DxH)	ϕ 157x70.6mm
Mass	3.8kg

Vibration isolator

(compatible with RA-1600/2200/2200CNC: Desk type)

Order No.	12AAK110
Vibration isolating method	Diaphragm isolation system
External dimensions (WxDxH)	830x800x700mm

Optional accessories used with the vibration isolator (No.12AAK110)

- Monitor arm (No.12AAK120)
- Side table (No.12AAL019)

Vibration isolator (air system)

(For RA-1600/2200/2200CNC)

Order No.	178-025
Vibration isolating method	Diaphragm isolation system
External dimensions (WxDxH)	765x565x51mm

Vibration isolator (air system)

(For RA-10/120/120P)

Order No.	211-013
Vibration isolating method	Diaphragm isolation system
External dimensions (WxDxH)	615x515x51mm

Cylindrical square

(Only for cylindricity-measurement-capable models.)

Order No.	350850
Cylindricity	2 μ m
Straightness	1 μ m
External dimensions (DxH)	ϕ 70x250mm
Mass	7.5kg



An inspection certificate is supplied as standard. Refer to page X for details.

Micro chuck

- Used for clamping workpieces smaller than ϕ 1 mm that the centering chuck cannot hold.



Code No.	211-031
Holding capacity	OD ϕ 0.2 - ϕ 1.5mm
External dimensions (DxH)	ϕ 107x48.5mm
Mass	0.6kg

Magnification calibrator

- A calibration gage to be used for the sensitivity adjustment of the detector.



An inspection certificate is supplied as standard. Refer to page X for details.

Code No.	211-045
Maximum calibration range	400 μ m
Scale interval	0.2 μ m
External dimensions (WxDxH)	235(max.)x185x70mm
Mass	4kg

Thin-workpiece table



Order No.	356038
Loading dia.	ϕ 100mm
External dimensions	ϕ 105x25mm
Mass	1.7kg

* Supplied with RA-H5200 as standard.

3X-extension detector holder

(RA-H5200 For the measurement of 3X deep hole)

Order No.	12AAF205
Mass	1.3kg

2X-extension detector holder

(RA-H5200/RA-2200/RA-1600 For the measurement of 2X deep hole)

Order No.	12AAF203
Mass	1.1kg

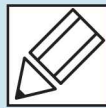
Sliding detector holder

(For RA-1600*)

Order No. 12AAL090

* Supplied with RA-H5200/RA-2200 as standard.

Quick Guide to Precision Measuring Instruments



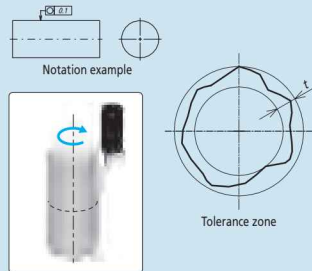
Roundtest (Roundform Measuring Instruments)

■ ISO 4291:1985 Methods for the assessment of departure from roundness -- Measurement of variations in radius

■ ISO 1101:2012 Geometrical product specifications (GPS) -- Geometrical tolerancing -- Tolerances of form, orientation, location and run-out

○ Roundness

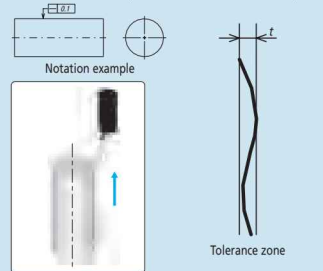
Any circumferential line must be contained within the tolerance zone formed between two coplanar circles with a difference in radii of t



Verification example using a roundness measuring instrument

— Straightness

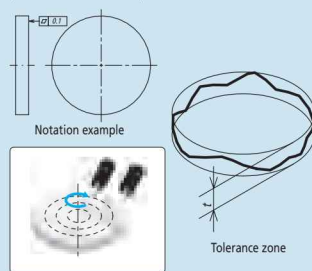
Any line on the surface must lie within the tolerance zone formed between two parallel straight lines a distance t apart and in the direction specified



Verification example using a roundness measuring instrument

□ Flatness

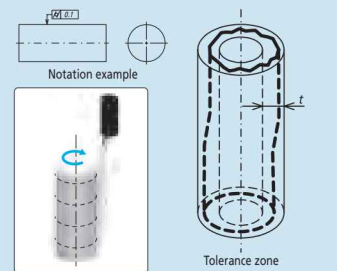
The surface must be contained within the tolerance zone formed between two parallel planes a distance t apart



Verification example using a roundness measuring instrument

○/□ Cylindricity

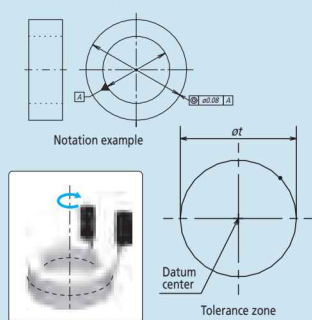
The surface must be contained within the tolerance zone formed between two coaxial cylinders with a difference in radii of t



Verification example using a roundness measuring instrument

◎ Concentricity

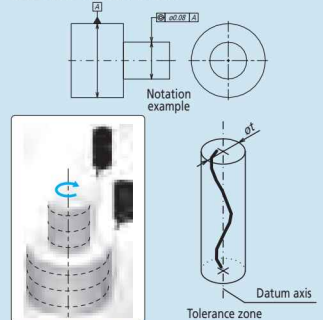
The center point must be contained within the tolerance zone formed by a circle of diameter t concentric with the datum



Verification example using a roundness measuring instrument

◎ Coaxiality

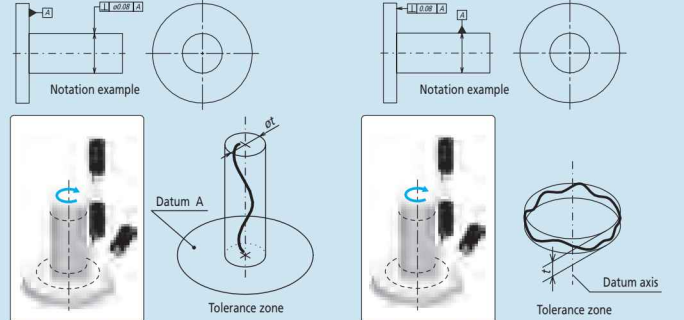
The axis must be contained within the tolerance zone formed by a cylinder of diameter t concentric with the datum



Verification example using a roundness measuring instrument

⊥ Perpendicularity

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

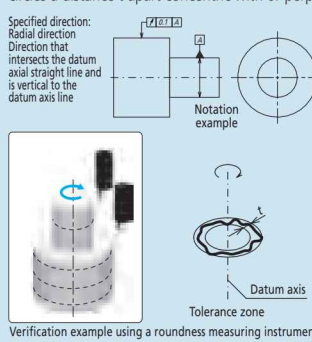


Verification example using a roundness measuring instrument

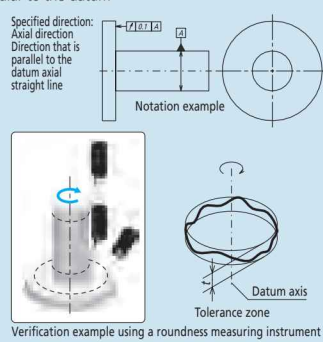
Verification example using a roundness measuring instrument

↗ Circular Runout (Radial and Axial)

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



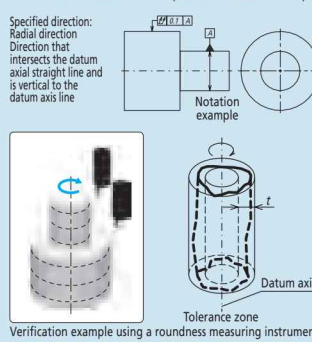
Verification example using a roundness measuring instrument



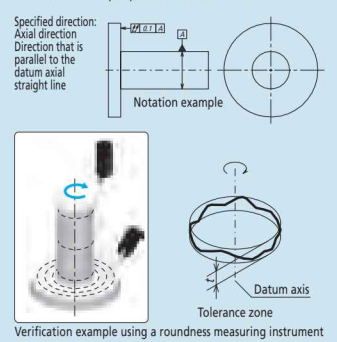
Verification example using a roundness measuring instrument

↗ Total Runout (Radial and Axial)

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



Verification example using a roundness measuring instrument

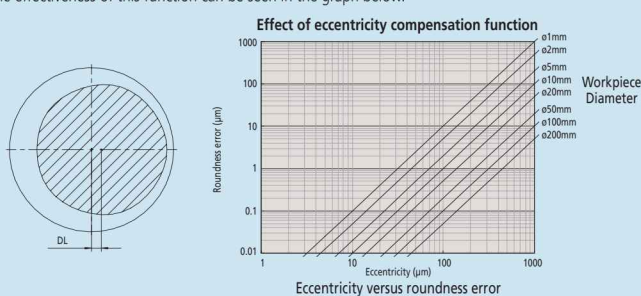


Verification example using a roundness measuring instrument

■ Adjustment prior to Measurement

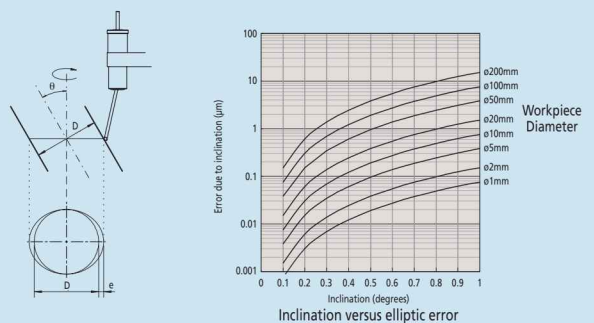
Centering

A displacement offset (eccentricity) between the Roundtest's turntable axis and that of the workpiece results in distortion of the measured form (limaçon error) and consequently produces an error in the calculated roundness value. The larger the eccentricity, the larger is the error in calculated roundness. Therefore the workpiece should be centered (axes made coincident) before measurement. Some roundness testers support accurate measurement with a limaçon error correction function. The effectiveness of this function can be seen in the graph below.



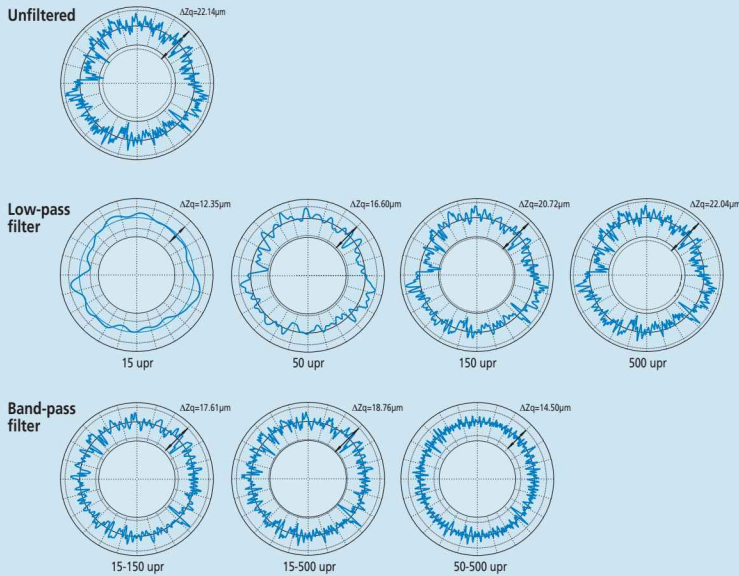
Leveling

Any inclination of the axis of a workpiece with respect to the rotational axis of the measuring instrument will cause an elliptic error. Leveling must be performed so that these axes are sufficiently parallel.



Effect of Filter Settings on the Measured Profile

Profiles can be filtered in various ways to reduce or eliminate unwanted detail, with a cut-off value set in terms of undulations per revolution (upr). The effect of different upr settings is shown in the diagrams below, which illustrate how the measured roundness value decreases as lower upr settings progressively smooth out the line.

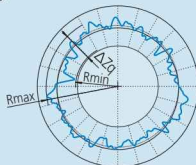


Evaluating the Measured Profile Roundness

Roundness testers use the measurement data to generate reference circles whose dimensions define the roundness value. There are four methods of generating these circles, as shown below, and each method has individual characteristics so the method that best matches the function of the workpiece should be chosen. Each method results in a different center position for the reference circles and therefore affects the axial location of the circular feature measured.

Least Square Circle (LSC)

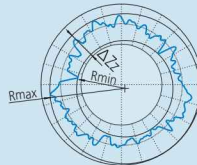
A circle is fitted to the measured profile such that the sum of the squares of the departure of the profile data from this circle is a minimum. The roundness figure is then defined as the difference between the maximum deviation of the profile from this circle (highest peak to the lowest valley).



$\Delta Zq = R_{max} - R_{min}$
 Δ^*Zq : A symbol indicating roundness value by LSC.

Minimum Zone Circles (MZC)

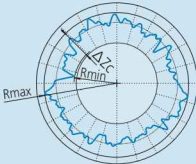
Two concentric circles are positioned to enclose the measured profile such that their radial difference is a minimum. The roundness figure is then defined as the radial separation of these two circles.



$\Delta Zz = R_{max} - R_{min}$
 Δ^*Zz : A symbol indicating roundness value by MZC.

Minimum Circumscribed Circle (MCC)

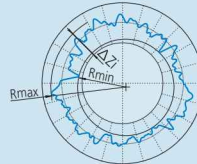
The smallest circle that can enclose the measured profile is created. The roundness figure is then defined as the maximum deviation of the profile from this circle. This circle is sometimes referred to as the 'ring gage' circle.



$\Delta Zc = R_{max} - R_{min}$
 Δ^*Zc : A symbol indicating roundness value by MCC.

Maximum Inscribed Circle (MIC)

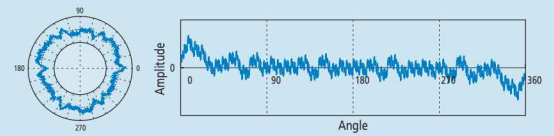
The largest circle that can be enclosed by the profile data is created. The roundness figure is then defined as the maximum deviation of the profile from this circle. This circle is sometimes referred to as the 'plug gage' circle.



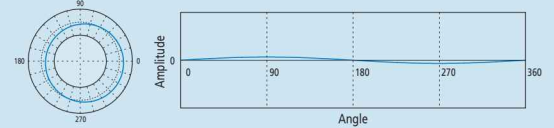
$\Delta Zi = R_{max} - R_{min}$
 Δ^*Zi : A symbol indicating roundness value by MIC.

Undulations Per Revolution (UPR) data in the roundness graphs

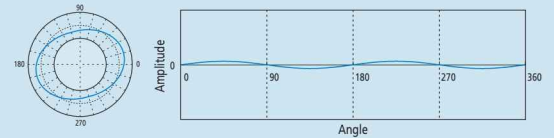
Measurement result graphs



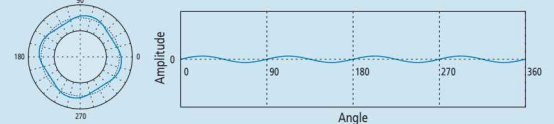
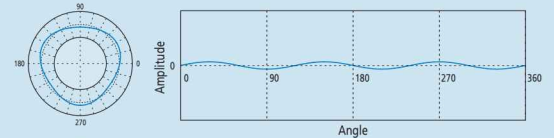
A 1 UPR condition indicates eccentricity of the workpiece relative to the rotational axis of the measuring instrument. The amplitude of undulation components depends on the leveling adjustment.



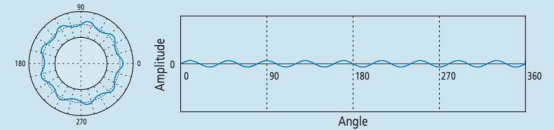
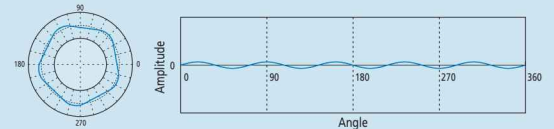
A 2 UPR condition may indicate: (1) insufficient leveling adjustment on the measuring instrument; (2) circular runout due to incorrect mounting of the workpiece on the machine tool that created its shape; (3) the form of the workpiece is elliptical by design as in, for example, an IC-engine piston.



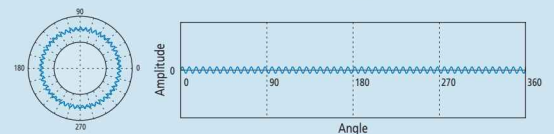
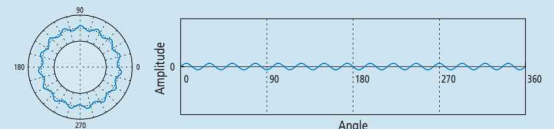
A 3 to 5 UPR condition may indicate: (1) Deformation due to over-tightening of the holding chuck on the measuring instrument; (2) Relaxation deformation due to stress release after unloading from the holding chuck on the machine tool that created its shape.



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



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



New Products



Micro Vickers Hardness Testing Machines

HM-200

Refer to page M-3 for details.



Vickers Hardness Testing Machines

HV-100

Refer to page M-5 for details.



Rockwell Hardness Testing Machines

HR-100/200/300/400

Refer to page M-8 for details.

Micro Vickers Hardness Testing Machines

Micro Vickers Hardness Testing Machines



Vickers Hardness Testing Machines

Vickers Hardness Testing Machines



Rockwell Hardness Testing Machines

Rockwell Hardness Testing Machines



Portable Hardness Testing Instruments

Rebound Type Portable Hardness Testing Instruments



INDEX

Micro Vickers Hardness Testing Machines	
HM-200	M-3
HM-100	M-4
Vickers Hardness Testing Machines	
HV-100	M-5
AVK-C0	M-6
Rockwell Hardness Testing Machines	
HR-100/200/300/400	M-7
HR-500	M-8
Portable Hardness Testing Instruments	
Rebound Type Portable Hardness Testing Instrument, HH-411	M-9
Hardness Testing Instrument for Sponge, Rubber, and Plastic, HH-300	M-10
Other	
Quick Guide to Precision Measuring Instruments	M-12

Hardness Testing Machines

Start quality control from the material — Mitutoyo's hardness testing machines can handle it



An inspection certificate is supplied as standard. Refer to page X for details.

HM-200

SERIES 810 — Micro Vickers Hardness Testing Machines

• Introduction of electromagnetic force generation into the loading mechanism

The latest electromagnetic force motor used in the loading mechanism enables the test force to be freely selected (see test force specifications) over the wide range of 0.4903mN to 19610mN. It is also possible to freely set the loading time and duration time. Now your desire for absolute control over the indentation size in Vickers hardness testing can be satisfied. The HM-200 series always offers the test force most appropriate for the specimen material and shape.

Note: Changing the test force may change the hardness value obtained due to material non-homogeneity. Surface treatment, such as Nitriding, can also produce the same effect because the material hardness changes with depth, and indentation depth depends on the test force.

• Newly-designed optical system

The new HM Plan series objective lenses are optimized for measuring characteristic indentation images. The lineup includes 6 types of long working distance objectives: 10X, 20X, 50X and 100X for measuring indentation images, and 2X and 5X for enabling wide-range measurement around indentations. LEDs, which have a longer life, produce less heat, consume less power and are more energy efficient than incandescent bulbs, are employed for the illumination system.



System A (HM-210A/220A)

SPECIFICATIONS

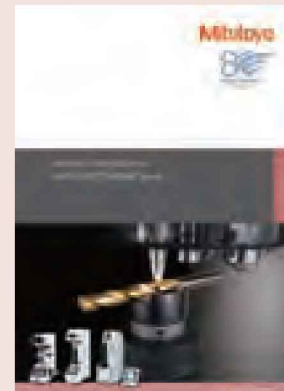
Order No.	810-401, 810-404										810-406, 810-409					
Model	HM-210										HM-220					
Applicable standards	JIS B 7725, ISO 6507-2															
Test force	mN	98.07	196.1	294.2	49.03	980.7	0.4903	0.9807	1.961	2.942	4.903	9.807	19.61	29.42	49.03	98.07
	(gf)	10	20	30	50	100	0.05	0.1	0.2	0.3	0.5	1	2	3	5	10
	mN	1961	2942	4903	9807	—	196.1	294.2	490.3	980.7	1961	2942	4903	9807	19610	—
	(gf)	200	300	500	1000	—	20	30	50	100	200	300	500	1000	2000	—
Arbitrary test force	1 type [Default: 245.2mN (25gf)]															
Test force control	Electromagnetic generation of force (force motor) and automatic control (load, duration, unload)															
Indenter shaft unit	Up to 2 pcs. mountable (one indenter shaft unit with Vickers indenter is mounted as standard)															
Objective lens unit	Up to 4 pcs. mountable (one standard lens 50X mounted as standard)															
Resolution of diagonal length of an indentation	Objective lens less than 50X: 0.1µm (Objective lens more than 50X: 0.01µm)															
Turret drive	Motor-driven and manual operation															
Specimen dimensions	System A/B: height 133mm, depth 160mm (when using manual XY stage 25X25) System C: height 112mm, depth 160mm, System D: height 72mm, depth 160mm															
Control panel	Built-in touch panel, 5.7" Color LCD (HM-210A/220A for System A), Control software (PC for System B/C/D)															
Functions*1	Calculation of Vickers/Knoop*2 hardness, and ceramic fracture toughness based on IF method (JIS R1697), 3 display format (standard, list, simple), GO/NG judgment, test condition guide, curve and user correction, hardness corresponding value, statistics calculation															
Output	Digimatic, serial, USB2.0 series A (for memory)*1, USB2.0 B Type (for system communication)															
External dimensions (excluding protrusions and stage); Main unit mass	System A: 315(W)×671(D)×595(H)mm/38.5kg System B/C/D: 315(W)×586(D)×741(H)mm/37.4kg															
Power supply (main unit)	AC100V 50/60Hz System A: 31W System B/C/D: 30W								AC100V 50/60Hz System A: 44W System B/C/D: 43W							
Power supply*3 (Control unit)	AC100V 50/60Hz 67W															

*810-401, 810-406: System A, 810-404, 810-409: System B/C/D

*1: Functions for System A. *2: For Knoop hardness test, Knoop indenter (optional) is required. *3: Supplied only for System C/D.

Optional Accessories

- 19BAA058: Diamond indenter for Vickers (For HM-210 series)
- 19BAA059: Diamond indenter for Vickers (For HM-220 series)
- 19BAA061: Diamond indenter for Knoop (For HM-210 series)
- 19BAA062: Diamond indenter for Knoop (For HM-220 series)
- 19BAA001: Hardness standard block 100HVM
- 19BAA002: Hardness standard block 200HVM
- 19BAA003: Hardness standard block 300HVM
- 19BAA004: Hardness standard block 400HVM
- 19BAA005: Hardness standard block 500HVM
- 19BAA006: Hardness standard block 600HVM
- 19BAA007: Hardness standard block 700HVM
- 19BAA008: Hardness standard block 800HVM
- 19BAA009: Hardness standard block 900HVM
- 19BAA010: Hardness standard block 40HVM
- 810-017: Special vise (opening width 100mm)
- 810-013: Sheet specimen table
- 810-014: Thin specimen table (horizontal type)
- 810-015: Thin specimen table (vertical type)
- 810-019: Tilting specimen table
- 810-020: Adjustable specimen holder
- 810-018: Rotary table
- 810-084: Rotatable adjustable specimen table
- 810-085: Sheet specimen table
- 810-095: Rotary tilting specimen table
- 375-056: Objective micrometer (for calculation of dimension ratio for a pixel of CCD camera)
- 810-650-1: Resin mold specimen table ø25.4
- 810-650-2: Resin mold specimen table ø30
- 810-650-3: Resin mold specimen table ø31.75
- 810-650-4: Resin mold specimen table ø38.1
- 810-650-5: Resin mold specimen table ø40
- 02ATE760: Dedicated table (for testing machine, PC)
- 810-641: Vibration Isolator (for testing machine)



Refer to the Hardness Testing Machines (Catalog No. E17001) for more details.

System A (HM-210A/220A)

All-in-one model with simple color touch-panel operation for motorized test force switching and motorized turret mount.

*Camera and monitor are optional accessories.



System C (HM-210C/220C)

In addition to the functions of System B, System C is equipped with motorized XY stage. This system is useful for improving the efficiency of operations such as multi-point hardness testing.

Automatic measurement of indentation / motorized XY stage



System B (HM-210B/220B)

System B is equipped with **AVPAK-20**, a the software package for automatic hardness testing systems that automatically measures the diagonal length of an indentation and calculates the corresponding hardness value. This means that measurement error caused by variation in operator interpretation is eliminated, so reducing costs.

Automatic measurement of indentation



System D (HM-210D/220D)

In addition to the functions of System B and System C, System D is equipped with the autofocus function.

This function allows for automatic hardness testing, thereby increasing efficiency and reducing labor costs.

Automatic measurement of indentation / motorized XY stage / Autofocusing



CAUTION: The **AVPAK-20** software package is not for use within, or export to, the United States of America. The **AVPAK-10** software package is for the United States of America.

HM-100 SERIES 810 — Micro Vickers Hardness Testing Machines



810-124
HM-101

810-125
HM-102

810-959
HM-103

SPECIFICATIONS

Order No.	810-124		810-125				810-959		
Model	HM-101		HM-102				HM-103		
Applicable standards	JIS B 7725, ISO 6507-2								
Test force	mN	98.07	245.2	490.3	980.7	1961	2942	4903	9807
	(gf)	10	25	50	100	200	300	500	1000
Test force control	Direct load method and automatic control (load, duration, unload)								
Objective lens	50X (for measurement) 10X (for observation)		50X (for measurement), 10X (for measurement/observation)						
Resolution of diagonal length of an indentation	0.2μm		0.1μm						
Turret drive	Manual switching								
Specimen dimensions	height:95mm, depth:150mm								
Control panel	—		Membrane keypad						
TV monitor unit	—		—				Standard		
Function	—		Calculation of Vickers / Knoop* hardness and GO/NG judgment						
Output	—		Digimatic, serial, and parallel						
External dimensions (excluding protrusions and stage); Main unit mass	—		380(W)x600(D)x590(H)mm/42kg						
	—		Control panel: 165(W)x235(D)x125(H)mm/1.5kg				TV monitor: 232(W)x227(D)x415(H)mm/4.4kg		
	—		—				—		
Power supply	—		AC100V 50/60Hz				—		
	Less than 20W		Less than 60W				Less than 90W		

*For Knoop hardness test, Knoop indenter (optional) is required.



An inspection certificate is supplied as standard. Refer to page X for details.

- This entry-level series of microhardness testers is suited for mechanical characteristic evaluation and quality control of electric/electronic components where test forces no smaller than 98.07mN/10gf are sufficient.



Refer to the Hardness Testing Machines (Catalog No. E17001) for more details.

Hardness Testing Machines

Start quality control from the material — Mitutoyo's hardness testing machines can handle it



An inspection certificate is supplied as standard. Refer to page X for details.

HV-100

SERIES 810 — Vickers Hardness Testing Machines

- Vickers hardness testers have a wide application in testing metals, especially small heat-treated parts, and are also suitable for making special-purpose tests such as carburized case hardness, maximum hardness of spot welds, high-temperature hardness, and fracture toughness of ceramic materials.
- Objective lenses specifically developed for hardness testing are supplied. A clear and natural view of an indentation is achieved by changing the light source of the illumination from halogen to LED.
- A new 2X lens for wide-angle observation has been added to the range. Now, magnifications of 10X, 20X, 50X and 100X for observation and gaging; and 5X and 2X for observation are available. Also, the working distance is doubled (5.9 to 11.8mm) for the 10X objective lens (in-house comparison) to minimize the risk of collision between the workpiece and the lens.

- In addition to Vickers hardness testing, fracture toughness tests (IF Method: JIS R 1607) and other tests can be performed with optional accessories such as a Knoop indenter and additional indenters and a weight for Micro Brinell testing.
- Four systems are available: Basic model A; model B equipped with automatic indentation reading function; model C equipped with automatic indentation reading function and automatic XY stage; model D equipped with automatic indentation reading function, automatic XY stage, and auto-focus stage.



System A (HV-110A/120A)

Optional Accessories

- 810-037:** Round table (Diameter: 180mm)
- 810-038:** Round table (Diameter: 250mm)
- 810-040:** V-anvil (large) (Diameter:40mm, Groove width:30mm)
- 810-041:** V-anvil (small) (Diameter:40mm, Groove width:6mm)
- 810-423:** Manual XY stage 50x50mm
- 19BAA011:** Hardness standard block 200HV
- 19BAA012:** Hardness standard block 300HV
- 19BAA013:** Hardness standard block 400HV
- 19BAA014:** Hardness standard block 500HV
- 19BAA015:** Hardness standard block 600HV
- 19BAA016:** Hardness standard block 700HV
- 19BAA017:** Hardness standard block 800HV
- 19BAA018:** Hardness standard block 900HV
- 11AAC702:** Stand for testing machine
- 11AAC719:** Vibration isolator
- 810-644:** Wing for vibration isolator (11AAC719)
- 998923:** System rack (vertical)

SPECIFICATIONS

Order No.	810-440, 810-443					810-445, 810-448				810-160			
Model	HV-110					HV-120				AVK-C0			
Applicable standards	JIS B 7725, ISO 6507-2												
Test force	N	9.807	19.61	29.42	49.03	2.942	4.903	9.807	24.51	9.807	49.03	98.07	245.2
	(kgf)	1	2	3	5	0.3	0.5	1	2.5	1	5	10	25
	N	98.07	196.1	294.2	490.3	49.03	98.07	196.1	294.2	490.3	—	—	—
	(kgf)	10	20	30	50	5	10	20	30	50	—	—	—
Test force control	Lever method and automatic control (load, duration, unload)									Lever method and automatic control (load, duration, unload)			
Objective lens	Up to 3 pcs. mountable (one standard lens 10X mounted as standard)									10X for measurement			
Resolution of diagonal length of an indentation	Objective lens less than 50X: 0.1μm (Objective lens more than 50X: 0.01μm)									1μm			
Turret drive	Motor driven and manual operation									Manual switching			
Specimen dimensions	System A: height 210mm, depth 170mm (when using flat anvil)												
	System B: height 181mm, depth 170mm (when using manual XY stage 50X50mm)												
	System C: height 172mm, depth 170mm, System D: height 132mm, depth 170mm												
Control panel	Built-in touch panel, 5.7" Color LCD (HM-110A/120A for System A), Control software (PC for System B/C/D)									—			
Functions*1	Calculation of Vickers/Knoop*2/Brinell*3 hardness, and ceramic fracture toughness based on IF method (JIS R1697), 3 display format (standard, list, simple), GO/NG judgment, test condition guide, curve and user correction, hardness corresponding value, statistics calculation									—			
Output	Digimatic, serial, USB2.0 series A (for memory)*1, USB2.0 B Type (for system communication)									—			
External dimensions (excluding protrusions and stage)	System A: 307(W)×696(D)×786(H)mm System B/C/D: 307(W)×627(D)×875(H)mm									210(W)×580(D)×705(H)mm			
Main unit mass	HV-110: Approx. 60kg, HV-120: Approx. 58kg									Approx. 49kg			
Power supply (main unit)	AC100V 50/60Hz System A: 24W System B/C/D: 22W									AC100V 50/60Hz Approx. 45W			
Power supply*4 (Control unit)	AC100V 50/60Hz 67W									—			

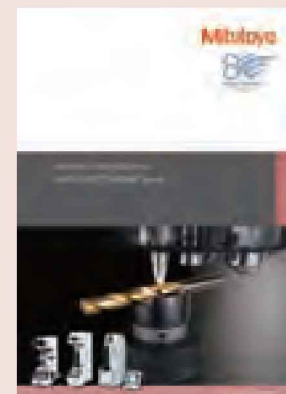
*810-440, 810-445: System A, 810-443, 810-448: System B/C/D

*1: Functions for System A.

*2: For Knoop hardness test, Knoop indenter (optional) is required.

*3: For Brinell hardness test, Brinell indenter (optional) and additional weight is required.

*4: Supplied only for System C/D.



Refer to the Hardness Testing Machines (Catalog No. E17001) for more details.



An inspection certificate is supplied as standard.
Refer to page X for details.

System A (HV-110A/HV-120A)

All-in-one model with simple color touch-panel operation for test force motorized switching and motorized turret mount.

*Camera and monitor are optional accessories.



System B (HV-110B/HV-120B)

System B is equipped with **AVPAK-20**, a the software package for automatic hardness testing systems that automatically measures the diagonal length of an indentation and calculates the corresponding hardness value. This means that measurement error caused by variation in operator interpretation is eliminated, so reducing costs.



Automatic measurement of indentation

System C (HV-110C/HV-120C)

In addition to the functions of System B, System C is equipped with motorized XY stage. This system is useful for improving the efficiency of operations such as multi-point hardness testing.



Automatic measurement of indentation / motorized XY stage

System D (HV-110D/HV-120D)

In addition to the functions of System B and System C, System D is equipped with the autofocus function. This function allows for automatic hardness testing, thereby increasing efficiency and reducing labor costs.



Automatic measurement of indentation / motorized XY stage / Autofocusing

CAUTION: The **AVPAK-20** software package is not for use and/or export to the United States of America. The **AVPAK-10** software package is for the United States of America.

AVK-C0 SERIES 810 — Vickers Hardness Testing Machines

- A basic Vickers hardness testing machine that is easy to use and economical.

*Refer to the table on page M-5 for specifications.



Refer to the Hardness Testing Machines (Catalog No. E17001) for more details.

Hardness Testing Machines

Start quality control from the material — Mitutoyo's hardness testing machines can handle it



An inspection certificate is supplied as standard. Refer to page X for details.

HR-100/200/300/400 SERIES 963 — Rockwell Hardness Testing Machines



963-210
HR-110MR

963-220
HR-210MR

963-231
HR-320MS

963-240
HR-430MR

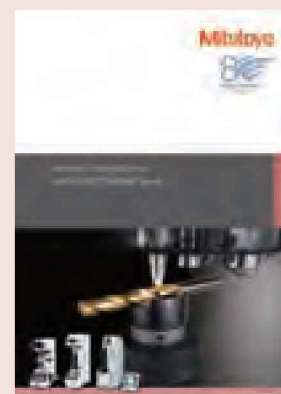
963-241
HR-430MS

- This series is economy type Rockwell hardness testing machines. We have a lineup of 5 models consisting of a digital display type and an analog display type.

SPECIFICATIONS

Order No.	963-210	963-220*	963-231*	963-240*	963-241*
Model	HR-110MR	HR-210MR	HR-320MS	HR-430MR	HR-430MS
Supported hardnesses	Rockwell hardness				
Preliminary test force (N)	—	—	Rockwell Superficial hardness	—	Rockwell Superficial hardness
Test force (N)	98.07		29.42 98.07	98.07	29.42 98.07
Superficial	—		147.1 294.2 441.3	—	147.1 294.2 441.3
Rockwell	—		588.4 980.7 1471	—	—
Standard	JIS B 7726 ISO6508-2 (ASTM E18)				
Hardness display	Analog		Digital		
Resolution	0.5HR graduation		0.1HR indication		
Preliminary test force (handling support)	Automatic pre-setting dial indicator		Loading navigator indication	Automatic steering wheel brake	
Preliminary test force switching	—	—	—	Dial switching	Dial switching
Total test force switching	Weight change			Dial switching	
Total test force load operation	Manual/lever operation	Motor drive, Button start		Motor drive, Automatic start	
Test force duration	Manual operation	Fixed 3-3.5s or manual operation	1-99s setting or manual operation (Can be set to any value in units of 1s)		
Maximum specimen height	180mm (100mm if cover is attached)				
Maximum specimen depth	165mm (from indenter axis to the frame)				
Function	—	—	OK/NG judgment function, Compensation function, Hardness conversion function		
Data output interface	—	—	S-232C, SPC (ON/OFF selectable in each output type)		
Power supply	No power required		100-240V AC 1.2A (AC adapter DC12V 3.5A)		
External dimensions	296(W) x 512(D) x 780(H)mm		214(W) x 512(D) x 780(H)mm		
Mass	49kg	46kg	47kg	49kg	50kg

Note: Using special accessories (optional), the Brinell indenter and measuring microscope, enables users to perform the Brinell hardness test.



Refer to the Hardness Testing Machines (Catalog No. E17001) for more details.



An inspection certificate is supplied as standard. Refer to page X for details.

wiZhard HR-500 SERIES 810 — Rockwell Hardness Testing Machines

- With the HR-500, the hardness of even the inside wall of a pipe-shaped specimen can be tested without cutting the specimen in half. What is more, the HR-500 can perform 3 types of hardness tests, not only Rockwell and Rockwell superficial but also Brinell, by introducing our proprietary electronic control technology and providing the Brinell hardness testing load sequence.



SPECIFICATIONS

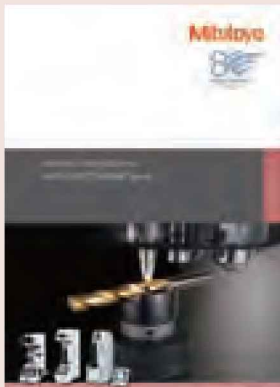
Order No.	810-202/810-205*1		810-203/810-206*1			810-204/810-207*1	
Model	HR-521/HR-521L		HR-522/HR-522L			HR-523/HR-523L	
Type of hardness test	Rockwell hardness/Rockwell Superficial hardness/Brinell hardness*2						
Standards	JIS B 7726 ISO6508-2 (ASTM E18)						
Preliminary test force (N)	29.42		98.07				
Total test force (N)	147.1		294.2		441.3		
Superficial			588.4		980.7		
Rockwell			1471				
Brinell	1839		61.29		98.07		153.2
			306.5		612.9		980.7
Test force control	Auto (load, duration, unload)						
Preliminary test force (handling support)	Manual (automatic brake and automatic load sequence)					Motor driven (manual operation is also available)	
Total test force switching	Switch operation touch panel						
Test force switching	Switch operation						
Test force duration time	0 to 120s (Can be set to any value in units of 1s.)						
Specimen maximum dimensions	Height: 250mm (Long type: 395mm) Depth: 150mm (between indenter shaft and test machine main unit)						
Allowable inner diameter of pipe specimen	Minimum hole diameter: 35mm (When the special specification indenter is used: 22mm)						
Function	Conversion function [HV, HK, HR (Rockwell hardness A, B, C, D, F, G / Rockwell Superficial 15T, 30T, 45T, 15N, 30N, 45N), HS, HB, Tensile strength]						
	OK/NG judgment function						
	Continuous measurement function (for specimens of the same thickness)						
	Cylindrical correction, spherical correction, offset correction, multi-point correction functions						
	Statistical calculation function						
External connection interface	For printer: Serial interface (compatible with the RS-232C standard), Digimatic interface, Centronics interface						
Power supply	100V AC, approx. 40VA or less, (120/220/240V AC set on shipment from factory.)						
External dimensions	Body: Approx. 250(W) x 670(D) x 605(H)mm, (Long types: 750(H)mm), Approx. 65kg (Long types: Approx. 75kg)						
Mass	Operation panel: Approx. 165 (W) x 260 (D) x 105 (H)mm approx. 0.75kg						

Order No. and Models for long types: **810-205*1**: HR-521L **810-206*1**: HR-522L **810-207*1**: HR-523L

*1 To denote your AC power cable add the following suffixes to the order No.:

A for UL/CSA, D for CEE, DC for CCC, E for BS, K for KC, C and No suffix are required for PSE.

*2 For Brinell hardness testing, an indenter (option) and a measurement microscope are required.



Refer to the Hardness Testing Machines (Catalog No. E17001) for more details.

Hardness Testing Machines

Start quality control from the material — Mitutoyo's hardness testing machines can handle it

HARDMATIC HH-411 SERIES 810 — Rebound Type Portable Hardness Tester



SPECIFICATIONS

Order No.	810-299 (JIS), 810-298 (ASTM)
Model	HH-411
Detector	Impact hammer with integrated detector and carbide-ball tip (D type: conforming to ASTM A 956)
Display unit	7-segment LCD
Hardness display range	Leeb hardness: 1 to 999HL
Display range (This display range varies depending on the conversion table used.)	Vickers hardness: 43 to 950HV Brinell hardness: 20 to 894HB Rockwell hardness (C scale): 19.3 to 68.2HRC Rockwell hardness (B scale): 13.5 to 101.7HRB Shore hardness: 13.2 to 99.3HS Tensile strength: 499 to 1996MPa
Function	Automatic angle correction Offset Pass or fail decision function Data save: 1800 Points Conversion (details in display range) Statistical calculation function Auto-sleep Dotting count display
Specimen requirements	Min. specimen thickness of 5mm or more and mass of 5kg or more (However, a specimen of mass of 0.1 to 5kg is measurable by securing to a massive base) Testing point: 5mm or more from edge of specimen, 3mm or more between testing points Specimen surface roughness: Ra of 2 μ m or less
Output	Digimatic interface Serial interface (RS-232C)
Power supply	Alkaline AA battery 2pcs or optional AC adapter (battery life: 70 hours)
External dimensions/Mass	Detector: ϕ 28x175mm in length, 120g Display: 70(W)x110(D)x35(H)mm, Approx. \pm 200g

* For elastic materials such as rubber, measurement cannot be performed.

The principle behind the Leeb hardness test is that the hardness is obtained by the rebound behavior of an impact hammer after a light blow on the specimen.

Therefore be aware that the test results are susceptible to the effect of the size (especially thickness) and surface roughness of a workpiece.



An inspection certificate is supplied as standard. Refer to page X for details.

- Excellent operability that performs hardness tests with the touch of a key and a compact body allows users to measure hardness at any fields. This instrument is best suited for on-site hardness tests such as large molds, railroad track, and welded spots in structures.



Refer to the Hardness Testing Machines (Catalog No. E17001) for more details.



An inspection certificate is supplied as standard.
Refer to page X for details.

- Hardness measurement by durometer is simply performed by holding the instrument against the surface of a specimen and reading the indicated value. This type of hardness tester is most widely used for hardness testing of sponge, rubber, plastic and other soft materials.

HARDMATIC HH-300 (Analog type) SERIES 811 — Durometers for Sponge, Rubber, and Plastics

Compact type



811-329-10 HH-329
811-335-10 HH-335
811-337-10 HH-337
811-335-11 HH-335-01
811-337-11 HH-337-01

Long type



811-331-10
HH-331
811-333-10
HH-333

SPECIFICATIONS

Order No.	811-329-10	811-331-10	811-333-10	811-335-10	811-335-11	811-337-10	811-337-11
Model No.	HH-329	HH-331	HH-333	HH-335	HH-335-01	HH-337	HH-337-01
Type	Compact	Long		Compact			
Measurement target	Soft rubber, sponge, felt, hard film	General rubber, soft plastic	hard rubber, hard plastic, ebonite	General rubber, soft plastic		hard rubber, hard plastic, ebonite	
Classification by specification	Type E	Type A	Type D	Type A		Type D	
Needle shape	Shaft diameter	—		ø1.25mm			
	Tip shape	Semi-sphere	Circular truncated cone	Cone	Circular truncated cone		Cone
	Tip angle	—	35°	30°	35°		30°
	Tip diameter	ø5mm	ø0.79mm	—	ø0.79mm		—
	Tip curvature	—	—	0.1mm	—		0.1mm
Needle platform	44x18mm	ø18mm		44x18mm	ø18mm	44x18mm	ø18mm
Protrusion of needle from platform	—			2.5mm			
Graduation	1						
Loading device W _E , W _A , W _D : spring force (mN) H _E , H _A , H _D : hardness	Coil spring W _E =550+75H _E (10 degrees 1300mN, 90 degrees 7300mN)	Coil spring W _A =550+75H _A (H _A : 10 - 90) (10 degrees 1300mN, 90 degrees 7300mN)	Coil spring W _D =444.5H _D (H _D : 20 to 90) (20 degrees 8890mN, 90 degrees 40005mN)	Coil spring W _A =550+75H _A (H _A : 10 - 90) (10 degrees 1300mN, 90 degrees 7300mN)		Coil spring W _D =444.5H _D (H _D : 20 to 90) (20 degrees 8890mN, 90 degrees 40005mN)	
Function	Peak hold						
External dimensions (WxDxH)	68x34x146mm	68x35x188mm		68x34x146mm			
Mass	300g	320g		300g	270g	300g	270g



Refer to the Hardness Testing Machines
(Catalog No. E17001) for more details.

Hardness Testing Machines

Start quality control from the material — Mitutoyo's hardness testing machines can handle it

HARDMATIC HH-300 (Digital type)

SERIES 811 — Durometers for Sponge, Rubber, and Plastics

Compact type



811-330-10 HH-330
811-336-10 HH-336
811-338-10 HH-338
811-336-11 HH-336-01
811-338-11 HH-338-01

Long type



811-332-10 HH-332
811-334-10 HH-334

SPECIFICATIONS

Order No.	811-330-10	811-332-10	811-334-10	811-336-10	811-336-11	811-338-10	811-338-11
Model No.	HH-330	HH-332	HH-334	HH-336	HH-336-01	HH-338	HH-338-01
Type	Compact	Long		Compact			
Measurement target	Soft rubber, sponge, felt, hard film	General rubber, soft plastic	hard rubber, hard plastic, ebonite	General rubber, soft plastic		hard rubber, hard plastic, ebonite	
Classification by specification	Type E	Type A	Type D	Type A		Type D	
Needle shape	Shaft diameter	—	—	ø1.25mm		—	
	Tip shape	Semi-sphere	Circular truncated cone	Cone	Circular truncated cone		Cone
	Tip angle	—	35°	30°	35°		30°
	Tip diameter	ø5mm	ø0.79mm	—	ø0.79mm		—
	Tip curvature	—	—	0.1mm	—		0.1mm
Needle platform	44x18mm	ø18mm		44x18mm	ø18mm	44x18mm	ø18mm
Protrusion of needle from platform	2.5mm						
Graduation	0.1						
Loading device W _E , W _A , W _D : spring force (mN) H _E , H _A , H _D : hardness	Coil spring W _E =550+75H _E (10 degrees 1300mN, 90 degrees 7300mN)	Coil spring W _A =550+75H _A (H _A : 10-90) (10 degrees 1300mN, 90 degrees 7300mN)	Coil spring W _D =444.5H _D (H _D : 20 to 90) (20 degrees 8890mN, 90 degrees 40005mN)	Coil spring W _A =550+75H _A (H _A : 10-90) (10 degrees 1300mN, 90 degrees 7300mN)		Coil spring W _D =444.5H _D (H _D : 20 to 90) (20 degrees 8890mN, 90 degrees 40005mN)	
Function	Hold function, Output function: Digimatic interface for printer, Tolerance judgment, Function lock						
Power supply	Button silver oxide battery SR44						
External dimensions (WxDxH)	59x40x147mm	59x41x190mm		59x40x147mm			
Mass	290g	310g		290g	260g	290g	260g

Optional Accessories for Dual-purpose Stand CTS Series

The CTS Series can be combined with the HH-300 Series for (1) hardness measurement, and (2) spring force testing of the HH-300 Series hardness tester main unit.

(3) By connecting the attached weight directly to the hardness tester to perform hardness measurement results in better repeatability than can be obtained compared to hardness measurement made by directly pressing the hardness tester against the workpiece by hand. This measurement method with a weight directly connected to the hardness tester is useful for measuring the hardness of large samples for which the stand cannot be used, as well as hardness measurement in the field.

The CTS Series includes 3 models for different hardness tester types. All 3 models can be used for (1), (2), and (3) above with one stand by adding a separately available accessory.

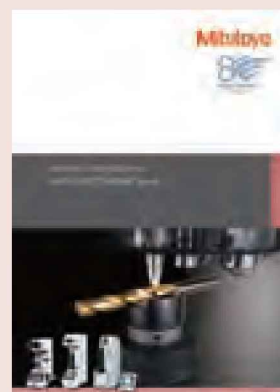
811-019 CTS-101



811-013 CTS-103



Order No.	811-019	811-012	811-013
Model	CTS-101	CTS-102	CTS-103
Applicable model	HH-331, 332	HH-333, 334, 337, 338	HH-335, 336



Refer to the Hardness Testing Machines (Catalog No. E17001) for more details.

Quick Guide to Precision Measuring Instruments



Hardness Testing Machines

■ Hardness Test Methods and Guidelines for Selection of a Hardness Testing Machine

Test Method	Micro Vickers	Micro surface material characteristics	Vickers	Rockwell	Rockwell Superficial	Durometer	Rebound type portable	Brinell	Shore
Material									
IC wafer	●	●							
Carbide, ceramics (cutting tool)		▲	●	●					
Steel (heat-treated material, raw material)	●	▲	●	●	●		●		●
Non-ferrous metal	●	▲	●	●	●		●		
Plastic		▲		●		●			
Grinding wheel				●					
Casting								●	
Sponge, rubber						●			
Shape									
Thin metal sheet (safety razor, metal foil)	●	●	●		●				
Thin film, plating, painting, surface layer (nitrided layer)	●	●							
small parts, acicular parts (clock hand, sewing-machine needle)	●	▲							
Large specimen (structure)							●	●	●
Metallic material configuration (hardness for each phase of multilayer alloy)	●	●							
Plastic plate	▲	▲		●		●			
Sponge, rubber plate						●			
Inspection, judgment									
Strength or physical property of materials	●	●	●	●	●	●	▲	●	●
Heat treatment process	●		●	●	●		▲		▲
Carburized case depth	●		●						
Decarburized layer depth	●		●		●				
Flame or high-frequency hardening layer depth	●		●	●					
Hardenability test			●	●					
Maximum hardness of a welded spot			●						
Weld hardness			●	●					
High-temperature hardness (high-temperature characteristics, hot-workability)			●						
Fracture toughness (ceramics)	●		●						

Key: ● Well-suited ▲ Reasonably suited



Methods of Hardness Measurement

(1) Vickers

Vickers hardness is a test method that has the widest application range, allowing hardness inspection with an arbitrary test force. This test has an extremely large number of application fields particularly for hardness tests conducted with a test force less than 9.807N (1kgf). As shown in the following formula, Vickers hardness is a value determined by dividing test force F (N) by contact area S (mm^2) between a specimen and an indenter, which is calculated from diagonal length d (mm, mean of two directional lengths) of an indentation formed by the indenter (a square pyramidal diamond, opposing face angle $\theta=136^\circ$) in the specimen using a test force F (N). k is a constant ($1/g=1/9.80665$).

$$HV = k \frac{F}{S} = 0.102 \frac{F}{S} = 0.102 \frac{2F \sin \frac{\theta}{2}}{d^2} = 0.1891 \frac{F}{d^2}$$

F : N
 d : mm

The error in the calculated Vickers hardness is given by the following formula. Here, Δd_1 , Δd_2 , and 'a' represent the measurement error that is due to the microscope, an error in reading an indentation, and the length of an edge line generated by opposing faces of an indenter tip, respectively. The unit of $\Delta \theta$ is degrees.

$$\frac{\Delta HV}{HV} = \frac{\Delta F}{F} - 2 \frac{\Delta d_1}{d} - 2 \frac{\Delta d_2}{d} - \frac{a^2}{d^2} \cdot 3.5 \times 10^{-3} \Delta \theta$$

(2) Knoop

As shown in the following formula, Knoop hardness is a value obtained by dividing test force by the projected area A (mm^2) of an indentation, which is calculated from the longer diagonal length d (mm) of the indentation formed by pressing a rhomboidal diamond indenter (opposing edge angles of $172^\circ 30'$ and 130°) into a specimen with test force F applied. Knoop hardness can also be measured by replacing the Vickers indenter of a microhardness testing machine with a Knoop indenter.

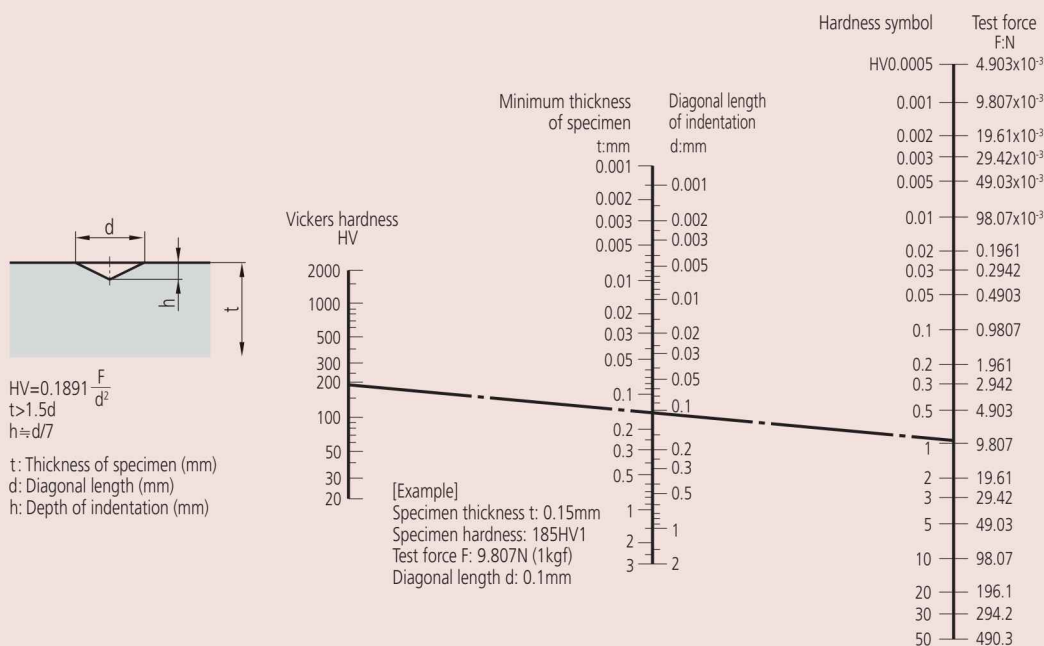
$$HK = k \frac{F}{A} = 0.102 \frac{F}{A} = 0.102 \frac{F}{cd^2} = 1.451 \frac{F}{d^2}$$

F : N
 d : mm
 c : Constant

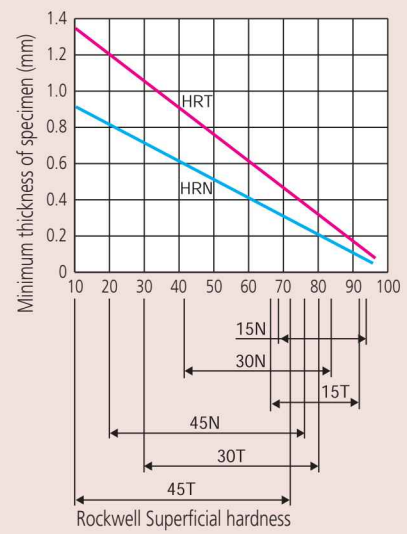
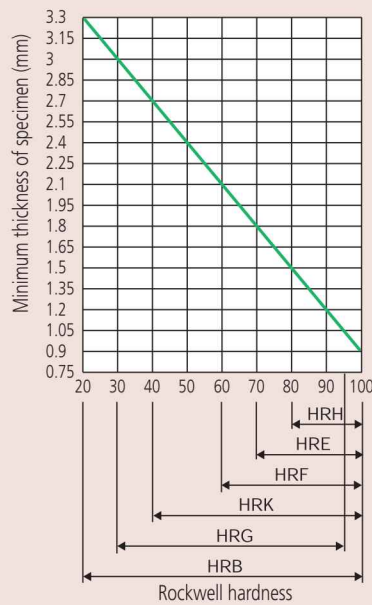
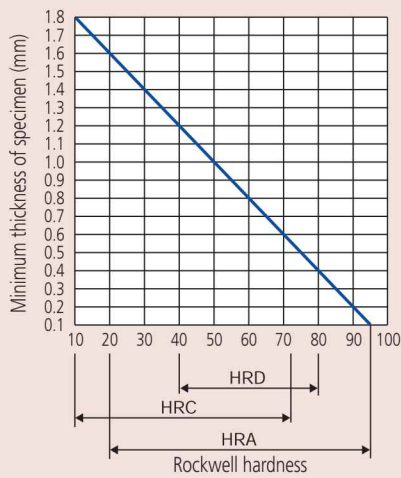
(3) Rockwell and Rockwell Superficial

To measure Rockwell or Rockwell Superficial hardness, first apply a preload force and then the test force to a specimen and return to the preload force using a diamond indenter (tip cone angle: 120° , tip radius: 0.2mm) or a sphere indenter (steel ball or carbide ball). This hardness value is obtained from the hardness formula expressed by the difference in indentation depth h (μm) between the preload and test forces. Rockwell uses a preload force of 98.07N, and Rockwell Superficial 29.42N. A specific symbol provided in combination with a type of indenter, test force, and hardness formula is known as a scale. Japanese Industrial Standards (JIS) define various scales of related hardness.

Relationship between Vickers Hardness and the Minimum Allowable Thickness of a Specimen



Relationship between Rockwell/Rockwell Superficial Hardness and the Minimum Thickness of a Specimen



Rockwell Hardness Scales

Scale	Indenter	Test force	Application
A	Diamond	588.4N	Carbide, sheet steel
D		980.7N	Case-hardened steel
C		1471N	Steel (100HRB or more to 70HRC or less)
F	Sphere of 1.5875mm diameter	588.4N	Bearing metal, annealed copper
B		980.7N	Brass
G		1471N	Hard aluminum alloy, beryllium copper, phosphor bronze
H	Sphere of 3.175mm diameter	588.4N	Bearing metal, grinding wheel
E		980.7N	Bearing metal
K	Sphere of 6.35mm diameter	1471N	Bearing metal
L		588.4N	Plastic, lead
M	980.7N		
P	1471N		
R	Sphere of 12.7mm diameter	588.4N	Plastic, lead
S		980.7N	
V		1471N	

Rockwell Superficial Hardness Scales

Scale	Indenter	Test force	Application
15-N	Diamond	147.1N	Thin surface-hardened layer on steel such as carburized or nitrided
30-N		294.2N	
45-N		441.3N	
15-T	Sphere of 1.5875mm diameter	147.1N	Sheet of mild steel, brass, bronze, etc.
30-T		294.2N	
45-T		441.3N	
15-W	Sphere of 3.175mm diameter	147.1N	Plastic, zinc, bearing alloy
30-W		294.2N	
45-W		441.3N	
15-X	Sphere of 6.35mm diameter	147.1N	Plastic, zinc, bearing alloy
30-X		294.2N	
45-X		441.3N	
15-Y	Sphere of 12.7mm diameter	147.1N	Plastic, zinc, bearing alloy
30-Y		294.2N	
45-Y		441.3N	

New Products



Ultra-high Accuracy CNC CMM

MICROCORD LEGEX Series

Refer to page N-11 - N-12 for details.



In-line CNC Coordinate Measuring System

MICROCORD MACH-3A Series

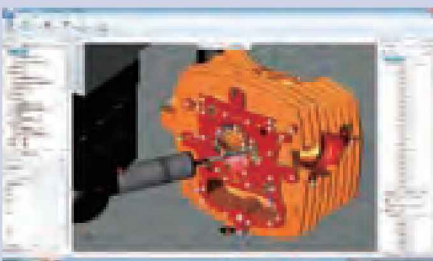
Refer to page N-15 for details.



Non-contact Line-Laser Probe for CMM

SurfaceMeasure

Refer to page N-19 for details.



Automatic measurement program generation software

MiCAT Planner

Refer to page N-23 - N-24 for details.



N

Coordinate Measuring Machines

MICROCORD (CMM)

Coordinate Measuring Machines



INDEX

MICROCORD (CMM)

CRYSTA-Apex S500/700/900 Series	N-3
CRYSTA-Apex S1200/1600/2000 Series	N-4
CRYSTA-Apex EX 500T/700T/900T Series	N-5
CRYSTA-Apex EX 1200R Series	N-6
STRATO-Apex Series	N-7
FALCIO-Apex 2000/3000 Series	N-9
Crysta-Apex C203016G/306020G	N-10
LEGEX Series	N-11
CARBstrato	N-13
CARBapex	N-14
MACH-3A 653	N-15
MACH-V 9106	N-15
MACH Ko-ga-me	N-16
Crysta-Plus M Series	N-17
CMM Probes	N-19
MCOSMOS	N-21
MiCAT Planner	N-23
MSURF	N-25
SpinArm-Apex	N-27
Clamping Tools	N-29
Quick Guide to Precision Measuring Instruments	N-30

Note: All Mitutoyo CNC CMM's manufactured since 2008 incorporate a main unit Startup system (relocation detection system), which disables operation when an unexpected vibration has occurred or the machine has been relocated. Be sure to contact your nearest Mitutoyo Sales Office prior to relocating your machine after initial installation.

Coordinate Measuring Machines

Precision measuring technology with three dimensions

Standard CNC CMM MICROCORD CRYSTA-Apex S500/700/900 Series

- The CRYSTA-Apex S500/700/900 series, CNC CMMs attain high accuracy (1/7 μ m), high speed, and high acceleration. This series offers flexibility with a wide variety of models for various workpiece sizes.
- The scale systems on Mitutoyo high-precision models utilizes a high-performance linear encoder (manufactured by Mitutoyo), for detecting axis position. In addition, various technologies have been utilized in the structure, part processing, and assembly to provide high accuracy measurement.
- Floor vibration at the installation location, can be a source of variations in measured values. The auto-leveling air spring vibration isolator is available as an option for CRYSTA-Apex S500/700/900 series. The vibration isolator insulates the main unit from floor vibrations and can quickly levels the CMM main unit, using a sensor that detects load fluctuations caused by axis movement of the CMM or workpiece loading.

- All CRYSTA-Apex S high-precision series CMM's are equipped with temperature compensation and therefore do not require a temperature controlled room. Accuracy is guaranteed within the range of 16 to 26°C.
- Refer to the CRYSTA-Apex S Series leaflet (Catalog No.E16004) for more details.



CRYSTA-Apex S 544



CRYSTA-Apex S 776



CRYSTA-Apex S 9106

SPECIFICATIONS

Model		CRYSTA-Apex S 544	CRYSTA-Apex S 574	CRYSTA-Apex S 776	CRYSTA-Apex S 7106	CRYSTA-Apex S 9106 (Z600) /9108 (Z800)	CRYSTA-Apex S 9166 (Z600) /9168 (Z800)	CRYSTA-Apex S 9206 (Z600) /9208 (Z800)	
Measuring range	X axis	500mm			700mm		900mm		
	Y axis	400mm	700mm	700mm	1000mm	1000mm	1600mm	2000mm	
	Z axis	400mm			600mm		600mm/800mm		
Maximum measuring speed		8mm/s			8mm/s		8mm/s (3mm/s for Z800 type)		
Drive speed		Each axis 8 to 300mm/s (CNC Mode), Maximum combined speed 519mm/s 0 to 80mm/s (J/S Mode: High Speed) 0 to 3mm/s (J/S Mode: Low Speed) 0.05mm/s (J/S Mode: Fine Speed)			Each axis 8 to 300mm/s (CNC Mode), Maximum combined speed 519mm/s 0 to 80mm/s (J/S Mode: High Speed) 0 to 3mm/s (J/S Mode: Low Speed) 0.05mm/s (J/S Mode: Fine Speed)		Each axis 8 to 300mm/s (CNC Mode), Maximum combined speed 519mm/s 0 to 80mm/s (J/S Mode: High Speed) 0 to 3mm/s (J/S Mode: Low Speed) 0.05mm/s (J/S Mode: Fine Speed)		
Maximum acceleration		Each axis 1333mm/s ² , Maximum combined speed 2309mm/s ²			Each axis 1333mm/s ² , Maximum combined speed 2309mm/s ²		Each axis 1333mm/s ² (1000mm/s ² for Z800 type) Maximum combined speed 2309mm/s ² (1732mm/s ² for Z800 type)		
Resolution		0.0001mm (0.1 μ m)			0.0001mm (0.1 μ m)		0.0001mm (0.1 μ m)		
Guide method		Air bearings on each axis			Air bearings on each axis		Air bearings on each axis		
Maximum measurable height		545mm			800mm		800mm (Z=600mm)/1000mm (Z=800mm)		
Maximum table loading		180kg			800kg	1000kg	1200kg	1500kg	1800kg
Mass (including the control device and installation platform)		515kg	625kg	1675kg	1951kg	2231kg (Z=600mm)	2868kg (Z=600mm)	3912kg (Z=600mm)	
						2261kg (Z=800mm)	2898kg (Z=800mm)	3942kg (Z=800mm)	
Air supply	Pressure	0.4MPa			0.4MPa		0.4MPa		
	Consumption	50L/min under normal conditions (air source: 100L/min)			60L/min under normal conditions (air source: 120L/min)		60L/min under normal conditions (air source: 120L/min)		

Note: While the appearance of the natural stone measuring table varies according to the source, the high stability for which this material is known can always be relied upon.

CRYSTA-Apex S 500/700/900 Series Accuracy

Unit: μ m

Probe used	Max. permissible length measurement error	Repeatability range of E ₀	Max. permissible single stylus form error
SP25M	E ₀ , MPE=1.7+3L/1000 (Temperature environment 1) E ₁₅₀ , MPE=1.7+3L/1000 (Temperature environment 1) E ₀ , MPE=1.7+4L/1000 (Temperature environment 2) E ₁₅₀ , MPE=1.7+4L/1000 (Temperature environment 2)	R ₀ , MPL=1.3	P _{FTH} , MPE=1.7

* L=Measuring length (unit: mm)

* Table at right defines temperature environments 1 and 2

CRYSTA-Apex S 500/700/900 Series Accuracy

Unit: μ m

Probe used	Max. permissible scanning error (MPE _{THP})
SP25M (Stylus: ϕ 4 x 50 mm)	2.3

CRYSTA-Apex S 500/700/900 Series Installation Temperature

		Temperature environment 1	Temperature environment 2
Limits within which accuracy is guaranteed	Temperature Range	20 \pm 2 °C	16 - 26 °C
	Rate of change	2 °C per hour or less 2 °C in 24 hours or less	2 °C per hour or less 5 °C in 24 hours or less
	Gradient	1 °C or less per meter	1 °C or less per meter

Standard CNC CMM MICROCORD CRYSTA-Apex S1200/1600/2000 Series

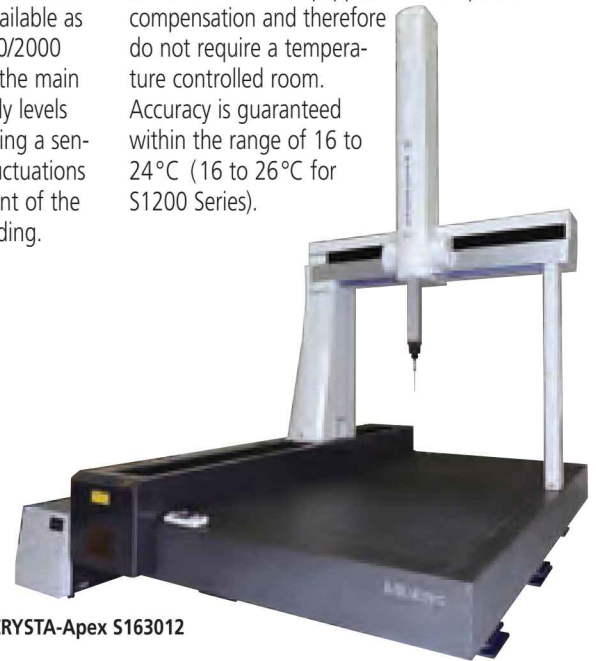
- The CRYSTA-Apex S1200/1600/2000 Series are large-sized CNC CMMs developed for supporting quality evaluation of large parts.
- The scale systems on Mitutoyo high-precision models utilizes a high-performance linear encoder (manufactured by Mitutoyo), for detecting axis position. In addition, various technologies have been utilized in the structure, part processing, and assembly to provide high accuracy measurement.
- Refer to the large Bridge and Gantry CNC CMM leaflet (Catalog No.E16009) for more details.

- Floor vibration at the installation location, can be a source of variations in measured values. The auto-leveling air spring vibration isolator is available as an option for CRYSTA-Apex S1200/1600/2000 Series. The vibration isolator insulates the main unit from floor vibrations and can quickly levels the CMM main unit, using a sensor that detects load fluctuations caused by axis movement of the CMM or workpiece loading.

- All CRYSTA-Apex S1200/1600/2000 high-precision series CMM's are equipped with temperature compensation and therefore do not require a temperature controlled room. Accuracy is guaranteed within the range of 16 to 24°C (16 to 26°C for S1200 Series).



CRYSTA-Apex S122010



CRYSTA-Apex S163012

SPECIFICATIONS

Model		CRYSTA-Apex S 121210	CRYSTA-Apex S 122010	CRYSTA-Apex S 123010	CRYSTA-Apex S 162012(Z1200)/162016(Z1600)	CRYSTA-Apex S 163012(Z1200)/163016(Z1600)	CRYSTA-Apex S 164012(Z1200)/164016(Z1600)	CRYSTA-Apex S 203016	CRYSTA-Apex S 204016
Measuring range	X axis	1200mm			1600mm			2000mm	
	Y axis	1200mm	2000mm	3000mm	2000mm	3000mm	4000mm	3000mm	4000mm
	Z axis	1000mm			1200mm/1600mm			1600mm	
Maximum measuring speed		5mm/s			3mm/s			3mm/s	
Drive speed		8 to 400mm/s (CNC Mode), Maximum combined speed 693mm/s 0 to 80mm/s (I/S Mode: High Speed) 0 to 3mm/s (I/S Mode: Low Speed) 0.05mm/s (I/S Mode: Fine Speed)			8 to 400mm/s (CNC Mode), Maximum combined speed 693mm/s 0 to 80mm/s (I/S Mode: High Speed) 0 to 3mm/s (I/S Mode: Low Speed) 0.05mm/s (I/S Mode: Fine Speed)			8 to 400mm/s (CNC Mode), Maximum combined speed 693mm/s 0 to 80mm/s (I/S Mode: High Speed) 0 to 3mm/s (I/S Mode: Low Speed) 0.05mm/s (I/S Mode: Fine Speed)	
Maximum acceleration		Each axis 1000mm/s ² , Maximum combined speed 1732mm/s ²			Each axis 800mm/s ² , Maximum combined speed 1386mm/s ²			Each axis 800mm/s ² , Maximum combined speed 1386mm/s ²	
Resolution		0.001mm (0.1µm)			0.001mm (0.1µm)			0.001mm (0.1µm)	
Guide method		Air bearings on each axis			Air bearings on each axis			Air bearings on each axis	
Maximum measurable height		1200mm			1400mm (Z=1200mm)/1800mm (Z=1600mm)			1800mm	
Maximum table loading		2000kg	2500kg	3000kg	3000kg	3500kg	4500kg	4000kg	5000kg
Mass (including the control device and installation platform)		4050kg	6150kg	9110kg	9300kg (Z=1200mm) 9350kg (Z=1600mm)	10600kg (Z=1200mm) 10650kg (Z=1600mm)	14800kg (Z=1200mm) 14850kg (Z=1200mm)	14100kg	19400kg
Air supply	Pressure	0.4MPa			0.4MPa			0.4MPa	
	Consumption	100L/min under normal conditions (air source: 150L/min)			150L/min under normal conditions (air source: 200L/min)			150L/min under normal conditions (air source: 200L/min)	

Note: While the appearance of the natural stone measuring table varies according to the source, the high stability for which this material is known can always be relied upon.

● CRYSTA-Apex S 1200 Series Accuracy Unit: µm

Probe used	Max. permissible length measurement error ISO 10360-2:2009
SP25M	E ₀ , MPE=2.3+3L/1000 (Temperature environment 1)
	E ₁₅₀ , MPE=2.3+3L/1000 (Temperature environment 1)
	E ₀ , MPE=2.3+4L/1000 (Temperature environment 2)
	E ₁₅₀ , MPE=2.3+4L/1000 (Temperature environment 2)

* L=Measuring length (unit: mm)
* Table below describes temperature environments 1 and 2.

● CRYSTA-Apex S 1600 Series Accuracy Unit: µm

Probe used	Max. permissible length measurement error ISO 10360-2:2009
SP25M	E ₀ , MPE=3.3+4.5L/1000 (4.5+5.5L/1000) (Temperature environment 1)
	E ₁₅₀ , MPE=3.3+4.5L/1000 (4.5+5.5L/1000) (Temperature environment 1)
	E ₀ , MPE=3.3+5.5L/1000 (4.5+6.5L/1000) (Temperature environment 2)
	E ₁₅₀ , MPE=3.3+5.5L/1000 (4.5+6.5L/1000) (Temperature environment 2)

* L=Measuring length (unit: mm)
* Table below describes temperature environments 1 and 2.
* () indicates Z: 1600 mm specification

● CRYSTA-Apex S 2000 Series Accuracy Unit: µm

Probe used	Max. permissible length measurement error ISO 10360-2:2009
SP25M	E ₀ , MPE=4.5+8L/1000 (Temperature environment 1)
	E ₁₅₀ , MPE=4.5+8L/1000 (Temperature environment 1)
	E ₀ , MPE=4.5+9L/1000 (Temperature environment 2)
	E ₁₅₀ , MPE=4.5+9L/1000 (Temperature environment 2)

* L=Measuring length (unit: mm)
* Table below describes temperature environments 1 and 2.

● CRYSTA-Apex S 1200 Series Installation Temperature

		Temperature environment 1	Temperature environment 2
Limits with- in which accuracy is guaranteed	Temperature Range	20±2 °C	16 - 26 °C
	Rate of change	2 °C per hour or less	2 °C per hour or less 5 °C in 24 hours or less
	Gradient	1 °C or less per meter	1 °C or less per meter

● CRYSTA-Apex S 1600 Series Installation Temperature

		Temperature environment 1	Temperature environment 2
Limits with- in which accuracy is guaranteed	Temperature Range	20±2 °C	20±4 °C
	Rate of change	1 °C per hour or less 2 °C in 24 hours or less	1 °C per hour or less 5 °C in 24 hours or less
	Gradient	1 °C or less per meter	1 °C or less per meter

● CRYSTA-Apex S 2000 Series Installation Temperature

		Temperature environment 1	Temperature environment 2
Limits with- in which accuracy is guaranteed	Temperature Range	20±2 °C	20±4 °C
	Rate of change	1 °C per hour or less 2 °C in 24 hours or less	1 °C per hour or less 5 °C in 24 hours or less
	Gradient	1 °C or less per meter	1 °C or less per meter

Coordinate Measuring Machines

Precision measuring technology with three dimensions

Standard CNC CMM MICROCORD CRYSTA-Apex EX 500T/700T/900T Series

- The CRYSTA-Apex EX 500T/700T/900T series CNC CMMs are equipped with the PH20 probe head and TP20 probe to create a range of standard 5-axis measuring machines.
- 5-axis operation reduces the time required for probe rotational movements and allows more flexible positioning. This also ensures easy access to complex workpieces and saves time during both programming and measurement.
- In addition to 3-axis point measurement similar to conventional coordinate measuring machines, the PH20 probe head also supports 'head touch' operation for rapid measurement using the two rotational axes of the probe head only, with no movement required along the CMM axes.
- All styli modules designed for the TP20 probe may be used. Automatic probe changeover is also supported.
- Even without the workpiece to be measured, a measurement program can be created on a PC using 3D CAD data. Compared to joystick operation, this makes for more efficient programming and also allows interference checking.



CRYSTA-Apex EX 544T



Specification of PH20

Rotation angle (Resolution)	Vertical (A-axis)	-115° to +115° (0.08sec)
	Horizontal (B-axis)	∞ (0.08sec)
Maximum stylus length	50mm	



Programming with a 3D CAD model



Refer to the CRYSTA-Apex EX Series leaflet (Catalog No.E16015) for more details.

SPECIFICATIONS

Items	Model	CRYSTA-Apex EX 544T	CRYSTA-Apex EX 574T	CRYSTA-Apex EX 776T	CRYSTA-Apex EX 7106T	CRYSTA-Apex EX 9106T	CRYSTA-Apex EX 9166T	CRYSTA-Apex EX 9206T
Measuring range	X axis	500mm		700mm		900mm		2000mm
	Y axis	400mm	700mm	700mm	1000mm	1000mm	1600mm	
	Z axis	400mm		600mm		600mm		
Drive speed	CNC MODE	Drive speed 8 - 300mm/s		Drive speed 8 - 300mm/s		Drive speed 8 - 300mm/s		
	J/S MODE	Measuring Speed 1 - 10mm/s		Measuring Speed 1 - 10mm/s		Measuring Speed 1 - 10mm/s		
Resolution		0.0001mm (0.1µm)		0.0001mm (0.1µm)		0.0001mm (0.1µm)		
Guide method		Air bearings on each axis		Air bearings on each axis		Air bearings on each axis		
Table loading	Maximum height	545mm		800mm		800mm		
	Maximum mass	180kg		800kg	1000kg	1200kg	1500kg	1800kg
Mass (including the control device and installation platform)		536kg	646kg	1696kg	1972kg	2252kg	2889kg	3933kg
Air supply	Pressure	0.4MPa		0.4MPa		0.4MPa		
	Consumption	50 L/min under normal conditions (air supply: 100 L/min)		60 L/min under normal conditions (air supply: 120 L/min)		60 L/min under normal conditions (air supply: 120 L/min)		

Note: While the appearance of the natural stone measuring table varies according to the source, the high stability for which this material is known can always be relied upon.

CRYSTA-Apex EX 500T/700T/900T Series Accuracy Unit: µm

Probe used	Max. permissible length measurement error ISO 10360-2:2009
PH20+TP20	$E_0, MPE=2.2+3L/1000$ (Temperature environment 1)
	$E_0, MPE=2.2+4L/1000$ (Temperature environment 2)

* L=Measuring length (unit: mm)

* Table at right defines temperature environments 1 and 2

CRYSTA-Apex EX 500T/700T/900T Series Installation Temperature

		Temperature environment 1	Temperature environment 2
Limits within which accuracy is guaranteed	Temperature Range	18 - 22 °C	16 - 26 °C
	Rate of change	2 °C per hour or less 2 °C in 24 hours or less	2 °C per hour or less 5 °C in 24 hours or less
	Gradient	1 °C or less per meter	1 °C or less per meter

Standard CNC CMM MICROCORD CRYSTA-Apex EX 1200R Series

- CRYSTA-Apex EX 1200R series products are advanced CNC CMMs equipped with the REVO probe head and a choice of probes to create a range of standard 5-axis measuring machines.
 - Two types of probes are supported: RSP2 for 5-axis scanning and SP25M type RSP3 probe allowing use of a cranked stylus. Automatic changeover of these probes with an auto probe changer is possible, enabling fully automated measurement of parts with diverse shapes.
 - Allows ultra high-speed 5-axis scanning (max. 500 mm/s), far surpassing conventional 3-axis control. Support for high-speed sampling of up to 4,000 points per second allows acquisition of densely spaced measurement points, even during fast scanning.
 - Internal implementation of laser sensing technology ensures high-accuracy measurement, even with long styli (up to 500 mm*).
- *Distance from probe rotation center to stylus tip

- 5-axis operation reduces the time required for probe repositioning movements and allows more flexible positioning. This also facilitates access to complex workpieces and saves time during both programming and measurement.
- Probe calibration of RSP2 requires only about 20 minutes to enable use of the full angular range. Compared to conventional scanning probes, this reduces preparation time.



CRYSTA-Apex EX 123010R

SPECIFICATIONS

Items		Model	CRYSTA-Apex EX 121210R	CRYSTA-Apex EX 122010R	CRYSTA-Apex EX 123010R
Measuring range	X axis			1200mm	
	Y axis		1200mm	2000mm	3000mm
	Z axis		960mm		
Drive speed	CNC MODE		Drive speed 8 - 300mm/s Measuring Speed 1 - 5mm/s		
	J/S MODE		0 - 80mm/s (J/S Mode: High Speed) 0 - 3mm/s (J/S Mode: Low Speed) 0 - 3mm/s (J/S Mode: Touch Speed)		
Drive acceleration			375mm/s ²		
Resolution			0.0001mm (0.1μm)		
Guide method			Air bearings on each axis		
Table loading	Maximum height		1160mm		
	Maximum mass		2000kg	2500kg	3000kg
Mass (including the control device and installation platform)			4050kg	6150kg	9110kg
Air supply	Pressure		CMM: 0.4MPa REVO: 0.5MPa		
	Consumption		150 L/min under normal conditions (air source: 230 L/min or more), 0.6MPa or more		

Note: While the appearance of the natural stone measuring table varies according to the source, the high stability for which this material is known can always be relied upon.

CRYSTA-Apex EX 121210R/122010R/123010R Series Accuracy Unit: μm

Probe used	Max. permissible length measurement error ISO 10360-2:2009
REVO+ RSP2+ RSH250	E ₀ , MPE=2.9+4L/1000 (Temperature environment1) E ₂₅₀ , MPE=2.9+4L/1000 (Temperature environment1) E ₀ , MPE=2.9+5L/1000 (Temperature environment2) E ₂₅₀ , MPE=2.9+5L/1000 (Temperature environment2)
REVO+ RSP3-3+ RSH-3	E ₀ , MPE=2.5+3L/1000 (Temperature environment1) E ₁₅₀ , MPE=2.5+3L/1000 (Temperature environment1) E ₀ , MPE=2.5+4L/1000 (Temperature environment2) E ₁₅₀ , MPE=2.5+4L/1000 (Temperature environment2)

* L=Measuring length (unit: mm)

* Table at right defines temperature environments 1 and 2

CRYSTA-Apex EX 121210R/122010R/123010R Series Installation Temperature

		Temperature environment 1	Temperature environment 2
Limits within which accuracy is guaranteed	Temperature Range	18 - 22 °C	16 - 26 °C
	Rate of change	2 °C per hour or less 2 °C in 24 hours or less	2 °C per hour or less 5 °C in 24 hours or less
	Gradient	1 °C or less per meter	1 °C or less per meter

Helical scan



Gasket scan



Sweep scan



Airfoil section scan



Specification of REVO Scanning Probe

Rotation angle (Resolution)	Vertical (A-axis)	-5° to +120° (0.08sec)
	Horizontal (B-axis)	∞ (0.08sec)
Maximum stylus length	500mm (Distance from probe rotation center to stylus tip)	



Coordinate Measuring Machines

Precision measuring technology with three dimensions

High Accuracy CNC CMM MICROCORD STRATO-Apex 500/700 Series

- The STRATO-Apex series is high-accuracy CNC CMMs. The series guarantees high accuracy and also high moving speed and acceleration achieved with improved rigid air bearings on all axial guideways.
- The scale systems on Mitutoyo high-precision models utilizes a high-performance linear encoder (manufactured by Mitutoyo), for detecting axis position. In addition, various technologies have been utilized in the structure, part processing, and assembly to provide high accuracy measurement.
- Floor vibration at the installation location, can be a source of variations in measured values. The auto-leveling air spring vibration isolator is equipped as standard for 700 Series and an option for model 574. The vibration isolator insulates the main unit from floor vibrations and can quickly levels the CMM main unit, using a sensor that detects load fluctuations caused by axis movement of the CMM or workpiece loading.
- All STRATO-Apex high-precision series CMM's are equipped with temperature compensation and therefore do not require a temperature controlled room. Accuracy is guaranteed within the range of 19 to 21°C for 700 Series and the range of 18 to 22°C for 574 model.



STRATO-Apex 574



STRATO-Apex 776

SPECIFICATIONS

Items		Model	STRATO-Apex 574	STRATO-Apex 776	STRATO-Apex 7106
Measuring range	X axis		500mm	700mm	
	Y axis		700mm	700mm	1000mm
	Z axis		400mm	600mm	
Measuring method			Linear encoder		
Drive speed	CNC MODE		Drive speed: From 8 to 300mm/s for each axis (maximum combined speed: 519mm/s)		
			Measuring speed 1 to 3mm/s		
	J/S MODE		Drive speed 0 to 80mm/s		
		Measuring speed 0 to 3mm/s			
			Fine-positioning speed 0.05mm/s		
Drive acceleration			1,330 mm/s ² for each axis (maximum combined acceleration: 2,310 mm/s ²)	1500mm/s ² for each axis (maximum combined speed: 2598mm/s ²)	
Resolution			0.00005mm (0.05μm)	0.00002mm (0.02μm)	
Guaranteed accuracy temperature environment	Range		18 to 22°C		
		Per hour	1.0°C		
	In 24 hours	2.0°C			
Gradient	vertical/horizontal		1 °C or less per meter		
Guide method			Air bearings on all axes (static pressure air bearings)		
Measuring table	Material		Granite		
	Size (table surface)		676×1420mm	880×1420mm	880×1720mm
	Tapped insert		M8×1.25		
Maximum measurable height			560mm	770mm	
Maximum table loading			180kg	500kg	800kg
Mass (including the vibration-damping platform and controller)			1530kg	1895kg	2180kg
Power supply specifications (including the probe option interface)			Power supply voltage: AC100-120/200-240V ± 10%; power supply capacity: 700 W (of which 170 W is used for the probe option interface)		
Air supply	Pressure		0.4 MPa		
	Consumption		60L/min under normal conditions (air source: At least 120L/min)		

Note: While the appearance of the natural stone measuring table varies according to the source, the high stability for which this material is known can always be relied upon.

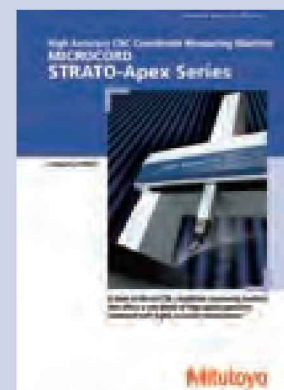
STRATO-Apex 574 Length measurement error Unit: μm

Standard	Probe used	Max. permissible length measurement error
ISO 10360-2: 2009	SP25M	E ₀ , MPE=0.7+2.5L/1000
		E ₁₅₀ , MPE=0.7+2.5L/1000

STRATO-Apex 700 Series Length measurement error Unit: μm

Standard	Probe used	Max. permissible length measurement error
ISO 10360-2: 2009	SP25M	E ₀ , MPE=0.9+2.5L/1000
		E ₁₅₀ , MPE=0.9+2.5L/1000

* L=Measuring length (unit: mm)



Refer to the STRATO-Apex Series leaflet (Catalog No.E16001) for more details.

High Accuracy CNC CMM MICROCORD STRATO-Apex 900/1600 Series

- Floor vibration at the installation location, can be a source of variations in measured values. The auto-leveling air spring vibration isolator is included as standard. The vibration isolator insulates the main unit from floor vibrations and can quickly levels the CMM main unit, using a sensor that detects load fluctuations caused by axis movement of the CMM or workpiece loading.
- All STRATO-Apex high-precision series CMM's are equipped with temperature compensation and therefore do not require a temperature controlled room. Accuracy is guaranteed within the range of 19 to 21°C for 900 Series and the range of 18 to 22°C for 1600 Series.



STRATO-Apex 9106



STRATO-Apex 163012

STRATO-Apex 900 Series Length measurement error Unit: μm

Standard	Probe used	Max. permissible length measurement error
ISO 10360-2: 2009	SP25M	$E_0, \text{MPE}=0.9+2.5L/1000$
		$E_{150, \text{MPE}}=0.9+2.5L/1000$

STRATO-Apex 162012/163012 Length measurement error Unit: μm

Standard	Probe used	Max. permissible length measurement error
ISO 10360-2: 2009	SP25M	$E_0, \text{MPE}=2.5+4.0L/1000$
		$E_{150, \text{MPE}}=2.5+4.0L/1000$

STRATO-Apex 162016/163016 Length measurement error Unit: μm

Standard	Probe used	Max. permissible length measurement error
ISO 10360-2: 2009	SP25M	$E_0, \text{MPE}=3.0+4.0L/1000$
		$E_{150, \text{MPE}}=3.0+4.0L/1000$

* L=Measuring length (unit: mm)

SPECIFICATIONS

Items		Model	STRATO-Apex 9106	STRATO-Apex 9166	STRATO-Apex 162012	STRATO-Apex 162016	STRATO-Apex 163012	STRATO-Apex 163016
Measuring range	X axis		900mm		1600mm			
	Y axis		1000mm	1600mm	2000mm		3000mm	
	Z axis		600mm		1200mm	1600mm	1200mm	1600mm
Measuring method			Linear encoder					
Drive speed	CNC MODE		Drive speed: From 8 to 300mm/s for each axis (maximum combined speed: 519mm/s)		Drive speed: From 8 to 350mm/s for each axis (maximum combined speed: 606mm/s)			
			Measuring speed 1 to 3mm/s					
	I/S MODE		Drive speed 0 to 80mm/s					
		Measuring speed 0 to 3mm/s						
		Fine-positioning speed 0.05mm/s						
Drive acceleration			1500mm/s ² for each axis (maximum combined speed: 2598mm/s ²)		780mm/s ² for each axis (maximum combined speed: 1350mm/s ²)			
Resolution			0.00002mm (0.02 μm)		0.00005mm (0.05 μm)			
Guaranteed accuracy temperature environment	Range		19 to 21°C		18 to 22°C			
	Rate of change	Per hour	1.0°C					
		In 24 hours	2.0°C					
Gradient	vertical/horizontal	1 °C or less per meter						
Guide method			Air bearings on all axes (static pressure air bearings)					
Measuring table	Material		Granite					
	Size (table surface)		1080×1720mm	1080×2320mm	1850×3280mm		1850×4280mm	
	Tapped insert		M8×1.25					
Maximum measurable height			770mm		1350mm	1750mm	1350mm	1750mm
Maximum table loading			800kg	1200kg	3500kg		4000kg	
Mass (including the vibration-damping platform and controller)			2410kg	3085kg	11150kg	11200kg	15300kg	15350kg
Power supply specifications (including the probe option interface)			Power supply voltage: AC100-120/200-240V ±10%; power supply capacity: 700 W (of which 170 W is used for the probe option interface)		Power supply voltage: AC100-120/200-240V ±10%; power supply capacity: 1500 W (of which 170 W is used for the probe option interface)			
Air supply	Pressure		0.4 MPa					
	Consumption		60L/min under normal conditions (air source: At least 120L/min)		100L/min under normal conditions (air source: At least 250L/min)			

Note: While the appearance of the natural stone measuring table varies according to the source, the high stability for which this material is known can always be relied upon.

Coordinate Measuring Machines

Precision measuring technology with three dimensions

High-accuracy Separate Guide Type MICROCORD FALCIO-Apex 2000/3000 Series

- The FALCIO-Apex 2000/3000 series are CNC CMMs that use Mitutoyo's standard structure for large machines which are designed to be used for measuring large and heavy workpieces with high accuracy. The picture on the right gives a good idea of how large the machine is. The measuring accuracy and drive speed are the world's highest level in the X-axis measuring range of 2000mm and 3000mm.
- The scale systems on Mitutoyo high-precision models utilizes a high-performance linear encoder (manufactured by Mitutoyo), for detecting axis position. In addition, various technologies have been utilized in the structure, part processing, and assembly to provide high accuracy measurement.
- These series are equipped with a system to automatically restore accuracy deterioration (MOVAC) caused by foundation deformation as a standard feature.
- All FALCIO-Apex 2000/3000 series high-precision series CMM's are equipped with temperature compensation and therefore do not require a temperature controlled room. Accuracy is guaranteed within the range of 18 to 22°C.
- Safety devices such as Z-axis beam sensor, tape switch, and area sensor are available as options.



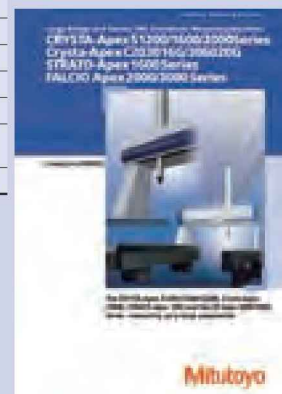
FALCIO-Apex 305015G

SPECIFICATIONS

Items		Model	FALCIO-Apex203015G	FALCIO-Apex204015G	FALCIO-Apex205015G	FALCIO-Apex305015G
Measuring range	X axis		2000mm	2000mm	2000mm	3000mm
	Y axis		3000mm	4000mm	5000mm	5000mm
	Z axis		1500mm	1500mm	1500mm	1500mm
Maximum drive speed	300mm/s for each axis (maximum combined speed: 520mm/s)					
Resolution	0.0001mm (0.1μm)					
Measuring error (When using SP25M)	MPE _E = (3.5+4L/1000)μm					
Guaranteed accuracy temperature range	18 to 22°C					
Guide method	Air bearings on each axis					
Machine dimensions	W		4430mm		5430mm	
	D		5950mm	6950mm	7950mm	7950mm
	H		4690mm			
Mass (including the vibration-damping platform and controller)		12000kg	14000kg	15000kg	16000kg	
Safety device (optional)	A tape switch and a beam sensor are mounted on the tip of the spindle.					

* L=Measuring length (unit: mm)

Note: While the appearance of the natural stone measuring table varies according to the source, the high stability for which this material is known can always be relied upon.



Refer to the Large Bridge and Gantry CNC Coordinate Measuring Machines leaflet (Catalog No.E16009) for more details.

Large Separate Guide Type MICROCORD Crysta-Apex C203016G/306020G

- The Crysta-Apex C203016G/306020G series is the world's largest moving bridge type CNC CMM incorporating Mitutoyo's original structure (moving bridge/installation type), which are designed to be used for measuring large and heavy workpieces with high accuracy.
- The scale systems on Mitutoyo high-precision models utilize a high-performance linear encoder (manufactured by Mitutoyo), for detecting axis position. In addition, various technologies have been utilized in the structure, part processing, and assembly to provide high accuracy measurement.
- As an option, the MOVAC system can be mounted to automatically restore accuracy caused by vibrations and other variations.
- All Crysta-Apex C203016G/306020G high-precision series CMM's are equipped with temperature compensation and therefore do not require a temperature controlled room. Accuracy is guaranteed within the range of 18 to 22°C.
- Safety devices such as Z-axis beam sensor, tape switch, and area sensor are available as options.



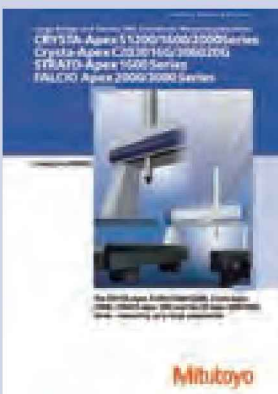
Crysta-Apex C306020G

SPECIFICATIONS

Items		Model	Crysta-Apex C203016G	Crysta-Apex C306020G
Measuring range	X axis		2000mm	3000mm
	Y axis		3000mm	6000mm
	Z axis		1600mm	2000mm
Maximum drive speed	300mm/s for each axis (maximum combined speed: 520mm/s)			
Resolution	0.0001mm (0.1μm)			
Measuring error (Using SP25M)			MPE _E = (6+6L/1000)μm	MPE _E = (8+7L/1000)μm
Guaranteed accuracy temperature range	18 to 22°C			
Guide method	Air bearings on each axis			
Machine dimensions	W		3700mm	5250mm
	D		4600mm	8470mm
	H		4600mm	5485mm
Mass (including controller)			6000kg	14000kg
Safety device (optional)	A tape switch and a beam sensor are mounted on the tip of the spindle.			

* L=Measuring length (unit: mm)

Note: While the appearance of the natural stone measuring table varies according to the source, the high stability for which this material is known can always be relied upon.



Refer to the Large Bridge and Gantry CNC Coordinate Measuring Machines leaflet (Catalog No.E16009) for more details.

Coordinate Measuring Machines

Precision measuring technology with three dimensions

Ultra-high Accuracy CNC CMM MICROCORD LEGEX series

- The LEGEX series is an ultra-high precision CNC CMM with the world's highest level of accuracy, made possible by rigorous analysis of all possible error-producing factors and the elimination or minimization of their effects.
- The fixed bridge structure and precision air bearings running on highly rigid guideways ensure superior motion stability and ultra-high geometrical accuracy. Thorough testing, using FEM structure analysis simulation, guarantees geometric motion accuracy that has minimal errors from fluctuations in the load and other variables. In addition, other various technologies have been utilized in the structure of the drive unit, measuring against vibration, etc. to provide ultra-high accuracy.
- Equipped with a combination of a Mitutoyo ultra-high accuracy scale unit, an ultra-high accuracy crystallized glass scale with a coefficient of thermal expansion of almost 0 and a high resolution, high-performance reflection type linear encoder. It provides excellent position detection for premium performance.



LEGEX 574



LEGEX 774

SPECIFICATIONS

Items		Model	LEGEX 574	LEGEX 774	LEGEX 776
Measuring range	X axis		500mm	700mm	
	Y axis		700mm		
	Z axis		450mm	600mm	
Measurement method			Ultrahigh-precision linear encoder		
Maximum drive speed			120mm/s for each axis (maximum combined speed: 200mm/s)		
Maximum acceleration			980mm/s ²		
Resolution			0.00001mm (0.01μm)		
Guide method			Air bearing		
Measuring table	Material		Cast iron*		
	Size		550x750mm	750x750mm	
	Tapped insert		M8x1.25mm (for workpiece clamping)		
Table loading	Maximum workpiece height		700mm	850mm	
	Maximum table loading		250kg	500kg	
Mass (main unit)			3500kg	5000kg	5100kg
Air supply	Pressure		0.5MPa		
	Consumption		120L/min under normal conditions (air source: 160L/min or more)		

*Ceramic coated type is also available as an option.

Main unit accuracy

Unit: μm

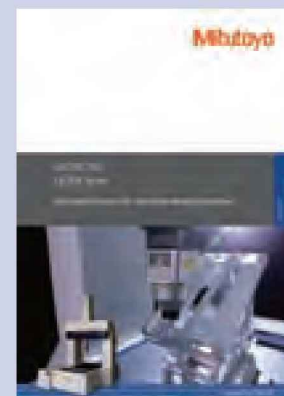
Probe	Length measurement error ISO 10360-2:2009
MPP310Q	$E_{0,MPE} = (0.28+L/1000)\mu\text{m}$ (Temperature environment 1) $E_{0,MPE} = (0.3+L/1000)\mu\text{m}$ (Temperature environment 2)

* L=Measuring length (unit: mm)

* Table at right defines temperature environments 1 and 2

Installation temperature environment

	Temperature environment 1	Temperature environment 2
Temperature range	19 - 21°C	18 - 22°C
Rate of change	0.5 °C per hour or less 1 °C in 24 hours or less	
Gradient	1 °C or less per meter	



Refer to the LEGEX Series leaflet (Catalog No.E16012) for more details.



- All LEGEX high-precision series CMM's are equipped with temperature compensation and therefore do not require a temperature controlled room. Accuracy is guaranteed within the range of 18 to 22°C.

- Many optional systems are available, including probes (contact and non-contact types), data processing units, and many other items to support the ultra-high accuracy measurement of a wide variety of work pieces. It is suitable for complex small to medium size workpieces such as a gear, bearing, lens, die, or scroll rotor which require high dimensional accuracy.



LEGEX 9106

SPECIFICATIONS

Items		Model	LEGEX 9106
Measuring range	X axis		900mm
	Y axis		1000mm
	Z axis		600mm
Measurement method			Ultrahigh-precision linear encoder
Maximum drive speed			120mm/s for each axis (maximum combined speed: 200mm/s)
Maximum acceleration			980mm/s ²
Resolution			0.0001mm (0.01μm)
Guide method			Air bearing
Measuring table	Material		Cast iron*
	Size		950×1050mm
	Tapped insert		M8×1.25mm (for workpiece clamping)
Table loading	Maximum workpiece height		850mm
	Maximum table loading		800kg
Mass (main unit)			6500kg
Air supply	Pressure		0.5MPa
	Consumption		120L/min under normal conditions (air source: 160L/min or more)

*Ceramic coated type is also available as an option.

Main unit accuracy

Unit: μm

Probe	Length measurement error ISO 10360-2:2009
MPP310Q	$E_{0,MPE} = (0.28+L/1000)\mu\text{m}$ (Temperature environment 1) $E_{0,MPE} = (0.3+L/1000)\mu\text{m}$ (Temperature environment 2)

* L=Measuring length (unit: mm)

* Table at right defines temperature environments 1 and 2

Installation temperature environment

	Temperature environment 1	Temperature environment 2
Temperature range	19 - 21°C	18 - 22°C
Rate of change	0.5 °C per hour or less 1 °C in 24 hours or less	
Gradient	1 °C or less per meter	

Coordinate Measuring Machines

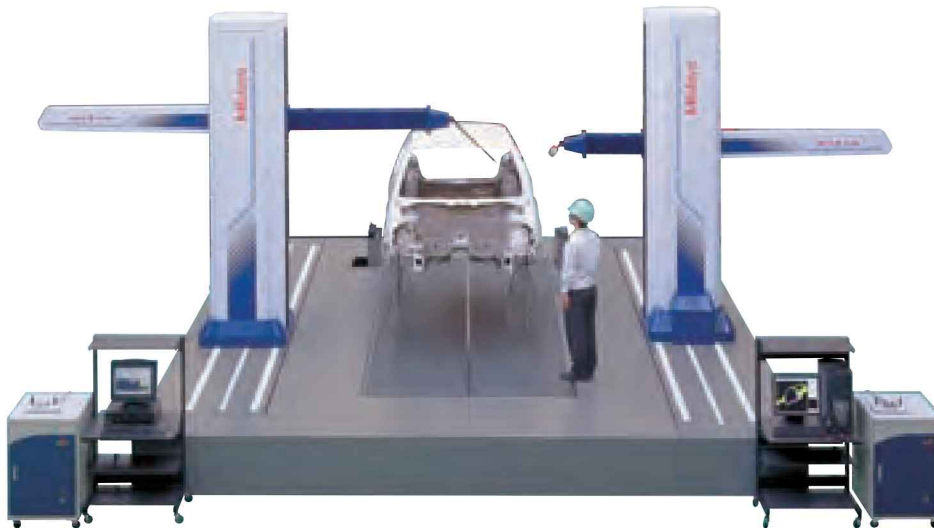
Precision measuring technology with three dimensions

Car Body Measuring System MICROCORD CARBstrato Series

- **The world's largest class**
The CARBstrato series is a lineup of the horizontal type CNC CMMs, offering the world's largest class measurement range that makes it possible to measure even car bodies.
- **Single & Dual**
Single and dual types are available to fit the intended use.
Single type: Measure a workpiece with a single CMM from the CARBstrato series
Dual type: Measure a workpiece placed between two simultaneously controlled CMMs from the CARBstrato series
- **Remarkable usability**
The CARBstrato series not only has remarkable usability, but also has the ability to enhance the safety operation by performing the procedures on the shop floor.
The Y-axis spindle in the vertical direction is set lower in order to perform measurements at a lower workpiece setting height.
In addition, the small cross-section of the Y-axis spindle reduces interference during measurement and expands the measurement area inside a car body.
- **Safety after the installation**
Since the height of the X-axis base is set lower, the required depth for the foundation before the installation is comparatively shallow. Also, the structure is designed to avoid possible problems (both long-term and short-term) such as a problem caused by aging of the foundation (concrete) after long-term use or accuracy deterioration (short-term) resulting in the bimetal phenomenon caused by deformation of the foundation or the X-axis base due to the common environmental changes.
- **Options**
 - In addition to the contact type touch trigger probe, a line laser probe for non-contact measurement is available.
 - Also available for measurement of car bodies, the essential measuring point search function is added to the dedicated software that is programmed based on the conventional software.
 - Various optional safety devices are available to enhance the safety of operators.

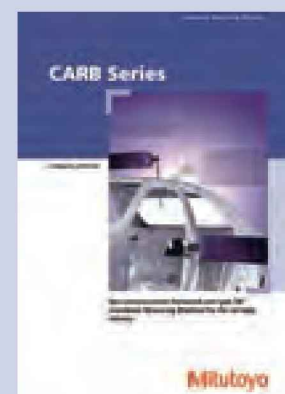


Measurement example for dual type
(Equipped with touch-trigger probe and line laser probe)



CARBstrato 601624D (Dual type)

*The bellows shown in the photo are optional.



Refer to the CARB Series leaflet
(Catalog No.E16014) for more details.

Car Body Measuring System MICROCORD CARBapex Series

- **The world's largest class**

The CARBapex series is a lineup of cost-effective horizontal type, large CNC CMMs, and offers the world's largest class measurement range that makes it possible to measure even car bodies.

- **Single & Dual**

Single and dual types are available to fit the intended use.

Single type: Measure a workpiece with a single CMM from the CARBstrato series

Dual type: Measure a workpiece placed between two simultaneously controlled CMMs from the CARBstrato series

Also, since the height of the X-axis base of both the single type and the dual type is set lower, the required depth for the foundation before the installation is comparatively shallow.

- **Remarkable usability**

The CARBapex series not only has remarkable usability, but also has the ability to enhance the safety operation by performing the procedures on the shop floor.

The Y-axis spindle in the vertical direction is set lower in order to perform measurements at a lower workpiece setting height.

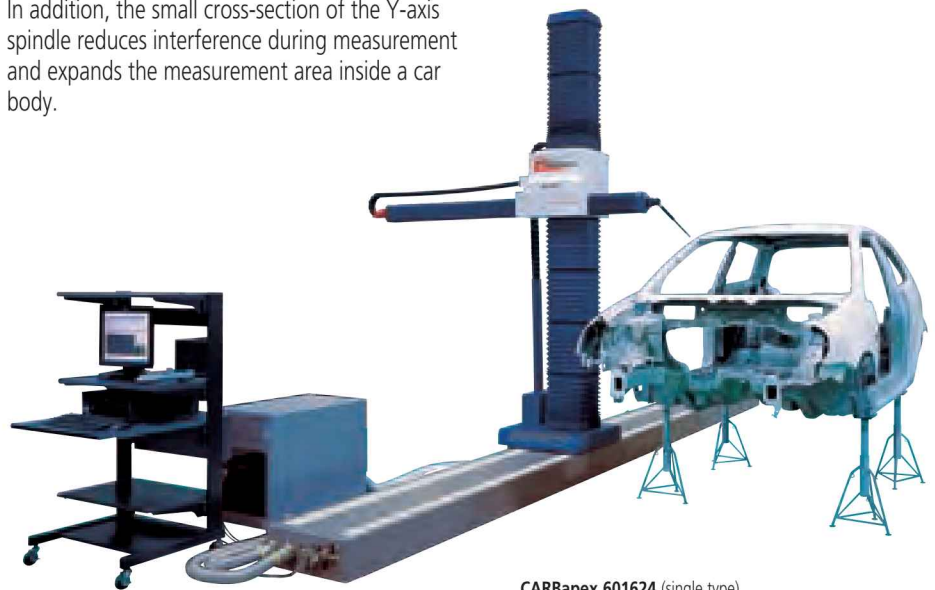
In addition, the small cross-section of the Y-axis spindle reduces interference during measurement and expands the measurement area inside a car body.

- **Options**

• In addition to the contact type touch trigger probe, a line laser probe for non-contact measurement is available.

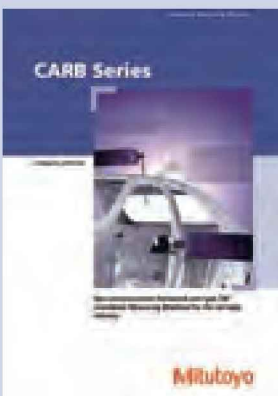
• Also available for measurement of car bodies, the essential measuring point search function is added to the dedicated software that is programmed based on the conventional software.

• Various optional safety devices are available to enhance the safety of operators.



CARBapex 601624 (single type)

*The bellows shown in the photo are optional.



Refer to the CARB Series leaflet
(Catalog No.E16014) for more details.

Coordinate Measuring Machines

Precision measuring technology with three dimensions

In-line Type CNC CMM MICROCORD MACH-3A 653

- In-line type CNC CMM (Horizontal type)
Incorporating the CMM controller and the host computer in the main unit results in a compact spacing saving footprint for the shop floor. This series is designed for 24 hour operation resulting in stable operation and remarkable durability.



MACH-3A 653

*The indexing table is optional.

SPECIFICATIONS

Items		Model	MACH-3A 653
Measuring range	X axis		600mm
	Y axis		500mm
	Z axis		280mm
Measuring speed			1 to 30mm/s (for TP7M)
Maximum drive speed			each axis 8 to 700mm/s; all axes 1212mm/s
Maximum drive acceleration			each axis 6860mm/s ² ; all axes 11882mm/s ²
Accuracy*	19 to 21°C		MPE _E = 2.5+3.5L/1000µm
	5 to 40°C		MPE _E = 3.9+6.5L/1000µm

* TP7M (Stylus: ø4×20mm) is used.

* L=Measuring length (unit: mm)

For information about guaranteed accuracy within a temperature range other than 5 to 40°C, contact your local Mitutoyo sales office.

In-line Type CNC CMM MICROCORD MACH-V9106

The MACH-V has been refined and has evolved over time maximizing machining operations by performing in-line or near-line, high speed coordinate measuring in concurrence with CNC machine tools. These high throughput machines can be incorporated within the manufacturing line and can provide pre/post machining feedback to your machine tool for machining adjustments.



MACH-V9106

*Sub-plate is optional.

SPECIFICATIONS

Items		Model	MACH-V9106
Measuring range	X axis		900mm
	Y axis		1000mm
	Z axis		600mm
Measuring speed			1 to 20mm/s (for TP7M)
Maximum drive speed			each axis 8 to 500mm/s; all axes 866mm/s
Maximum drive acceleration			each axis 4900mm/s ² ; all axes 8480mm/s ²
Accuracy*	19 to 21°C		E ₀ , MPE = 2.5+3.5L/1000µm
	5 to 35°C		E ₀ , MPE = 3.6+5.8L/1000µm

* TP7M (Stylus: ø4×20mm) is used.

* L=Measuring length (unit: mm)

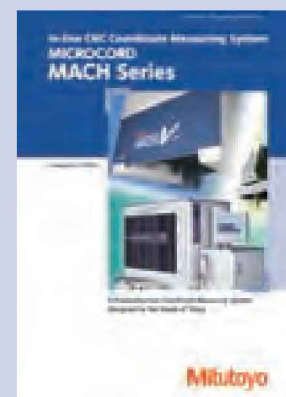
For information about guaranteed accuracy within a temperature range other than 5 to 35°C, contact your local Mitutoyo sales office.

Guaranteed accuracy temperature for MACH-3A 653

		Temperature environment
Accuracy assurance conditions	Range	5 to 40°C
	Rate of change	2 °C per hour or less 10 °C in 24 hours or less
	Gradient	Vertical 1 °C or less per meter Horizontal 1 °C or less per meter

Guaranteed accuracy temperature for MACH-V9106

		Temperature environment
Accuracy assurance conditions	Range	5 to 35°C
	Rate of change	2 °C per hour or less 10 °C in 24 hours or less
	Gradient	1 °C or less per meter (in horizontal/vertical direction)



Refer to the MACH Series leaflet
(Catalog No.E16010) for more details.

Standalone system

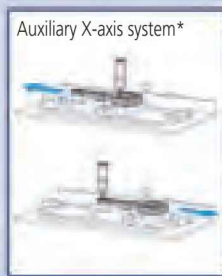
Workpiece measurement within Ko-ga-me's measuring volume

MACH Ko-ga-me Stand (Option)



Moving-head system

Example of moving-head system



*An auxiliary X-axis system shall be provided by the customer.

Guaranteed accuracy temperature for MACH Ko-ga-me

	Temperature environment
Temperature range	10 to 35°C
Rate of change	2 °C per hour or less
Gradient	1 °C or less per meter (in horizontal/vertical direction)

Agile Measuring System MACH Ko-ga-me

- Can be used in standalone applications or integrated into work cells.
- If required, the system can measure workpiece features that exceed the Ko-ga-me's X stroke by mounting the workpiece, or the Ko-ga-me, on an auxiliary X axis.
- Ideal for inspection of large or small workpieces and offers a wide choice of measuring probes including touch-trigger and scanning types. (Note: Probe choice may be restricted, depending on the application.)



SPECIFICATIONS

Items	Model	KGM888-B	KGM12128-B
Measuring range (X, Y, Z)		80×80×80mm	120×120×80mm
Accuracy*	Max. permissible length measurement error E _{0,MPE} (ISO 10360-2:2009)	19-21°C: (2.4+5.7L/1000)μm 15-25°C: (2.7+6.4L/1000)μm 10-30°C: (3.1+7.2L/1000)μm 10-35°C: (3.4+7.9L/1000)μm	
Drive speed		Max. 200 (1 axis) / Max. 340 (Composition of 3 axes)	
Drive acceleration		Max. 3900 (1 axis) / Max. 6750 (Composition of 3 axes)	

* When using TP200 or SP25M

* L=Measuring length (unit: mm)

In-line measurement

- Incorporating a measuring instrument in a production line allows earlier detection of defectives.
- The management of absolute dimensions facilitates feedback to the processing machine.
- Also applicable to diversified small-quantity production.
- A traceable quality control system can be built.
- High-accuracy measurement can be performed.



Coordinate Measuring Machines

Precision measuring technology with three dimensions

Manual Type CMM MICROCORD Crysta-Plus M Series

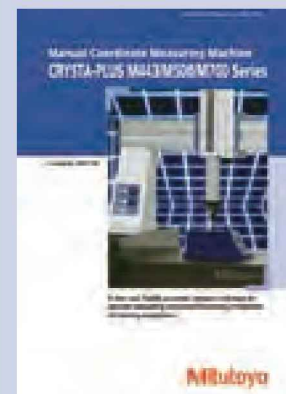
- Manual floating type CMMs developed in quest for high-accuracy, low-cost and easy operation. The Crysta-Plus M is suitable to measure a wide range of applications from a simple dimension to complex form.
- The scale systems on Mitutoyo high-precision models utilizes a high-performance linear encoder (manufactured by Mitutoyo), for detecting axis position. In addition, various technologies have been utilized in the structure, part processing, and assembly to provide high accuracy measurement.
- The Crysta-Plus M700 series has a large main unit, and is equipped with a mobile clamp so that one-touch clamping on each axis can be performed by hand. Continuous fine feed over the entire measuring range can be performed.
- Crysta high-precision series CMM's are equipped with temperature compensation and therefore do not require a temperature controlled room. Accuracy is guaranteed within the range of 15 to 30°C.
- Available options include the auto-leveling air spring vibration isolator and the illuminator unit for the probe.



Crysta-Plus M443 with MCOSMOS



Crysta-Plus M574 with MCOSMOS



Refer to the Crysta-Plus M Series leaflet (Catalog No.E4332) for more details.



Crysta-Plus M7106

SPECIFICATIONS

Items		Model	Crysta-Plus M443	Crysta-Plus M544	Crysta-Plus M574	Crysta-Plus M776	Crysta-Plus M7106
Measuring range	X axis		400mm	500mm		700mm	
	Y axis		400mm	400mm	700mm	700mm	1000mm
	Z axis		300mm	400mm		600mm	
Resolution			0.0005mm (0.5μm)			0.0005mm (0.5μm)	
Accuracy *1,*2 (at 20°C)	Measuring error (E)		$E = (3.0 + 4L/1000)^{*3} \mu\text{m}$	$E = (3.5 + 4L/1000)^{*3} \mu\text{m}$		$E = (4.5 + 4.5L/1000)^{*3} \mu\text{m}$	
	Probing error (R)		4.0μm	4.0μm		5.0μm	
Guide method			Air bearings on each axis				
Clamping of each axis			One-touch air clamp (Mobile clamp switch Box is provided for M700 series)				
Fine feed of each axis			Continuous fine feed over the entire measuring range				
Maximum measurable height			480mm	590mm		800mm	
Maximum table loading			180kg	180kg		500kg	800kg
Mass (including stand)			410kg	512kg	646kg	1560kg	1800kg
Z-axis balancing method			Counterweight				
Air supply	Pressure		0.35MPa (air source: 0.5 to 0.9MPa)			0.4MPa (air source: 0.5 to 0.9MPa)	
	Consumption		50L/min under normal conditions (air source: 100L/min)				

*1 According to ISO 10360-2 methods

*2 When using the touch-trigger probe MH20i/ MH20/ TP20 and stylus (L10mm)

*3 L=Measuring length (unit: mm)

Note: While the appearance of the natural stone measuring table varies according to the source, the high stability for which this material is known can always be relied upon.

Guaranteed accuracy temperature limits for Crysta-Plus M Series

Without thermal compensation		19 to 21°C (Temperature change: 2.0°C or less/8hrs)
With compensation	Range	15 to 30°C
	Rate of change	2 °C per hour or less 5 °C in 24 hours or less
	Gradient	1 °C or less per meter

Coordinate Measuring Machines

Precision measuring technology with three dimensions

Scanning probe

MPP-310Q/MPP-310

Ultra-high accuracy and low measuring force scanning probe

The ultra-high precision scanning probe adapts for directional movement. The compact size of this probe is ideal for low measuring force and high speed scanning. Data collection can be performed by the scanning measurement, ultra-high precision point measurement and the center alignment measurement.



SP80

High accuracy scanning probe (long stylus supported)

A highly accurate and long stylus up to 500mm (both horizontally and vertically) can be installed. This ultra-high precision scanning probe allows data collection by the scanning measurement, the ultra-high precision point measurement and the center alignment point measurement.



MPP-10

Probe for effective thread-depth measurement

This is the only probe in the world that is dedicated for effective screw depth used with a CNC CMM. The probe can also attach to the probe head (PH10M/10MQ) to changing the orientation to measure bores in various directions.



SP25M

Compact high accuracy type scanning probe

This compact, high accuracy type scanning probe has $\varnothing 25\text{mm}$ outside diameter. The multi-functioning scanning probe performs data collection by the scanning measurement, the ultra-high precision point measurement and the center alignment point measurement. The probe can be attached to a probe head (PH10M/10MQ) to automatically change the orientation allowing for more flexible measurements.



REVO

High speed 5-axis scanning head

This high speed scanning head delivers high accuracy measurement while delivering high-throughput. The use of a stylus increases flexibility up to 500mm and makes measuring 5-axis with simultaneous control and non-step indexing possible.



Non-contact probe

SurfaceMeasure606/606T/1010

Non-contact type laser probe

This compact, high accuracy, non-contact type laser probe is designed for use with CNC CMMs. The scanning probe automatically adjusts to workpiece surface characteristics to deliver highly efficient measurements. Automatic laser intensity and camera sensitivity adjust according to the environment and the workpiece material, for simpler and more comfortable laser scanning. Improvements to the probe have increased the measurement speed and accuracy without interference.



SurfaceMeasure606

SurfaceMeasure606T

QVP

QUICK VISION probe

This CNC CMM Quick Vision Probe utilizes Mitutoyo's technology in a vision measuring machine for totally-automated video measurement.



CF20

Centering microscope for CMMs

This centering microscope can measure small holes or elastic bodies that are very difficult to measure using a contact type probe such as the touch-trigger probe. A CMM can be used as a large microscope.



Probe for roughness measurement

SURFTEST PROBE

Probe for surface roughness measurement

Mounting of this probe on a CMM enables surface roughness measurement and analysis to be included in fully automatic CNC measurement cycles. This probe is compatible with the automatic probe changer, and therefore can be automatically replaced with another type of probe for 3D coordinate measurement. A wide variety of roughness analyses can be performed using the dedicated evaluation program.



Touch-trigger probe

TP7M



High accuracy touch-trigger probe

This high-accuracy touch-trigger probe has high repetitive accuracy of $2\sigma \leq 0.25\mu\text{m}$. A long stylus up to 150mm can be installed.

TP200



Compact high-accuracy touch-trigger probe

This compact, high accuracy, touch-trigger probe is $\phi 13.5\text{mm}$ outside diameter. Styli auto-changing (optional) is supported.



TP20



Compact touch-trigger probe

This compact, touch-trigger probe is $\phi 13.2\text{mm}$ outside diameter. Styli auto-changing (optional) is supported when mounted on a CNC CMM.



MH20i

Touch-trigger probe equipped with manual probe head

This touch-trigger probe equipped with manual probe head is designed for use with manual CMMs. The probe head section may be manually indexed to 168 positions.



MH20

Touch-trigger probe equipped with manual probe head

This touch-trigger probe equipped with manual probe head is designed for use with manual CMMs. The probe head section can be manually positioned to the desired orientation.



UMAP-CMM

Micro touch probe

A stylus with an ultra-small diameter of $\phi 0.1\text{mm}$ or $\phi 0.3\text{mm}$ can be used. Measurement of miniscule form by mounting on the PH10MQ.



PH20

5-axis control touch-trigger system

Thanks to the unique "head touches", it is possible to measure by movement of the probe head instead of coordinate measurement. Also, measuring time can significantly be shortened by means of 5-axis concurrent control and stepless positioning angle.



Probe head

PH10M/10MQ

Motorized probe head

The probe allows automatic control of positioning (up to 720 directions) of the mounted probe. It is possible to mount not only a touch-trigger probe but also any scanning probe, vision probe, laser probe, screw thread depth probe, etc. Auto-changing is available (optional).



▲ Mounting example of touch-trigger probe

MIH

Mounting example of touch-trigger probe

This probe head allows manual positioning (up to 720 directions) of the mounted probe (for TP200/ TP20/ TP2-5W). A probe extension up to 300mm can be attached.



▲ Mounting example of touch-trigger probe

PH1

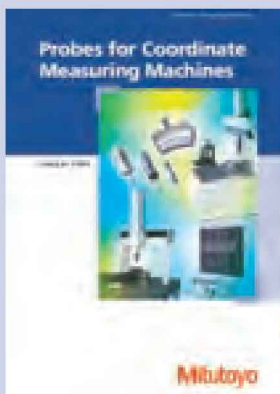
Mounting example of touch-trigger probe

This manual probe head is designed for use with the TP200/ TP20.

It is possible to manually change positioning of the attached probe to the desired orientation.



▲ Mounting example of touch-trigger probe



Refer to the Probes for Coordinate Measuring Machines leaflet (Catalog No.E16005) for more details.

Coordinate Measuring Machines

Precision measuring technology with three dimensions

MiCAT
Mitutoyo Intelligent Computer Aided Technology
 the standard in world
 metrology software
cmm

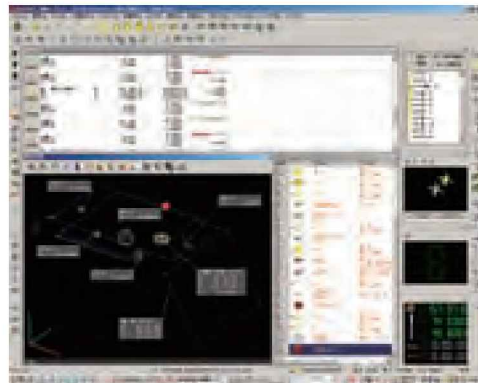
Software for Manual / CNC Coordinate Measuring Machines MCOSMOS

MCOSMOS software modules

	GEOPAK	CAT1000P	CAT1000S	SCANPAK
MCOSMOS-1	○	—	—	—
MCOSMOS-2	○	○	○	—
MCOSMOS-3	○	○	○	○

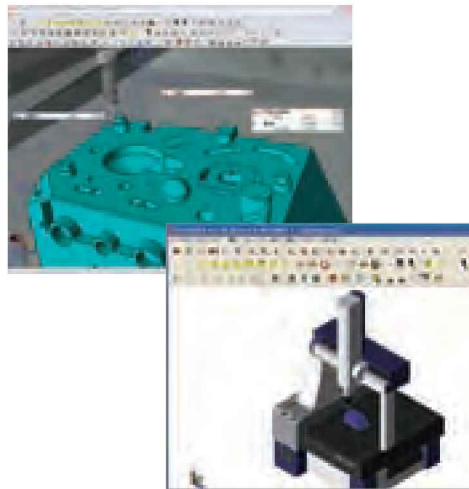
GEOPAK [General purpose measurement program]

This is the basic software for dimension measurement. The enhanced graphic functionality allows real time drawing of the measurement result, and the best-fit function, previously optional, and even the geometrical deviation drawing function are now provided as standard.



CAT1000P [On-/Off-line teaching program]

This software is used for on-/off-line teaching. The interference check function is also added so that programming error when off-line can be prevented. In addition to SAT and STEP, (standard function) as CAD data that can be imported, CATIA V4/V5, PARASOLID, Creo, etc. are supported. (optional)



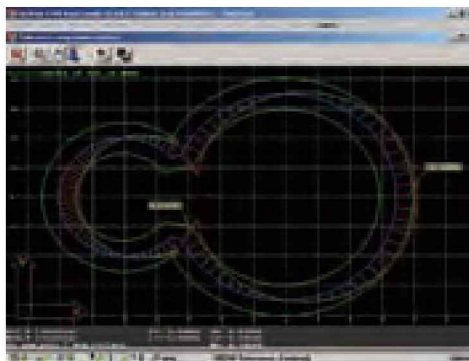
CAT1000S [Curved surface evaluation program]

This software is used for free-form surface evaluation and on-/off-line teaching. It is possible to display measurement results on CAD data in various ways.



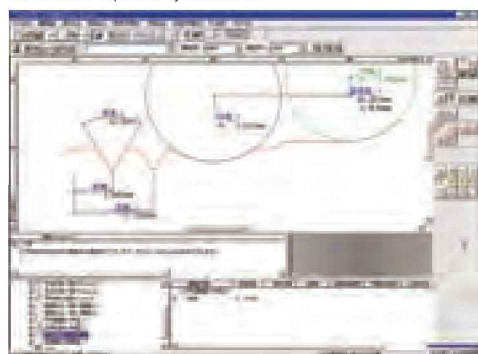
SCANPAK [Contour measurement program]

This software enables measurement/evaluation of two-dimensional sectional contours. The data output function to CAD, etc. that had been optional before is featured.

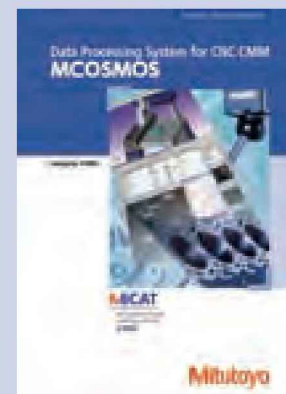


FORMTRACEPAK-AP [Analysis program]

This program is used for minutely analyzing two-dimensional curved lines captured by SCANPAK.



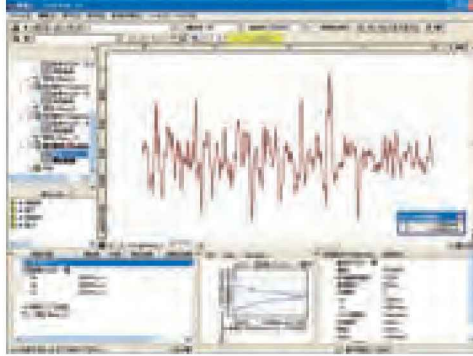
- MCOSMOS is the data processing program family for the CMM that runs on Windows 7 SP1.
- It is unnecessary to learn any special code since measurement can be performed by selecting the icons or the pull-down menu to select functions in the same manner as for Windows OS operation.
- There are two types of MCOSMOS programs: one for manual CMMs and one for CNC CMMs. Therefore, it is possible to perform measurement with a consistent operation method starting from manual measurement to CNC measurement.
- It is possible to display elements obtained by measurement/computation in graphical format and to recall any particular element just by clicking the respective graphic.
- The screen layout can be customized as needed since it is easy to turn each screen on/off and to freely edit the display size/position.



Refer to the MCOSMOS Software leaflet (Catalog No.E16008) for more details.

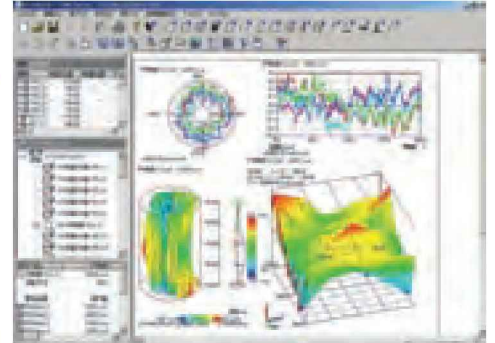
SURFPAK-SP [Analysis program]

This is a software program as used for the roughness probe "SURFTEST PROBE" for a CMM. With this program, surface roughness analysis conforming to standards such as ISO, JIS, ANSI, and VDA are available. Cooperation with MCOSMOS enables full-automatic dimensional measurement and surface roughness measurement.



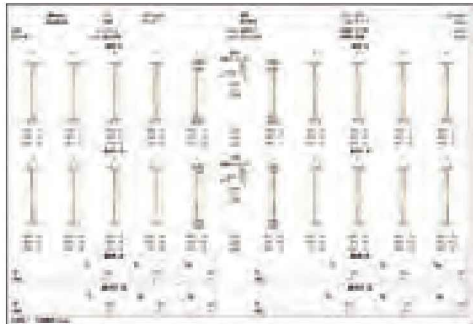
ROUNDPAK-CMM

The function of analysis software as used for roundness measuring machines is now available on MCOSMOS. As well as roundness and cylindricity evaluation, various filters are also available.



GEARPAK-Cylindrical [Gear evaluation program]

This is a program for evaluation of involute gear teeth obtained from CNC CMMs, and tooth profile or tooth trace based on cylindrical gear measurement data.



[Result drawing]

MAFIS [Blade evaluation program]

This software is used for evaluation of sectional contours of blades to be used in jet engines for aircraft.

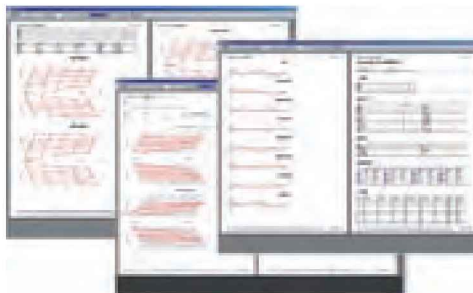


GEARPAK-Worm [Gear evaluation program]

This is a program for evaluation of tooth form, tooth trace, etc., based on worm measurement data obtained from CNC CMMs.

GEARPAK-Bevel/Hypoid [Gear production support/evaluation program]

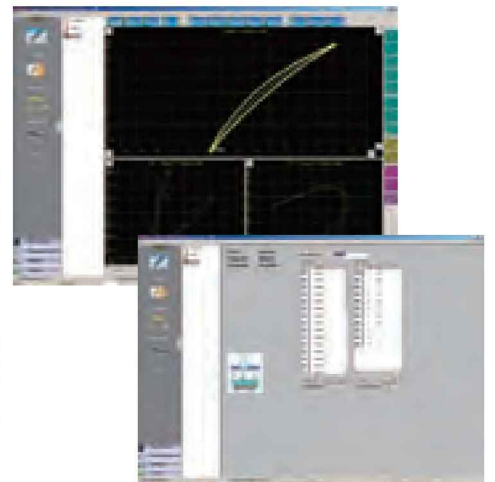
This is a program for evaluation of tooth form, pitch error, etc., based on measurement data from bevel or hypoid gears obtained by CNC CMM.



[Result drawing]

MAFIS Express [Blade measurement/Evaluation program]

This software program enables creation of measurement programs and measurement and analysis of blades and blisks. A part program for measurement can be automatically created just by selecting required contents and evaluation conditions. The measurement results will be displayed in a report including 2D graphics.



Coordinate Measuring Machines

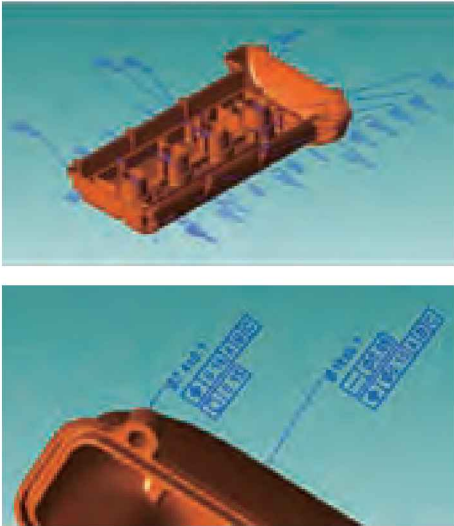
Precision measuring technology with three dimensions

Automatic measurement program generation software MiCAT Planner

One-click programming that changes the relationship between people and precision measurement

- Identifies tolerance information included in 3D models with Product and Manufacturing Information (PMI), defines measurement locations and creates a measurement program fully automatically.
- Utilizing the rule editor function to set the measurement rules prevents variation in measurement quality between program writers.
- Through its optimization function, the software estimates the shortest route for measurement with the minimum of probe repositioning and tool changing, and creates a program that enables measurement in the minimum possible time.

CAD data with tolerance information

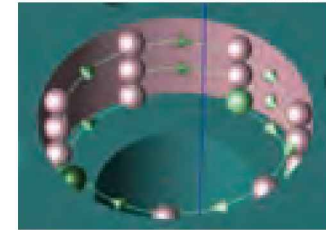


CMM System structural information

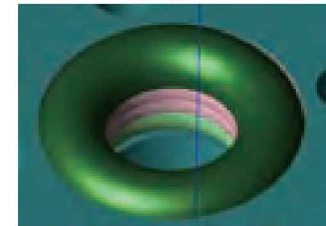


User defined measurement rules

(number of locations to measure CAD data with tolerance information and sampling method, etc.,)

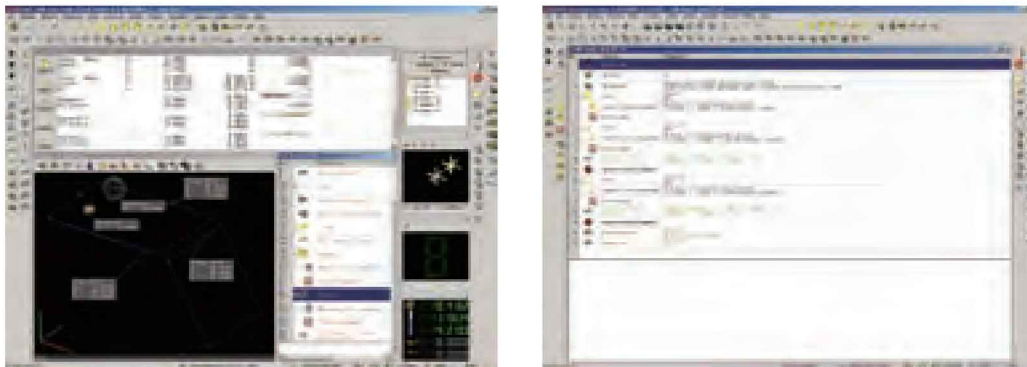


Example of sampling method: touch measurement



Example of sampling method: scanning measurement

Instantly and automatically creates a measurement program



Output a measurement program for MCOSMOS

Screen setups and features

- MiCAT Planner screen setups offer simple interfaces such as 3D view and plain view, thereby enabling intuitive operation. The placement and window sizes of the interfaces can be freely customized.

3D view

- Full-color graphics show:
 - Measuring machine details
 - CAD model with tolerances
 - Measurement points and measurement paths
 - Measurement animations

Plan view

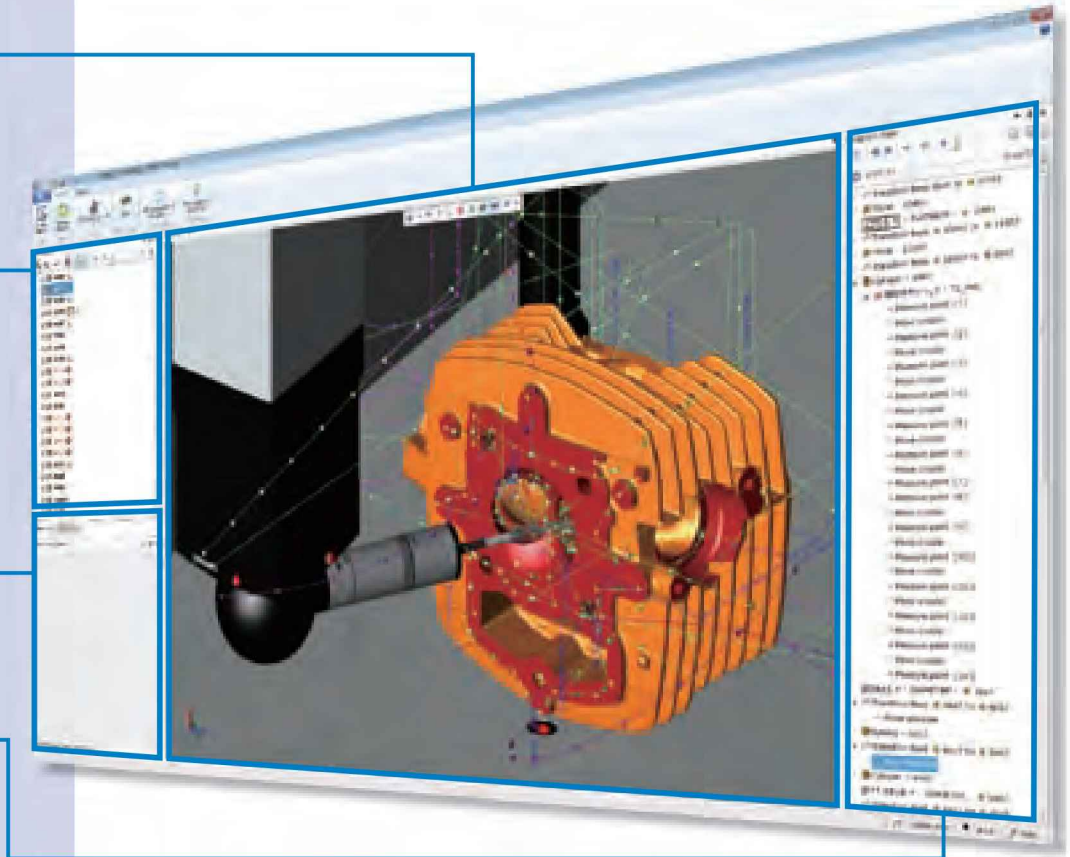
- Shows lists such as measurement parameters and tolerances.
- Lets you flag measurements and assessments using check boxes.
- The parameters are set in the order of the measurements.
- You can easily change the order of measurements by dragging and dropping parameters using a mouse.

Properties view

You can change the names of parameters, tolerance items and measurement points, and edit measurement points for individual parameters.

Program view

- Shows measurement details and measurement estimation times.
- Enables animation of measurement programs in 3D.



Supported CAD formats

CAD format	Extension	Extension
ACIS	.sat	R1-R25 (PM unsupported)
UG/NX *1	.prt	11-18, NX1-9
Creo Parametric (Pro/E) **1	.prt/.prt.*	16-Wildfire5, Creo 1.0-2.0
CATIA v5 *1	.CATPART	R8 - R24 (V5 - 6R2014)

*1 Option (either one is included as standard)
Note: the model requires that you have the solid model.
Assembly data is not supported.

Tolerance information add function

Lets you add tolerances in the software even for 3D CAD models containing no tolerance information. Automatically create optimal measuring programs based on the added tolerance specifications.

Supports MCOSMOS

MCOSMOS 4.0R5 or higher

* To use a measuring program created by the MiCAT Planner you will need a special "right to execute".
A "right to execute" for one 3D measuring machine is included in the MiCAT Planner.

Supported languages

Available in 9 languages (Japanese, English (US, UK), German, French, Spanish, Portuguese, Italian, Chinese (simplified) and Korean.)

Case study

Compare the measurement part-programming time for a test piece.

1: Programming in 2D drawing: 45-60 minutes

2: Programming using 2D drawing + 3D CAD: 15-20 minutes

3: Create with MiCAT Planner (using 3D CAD model + PMI): approx. 3 minutes!

Note: The measurement rules are defined in advance.



Part-programming time
Reduced by up to 95% !!

Guarantee a **dramatically reduced development phase** and at the same time improve product quality.

Coordinate Measuring Machines

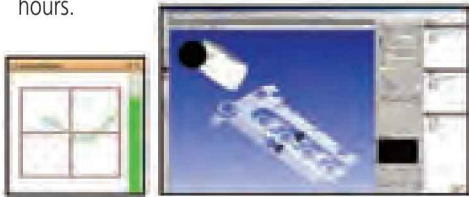
Precision measuring technology with three dimensions

Software for Manual/CNC Coordinate Measuring Machines MSURF

Scanning: MSURF-S

A scanning path can be created just by defining a scanning start point, a scanning length, and a scanning width.

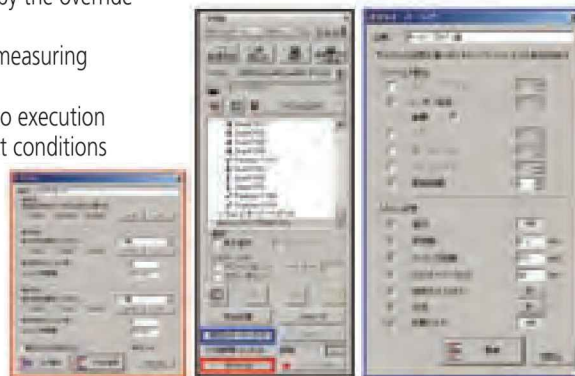
- Specifying the 3 points can be simply performed by operating the joystick while watching the camera view.
- When a point group or master data exists on the screen, the 3 points can be defined by selecting the data using the mouse. This is useful for creation of the measuring path by simulation and specification for re-measurement of data left behind, which helps reduce measuring man-hours.
- Operating joystick buttons enables configuration and execution of a scanning path, and registration to or deletion from a macro. Capability of measurement without using a PC has significantly improved operational efficiency, especially for large-sized CMMs.



*Functions added from MSURF V2.011 or later

Scanning paths can be registered as a measurement macro.

- The measurement conditions of a measurement macro can be partly or wholly changed by the override function.
- The sub-macro function is effective for measuring multiple, identical workpieces.
- A trial calculation of measurement macro execution time is made based on the measurement conditions and the specifications of the CMM.



MSURF-S can be started from MCOSMOS.

- A work coordinate system created with MCOSMOS can be used with MSURF-S. Therefore, fully automatic measurement combined with "Contact Measurement/ Non-Contact Measurement" can be performed.



Note: If not using ACR3, probe replacement is performed manually.

- MSURF is a software program that enables users to perform operations from measurement to evaluation on the same platform when the non-contact line laser probe, SurfaceMeasure, is used. Three types of software are provided according to the task.

MSURF-S: Calculates point cloud data measured by CNC CMM with SurfaceMeasure. It generates scanning paths by defining the scanning start position, length, and width.

MSURF-I: Conducts analysis or comparison verification of measured point cloud data in reference to nominal data (supporting CAD data import).

MSURF-G: Primarily creates part programs (measurement procedure programs) using CAD data.

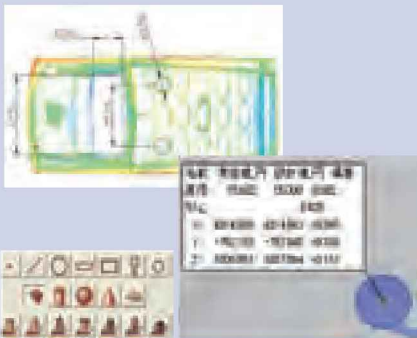
Inspection: MSURF-I

CAD data import

- SAT and STEP format are supported as standard.
- As an option, CATIA V4, CATIA V5, Creo, Unigraphics/NX, IGES, VDAFS, Parasolid, and Solidworks are available.

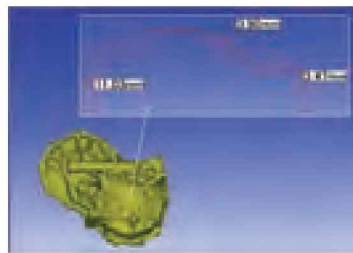
Comparison by features

- MSURF-I can detect various features from point cloud or mesh data and compare them with nominal data. It can also calculate distances between features that have point data such as circle elements.
- Detectable features include basic plane, point, straight line, circle, slot, cylinder, cone, sphere, etc., and also weld bolt, weld nut, cylindrical pin, T-shaped stud, and more.

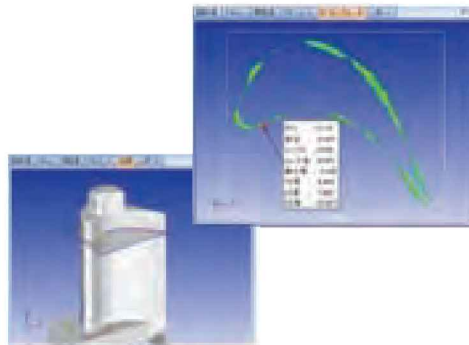


Comparison of cross-sectional shape

- Cut of a point cloud, mesh data, or master data allows for comparison of cross-sectional shapes and calculation of angle, distance, radius of curvature, and more.
- The turbine blade analysis function enables calculation of LE thickness, TE thickness, maximum thickness, cord length, etc.



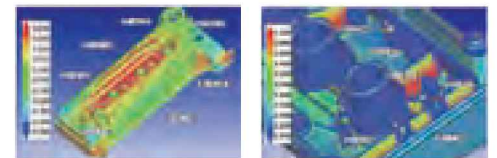
Section evaluation (dimensional calculation)



Turbine blade analysis (optional function)

Comparison of plane shape

- The plane shape error will be displayed on a color map by comparing a point cloud or mesh data with CAD data.
- Thickness can be displayed on a color map, therefore it is not necessary to cut a real workpiece as before.
- Capability of defining the shape of digital calipers enables evaluation of various types of uneven gaps.
- The evaluation of surface curvature can be used for evaluating an angle R within a specified dimensional tolerance.



Error color map

Thickness color map



Evaluation of step/clearance

Surface curvature evaluation

Creation of operating procedure macro by automation function

- The automation function allows users to record the operating procedure including execution of a measurement macro.
- A series of operations from measurement to evaluation and report can be automated.

Off-line teaching: MSURF-G

MSURF-G allows users to create measurement macros using model data. Therefore, users can start measurement immediately a real workpiece is available.

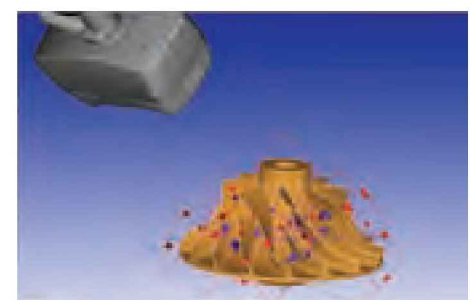
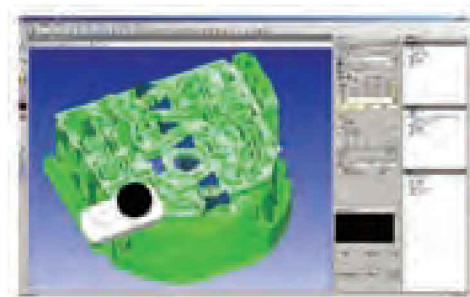
MSURF-G can improve the operating rate of your measuring instrument. Combining it with MSURF-I can remarkably reduce the man-hours from measurement to product evaluation.

- CMM-occupying time for creating measurement macros can be reduced.
- Measurement macros can be simply created without depending on operator's skill.
- The workflow from measurement to evaluation can be optimized.

MSURF-PLANNER

MSURF-PLANNER is software to automatically create measurement macros (surface form, feature form) for the line laser probe from 3D CAD data. Optimized data (travel path, number of probe head revolutions, etc.) of a measurement path will contribute to improvements in productivity.

*MSURF-PLANNER is optional software for MSURF-S and MSURF-G.



Coordinate Measuring Machines

Precision measuring technology with three dimensions

Multi-axis Portable Coordinate Measuring System SpinArm-Apex



SpinArm-Apex 186H



SpinArm-Apex 367H



SPECIFICATIONS

SpinArm-Apex H series (High accuracy, 6-axis model)

Model No.	SpinArm-Apex 186H	SpinArm-Apex 246H	SpinArm-Apex 306H	SpinArm-Apex 366H
Measuring envelop (Probe reaching diameter) *1	1800 mm	2400 mm	3000 mm	3600 mm
Repeatability *2*4	±0.021 mm	±0.026 mm	±0.044 mm	±0.060 mm
Accuracy (Arm type) *2*4	±0.028 mm	±0.035 mm	±0.058 mm	±0.072 mm
Mass (main unit)	15.0 kg	15.2 kg	15.7 kg	16.1 kg

SpinArm-Apex H series (High accuracy, 7-axis model)

Model No.	SpinArm-Apex 247H	SpinArm-Apex 307H	SpinArm-Apex 367H
Measuring envelop (Probe reaching diameter) *1	2400 mm	3000 mm	3600 mm
Repeatability *2*4	± 0.031 mm	± 0.051 mm	± 0.071 mm
Accuracy (Arm type) *2*4	± 0.042 mm	± 0.072 mm	± 0.103 mm
Mass (main unit)	15.6 kg	16.1 kg	16.5 kg

SpinArm-Apex S series (Standard, 6-axis model)

Model No.	SpinArm-Apex 186S	SpinArm-Apex 246S	SpinArm-Apex 306S	SpinArm-Apex 366S
Measuring envelop (Probe reaching diameter) *1	1800 mm	2400 mm	3000 mm	3600 mm
Repeatability *2*3	± 0.040 mm	± 0.050 mm	± 0.080 mm	± 0.100 mm
Accuracy (Arm type) *2*3	± 0.055 mm	± 0.065 mm	± 0.100 mm	± 0.135 mm
Mass (main unit)	15.0 kg	15.2 kg	15.7 kg	16.1 kg

SpinArm-Apex S series (Standard, 7-axis model)

Model No.	SpinArm-Apex 247S	SpinArm-Apex 307S	SpinArm-Apex 367S
Measuring envelop (Probe reaching diameter) *1	2400 mm	3000 mm	3600 mm
Repeatability *2*3	± 0.055 mm	± 0.090 mm	± 0.110 mm
Accuracy (Arm type) *2*3	± 0.080 mm	± 0.135 mm	± 0.165 mm
Mass (main unit)	15.6 kg	16.1 kg	16.5 kg

*1 Measurement range is expressed as a diameter value at the maximum reach using software with the Sø10mm standard probe mounted.

*2 According to Mitutoyo's acceptance procedure. The accuracy guaranteed value above is determined when MSS-5R11G probe is mounted.

*3 Guaranteed accuracy temperature: 16°C - 24°C (temperature gradient: 2 °C per hour)

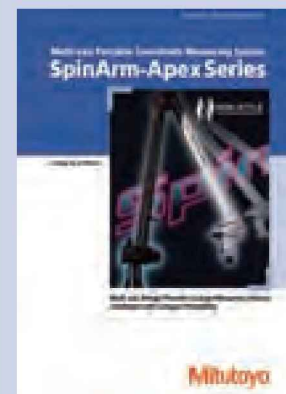
*4 Guaranteed accuracy temperature: 18°C - 22°C (temperature gradient: 2 °C per hour)



SpinArm-Apex is a fully articulated coordinate measuring system featuring a wide range of measurement. The highly portable design of SpinArm-Apex enables the system to be positioned at any point near the workpiece.

- Enables measurement of workpieces of complex shape in any direction.
- Portability enables the measurement system to be positioned close to the workpiece.
- Brake mechanism enhances the usability greatly.
- Counterbalance for easier operation.
- Supports both non-contact line laser probes and contact probes concurrently.

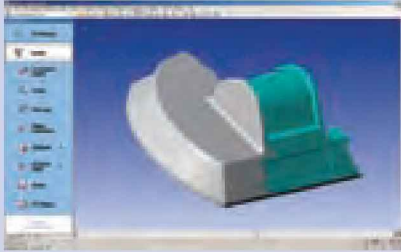
* Not for use in, or export to, to the United States of America.



Refer to the SpinArm-Apex Series leaflet (Catalog No.E16006) for more details.

MSURF-M

- Software for controlling line laser probe. It can perform digitizing for sophisticated solid shape or large workpieces.



Non-contact Line Laser Probe for SpinArm-Apex SurfaceMeasure

Line laser measurement solution

Line laser probe dedicated for non-contact digitizing



SurfaceMeasure series

SPECIFICATIONS

Items	Model	SurfaceMeasure606	SurfaceMeasure610	SurfaceMeasure1010
Laser irradiation method		Line Laser (single)		
Max. scan width		60mm	60mm	Max. 100mm
Max. scan depth		60mm	100mm	100mm
Stand-off		240mm	282mm	282mm
Scanning error*		12 μ m	15 μ m	18 μ m
Acquisition rate		50,000 points/sec [50 lines/sec]		
Mass		430g	400g	400g
Laser Class	EN/IEC	Class2 [EN/IEC 60825-1(2007)]		
	JIS	Class2 [JIS C 6802 : 2011]		
	Laser type	Red semiconductor		
Line Laser	Wavelength	660nm		
	Output	4mW		
Point Laser	Wavelength	635nm		
	Output	1mW		

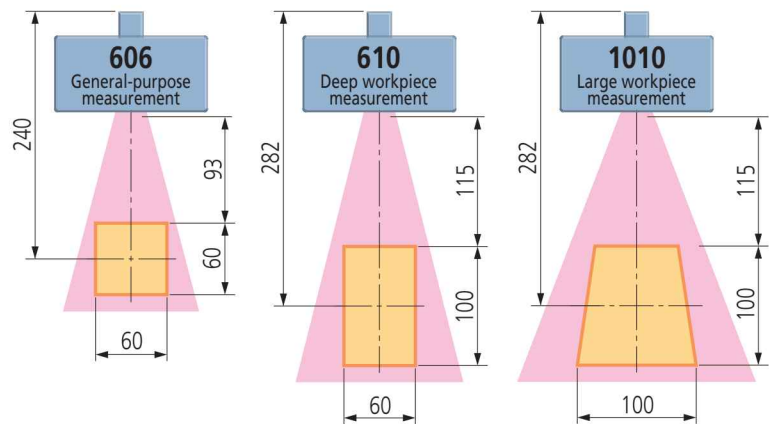
*Accuracy inspection environment: 20°C \pm 1°C/Humidity: 50% \pm 10%

*Target workpiece: Specified master ball for inspection (Diameter 30mm)

*Inspection method: According to Mitutoyo's acceptance procedure, (1 σ /sphere measurement, probe alone)

*It is not a guarantee accuracy when mounting SpinArm-Apex.

Unit: mm



Coordinate Measuring Machines

Precision measuring technology with three dimensions

Clamping System

- A workpiece can be mounted on a CMM's measuring table using a variety of combinations of Eco-Fix clamping components. A dedicated fixturing jig isn't necessary.
- Starter kits "Eco-fix Kit S" and "Eco-fix Kit L" are available.

Eco-fix Kit S



A kit includes a 250mm x 250mm base plate and a variety of clamping components.

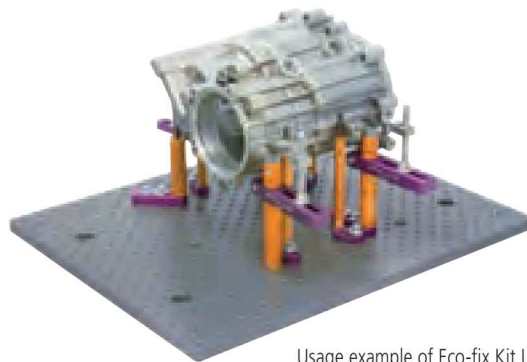
Eco-fix Kit L



A kit includes a 500mm x 400mm base plate and a variety of clamping components.



Usage example of Eco-fix Kit S



Usage example of Eco-fix Kit L

Note: Individual clamping components are not available for sale. A component extension kit is available for partial replacement.

Due to a probe contact or vibration of the measuring instrument, a measurement error may occur if the fixing is insufficient.



Performance Assessment Method of Coordinate Measuring Machines

Regarding the performance assessment method of CMM, a revision of ISO 10360 series was issued in 2003, and was partially revised in 2009. The following describes the standard inspection method including the revised content.

Table 1 ISO 10360 series

	Item	ISO Standard No.	Year of issue
1	Terms	ISO 10360-1:2000	2002
2	Length measurement*	ISO 10360-2:2001	2001
3	Rotary table equipped CMM	ISO 10360-3:2000	2000
4	Scanning measurement	ISO 10360-4:2000	2000
5	Single/Multi-styli measurement**	ISO 10360-5:2002	2002
6	Software inspection	ISO 10360-6:2001	2001

* Revised in 2009 **Revised in 2010

Maximum permissible length measurement error $E_{0,MPE}$ [ISO 10360-2:2009]

Using the standard CMM with specified probe, measure 5 different calibrated lengths 3 times each in 7 directions within the measuring volume (as indicated in Figure 1), making a total of 105 measurements.

If these measurement results, including the allowance for the uncertainty of measurement, are equal to or less than the values specified by the manufacturer, then it proves that the performance of the CMM meets its specification. The result of OK/NG is required to be judged considering the uncertainties. The maximum permissible error (standard value) of the test may be expressed in any of the following three forms (unit: μm).

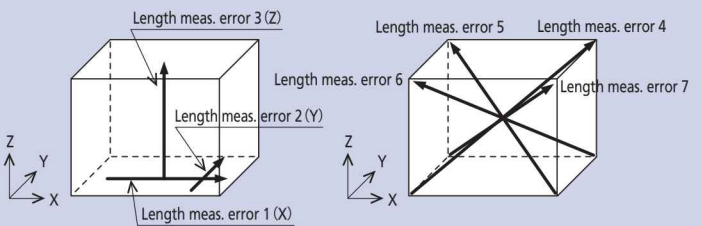


Figure 1 Measuring directions to obtain length measurement error

$$E_{0,MPE} (MPE_E) = A + L/K \leq B$$

$$E_{0,MPE} (MPE_E) = A + L/K$$

$$E_{0,MPE} (MPE_E) = B$$

$$\left\{ \begin{array}{l} A: \text{Constant } (\mu\text{m}) \text{ specified by the manufacturer} \\ K: \text{Dimensionless constant specified by the manufacturer} \\ L: \text{Measured length (mm)} \\ B: \text{Upper limit value } (\mu\text{m}) \text{ specified by the manufacturer} \end{array} \right.$$

* ISO 10360-2:2009 specifies measurement in 4 different directions as essential and recommends measurement parallel to each axis, while ISO 10360-2:2001 specified the measurement "in arbitrary 7 directions."

The following error definitions were added in ISO 10360-2:2009.

Maximum Permissible Length Measurement Error / Length Measurement Error when Z-axis stylus offset is 150mm $E_{150,MPE}$ [ISO 10360-2:2009]

In addition to length measurement in 7 directions, ISO 10360-2:2009 specifies measuring in 2 lines over the diagonal YZ or XZ plane with probe offset.

Note: The stylus offset is set at 150mm as default.

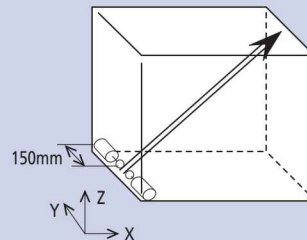


Figure 2 Length measurement error when Z-axis stylus offset is 150mm

Maximum Permissible Limit in Repetitive Length Measurements R_0, MPL [ISO 10360-2:2009]

Maximum Permissible Limit in Repetitive Length Measurements R_0, MPL [ISO 10360-2:2009]

After measuring the given length 3 times, evaluate variation in measurement results. Then, calculate the repeatability range R_0 .

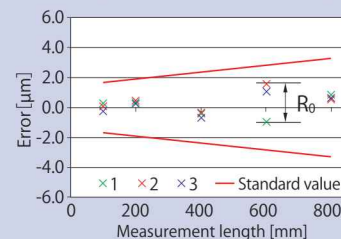


Figure 3 Repeating range of length measurement

Maximum Permissible Rotation Axis Radial-Direction Error MPE_{FR} , Maximum Permissible Rotation Axis Connecting-Direction Error MPE_{FT} , and Maximum Permissible Rotation Axis Axial-Direction Error MPE_{FA} [ISO 10360-3:2000]

The test procedure under this standard is to place two standard spheres on the rotary table as shown in Figure 4. Rotate the rotary table to a total of 15 positions including 0°, 7 positions in the plus (+) direction, and 7 positions in the minus (-) direction and measure the center coordinates of the two spheres in each position. Then, add the uncertainty of the standard sphere shape to each variation (range) of radial direction elements, connecting direction elements, and rotational axis direction elements of the two standard sphere center coordinates. If these calculated values are less than the specified values, the evaluation test is passed.

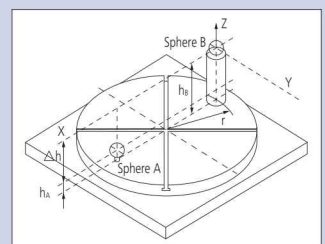
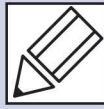


Figure 4 Evaluation of a CMM with a rotary table



■ Maximum Permissible Scanning Probing Error MPE^{THP} [ISO 10360-4:2000]

This is the accuracy standard for a CMM if equipped with a scanning probe. Scanning probing error was standardized in ISO 10360-2:2009 for the first time. The test procedure under this standard is to perform a scanning measurement of 4 planes on the standard sphere and then, for the least squares sphere center calculated using all the measurement points, calculate the range (dimension 'A' in Figure 3) in which all measurement points exist. Based on the least squares sphere center calculated above, calculate the distance between the calibrated standard sphere radius and the maximum measurement point or minimum measurement point, and take the larger distance (dimension 'B' in Figure 3). Add an extended uncertainty that combines the uncertainty of the stylus tip shape and the uncertainty of the standard test sphere shape to each A and B dimension. If both calculated values are less than the specified values, this scanning probe test is passed.

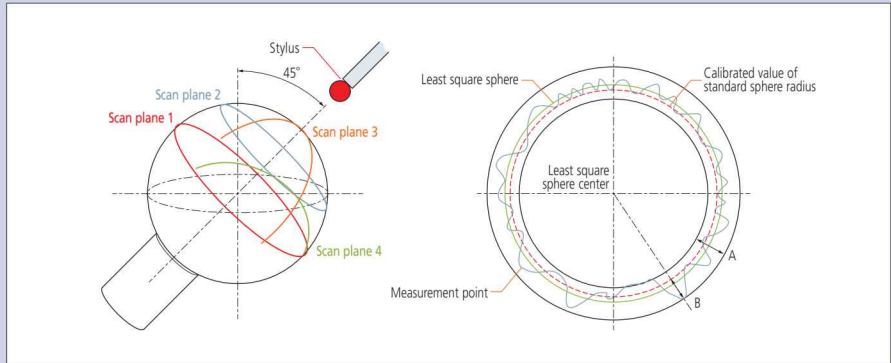


Figure 3 Target measurement planes for the maximum permissible scanning probing error and its evaluation concept

■ Maximum Permissible Single Stylus Form Error $P_{FTU, MPE}$ [ISO 10360-5:2010]

This measurement was included in the dimensional measurement in ISO 10360-2:2009. However, it is specified as "CMMs using single and multiple stylus contacting probing systems" in ISO 10360-5:2010.

The measurement procedure has not been changed, and the following should be performed.

Measure the defined target points on a standard sphere (25 points, as in Figure 6) and use all the results to calculate the center position of the sphere by a least squares method.

Then, calculate the distance R from the center position of the sphere by a least squares method for each of the 25 measurement points, and obtain the radius difference $R_{max} - R_{min}$. If the radius difference, to which a compound uncertainty of forms of the stylus tip and the standard test sphere are added, is equal to or less than the specified value, it can be judged that the probe has passed the test.

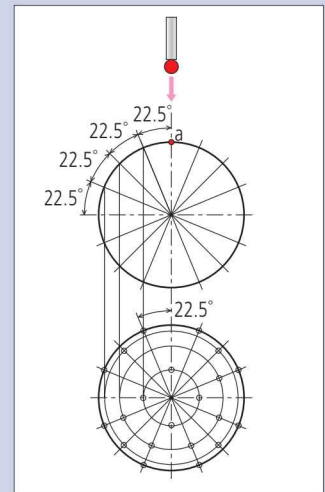


Figure 2 Target points for determining the Maximum Permissible Probing Error

■ Measurement Uncertainty of CMM

Measurement uncertainty is an indication used for evaluating reliability of measurement results.

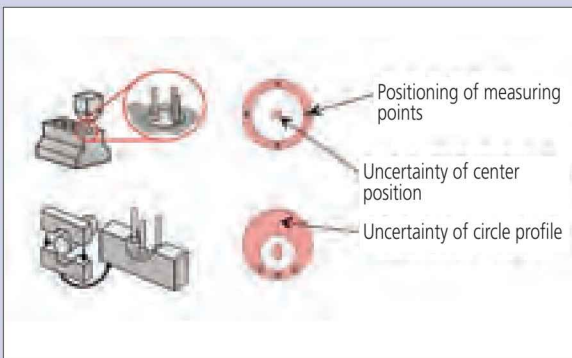
In ISO 14253-1:2013, it is proposed to consider the uncertainty when evaluating the measurement result in reference to the specification.

However, it is not easy to estimate the uncertainty of the measurement performed by a CMM.

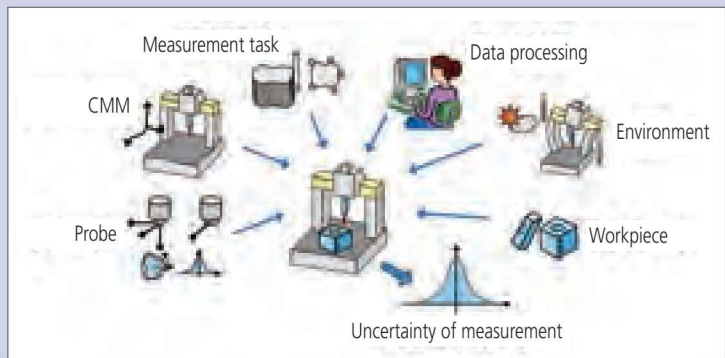
To estimate the uncertainty of the measurement, it is necessary to quantify each source of the uncertainty, and determine how it propagates to the measurement result. The CMM is capable of having all types of settings that determine how the measurement should be performed, such as measurement point distribution, or datum definition, according to the drawing instruction or operator's intention. This feature makes it harder to detect the source of uncertainty influencing the result. Taking the circle measurement as an example, just a difference of one measurement point and its distribution causes the necessity of recalculation of the uncertainty.

Also, there are many sources of uncertainty to be considered with the CMM and their interactions are complicated.

Because of the above, it is almost impossible to generalize on how to estimate measurement uncertainty of the CMM.



Example of circle measurement by CMM

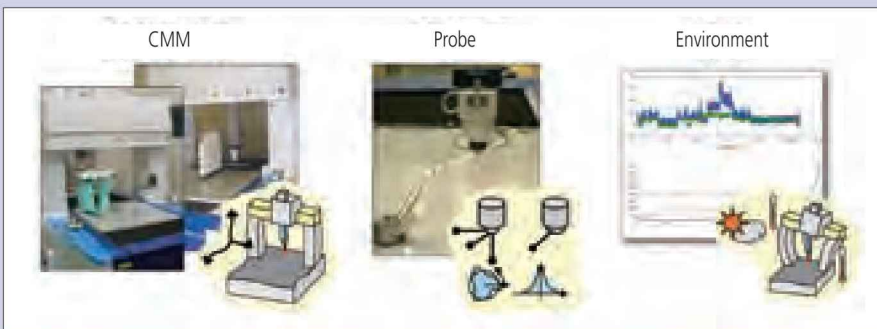


Major contributions that cause measurement uncertainty of the CMM

■ Measurement uncertainty of the CMM and the Virtual CMM software

The Virtual CMM software enables estimation of complicated measurement uncertainty of a CMM. The software simulates a CMM on a PC based on its machine characteristics and performs virtual (simulated) measurements. The simulated measurements are performed according to the part program created by the operator. The machine characteristics are evaluated from experimental values based on geometrical characteristics of the actual machine, probing characteristics, and temperature environment, etc. The measurement uncertainty of the CMM can be easily estimated by using the Virtual CMM software package. ISO15530 Part 4 (ISO/TS 15530-4(2008)) defines how to verify the validity of task-specific measurement uncertainty using computer simulations.

Virtual CMM conforms to this specification.



Quantification of CMM uncertainty elements by experiment

Note: Virtual CMM is a software package originally developed by PTB (Physikalisch-Technische Bundesanstalt).

Relevant parts of *ISO15530: Geometrical Product Specifications (GPS) – Coordinate measuring machines (CMM): Technique for determining the uncertainty of measurement –*

Part 3: Use of calibrated workpieces or measurement standards

Part 4: Evaluating task-specific measurement uncertainty using simulation [Technical Specification]

Corporate Overview





Domestic Network



Overseas Network



INDEX

Mitutoyo Network	
Domestic Network	U-3
Overseas Network	U-5
Agents / Distributors	U-7
M ³ Solution Center	U-9
Measuring instrument accompanied with an Inspection certificate	U-11
Download service at Mitutoyo web site	U-13

Domestic Network

Providing the highest quality services is our mission. In order to support a broad range of customer needs, Mitutoyo is strengthening its network to enable support to be provided even more quickly and effectively. We are expanding our circle of trust with customers through our integrated service system, which ranges from consultations and proposals to after-sales support.



Sendai Sales Office



Utsunomiya Sales Office



Suwa Sales Office



Osaka Sales Office



Fukuoka Sales Office



Kawasaki Plant



Tsukuba Laboratory



Utsunomiya Operations



Kiyohara Production Department



- Headquarters
- Sales
- Service Center
- Calibration Center
- M³ Solution Center
- Mitutoyo Institute of Metrology
- Research and Development Facility
- Manufacturing Facility



Headquarters

Headquarters

TEL (044) 813-8201 FAX (044) 813-8210

Sales

Sendai Sales Office

TEL (022) 231-6881 FAX (022) 231-6884
Kooriyama Resident Office TEL (024) 931-4331

Utsunomiya Sales Office

TEL (028) 660-6240 FAX (028) 660-6248
Tsukuba Resident Office TEL (029) 839-9139

Isesaki Sales Office

TEL (0270) 21-5471 FAX (0270) 21-5613
Niigata Resident Office TEL (025) 281-4360
Saitama Resident Office TEL (048) 667-1431

Kawasaki Sales Office

TEL (044) 813-1611 FAX (044) 813-1610
Tokyo Resident Office TEL (03) 3452-0481

Atsugi Sales Office

TEL (046) 226-1020 FAX (046) 229-5450
Fuji Resident Office TEL (0545) 55-1677

Suwa Sales Office

TEL (0266) 53-6414 FAX (0266) 58-1830
Ueda Resident Office TEL (0268) 26-4531

Hamamatsu Sales Office

TEL (053) 464-1451 FAX (053) 464-1683

Anjo Sales Office

TEL (0566) 98-7070 FAX (0566) 98-6761

Nagoya Sales Office

TEL (052) 741-0382 FAX (052) 733-0921

Kanazawa Sales Office

TEL (076) 222-1160 FAX (076) 222-1161

Osaka Sales Office

TEL (06) 6613-8801 FAX (06) 6613-8817
Kobe Resident Office TEL (078) 924-4560

Keiji Sales Office

TEL (077) 569-4171 FAX (077) 569-4172

Okayama Sales Office

TEL (086) 242-5625 FAX (086) 242-5653

Hiroshima Sales Office

TEL (082) 427-1161 FAX (082) 427-1163

Fukuoka Sales Office

TEL (092) 411-2911 FAX (092) 473-1470

Service Centers

Techno-Service Business Division

TEL (044) 813-8213 FAX (044) 822-4136

Utsunomiya Service Center

TEL (028) 660-6280 FAX (028) 660-6257

Yokohama Service Center

TEL (045) 938-5718 FAX (045) 938-5721

Suwa Service Center

TEL (0266)53-5495 FAX (0266)58-1830

Nagoya Service Center

TEL (052) 731-7100 FAX (052) 731-6110

Anjo Service Center

TEL (0566) 96-0745 FAX (0566) 96-0747

Osaka Service Center

TEL (06) 6613-8813 FAX (06) 6613-8818

Hiroshima Service Center

TEL (082) 427-1164 FAX (082) 427-1163

Fukuoka Service Center

TEL (092) 411-2909 FAX (092) 482-7894

Seismic monitoring system Service Section

Testing machine Service Section

TEL (045) 938-5718 FAX (045) 938-5721

Overseas Service Support Section

TEL (044) 813-8247 FAX (044) 822-4136

Calibration Centers

Utsunomiya Measurement

Standards Calibration Center

TEL (028) 656-1432 FAX (028) 656-8443

Kawasaki Calibration Center

TEL (044) 813-8214 FAX (044) 813-8223

Hiroshima Calibration Center

TEL (0823) 70-3820 FAX (0823) 70-3833

M³ Solution Centers

UTSUNOMIYA

TEL (028) 660-6240 FAX (028) 660-6248

TOKYO

TEL (044) 813-1611 FAX (044) 813-1610

SUWA

TEL (0266) 53-6414 FAX (0266) 58-1830

ANJO

TEL (0566) 98-7070 FAX (0566) 98-6761

OSAKA

TEL (06) 6613-8801 FAX (06) 6613-8817

HIROSHIMA

Please contact to M³ Solution Center FUKUOKA.
Or Please contact to Hiroshima Sales Office.

FUKUOKA

TEL (092) 411-2911 FAX (092) 473-1470

Mitutoyo Metrology Institute

Mitutoyo Metrology Institute (Tokyo)

TEL (044) 822-4124 FAX (044) 822-4000

Mitutoyo Metrology Institute (Osaka)

TEL (06) 6613-8810 FAX (06) 6613-8821

Research and Development Facilities

Tsukuba Laboratory

TEL (029) 839-1022 FAX (029) 839-1023

Research & Development Division

TEL (044) 822-4137 FAX (044) 822-4127

Manufacturing Facilities

Kawasaki Plant

Production Department

TEL (044) 822-4132 FAX (044) 844-9835

Utsunomiya Operations

Production Department 1

TEL (028) 656-1117 FAX (028) 656-2164

Utsunomiya Operations

Production Department 2

TEL (028) 656-1309 FAX (028) 656-2164

Utsunomiya Operations

Kiyohara Production Department

TEL (028) 667-4811 FAX (028) 667-4810

Nakatsugawa Plant

Production Department

TEL (0573) 68-8201 FAX (0573) 68-8210

Hiroshima Operations

Kure Production Department

TEL (0823) 71-6111 FAX (0823) 73-2193

Hiroshima Operations

Shiwa Production Department

TEL (082) 433-2077 FAX (082) 433-2695

Hiroshima Operations

Gohara Production Department

TEL (0823) 77-1721 FAX (0823) 77-1724

Miyazaki Plant

TEL (0985) 86-2591 FAX (0985) 86-0827

Onomi Plant

TEL (0889) 57-2036 FAX (0889) 57-2178



Nakatsugawa Plant



Kure Production Department



Gohara Production Department



Shiwa Production Department



Miyazaki Plant

Overseas Network

Following the establishment of MTI Corporation (U.S.) in 1963, Mitutoyo has been expanding its market throughout the world. Currently, the company has R&D, manufacturing, sales, and engineering service bases in 30 countries, as well as network of distributors in some 80 countries. Mitutoyo maintains its rock-solid status as a leading global manufacturer providing services tailored to each regional society.



Mitutoyo Research Center Europe B.V.



Mitutoyo Europe GmbH



Mitutoyo (UK) Ltd.



Mitutoyo France S.A.R.L.



Mitutoyo Italiana S.R.L.



Mitutoyo Nederland B.V.



Mitutoyo Belgium N.V.



Mitutoyo Schweiz AG



Mitutoyo Scandinavia AB



Mitutoyo Cesko, s.r.o.



Mitutoyo Polska Sp. z o.o.



Mitutoyo Hungária Kft.



Mitutoyo Asia Pacific Pte. Ltd.
Regional Headquarters



Mitutoyo (Malaysia) Sdn. Bhd.



PT. Mitutoyo Indonesia



Mitutoyo (Thailand) Co., Ltd.



Mitutoyo Vietnam Co., Ltd.



Mitutoyo South Asia Pvt. Ltd.

Headquarters (Overseas Sales Division)

20-1, Sakado 1-chome, Takatsu-ku, Kawasaki-shi
213-8533
TEL: 81(044)813-8201 FAX: 81(044)813-8210

Europe

Mitutoyo Europe GmbH
Borsigstrasse 8-10, 41469 Neuss, GERMANY
TEL: 49(2137)102-0 FAX: 49(2137)102-351

Mitutoyo CTL Germany GmbH
Neckarstrasse 1/8, 78727 Oberdorf, GERMANY
TEL: 49(7152)6080-0 FAX: 49(7152)6080-6

KOMEK Industrielle Messtechnik GmbH
Zum Wasserwerk 3 66333 Völklingen, GERMANY
TEL: 49(6898)91110 FAX: 49(6898)9111100

Germany

Mitutoyo Deutschland GmbH
Borsigstrasse 8-10, 41469 Neuss, GERMANY
TEL: 49(2137)102-0 FAX: 49(2137)86 85

M³ Solution Center Hamburg
Tempowerking 9-im HIT-Technologiepark 21079
Hamburg, GERMANY
TEL: 49(40)791894-0 FAX: 49(40)791894-50

M³ Solution Center Berlin
Paradiesstrasse 208, 12526 Berlin, GERMANY
TEL: 49(30)2611 267 FAX: 49(30)26 29 209

M³ Solution Center Eisenach
im tbz Eisenach, Heinrich-Ehrhardt-Platz, 99817
Eisenach, GERMANY

TEL: 49(3691)88909-0 FAX: 49(3691)88909-9

M³ Solution Center Ingolstadt
Marie-Curie-Strasse 1A, 85055 Ingolstadt, GERMANY
TEL: 49(841)954920 FAX: 49(841)9549250

M³ Solution Center Leonberg
Steinbeisstrasse 2, 71229 Leonberg, GERMANY
TEL: 49(7152)6080-0 FAX: 49(7152)608060

Mitutoyo-Messgeräte Leonberg GmbH
Heidenheimer Strasse 14, 71229 Leonberg, GERMANY
TEL: 49(7152)9237-0 FAX: 49(7152)9237-29

U.K.

Mitutoyo (UK) Ltd.
Joule Road, West Point Business Park, Andover,
Hampshire SP10 3UX UNITED KINGDOM
TEL: 44(1264)353123 FAX: 44(1264)354883

M³ Solution Center Coventry
Unit6, Banner Park, Wickmans Drive, Coventry,
Warwickshire CV4 9XA, UNITED KINGDOM
TEL: 44(2476)426300 FAX: 44(2476)426339

M³ Solution Center Halifax
Lowfields Business Park, Navigation Close, Elland,
West Yorkshire HX5 9HB, UNITED KINGDOM
TEL: 44(1422)375566 FAX: 44(1422)328025

M³ Solution Center East Kilbride
The Baird Building, Rankine Avenue, Scottish Enterprise
Technology Park, East Kilbride G75 0QF,
UNITED KINGDOM

TEL: 44(1355)581170 FAX: 44(1355)581171

France

Mitutoyo France
Paris Nord 2-123 rue de la Belle Etoile, BP 59267 ROISSY
EN FRANCE 95957 ROISSY CDG CEDEX, FRANCE
TEL: 33(1) 49 38 35 00 FAX: 33(1) 48 63 27 70

M³ Solution Center LYON
Parc Mail 523, cours du 3^{ème} millénaire, 69791
Saint-Priest Cedex, FRANCE
TEL: 33(1) 49 38 35 70 FAX: 33(1) 49 38 35 79

M³ Solution Center STRASBOURG
Parc de la porte Sud, Rue du pont du péage, 67118
Geispolsheim, FRANCE
TEL: 33(1) 49 38 35 80 FAX: 33(1) 49 38 35 89

M³ Solution Center CLUSES
Espace Scionzier 480 Avenue, des Lacs, 74950
Scionzier, FRANCE
TEL: 33(1) 49 38 35 90 FAX: 33(1) 49 38 35 99

M³ Solution Center TOULOUSE
Aeroparc Saint-Martin ZAC de Saint Martin du Touch, 12
rue de Caulet, Cellule B08, 31300 TOULOUSE, FRANCE
TEL: 33(5) 82 95 60 69

Italy

Mitutoyo ITALIANA S.r.l.
Corso Europa, 7 - 20020 Lainate (MI), ITALY
TEL: 39(02)935781 FAX: 39(02)9373290*93578255

M³ Solution Center TORINO
Via Brandizzo, 133/F - 10088 Volpiano (TO), ITALY
TEL: 39(0)11 9123995 FAX: 39(0)11 9953202

M³ Solution Center CHIETI
Contrada Santa Calcagna - 66020 Rocca S. Giovanni (CH),
ITALY
TEL/FAX: 39(0872)709217

Netherlands

Mitutoyo Nederland B.V.
Storkstraat 40, 3905 KX Veenendaal, THE NETHERLANDS
TEL: 31(0)318-534911 FAX: 31(0)318-534811

Mitutoyo Research Center Europe B.V.
De Rijn 18, 5684 PJ Best, THE NETHERLANDS
TEL: 31(0)499-320200 FAX: 31(0)499-320299

Belgium

Mitutoyo Belgium N.V.
Hogenaakkerhoek straat 8, 9150 Kruibeke, BELGIUM
TEL: 32(0)3-2540444 FAX: 32(0)3-2540445

Sweden

Mitutoyo Scandinavia AB
Slättvägen 6, 194 54 Upplands Väsby, SWEDEN
TEL: 46(0)8 594 109 50 FAX: 46(0)8 590 924 10

M³ Solution Center Alingsås
Kristineholmsvägen 26, 441 39 Alingsås, SWEDEN
TEL: 46(0)8 594 109 50 FAX: 46(0)322 63 31 62

M³ Solution Center Värnamo
Storgårdsbacken 9, 331 30 Värnamo, SWEDEN
TEL: 46(0)8 594 109 50 FAX: 46(0)370 463 34

Finland

Mitutoyo Scandinavia Aktiebolag Finnish Branch
Viherritijä 2A, FI-33960, Pirkkala, FINLAND
TEL: 358 207 929 640

Switzerland

Mitutoyo Schweiz AG
Steinackerstrasse 35, 8902 Urdorf, SWITZERLAND
TEL: 41(0)447361150 FAX: 41(0)447361151

Poland

Mitutoyo Polska Sp. z o.o.
Ul. Graniczna 8A 54-610 Wrocław, POLAND
TEL: 48(71)354 83 50 FAX: 48(71)354 83 55

Czech Republic

Mitutoyo Cesko, s.r.o.
Dubská 1626, 415 01 Teplice, CZECH REP
TEL: 420-417-579-866 FAX: 420-417-579-867

Hungary

Mitutoyo Hungária Kft.
Záhony utca 7, D-building / Ground floor, H-1031
Budapest, HUNGARY
TEL: 36(1)2141447 FAX: 36(1)2141448

Romania

Mitutoyo Romania SRL
1A Drumul Garii Odai Street, showroom, Ground Floor,
OTOPENI-ILFOV, ROMANIA
TEL: 40(0)311012088 FAX: 40(0)311012089

Russian Federation

Mitutoyo RUS LLC
13 Sharikopodshipnikovskaya, bld.2, 115088 Moscow,
RUSSIAN FEDERATION
TEL: (7)495 7450752 FAX: (7)495 7450752

Austria

Mitutoyo Austria GmbH
Johann Roithner Straße 131 A-4050 Traun, AUSTRIA
TEL: 43(0)7229/23850 FAX: 43(0)7229/23850-90

Singapore

Mitutoyo Asia Pacific Pte. Ltd.
Head Office / M³ Solution Center
24 Kallang Avenue, Mitutoyo Building, SINGAPORE
339415
TEL: (65)6294 2211 FAX: (65)6299 6666

Malaysia

Mitutoyo (Malaysia) Sdn. Bhd.
Kuala Lumpur Head Office / M³ Solution Center
Mah Sing Intergrated Industrial Park, 4, Jalan Utamad
U5/14, Section U5, 40150 Shah Alam, Selangor,
MALAYSIA
TEL: (60)3-7845 9318 FAX: (60)3-7845 9346

Penang Branch Office / M³ Solution Center
30, Persiaran Mahsuri 1/2, Sunway Tunas, 11900 Bayan
Lepas, Penang, MALAYSIA
TEL: (60)4-641 1998 FAX: (60)4-641 2998

Johor Branch Office / M³ Solution Center
70 (Ground Floor), Jalan Molek 1/28, Taman Molek,
81100 Johor Bahru, Johor, MALAYSIA
TEL: (60)7-352 1626 FAX: (60)7-352 1628

Indonesia

PT. Mitutoyo Indonesia
Head Office / M³ Solution Center
Jalan Sriwijaya No.26 Desa Cibatu Kec. Cikarang Selatan
Kab. Bekasi 17530, INDONESIA
TEL: (62)21-2962 8600 FAX: (62)21-2962 8604

Thailand

Mitutoyo (Thailand) Co., Ltd.
Bangkok Head Office / M³ Solution Center
76/3-5, Chaengwattana Road, Kwaeng Anusawaree,
Khet Bangkaen, Bangkok 10220, THAILAND
TEL: (66)2-521 6130 FAX: (66)2-521 6136

Cholburi Branch / M³ Solution Center
7/1, Moo 3, Tambon Bowin, Amphur Sriracha, Cholburi
20230, THAILAND
TEL: (66)3-834 5783 FAX: (66)3-834 5788

Amata Nakorn Branch / M³ Solution Center
700/199, Moo 1, Tambon BanKao, Amphur PhanThong,
Cholburi 20160, THAILAND
TEL: (66)3-846 8976 FAX: (66)3-846 8978

Thailand
7/1, Moo 3, Tambon Bowin, Amphur Sriracha, Cholburi
20230, THAILAND
TEL: (66)3-834 5783 FAX: (66)3-834 5788

Amata Nakorn Branch / M³ Solution Center
700/199, Moo 1, Tambon BanKao, Amphur PhanThong,
Cholburi 20160, THAILAND
TEL: (66)3-846 8976 FAX: (66)3-846 8978

Vietnam

Mitutoyo Vietnam Co., Ltd.
Hanoi Head Office / M³ Solution Center
No. 07-TT4, My Dinh - Me Tri Urban Zone, My Dinh 1
Ward, Nam Tu Liem District, Hanoi, VIETNAM
TEL: (84)4-3768 8963 FAX: (84)4-3768 8960

Ho Chi Minh City Branch Office / M³ Solution Center
31 Phan Xich Long Street, Ward 2, Phu Nhuan District,
Ho Chi Minh City, VIETNAM
TEL: (84)8-3517 4561 FAX: (84)8-3517 4582

Philippines
Mitutoyo Philippines, Inc.
Unit 2103, Bldg 2 GMV Center, 107 North Main Avenue,
Laguna Technopark, Binan, Laguna 4028, PHILIPPINES
TEL/FAX: 63 49 544 0272



- Sales
- Research and Development Facility
- Manufacturing Facility



Mitutoyo America Corporation
Head Office



Mitutoyo Sul Americana Ltda.
Argentina Branch



Mitutoyo Canada Inc.



Mitutoyo Mexicana S.A. de C.V.



Mitutoyo Measuring Instruments
(Shanghai) Co., Ltd.



Tianjin Office



Mitutoyo Measuring Instruments
(Suzhou) Co., Ltd.



Mitutoyo Taiwan Co., Ltd.



Mitutoyo Korea Corporation



Mitutoyo Sul Americana Ltda. Factory
(Suzano)

India

Mitutoyo South Asia Pvt. Ltd.
Head Office / M³ Solution Center
C-122, Okhla Industrial Area, Phase-I,
New Delhi-110 020, INDIA
TEL: 91(11)2637-2090 FAX: 91(11)2637-2636

MSA Gurgaon technical center

Plot No. 65, Phase-IV, Udyog Vihar,
Gurgaon – 122016, INDIA
TEL: 91(11)24-2340294

Mumbai Region Head office

303, Sentinel Hiranandani Business Park Powai,
Mumbai-400 076, INDIA
TEL: 91(22)2570-0684, 837, 839 FAX: 91(22)2570-0685

Pune Office / M³ Solution Center

G2/G3, Pride Kumar Senate, F.P. No. 402 Off. Senapati
Bapat Road, Pune-411 016, INDIA
TEL: 91(20)6603-3643, 45, 46 FAX: 91(20)6603-3644

Vadodara office

S-1&S-2, Olive Complex, Nr. Haveli, Nizampura,
Vadodara-390 002, INDIA
TEL: (91) 265-2750781 FAX: (91) 265-2750782

Bengaluru Region Head office / M³ Solution Center

No. 5, 100 Ft. Road, 17th Main, Koramangala, 4th Block,
Bengaluru-560 034, INDIA
TEL: 91(80)2563-0946, 47, 48 FAX: 91(80)2563-0949

Chennai Office / M³ Solution Center

No. 624, Anna Salai Teynampet, Chennai-600 018, INDIA
TEL: 91(44)2432-8823, 24, 27, 28 FAX: 91(44)2432-8825

Kolkata Office

Unit No. 1208, Om Tower, 32, J.L.Nehru Road,
Kolkata-700 071, INDIA
TEL: 91(33)2227088/40060635 FAX: 91(33)22266817

Taiwan

Mitutoyo Taiwan Co., Ltd. / M³ Solution Center Taipei
4F, No.71, Zhousi St., Neihsu Dist., Taipei City 114, TAIWAN(R.O.C.)
TEL: 886(2)5573-5902 FAX: 886(2)8752-3267

Taichung Branch / M³ Solution Center Taichung

1F., No.758, Zhongming S. Rd., South Dist., Taichung City
402, TAIWAN(R.O.C.)
TEL: 886(4)2262-9188 FAX: 886(4)2262-9166

Kaohsiung Branch / M³ Solution Center Kaohsiung

13F.-3, No.31, Haibian Rd., Lingya1 Dist.,
Kaohsiung City 802, TAIWAN(R.O.C.)
TEL: 886(7)334-6168 FAX: 886(7)334-6160

South Korea

Mitutoyo Korea Corporation

Head Office / M³ Solution Center
Sanbon-dong, Geumjeong high view Build., 6F, 153-8,
Lsi-ro, Gumpo-si, Gyeonggi-do, 15808 KOREA
TEL: 82(31)361-4200 FAX: 82(31)361-4201

Busan Office / M³ Solution Center

(3150-3, Daeyeo 2-dong) 8, Yutongdangji 1-ro 49beon-gil,
Gangseo-gu, Busan, 46721 KOREA
TEL: 82(51)718-2140 FAX: 82(51)324-0104

Daegu Office / M³ Solution Center

(Galsan-dong, Daegu Business Center), 301-Ho, 217,
Seongsongdong-dan-ro, Dalseo-gu, Daegu 42704 KOREA
TEL: 82(53)593-5602 FAX: 82(53)593-5603

China

Mitutoyo Measuring Instruments (Shanghai) Co., Ltd.
12F, Nextage Business Center, No.1111, Pudong South
Road, Pudong New District, Shanghai 200120, CHINA
TEL: 86(21)5836-0718 FAX: 86(21)5836-0717

Suzhou Office / M³ Solution Center China (Suzhou)

No. 46 Baiyu Road, Suzhou 215021, CHINA
TEL: 86(512)6522-1790 FAX: 86(512)6251-3420

Wuhan Office

RM. 1701, Wuhan Wanda Center, No. 96, Linjiang Road,
Wuchang District, Wuhan Hubei 430060, CHINA
TEL: 86(27)8544-8631 FAX: 86(27)8544-6227

Chengdu Office

1-705, New Angle Plaza, 668# Jindong Road,
Jinjiang District, Chengdu, Sichuan 610066, CHINA
TEL: 86(28)8671-8936 FAX: 86(28)8671-9086

Hangzhou Office

RM.804, Eastern International Business Center Building 1,
No.600 Jinsha Road Hangzhou Economic and
Technological Development Zone, 310018, CHINA
TEL: 86(571)8288-0319 FAX: 86(571)8288-0320

Tianjin Office / M³ Solution Center Tianjin

RM. A+B+C 15F, TEDA Building, No.256 Jie-fang Nan
Road Hexi District, Tianjin 300042, CHINA
TEL: 86(22)5888-1700 FAX: 86(22)5888-1701

Changchun Office

RM.1801, Kaifa Dasha, No. 5188 Ziyou Avenue,
Changchun 130013, CHINA
TEL: 86(431)84612510 FAX: 86(431)84644411

Qingdao Office / M³ Solution Center Qingdao

Room 638, 6F, No.192 Zhengyang Road, Chengyang
District, Qingdao, Shandong, 266109, CHINA
TEL: 86(532)80961936 FAX: 86(532)80961937

Xi'an Office

RM. 805, Xi'an International Trade Center, No. 196
Xiaozhai East Road, Xi'an, 710061, CHINA
TEL: 86(29)85381380 FAX: 86(29)85381381

Dalian Office

RM.1008, Grand Central IFC, No.128 Jin ma Road,
Economic Development Zone, Dalian 116600, CHINA
TEL: 86(411)8718 1212 FAX: 86(411)8754-7587

Zhengzhou Office

Room1801, 18/F, Unit1, Building No.23, Shangwu Inner
Ring Road, Zhengdong New District, Zhengzhou City,
Henan Province, 450018, CHINA
TEL: 86(371)6097-6436 FAX: 86(371)6097-6981

Mitutoyo Leoport Metrology (Hong Kong) Limited

Room 818, 8/F, Vanta Industrial Centre, No.21-33,
Tai Lin Pai Road, Kwai Chung, NT, HONG KONG
TEL: (852)2992-2088 FAX: (852)2670-2488

Mitutoyo Leoport Metrology (Dongguan) Limited / M³ Solution Center Dongguan

No.26, Guang Chang Road, Chong Tou Zone,
Chang An Town, Dongguan, 523855, CHINA
TEL: 86(769)8541 7715 FAX: 86(769)-8541 7745

Mitutoyo Leoport Metrology (Dongguan) Limited - Fuzhou office

Rm 2104, City Commercial Centre, No.129 Wu Yi Road N.,
Fuzhou City, Fujian Province, CHINA
TEL: (86) 591 8761 8095 FAX: (86) 591 8761 8096

Mitutoyo Leoport Metrology (Dongguan) Limited - Changsha office

Rm 2207, Shiner International Plaza, No. 88, Kaiyuan
Middle Road, Changsha City, Hunan Province, CHINA
TEL: (86) 731 8401 9276 FAX: (86) 731 8401 9376

Mitutoyo Measuring Instruments (Suzhou) Co., Ltd.

No. 46 Baiyu Road, Suzhou 215021, CHINA
TEL: 86(512)6252-2660 FAX: 86(512)6252-2580

U.S.A.

Mitutoyo America Corporation

965 Corporate Blvd., Aurora, IL 60502, U.S.A.
TEL: 1-(630)820-9666 Toll Free No. 1-888-648-8869
FAX: 1-(630)820-2614

M³ Solution Center-Illinois

965 Corporate Blvd., Aurora, IL 60502, U.S.A.
TEL: 1-(630)978-5358 FAX: 1-(630)820-7403

M³ Solution Center-Ohio

6220 Hi-Tek Ct., Mason, OH 45040, U.S.A.
TEL: 1-(513)754-0709 FAX: 1-(513)754-0718

M³ Solution Center-Michigan

44768 Helm Street, Plymouth, MI 48170, U.S.A.
TEL: 1-(425)821-3906 FAX: 1-734)459-0455

M³ Solution Center-California

16925 E. Gale Ave., City of Industry, CA 91745, U.S.A.
TEL: 1-(626)961-9661 FAX: 1-(626)333-8019

M³ Solution Center-Massachusetts

753 Forest Street, Suite 110, Marlborough, MA 01752, U.S.A.
TEL: 1-(888)648-8869 FAX: 1-(508)485-0782

M³ Solution Center-North Carolina

11515 Vanstory Dr., Suite 150, Huntersville, NC 28078, U.S.A.
TEL: 1-(704)875-8332 FAX: 1-(704)875-9273

M³ Solution Center-Alabama

2100 Riverchase Center Suite 106 Hoover, AL 35244, U.S.A.
TEL: 1-(205)988-3705 FAX: 1-(205)988-3423

Mitutoyo America Corporation Calibration Lab

965 Corporate Blvd., Aurora, IL 60502, U.S.A.
TEL: 1-630-820-9666 FAX: 1-630-820-2614

Mico Encoder, Inc.

11533 NE 118th St., bldg. M, Kirkland, WA 98034, U.S.A.
TEL: 1-(425)821-3906 FAX: 1-(425)821-3228

Mico Encoder Los Angeles, Inc.

16925 E. Gale Ave. City of Industry, CA 91745, U.S.A.
TEL: 1-626-961-9661 FAX: 1-626-333-8019

M³ Solution Center-Washington

1000 SW 34th Street Suite G, Renton WA 98057, U.S.A.
TEL: 1-(888)-648-8869 FAX: 1-(205)-988-3423

M³ Solution Center-Texas

4560 Kendrick Plaza Drive Suite 120, Houston, TX 77032, U.S.A.
TEL: 1-(888)-648-8869 FAX: 1-(281)-227-0937

Canada

Mitutoyo Canada Inc.

2121 Meadowdale Blvd., Mississauga, Ont. L5N 5N1,
CANADA
TEL: 1-(905)821-1261 FAX: 1-(905)821-4968

Montreal Office

7075 Place Robert-Joncas Suite 129, Montreal,
Quebec H4M 2Z2, CANADA
TEL: 1-(514)337-5994 FAX: 1-(514)337-4498

Argentina

Mitutoyo Sul Americana Ltda.

Av. B. Mitre 891/899 – C.P. (B1603CQ) Vicente
López – Pcia. Buenos Aires – ARGENTINA
TEL: 54(11)4730-1433 FAX: 54(11)4730-1411

Sucursal Cordoba

Av. Amadeo Sabattini, 1296, esq. Madrid
B° Crisol Sur – CP 5000, Córdoba, ARGENTINA
TEL/FAX: 54 (351) 456-6251

Brazil

Mitutoyo Sul Americana Ltda.

Av. Joao Carlos da Silva Borges, 1240 - CEP 04726-002
- Santo Amaro - São Paulo - SP, BRASIL
TEL: 55(11)5643-0000 FAX: 55(11)5641-3722

Regional Office

Belo Horizonte - MG

TEL: 55(31)3531-5511 FAX: 55(31)3594-4482

Rio Grande do Sul / PR, SC

TEL/FAX: 55(51)3342-1498 TEL: 55(51)3337-0206

Rio de Janeiro - RJ

TEL: 55(21)3333-4899 TEL/FAX: 55(21)2401-9958

Santa Barbara D'Oeste - SP

TEL: 55(19)3455-2062 FAX: 55(19)3454-6103

Norte, Nordeste, Centro Oeste

TEL: 55(11)5643-0060 FAX: 55(11)5641-9029

Escritorio BA / SE

TEL/FAX: 55(71)3326-5232

Factory (Suzano)

Rodovia Indio Tibirica 1555, BAIRRO RAFFO,
CEP 08620-000, SUZANO-SP, BRASIL
TEL: 55(11)4746-5858 FAX: 55(11)4746-5936

Mexico

Mitutoyo Mexicana S. A. de C. V.

Prolongacion Industrial Elctrica No. 15 Parque Industrial
Naucalpan, Naucalpan de Juárez, Estado de México
C.P. 53370, MÉXICO
TEL: 52 (01-55) 5312-5612

Monterrey Office / M³ Solution Center

Av. Morones Prieto No.914, Oriente Local, 105 Plaza Matz
Col. La Huerta, C.P. 67140 Guadalupe, N.L., MÉXICO
TEL: 52 (01-81) 8398-8227, 8398-8228, 8398-8244,
8398-8245 and 8398-8246
FAX: 52 (01-81) 8398-8245

Tijuana Office / M³ Solution Center

Av. 2o. eje Oriente-Poniente No. 19075 Int. 18
Col. Cd. Industrial Nueva Tijuana
C.P. 22500 Tijuana, B. C., MÉXICO
TEL: 52 (01-664) 647- 5024

Querétaro Office / M³ Solution Center

Av. Constituyentes Ote. 71-B,
Fraccionamiento Observatorio
C.P. 76040 Querétaro, Qro. MÉXICO
TEL: 52 (01-442) 340-8018, 340-8019 and 340-8020
FAX: 52 (01-442) 340-8017

AguaCalientes Office / M³ Solution Center

Av. AguaCalientes No. 622, Local 15 Centro Comercial
El Cílinaro, Fracc. Pulgas Pandas Norte, C.P. 20138
AguaCalientes Aqs, MÉXICO
TEL: 52 (01-449) 174-4140 and 174-4143

Irapuato Office / M³ Solution Center Irapuato

Boulevard a Villas de Irapuato No. 1460 L.1 Col. Ejido
Irapuato C.P. 36643 Irapuato, Gto., MÉXICO
TEL: 52 (01-462) 144-1200 and 144-1400

Mitutoyo's global sales and service network

Mitutoyo helps improve product quality through measurement.





For more information about Mitutoyo Group Companies and Agents/Distributors, refer to the web site below:
<http://www.mitutoyo.co.jp/global.html> (See also page U-14)



M³ Solution Center

*M³ = Mitutoyo, Measurement, Metrology

Specialists in each field meet each customer's needs in detail

In order to meet the precise needs of customers, Mitutoyo has built a domestic sales network of 12 sales centers and 25 offices. Along with strengthening the company's ability to rapidly and accurately satisfy customer needs, the company has also built an extensive after-sales network.

Mitutoyo has also created its M³ Solution Centers that are specifically designed to address measurement-related challenges from customers. Here, effective solutions to out-of-the ordinary requirements can be found through demonstrations of the company's products, and latest technology, in combination with consultations with Mitutoyo's metrology experts.

M³ Solution Center-Illinois (U.S.A.)



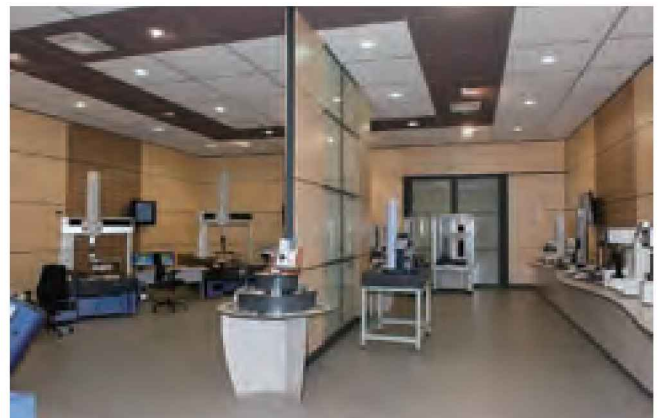
M³ Solution Center Ingolstadt (Germany)



Mitutoyo Canada Inc. (Canada)



M³ Solution Center Toulouse (France)



Through M³ Solution Centers across the world, we offer optimum measuring solutions to our customers.

In recent years, as the reduction of lead times has become a major theme in manufacturing, in the category of large measuring equipment such as coordinate measuring machines, including car body CMMs and form measuring instruments, demand for CNC machines (computer numerical control automated measuring machines) has been rising. Moreover, along with a similar increase in demand for 3D CAD, non-contact measurement using laser sensor probes has become common for 3D measuring machines. By providing M³ Solution Centers in various locations across the world, Mitutoyo is in a position to propose the use of its technologies in the fields of hardware, software, sensors, automatic control, handling systems, and the various types of tools, combined with thirdparty technologies, to answer customers' issues relating to advanced measurement.

A network spanning Japan, Asia, Europe, and America provides solutions to all kinds of problems on a global basis.

Our mission is to provide optimum solutions tailored to the measurement-related needs of our customers in a speedy and accurate manner. In order to effectively respond to the various requests and tasks given us by customers all around the world, Mitutoyo has set up M³ Solution Centers that promote our measuring technologies to a worldwide audience. Our collaborative network, which spans Japan, Asia, Europe, and America, allows us to respond to needs on a global basis.

M³ Solution Center Taichung (Taiwan)



M³ Solution Center (Singapore)



MSA Gurgaon Technical Center (India)



M³ Solution Center (Korea)



Measuring instrument accompanied with an inspection certificate

As part of quality assurance, Mitutoyo will attach data at the time of factory shipment*1 to the products listed in page U-12.*2 Also, if calibration of the measuring instrument is requested at the time of purchase, we will issue, at a separate charge, a calibration certificate that proves traceability with the reference gage. If you wish to request calibration, please contact your local Mitutoyo sales office.

*1: For some products whose purchase date cannot be identified, the inspection data at the time of factory shipment cannot be used in the calibration certificate. For details, please contact your local Mitutoyo sales office.

*2: The products are listed in the series name. There are some models that will not be accompanied with an inspection certificate.



- For the details of the inspection items to be included in the inspection certificate, please contact your local Mitutoyo sales office.
- If you have a request on inspection items, contact your local Mitutoyo sales office.



QuantuMike
293-140-30



IP67 ABSOLUTE Coolant Proof Caliper
500-702-20



Digimatic Indicators
543-563



Ratchet Thimble Micrometer
102-701

	Products Name	Page
Micrometers (only for models with the range of 0-25mm and 25-50mm)	High-Accuracy Digimatic Micrometer	B-3 to B-4
	QuantuMike	B-5 to B-6
	Coolant Proof Micrometer	B-7 to B-8
	Digimatic Outside Micrometer	B-9
	Outside Micrometer	B-13
	Ratchet Thimble Micrometer	B-14
	Outside Micrometer	B-15
	Inside Diameter Measuring Tools	Digimatic Holtest
Holtest		C-7 to C-10
Holtest (Type II)		C-11 to C-12
ABSOLUTE Borematic		C-13 to C-16
Inside Micro Checker		C-26
Calipers	SuperCaliper	D-3 to D-4
	IP67 ABSOLUTE Coolant Proof Caliper	D-5 to D-6
	ABSOLUTE Digimatic Caliper	D-7 to D-8
	ABSOLUTE Solar Caliper	D-10
	Dial Caliper	D-16
Height Gages	CERA Caliper Checker	D-53
High Precision Height Measuring Tools	Linear Height	D-55 to D-56
	QM-Height	D-57 to D-58
Depth Gages	Depth Micro Checker	D-63
Gauge Blocks	Gauge Blocks with a Calibrated Coefficient of Thermal Expansion	E-6
	ZERO CERA Block	E-6
	Metric/Inch Rectangular Gauge Block Set	E-7 to E-10
	Micrometer Inspection Gauge Block Set	E-11 to E-12
	Individual Metric/Inch Rectangular Gauge Block	E-13 to E-16
	Metric/Inch Square Gauge Block Set	E-21 to E-22
	Individual Metric/Inch Square Gauge Block	E-23 to E-24
	Step Master	E-27
	Automatic Gauge Block Interferometer GBI	E-31
	Gauge Block Comparator GBCD-100A	E-31
	Gauge Block Comparator GBCD-250	E-32
	Reference Gages	Height Master
Digital Height Master		E-35
Riser Blocks		E-36
Universal Height Master		E-37
Check Master		E-38
High Accuracy Check Master		E-38
Standard scale		E-39
Working Standard Scales		E-40
CERA Straight Master		E-41
High Precision Square		E-42
Black Granite Surface Plates		E-51 to E-52

	Products Name	Page
Digimatic Indicators	ABSOLUTE Solar-Powered Digimatic Indicator ID-SS	F-3
	ABSOLUTE Digimatic Indicator ID-SX	F-4
	ABSOLUTE Digimatic Indicator ID-CX	F-5 to F-6
	ABSOLUTE Digimatic Indicator ID-C (Peak-Value Hold Type)	F-9
	ABSOLUTE Digimatic Indicator ID-C (Bore Gage Type)	F-10
	ABSOLUTE Digimatic Indicator ID-C (Calculation Type)	F-11
	ABSOLUTE Digimatic Indicator ID-C (Signal Output Function Type)	F-13
	ABSOLUTE Digimatic Indicator ID-H	F-15 to F-16
	Dial Indicators	Dial Indicator
Inspection Instrument for Dial Indicators	i-Checker	F-71
	Calibration Tester *521series	F-72
Linear Gages	High-precision LGH (0.01µm resolution)	G-17 to G-18
	Super high-precision LGH (0.01µm resolution)	G-19 to G-20
Laser Scan Micrometers	Calibration Gage Set	G-52
Linear Scales	Linear Scales AT series	H-8 to H-19
	Linear Scales ST series	H-22 to H-27
	MICSYS-SA1 2D Image Correlation Encoder	H-29
Surftest	Surftest (except for SJ-210 and SJ-310 series)	L-7 to L-12
	Y-axis table	L-14
	Step gage	L-16
Formtracer	Formtracer	L-27 to L-30
Contracer	Contracer	L-19, L-21, L-22
	Y-axis table	L-26
Roundtest	Roundtest	L-33 to L-39
	Cylindrical square	L-42
	Magnification calibrator	L-42
Hardness Testing Machines	Micro Vickers Hardness Testing Machines	M-3 to M-4
	Vickers Hardness Testing Machines	M-5 to M-6
	Rockwell Hardness Testing machines	M-7 to M-8
	Impact Type Hardness Tester (HH-411)	M-9

* Some products mentioned above will not be accompanied with an inspection certificate as standard.



In the Spirit of Mitutoyo

To become a complete man, one must acquire Wisdom, Benevolence and Valor. With Wisdom only, one tends to be cold. Benevolence alone makes one weaker. With valor only, one may reach beyond his capabilities. When the three qualities are combined, however, one will become a complete man. Similarly, success in enterprise lies in the knowledge of Heaven, Earth and Man. Business will succeed only when these factors, "heavensent" chances, natural opportunities, and harmony of man are present. Without even one factor, success is remote. In Buddhism, Butsu (Buddha), Po (Doctrine) and So (Priest) are three principle treasures for its promotion of the teaching. In Christianity, God, Bible and Minister. The word MITUTOYO signifies three abundances. "Mitsu" means three, while "Toyo" stands for a state of abundance. The name MITUTOYO was selected, with a sincere wish to see more complete men, to create a prosperous enterprise and to introduce righteous religion to all, along with the lasting wish for a peaceful world and fulfillment of meaningful life.

SINGAPORE REGIONAL HEADQUARTERS

Mitutoyo Asia Pacific Pte. Ltd.

Company Reg No. 197800892N

24 Kallang Avenue, Mitutoyo Building, Singapore 339415

Tel: (65) 6294 2211 Fax: (65) 6299 6666

E-mail: mapsg@mitutoyo.com.sg



www.mitutoyo.com.sg

www.mitutoyo.com.my

www.mitutoyo.co.th

www.mitutoyo.co.id

www.mitutoyo.com.vn

www.mitutoyo.com.ph

MALAYSIA

Mitutoyo (Malaysia) Sdn. Bhd.

Mah Sing Integrated Industrial Park,
4, Jalan Utarid U5/14, Section U5,
40150 Shah Alam, Selangor, Malaysia

Tel: (60) 3-7845 9318

Fax: (60) 3-7845 9346

E-mail: mmsb@mitutoyo.com.my

Penang Branch

30, Persiaran Mahsuri 1/2,
Sunway Tunas,
11900 Bayan Lepas, Penang, Malaysia

Tel: (60) 4641 1998

Fax: (60) 4641 2998

E-mail: mmsbpen@mitutoyo.com.my

Johor Branch

70 (Ground Floor), Jalan Molek 1/28,
Taman Molek,
81100 Johor Bahru, Johor, Malaysia

Tel: (60) 7352 1626

Fax: (60) 7352 1628

E-mail: mmsbjhr@mitutoyo.com.my

THAILAND

Mitutoyo (Thailand) Co., Ltd.

76/3-5, Chaengwattana Road,
Kwaeng Anusaowaree, Khet Bangkaen,
Bangkok 10220, Thailand

Tel: (66) 2080 3500

Fax: (66) 2521 6136

E-mail: office@mitutoyo.co.th

Chonburi Branch

7/1, Moo 3, Tambon Bowin,
Amphur Sriracha,
Chonburi 20230, Thailand

Tel: (66) 2080 3563

Fax: (66) 3834 5788

E-mail: office@mitutoyo.co.th

Amata Nakorn Branch

700/199, Moo 1, Tambon Bankao,
Amphur Phanthong,
Chonburi 20160, Thailand

Tel: (66) 2080 3565

Fax: (66) 3846 8978

E-mail: office@mitutoyo.co.th

INDONESIA

PT. Mitutoyo Indonesia

Jalan Sriwijaya No.26 Desa cibatu
Kec. Cikarang Selatan
Kab. Bekasi 17530, Indonesia

Tel: (62) 21-2962 8600

Fax: (62) 21-2962 8604

E-mail: ptmi@mitutoyo.co.id

VIETNAM

Mitutoyo Vietnam Co., Ltd.

No. 07-TT4, My Dinh - Me Tri Urban Zone,
My Dinh 1 Ward, Nam Tu Liem District,
Hanoi, Vietnam

Tel: (84) 4-3768 8963

Fax: (84) 4-3768 8960

E-mail: mvc-hn@mitutoyo.com.vn

Ho Chi Minh City Branch

31 Phan Xich Long Street,
Ward 2, Phu Nhuan District,
Ho Chi Minh City, Vietnam

Tel: (84) 8-3840 3489

Fax: (84) 8-3840 3498

E-mail: mvc-hcmc@mitutoyo.com.vn

PHILIPPINES

Mitutoyo Philippines, Inc.

Unit 2103, GMV Building 2,
107 North Main Avenue,
Laguna Technopark, Biñan,
Laguna 4024, Philippines

Tel: (63) 4-9544 0272

Fax: (63) 4-9544 0272

E-mail: mpi@mitutoyo.com.ph

Distributed by: