Featured Products

Surface Roughness Measurement (Surface Texture Measuring Instruments)

SJ-220/310/410/500/2100 Series

Refer to page J-3 for details

FORMTRACER Avant (Contour Measuring Instruments)

C3000/4000 Series

Refer to page J-10 for details.

FORMTRACER Avant (Contour & Surface Texture Measuring Instruments)

FTA-H3000 Series

Refer to page J-12 for details.

ROUNDTRACER EXTREME (CNC Roundness/Cylindricity Measuring System)

RTX-0605-A

Refer to page J-25 for details.

ROUNDTRACER FLASH (Optical Shaft Measuring System)

S-100 / 300 Series

Refer to page J-25 for details

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Form Measurement

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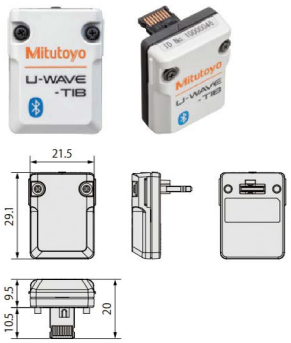
Mitutoyo

Surftest

MeasurLink ENABLED
Data Management Software by Mitutoyo

Surftest SJ-220
SERIES 178 – On-site Surface Roughness Tester



Wireless Unit for Measuring Instrument U-WAVE-TIB

264-628

It can only be used in countries where wirelesss certification has been obtained, including the country of purchase. For use in countries other than the country of purchase, please contact the nearest Mitutoyo M³ Solution Center.

Free Communication Software

Output software based on Microsoft-Excel for controlling the devices and reproducing and storing the measurement data.

SPECIFICATIONS

Model No.			Standard drive unit		Retractable drive unit		Transverse tracing drive unit	
			SJ-220 (0.75 mN type)	**SJ-220** (4 mN type)	**SJ-220** (0.75 mN type)	**SJ-220** (4 mN type)	**SJ-220** (0.75 mN type)	**SJ-220** (4 mN type)
inch/mm			**178-741-13**	**178-742-13**	**178-743-13**	**178-744-13**	**178-745-13**	**178-746-13**
Drive Unit Order No.			178-747		178-748		178-749	
Measuring range	X-axis		16.0 mm				5.6 mm	
	Detector	Range	360 µm (-200 µm to +160 µm)					
		Range/Resolution	360 µm/0.0256 µm, 100 µm/0.0064 µm, 25 µm/0.0016 µm					
Measuring force/Stylus tip shape			Depends on the Order No.: 0.75 mN/2 µmR 60° 4 mN/5 µmR 90°					
Applicable standards			JIS B 0601:1982 / 1994 / 2013 JIS B 0671:2002 JIS B 0631:2000 ISO 4287:1997 ISO 13565:1996 ISO 12085:1996 ISO 21920:2021 ASME B46.1 VDA2006					
Assessed profile			Primary profile, Roughness profile, DF profile, Roughness motif profile					

Standard accessories for SJ-220

12AAY583	Handy case
12BAA303	Connecting cable
12BAS450	AC adaptor
12BAS451	USB 2.0 cable
178-601-1	Roughness specimen (mm)
178-602-1	Roughness specimen (inch/mm)
178-605	Roughness specimen (mm) for Transverse drive
178-606	Roughness specimen (inch/mm) for Transverse drive
12BAK700	Calibration stage
12BAS476	Tool for battery switch
12AAE643	Point -contact adapter for transverse drive
12AAE644	V-type adapter for transverse drive

SJ Stand 178-069
(must order optional part **12AAA221** to mount **SJ-220/310** drive unit)

Surftest SJ-310
SERIES 178 — On-site Surface Roughness Tester

MeasurLink ENABLED
Data Management Software by Mitutoyo

SPECIFICATIONS

Model No.			Standard drive unit		Retractable drive unit		Transverse tracing drive unit	
			SJ-310 (0.75 mN type)	**SJ-310** (4 mN type)	**SJ-310** (0.75 mN type)	**SJ-310** (4 mN type)	**SJ-310** (0.75 mN type)	**SJ-310** (4 mN type)
inch/mm			**178-571-21A**	**178-571-22A**	**178-573-21A**	**178-573-22A**	**178-575-21A**	**178-575-22A**
Drive unit Order No.			178-747		178-748		178-749	
Measuring range	X-axis		16.0 mm				5.6 mm	
	Detector	Range	360 µm (-200 µm to +160 µm)					
		Range/Resolution	360 µm/0.0256 µm, 100 µm/0.0064 µm, 25 µm/0.0016 µm					
Measuring force/Stylus tip shape			Depends on the Order No.: 0.75 mN/2 µmR 60° (when the Order No. ends with "**-21**") 4 mN/5 µmR 90° (when the Order No. ends with "**-22**")					
Applicable standards			JIS B 0601:2001, JIS B 0601:1994, JIS B 0601:1982, VDA, ISO:1997, ANSI					
Assessed profile			Primary profile, Roughness profile, DF profile, Roughness motif profile, Waviness motif profile					

Standard accessories for SJ-310

12AAW066	Connecting cable for Drive unit to Display unit
178-602	Roughness reference specimen (Ra3 µm)
178-606	Roughness reference specimen (Ra1 µm) (For Transverse Drive Type only)
357651	AC adapter
12AAA217	Nosepiece for plane surface
12AAA218	Nosepiece for cylinder
12AAA216	Supporting leg
12AAE643	Point-contact adapter (For Transverse Drive Type only)
12AAE644	V-type adapter (For Transverse Drive Type only)
12BAK700	Calibration stage
12BAG834	Stylus pen
12BAL402	Protection sheet
270732	Printer paper (5 pieces)
12BAL400	Carrying case

Philips screwdriver, strap for stylus pen, operation manual, quick reference manual, warranty.

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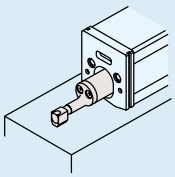
Optional Accessories for Surftest SJ-220/310

Detector

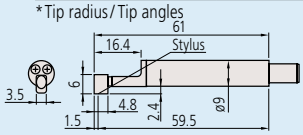
Unit: mm

• Standard detectors

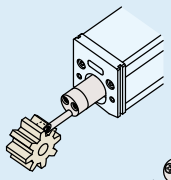


Order No.	Measuring force	Stylus profiles*	Remarks
178-296	0.75 mN	2 µmR/60°	Dedicated to the standard/retractable drive unit
178-390	4 mN	5 µmR/90°	
178-387	0.75 mN	2 µmR/60°	Dedicated to the transverse tracing drive unit
178-386	4 mN	5 µmR/90°	
178-391	4 mN	10 µmR/90°	Dedicated to the standard/retractable drive unit

*Tip radius/Tip angles

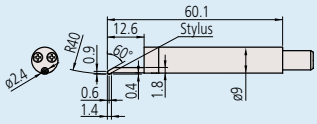


• Gear-tooth surface detectors

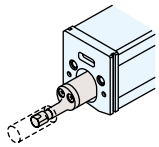


Order No.	Measuring force	Stylus profiles*
178-388	0.75 mN	2 µmR/60°
178-398	4 mN	5 µmR/60°

*Tip radius/Tip angles

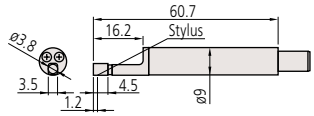


• Small hole detectors

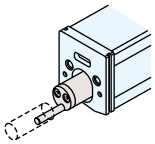


Order No.	Measuring force	Stylus profiles*	Remarks
178-383	0.75 mN	2 µmR/60°	Minimum measurable hole diameter: ø4.5 mm
178-392	4 mN	5 µmR/90°	

*Tip radius/Tip angles

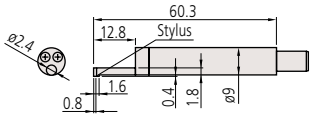


• Extra small hole detectors

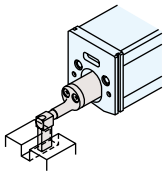


Order No.	Measuring force	Stylus profiles*	Remarks
178-384	0.75 mN	2 µmR/60°	Minimum measurable hole diameter: ø2.8 mm
178-393	4 mN	5 µmR/90°	

*Tip radius/Tip angles

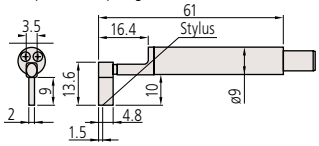


• Deep groove detectors



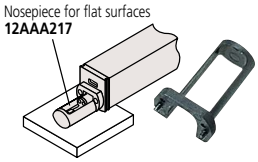
Order No.	Measuring force	Stylus profiles*	Remarks
178-385	0.75 mN	2 µmR/60°	Not available for the transverse tracing drive unit
178-394	4 mN	5 µmR/90°	

*Tip radius/Tip angles



Optional Accessories for Drive Units

• Nosepiece for flat surfaces



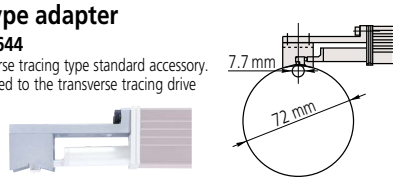
12AAA217
- Standard accessory for the standard/retractable drive unit of the **SJ-310** Series
- Not available for the transverse tracing drive unit

• Nosepiece for cylindrical surfaces

12AAA218
- Standard accessory for the standard/retractable drive unit of the **SJ-310** Series
- Not available for the transverse tracing drive unit

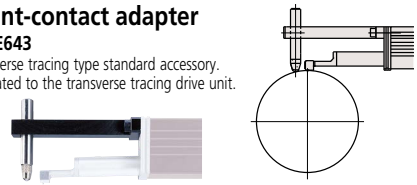
• V-type adapter

12AAE644
- Transverse tracing type standard accessory.
- Dedicated to the transverse tracing drive unit.



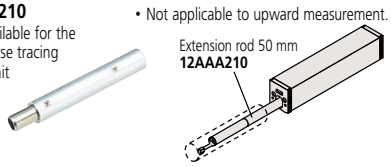
• Point-contact adapter

12AAE643
- Transverse tracing type standard accessory.
- Dedicated to the transverse tracing drive unit.



• Extension rod (50 mm) (Note: Only one rod can be used.)

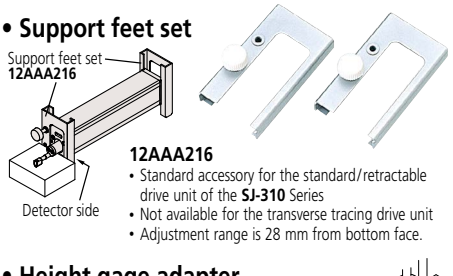
12AAA210
- Not available for the transverse tracing drive unit
- Not applicable to upward measurement.



• Extension cable (1 m) (Note: Only one rod can be used.)

12BAA303
- For the connection between the calculation display unit and drive unit

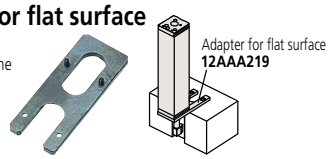
• Support feet set



12AAA216
- Standard accessory for the standard/retractable drive unit of the **SJ-310** Series
- Not available for the transverse tracing drive unit
- Adjustment range is 28 mm from bottom face.

• Adapter for flat surface

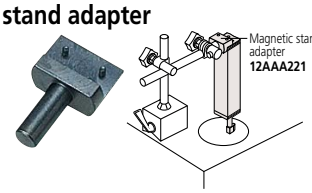
12AAA219
- Not available for the transverse tracing drive unit



• Magnetic stand adapter

12AAA221
Mounting spigot diameter is 8 mm.

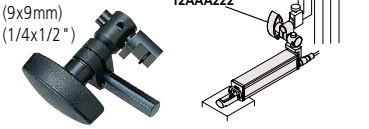
12AAA220
Mounting spigot diameter is 9.5 mm.



• Height gage adapter

Note: Suitable for a height gage holder designed for 9×9 mm section scribers.

12AAA222 (9x9mm)
12AAA233 (1/4x1/2")



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Surftest

Surftest SJ-410
SERIES 178
Compact Surface Roughness Tester

MeasurLink® ENABLED
Data Management Software by Mitutoyo

PROPRIETARY INSPECTION CERTIFICATE

SPECIFICATIONS

Model No.		SJ-411		SJ-412	
	inch/mm	178-581-31A	178-581-32A	178-583-31A	178-583-32A
Measuring range	X-axis	25 mm		50 mm	
	Z-axis (detector)	800 µm, 80 µm, 8 µm Up to 2,400 µm when using an optional stylus.			
Detector	Detection method	Differential inductance			
	Resolution	0.0125 µm (800 µm range), 0.00125 µm (80 µm range), 0.000125 µm (8 µm range)			
	Stylus tip shape (Angle/Radius)	60°/2 µm	90°/5 µm	60°/2 µm	90°/5 µm
	Measuring force	0.75 mN	4 mN	0.75 mN	4 mN
	Radius of skid curvature	40 mm			
	Measuring methods	Skidless/Skidded (switchable)			
Drive unit (X-axis)	Measuring speed	0.05, 0.1, 0.2, 0.5, 1.0 mm/s			
	Drive speed	0.5, 1, 2, 5 mm/s			
	Straightness	0.3 µm/25 mm		0.5 µm/50 mm	
Up/down inclination unit	Vertical travel	10 mm			
	Inclination adjustment angle	±1.5°			
Applicable standards		JIS 1982/JIS 1994/JIS 2001/ISO 1997/ANSI/VDA			
Parameter		Ra, Rq, Rz, Ry, Rp, Rv, Rt, R3z, Rsk, Rku, Rc, RPc, RSm, Rmax*1, Rz1max*2, S, HSC, RzJIS*3, Rppi, RΔa, RΔq, Rlr, Rmr, Rmr(c), RσC, Rk, Rpk, Rvk, Mr1, Mr2, A1, A2, Vo, λa, λq, Lo, Rpm, tp*4, Htp*4, R, Rx, AR, W, AW, Wx, Wte Customizable			
Filtered profile		Primary profile, Roughness profile, DF profile, Waviness profile, Roughness motif profile, Waviness motif profile			
Analysis graph		Material ratio curve, Profile height amplitude distribution curve			
Data compensation functions		Parabola, Hyperbola, Ellipse, Circle, Tilt, No compensation			
Filter		2CR, PC75, Gaussian			
Cutoff value	λc	0.08, 0.25, 0.8, 2.5, 8 mm			
	λs *5	2.5, 8, 25 µm			
Sampling length		0.08, 0.25, 0.8, 2.5, 8, 25 mm			
Number of intervals		x1, x2, x3, x4, x5, x6, x7, x8, x9, x10, x11, x12, x13, x14, x15, x16, x17, x18, x19, x20			
Arbitrary length		0.1 to 25 mm		0.1 to 50 mm	
Calculation display unit	Customization	Selection of display/evaluation roughness parameter			
	Simplified contour analysis function	Step, Step quantity, Area, Coordinate difference			
	D.A.T. (Digimatic Adjustment Table) function	Helps to level workpiece prior to skidless measurement			
	Real sampling function	Inputs the displacement of the detector while stopping the drive unit			
	Statistical processing	Calculates the maximum value, minimum value, average value, standard deviation, pass rate and histogram for each parameter.			
	Judgment*6	Maximum value rule, 16% rule, mean value rule, standard deviation (1σ, 2σ, 3σ)			
	Storing measurement condition	Max. 10 (calculation display unit)			
	Print function (Built-in thermal printer)	Measurement condition/Calculation result/Judgment result/Calculation result per segment/Tolerance value/Evaluation curve/Graphic curve/Material ratio curve/Profile height amplitude distribution curve/Environmental setting items/Statistical result (Histogram)			
	Display language	16 languages (Japanese, English, German, French, Italian, Spanish, Portuguese, Korean, Chinese (simplified/traditional), Czech, Polish, Hungarian,Turkish, Swedish, Dutch)			
	Storage function	Built-in memory: Measurement condition (Up to 10) Memory card (optional): 500 measurement conditions, 10000 measured profiles, 500 display images, 10000 text files, 500 statistical data, 1 backup file of device setting data, 10 data of Trace 10			
	External I/O functions	USB I/F, Digimatic output, RS-232C I/F, Foot switch I/F			
Power supply	Battery Charging time/Endurance	Built-in battery (rechargeable Ni-MH battery)/AC adapter Charging time of the built-in battery: about 4 hours (may vary due to ambient temperature) Endurance: about 1000 measurements (differs slightly due to use conditions/environment)			
	Max. power consumption	50 W			
External dimensions (W×D×H)	Calculation display unit	275×198×109 mm			
	Up/down inclination unit	130.9×63×99 mm			
	Drive unit	128×35.8×46.6 mm		154.5×35.8×46.6 mm	
Mass	Calculation display unit	1.7 kg			
	Up/down inclination unit	0.4 kg			
	Drive unit	0.6 kg		0.64 kg	
Standard Accessories		Detector*7/Standard stylus*8 **178-602** Roughness specimen (Ra3 µm) **270732** Receipt paper (Standard type: 5-roll set) **12BAL402** Protective sheet for the LCD (×1 sheet) **12BAR507** Touch pen **12AAN041** Carrying case		AC adapter, Power cable, Flat-blade screwdriver, Phillips screwdriver, Hex wrench, Strap for the touch pen, Operation manual, One-sheet manual, Warranty card	

*1 Calculation is available only when selecting the VDA, ANSI, or JIS 1982 standards.
*2 Calculation is available only when selecting the ISO 1997 standard. *3 Calculation is available only when selecting the JIS 2001 standard.
*4 Calculation is available only when selecting the ANSI standard. *5 Not available when selecting the JIS 1982 standard.
*6 Only the mean value rule is available for the ANSI standard. 16% rule is not available when selecting the VDA standard.
*7 Depending on the Order No. of the **SJ-410** Series main unit, **178-396** (0.75 mN) or **178-397** (4 mN) is provided as standard.
*8 Standard stylus (**12AAC731** or **12AAB403**) supporting the provided detector is provided as standard.

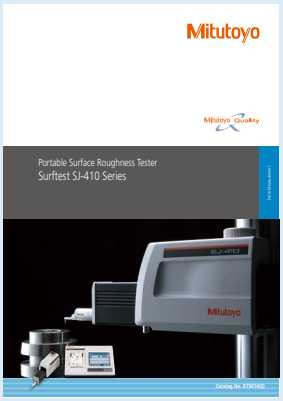
Surfstand (optional accessory)

Mounted on the same large surface plate as the workpiece to be inspected, this substantially built stand can be maneuvered and adjusted to position the detector on practically any surface of the workpiece desired. The SJ-400 Series detector is carried on an adjustable-length tube mounted on an extendable arm carried by a vertically traveling carriage on the column, thus enabling positioning of the detector anywhere in the vertical plane within reach.

Order No.		64PMI307
Measuring range	Z-axis at 0 degrees	663mm max
	X-axis at 0 degrees	550mm max from base
	Theta-1 axis	180°(+90°to -90°)
	Theta-2 axis	360°(+180°to -180°)
	Depth into bore	453mm max
Dimensions	Height	986mm (not including the lifting eye)
	Width	850mm max
	Depth	280mm
	Weight	55kg
Compatible Surftests		SJ-411 & SJ-412

Optional Accessories for SJ-410 Consumables

- Receipt paper Standard type (5-roll set) **270732**
- Receipt paper High-durability paper (5-roll set) **12AAA876**
- Protective sheet for the touch panel (×10 sheets) **12AAN040**
- Memory card (2 GB) **12AAW452**



Refer to the Surftest **SJ-410** Series Brochure (**E15014(6)-US**) for more details.

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PROPRIETARY INSPECTION CERTIFICATE

Surftest SJ-500/SV-2100
SERIES 178 — Dedicated Control Unit Type Surface Roughness Tester

High precision and high performance type surface roughness tester with a dedicated control unit, offering a user-friendly display and simple operation.

- Equipped with a 7.5-inch, color TFT LCD, color icons and touch panel controls, the display unit is easy to read and simple to operate.
- A built-in joystick on the control unit allows quick and easy positioning. The manual adjustment knob allows fine positioning of a small stylus for measuring small holes.
- In addition to the roughness parameters compliant with ISO/JIS/ANSI/VDA surface roughness standards, contour analysis is also available.

SV-2100M4

SV-2100S4


SJ-500

SPECIFICATIONS

Model No.		SJ-500	SV-2100M4*1	SV-2100S4*1	SV-2100H4*1	SV-2100W4*1
inch/mm		178-533-11	178-637-11	178-681-01A	178-683-01A	178-685-01A
Detector Measuring Force		0.75mN	0.75mN	0.75mN	0.75mN	0.75mN
Stand type		—*2	Manual stand	Motorized stand		
Measuring range	Z1-axis (detector)	800 µm, 80 µm, 8 µm				
	X-axis	50 mm	100 mm			
Resolution	X-axis	0.05 µm				
	Z1-axis (detector)	0.01 µm (800 µm), 0.001 µm (80 µm), 0.0001 µm (8 µm)				
	Z2-axis (column)	—	—	1 µm		
Assessed profile		Primary profile, Roughness profile, Waviness profile, DF profile, Roughness motif profile, Waviness motif profile				

*1 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.
*2 Stand for **SJ-500** is optional.

MeasurLink® ENABLED
Data Management Software by Mitutoyo

PROPRIETARY INSPECTION CERTIFICATE

Surftest SJ-500P
SERIES 178 — Data Processing Unit (PC) Surface Roughness Testers

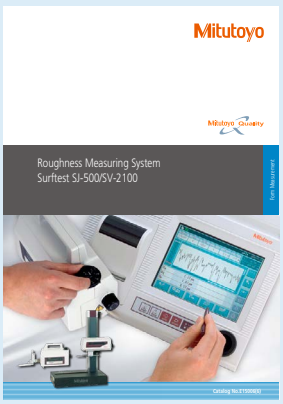
A superior data processing tester with PC data analysis for higher efficiency.

Note: If a power column type (SV-2100S4/H4/W4) with PC data-processing is required, consider the FORMTRACER Avant S3000 Series (Refer to page L-9 for specifications).


SJ-500P

FORMTRACEPAK: Best-selling Surface Roughness Analysis Program

Best-selling dedicated software for surface roughness measurement and analysis. Features a flexible printer format and creation of an original inspection certificate.



Refer to the Surftest **SJ-500**/**SV-2100** Brochure (**E15006(6)-US**) for more details.

SPECIFICATIONS

Type of data processing unit		PC type
Model No.		SJ-500P
inch/mm		178-534-23
Detector Measuring Force		0.75mN
Elevating shaft mechanism of stand		—*2
Measuring range	X-axis	50 mm
	Z1-axis (detector)	800 µm, 80 µm, 8 µm
Z2-axis (column) travel range		—
Resolution	X-axis	0.05 µm
	Z1-axis (detector)	0.01 µm (800 µm), 0.001 µm (80 µm), 0.0001 µm (8 µm)
	Z2-axis (column)	—
Applicable standards		JIS 1982/JIS 1994/JIS 2001/ISO 1997/ANSI/VDA
Assessed profile		Primary profile, Roughness profile, Waviness profile, Filtered waviness profile, Rolling circle waviness profile, Rolling circle center line waviness profile, Envelope residual profile, DIN4776 profile, Roughness motif profile, Waviness motif profile

*1 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.
*2 The simplified stand or manual column stand is available as an optional accessory.

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Surftest

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PROPRIETARY INSPECTION CERTIFICATE

Surftest Extreme SV-3000CNC/SV-M3000CNC
SERIES 178 — CNC Surface Roughness Testers

SV-3000CNC
(Inclinable drive unit + Y-axis table)

SV-M3000CNC
(Surface Roughness Tester with built-in Y-axis.)
(The photo represents a special specification model.)

- The X1, Y and Z2 axes have a maximum drive speed of 200 mm/s.
  This permits high-speed positioning that can potentially result in a large increase in the throughput of multiple-profile/multiple-workpiece measurement tasks.
- Capable of inclined plane measurement through 2 axis simultaneous control in X and Y.
- Models equipped with the Alpha-axis allow continuous measurement on horizontal and inclined surfaces by power-tilting the X1-axis.
- It is possible to expand the measuring range for multiple workpieces through positioning in the Y-axis.
- All connecting cables are contained within the measuring instrument to eliminate any inconvenience during measurement.
- Since the Z1-axis detector incorporates an anti-collision safety device, the detector unit will automatically stop if it touches a workpiece or fixture.
- Surftest Extreme **SV-M3000CNC** (CNC Surface Roughness Tester with a movable Y-axis table) that handles measurement of large/heavy workpieces, such as engine blocks or crankshafts, is also available.
- Optional external control function (Ext I/O) through bidirectional communication (RS-232C) with the PLC (programmable logic controller) is available.

SV-3000CNC SPECIFICATIONS

Model No.			SV-3000CNC			
	inch/mm		178-508-13	178-528-13	178-509-13	178-529-13
X1-axis (drive unit)	Measuring range		200 mm			
	Resolution		0.05 µm			
	Scale type		Reflective-type linear encoder			
	Drive speed	CNC mode	Max. 200 mm/s			
		Joystick mode	0 to 50 mm/s			
	Measuring speed		0.02, 0.05, 0.1, 0.2, 0.5, 1.0, 2.0 mm/s			
	Measuring direction		Pulling			
	Straightness		0.5 µm/200 mm			
Y-axis (table)	Y-axis table unit		Installed			
	Measuring range		200 mm			
	Resolution		0.05 µm			
	Drive speed	CNC mode	Max. 200 mm/s			
		Joystick mode	0 to 50 mm/s			
	Maximum table loading weight		20 kg			
Z2-axis (column)	Z2-axis vertical travel		300mm	500mm	300mm	500mm
	Resolution		0.05 µm			
	Scale type		Reflective-type linear encoder			
	Drive speed	CNC mode	Max. 200 mm/s			
		Joystick mode	0 to 50 mm/s			
Base unit	Base size (width×depth)		750×600 mm			
	Base material		-	Granite	-	-
	Alpha-axis unit		-	-	Installed	Installed

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.

SV-M3000CNC SPECIFICATIONS

Model No.			SV-M3000CNC
	inch/mm		178-549-1
X1-axis (drive unit)	Measuring range		200 mm
	Resolution		0.05 µm
	Scale type		Reflective-type linear encoder
	Drive speed	CNC mode	Max. 200 mm/s
		Joystick mode	0 to 50 mm/s
	Measuring speed		0.02, 0.05, 0.1, 0.2, 0.5, 1.0, 2.0 mm/s
	Straightness	When using a standard detector	0.5 µm/200 mm
Z2-axis (column)	Measuring range		500 mm
	Resolution		0.05 µm
	Scale type		Reflective-type linear encoder
	Drive speed	CNC mode	Max. 200 mm/s
		Joystick mode	0 to 50 mm/s
Y-axis	Measuring range		800 mm
	Resolution		0.05 µm
	Scale type		Reflective-type linear encoder
	Drive speed	CNC mode	Max. 200 mm/s
		Joystick mode	0 to 50 mm/s
	Measuring speed		0.02 to 2 mm/s
	Straightness	When using a standard detector holder	Narrow range 0.5 µm/50 mm Wide range 2 µm/800 mm
Base unit	Base size (width×depth)		600×1500 mm
	Base material		Steel
	Maximum table loading		300 kg

Find a Distributor

Refer to the CNC Form Measuring Instrument Series Brochure (**E15021-US**) for more details.

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Contour Measuring System enabling measurement that is fast, accurate, and easy.

• The operation flow is significantly shortened by arranging the controls for stylus position change, measurement start/stop and return on the front of the drive unit.

Centralized front control panel

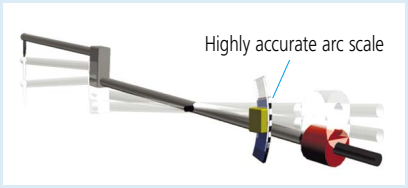
• Fine and coarse X-axis positioning can be performed easily by using the jog shuttle that covers the whole measuring range.

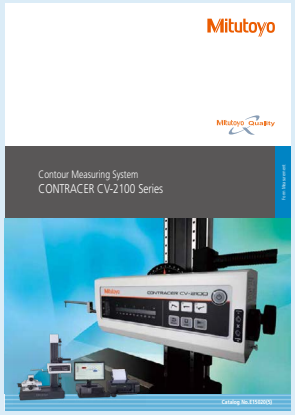
Motor-driven jog shuttle

• The quick-vertical-motion stand allows operators to swiftly and easily move the drive unit to and from the measurement height without having to push or pull (only for CV-2100M4).

Quick-vertical-motion stand

• The detector unit (Z1-axis) is equipped with a highly accurate arc scale. This scale directly tracks the arc locus of the stylus tip so that the most accurate compensation can be applied to the scale output, which leads to higher accuracy and resolution. Operators are free from bothersome operations such as measurement magnification switching and calibrating each magnification as required for analog instruments.

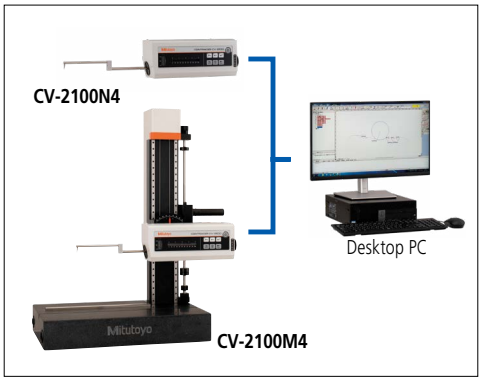




Refer to the Contracer **CV-2100** Series Brochure (**E15020(5)-US**) for more details.

Contracer CV-2100
SERIES 218 — Contour Measuring Instruments

CV-2100M4



Optional Column Stand for CV-2100N4

• Allows the use of the **CV-2100N4** in a fixed configuration.

218-042

Base material: Granite
Inclination range: ±45°
Vertical travel: 320 mm
Mass: 110 kg
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.

SPECIFICATIONS

Model No.		CV-2100M4	CV-2100N4
inch/mm		218-643-13	218-623-13
Measuring range	X-axis	100 mm	
	Z1-axis (detector unit)	50 mm	
Z2-axis (column) travel range		350 mm	—
X-axis inclination angle		±45°	
Resolution	X-axis	0.1 µm	
	Z1-axis	0.1 µm	
Drive method	X-axis	Motor (0 to 20 mm/s)	
	Vertical travel (Z-axis column)	Manual (Quick-vertical-motion, fine)	—
Measuring speed		0.02, 0.05, 0.1, 0.2, 0.5, 1.0, 2.0, 5.0 mm/s	
Straightness (when the X-axis is horizontal)		2.5 µm/100 mm	
Accuracy (20 °C)	X-axis	±(2.5+0.02L) µm L = Measurement Length (mm)	
	Z1-axis	±(2.5+|0.1H|) µm H = Measurementt height from horizontal position within ±25 mm	
Measuring direction		Both pulling and pushing directions	
Measuring face direction		Downward direction	
Measuring force		30±10 mN (3 gf)	
Traceable angle (using the standard stylus)		Ascent 77°, Descent 87° (according to surface property)	
External dimensions (W×D×H)		745×450×885 mm	651×143×138.5 mm
Mass		145.8 kg	5.8 kg

Note 1: 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.
Note 2: For the **CV-2100N4**, a manual column stand (optionally available) or custom fixture is required.

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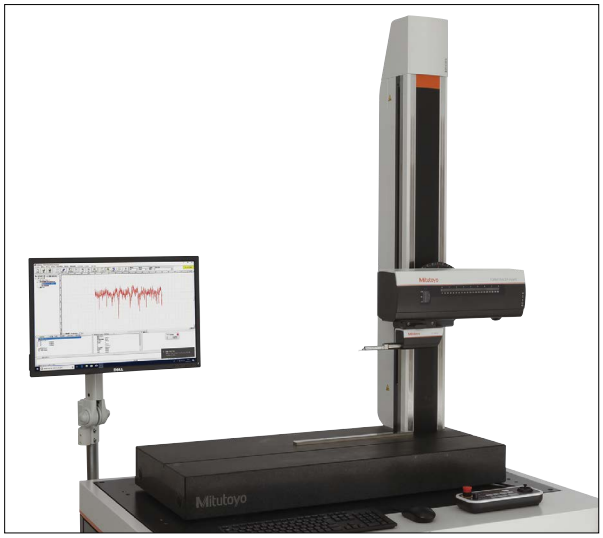
FORMTRACER Avant S3000 Series
SERIES 178 — Surface Roughness Measuring Instruments

FTA-S4S3000

- **FORMTRACER Avant S3000** Series are highly functional and user-friendly surface roughness measuring systems with innovative design features.
- The **FORMTRACER Avant S3000** Series includes models with inclined drive unit. Inclining the drive unit makes it easier to approach target surfaces and measure large workpieces.
- Equipped with an operability focused, new style remote box. The new part program key strongly supports manual part-programming.
- High throughput is achieved thanks to high drive speed (X-axis: Max. 80 mm/s, Z2-axis: Max. 30 mm/s) and acceleration (X-axis: 30 mm/s2).
- All connecting cables are contained within the measuring instrument to eliminate any inconvenience during measurement.
- The Z1-axis detector is equipped with a built-in anti-collision safety device.
- A variety of detector holders (optional) are available.
- A detector for measuring contours can be retrofitted.

Inclined drive unit



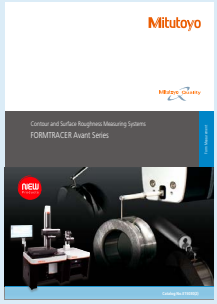
Large sized base models and high-column models are added to the line-up.

Remote box with user-friendly operability

Detector holder (optional)

Mitutoyo

Got Questions?



Refer to the **FORMTRACER Avant** Series Brochure (**E15030(2)-US**) for more details.

SPECIFICATIONS

Model No.		FTA-S4S3000	FTA-H4S3000	FTA-W4S3000	FTA-L4S3000	FTA-S8S3000	FTA-H8S3000	FTA-W8S3000	FTA-L8S3000
inch/mm		178-151-13	178-152-13	178-153-13	178-154-13	178-156-13	178-157-13	178-158-13	178-159-13
Measuring range	X-axis	100 mm				200 mm			
	Z1-axis	800 µm, 80 µm, 8 µm							
Straightness (when the X-axis is horizontal)		(0.05+0.001L) µm L = Measurement Length (mm)				(0.1+0.002L) µm L = Measurement Length (mm)			
X-axis inclination angle		±45° (Only for models with X-axis inclining drive unit)							
Z2-axis (column) travel range		300 mm	500 mm		700 mm	300 mm	500 mm		700 mm
Base size (W×D)		60×450 mm		1000×450 mm		600×450 mm		1000×450 mm	
Base material		Granite							

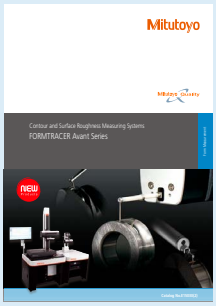
Note: While the appearance of the natural stone measuring table varies according to the source, the high stability for which this material is known can always be relied upon.

FORMTRACER Avant C3000/4000 Series
SERIES 218 — Contour Measuring Instruments

- **FORMTRACER Avant C3000/4000** Series are highly functional and user-friendly contour measuring systems with innovative design features.
- **FORMTRACER Avant C3000/4000** Series comes with the inclined drive unit as standard, making approach to the target surface and measurement of large workpieces much easier.


Inclined drive unit

- Equipped with an operability focused, new style remote box. The new part program key strongly supports manual part-programming.
- High throughput is achieved thanks to high drive speed (X-axis: Max. 80 mm/s, Z2-axis: Max. 30 mm/s) and acceleration (X-axis: 30 mm/s2).
- All connecting cables are contained within the measuring instrument to eliminate any inconvenience during measurement.
- The Z1-axis detector is equipped with a built-in anti-collision safety device.
- A detector for measuring roughness can be retrofitted.
- The arm of the detector is a user-friendly, magnetic, one-touch, detachable mechanism.
- **C4000** type is a highly functional contour measuring system that has a wide-range digital detector (measuring range: 60 mm), top/bottom plane continuous measurement function, automatic variable measuring force function, and stylus drop detection function.



Refer to the **FORMTRACER Avant** Series Brochure (**E15030(2)-US**) for more details.


FTA-S4C3000


FTA-S4C4000


Large-sized base models and high-column models are added to the line-up.


Remote box with user-friendly operability

Detector

SPECIFICATIONS

Model No.			FTA-S4C3000	FTA-H4C3000	FTA-W4C3000	FTA-L4C3000	FTA-S8C3000	FTA-H8C3000	FTA-W8C3000	FTA-L8C3000
			FTA-S4C4000	FTA-H4C4000	FTA-W4C4000	FTA-L4C4000	FTA-S8C4000	FTA-H8C4000	FTA-W8C4000	FTA-L8C4000
		inch/mm	218-361-13	218-362-13	218-363-13	218-364-13	218-366-13	218-367-13	218-368-13	218-369-13
			218-371-13	218-372-13	218-373-13	218-374-13	218-376-13	218-377-13	218-378-13	218-379-13
Measuring range		X-axis	100 mm				200 mm			
		Z1-axis	60 mm (±30 mm in horizontal situation)							
Straightness (when the X-axis is horizontal)			0.8 µm/100 mm				2 µm/200 mm			
Accuracy (20 °C)	C3000	X-axis	(0.8+0.01L) µm L = Measurement Length (mm)				(0.8+0.015L) µm L = Measurement Length (mm)			
		Z1-axis (detector unit)	±(1.2+|2H|/100) µm H = Measurement height from the horizontal position (mm)							
	C4000	X-axis	(0.8+0.01L) µm L = Measurement Length (mm)				(0.8+0.015L) µm L = Measurement Length (mm)			
		Z1-axis (detector unit)	±(0.8+|2H|/100) µm H = Measurement height from the horizontal position (mm)							
X-axis inclination angle			±45°							
Z2-axis (column) travel range			300 mm	500 mm		700 mm	300 mm	500 mm		700 mm
Base size (W×D)			600×450 mm		1000×450 mm		600×450 mm		1000×450 mm	
Base material			Granite							

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.

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PROPRIETARY INSPECTION CERTIFICATE

FORMTRACER Avant D3000/4000 Series
SERIES 525 — Surface Roughness / Contour Measuring Instruments

FTA-S4D3000
(Detector for surface roughness measurement attaching example, Inclined drive unit, with monitor arm)

FTA-S4D4000
(Detector for form/contour measurement attaching example, Inclined drive unit, with monitor arm)

- **FORMTRACER Avant D3000/4000** Series are highly functional and user-friendly surface texture measuring systems with innovative design features. Both surface roughness measurement and contour measurement are available on a single system just by replacing the detector.
- The contour/roughness detector can be replaced without turning off the controller power and without using any tool. Furthermore, the detector is recognized automatically.
- **FORMTRACER Avant D** Series comes with the inclined drive unit as standard, making approach to the target surface and measurement of large workpieces much easier.
- Equipped with an operability focused, new style remote box. The new part program key strongly supports manual part-programming.
- High throughput is achieved thanks to high drive speed (X-axis: Max. 80 mm/s, Z2-axis: Max. 30 mm/s) and acceleration (X-axis: 30 mm/s2).
- All connecting cables are contained within the measuring instrument to eliminate any inconvenience during measurement.
- The Z1-axis detector is equipped with a built-in anti-collision safety device.
- The arm of the detector for contour measurement is a magnetic, one-touch, detachable mechanism.
- **D4000** type is a highly functional contour measuring system with a digital detector (measuring range: 60 mm) that enables a wide measurement range, top/bottom plane continuous measurement function, automatic variable measuring force function, and stylus drop detection function.

Large-sized base models and high-column models are added to the line-up.

Inclined drive unit

Connecting cables are contained within the measuring instrument.

Remote box with user-friendly operability

Detector holder (optional)

Detector

Talk to Sales

SPECIFICATIONS

Model No.			FTA-S4D3000 FTA-S4D4000	FTA-H4D3000 FTA-H4D4000	FTA-W4D3000 FTA-W4D4000	FTA-L4D3000 FTA-L4D4000	FTA-S8D3000 FTA-S8D4000	FTA-H8D3000 FTA-H8D4000	FTA-W8D3000 FTA-W8D4000	FTA-L8D3000 FTA-L8D4000
inch/mm			525-311-13 525-321-13	525-312-13 525-322-13	525-313-13 525-323-13	525-314-13 525-324-13	525-316-13 525-326-13	525-317-13 525-327-13	525-318-13 525-328-13	525-319-13 525-329-13
Surface roughness measurement										
Measuring range		X-axis	100 mm				200 mm			
		Z1-axis	800 µm, 80 µm, 8 µm							
Straightness (when the X-axis is horizontal)			(0.05+0.001L) µm L = Measurement Length (mm)				(0.1+0.002L) µm L = Measurement Length (mm)			
Contour measurement										
Measuring range		X-axis	100 mm				200 mm			
		Z1-axis	60 mm (±30 mm in horizontal situation)							
Straightness (when the X-axis is horizontal)			0.8 µm/100 mm				2 µm/200 mm			
Accuracy (20 °C)	D3000	X-axis	(0.8+0.01L) µm L = Measurement Length (mm)				(0.8+0.015L) µm L = Measurement Length (mm)			
		Z1-axis (detector unit)	±(1.2+|2H|/100) µm H = Measurement height from the horizontal position (mm)							
	D4000	X-axis	(0.8+0.01L) µm L = Measurement Length (mm)				(0.8+0.015L) µm L = Measurement Length (mm)			
		Z1-axis (detector unit)	±(0.8+|2H|/100) µm H = Measurement height from the horizontal position (mm)							
Common specifications										
X-axis inclination angle			±45°							
Z2-axis (column) travel range			300 mm	500 mm		700 mm	300 mm	500 mm		700 mm
Base size (W×D)			600×450 mm		1000×450 mm		600×450 mm		1000×450 mm	
Base material			Granite							

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.

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FTA-H3000 Series
SERIES 525 — Contour and Surface Roughness Measuring System

- **FTA-H3000** Series are highly functional and user-friendly surface texture measuring systems with innovative design features. They enable simultaneous measurement of both surface roughness and contour without changing the detector.
- Large-sized base models and high-column models are newly added to the line-up.
- Equipped with a wide range and high resolution Z1-axis detector.
- **FTA-H3000** Series comes with the inclined drive unit as standard, making approach to the target surface and measurement of large workpieces much easier.
- Equipped with an operability focused, new style remote box. The new part program key strongly supports manual part-programming.
- High throughput is achieved thanks to high drive speed (X-axis: Max. 80 mm/s, Z2-axis: Max. 30 mm/s).
- All connecting cables are contained within the measuring instrument to eliminate any inconvenience during measurement.
- The Z1-axis detector is equipped with a built-in anti-collision safety device.

FTA-H3000

FTA-H3000
(with monitor arm)

Refer to the FORMTRACER Avant Series Brochure (**E15030(2)-US)** for more details.


Inclinable drive unit


Detector sliding mechanism


Connecting cables are contained within the measuring instrument.


Contour & Roughness Detector H3000

SPECIFICATIONS

Model No.			FTA-S4H3000	FTA-H4H3000	FTA-W4H3000	FTA-L4H3000	FTA-S8H3000	FTA-H8H3000	FTA-W8H3000	FTA-L8H3000
inch/mm			525-241-13	525-242-13	525-243-13	525-244-13	525-246-13	525-247-13	525-248-13	525-249-13
Measuring range	X-axis		100 mm				200 mm			
	Z1-axis		16mm (±8mm from the horizontal position)							
Straightness (when the X-axis is horizontal)			0.2 µm/100 mm				0.6 µm/200 mm			
Accuracy (20 °C)	X-axis		±(0.8+0.01L) µm L = Measurement Length (mm)				(0.8+0.015L) µm L = Measurement Length (mm)			
	Z1-axis (detector unit)		±(0.5+ | 2H | /100) µm H = Measurement height from the horizontal position (mm)							
Detector (Z1-axis)	Detection method		Arc scale (RT-10µm)							
	Measuring force		0.75 mN							
	Stylus tip	Standard	Tip radius 2 µm, Tip angle 60°, Diamond (surface roughness/contour)							
		Cone	Tip radius 25 µm, Tip angle 30°, Sapphire (contour)							
	Stroke limit function		Specified range: -7mm to +7mm Positioning accuracy range: ± 1 mm							
X-axis inclination angle			±45°							
Z2-axis (column) travel range			300 mm	500 mm		700 mm	300 mm	500 mm		700 mm
Base size (W×D)			600×450 mm		1000×450 mm		600×450 mm		1000×450 mm	
Base material			Granite							

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.

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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)

SV-C4500CNC

- High-accuracy stylus type CNC Surface Roughness/ Contour Measuring System allows measurement of surface roughness and form/contour with one unit through detector replacement.
- 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 through positioning in the Y-axis direction.
- 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.

SPECIFICATIONS

Model No.				SV-C4500CNC			
		inch/mm		525-701-13	525-702-13	525-703-13	525-704-13
X1-axis (Drive unit)		Measuring range		200 mm			
		Resolution		0.05 µm			
		Scale type		Reflective-type linear encoder			
		Drive Speed	CNC Mode	Max. 200 mm/s			
			Joystick mode	0 to 50 mm/s			
		Measuring Speed		0.02 to 2.0 mm/s			
	Contour	Measuring direction		Pulling and Pushing			
		Straightness		2 µm / 200 mm			
		Accuracy (20 °C)		±(0.8+4L /200) µm L: Measuring length (mm)			
	Surface roughness	Measuring direction		Pulling			
		Straightness		0.5 µm / 200 mm			
Z1-axis (Detector)	Contour	Measuring range		60 mm (±30 mm from the horizontal)			
		Resolution		0.02 µm			
		Scale type		Arc			
		Accuracy (20 °C)		±(0.8+|2H| /100) µm H: Measuring height position			
	Surface roughness	Measuring range		800 µm, 80 µm, 8 µm			
		Resolution		0.01 µm, 0.001 µm, 0.0001 µm			
		Y-axis table unit		Installed			
		Measuring range		200 mm			
		Resolution		0.05 µm			
		Drive Speed	CNC mode	Max. 200 mm/s			
			Joystick mode	0 to 50 mm/s			
		Max. table loading weight		20 kg			
Z2-axis (Column)		22-axis vertical travel		300 mm		500 mm	
		Resolution		0.05 µm			
		Scale type		Reflective-type linear encoder			
		Drive speed	CNC mode	Max. 200 mm/s			
			Joystick mode	0 to 50 mm/s			
Base Unit		Base size (width x depth)		750 x 600 mm			
		Base material		Granite			
		Alpha-axis unit		-	Installed	-	Installed

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.

Need Repair?

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

CS-H5000CNC
(with Y-axis table)

Wide-range detector employing active control technology

- Since the Z1-axis detector incorporates an anti-collision safety device, the detector unit will automatically stop if it touches a workpiece or fixture.
- 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 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.

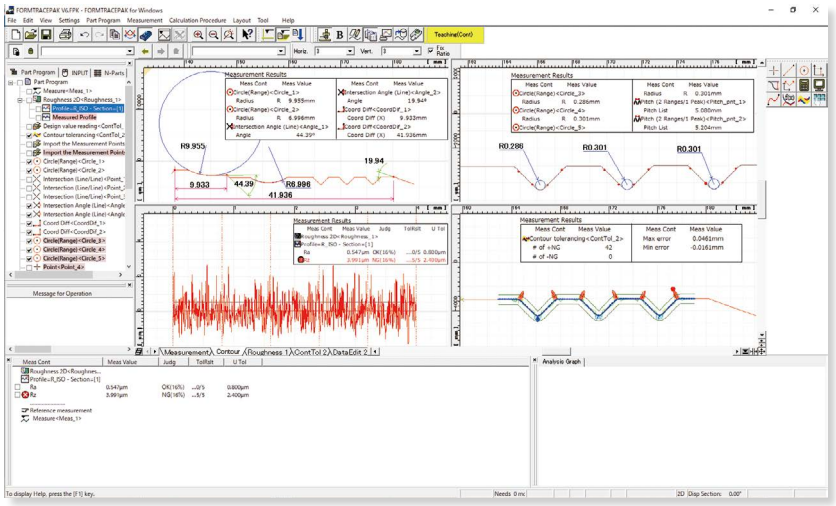
SPECIFICATIONS

Model No.			CS-5000CNC				CS-H5000CNC		
	inch/mm		525-727-13	525-729-13	525-747-13	525-749-13	525-777-13	525-706-13	525-707-13
X1-axis (drive unit)	Measuring range		200 mm						
	Resolution		0.005 µm						
	Scale type		Transmission-type linear scale						
	Drive speed	CNC mode	Max. 40 mm/s						
		Joystick mode	0 to 40 mm/s						
	Measuring speed		Roughness measurement: 0.02 to 0.2 mm/s Contour measurement: 0.02 to 2.0 mm/s						
	Measuring direction		Pulling and Pushing						
	Straightness	with standard stylus	(0.1+0.0015L) µm				(0.05+0.0003L) µm		
		with 2X-long stylus	(0.2+0.0015L) µm				(0.1+0.0015L) µm		
	Accuracy (at 20 °C)		±(0.3+0.002L) µm L: Measuring length (mm)				±(0.16+0.001L) µm L: Measuring length (mm)		
Alpha-axis	Inclination range		- 45° (CCW), +10° (CW)				—		
Y-axis table	Measuring range		—	200 mm	—	200 mm	200 mm	—	200 mm
	Resolution		—	0.05 µm	—	0.05 µm	0.05 µm	—	0.05 µm
	Scale type		—	Reflection-type linear scale	—	Reflection-type linear scale	Reflection-type linear scale	—	Reflection-type linear scale
	Drive speed	CNC mode	—	Max. 200 mm/s	—	Max. 200 mm/s	Max. 200 mm/s	—	Max. 200 mm/s
		Manual mode	—	0 to 50 mm/s	—	0 to 50 mm/s	0 to 50 mm/s	—	0 to 50 mm/s
	Maximum loading mass		—	20 kg (at table center)	—	20 kg (at table center)	20 kg (at table center)	—	20 kg (at table center)
	Straightness		—	0.5 µm / 200 mm	—	0.5 µm / 200 mm	0.5 µm / 200 mm	—	0.5 µm / 200 mm
	Accuracy (at 20° C)		—	± (2+2L/100) µm	—	± (2+2L/100) µm	± (2+2L/100) µm	—	± (2+2L/100) µm
	Table size		—	200 x 200 mm	—	200 x 200 mm	200 x 200 mm	—	200 x 200 mm
	External dimensions (W x D x H)		—	320 x 646 x 105 mm	—	320 x 646 x 105 mm	320 x 646 x 105 mm	—	320 x 646 x 105 mm
	Mass		—	35 kg	—	35 kg	35 kg	—	35 kg
Z1-axis (Detector)	Measuring range	with standard stylus	12 mm						
		with 2X-long stylus	24 mm						
	Resolution	with standard stylus	0.0008 µm						
		with 2X-long stylus	0.0016 µm						
	Vertical movement of the stylus		Arc motion						
	Scale type		Transmission-type linear scale						
	Accuracy (at 20 °C)		±(0.3+|0.02H|) µm H: Probing height (mm)				±(0.07+|0.02H|) µm H: Probing height (mm)		
	Measuring force	with standard stylus	4 mN (Fixed)						
		with 2X-long stylus	0.75 mN (Fixed)						
	Traceable angle		Ascent: 60°, Descent: 60° (Depends on the surface texture)						
	Stylus tip shape	Standard stylus	Tip radius: 5 µm, Tip angle: 40°, Diamond						
		Standard ball stylus	Tip ball radius: 0.25 mm, Sapphire						
		2X-long stylus	Tip radius: 5 µm, Tip angle: 40°, Diamond						
			—				Tip radius: 2 µm, Tip angle: 60°, Diamond		
		2X-long ball stylus	Tip ball radius: 0.25 mm, Sapphire						
	Face of stylus		Downward						
Z2-axis (Column)	Travel range	Z2-axis (column)	300 mm		500 mm		300 mm	500 mm	
	Resolution		0.05 µm						
	Scale type		Reflective-type linear scale						
	Drive speed	CNC mode	Max. 200 mm/s						
		Joystick mode	0 to 50 mm/s						
Base	Base size (W×D)		800 x 600 x 1000 mm		800 x 600 x 1200 mm		800 x 600 x 1000 mm	800 x 600 x 1200 mm	
	Base material		Granite						
	Alpha-axis unit		Installed	Installed	Installed	Installed	—		

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

Formtracer

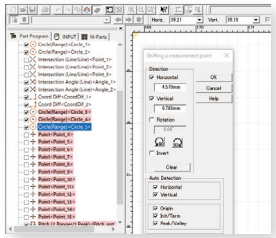
Surface Roughness/Contour Analysis Program FORMTRACEPAK



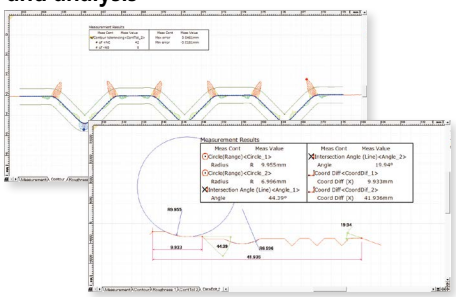
- **FORMTRACEPAK** functions offer total support for controlling the measurement system, surface roughness analysis, contour tolerancing, and inspection report creation.

• Editing measurement procedures

The items displayed in the measuremaent procedure window can be directly modified. You can, for example, perform new analyses by modifying the evaluation setup or roughness standard.

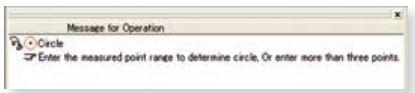


• Versatile graphics windowing for data and analysis



• Operation messaging

The operation message window for explaining the next step is incorporated.

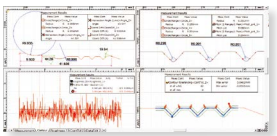


• Tab-selection graphics window

Just select a tab to display the measurement data required, such as contour, roughness, or tolerancing results.

• Dividing the screen into two or four windows

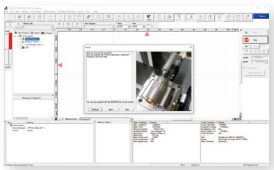
The screen can be divided into two, or four, windows for the convenient display of measurement data (for contour and roughness), analysis results, and contour tolerancing data, as required.



• Measurement control

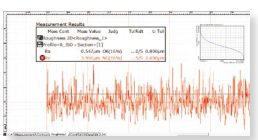
To make only a single measurement, you can create a part program in the single mode. To measure multiple workpieces of an identical shape, you can use the teaching mode. Since you can embed the entire flow, from making measurement to printing a report, into a part program, you can efficiently make measurements, analyze data, and output a report. A function is also provided that enables you to insert comments accompanied with photographs at desired timings, enabling you to embed the roles described in a measurement procedure document that specifies important points such as work settings.

To make immediate measurements, you can use the pull-down menu to easily select and call up the desired operating procedure.



• Displaying the results in the graphics window

You can paste the graphics obtained from measurements, as well as measurement values (including pass/fail results) and an analysis graph, into the graphics window. This enables you to check the graphics and measurement results at a glance using the graphics window alone.



Mitutoyo

Where to Buy

Refer to the **FORMTRACEPAK** Brochure (**E15018(4)-US**) for more details.

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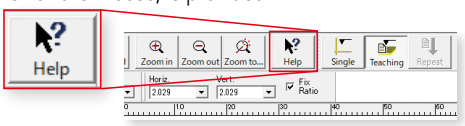
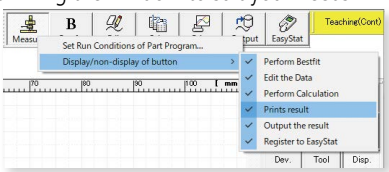
• Online help functions

Online help that can be viewed any time is incorporated into the software. In addition to index and keyword searches, a status-saving help button, which displays menus and Windows help with a click of the mouse, is provided.



• Button-editing function

You can hide buttons that are not used frequently. For example, you can choose to display only those buttons that are used frequently and increase the size of the displayed graphics window, thereby customizing the window to suit your needs.



• Multiple language support (18 languages)

You can switch the language to be used in the measurement, analysis, and layout windows. After measurements have been made, you can switch to another language and create a report in that language. This function can be used worldwide.

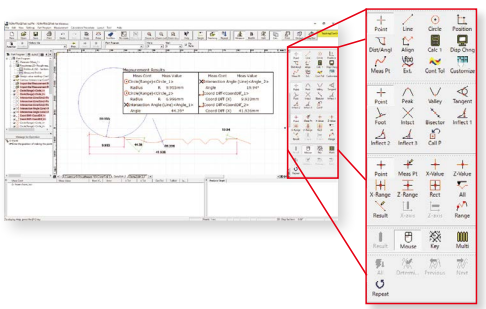
• Simple statistical commands

You can perform statistical calculations of roughness parameters and contour analysis results without using a separate program such as Excel.

CONTOUR MEASUREMENT

• Contour analysis

A wide variety of commands, which form the basic elements for analysis, are provided, including those for points (10 types), lines (6 types) and circles (6 types). A rich set of commands that combine these elements to calculate angles, pitches and distances as well as performing contour tolerancing and design value generation are also provided as standard features. These functions, combined with the function that enables you to customize the calculation command buttons by hiding less frequently used commands, help you to tailor the window according to the user's environment.

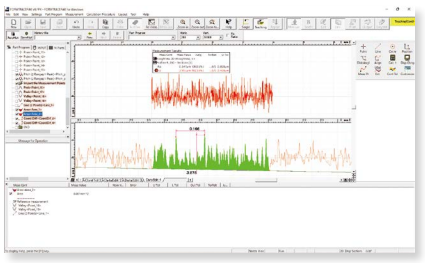


- **Contour-tolerancing as a standard feature**
- **Design value generation**
- **Data combination**
- **Simple pitch calculation**

SURFACE ROUGHNESS MEASUREMENT

• Surface roughness analysis

FORMTRACEPAK can perform surface roughness analyses that conform to various standards such as ISO, JIS, ANSI and VDA. For comparing measurement values with the tolerance limits, you can use the 16% rule or the maximum value rule. Furthermore, since **FORMTRACEPAK** comes with parameter calculation functions as well as a rich set of graphic analysis functions, it can be widely utilized for everything from routine quality control to R&D applications. It also includes many other functions such as the function for eliminating (compensating) shapes, such as slopes and radiused surfaces (R-surfaces), and data deletion.



- **Micro contour analysis**
- **Simple input using drawing symbols**
- **Multiple-point measurement**
- **Analysis using multiple-point measurements**
- **Reference length dialog box**
- **Analysis condition modification with preview**
- **R-surface automatic measurement**

Refer to the **FORMTRACEPAK** Brochure (**E15018(4)-US**) for more details.

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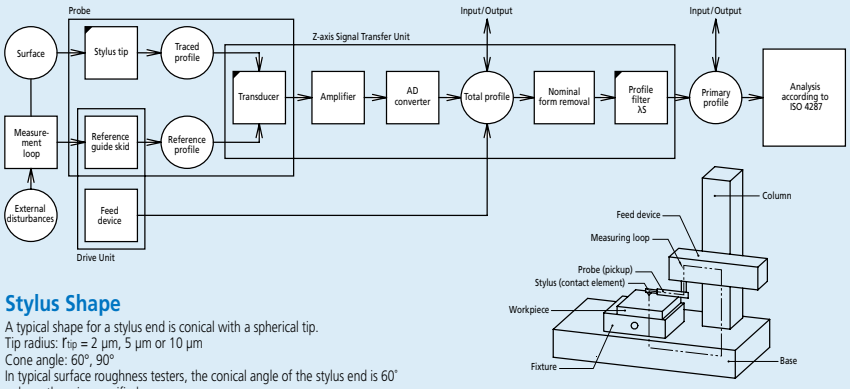
Quick Guide to Precision Measuring Instruments

Surftest (Surface Roughness Testers)

ISO 4287: 1997 Geometrical Product Specifications (GPS) – Surface Texture: Profile method– Terms, definitions, and surface texture parameters
ISO 4288: 1996 Geometrical Product Specifications (GPS) – Surface Texture: Profile method– Rules and procedures for the assessment of surface texture
ISO 3274: 1996 Geometrical Product Specifications (GPS) – Surface Texture: Profile method– Nominal characteristics of contact (stylus) instruments
ISO 11562: 1996 Geometrical Product Specifications (GPS) – Surface texture: Profile method– Metrological characteristics of phase correct filters

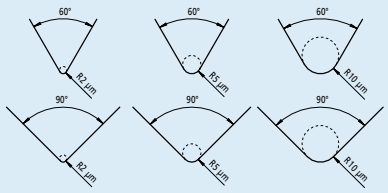
Elements of Contact Type Surface Roughness Measuring Instruments

ISO 3274: 1996 (JIS B 0651: 2001)



Stylus Shape

A typical shape for a stylus end is conical with a spherical tip.
Tip radius: r_{tip} = 2 µm, 5 µm or 10 µm
Cone angle: 60°, 90°
In typical surface roughness testers, the conical angle of the stylus end is 60° unless otherwise specified.



Static Measuring Force

Nominal radius of curvature of stylus tip: µm	Static measuring force at the mean position of stylus: mN	Tolerance on static measuring force variations: mN/µm
2	0.75	0.035
5	0.75 (4.0) *	0.2
10		

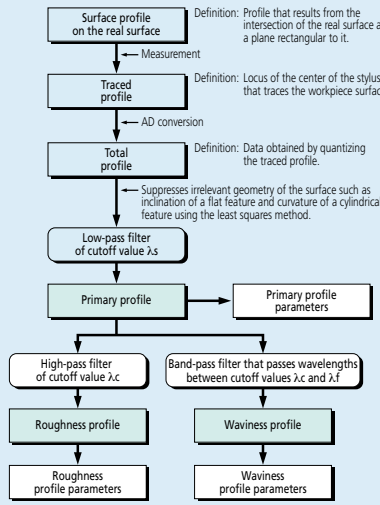
* The maximum value of static measuring force at the average position of a stylus is to be 4.0 mN for a probe with a special structure including a replaceable stylus.

Metrological Characterization of Phase Correct Filters

ISO 11562: 1996 (JIS B 0632: 2001)

A profile filter is a phase-correct filter without phase delay (cause of profile distortion dependent on wavelength).
The weight function of a phase-correct filter shows a normal (Gaussian) distribution in which the amplitude transmission is 50% at the cutoff wavelength.

Data Processing Flow



Relationship between Cutoff Value and Stylus Tip Radius

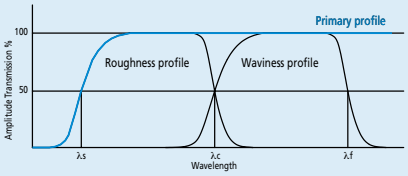
The following table lists the relationship between the roughness profile cutoff value λc, stylus tip radius r_{tip}, and cutoff ratio λc/λs.

λc mm	λs µm	λc/λs	Maximum r_{tip} µm	Maximum sampling length µm
0.08	2.5	30	2	0.5
0.25	2.5	100	2	0.5
0.8	2.5	300	2 *1	0.5
2.5	8	300	5 *2	1.5
8	25	300	10 *2	5

*1 For a surface with Ra>0.5 µm or Rz>3 µm, a significant error will not usually occur in a measurement even if r_{tip} = 5 µm.
*2 If a cutoff value λs is 2.5 µm or 8 µm, attenuation of the signal due to the mechanical filtering effect of a stylus with the recommended tip radius appears outside the roughness profile pass band. Therefore, a small error in stylus tip radius or shape does not affect parameter values calculated from measurements. If a specific cutoff ratio is required, the ratio must be defined.

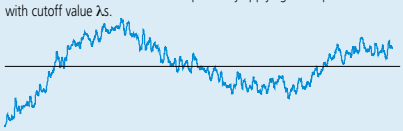
Surface Profiles

ISO 4287:1997 (JIS B 0601: 2013)



Primary Profile

Profile obtained from the measured profile by applying a low-pass filter with cutoff value λs.

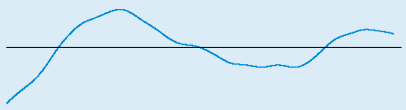


Roughness Profile

Profile obtained from the primary profile by suppressing the longer wavelength components using a high-pass filter of cutoff value λc.

Waviness Profile

Profile obtained by applying a band-pass filter to the primary profile to remove the longer wavelengths above λf and the shorter wavelengths below λc.



Roughness sampling length for non-periodic profiles

ISO 4288: 1996 (JIS B 0633: 2001)

Table 1: Sampling lengths for aperiodic profile roughness parameters (Ra, Rq, Rsk, Rku, $R\Delta q$), material ratio curve, probability density function, and related parameters

Ra µm	Sampling length l_r mm	Evaluation length l_n mm
(0.006)<Ra≤0.02	0.08	0.4
0.02 <Ra≤0.1	0.25	1.25
0.1 <Ra≤2	0.8	4
2 <Ra≤10	2.5	12.5
10 <Ra≤80	8	40

Table 2: Sampling lengths for aperiodic profile roughness parameters (Rz, Rv, Rp, Rc, Rt)

Rz $Rz1max.$ µm	Sampling length l_r mm	Evaluation length l_n mm
(0.025)<Rz, $Rz1max.$≤0.1	0.08	0.4
0.1 <Rz, $Rz1max.$≤0.5	0.25	1.25
0.5 <Rz, $Rz1max.$≤10	0.8	4
10 <Rz, $Rz1max.$≤50	2.5	12.5
50 <Rz, $Rz1max.$≤200	8	40

1) Rz is used for measurement of Rz, Rv, Rp, Rc, and Rt.
2) $Rz1max.$ only used for measurement of $Rz1max.$, $Rv1max.$, $Rp1max.$, and $Rc1max.$.

Table 3: Sampling lengths for measurement of periodic roughness profile roughness parameters and periodic or aperiodic profile parameter RSm

Rsm mm	Sampling length l_r mm	Evaluation length l_n mm
0.013 <RSm≤0.04	0.08	0.4
0.04 <RSm≤0.13	0.25	1.25
0.13 <RSm≤0.4	0.8	4
0.4 <RSm≤1.3	2.5	12.5
1.3 <RSm≤4	8	40

Procedure for determining a sampling length if it is not specified

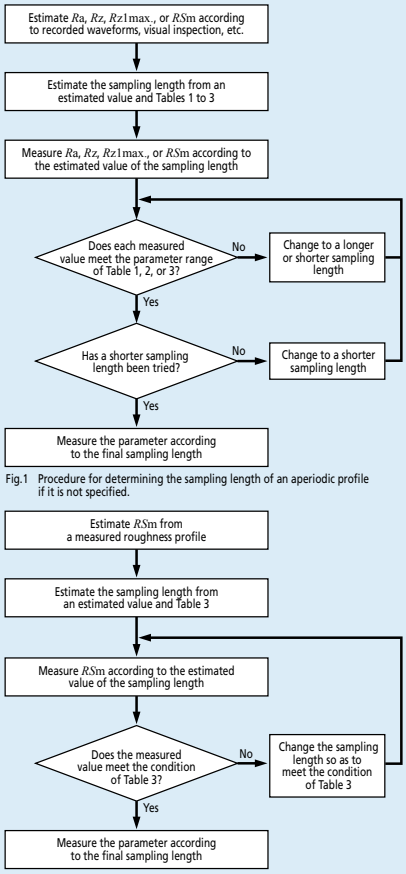


Fig.1 Procedure for determining the sampling length of an aperiodic profile if it is not specified.

Fig.2 Procedure for determining the sampling length of a periodic profile if it is not specified.

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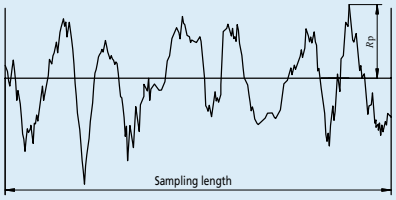
Definition of Parameters

ISO 4287: 1997, Amd. 1: 2009 (JIS B 0261: 2013)

Amplitude Parameters (peak and valley)

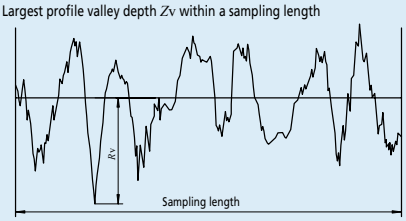
Maximum peak height of the primary profile *Pp*
Maximum peak height of the roughness profile *Rp*
Maximum peak height of the waviness profile *Wp*

Largest profile peak height *Zp* within a sampling length



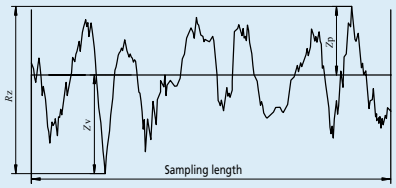
Maximum valley depth of the primary profile *Pv*
Maximum valley depth of the roughness profile *Rv*
Maximum valley depth of the waviness profile *Wv*

Largest profile valley depth *Zv* within a sampling length



Maximum height of the primary profile *Pz*
Maximum height of the roughness profile *Rz*
Maximum height of the waviness profile *Wz*

Sum of height of the largest profile peak height *Zp* and the largest profile valley depth *Zv* within a sampling length

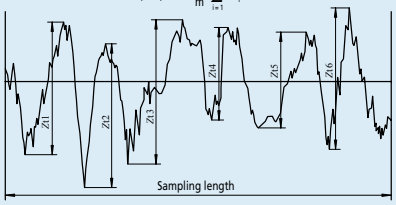


In the old JIS and ISO 4287-1: 1984, *Rz* was used to indicate the "ten point height of irregularities". Care must be taken because differences between results obtained according to the existing and old standards are not always negligibly small. (Be sure to check whether the drawing instructions conform to existing or old standards.)

Mean height of the primary profile elements *Pc*
Mean height of the roughness profile elements *Rc*
Mean height of the waviness profile elements *Wc*

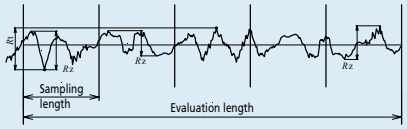
Mean value of the profile element heights *Zt* within a sampling length

$$Pc,\ Rc,\ Wc = \frac{1}{m}\sum_{i=1}^{m} Zt_i$$



Total height of the primary profile *Pt*
Total height of the roughness profile *Rt*
Total height of the waviness profile *Wt*

Sum of the height of the largest profile peak height *Zp* and the largest profile valley depth *Zv* within the evaluation length



Amplitude Parameters (average of ordinates)

Arithmetical mean deviation of the primary profile *Pa*
Arithmetical mean deviation of the roughness profile *Ra*
Arithmetical mean deviation of the waviness profile *Wa*

Arithmetic mean of the absolute ordinate values Z(x) within a sampling length

$$Pa,\ Ra,\ Wa = \frac{1}{l}\int_0^l |Z(x)|dx$$

with l as *lp*, *lr*, or *lw* according to the case.

Root mean square deviation of the primary profile *Pq*
Root mean square deviation of the roughness profile *Rq*
Root mean square deviation of the waviness profile *Wq*

Root mean square value of the ordinate values Z(x) within a sampling length

$$Pq,\ Rq,\ Wq = \sqrt{\frac{1}{l}\int_0^l Z^2(x)dx}$$

with l as *lp*, *lr*, or *lw* according to the case.

Skewness of the primary profile *Psk*
Skewness of the roughness profile *Rsk*
Skewness of the waviness profile *Wsk*

Quotient of the mean cube value of the ordinate values Z(x) and the cube of *Pq*, *Rq*, or *Wq* respectively, within a sampling length

$$Rsk = \frac{1}{Rq^3}\left[\frac{1}{lr}\int_0^{lr} Z^3(x)dx\right]$$

The above equation defines ***Rsk***. ***Psk*** and ***Wsk*** are defined in a similar manner. ***Psk***, ***Rsk***, and ***Wsk*** are measures of the asymmetry of the probability density function of the ordinate values.

Kurtosis of the primary profile *Pku*
Kurtosis of the roughness profile *Rku*
Kurtosis of the waviness profile *Wku*

Quotient of the mean quartic value of the ordinate values Z(x) and the fourth power of *Pq*, *Rq*, or *Wq* respectively, within a sampling length

$$Rku = \frac{1}{Rq^4}\left[\frac{1}{lr}\int_0^{lr} Z^4(x)dx\right]$$

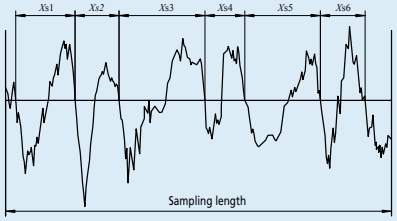
The above equation defines ***Rku***. ***Pku*** and ***Wku*** are defined in a similar manner. ***Pku***, ***Rku***, and ***Wku*** are measures of the sharpness of the probability density function of the ordinate values.

Spacing Parameters

Mean width of the primary profile elements *PSm*
Mean width of the roughness profile elements *RSm*
Mean width of the waviness profile elements *WSm*

Mean value of the profile element widths *Xs* within a sampling length

$$PSm,\ RSm,\ WSm = \frac{1}{m}\sum_{i=1}^{m} Xs_i$$



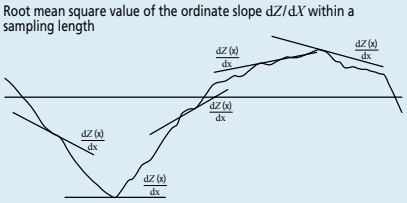
Peak count number based on the primary profile elements *PPc*
Peak count number based on the roughness profile elements *RPc*
Peak count number based on the waviness profile elements *WPc*

$$RPc = \frac{1}{RSm}$$

Hybrid Parameters

Root mean square slope of the primary profile *PΔq*
Root mean square slope of the roughness profile *RΔq*
Root mean square slope of the waviness profile *WΔq*

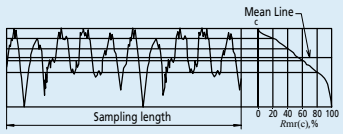
Root mean square value of the ordinate slope dZ/dX within a sampling length



Curves, Probability Density Function, and Related Parameters

Material ratio curve of the profile (Abbott-Firestone curve)

Curve representing the material ratio of the profile as a function of section level c



Material ratio of the primary profile *Pmr (c)*
Material ratio of the roughness profile *Rmr (c)*
Material ratio of the waviness profile *Wmr (c)*

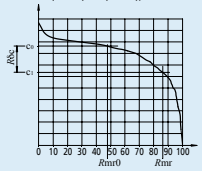
Ratio of the material length of the profile elements *Ml* (c) at a given level c to the evaluation length

$$Pmr\ (c),\ Rmr\ (c),\ Wmr\ (c) = \frac{Ml(c)}{ln}$$

Section height difference of the primary profile *Pδc*
Section height difference of the roughness profile *Rδc*
Section height difference of the waviness profile *Wδc*

Vertical distance between two section levels of a given material ratio

$$R\delta c = c\ (Rmr1) - c\ (Rmr2);\ Rmr1 < Rmr2$$



Relative material ratio of the primary profile *Pmr*
Relative material ratio of the roughness profile *Rmr*
Relative material ratio of the waviness profile *Wmr*

Material ratio determined at a profile section level *Rδc* related to the reference section level c_0

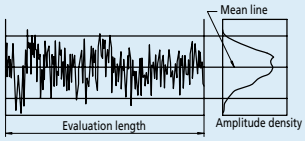
$$Pmr,\ Rmr,\ Wmr = Pmr\ (c_1),\ Rmr\ (c_1),\ Wmr\ (c_1)$$

where $c_1 = c_0 - R\delta c\ (P\delta c, W\delta c)$

$c_0 = c\ (Pm0, Rmr0, Wmr0)$

Probability density function
(profile height amplitude distribution curve)

Sample probability density function of the ordinate Z(x) within the evaluation length

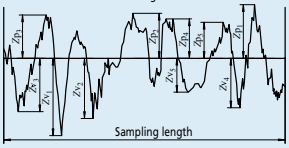


JIS Specific Parameters

Ten-point height of irregularities, Rz_{JIS}

Sum of the absolute mean height of the five highest profile peaks and the absolute mean depth of the five deepest profile valleys, measured from the mean line within the sampling length of a roughness profile. This profile is obtained from the primary profile using a phase-correct band-pass filter with cutoff values of lc and ls.

$$Rz_{JIS} = \frac{|Zp_1+Zp_2+Zp_3+Zp_4+Zp_5| + |Zv_1+Zv_2+Zv_3+Zv_4+Zv_5|}{5}$$



Symbol	Used profile
Rz_{JIS82}	Surface profile as measured
Rz_{JIS94}	Roughness profile derived from the primary profile using a phase-correct high-pass filter

Arithmetic mean deviation of the profile Ra_{75}

Arithmetic mean of the absolute values of the profile deviations from the mean line within the sampling length of the roughness profile (75%). This profile is obtained from a measurement profile using an analog high-pass filter with an attenuation factor of 12db/octave and a cutoff value of λ.c.

$$Ra_{75} = \frac{1}{ln}\int_0^{ln} |Z(x)|dx$$

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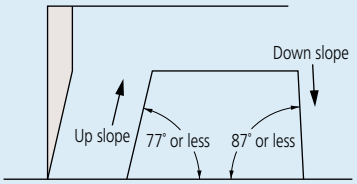
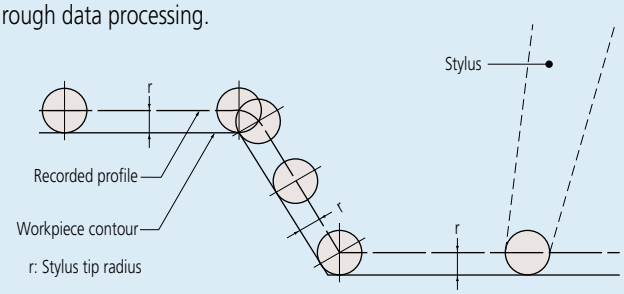
Traceable Angle



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.

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 0.025 mm.) 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.

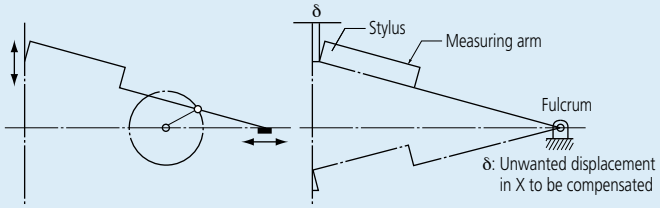


If a profile is read from the recorder through a template or scale, it is necessary to compensate for the stylus tip radius beforehand according to the applied measurement magnification.

Compensating for Arm Rotation

When the stylus traces through a circular-arc, error arises in the X-axis direction of the recorded profile. Possible methods for compensating for this effect are as follows:

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, for example, 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 (Z-axis) load.

Circular-Arc / Linear Tracing

The locus traced by the stylus tip during vertical stylus movement can be a circular arc or a straight line. Ensuring a straight-line locus entails complex mechanics, while in the case of a circular-arc locus, if the amplitude of stylus displacement is large in the vertical direction, an error (δ) in the recorded profile in the horizontal direction arises.
(See figure at lower left)

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, for example) 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

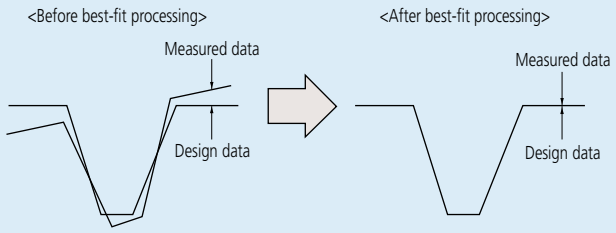
The measured contour is input into the data processing section in real time and a dedicated program performs the analysis using the mouse and/or keyboard. The angle, radius, step, pitch and other data are directly displayed as numerical values. Analysis combining coordinate systems can be easily performed.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

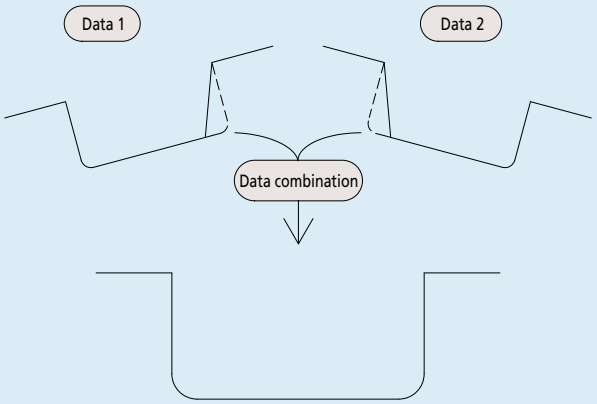
If there is a standard for surface profile data, tolerancing with design data is performed according to the standard. If there is no standard, or if tolerancing only with shape is desired, best-fitting between design data and measurement data can be performed.



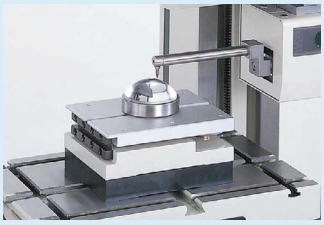
The best-fit processing algorithm searches for deviations between both sets of data and derives a coordinate system in which the sum of squares of the deviations is a minimum when the measured data is overlaid on the design data.

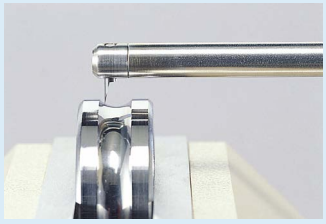
Data Combination

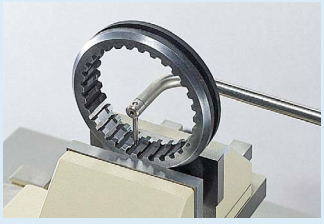
Conventionally, if tracing a complete contour is prevented by stylus traceable-angle restrictions, then it has to be divided into several sections that are then measured and evaluated separately. This function avoids this undesirable situation by combining the separate sections into one contour by overlaying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

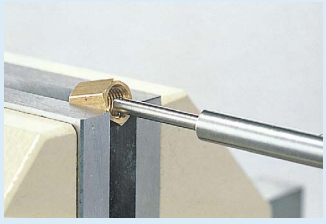


Measurement Examples

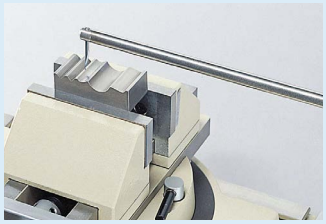

Aspheric lens contour


Inner/outer ring contour of a bearing


Internal gear teeth


Female thread form


Male thread form


Gage contour

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Roundtest

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PROPRIETARY INSPECTION CERTIFICATE

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

RA-120

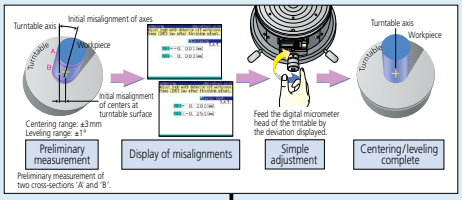
RA-120P

The analysis capabilities for the various models (**RA-120**/**120P**/**10**) vary. For details, refer to page L-26.

Easy operation, compact and outstanding cost/performance ratio, 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. function? <Patented>



Dedicated analysis unit type (RA-120)

- Compact, lightweight design due to incorporating electronic components inside the main unit.

Data analysis by PC (RA-120P)

- **ROUNDPAK**, a data analysis program employs Windows OS and archives higher level of analysis.

Refer to the Roundtest **RA-120**/**120P** Brochure (**E15008**) for more details.

Get a Quote

SPECIFICATIONS

Model No.			RA-120		RA-120P	
		inch/mm	211-544-13	211-543-13	211-547-11	211-546-13
		DAT Function	-	Installed	-	Installed
Turntable	Rotational accuracy (JIS B 7451-1997)	Radial direction	(0.04 + 6H/10000) μm H: Probing height (mm)			
		Axial direction	(0.04 + 6X/10000) μm X: distance from the center of rotation (mm)			
	Maximum probing diameter*1		ø280 mm (ø380 mm: for the vertical position when detector holder is installed reversely, the maximum probing height is up to 50 mm from the table top.)			
	Maximum loading mass		25 kg			
Vertical movement	Vertical travel		280 mm			
X-axis	Travel range		165 mm (-25 mm to 140 mm from the rotation center)			
Detector*2	Measuring range		±1000 μm			

*1 Auxiliary stage for a low-height workpiece (optional) is required for the measurement 20 mm or less in the radial direction from the center point of the table and 20 mm or less from the table top.
*2 Only the standard length stylus is applicable to this detector. The long type cannot be used.

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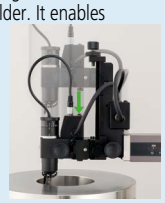
Roundtest RA-1600M
SERIES 211 — Roundness/Cylindricity Measuring System

- Compact body and a wide measuring range assures precision that compares well with that of higher-grade models.
- 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 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.



Refer to the Roundtest **RA-1600M** Brochure (**E15000**) for more details.

RA-1600M

Detector safety mechanism

SPECIFICATIONS

Model No.			RA-1600M
		inch/mm	211-724-11
Turntable	Rotational accuracy (JIS B 7451-1997)	Radial direction	(0.03 + 6H / 10000) µm H: Probing height (mm)
		Axial direction	(0.03 + 6X / 10000) µm X: Distance from the center of rotation (mm)
	Maximum loading mass		25 kg
	Maximum probing diameter		ø280 mm
Vertical movement (Z-axis column unit)	Vertical travel		300 mm
X-axis	Travel range		165 mm (-25 mm to +140 mm from the rotation center)
Detector	Measuring range	Standard	±400 µm/±40 µm/±4 µm
		Tracking	±5 mm

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

Achieved the world's highest level of accuracy for this class of machine. A high-performance automatic system equipped with a high-speed automatic centering/leveling function.

- High-speed automatic centering/leveling function contributes to a significant reduction in the man-hours required for setups.
- A fully automatic system 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 orientation (up to 50 mm ID).
- The automatic positioning function of the turntable enables automatic measurement in combination with table rotation and slider/column movement.
- Advanced graphical analysis such as power spectrum chart is available.
- A sliding mechanism is incorporated in the detector holder part.

Refer to the Roundtest **RA-2200** Series Brochure (**E15001(3)-US**) for more details.

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

RA-2200AH
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
		inch/mm	211-511-11	211-514-13	211-512-11	211-516-13
Turntable	Rotational accuracy (JIS B 7451-1997)	Radial direction	(0.02 + 3.5H/10000) µm H: Probing height (mm)			
		Axial direction	(0.02 + 3.5X/10000) µm X: Distance from the center of rotation(mm)			
	Maximum loading mass		30 kg			
	Maximum probing diameter		ø300 mm			
Vertical movement (Z-axis column unit)	Vertical travel		300 mm		500 mm	
X-axis	Travel range		175 mm (-25 mm to +150 mm from the rotation center)			
Detector	Measuring range	Standard	±400 µm/±40 µm/±4 µm			
		Tracking	±5 mm			

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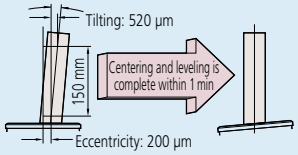
PROPRIETARY INSPECTION CERTIFICATE

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

RA-H5200AS
with side table
(option 178-181)

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

- High-speed automatic centering/leveling function contributes to a significant reduction in the man-hours required for setups.



- A fully automatic system 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 orientation (up to 50 mm ID).
- The automatic positioning function of the turntable enables automatic measurement in combination with table rotation and slider/column movement.
- Advanced graphical analysis such as a power spectrum chart is available.
- A sliding mechanism is incorporated in the detector holder.

SPECIFICATIONS

Model No.			RA-H5200AS	RA-H5200AH
		inch/mm	211-531-11	211-532-11
Turntable	Rotational accuracy (JIS B 7451-1997)	Radial direction	(0.02 + 3.5H/10000) µm H: Probing height (mm)	
		Axial direction	(0.02 + 3.5X/10000) µm X: Distance from the center of rotation (mm)	
	Maximum loading mass		80 kg (On auto-centering: 65 kg)	
	Maximum probing diameter		ø400 mm	
Vertical movement (Z-axis column unit)	Vertical travel		350 mm	550 mm
X-axis	Travel range		225 mm (-25 mm to +200 mm from the rotation center)	
Detector	Measuring range	Standard	±400 µm/±40 µm/±4 µm	
		Tracking	±5 mm	

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

RA-2200AH PLUS
System vibration isolator (with side table)

- The turntable with automatic centering and leveling function is equipped as standard, which frees operators from manual centering and leveling operations.
- 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.
- 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 (optional) is supported.

SPECIFICATIONS

Model No.			RA-2200AS PLUS	RA-2200AH PLUS
		inch/mm	211-517-11	211-518-11
Turntable	Rotational accuracy (JIS B 7451-1997)	Radial direction	(0.02 + 3.5H/10000) µm H: Probing height (mm)	
		Axial direction	(0.02 + 3.5X/10000) µm X: Distance from the center of rotation (mm)	
	Maximum loading mass		30 kg	
	Maximum probing diameter		ø256 mm	
Vertical movement (Z-axis column unit)	Vertical travel		300 mm	500 mm
X-axis	Travel range		175 mm (-25 mm to +150 mm from the rotation center)	
Detector	Measuring range	Standard	±400 µm/±40 µm/±4 µm	
		Tracking	±5 mm	

Refer to the Roundtest **RA-2200** Series Brochure (**E15001(3)-US**) for more details.

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

A fully automated machine with highest-level accuracy that can greatly improve productivity and efficiency.

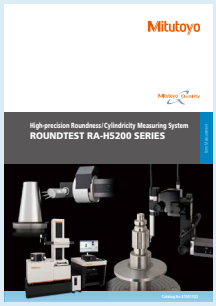
- The turntable with automatic centering and leveling function is equipped as standard, which frees operators from manual centering and leveling operations.
- Automatic control of holder arm posture (vertical/horizontal) and the rotation feature of the detector (rotates in 1° increments in the range of 0 to 270°) enables continuous measurement of various feature combinations, such as OD/ID and/or top/ bottom plane measurements.
- 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 (optional) is supported.

RA-H5200AS PLUS
with side table
(option 178-181)

SPECIFICATIONS

Model No.			RA-H5200AS PLUS	RA-H5200AH PLUS
		inch/mm	211-533-11	211-534-11
Turntable	Rotational accuracy (JIS B 7451-1997)	Radial direction	(0.02 + 3.5H/10000) µm H: Probing height (mm)	
		Axial direction	(0.02 + 3.5X/10000) µm X: Distance from the center of rotation (mm)	
	Maximum loading mass		80 kg (On auto-centering: 65 kg)	
	Maximum probing diameter		ø356 mm	
Vertical movement (Z-axis column unit)	Vertical travel		350 mm	550 mm
X-axis	Travel range		225 mm (-25 mm to +200 mm from the rotation center)	
Detector	Measuring range	Standard	±400 µm/±40 µm/±4 µm	
		Tracking	±5 mm	

Need Support?



Refer to the Roundtest **RA-H5200** Series Brochure (**E15011(2)-US**) for more details.

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Roundtracer

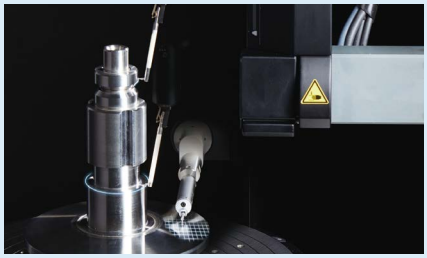
MeasurLink ENABLED
Data Management Software by Mitutoyo

PROPRIETARY INSPECTION CERTIFICATE

ROUNDTRACER EXTREME SERIES 211 — CNC Roundness/ Cylindricity Measuring System

RTX-0605-A
(Optional side table 12AAV541)

- ROUNDTRACER EXTREME models are triple-role CNC profile measuring systems that integrate the roundness and cylindricity measuring capabilities of our ROUNDTEST models and the contour and surface roughness measuring capabilities of our hybrid, dual-role FORMTRACER models to measure surface roughness, contour, roundness, and cylindricity.



- A detector holder with motorized sliding function enables continuous inside and upper surface measurement of thick workpieces.

SPECIFICATIONS

Model No.			RTX-0605-A
	inch/mm		211-552-11
Turntable	Rotational accuracy (JIS B 7451:1997)	Radial direction	(0.02 + 3.5H/10000) µm H: Probing height (mm)
		Axial direction	(0.02 + 3.5R/10000) µm R: Measuring radius (mm)
	Maximum loading mass		60 kg
	Maximum probing diameter		ø680 mm
Vertical movement (Z-axis column unit)	Travel range		550 mm
X-axis	Travel range		197 mm (-33 mm to 164 mm from the rotation center)*
Detectors	Measuring range		±400 µm/±40 µm/±3.6 µm

* Value when the measuring system is mounted with a roundness detector and a standard stylus, and is in the outside diameter measuring position with the stylus at 0°.

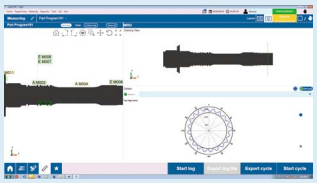
Refer to the ROUNDTRACER EXTREME Brochure (**E15032**) for more details.

Roundtracer Flash Series 211 - Roundness / Cylindricity Measuring System

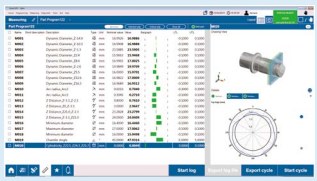
211-581-02MEU

The Roundtracer Flash is a fast, flexible and precise optical shaft measuring system. The instrument is a good solution for accurate quality control in a laboratory as well as in the production environment.

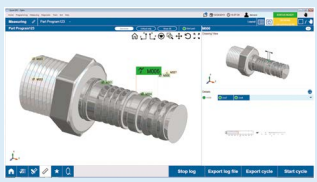
- Dimensional, position, form analysis in static and dynamic mode.
- Image sensors integrated in a fixed position across the product structure to cover the entire measurement range.
- Less mechanical stress.
- Side-by-side 2D image architecture.
- Short cycle time.
- One-click measuring cycle activation.
- Graphical user interface via touchscreen monitor.
- Thread and camshaft measurement functionality.



Smart search function provides part detail review by images and trend visualization.



Superior setup flexibility



Intuitive user interface

SPECIFICATIONS

Model No.		S100	S300
		211-581-01MEU	211-583-01MEU
Z-axis (column) vertical travel		100mm	300mm
Measuring Range		ø60 mm	
Max. turntable loading		6 kg	
Measuring uncertainty	Length	U95 (2+L[mm]/200) µm	
	Diameter	U95 (1+LDmm]/200) µm	
Workpiece loading mode		Manual and automatic (by robot)	
Workpiece rotation		Standard	
Measuring mode		Static and dynamic	
Dimensions (WxDxH)		925x615x640mm	925x615x840mm

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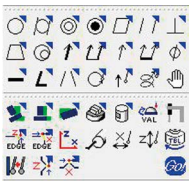
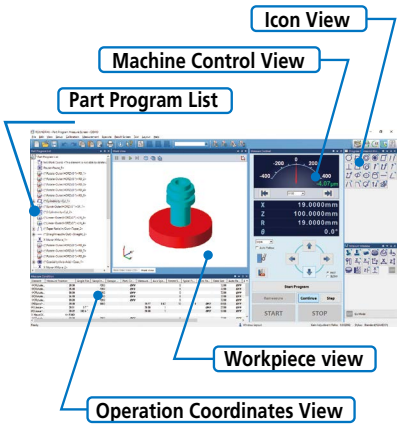
ROUNDPAK
Roundness/Cylindricity measurement/Analysis software

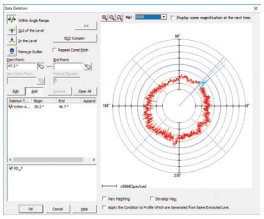
- A wide variety of parameters including those for roundness/cylindricity, as well as flatness and parallelism, are provided as standard features. You can visually select these parameters using icons.



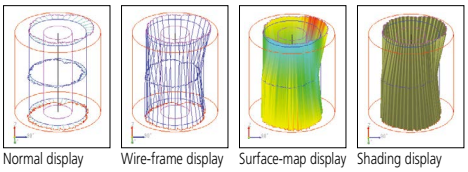
ROUNDPAK also comes with specialized functions, such as the design value best-fit analysis function, the harmonic analysis function, and a function for recording the peak or trough points on a circumference. Data that has already been collected can be easily used for re-calculation or deleted.



Data deletion



- Analysis results such as cylindricity and coaxiality can be visually expressed in 3D graphics.



Normal display | Wire-frame display | Surface-map display | Shading display

- The customer can create reports in custom formats by specifying how the analysis results will be displayed as well as the sizes and positions of graphics. The analysis result window can be directly utilized as a layout window. Since the measurement procedure, including the layout information, is saved, the entire process, from measurement start, calculation, result saving, and finally to printing, can be automatically executed.

- An offline teaching function is provided to create a part program (measurement procedure) without an actual measurement target, enabling the user to virtually execute the measurement operation in a 3D simulation window.

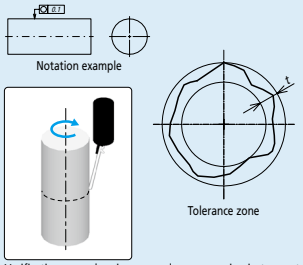
Analysis type		Model	RTX-0605-A	RA-2200/H5200 RA-2200 PLUS/H5200 PLUS	RA-1600	RA-120P	RA-120	RA-10
Roundness		○	✓	✓	✓	✓	✓	✓
Cylindricity		⌭	✓	✓	✓			
Concentricity		◎	✓	✓	✓	✓	✓	✓
Coaxiality	Axis element	◉	✓	✓	✓	✓	✓	✓
	Axis		✓	✓	✓	✓		
Flatness		▱	✓	✓	✓	✓	✓	✓
Parallelism		//	✓	✓	✓	✓	✓	
Perpendicularity		⊥	✓	✓	✓	✓	✓	
Radial deviation		⏢	✓	✓	✓			
Thickness deviation		⌀	✓	✓	✓	✓	✓	
Radial runout		↗	✓	✓	✓	✓	✓	✓
Total runout		⌰	✓	✓	✓			
Diameter measurement		ϕ	✓	✓	✓			
Straightness		—	✓	✓	✓			
Inclination		∠	✓	✓	✓			
Taper		/\	✓	✓	✓			
Diameter contour tolerancing		⌖	✓	✓	✓			
Rectilinear contour tolerancing		⌒	✓	✓	✓			
Width measurement (only CNC)		⌶	✓	✓ (only PLUS and CNC)				
Power spectrum			✓	✓	✓			
Harmonic analysis			✓	✓	✓	✓		
Profile operation			✓	✓	✓	✓		
Tapered surface analysis			✓	✓	✓			
Lead (twist) analysis			✓ (optional)					
3D surface property analysis			✓ (optional)					

Find Training

Roundtest (Roundform Measuring Instruments)

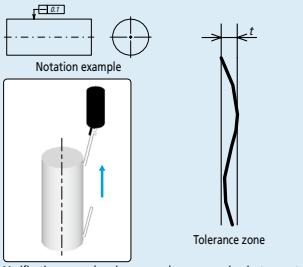
Geometrical tolerances ISO/DIS 1101: 1996*1, ISO 5459*2

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



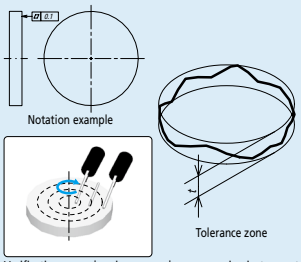
Verification example using a roundness measuring instrument

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



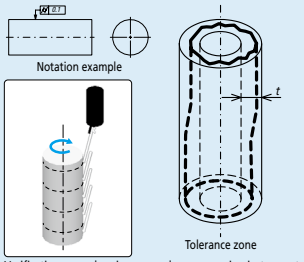
Verification example using a roundness measuring instrument

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



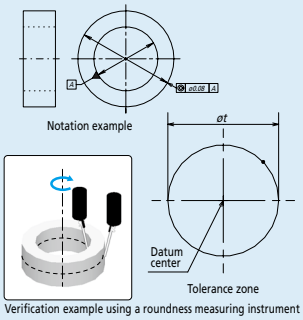
Verification example using a roundness measuring instrument

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



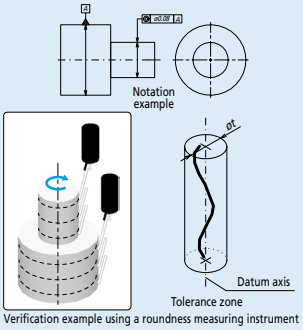
Verification example using a roundness measuring instrument

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



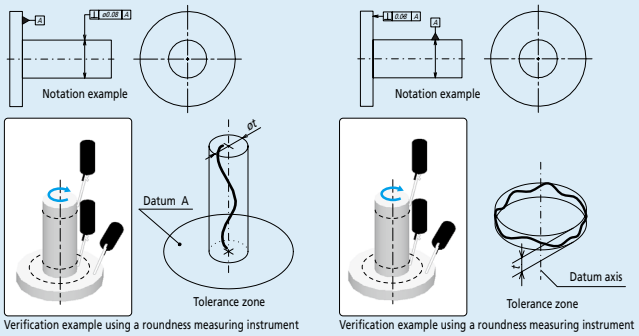
Verification example using a roundness measuring instrument

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



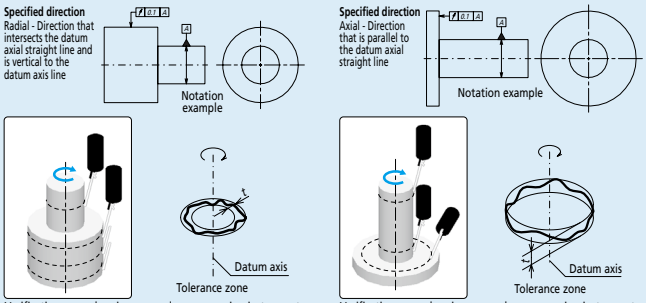
Verification example using a roundness measuring instrument

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



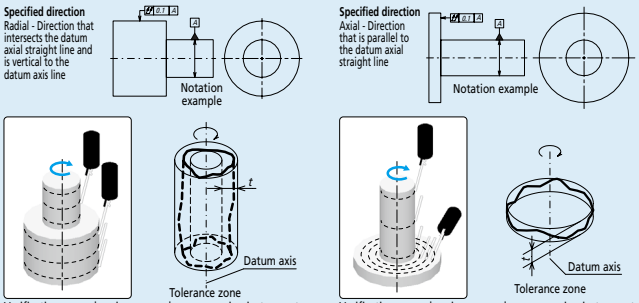
Verification example using a roundness measuring instrument

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

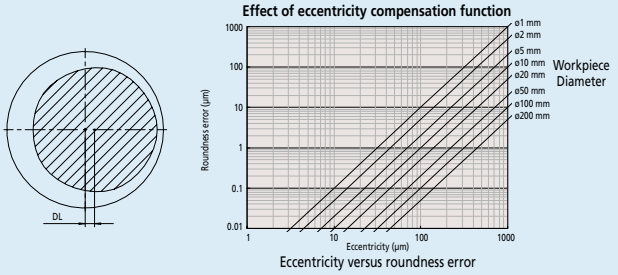
Total Runout (Radial and Axial)
The surface must be contained within the tolerance zone formed between two coaxial cylinders with a difference in radii of t, or planes a distance t apart, concentric with or perpendicular to the datum



Verification example using a roundness measuring instrument

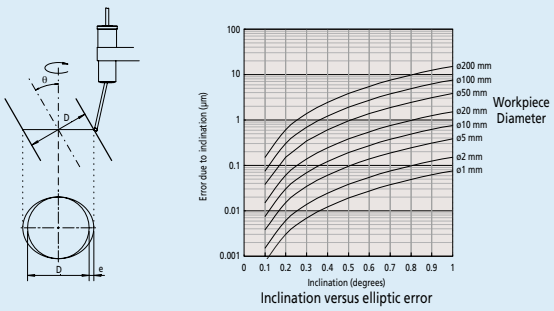
Adjustment prior to Measurement ISO 4291: 1985*3

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 consequentially 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.



Eccentricity versus roundness error

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.



Inclination versus elliptic error

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Effect of Filter Settings on the Measured Profile ISO 12181-2: 2011*4

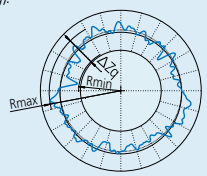
Profiles can be filtered in various ways to reduce or eliminate unwanted detail, with a cut-off value set in terms of undulations per revolution (upr). The effect of different upr settings is shown in the diagrams below, which illustrate how the measured roundness value decreases as lower upr settings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

Evaluating the Measured Profile Roundness ISO 12181-1: 2011*5, ISO 4291: 1985*3

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)

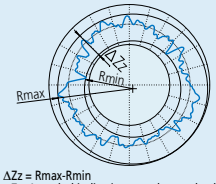
A circle is fitted to the measured profile such that the sum of the squares of the departure of the profile data from this circle is a minimum. The roundness figure is then defined as the difference between the maximum deviation of the profile from this circle (highest peak to the lowest valley).



ΔZq = Rmax-Rmin
ΔZq: A symbol indicating roundness value by LSC.

Minimum Zone Circles (MZC)

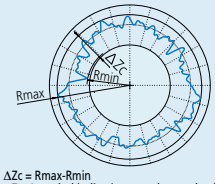
Two concentric circles are positioned to enclose the measured profile such that their radial difference is a minimum. The roundness figure is then defined as the radial separation of these two circles.



ΔZz = Rmax-Rmin
ΔZz: A symbol indicating roundness value by MZC.

Minimum Circumscribed Circle (MCC)

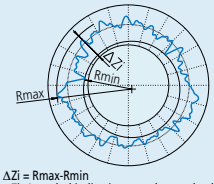
The smallest circle that can enclose the measured profile is created. The roundness figure is then defined as the maximum deviation of the profile from this circle. This circle is sometimes referred to as the 'ring gage' circle.



ΔZc = Rmax-Rmin
ΔZc: 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.



ΔZi = Rmax-Rmin
ΔZi: A symbol indicating roundness value by MIC.

Filtering

	2CR filter	Gaussian filter
Standard	ISO 4291: 1985*3	ISO 12181-1: 2011*5
Attenuation rate	75%	50%

Terms and abbreviated terms ISO 12181-1: 2011*5

Abbreviated terms	Terms
LSCI	Least squares reference circle
LSCY	Least squares reference cylinder
LSLI	Least squares reference line
LSPL	Least squares reference plane
LCD	Local cylindricity deviation
LFD	Local flatness deviation
LRD	Local roundness deviation
LSD	Local straightness deviation
MICI	Maximum inscribed reference circle
MICY	Maximum inscribed reference cylinder
MCCI	Minimum circumscribed reference circle
MCCY	Minimum circumscribed reference cylinder
MZCI	Minimum zone reference circles
MZCY	Minimum zone reference cylinder
MZLI	Minimum zone reference lines
MZPL	Minimum zone reference planes
UPR	Undulations per revolution

Parameters and abbreviated terms ISO 12181-1: 2011*5

Abbreviated terms	Parameter	Reference element*			
		Minimum zone	Least square	Minimum circumscribed	Minimum inscribed
CYLtt	Cylinder taper		✓		
STRsg	Generatrix straightness deviation		✓		
STRlc	Local generatrix straightness deviation		✓		
CYLp	Peak-to-reference cylindricity deviation		✓		
FLTp	Peak-to-reference flatness deviation		✓		
RONp	Peak-to-reference roundness deviation		✓		
STRp	Peak-to-reference straightness deviation		✓		
CYLt	Peak-to-valley cylindricity deviation	✓	✓	✓	✓
FLTt	Peak-to-valley flatness deviation	✓	✓		
RONt	Peak-to-valley roundness deviation	✓	✓	✓	✓
STRt	Peak-to-valley straightness deviation	✓	✓		
CYLv	Reference-to-valley cylindricity deviation		✓		
FLTv	Reference-to-valley flatness deviation		✓		
RONv	Reference-to-valley roundness deviation		✓		
STRv	Reference-to-valley straightness deviation		✓		
CYLq	Root-mean-square cylindricity deviation		✓		
FLTq	Root-mean-squareflatness deviation		✓		
RONq	Root-mean-square roundness deviation		✓		
STRq	Root-mean-square straightness deviation		✓		
STRsa	Straightness deviation of the extracted median line	✓	✓	✓	✓

* The reference elements to which the parameter can be applied.

*1 ISO/DIS 1101: 1996 Geometrical Product Specifications (GPS) - Geometrical tolerancing - Tolerancing of form, orientation, location and run-out
*2 ISO 5459 Technical drawings - Geometrical tolerancing - Datums and datum-systems for geometrical tolerances
*3 ISO 4291: 1985 Methods for the assessment of departure from roundness - Measurement of variations in radius
*4 ISO 12181-2: 2011 Geometrical Product Specifications (GPS) - Roundness - Part2: Specification operators
*5 ISO 12181-1: 2011 Geometrical Product Specifications (GPS) - Roundness - Part 1: Vocabulary and parameters of roundness