Surftest

Formtracer

Contracer

Roundtest

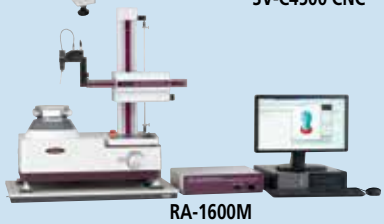
SV-C3200 / SV-C4500

CV-2100

SJ-410

INDEX

SV-C4500 CNC



RA-1600M

Mitutoyo

Surftest SJ-210/SJ-310

SERIES 178 — Portable Surface Roughness Tester

Surftest SJ-210

FEATURES

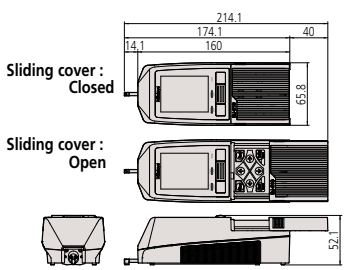
- The 2.4-inch color graphic LCD provides excellent readability and an intuitive display that is easy to use. The LCD also includes a backlight for improved visibility in dark environments.
- The Surftest SJ-210 can be easily operated using the buttons on the front of the unit and under the sliding cover.
- Up to 10 measurement conditions and one measured profile can be stored in the internal memory.
- An optional memory card can be used as an extended memory to store large quantities of measured profiles and conditions.
- Access to each feature can be password-protected, which prevents unintended operations and allows you to protect your settings.
- The display interface supports 16 languages, which can be freely switched.
- An alarm warns you when the cumulative measurement distance exceeds a preset limit.
- The Surftest SJ-210 complies with the following standards: JIS (JIS-B0601-2001, JIS-B0601-1994, JIS B0601-1982), VDA, ISO-1997, and ANSI.
- In addition to calculation results, the Surftest SJ-210 can display sectional calculation results and assessed profiles, load curves, and amplitude distribution curves.

SPECIFICATIONS/CONFIGURATION

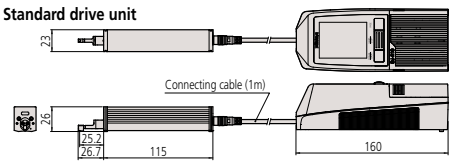
Model No.	SJ-210					
Order No. (inch/mm)	**178-561-01A**	**178-561-02A**	**178-563-01A**	**178-563-02A**	**178-565-01A**	**178-565-02A**
Drive unit	Standard type (**178-230-2**)		Retractable type (**178-235**)		Transverse tracing type (**178-233-2**)	
Detector	0.75mN type (**178-296**)	4mN type (**178-390**)	0.75mN type (**178-296**)	4mN type (**178-390**)	0.75mN type (**178-387**)	4mN type (**178-386**)
Display unit	Compact type (178-253A)					
Detector: Tip angle	60°	90°	60°	90°	60°	90°
Stylus tip radius	2µm	5µm	2µm	5µm	2µm	5µm
Detector measuring force	0.75mN	4mN	0.75mN	4mN	0.75mN	4mN
Standard accessories	**12BAA303** Connecting cable **178-602** Roughness specimen (Ra 3.00µm) **12BAK699** Carrying case **12BAK700** Calibration stage **12BAK820** Protective sheets for display AC Adapter Operation manual Quick reference manual Warranty				**12BAA303** Connecting cable **178-606** Roughness specimen (Ra 1.00µm) **12AAE643** Point-contact adapter **12AAE644** V-type adapter **12BAK699** Carrying case **12BAK700** Calibration stage **12BAK820** Protective sheets for display AC Adapter, Operation manual Quick reference manual, Warranty	

DIMENSIONS Display unit, Drive unit

Drive unit inside display unit (Standard detector installed in drive unit) SJ-210 series



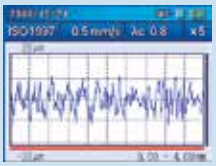
Standard drive unit



Drive unit not stored inside display unit (Standard detector installed in drive unit) SJ-210 series Standard drive unit

*** For Retractable and Transverse type drive units, please see pg. J-3.**

Unit: mm



Technical Data: SJ-210

X axis (drive unit)
- Measuring range: .70"(17.5mm) .22"(5.6mm) Transverse type
- Measuring speed: .01, .02, .03"/s (0.25, 0.5, 0.75mm/s) .039"/s (1mm/s) (Returning))

Detector:
- Range / Resolution: Auto / depending on the measurement range 14400 µin / .8 in (360 µm / 0.02 µm) 4000 µin / .2 µin (100 µm / 0.006 µm) 1000 µin / .08 µin (25 µm / 0.002 µm)
- Measuring method: skidded
- Measuring force: 4mN (0.75mN)
- Stylus tip: Diamond, 90° / 5µmR (60° / 2µmR)
- Skid radius of curvature: 40mm
- Skid force: less than 400mN
- Type: Differential inductance

Power supply: Two-way power supply: battery (rechargeable Ni-MH battery) and AC adapter
- Charging time: about 4 hours (may vary due to ambient temperature)
- Endurance: about 1000 measurements (differs slightly due to use conditions/ environment)

External I/O: USB I/F, Digimatic Output, Printer Output, RS-232C I/F, Foot SW I/F

Data storage: Micro SD card w/ adapter (4GB) (option **12AAL069**)

Dimensions (W x D x H)
- Display unit: 2.05x2.59x6.3"(52.1 x 65.8 x 160mm)
- Drive Unit: 4.5x.9x1"(115 x 23 x 26mm)

Mass: About 1.1lb (0.5kg) (Display unit + Drive unit + Standard detector)

Evaluation Capability: SJ-210

Applicable standards:
JIS'82, JIS'94, JIS'01, ISO'97, ANSI, VDA

Assessed profiles:
Primary profile, Roughness profile, DF profile, Roughness profile-Motif

Evaluation parameters:
Ra, Rc, Ry, Rz, Rq, Rt, Rmax, Rp, Rv, R3z, Rsk, Rku, Rc, RPc, Rsm, Rz1max, S, HSC, RzJIS, Rppi, RΔa, RΔq, Rlr, Rmr, Rmr(c), RδC, Rk, Rpk, Rvk, Mr1, Mr2, A1, A2, Vo, Rpm, tp, Htp, R, Rx, AR, Possible Customize

Analysis graphs: Bearning area curve / Amplitude distribution curve

Digital filters: Gaussian , 2CR75 , PC75

Cut off length: λc: .003, .01, .03, .1" (0.08, 0.25, 0.8, 2.5mm) λs: .1, .3"(2.5, 8µm)

Sampling length: .003, .01, .03, .1" or arbitrary (0.08, 0.25, 0.8, 2.5mm) or arbitrary

Number of sampling lengths (x n):
x1, x2, x3, x4, x5, x6, x7, x8, x9, x10 arbitrary length (0.3 to16.0mm: 0.01mm interval)
x1, x2, x3, x4, x5, x6, x7, x8, x9, x10 arbitrary length (0.3 to 5.6mm: 0.01mm interval)*
* Only for Transverse tracing drive unit type

Function: SJ-210

Customization: Desired parameters can be selected for calculation and display.

Go/no-go judgment: By max value / 16% / Standard dev.
Storage of measurement condition: Save the conditions at power OFF

Storage: Internal memory: Measurement condition (10 sets), Measured profile (1set)
Memory card (Option): 500 measurement conditions, 10,000 measured profiles, 500 display images
Text file (Measurement conditions / Measured profile / Assessed profile / Bearing area curve / Amplitude distribution curve)

Calibration: Auto-calibration with the entry of numerical value / Average calibration with multiple measurement (Max.5 times) is available

Technical Data: SJ-310

X axis (drive unit)
- Measuring range: .70"(17.5mm) .22"(5.6mm) Transverse type
- Measuring speed: .01, .02, .03"/s (0.25, 0.5, 0.75mm/s) .039"/s(1mm/s) Returning

Detector:
- Range / Resolution: Auto / depending on the measurement range 14400 µin / .8 in (360 µm / 0.02 µm) 4000 µin / .2 µin (100 µm / 0.006 µm) 1000 µin / .08 µin (25 µm / 0.002 µm)
- Measuring method: skidded
- Measuring force: 4mN (0.75mN)
- Stylus tip: Diamond, 90° / 5µmR (60° / 2µmR)
- Skid radius of curvature: 40mm
- Skid force: less than 400mN
- Type: Differential inductance

Power supply: Two-way power supply: battery (rechargeable Ni-MH battery) and AC adapter

Battery
- Charging time: 4 hours maximum
- Recharge cycles: Approximately 1500 times (slightly varies with the usage and environmental conditions)

External I/O: USB I/F, Digimatic Output, RS-232C I/F, External SW I/F

Data storage: Micro SD card w/ adapter (4GB) (option **12AAA841**)

Dimensions (W x D x H)
- Control unit: 10.8x4.29x7.8" (275 x 109 x 198mm)
- Drive unit: 4.5x.9x1"(115 x 23 x 26mm)

Mass
- Display unit: Approx. 3.7lb (1.7kg)
- Drive unit: .4lb (0.2kg)

Evaluation Capability: SJ-310

Applicable standards:
JIS'82, JIS'94, JIS'01, ISO'97, ANSI, VDA

Assessed profiles:
P (primary profile), R (roughness profile), DIN4776, roughness motif, waviness motif

Evaluation parameters:
Ra, Ry, Rz, Rt, Rp, Rq, Rv, Rsk, Rku, Rc, RSm, S, RPc, R3z, Rmr(c), Rpk, Rvk, Rδc,, Rk, Mr1, Mr2, Lo, Rppi, R, AR, Rx, A1, A2, Vo, HSC, Rmr, SK, Ku, RΔa, RΔq, Rlr, λa, λq, Rpm, RzJIS (JIS'01), tp (ANSI), Htp (ANSI), Wte, Wx, W, AW, Rz1max (ISO), Rmax (VDA, ANSI, JIS'82), Possible Customize

Analysis graphs:
Bearing Area Curve (BAC), Amplitude Distribution Curve (ADC)

Digital filter: 2CR, PC75, Gaussian

Cutoff length: λc: .003, .01, .03, .1, .3" (0.08, 0.25, 0.8, 2.5, 8mm) λs: .1, .3"(2.5, 8µm)

Sampling length: .003, .01, .03, .1, .3" or arbitrary (0.08, 0.25, 0.8, 2.5, 8mm) or arbitrary

Number of sampling lengths (x n):
x1, x2, x3, x4, x5, x6, x7, x8, x9, x10 arbitrary length (0.3 to16.0mm: 0.01mm interval)
x1, x2, x3, x4, x5, x6, x7, x8, x9, x10 arbitrary length (0.3 to 5.6mm: 0.01mm interval)*
* Only for Transverse tracing drive unit type

Printer: Thermal type

Printing width: 48mm (paper width: 58mm)

Recording magnification:
Vertical magnification: 10X to 100,000X, Auto
Horizontal magnification: 1X to 1,000X, Auto

Function: SJ-310

Customization: Desired parameters can be selected for calculation and display.

Statistical processing: Maximum value, minimum value, mean value, standard deviation, pass rate, histogram of each parameter

Go/no-go judgment: maximum value rule, 16% rule, average value rule, standard deviation (1σ, 2σ, 3σ)

Storage: Internal memory: Measurement condition (10 sets)

Memory card (Option): 500 measurement conditions, 10,000 measured profiles, 500 display images, Text file (Measurement conditions / Measured profile / Assessed profile / Bearing area curve / Amplitude distribution curve), 500 statistical data, etc.

Calibration: Auto-calibration with the entry of numerical value / Average calibration with multiple measurement (Max.12 times) is available.

Power-saving function: Auto-sleep-function, Auto light-off of Backlight by ECO mode.

Surftest SJ-210/SJ-310

SERIES 178 — Portable Surface Roughness Tester

Surftest SJ-310

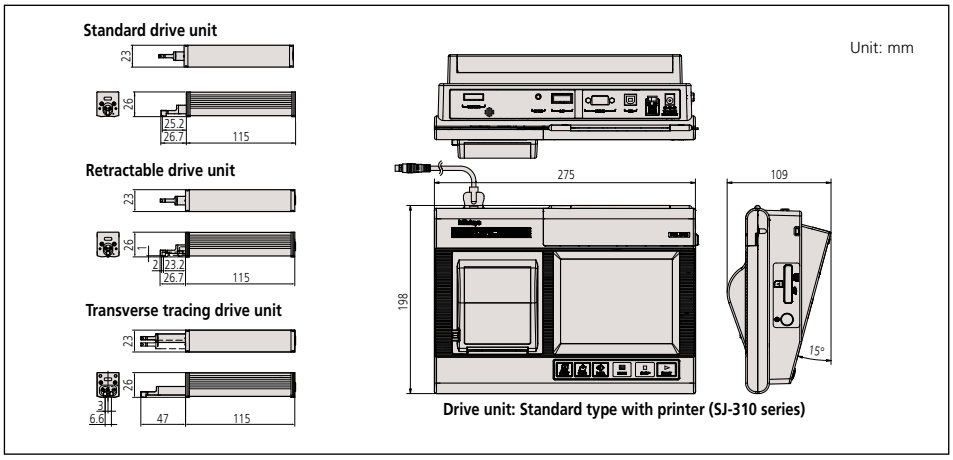
FEATURES

- The data processing unit offers large 5.7-inch color graphic LCD touch-panel for superior readability and operability. The LCD also includes a backlight for improved visibility in dark environments.
- The excellent user interface provides intuitive and easy-to-understand operability.
- Complies with the following standards: JIS (JIS-B0601-2001, JIS-B0601-1994, JIS B0601-1982), VDA, ISO- 1997, and ANSI.
- The Measure-Start and other frequently used buttons are strengthened to resist wear and the detrimental effects of workshop contaminants.
- Equipped with a large-capacity battery allowing approximately 1500 measurements when fully charged.
- Includes convenient carrying case for protection in the field.
- A high-speed printer is built into the main unit. Either landscape or portfolio mode can be selected according to the application. Paper saving mode is supported.
- The display interface supports 16 languages, which can be easily switched.
- 10 sets of measurement conditions can be saved in the measurement unit–an optional memory card can save measurement conditions and the measured profile.

SPECIFICATIONS/CONFIGURATION

Model No.	SJ-310					
Order No. (inch/mm)	**178-571-01A**	**178-571-02A**	**178-573-01A**	**178-573-02A**	**178-575-01A**	**178-575-02A**
Drive unit	Standard type (**178-230-2**)		Retractable type (**178-235**)		Transverse tracing type (**178-233-2**)	
Detector	0.75mN type (**178-296**)	4mN type (**178-390**)	0.75mN type (**178-296**)	4mN type (**178-390**)	0.75mN type (**178-387**)	4mN type (**178-386**)
Display unit	Standard type with printer					
Detector: Tip angle	60°	90°	60°	90°	60°	90°
Stylus tip radius	2µm	5µm	2µm	5µm	2µm	5µm
Detector measuring force	0.75mN	4mN	0.75mN	4mN	0.75mN	4mN
Standard accessories	**12AAM475** Connecting cable **12AAA217** Nosepiece for plane surface **12AAA218** Nosepiece for cylinder **12AAA216** Supporting leg **12BAK700** Calibration stage **12BAG834** Stylus pen **12BAL402** Protection sheet **270732** Printer paper (5 pieces) **12BAL400** Carrying case **178-602** Roughness reference specimen (Ra 3µm), AC adapter, Philips screwdriver, Strap for stylus pen, Operation manual, Quick reference manual, Warranty				**12AAM475** Connecting cable **12AAE643** Point-contact adapter **12AAE644** V-type adapter **12BAK700** Calibration stage **12BAG834** Stylus pen **12BAL402** Protection sheet **270732** Printer paper (5 pieces) **12BAL400** Carrying case **178-606** Roughness reference specimen (Ra 1µm), AC adapter, Philips screwdriver, Strap for stylus pen, Operation manual, Quick reference manual, Warranty	

DIMENSIONS Display unit, Drive unit



Drive unit: Standard type with printer (SJ-310 series)

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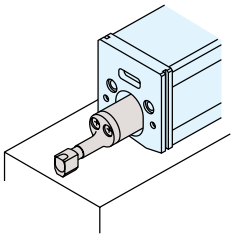
Surftest SJ-210 / SJ-310

SERIES 178 — Optional Accessories

Detectors

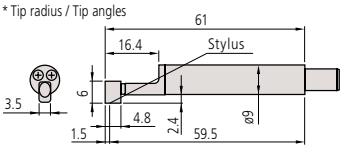
Unit: mm

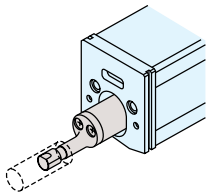


Standard detectors

Order No.	Measuring force	Stylus profiles*	Remarks column
178-296	0.75mN	2µmR/60°	Dedicated to the standard/ retractable drive unit
178-390	4 mN	5µmR/90°	
178-387	0.75mN	2µmR/60°	Dedicated to the transverse tracing drive unit
178-386	4 mN	5µmR/90°	
178-395	0.75mN	2µmR/90°	Dedicated to the standard/ retractable drive unit
178-391	4 mN	10µmR/90°	

* Tip radius / Tip angles

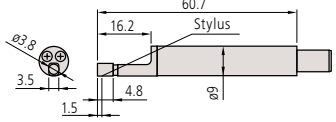


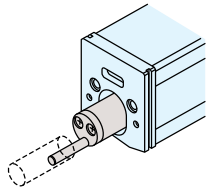


Small hole detectors

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

* Tip radius / Tip angles

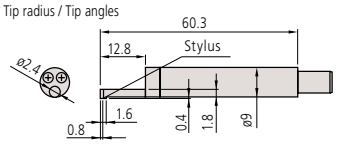


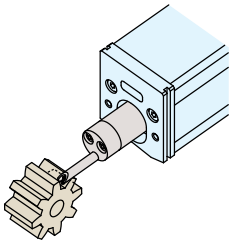


Extra small hole detectors

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

* Tip radius / Tip angles

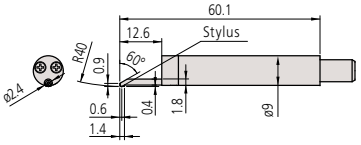


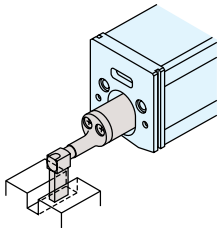


Gear-tooth surface detectors

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

* Tip radius / Tip angles

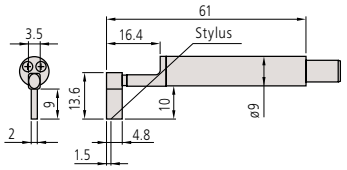




Deep groove detectors

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

* Tip radius / Tip angles



SJ-Printer for SJ-210

Assessed profiles and calculation results and curves can be printed out by connecting the SJ-210-dedicated printer, which is palm sized (W x D x H: 93x125x70mm) and can run on an internal battery.

- Power supply can be selected. (AC adapter or battery pack)
- Printable items: Measurement conditions, calculation results, assessed profile, bearing area curve (BAC), amplitude distribution curve (ADC), and environment settings.

178-421A

*Not compatible with older **SJ-201** models.

Example of the connection with **SJ-210**

Durable Printer paper (25m, 5 rolls/set): **12AAA876**

Printer paper (5 packs): **270732**

RS-232C cable: **12AAL067**

DP-1VA

It is possible to process Digimatic data output from the Surftest SJ series with the DP-1VA. This compact, hand-held device can provide printouts of measurement data and various statistical analyses results such as histograms, D-charts, and Xbar-R control charts. With optional output cables, DP-1VA is also capable of RS-232C output of measurement data to a PC (cable **09EAA084**) and go/no-go condition output (cable **965516**).

264-505A

Connecting cable: **936937** 40"(1m)
Connecting cable: **965014** 80" (2m)
AC adapter: **06AEG180JA**
Printer paper: **09EAA082**

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

Free Communication Software

SJ-Tools

This program can be downloaded for FREE from the Mitutoyo website. http:www.mitutoyo.com

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

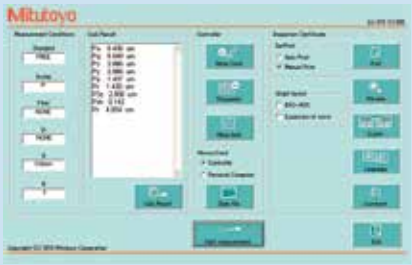
* Microsoft-Excel is not included in the scope of supply.

Complete with exclusive accessories.

- Measurement device control
- Definition of measurement variables
- Graphic representation of the profile
- Storage of measurement records
- Documentation of measurement results
- Connecting cable

Optional cables (Required for software communication)

12AAL068: USB PC connecting cable (USB cable) for SJ-210
12AAD510: USB PC connecting cable (USB cable) for SJ-310/410
12AAL067: RS-232C cable for SJ-210
12AAA882: RS-232C cable for SJ-310/410
12AAH490: USB PC connecting cable for SJ-500/SV-2100

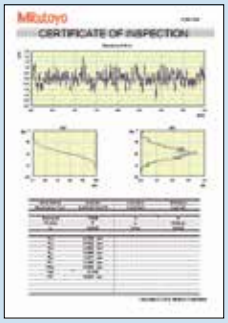


SJ-Tools input mask for Surftest SJ series

Required environment*:

- OS:
  Windows XP-SP3
  Windows Vista
  Windows 7/8/10
- Spreadsheet software:
  Microsoft Excel 2000/2002/2003/2007/2010/2013/2016

* Windows OS and Microsoft Excel are products of Microsoft Corporation.



SJ-Tools output record from MS-Excel

Optional Accessories

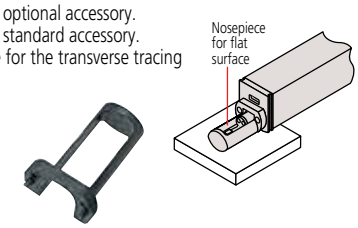
12AAL272: SJ-210 Replacement Battery Pack
12AAN046: SJ-310 Replacement Battery Pack
12BAK820: SJ-210 Display Protection Sheet (1pc.)
12AAL066: SJ-210 Display Protection Sheet (5pcs.)
12BAL402: SJ-310 Display Protection Sheet (1pc.)
12AAN040: SJ-310 Display Protection Sheet (10pcs.)
178-601: Precision Reference Specimen (Ra 3.00 µm)
178-602: Precision Reference Specimen (Ra 119 µin / 3.00 µm)
178-603: Precision Reference Specimen – 2 values (GAR)
178-604: Precision Reference Specimen – 2 Values (MIT)
178-606: Precision Reference Specimen for Transverse Drive (Ra 39.5 µin /1.0 µm)
178-029: Manual Column Stand, must use adapter 12AAA221 to mount SJ drive unit.

Nosepiece, Adapter

Nosepiece for flat surfaces

12AAA217

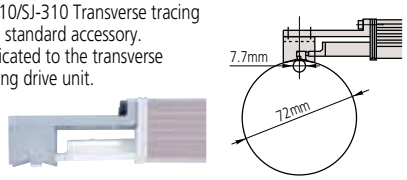
- SJ-210/210R optional accessory.
- SJ-310/310R standard accessory.
- Not available for the transverse tracing drive unit.



V-type adapter

12AAE644

- SJ-210/SJ-310 Transverse tracing type standard accessory.
- Dedicated to the transverse tracing drive unit.

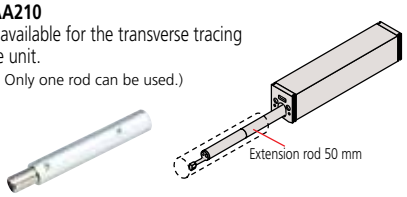


Extension rod (50mm)

12AAA210

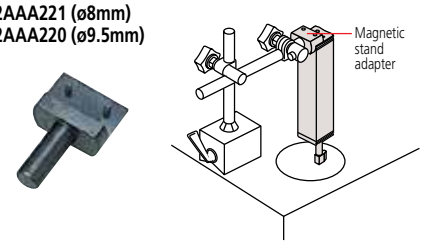
- Not available for the transverse tracing drive unit.

(Note: Only one rod can be used.)



Magnetic stand adapter

12AAA221 (ø8mm)
12AAA220 (ø9.5mm)



Extension cable (1m)

12BAA303

- Only one cable can be used.

Nosepiece for cylindrical surfaces

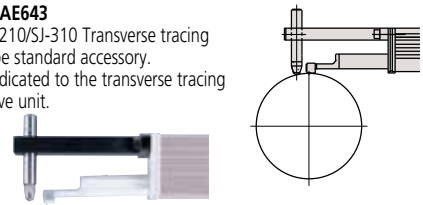
12AAA218

- SJ-210/210R optional accessory.
- SJ-310/310R standard accessory.
- Not available for the transverse tracing drive unit.
- ø30mm or smaller workpiece

Point-contact adapter

12AAE643

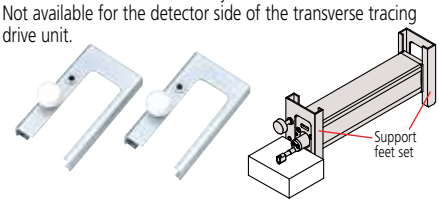
- SJ-210/SJ-310 Transverse tracing type standard accessory.
- Dedicated to the transverse tracing drive unit.



Support feet set

12AAA216

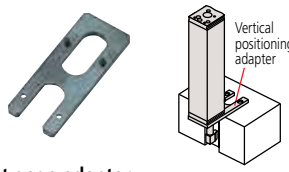
- SJ-210/210R optional accessory.
- SJ-310/310R standard accessory.
- Not available for the detector side of the transverse tracing drive unit.



Vertical positioning adapter

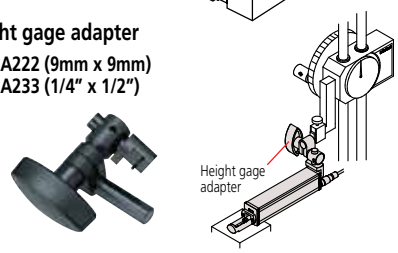
12AAA219

- Not available for the transverse tracing drive unit.



Height gage adapter

12AAA222 (9mm x 9mm)
12AAA233 (1/4" x 1/2")



Setting attachments

* Not available for the transverse tracing drive unit

Improves measurement efficiency by allowing the setup of workpieces of the same type and the positioning of hard-to-access features of a workpiece.

No. 178-033

V-type for measuring in the cylinder axis direction

The V-width is adjustable to the cylinder diameter facilitating axial measurement of a wide range of cylinder diameters.

- Adjustable range: ø 5 - 150mm

No. 178-034

Setting attachment: Magnetic slider type

Best suited for measurement of the flat surface of a workpiece that has partial indentions and steps and that is hard to set the drive unit. Combination use with the magnet type specimen holder (Option No. 12AAA910) further improves the ease of operation.

No. 178-035

Setting attachment: Inside diameter type

Greatly facilitates measurement of internal wall surfaces of, for example, cylinder-block bores.

- Applicable diameter: ø75 - ø95mm
- Accessible depth: 30 - 135mm

Mitutoyo

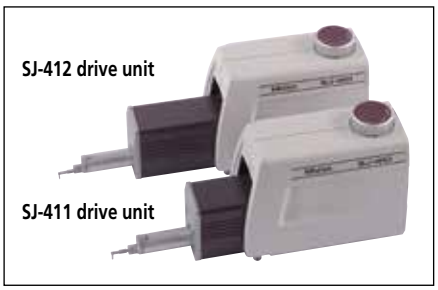
Surftest SJ-410

SERIES 178 — Portable Surface Roughness Tester

FEATURES

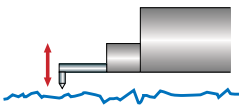
- Both skidded and skidless measurement are possible with this series. Equipped with 46 roughness parameters that conform to the latest ISO, DIN, ANSI, and JIS standards.
- A wide-range, high-resolution detector and a drive unit provide superior high-accuracy measurement in its class.

Detector
Measuring range: 800µm
Resolution: 0.000125µm (at 8µm range)
Drive unit
Straightness/traverse length
SJ-411: 0.3µm/25mm
SJ-412: 0.5µm/50mm



- A skidless detector and a curved surface compensation function provide efficient evaluation of cylinder surface roughness.
- Ultra-fine steps, straightness and waviness can be measured by using the skidless measurement function.
- The handheld data processing unit and the 5.7-inch color graphic LCD touch-panel provides superior readability and operability. The LCD also includes a backlight for improved visibility in dark environments.
- The excellent user interface provides intuitive and easy-to-understand operability.
- Measured data can be output to a PC with optional RS-232C or USB cable.
- Digital filter function for non-distorted roughness profiles.
- Go/no-go judgment function.
- Auto-calibration function.
- The display interface supports 16 languages, which can be freely switched.
- Simplified contour analysis function supports the four types of measurement: step, level change, area and coordinate difference.
- Access to each feature can be password-protected, which prevents unintended operations and allows you to protect your settings.
- The optional attachments for mounting on a column stand significantly increase the operability.

Skidless measurement



Surftest SJ-411

SPECIFICATIONS

Model No.		SJ-411	SJ-411	SJ-412	SJ-412
Order No. (inch/mm)		**178-581-01A**	**178-581-02A**	**178-583-01A**	**178-583-02A**
Detector measuring force		0.75mN	4mN	0.75mN	4mN
Evaluation range		25mm	25mm	50mm	50mm
Stylus tip	Tip angle	60°	90°	60°	90°
	Tip radius	2µm	5µm	2µm	5µm

Technical Data: X axis (drive unit)

Measuring range: 1"(25mm) (SJ-411), 2"(50mm) (SJ-412)
Measuring speed: .002, .004, .008, .02, .04"/s (0.05, 0.1, 0.5, 1.0mm/s)
Return speed: .02, .04, .08"/s (0.5, 1.0, 2.0mm/s)
Traversing direction: Backward
Traverse linearity: 12 µin / 1"(0.3µm/25mm) (SJ-411), 20 µin / 2"(0.5µm/50mm) (SJ-412)
Positioning: ±1.5° (tilting), 10mm (up/down)
Detector Range / resolution: 800µm / 0.0125µm, 80µm / 0.00125µm, 8µm / 0.000125µm (up to 2400µm with an optional stylus)
Measurement method: Skidless / skidded
Measuring force: 0.75mN (4mN)
Stylus tip: Diamond, 60° / 2µmR (90° / 5µmR)
Skid radius of curvature: 40mm
Type: Differential inductance
Power supply: Via AC adapter / rechargeable battery
Battery life: Max. app. 1000 measurements (w/o printing)
Recharge time: 4 hours Data output Via USB interface / RS-232C interface / SPC output
Storage:Internal memory: Measurement condition (10 sets)
Memory card (Option): 500 measurement conditions, 10,000 measured profiles, 500 display images, Text file (Measurement conditions / Measured profile / Assessed profile / Bearing area curve / Amplitude distribution curve), 500 statistical data, etc.
Dimensions (W x D x H)
Display unit: 10.8x4.3x7.8"(275x109 x198mm)
Height-tilt adjustment unit: 5.16x2.48x3.9"(131x63x99mm)
Drive unit: 5.04x1.41x1.83"(128x36x47mm)(SJ-411), 6.1x1.41x1.83"(155x36x47mm) (SJ-412)
Mass Control unit: Approx. 3.75lb (1.7kg)
Height-tilt adjustment unit: Approx. .9lb (0.4kg)
Drive unit: 1.3lb(0.6kg) (SJ-411), 1.5lb(0.7kg)(SJ-412)

Evaluation Capability

Applicable standards: JIS'82, JIS'94, JIS'01, ISO'97, ANSI, VDA, Free
Assessed profiles: P (primary profile), R (roughness profile), DF (DF profile), W (filtered waviness profile), roughness motif, waviness motif
Evaluation parameters: Ra, Rq, Rz, Ry, Rp, Rv, Rt, R3z, Rsk, Rku, Rc, RPc, RSm, Rmax(VDA, ANSI), Rz1max(ISO'97), S, HSC, RzJIS(JIS'01), Rppi, RΔa, RΔq, Rlr, Rmr, Rmr(c), Rδc, Rk, Rpk, Rvk, Mr1, Mr2, A1, A2, Vo, λq, Lo, Rpm, tp(ANSI), Htp(ANSI), R, Rx, AR, W, AW, Wx, Wte
Analysis graphs: Bearing Area Curve (BAC), Amplitude Distribution Curve (ADC)
Digital filter: 2CR, PC75, Gaussian
Cutoff length: λc: .003, .01, .03, .1, .3" (0.08, 0.25, 0.8, 2.5, 8mm)
λs: 100, 320, 1000µin (2.5, 8, 25µm)(Availability of switching depends of the selected standard.)
Sampling length: 0.08, 0.25, 0.8, 2.5, 8, 25*mm; or arbitrary length in range 0.1 to 25mm (0.1 to 50mm: SJ-412) in 0.01mm increments
Number of sampling lengths: 1, 2, 3, ~20 (limited by traverse range)
Printer: Thermal type
Printing width: 48mm (paper width: 58mm)
Recording magnification
Vertical magnification: 10X to 100,000X, Auto
Horizontal magnification: 1X to 1,000X, Auto
Function
Customize: Selection of display/evaluation parameter
Data compensation: R-surface, Tilt compensation
Ruler function: Step, level change, area and coordinate difference
D.A.T. function: Helps to level workpiece prior to skidless measurement displacement detection mode enables the stylus displacement to be input while the drive unit is stopped.
Statistical processing: Max. value, Min. value, Mean value, Standard deviation (s), Pass ratio, Histogram
GO/NG judgement: Maximum value rule, 16% rule, average value rule, standard deviation (1σ, 2σ, 3σ)
Calibration: Auto-calibration with the entry of numerical value /average calibration with multiple measurement (Max.12 times) is available.
Power saving function: Auto-sleep-function, Auto light-off of Backlight by ECO mode.

* Only for SJ-412

Surftest SJ-410

SERIES 178 — Portable Surface Roughness Tester

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

Free Communication Software

SJ-Tools

This program can be downloaded for FREE from the Mitutoyo website. http:www.mitutoyo.com

Output software based on Microsoft-Excel* for controlling the devices and reproducing and storing the measurement data.
*Microsoft-Excel is not included in the scope of supply.

Complete with exclusive accessories.
- Measurement device control
- Definition of measurement variables
- Graphic representation of the profile
- Storage of measurement results
- Documentation of measurement results

Optional cables (Required for software communication)
12AAD510: USB PC connecting cable (USB cable)
12AAA882: RS-232C connecting cable

Optional Accessories

178-611: Step gage (2µm, 10µm)
178-612: Step gage (2µm, 10µm, 79µin, 394µin)
178-610: Step gage (step: 1µm, 2µm, 5µm, 10µm)
12AAM556: Height/tilt adjustment unit for SJ-410
178-039: Manual column stand (granite base) (vertical travel: 250mm)
178-010: Auto-set unit for **178-039**
178-020: X axis adjustment unit for **178-039**
178-030: Tilting adjustment unit (Inclination adjustment unit) for **178-039**
12AAB358: Cylindrical surface adapter (workpiece dia.: 15 - 60mm)
178-016: Leveling table (tilting: ±1.5°, max. loading: 15kg)
178-048: Leveling table with D.A.T function (mm) (tilting: ±1.5°, max. loading: 15kg)
178-058: Leveling table with D.A.T function (inch) (tilting: ±1.5°, max. loading: 15kg)
178-043-1: XY leveling table (25 x 25mm) (tilting: ±1.5°, max. loading: 15kg, swiveling: ±3°)
178-053-1: XY leveling table (1" x 1") (tilting: ±1.5°, max. loading: 15kg, swiveling: ±3°)
178-042-1: Digital XY leveling table (25 x 25mm) (tilting: ±1.5°, max. loading: 15kg, swiveling: ±3°)
178-052-1: Digital XY leveling table (1" x 1") (tilting: ±1.5°, max. loading: 15kg, swiveling: ±3°)
178-049: Digital XY leveling table (25 x 25mm) (max. loading: 15kg)
178-059: Digimatic XY leveling table (1" x 1") (max. loading: 15kg)
178-019: Precision vise for XY leveling table (jaw opening: 36mm)
998291: Precision V-block for XY leveling table (workpiece dia.: 1 - 160mm)
12AAL069: Micro SD card w/adapter (4GB)
965014: SPC cable (2m)
264-012-10: Input tool (USB type)
264-505A: DP-1VA
———: Detectors, Styli, and nosepieces (See pg. J-22/23.)

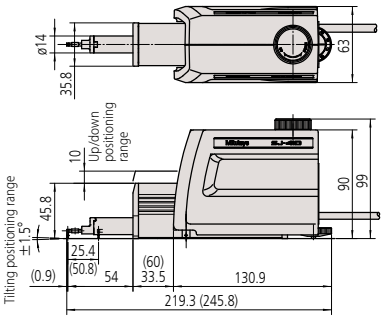
Consumables

12AAN040: LCD protective sheet (10 sheets/set)
12AAA876: Durable printer paper (25m, 5 rolls/set)
270732: Printer paper (5 pack)
12AAN046: Replacement battery
12AAJ088: Footswitch

DIMENSIONS

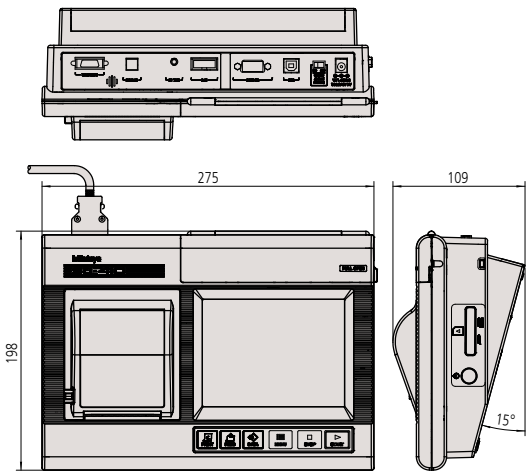
Unit: mm

Drive unit

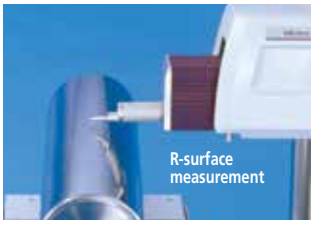


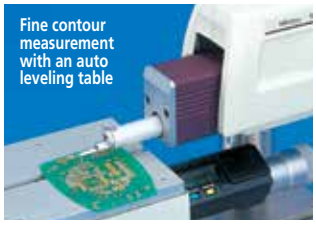
( ): Referring to dimensions when a 50mm drive is mounted to SJ-412.

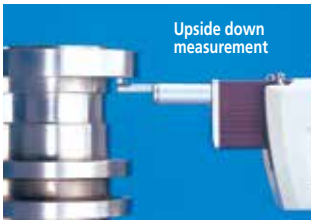
Display unit

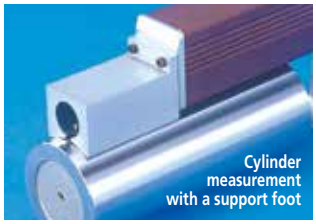


MEASUREMENT APPLICATIONS









Carrying case is a standard accessory.

Manual column stand **178-039**

With optional accessories.

178-010: Auto-set unit
178-020: X-axis adjustment unit
178-030: Tilting adjustment unit

Mitutoyo

Surftest SJ-500/P, SV-2100

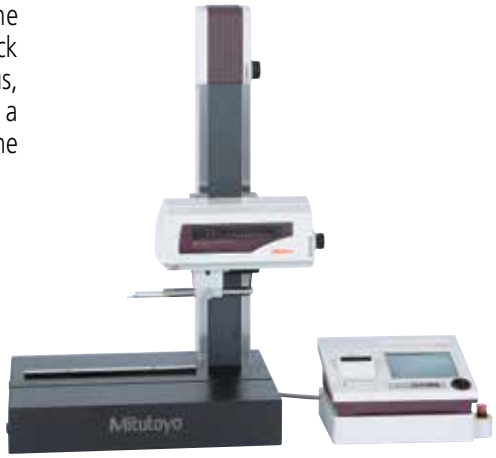
SERIES 178 — with Dedicated Control / PC System / Display Unit

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

FEATURES

- User-friendly display and simple operation equipped with a highly visible color 7.5-inch TFT LCD.
- Easy positioning. A joy stick built in the dedicated control unit allows easy and quick positioning. Fine positioning of a small stylus, required for measuring the inner side of a small hole, easily can be made using the manual knob.
- Easy setting of measuring conditions for surface roughness. Equipped with simple input function allows inputs according to drawing instruction symbols of ISO/JIS roughness standards. Troublesome measuring condition settings can be easily input by directly selecting a drawing instruction symbol for surface roughness from the menu.

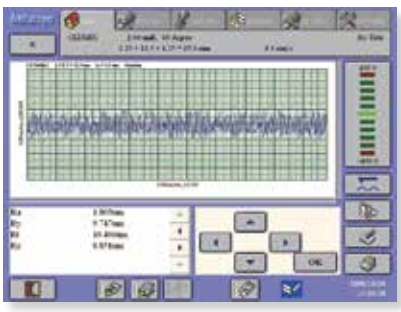
SJ-500



SV-2100S4

SJ-500P

SURFPAK-EZ: Easy-to-use task-focused software



Measurement and results display screen

User-friendly graphical display and button layout allows intuitive operation. Simplified fine-contour analysis provided as standard, including step, area, angle, and circle calculation.

Technical Data: SJ-500

X-axis (drive unit)
- Measuring range: 1.97" (50mm)
- Resolution: 1.97µin (0.05µm)
- Measurement method: Linear encoder
- Drive speed: 0 - .78"/s (0 - 20mm/s)
- Measuring speed: .00078 - .2"/s (0.02 - 5mm/s)
- Traversing direction: Backward
- Traverse linearity: 7.8µin/1.97" (0.2µm / 50mm)
- Positioning: ±1.5° (tilting, with DAT function)
  1.18" (30mm) (up/down)

Detector
- Resolution / Range: .4µin/32000µin, .04µin/3200µin, .004µin/320µin
  0.01µm (800µm), 0.001µm (80µm), 0.0001µm (8µm)
- Detecting method: Skidless / skid measurement
- Measuring force: 4mN (0.75mN) (low force type)
- Stylus tip: Diamond, 90° / 5µmR
  (60° / 2µmR: low force type)
- Skid radius of curvature: 1.57" (40mm)
- Detecting method: Differential inductance

Control unit
- Display: 7.5" color TFT with backlight
- Printer: Built-in thermal printer
- Magnification: Horizontal: X10 to X500,000, Auto
  Vertical: X0.5 to X10,000, Auto
- Drive unit control: Joystick operation with manual knob

Technical Data: SV-2100

X-axis (drive unit)
- Measuring range: 3.94" (100mm)
- Resolution: 1.97µin (0.05µm)
- Measurement method: Linear encoder
- Drive speed: 0 - 1.57"/s (0 - 40mm/s)
- Measuring speed: .00078 - .197"/s (0.02 - 5mm/s)
- Traversing direction: Pull
- Traverse linearity: 6µin/4" (0.15µm / 100mm)

Z2-axis (column)
- Type: Manual operation or power drive
- Vertical travel: 13.8" or 21.6" (350mm or 550mm*)
- Resolution*: 1µm
- Measurement method*: Rotary encoder
- Drive speed*: 0 - .78"/s (0 - 20mm/s)

*Only for power-drive type

Detector
- Resolution / Range : .4µin/32000µin, .04µin/3200µin, .004µin/320µin
  0.01µm / 800µm , 0.001µm / 80µm, 0.0001µm / 8µm
- Detecting method: Skidless / skid measurement
- Measuring force: 4mN or 0.75mN (low force type)
- Stylus tip: Diamond, 90° / 5µmR
  (60° / 2µmR: low force type)
- Skid radius of curvature: 1.57" (40mm)
- Detecting method: Differential inductance

Control unit
- Display: 7.5" color TFT with backlight
- Printer: Built-in thermal printer
- Magnification: Horizontal: X10 to X500,000, Auto
  Vertical: X0.5 to X10,000, Auto
- Drive unit control: Joystick operation with manual knob

Evaluation Capability

Cutoff length
ls: 0.25µm, 0.8µm, 2.5µm, 8µm, 25µm, 250µm, no filter
lc*: 0.025mm, 0.08mm, 0.25mm, 0.8mm, 2.5mm, 8mm, 25mm
lf: 0.08mm, 0.25mm, 0.8mm, 2.5mm, 8mm, 25mm, no filter

Sampling length (L)*
0.025mm, 0.08mm, 0.25mm, 0.8mm, 2.5mm, 8mm, 25mm, 80mm (SV-2100 only)

Data compensation functions
Parabola compensation, hyperbola compensation, ellipse compensation, R-plane (curved surface) compensation, conic compensation, tilt compensation

*Arbitrary length can be specified in the range from 0.02mm to 50mm.

12AAA876: High durable printer paper (5 Rolls/set)
270732: Standard type printer paper (5pcs.)
12AAA841: Compact Flash memory card (128 MB)

Surftest SJ-500/P, SV-2100

SERIES 178 — with Dedicated Control / PC System / Display Unit

SPECIFICATIONS

Model no.	SJ-500P	SJ-500	SV-2100M4	SV-2100S4	SV-2100H4	SV-2100W4
Type of Data processing	PC System	Dedicated Data Processor	Dedicated Data Processor			
Order No. (inch)	**178-531-02A**	**178-533-02A**	**178-637-01A**	**178-681-01A**	**178-683-01A**	**178-685-01A**
Measuring force of detector	4mN	4mN	0.75mN			
X-axis measuring range	2″ (50mm)		4″ (100mm)			
Vertical travel	Optional stand		13.8″ (350mm) manual column	13.8″ (350mm) power column	21.6″ (550mm) power column	
Granite base size (WxD)	Optional stand		23.6 x 17.7″ (600 x 450mm)			39.4 x 17.7″ (1000 x 450mm)
PC I/F Unit	13.7 x 10.4 x 3.4″ (350 x 263 x 86mm)	NA	NA	NA	NA	NA
Dimensions (main unit, WxDxH)	16.7 x 3.7 x 6.3″ (425 x 94 x 160mm)		28.2 x 17.7 x 34″ (716 x 450 x 863mm)	28.2 x 17.7 x 38″ (716 x 450 x 966mm)	28.2 x 17.7 x 46″ (716 x 450 x 1166mm)	44 x 17.7 x 46.3″ (1116 x 450 x 1176mm)
Main unit Mass	5.9 lbs. (2.7 kg)		308.6 lbs. (140 kg)	308.6 lbs. (140 kg)	330 lbs. (150 kg)	485 lbs (220 kg)
Assessed profiles	Dedicated data processor type: P (primary profile), R (roughness profile), WC, envelope residual profile, roughness motif, waviness motif PC system type: P (primary profile), R (roughness profile), WC, WCA, WE, WEA, DIN4776 profile, E (envelope residual profile), roughness motif, waviness motif					
Evaluation parameters	Dedicated data processor type: Ra, Rc, Ry, Rz, Rq, Rt, Rmax, Rp, Rv, R3z, Sm, S, Pc, mr (c),δc, mr, tp, Htp, Lo, lr, Ppi, HSC, Δa, Δq, Ku, Sk, Rpk, Rvk, Rk, Mr1, Mr2, A1, A2, Vo, λa, λq, R, AR, Rx, W, AW, Wx, Wte, (43 parameters), Customization PC system type: Pa, Pq, Psk, Pku, Pp, Pv, Pz, Pt, Pc, PSm, PΔq, Pmr (c), Pmr, Pδc, Ra, Rq, Rsk, Rku, Rp, Rv, Rz, Rt, Rc, RSm, RΔq, Rmr (c), Rmr, Rδc, Wa, Wq, Wsk, Wku, Wp, Wv, Wz, Wt, Wc, WSm, WΔq, Wmr (c), Wmr, Wδc, Rk, Rpk, Rvk, Mr1, Mr2, A1, A2, Rx, AR, R, Wx, AW, W, Wte, Ry, RyDIN, RzDIN, R3y, R3z, S, HSC, Lo, lr, Δa, λa, λq, Vo, Htp, NR, NCRX, CPM, SR, SAR, NW, SW, SAW					
Analysis graphs	Dedicated data processor type: ADC, BAC, power spectrum graph PC system type: ADC, BAC Graph, power spectrum graph, auto-correlation graph, Walsh power spectrum graph, Walsh auto-correlation graph, slope distribution graph, local peak distribution graph, parameter distribution graph					
Curved surface compensation	Dedicated data processor type: Parabolic compensation, Hyperbolic compensation, Elliptical compensation, Circular compensation Conic compensation, Inclination (Entire, Arbitrary) PC system type: Parabolic compensation, Hyperbolic compensation, Elliptical compensation, Circular compensation, Conic compensation, Inclination (Entire, Arbitrary), Polynomial compensation					
Contour analysis	Dedicated data processor type: Area, Circle, Angle, Coordinate difference, Step, Inclination PC system type (SURFPAK-EZ): Area, Circle, Angle, Coordinate difference, Step, Inclination					
Filters	Dedicated data processor type: 2CR-75%, 2CRPC-75%, Gaussian, Robust-spline PC system type: 2CR-75%, 2CR-50%, 2CRPC-75%, 2CRPC-50%, Gaussian, Robust-spline					

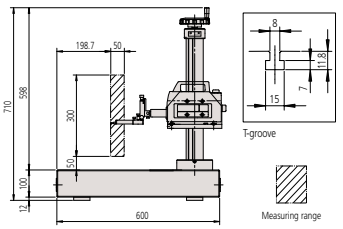
Manual column stand options: 178-085 and 178-089 (for SJ-500)

Suitable for desktop use in inspection rooms and such.

No.178-085* Does not include measuring unit
Vertical adjustment range: 11.8" (300mm)
Dimension (W × D × H): 23.6" x 17.7" x 28"
(600 × 450 × 710mm)
Weight: 242 lbs (110kg)

No.178-089* Does not include measuring unit
Vertical adjustment range: 9.8" (250mm)
Dimension (W × D × H): 15.7 x 9.8 x 2.4"
(400 × 250 × 60mm)
Weight: 44 lbs (20kg)

Dimensions of SJ-500 w/ manual column stand **178-085**



Unit: mm

Auto-leveling table: 178-081 (for SJ-500 / SV-2100M4), 178-083 (for SV-2100S4 / H4 / W4)

This is a stage that performs fully automatic leveling as measurement starts, freeing the user from this tedious operation. Fully automatic leveling can be done quickly by anyone. In addition, the operation is easy and reliable.

Inclination adjustment angle	±2°
Maximum load	15.4 lbs (7kg)
Table dimensions	5.12 x 3.94"(130x100mm)
Mass	7.7lbs (3.5kg)

Mitutoyo

Surftest SV-3200

SERIES 178 — Surface Roughness Testers

SV-3200L4 (with options)

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

*Shown with optional accessories.

SV-3200H4 with PC

The Surftest SV-3200 Series provide high-accuracy, high-level analysis and multi-functionality in measurement of surface roughness.

FEATURES

- Mitutoyo's Surftest SV-3200 Series provides high-accuracy, high-level analysis and multi-functionality in three-dimensional analysis and measurement of fine contour, as well as the conventional type surface roughness measurement.
- Peripheral devices such as the auto-leveling table are available to enhance operability and to enable automatic measurement.
- FORMTRACEPAK V5, dedicated data-analyzing software, is installed. This software allows data management in a consistent format, from the work site to the laboratory.
- Ceramic, which is known for its superb anti-abrasive property, is used as the X-axis drive unit guide. No lubrication of the guide is required.
- High-accuracy glass scales are built-in on X-axis (resolution: 1.97µin (0.05µm) and Z2-axis (column, resolution: 39.4µin (1µm) to ensure high-accuracy positioning.

The SV-3200 series manifest high-reliability especially in the horizontal roughness parameters (S, Sm), that require high-accuracy of the X-axis travel.

- When equipped with high accuracy Y-axis table and 3D surface analysis software MCubeMap, this offers CNC type capabilities usually performed on Extreme series machines.
- Various optional detector holders such as Crank Rotary type and Manual Rotary type make this versatile for many different applications.
- New optional Digital Automatic Tilt (DAT) function is best suited for workpieces that are too large for leveling tables.

Technical Data

X-axis
- Measuring range: 4" or 8" (100mm or 200mm)
- Resolution: 1.97µin (0.05µm)
- Measurement method: Linear encoder
- Drive speed: 0 - 3.1"/s (0 - 80mm/s)
- Measuring speed: .00078 - .78"/s (0.2 - 20mm/s)**
- Traversing direction: Backward
- Traverse linearity: 4": (2+L)µin (0.05+0.001L)µm*
  8": 20µin / 8"(0.5µm/200mm)

Z2-axis (column)
- Vertical travel: 12", 20"or 27.6" (300mm, 500mm or 700mm) power drive
- Resolution: 39.4µin (1µm)
- Measurement method: ABSOLUTE linear encoder
- Drive speed: 0 - 1.2"/s (0 - 30mm/s)

Detector
- Range / resolution: 32000 µin / .4 µin, 3200µin / .04µin, 320 µin / .004µin (up to 96000 µin with an optional stylus) {(800µm / 0.01µm, 80µm / 0.001µm, 8µm / 0.0001µm) (up to 2400µm with an optional stylus)}
- Detecting method: Skidless / skid measurement
- Measuring force: 0.75mN (low force type)
- Stylus tip: Diamond, 60°/2µmR (low-force type)
- Skid radius of curvature: 1.57" (40mm)
- Detecting method: Differential inductance

Base size (W x H): 23.6 x 17.7" (600 x 450mm) or 39.4 x 17.7" (1000 x 450mm)

Base material: Granite

*L = Measured length inch (mm)
**Recommended speed: under 5mm/s
If using higher speed, stylus tip may be chipped and/or accuracy may be worse, depending on surface condition.

Evaluation Capability: FORMTRACEPAK V5

Assessed profiles
P (primary profile), R (roughness profile), WC, WCA, WE, WEA, DIN4776 profile, envelope residual profile, roughness motif, waviness motif

Evaluation parameters
Ra, Rq, Rz, Ry, Rz(JIS), Ry(DIN), Rc, Rp, Rpmax, Rpi, Rv, Rvmax, Rvi, Rt, Rti, R3z, R3zi, R3y, S, Pc (Ppi), Sm, HSC, mr, δc, plateau ratio, mrd, Rk, Rpk, Rvk, Mr1, Mr2, Δa, Δq, λa, λq, Sk, Ku, Lo, Lr, A1, A2
Roughness motif parameters: Rx, R, AR, SR, SAR, NR, NCRX, CPM
Waviness motif parameters: Wte, Wx, W, AW SW, SAW, NW

Analysis graphs
ADC, BAC1, BAC2, power spectrum chart, auto-correlation chart, Walsh power spectrum chart, Walsh auto-correlation chart, slope distribution chart, local peak distribution chart, parameter distribution chart

Digital filter 2CR-75%, 2CR-50%, 2CR-75% (phase corrected), 2CR-50% (phase corrected), Gaussian-50%

Cutoff length*
λc: .001, .003, .01, .03, .1, .3, 1"
(0.025mm, 0.08mm, 0.25mm, 0.8mm, 2.5mm, 8mm, 25mm)
fl: .001, .003, .01, .03, .1, .3, 1"
(0.08mm, 0.25mm, 0.8mm, 2.5mm, 8mm, 25mm)
fh: .001, .003, .01, .03, .1, .3, 1"
(0.08mm, 0.25mm, 0.8mm, 2.5mm, 8mm)

Sampling length (L)*.001, .003, .01, .03, .1, .3, 1"
(0.025mm, 0.08mm, 0.25mm, 0.8mm, 2.5mm, 8mm, 25mm)

Data compensation functions
Tilt compensation, R-plane (curved surface) compensation, ellipse compensation, parabola compensation, hyperbola compensation, quadric curve automatic compensation, polynomial compensation, polynomial automatic compensation

*Arbitrary length can be specified in the range from .001" (0.025mm) to the maximum traverse length.

Surftest SV-3200

SERIES 178 — Surface Roughness Testers

SPECIFICATIONS

Models without X-axis inclination function

Model No.	SV-3200S4	SV-3200H4	SV-3200W4	SV-3200L4
Order No. (inch)	**178-424-11A**	**178-425-11A**	**178-426-11A**	**178-464-11A**
Order No. (inch)	**178-444-11A**	**178-445-11A**	**178-446-11A**	**178-484-11A**
Measuring force of detector	0.75mN	0.75mN	0.75mN	0.75mN
X-axis measuring range	4" (100mm)	4" (100mm)	4" (100mm)	4" (100mm)
Vertical travel	12" (300mm) power column	20" (500mm) power column	20" (500mm) power column	27.6" (700mm) power column
Granite base size (WxD)	23.6 x 17.7" (600 x 450mm)	23.6 x 17.7" (600 x 450mm)	39.4 x 17.7" (1000 x 450mm)	39.4 x 17.7" (1000 x 450mm)
Dimensions (main unit, WxDxH)	29.8 x 19.0 x 38.0" (756 x 482 x 966mm)	29.8 x 19.0 x 45.9" (756 x 482 x 1166mm)	45.5 x 19.0 x 46.3" (1156 x 482 x 1176mm)	45.5 x 19.0 x 56.5" (1156 x 482 x 1436mm)
Mass (main unit)	308 lbs (140kg)	330 lbs (150kg)	485 lbs (220kg)	595 lbs (270kg)

Model No.	SV-3200S8	SV-3200H8	SV-3200W8	SV-3200L8
Order No. (inch)	**178-427-11A**	**178-428-11A**	**178-429-11A**	**178-465-11A**
Order No. (inch)	**178-447-11A**	**178-448-11A**	**178-449-11A**	**178-485-11A**
Measuring force of detector	0.75mN	0.75mN	0.75mN	0.75mN
X-axis measuring range	8" (200mm)	8" (200mm)	8" (200mm)	8" (200mm)
Vertical travel	12" (300mm) power column	20"(500mm) power column	20" (500mm) power column	27.6" (700mm) power column
Granite base size (WxD)	23.6 x 17.7" (600 x 450mm)	23.6 x 17.7" (600 x 450mm)	39.4 x 17.7"(1000 x 450mm)	39.4 x 17.7"(1000 x 450mm)
Dimensions (main unit, WxDxH)	30.2 x 19.0 x 38.0" (766 x 482 x 966mm)	30.2 x 19.0 x 45.9" (766 x 482 x 1166mm)	45.9 x 19.0 x 46.3" (1166 x 482 x 1176mm)	45.5 x 19.0 x 56.5" (1156 x 482 x 1436mm)
Mass (main unit)	308 lbs (140kg)	330 lbs (150kg)	485 lbs (220kg)	595 lbs (270kg)

Optional Accessories

178-602-1: Reference Specimen (Supports ISO)

178-611: Reference Step Specimen (2µm, 10µm)
178-612: Reference Step Specimen (2µm, 10µm, 79µin, 394µin)
178-610: Step gage (1µm, 2µm, 5µm, 10µm)
178-047: Three-axis adjustment table (including 998291 precision V-block.)
178-016: Leveling table
178-042-1: Digimatic XY leveling table (25 x 25mm)
178-052-1: Digimatic XY leveling table (1 x 1")
178-043-1: XY leveling table (25 x 25mm)
178-053-1: XY leveling table (1 x 1")
178-019: Precision vise*
998291: Precision V-block*
181-902-10: V-block set with clamp (Max. workpiece dia.: 25mm)
181-901-10: V-block set with clamp (Max. workpiece dia.: 1")

(See page J-22/23.) Detectors, styli, and nosepieces
*Use with an XY leveling table

Optional Accessories

A wide range of peripherals are available to support various challenging measurement needs.

Y-axis Table
178-097 for multiple workpiece measurement
178-096 for 3D measurement
*Not a measuring axis, only for positioning.

3D-Auto Leveling Table
178-077
*Used together with **178-096**

Digital Advanced Tilting Unit
178-040
*Contact Sales Rep for details. Recommend to be installed in manufacturer's facility.

(See page J-25 for more accessories.)

178-071 (S-3000)
Standard Detector Holder

178-075 (S-3000CR)
Crank Rotary Type Detector Holder

178-074 (S-3000C)
Crank Type Detector Holder

178-076 (S-3000MR)
Manual Rotary Type Detector Holder

Mitutoyo

Surftest Extreme SV-3000CNC

SERIES 178 — CNC Surface Measuring Instruments

FEATURES

- High-accuracy CNC surface roughness measuring instrument allows surface roughness measurement in both axes.
- Each axes has the maximum drive speed of 200 mm/s, which permits high-speed positioning that may result in a large increase in the throughput of multiple-profile/multiple-workpiece measurement tasks.
- For models with the α-axis, it is possible to perform continuous measurement over horizontal and inclined surfaces by power-tilting the drive unit.
- For models with the Y-axis table, it is possible to expand the measuring range for multiple workpieces, etc., through positioning in the Y-axis direction.
- Using optional rotary table θ1 and θ2 designed to use with the CNC models enables it to expand the CNC measurement application range.
- Inclined plane measurements is possible through 2-axis simultaneous control in the X- and Y-axis directions.
- Since the detector unit incorporates an anti-collision safety device, the detector unit will automatically stop even if its main body collides with a workpiece or fixture.
- Supplied with an easy-to-operate Remote Box. The user can make any movement by selecting the required axis using the two joysticks. The current axis selection is easily identified by the icon on the key top.
- Communication with the data processing/analysis section is via USB.

SV-3000CNC w/ PC system and software
PC stand is not included, isolation stand is optional

SPECIFICATIONS

Model No.	SV-3000CNC		SV-3000CNC	
Order No. (100V - 120V)	**178-508-13**	**178-528-13**	**178-509-13**	**178-529-13**
X1-axis measuring range	8" (200mm)	8" (200mm)	8" (200mm)	8" (200mm)
Z2-axis vertical travel	12" (300mm)	20" (500mm)	12" (300mm)	20" (500mm)
Y-axis table unit	Installed	Installed	Installed	Installed
α-axis unit	—	—	Installed	Installed

Technical Data: SV-3000CNC

X1-axis
- Measuring range: 8" (200mm)
- Resolution: 1.97µin (0.05µm)
- Measurement method: Reflective-type linear encoder
- Drive speed: 7.87"/s (200mm/s) (CNC, max.)
  0 - 2.0"/s (0 - 50mm/s) (joystick)
- Measuring speed: .00078 - .078"/s (0.02 - 2mm/s)
- Traversing direction: Backward
- Traverse linearity: 20 µin/8" (0.5µm/200mm)

α-axis**
- Inclination angle: -45° to +10°
- Resolution: 0.000225°
- Rotating speed: 1rpm

Z2-axis (column)
- Vertical travel: 12" (300mm) 20"*(500mm)
- Resolution: 1.97µin (0.05µm)
- Measurement method: Reflective-type linear encoder
- Drive speed: 7.87"/s (200mm/s) (max., CNC)
  0 - 2.4"/s (0 - 60mm/s) (joystick)
- Base size (W x H): 29.5 x 23.6" (750 x 600mm)
- Base material: Granite

Detector
- Range / resolution: 32000 µin / .4 µin, 3200µin / .04µin,
  320 µin / .004µin
  (up to 96,000 µin with an optional stylus)
  {(800µm / 0.01µm, 80µm / 0.001µm,
  8µm / 0.0001µm)
  (up to 2400µm with an optional stylus)}
- Measuring force: 4mN (0.75mN) (low-force type)
- Stylus tip: Diamond, 90°/5µmR
  (60°/2µmR: low-force type)

Dimension (W x D x H): 31.5 x 24.4 x 39.4"
(800 x 620 x 1000mm)
31.5 x 24.4 x 47.2"
(800 x 620 x 1200mm)*

Mass 529 lbs (240kg) 551lbs (250kg)*
*High-column model

Y-axis table unit**
- Measuring range: 8" (200mm)
- Minimum reading : 1.97µin (0.05µm)
- Scale unit: Reflective-type Linear Encoder
- Drive speed: 7.87"/s (200mm/s) (max., CNC)
  0 - 2.4"/s (0 - 60mm/s) (joystick)

Maximum loading capacity: 44 lbs (20kg)
Traverse linearity 20µin/8" (0.5µm/200mm)
Linear displacement accuracy (at 20°C):
± (80+2L/4)µin {± (2+2L/100) µm}
L: Dimension between two measured points (mm)
- Table size: 7.87 x 7.87" (200 x 200mm)
- Dimensions (W x D x H): 12.6 x 25.4 x 4.1"
  (320 x 646 x 105mm)
- Mass: 77 lbs (35kg)

**Y-axis table included only as a factory installed option.

Optional Accessories

Vibration isolation stand
Vibration isolation mechanism: Diaphragm air spring
- Natural frequency : 2.5 - 3.5Hz
- Damping mechanism: Orifice
- Leveling mechanism: Automatic control with mechanical valves
- Air supply pressure: 0.4MPa

Allowable loading capacity: 772 lbs (350kg)
- Dimensions (W x D x H): 39.4 x 35.2 x 28.1"
  (1000 x 895 x 715mm)
- Mass: 617 lbs (280kg)

Surftest Extreme SV-M3000CNC

SERIES 178 — CNC Surface Measuring Instruments

Technical Data: SV-M3000CNC

X1-axis
- Measuring range: 8" (200mm)
- Resolution: 1.97µin (0.05µm)
- Measurement method: Reflective-type linear encoder
- Drive speed: 7.87"/s (200mm/s) (max., CNC)
  0 - 1.97"/s (0 - 50mm/s) (joystick)
- Measuring speed: .00078 - .08"/s (0.02 - 2mm/s)
- Traverse linearity: 20µin/8" (0.5µm/200mm)
  28µin/8" (0.7µm/200mm) (long-type detector)
  20µin/8" (0.5µm/200mm) (rotary-type detector, up/down direction)
  28µin/8" (0.7µm/200mm) (long-type detector, foward/backward direction)

α-axis
- Inclination angle: -45° to +10°
- Resolution: 0.000225°
- Rotating speed: 1rpm

Z2-axis (column)
- Vertical travel: 20"(500mm)
- Resolution: 1.97µin (0.05µm)
- Measurement method: Reflective-type linear encoder
- Drive speed: 7.87"/s (200mm/s) (CNC, max.)
  0 - 1.97"/s (0 - 50mm/s) (joystick)

Y-axis
- Measuring range: 32" (800mm)
- Resolution: 1.97µin (0.05µm)
- Measurement method: Reflective-type linear encoder
- Drive speed: 7.87"/s (200mm/s) (max., CNC)
  0 - 1.97"/s (0 - 50mm/s) (joystick)
- Measuring speed: .00078- .08"/s (0.02 - 2mm/s)
- Traverse linearity: 20µin/2" (0.5µm/50mm), 80µin/32" (2µm/800mm) 28µin/2" (0.7µm/50mm), 120µin/32" (3µm/800mm) (long-type detector) 28µin/2" (0.7µm/50mm), 120µin/32" (3µm/800mm) (rotary-type detector, up/down direction)

Base unit
- Size (W x H): 23.6 x 59.1" (600 x 1500mm)
- Material: Steel
- Loading capacity: 661 lbs (300kg)

Detector
- Range / resolution: 32000 µin / .4 µin, 3200µin / .04µin, 320 µin / .004µin (up to 96,000 µin with an optional stylus) {800µm / 0.01µm, 80µm / 0.001µm, 8µm / 0.0001µm (up to 2400µm with an optional stylus)}
- Detecting method: Skidless / skid measurement
- Measuring force: 4mN or 0.75mN (low-force type)
- Stylus tip: Diamond, 90°/5µmR (60°/2µmR: low-force type)
- Skid radius of curvature: 1.57" (40mm)
- Detecting method: Differential inductance

Dimension (W x D x H): 42.7 x 66.7 x 75.7" (1085 x 1695 x 1922mm)

Mass: 3527 lbs (1600Kg) (including vibration isolating unit)

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the standard in world metrology software
FORM

Software

FORMTRACEPAK V5

Enables control of the optional motor-driven Y-axis table and rotary table for realizing efficient measurement automation. You can also perform contour evaluation that allows free analysis of level differences, angle, pitch, area and other characteristics based on surface roughness data. In addition, analysis results can be saved in the "html","mhtml" or pdf format which allows Internet Explorer or MS-Word compatibility, allowing PC without layout editing programs to view analysis results.

Contour Measurement & Surface Roughness Measurement Screen

Report Layout Screen

SV-M3000CNC with personal computer system and software

* PC stand not included

FEATURES

- CNC Surface Roughness Tester covers measurement of large/heavy workpieces such as engine blocks, crankshafts, etc.
- In combination with the surface roughness detector rotating unit, S-3000AR (optional), it can perform continuous measurement over the bottom, top and side surfaces of a workpiece.
- Compatible with the optional large table for supporting a load of 220 lbs (100 kg) or a large θ2 table. Enables continuous automatic measurement of large-size workpieces.
- Suitable for automatic surface roughness measurement on large and heavy workpieces.
- Employs the column-moving type configuration that is not restricted by workpiece size. This is advantageous for measuring heavy workpieces, such as engine blocks, crankshafts, etc.
- Provides 31.5" (800mm) of Y-axis stroke. This makes it possible to measure multiple profiles on large workpieces.
- Load table has a self-contained structure to ensure that various size workpieces, jigs, auto-feed devices, etc., are easily accommodated and can be specified, if required, by special order.

SPECIFICATIONS

Model No.	SV-M3000CNC
Order No. (100V - 120V)	**178-549-1**
X1-axis measuring range	8" (200mm)
Z2-axis column travel range	20" (500mm)
Y-axis travel range	32" (800mm)
α-axis inclination angle	-45° (CCW), +10° (CW)

Mitutoyo

Formtracer SV-C3200 / SV-C4500

SERIES 525 — Surface Roughness / Contour Measuring System

SV-C3200L4 (with options)

SV-C3200S4 with personal computer system and software

FEATURES

- Dramatically increased drive speed (X axis: 3.1"/s (80mm/s), Z2 axis column: 1.2"/s (30mm/s) further reduces total measurement time.
- In order to maintain the traverse linearity specification for an extended period of time, Mitutoyo has adopted highly rigid ceramic guides that combine the characteristics of smallest secular change and remarkable resistance to abrasion.
- The drive unit (X-axis) and column (Z2-axis) are equipped with a high-accuracy linear encoder (ABS type on Z2-axis). This improves reproducibility of continuous automatic measurement of small holes in the vertical direction and repeated measurement of parts which are difficult to position.

Automatic Measurement

- A wide range of optional peripherals are available to support quick and easy CNC operation.

Y-axis Table

Rotary Table θ1

Rotary Table θ2

Surface Roughness Measurement

- Traverse linearity: (2+1L)µin (±(0.05+0.001L) µm*)
  Designed to handle workpieces calling for high accuracy.
  *S4, H4, W4 types, L = Drive length inch (mm)
- Compliant with JIS '82/'94/'01, ISO, ANSI, DIN, VDA, and other international surface roughness standards.
- Equipped with a standard high accuracy detector (0.75mN/4mN measuring force) providing a resolution down to 0.004µin (0.0001µm).

Contour Drive Measurement

- X axis accuracy: ± (31.5+10L)µin (±(0.8+0.01L)µm*)
  Z1-axis accuracy: ± (31.5+l20Hl)µin (±(0.8+l2Hl/100)µm*)
  Designed to handle workpieces calling for high accuracy.
  * SV-C4500S4, H4, W4 types, L = Drive length, H = Measurement height inch (mm)
- The contour drive unit of SV-C4500 series instruments can continuously measure in the upward and downward directions without the need to change the arm orientation or reset the workpiece, when combined with the double cone-end stylus (a new product with contact points in the upward and downward directions).

Technical Data: Common

Power supply:	100 – 240VAC ±10%, 50/60Hz
Power consumption:	400W (main unit only)

Technical Data: Contour Measurement

X-axis

Measuring range:	4" (100mm) or 8" (200mm)
Resolution:	1.97µin (0.05µm)
Measurement method:	Reflective-type linear encoder
Drive speed:	3.1"/s (80mm/s) and manual
Measuring speed:	.00078 - .78"/s (0.02 - 20mm/s)*

*Recommended speed: under 5mm/s
If using higher speed, stylus tip may be chipped and/or accuracy may be worse, depending on surface condition.

Measuring direction:	Forward/backward
Traverse linearity:	32µin/4"(0.8µm/100mm) 79µin/8" (2µm/200mm) *with the X axis in horizontal orientation
Linear displacement:	±(32+10L)µin (±0.8+0.01L) µm (SV-C3200S4, H4, W4)
accuracy (at 20°C)	±(32+10L)µin (±0.8+0.01L)µm (SV-C4500S4, H4, W4) ±(32+20L)µin (±0.8+0.02L)µm (SV-C3200S8, H8, W8) ±(32+20L)µin (±0.8+0.02L)µm SV-C4500S8, H8, W8) * L = Drive length inch (mm)
Inclination range:	±45°

Z2-axis (column)

Vertical travel:	12"(300mm) or 20"(500mm)
Resolution:	39.4µin (1µm)
Measurement method:	ABSOLUTE linear encoder
Drive speed:	0 - 1.2"/s (0 - 30mm/s) and manual

Z1-axis (detector unit)

Measuring range:	±1.2" (±30mm)
Resolution:	1.57µin (0.04µm) (SV-C3200 series), .78µin (0.02µm) (SV-C4500 series)
Measurement method:	Linear encoder (SV-C3200 series), Laser hologage (SV-C4500 series)
Linear displacement:	±(63+l20lH) µin (±(1.4+l2Hl/100)µm) (SV-C3200 series)
accuracy (at 20°C)	±(31.5+l20Hl) µin (±(0.8+l2Hl/100)µm) (SV-C4500 series) *H: Measurement height from the horizontal position (mm)
Stylus up/down operation:	Arc movement
Face of stylus:	Upward/downward (SV-C3200) Upward/downward (Direction switch by Formtracepak) (SV-C4500)
Measuring force:	30mN (SV-C3200) 10, 20, 30, 40, 50mN (SV-C4500) * As for SV-C4500, set the measurement force with Formtracepak.
Traceable angle:	Ascent: 77°, descent: 83° (using the standard stylus provided and depending on the surface roughness)
Stylus tip	Radius: 25µm, carbide tip

Technical Data: Surface Roughness Measurement

X1-axis

Measuring range:	4" (100mm) or 8" (200mm)
Resolution:	1.97µin (0.05µm)
Measurement method:	Linear encoder
Drive speed:	3.1"/s (80mm/s)
Traversing direction:	Backward
Traverse linearity:	(2+1L) µin (0.05+1L/1000)µm (S4, H4, W4 types) 20µin/8"(0.5µm/200mm) (S8, H8, W8 types)

Z2-axis (column)

Vertical travel:	12" (300mm) or 20" (500mm)
Resolution:	39.4 µin (1µm)
Measurement method:	ABSOLUTE linear encoder
Drive speed:	0 - 1.2"/s (0 - 30mm/s) and manual

Detector

Range / resolution:	32000 µin / .4 µin, 3200µin / .04µin, 320 µin / .004µin (up to 96000 µin with an optional stylus) {800µm / 0.01µm, 80µm / 0.001µm, 8µm / 0.0001µm (up to 2400µm with an optional stylus)}
Detecting method:	Skidless / skid measurement
Measuring force:	0.75mN (low force type)
Stylus tip:	Diamond 60°/2µmR (low force type)
Skid radius of curvature:	1.57" (40mm)
Detecting method:	Differential inductance

Formtracer SV-C3200 / SV-C4500

SERIES 525 — Surface Roughness / Contour Measuring System

SPECIFICATIONS

Model No.	SV-C3200S4	SV-C3200H4	SV-C3200W4	SV-C3200L4
Order No. (inch)	**525-491-11A**	**525-492-11A**	**525-493-11A**	**525-494-11A**
Model No.	SV-C4500S4	SV-C4500H4	SV-C4500W4	SV-C4500L4
Order No. (inch)	**525-451-11A**	**525-452-11A**	**525-453-11A**	**525-454-11A**
X1-axis measuring range	4" (100mm)	4" (100mm)	4" (100mm)	4" (100mm)
Measuring force of detector	0.75mN	0.75mN	0.75mN	0.75mN
Vertical travel	12" (300mm) power column	20" (500mm) power column	20" (500mm) power column	27.6" (700mm) power column
Granite base size (WxD)	23.6 x 17.7" (600 x 450mm)	23.6 x 17.7" (600 x 450mm)	39.4 x 17.7" (1000 x 450mm)	39.4 x 17.7" (1000 x 450mm)
Dimensions (main unit, WxDxH)	39.2 x 22.6 x 38.0" (996 x 575 x 966mm)	39.2 x 22.6 x 46.3" (996 x 575 x 1176mm)	55.4 x 22.6 x 46.3" (1396 x 575 x 1176mm)	55.4 x 22.6 x 56.1" (1396 x 575 x 1426mm)
Mass (main unit)	308 lbs (140kg)	330 lbs (150kg)	485 lbs (220kg)	595 lbs (270kg)

Model No.	SV-C3200S8	SV-C3200H8	SV-C3200W8	SV-C3200WL8
Order No. (inch)	**525-496-11A**	**525-497-11A**	**525-498-11A**	**525-499-11A**
Model No.	SV-C4500S8	SV-C4500H8	SV-C4500W8	SV-C4500L8
Order No. (inch)	**525-456-11A**	**525-457-11A**	**525-458-11A**	**525-459-11A**
X1-axis measuring range	8" (200mm)	8" (200mm)	8" (200mm)	4" (100mm)
Measuring force of detector	0.75mN	0.75mN	0.75mN	0.75mN
Vertical travel	12" (300mm) power column	20" (500mm) power column	20" (500mm) power column	27.6" (700mm) power column
Granite base size (WxD)	23.6 x 17.7" (600 x 450mm)	23.6 x 17.7" (600 x 450mm)	39.4 x 17.7" (1000 x 450mm)	39.4 x 17.7" (1000 x 450mm)
Dimensions (main unit, WxDxH)	39.6 x 22.6 x 38.0" (1006 x 575 x 966mm)	39.6 x 22.6 x 46.3" (1006 x 575 x 1176mm)	55.4 x 22.6 x 46.3" (1406 x 575 x 1176mm)	55.4 x 22.6 x 56.1" (1396 x 575 x 1426mm)
Mass (main unit)	308 lbs (140kg)	330 lbs (150kg)	485 lbs (220kg)	595 lbs (270kg)

MiCAT
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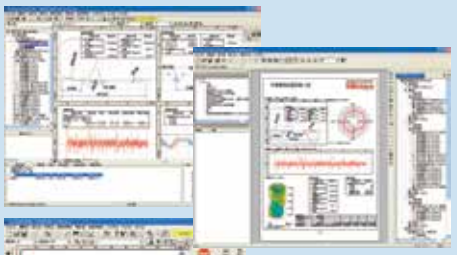
the standard in world metrology software
FORM

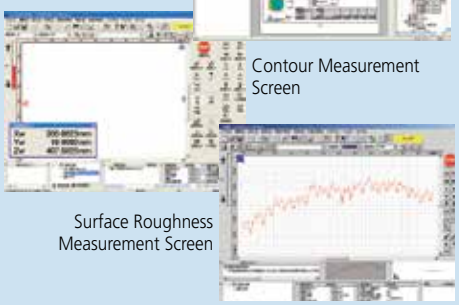
Software

FORMTRACEPAK V5

Enables control of the optional motor-driven Y-axis table and rotary table for realizing efficient measurement automation. You can also perform contour evaluation that allows free analysis of level differences, angle, pitch, area and other characteristics based on surface roughness data. In addition, analysis results can be saved in the "html", "mhtml" or pdf format which allows Internet Explorer or MS-Word compatibility, allowing PC without layout editing programs to view analysis results.



Contour Measurement Screen



Surface Roughness Measurement Screen

Optional Accessories

A wide range of peripherals are available to support various challenging measurement needs.

Y-axis Table
178-097 for multiple workpiece measurement
178-096 for 3D measurement
*Not a measuring axis, only for positioning.

3D-Auto Leveling Table
178-077
*Used together with **178-096**

(See page J-25 for more accessories.)

178-071 (S-3000)
Standard Detector Holder

178-091 (S-3000CR)
Crank Rotary Type Detector Holder

178-074 (S-3000C)
Crank Type Detector Holder

178-092 (S-3000MR)
Manual Rotary Type Detector Holder

Mitutoyo

Formtracer Extreme SV-C4500CNC

SERIES 525 — Surface Roughness/Form Measuring Instrument

SV-C4500CNC with recommended machine vibration stand

* PC stand not included

Surface roughness detector

Contour Z-axis detector

FEATURES

- High-accuracy CNC surface roughness/form measuring instrument allows both measurement of surface roughness and form/contour with one unit.
- Each axes has the maximum drive speed of 7.87"/s (200 mm/s), which permits high-speed positioning that may result in a large increase in the throughput of multiple-profile/multiple-workpiece measurement tasks.
- For models with the α axis, it is possible to perform continuous measurement over horizontal and inclined surfaces by power-tilting the detector unit.
- For models with the Y-axis table, it is possible to expand the measuring range for multiple workpieces, etc., through positioning in the Y-axis direction.
- When combined with the double cone-end stylus (a new product with diametrically opposed contact points), the instrument can continuously measure in the upward and downward directions without the need to change the arm orientation or reset the workpiece fixturing.
- The measuring force can be switched among five levels (upward and downward) from the data-processing program (Formtracepak).
- Enables inclined plane measurements through 2-axis simultaneous control in the X- and Y-axis directions.
- When the detector for form/contour measurement is replaced with that for surface roughness measurement, or vice versa, it is a simple, one-touch replacement without re-routing of the connecting cables.
- Since the Z1-axis detector incorporates an anti-collision safety device, the detector unit will automatically stop even if its main body collides with a workpiece or fixture.
- Supplied with an easy-to-operate Remote Box. The user can make any movement by selecting the required axis using the two joysticks. The current axis selection is easily identified by the icon on the key top.
- Communication with the Data Processing/Analysis section is via USB.

Technical Data: Common

Base size (W x H):	31 x 39.4" (800 x 1000mm) Type S 34 x 47.2" (800 x 1200mm) Type H
Base material:	Granite
Mass:	529 lbs (240kg) Type S 551 lbs (250kg) Type H
Power supply:	100 – 120VAC ±10%, 50/60Hz
Power consumption:	500W (main unit only)

Technical Data: Contour Measurement

X1-axis

Measuring range:	8" (200mm)
Resolution:	1.97µin (0.05µm)
Measurement method:	Reflective-type linear encoder
Drive speed:	7.87"/s (200mm/s) (max., CNC) 0 - 2"/s (0 - 50mm/s) (joystick)
Measuring speed:	.00078 - .08"/s (0.02 - 2mm/s)
Measuring direction:	Forward / Backward
Traverse linearity:	80µin / 8"(2µm/200mm) *with the X axis in horizontal orientation
Linear displacement accuracy (at 20°C):	±(0.8+4L/200)mm * L = Drive length (mm)

α-axis* Depends on Code #

Inclination angle:	-45° to +10°
Resolution:	0.000225°
Rotating speed:	1rpm

Z2-axis (column)

Vertical travel:	12" or 20" (300mm or 500mm)
Resolution:	1.97µin (0.05µm)
Measurement method:	Reflective-type linear encoder
Drive speed:	7.87"/s (200mm/s) (max., CNC) 0 - 2."/s (0 - 50mm/s) (joystick)

Z1-axis (detector unit)

Measuring range:	±1.2" (±30mm)
Resolution:	.787µin (0.02µm)
Measurement method:	Reflective Type detector unit
Linear displacement:	
Accuracy (at 20°C)	±(32+110H)µin (±(0.8+I2HI/100)µm) *H: Measurement height from the horizontal position (mm) w/o α-axis: ±(1.5+10HI/1000)µm
Stylus up/down operation:	Arc movement
Face of stylus:	Downward
Measuring force:	10, 20, 30, 40, 50mN
Traceable angle:	Ascent: 70°, descent: 70° (using the standard stylus provided and depending on the surface roughness)
Stylus tip	Radius: 25µm, carbide tip

Technical Data: Surface Roughness Measurement

X1-axis

Measuring range:	8" (200mm)
Resolution:	1.97µin (0.05µm)
Measurement method:	Reflective-type linear encoder
Drive speed:	7.87"/s (200mm/s) (max., CNC) 0 - 2"/s (0 - 50mm/s) (joystick)
Measuring speed:	.00078 - .08"/s (0.02 - 2mm/s)
Traversing direction:	Pulling
Traverse linearity:	20µin/8" (0.5µm/200mm)

α-axis* Depends on Code #

Inclination angle:	-45° to +10°
Resolution:	0.000225°
Rotating speed:	1rpm

Z2-axis (column)

Vertical travel:	12" or 20" (300mm or 500mm)
Resolution:	1.97µin (0.05µm)
Measurement method:	Reflective-type linear encoder
Drive speed:	7.87"/s (200mm/s) (max., CNC) 0 - 2"/s (0 - 50mm/s) (joystick)

Detector (optional)

Range / resolution:	32000 µin / .4 µin, 3200µin / .04µin, 320 µin / .004µin (up to 96000 µin with an optional stylus) {800µm / 0.01µm, 80µm / 0.001µm, 8µm / 0.0001µm (up to 2400µm with an optional stylus)}
Detecting method:	Skidless / skid measurement
Measuring force:	0.75mN
Stylus tip:	60°/2µmR
Skid radius of curvature:	1.57" (40mm)
Detecting method:	Differential inductance

Formtracer Extreme SV-C4500CNC

SERIES 525 — Surface Roughness/Form Measuring Instrument

Y-axis table unit**

Measuring range: 8" (200mm)
Minimum reading : 1.97µin (0.05µm)
Scale unit: Reflective-type linear encoder
Drive speed: 200mm/s (max., CNC)
0 - 2"/s (0 - 50mm/s) (joystick)
Maximum loading capacity: 44 lbs (20kg)
Traverse linearity 20µin/8" (0.5µm/200mm) Surface roughness
80µin/8" (2µm/200mm) contour
Linear displacement accuracy (at 20°C):
± (80+20L)µin{± (2+2L/100) µm}
contour mode
L: Dimension between two measured points (mm)
Table size: 7.8 x 7.8"(200 x 200mm)
Dimensions (W x D x H): 2.6 x 25.4 x 4.1"
(320 x 646 x 105mm)
Mass: 77 lbs (35kg)

**Y-axis table included only as a factory installed option.

Optional Accessories

Machine vibration stand: 12AAE032

Vibration isolation mechanism: Diaphragm air spring
Natural frequency : 2.5 - 3.5Hz
Damping mechanism: Orifice
Leveling mechanism: Automatic control with mechanical valves
Air supply pressure: 0.4Mpa
Allowable loading capacity: 772 lbs (350kg)
Dimensions (W x D x H): 39.4 x 35.2 x 28.1"
(1000 x 895 x 715mm)
Mass: 617 lbs (280kg)

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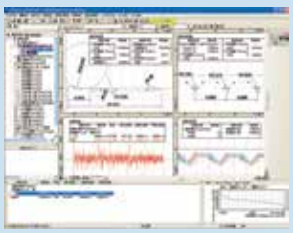
the standard in world metrology software
FORM

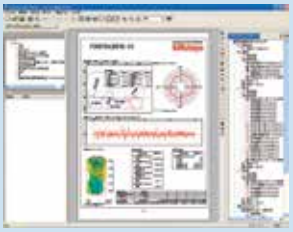
Software

FORMTRACEPAK V5

Enables control of the optional motor-driven Y-axis table and rotary table for realizing efficient measurement automation. You can also perform contour evaluation that allows free analysis of level differences, angle, pitch, area and other characteristics based on surface roughness data. In addition, analysis results can be saved in the "html", "mhtml" or pdf format which allows Internet Explorer or MS-Word compatibility, allowing PC without layout editing programs to view analysis results.



Contour Measurement and Surface Roughness Measurement Screen



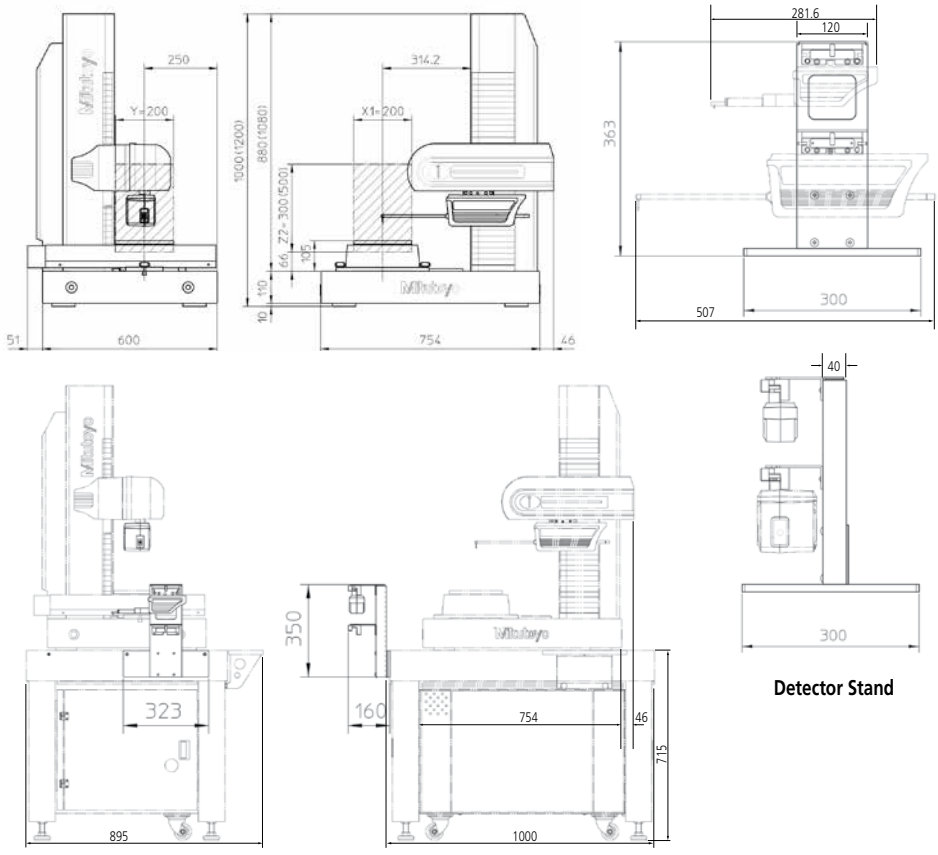
Report Layout Screen

SPECIFICATIONS

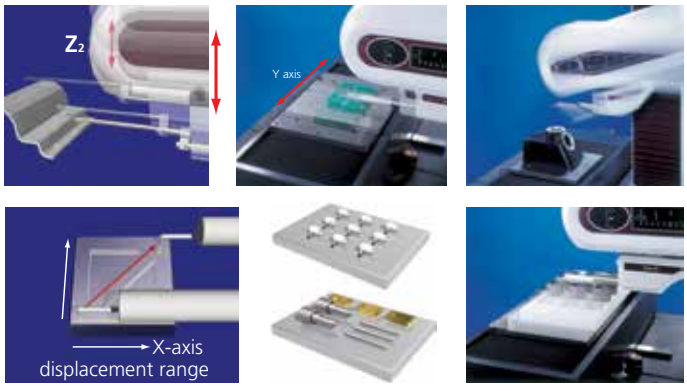
Model No.	SV-C4500S CNC	SV-C4500H CNC
Order No. (100V - 120V)	**525-674-1**	**525-694-1A**
X1-axis measuring range	8" (200mm)	8" (200mm)
Z2-axis vertical travel	12" (300mm)	20"(500mm)
Y-axis table unit	Installed	Installed
α-axis unit	Installed	Installed
Granite base size (WxD)	29.5 x 23.6"(750 x 600mm)	29.5 x 23.6"(750 x 600mm)
Dimensions (main unit, WxDxH)	31.5 x 24.4 x 39.4"(800 x 620 x 1000mm)	31.5 x 24.4 x 47.2"(800 x 620 x 1200mm)
Mass (main unit)	529 lbs (240kg)	551 lbs (250kg)

DIMENSIONS

Unit: mm



Detector Stand



Mitutoyo

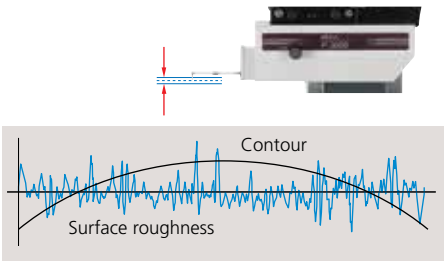
Formtracer CS-3200

SERIES 525 — Form Measuring Instruments

CS-3200S4 with personal computer system and software
* PC stand not included.

FEATURES

- Highest measurement accuracy in its class.
  X axis: ±(1+0.01L)µm
  Z1 axis: ±(1.5+l2Hl/100)µm
- To detect surface roughness and contour in a single measurement the Z1-axis detector unit of CS-3200S4 has a wide measuring range and high resolution of 5mm / 0.08µm to 0.05mm / 0.0008µm.



- In order to maintain the traverse linearity specification for an extended period of time, Mitutoyo has adopted highly rigid ceramic guides that combine the characteristics of smallest secular change and remarkable resistance to abrasion.
- Drastically increased drive speed further reduces total measurement time.
  X axis: 80mm/s, Z2 axis: 20mm/s
- To enhance safety during fast traverse, the Z-axis detector unit incorporates a safety device (Automatic Stop-On-Collision Mechanism).
- The detector unit can be extended to avoid interference between the drive unit and workpiece. The measuring range is shifted to the left by 2.76" (70mm).

- Incorporation of an ABS scale in the Z2 axis eliminates the need for origin point re-setting conventionally required for every step of repeated measurements over step or multiple sections.
- Small holes and inclined planes can be efficiently measured using the inclined X-axis drive unit and fine-feed handles on the X and Z2 axes.
- All detector and drive unit cables are housed inside the main unit to eliminate any risk of abrasion and guarantee trouble-free, high-speed operation.
- Orientation of the drive unit can be inclined by ±45°. This allows CS-3200 to measure an inclined surface quickly.

ABSOLUTE®
Absolute System Patented by MITUTOYO

Technical Data: Contour Measurement

X1-axis
- Measuring range: 4" (100mm)
- Resolution: 1.97µin (0.05µm)
- Measurement method: Reflective-type linear encoder
- Drive speed: 0 - 3.1"/s (0 - 80mm/s) and manual
- Measuring speed: .00078 - .00787"/s (0.02 - 0.2mm/s) (surface roughness) 0.00078 - 0.0787"/s (0.02 - 2mm/s) (contour)
- Measuring direction: Forward / Backward
- Traverse linearity: 8µin/4" (16µin/4") [0.2µm/100mm (0.4µm/100mm)] ( ): at the protruded detector position *with the X axis in horizontal orientation
- Linear displacement accuracy (at 20°C): ± (32+10L)µin {±(0.8+0.01L)µm} * L = Drive length (mm)
- Inclination range: ±45°

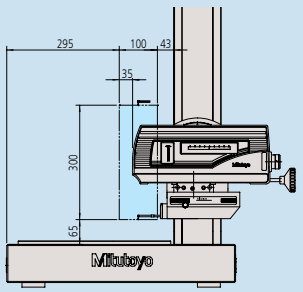
Z2-axis (column)
- Vertical travel: 12" (300mm)
- Resolution: 39.4µin (1µm)
- Measurement method: ABSOLUTE linear encoder
- Drive speed: 0 - .78"/s (0 - 20mm/s) and manual

Z1-axis (detector unit)
- Measuring resolution / range: 3µin/.2", .3µin/.02", .03µin/.002" (0.08µm/5mm, 0.008µm/0.5mm, 0.0008µm/0.05mm)
- Measurement method: Differential inductance method
- Linear displacement Accuracy (at 20°C): ±(60+20H)µin ±(1.5+2H/100)µm *H: Measurement height from the horizontal position (mm)
- Stylus up/down operation: Arc movement
- Face of stylus: Downward
- Measuring force: 0.75mN
- Traceable angle: Ascent: 65°, descent: 65° (using the standard stylus provided and depending on the surface roughness)
- Stylus tip: Radius: 2µm, diamond
- Base size (W x H): 23.6 x 17.7" (600 x 450mm)
- Base material: Granite
- Mass: 309 lbs (140kg) (main unit)
- Power supply: 100 – 240VAC ±10%, 50/60Hz
- Power consumption: 400W (main unit only)

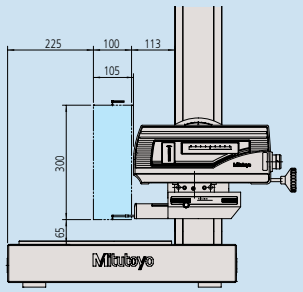
Protrusion of Detector Position

Normal detector position

Unit: mm



When detector is maximally extended
(Extended by 70mm from normal position)



Formtracer CS-3200

SERIES 525 — Form Measuring Instruments

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

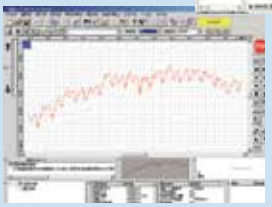
Software

FORMTRACEPAK6000

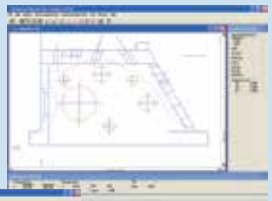
Enables control of the optional motor-driven Y-axis table and rotary table for realizing efficient measurement automation. You can also perform contour evaluation that allows free analysis of level differences, angle, pitch, area and other characteristics based on surface roughness data. In addition, you can create an original inspection certificate by setting the print format to suit your particular requirements.

Measuring instrument control

Contour analysis



Surface roughness analysis



Design data creation (CAD file import)

Contour verification

Inspection certificate creation

Main Unit Startup System

This machine incorporates a startup system (relocation detection system), which disables operation when an unexpected vibration is applied or the machine is relocated. Be sure to contact your nearest Mitutoyo prior to relocating this machine after initial installation.

SPECIFICATIONS

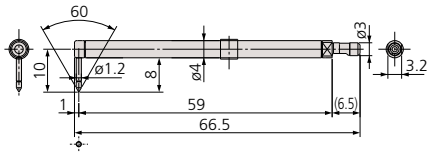
Model No.	CS-3200S4
Order No. (inch)	**525-411A**
X1-axis measuring range	4" (100mm)
Z2-axis vertical travel	12" (300mm)

Stylus

(Unit: inch (mm))

Standard stylus: No. 12AAD554

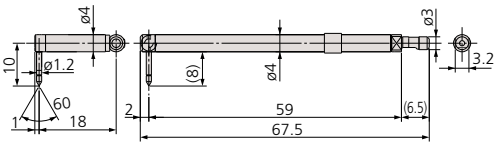
Tip radius: 2 µm
Tip angle: 60° cone
Tip material: Diamond



For contour/surface roughness measurement
Measurable depth: .28" (7mm) max.

Eccentric stylus: No. 12AAD558

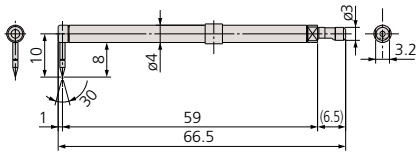
Tip radius: 2 µm
Tip angle: 60° cone
Tip material: Diamond



For contour/surface roughness measurement
Measurable offset length: .60" (15mm)

Cone stylus: No. 12AAD552

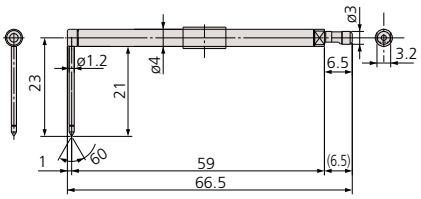
Tip radius: 25 µm
Tip angle: 30° cone
Tip material: Sapphire



For contour measurement
Measurable depth: .28" (7mm) max.

Deep Groove stylus: No. 12AAD560

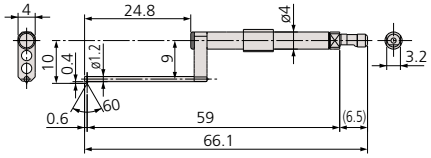
Tip radius: 2 µm
Tip angle: 60° cone
Tip material: Diamond



For contour/surface roughness measurement
Measurable depth: .79" (20mm) max.

Small hole stylus: No. 12AAD556

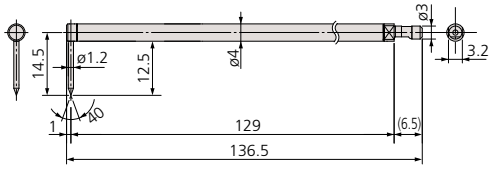
Tip radius: 2 µm
Tip angle: 60° cone
Tip material: Diamond



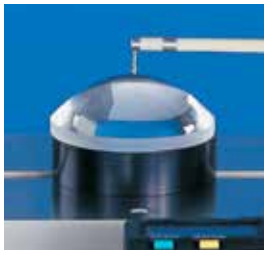
For contour/surface roughness measurement
Applicable hole: ø.08" (ø2mm) min.

2x-long stylus: No. 12AAD562

Tip radius: 5 µm
Tip angle: 40° cone
Tip material: Diamond



For contour/surface roughness measurement
Measurable depth: .39" (10mm) max.



Measuring lens

Measuring ball screw

Measuring bearing ring

Mitutoyo

Formtracer Extreme CS-5000CNC / CS-H5000CNC

SERIES 525 — CNC Form Measuring Instruments

CS-H5000CNC with personal computer system and software

* PC stand not included

Remote box

Wide range detector employing active control technology

FEATURES

- High-accuracy stylus-type CNC surface measuring instrument allows simultaneous measurement of surface roughness and form/contour.
- The X1 axis has a maximum drive speed of 1.57"/s (40 mm/s) and Z2 axis has a maximum drive speed of 7.87"/s (200 mm/s). This permits high-speed positioning that may result in a large increase in the throughput of multiple-profile / multiple-workpiece measurement tasks.
- A Mitutoyo Laser Holoscale is incorporated in the X1 axis and Z1 axis so that high resolution (X1 axis: 6.25nm, Z1 axis: 4nm/8nm) is achieved and batch measurement of form / contour and surface roughness can be made.
- The active control method is employed for the Z1-axis detector to implement a wide-range measurement capability wherein the variation in dynamic measuring force is restricted.
- Since the Z1-axis detector incorporates an anti-collision safety device, the detector unit will automatically stop even if its main body collides with 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.
- For models with the Y-axis table, it is possible to expand the measuring range for multiple workpieces, etc., through positioning in the Y-axis direction.
- Supplied with the easy-to-operate Remote Box, the user can make any movement by selecting the required axis using the two joysticks. The current axis selection is easily identified by the icon on the key top.
- Uses USB for communicating with the Data Processing / Analysis Unit (optional).

Technical Data:

X1 axis

Measuring range:	8" (200mm)
Resolution:	0.25µin (0.00625µm)
Measurement method:	Laser Holoscale
Drive speed:	Max. 1.57"/s (40mm/s) (in CNC mode) 0 - 1.57"/s (0 - 40mm/s) (in joystick control mode)
Measuring speed:	.0008 - .008"/s (0.02 - 0.2mm/s) (surface roughness) .0008 - .08"/s (0.02 - 2mm/s) (form/contour)
Measuring direction:	Forward / Backward
Traverse linearity:	(4+1.5L)µin {(0.1+0.0015L)µm} with standard stylus (8+1.5L)µin {(0.2+0.0015L)µm} with 2X-long stylus
*Traverse linearity:	(2+3L)µin {(0.05+0.0003L)}µm with standard stylus (4+1.5L)µin {(0.1+0.0015L)}µm with 2X-long stylus
Linear displacement accuracy ±(20°C):	±(12+2L)µin {±(0.3+0.002L)µm}
*Linear displacement accuracy ±(20°C):	±(2.8+6.3+L)µin {±(0.16+0.001L)µm} L = Measured length inch (mm)

Z1 axis

Measuring range:	.47" (12mm) (with standard stylus) .94" (24mm) (with 2X-long stylus)
Resolution:	.16µin (0.004µm) (with standard stylus) .32µin (0.008µm) (with 2X-long stylus)
*Resolution:	.03µin (0.0008µm) (with standard stylus) .06µin (0.0016µm) (with 2X-long stylus)
Stylus up/down:	Arc movement
Measurement method:	Transmission-type laser linear encoder
Linear displacement accuracy (20°C):	±(12+120H)µin {±(0.3+I0.02HI)µm}
*Linear displacement accuracy (20°C):	±(2.8+120H)µin {±(0.07+I0.02HI)µm} H = Measured height inch (mm)
Measuring force:	4mN (with standard stylus) 0.75mN (with 2X-long stylus)
Traceable angle:	60° for ascent, 60° for descent (Depending on the workpiece surface condition)
Stylus tip: (ball stylus)	Radius: 5µm, angle: 40°, diamond (Radius: 0.25mm, sapphire)
Face of stylus:	Downward

Z2 axis (column unit)

Measuring range:	12" (300mm) (20" (500mm) high column type)
Resolution:	1.97µin (0.05µm)
Measurement method:	Reflective-type linear encoder
Drive speed:	Max. 7.87"/s (200mm/s) (in CNC mode) 0 - 1.97"/s (0 - 50mm/s) (in joystick control mode)
Base size (W x D):	29.5 x 23.6" (750 x 600mm)
Base material:	Granite
Dimension (W x D x H):	31.5 x 24.4 39.4" (800 x 620 x 1000mm) 31.5 x 24.4 x 47.2" (800 x 620 x 1200mm: high column type)
Mass:	529 lbs (240kg) 551 lbs (250kg): high column type))

*CS-H5000CNC model in red.

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

Formtracer Extreme CS-5000CNC / CS-H5000CNC

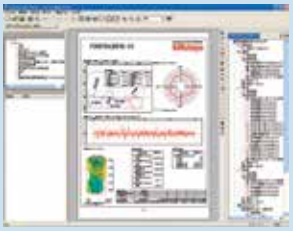
SERIES 525 — CNC Form Measuring Instruments

Software

FORMTRACEPAK V5
Enables control of the optional motor-driven Y-axis table and rotary table for realizing efficient measurement automation. You can also perform contour evaluation that allows free analysis of level differences, angle, pitch, area and other characteristics based on surface roughness data. In addition, analysis results can be saved in the "html", "mhtml" or pdf format which allows Internet Explorer or MS-Word compatibility, allowing PC without layout editing programs to view analysis results.

Contour Measurement and Surface Roughness Measurement Screen

Report Layout Screen



ASLPAK (optional software)
Aspherical lens analysis program recommended to be used with CS-H5000CNC and CS-5000CNC models. To make full use of software functions, optional accessories such as y-axis table, 3DALT and theta θ-1 table are required. The functions can be restricted without the optional accessories.

SPECIFICATIONS

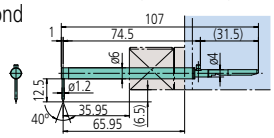
Model No.	CS-5000CNC	CS-5000CNC
Order No. (100V - 120V)	**525-727-13**	**525-729-13**
X1-axis measuring range	8" (200mm)	8" (200mm)
Z2-axis vertical travel	12" (300mm)	12" (300mm)
Y-axis table unit	—	Installed
α-axis unit	Installed	Installed

Model No.	CS-5000CNC	CS-5000CNC
Order No. (100V - 120V)	**525-747-13**	**525-749-13**
X1-axis measuring range	8" (200mm)	8" (200mm)
Z2-axis vertical travel	20" (500mm)	20" (500mm)
Y-axis table unit	—	Installed
α-axis unit	Installed	Installed

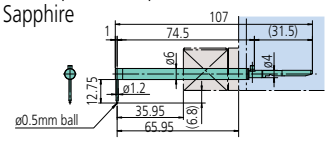
Model No.	CS-H5000CNC	CS-H5000CNC	CS-H5000HCNC	CS-H5000HCNC
Order No. (100V - 120V)	**525-776-13**	**525-777-13**	**525-706-13**	**525-707-13**
X1-axis measuring range	8" (200mm)	8" (200mm)	8" (200mm)	8" (200mm)
Z2-axis vertical travel	12" (300mm)	12" (300mm)	20" (500mm)	20" (500mm)
Y-axis table unit	—	Installed	—	Installed

Stylus

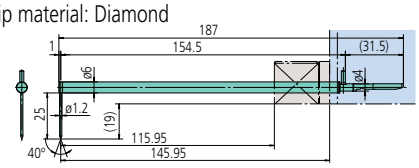
12AAD543*1**:** Standard-length stylus (tip radius: 5µm)
12AAJ037*2**:** For CS-H5000CNC (tip radius: 5µm)
Tip material: Diamond



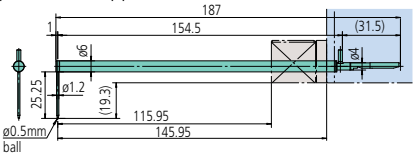
12AAD544*1*2**:** Standard-length ball stylus (tip radius: 5µm)
Tip material: Sapphire



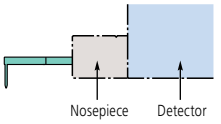
12AAD545*1**:** Double-length stylus (tip radius: 5µm)
12AAJ039*2**:** For CS-H5000CNC (tip radius: 5µm)
Tip material: Diamond



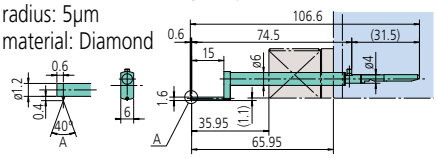
12AAD546*1*2**:** Double-length ball stylus
Tip material: Sapphire



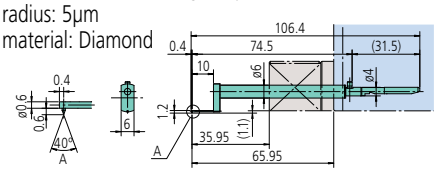
*1: Standard accessory of CS-5000CNC
*2: Standard accessory of CS-H5000CNC



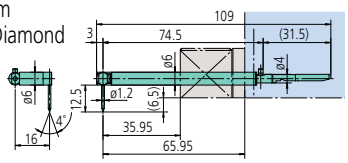
12AAD651: Standard-length stylus for small hole
Tip radius: 5µm
Tip material: Diamond



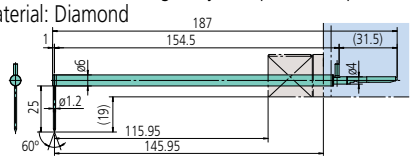
12AAD652: Standard-length stylus for extra-small hole
Tip radius: 5µm
Tip material: Diamond



12AAD653: Standard-length eccentric stylus
Tip radius: 5µm
Tip material: Diamond



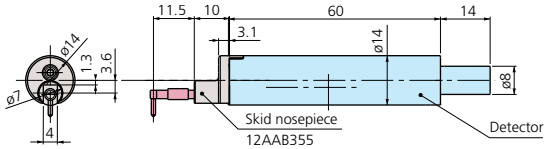
12AAJ041*2**:** Double-length stylus (tip radius: 2µm)
Tip material: Diamond



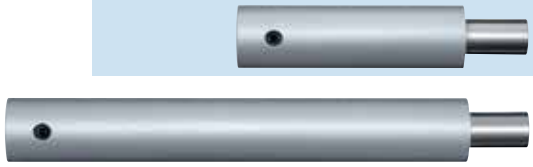
Mitutoyo

Optional Styli for Surface Roughness Measurement

Compatible with SJ-410, SJ-500, SV-2100, SV-3100, SV-3000CNC, SV-M3000CNC, SV-C3200, SV-C4500 Series



Detector (0.75mN): **178-396-2**
Detector (4mN): **178-397-2**

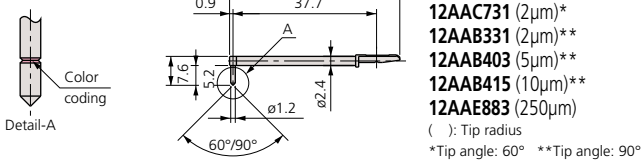


Extension rods
(12AAG202: 50mm, 12AAG203: 100mm)

Styli

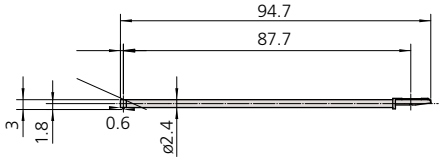
Unit: mm

Standard stylus



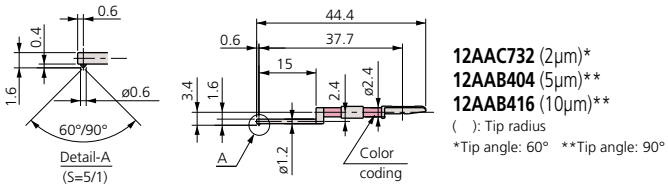
12AAE882 (1µm)*
12AAE924 (1µm)**
12AAC731 (2µm)*
12AAB331 (2µm)**
12AAB403 (5µm)**
12AAB415 (10µm)**
12AAE883 (250µm)
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

2X long for deep hole



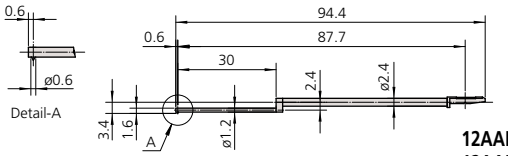
12AAE898 (2µm)*
12AAE914 (5µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

For small hole



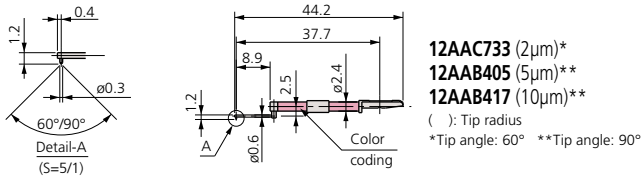
12AAC732 (2µm)*
12AAB404 (5µm)**
12AAB416 (10µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

For small hole/2X long for deep hole



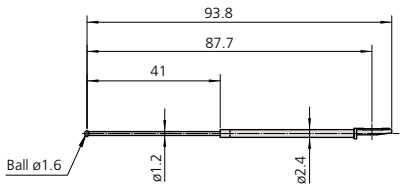
12AAE892 (2µm)*
12AAE908 (5µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

For extra-small hole



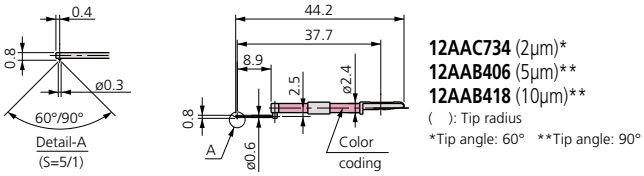
12AAC733 (2µm)*
12AAB405 (5µm)**
12AAB417 (10µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

For small hole*2



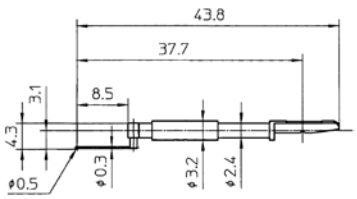
12AAE884 (0.8mm)
( ): Tip radius

For extra-minute hole



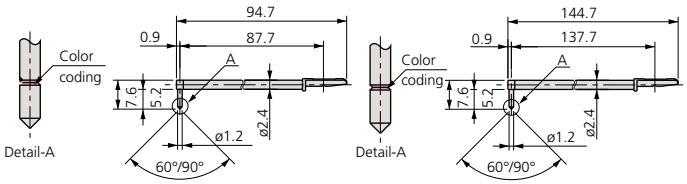
12AAC734 (2µm)*
12AAB406 (5µm)**
12AAB418 (10µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

For ultra-small hole *1*2



12AAJ662 (0.25mm)
( ): Tip radius

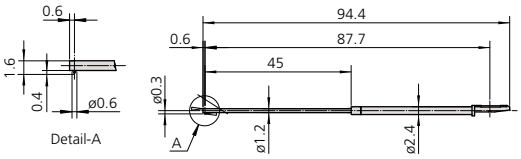
For deep hole (2X long and 3X long)



2X stylus
12AAC740 (2µm)*
12AAB413 (5µm)**
12AAB425 (10µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

3X stylus
12AAC741 (2µm)*
12AAB414 (5µm)**
12AAB426 (10µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

For small-slotted hole



12AAE938 (2µm)*
12AAE940 (5µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

*1: For downward-facing measurement only
*2: Used for calibration, a standard step gauge (No.178-611, option) is also required.

Tip radius	1µm	2µm	5µm	10µm	250µm
Color coding	White	Black	No color	Yellow	No notch or color

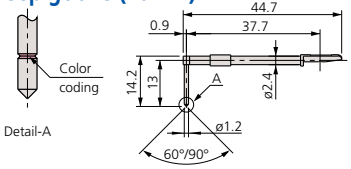
Optional Styli for Surface Roughness Measurement

Compatible with SJ-410, SJ-500, SV-2100, SV-3200, SV-3000CNC, SV-M3000CNC, SV-C3200, SV-C4500 Series

Styli

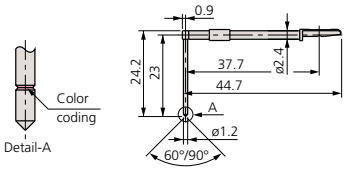
Unit: mm

For deep goove (10mm)



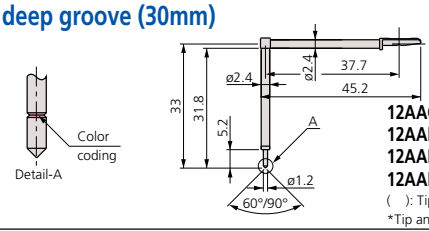
12AAC735 (2µm)*
12AAB409 (5µm)**
12AAB421 (10µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

For deep groove (20mm)



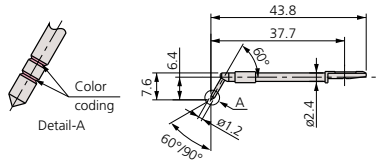
12AAC736 (2µm)*
12AAB408 (5µm)**
12AAB420 (10µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

For deep groove (30mm)



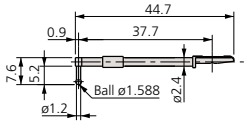
12AAC737 (2µm)*
12AAB335 (2µm)**
12AAB407 (5µm)**
12AAB419 (10µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

For gear tooth



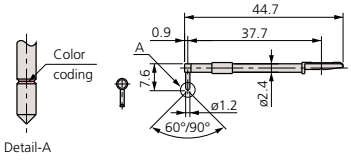
12AAB339 (2µm)*
12AAB410 (5µm)**
12AAB422 (10µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

For rolling circle waviness surface*2



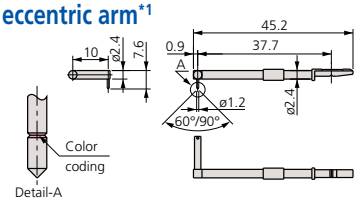
12AAB338 (0.8mm)
( ): Tip radius

For knife-edge detector



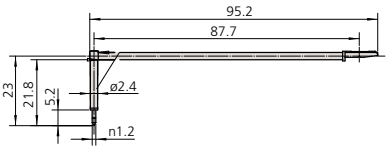
12AAC738 (2µm)*
12AAB411 (5µm)**
12AAB423 (10µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

For eccentric arm*1



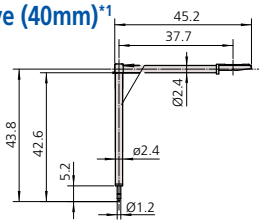
12AAC739 (2µm)*
12AAB412 (5µm)**
12AAB424 (10µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

For deep groove (20mm)*1/2X Long for deep hole



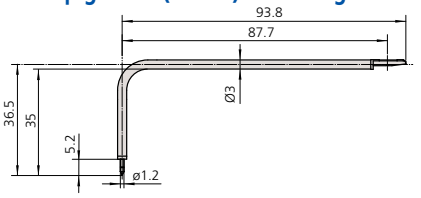
12AAE893 (2µm)*
12AAE909 (5µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

For deep groove (40mm)*1



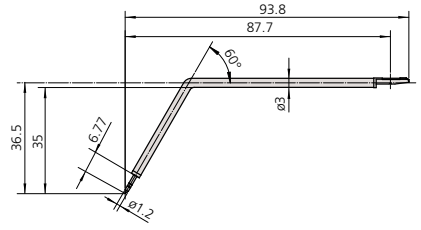
12AAE895 (2µm)*
12AAE911 (5µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

For deep groove (30mm)*1/2X Long for deep hole



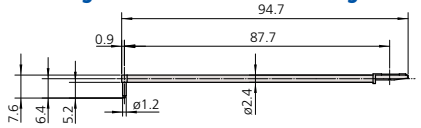
12AAE894 (2µm)*
12AAE910 (5µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

For gear tooth*1/2X Long for deep hole



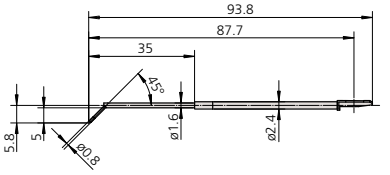
12AAE896 (2µm)*
12AAE912 (5µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

For rolling circle waviness*1/2X Long for deep hole*2



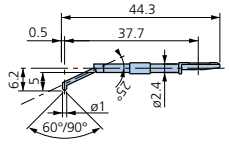
12AAE886 (0.25mm)
( ): Tip radius

For corner hole*1/2X Long for deep hole



12AAM601 (2µm)*
12AAM603 (5µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

For bottom surface



12AAE899 (2µm)*
12AAE915 (5µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

Tip radius	1µm	2µm	5µm	10µm	250µm
Color coding	White	Black	No color	Yellow	No notch or color

*1: For downward-facing measurement only
*2: Used for calibration, a standard step gauge (No.178-611, option) is also required.

Mitutoyo

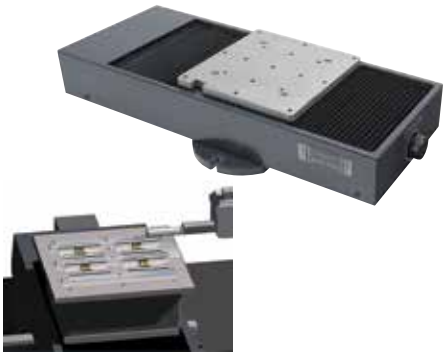
Optional Accessories for Automatic Measurement

Compatible with SV-3200, SV-C3200, SV-C4500, CS-3200 and CNC Models

Y-axis table*: 178-097

A Y-axis table for both positioning and capable of 3D surface roughness measurement when used withoptional software FTPK-PRO or MCubeMap.**

* Not supporting Y-axis measurements. ** Only for **178-096**



	178-097	178-096
Travel range	8" (200mm)	4" (100mm)
Resolution	1.97µin (0.05µm)	1.97µin (0.05µm)
Positioning accuracy	±3µm	±1µm
Drive speed	Max. 3.15"/s (80mm/s)	Max. .78"/s (20mm/s)
Maximum load	110 lbs (50kg)	33 lbs (50kg)
Mass	62 lbs (28kg)	68 lbs (31kg)

θ2-axis table: 178-078*

You can measure multiple points on a cylindrical workpiece and automate front/rear-side measurement.

* θ2-axis mounting plate (**12AAE718**) is required when directly installing on the base of the SV-3100.

Displacement	360°
Resolution	0.0072°
Maximum load (loading moment)	8.8 lbs (4kg) (343 N•cm or less)
Rotational speed	Max. 18°/s
Mass	11 lbs (5kg)

Quick chuck: 211-032

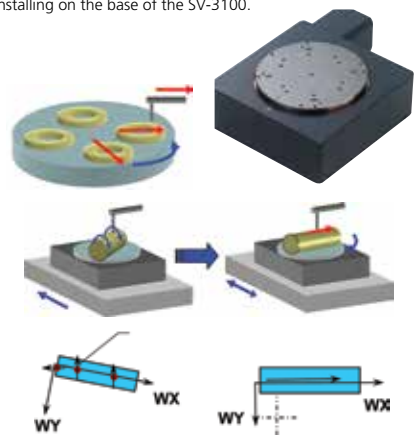
This chuck is useful when measuring small workpieces. You can easily clamp them with its knurled ring.

Retention range	Inner latch	OD: ø.04 - 1.42" (1 - 36mm)
	Inner latch	ID: ø.55 - 2.76" (14 - 70mm)
	Outer latch	OD: ø.04 - 2.95" (1 - 75mm)
Dimensions		ø 4.65 x 1.61" (118 x 41mm)
Mass		2.6 lbs (1.2kg)

θ1-axis table: 12AAD975*

For efficient measurement in the axial/transverse directions. When measuring a cylindrical workpiece, automatic alignment can be performed in combination with the Y-axis table.

* θ1-axis mounting plate (**12AAE630**) is required when directly installing on the base of the SV-3100.



Displacement	360°
Resolution	0.004°
Maximum load	26.5 lbs (12kg)
Rotational speed	Max. 10°/s
Mass	15 lbs (7kg)

Auto-leveling table: 178-087

This is a stage that performs fully automatic leveling as measurement starts, freeing the user from this troublesome operation. Fully automatic leveling can be done quickly by anyone. In addition, the operation is easy and reliable.

Inclination adjustment angle	±2°
Maximum load	15 lbs (7kg)
Table dimensions	5.1 x 3.9"(130 x 100mm)
Mass	7.7 lbs (3.5kg)

Micro-chuck: 211-031

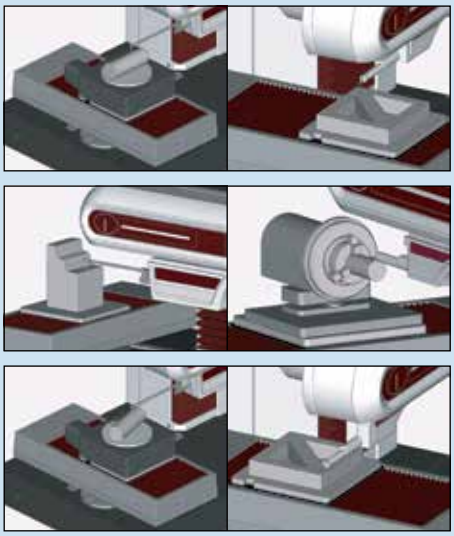
This chuck is suitable for clamping extra-small diameter workpieces (ø1mm or less), which cannot be retained with the centering chuck.

Retention range	OD: ø 0 - .06" (0 - 1.5mm)
Dimensions	ø 4.65 x 1.9" (118 x 48.5mm)
Mass	1.3 lbs (0.6kg)

Examples of optimal combinations of accessories for CNC models

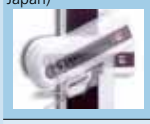
Function \ Optional accessory	Y-axis Table	θ1 Table	θ2 Table
Automatic leveling	—	—	—
Automatic alignment (Patent registered: Japan)	●	●	—
Multiple workpiece batch measurement	▲	—	—
Measurement in the Y-axis direction	●	—	—
Oblique measurement of XY plane **	●	—	—
Outside 3D surface roughness measurement/evaluation **	●	—	—
Multiple-piece measurement in the Y-axis direction (Positioning in the Y-axis direction)	●	—	—
Multiple-piece measurement in the radius direction (Positioning in the rotating direction of XY plane)	▲	●	—
Tracking measurement in the Z-axis direction *	—	—	—
Inclined surface measurement in the X-axis direction	▲	—	—
Inclined hole inside measurement in the X-axis direction	▲	—	—
Multiple cylinder generatrix line measurement	▲	—	●
Measurement of both top and bottom surfaces	▲	—	●
Rotary positioning of large workpiece ***	—	—	—
Upward/downward and frontward/backward measurement of large workpiece ***	—	—	—

* : Applicable only to form/contour measurement
** : Applicable only to surface roughness measurement
*** : Applicable only for SV-M3000CNC

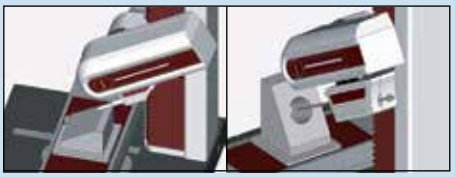


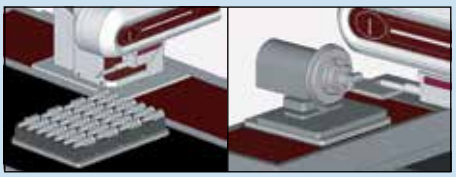
Optional Accessories for Surftest / Formtracer

Compatible with Desktop Models of Surftest and Formtracer

Drive unit tilting function (Patent pending: Japan)	Large θ Table	Rotary-type detector holder
		
●	—	—
▲	—	—
—	—	—
—	—	—
—	—	—
▲	—	—
—	—	—
—	—	—
—	—	—
●	—	—
●	—	—
—	—	—
—	—	—
—	●	—
—	—	●

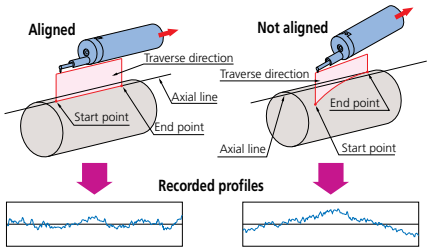
●: Essential ▲: Recommended
—: Not necessary

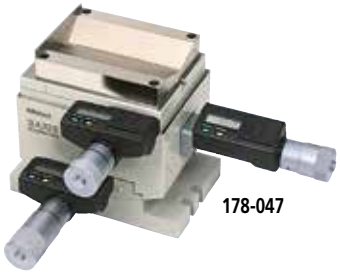




3-axis adjustment table

This table helps make the required alignment adjustments when measuring cylindrical surfaces. The corrections for the pitch angle and the swivel angle are determined from a preliminary measurement and the Digimatic micrometers are adjusted accordingly. A flat-surfaced workpiece also can be leveled with this table.



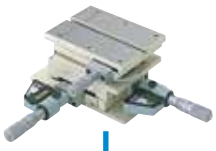

178-047

Leveling table

178-043-1 (mm), **178-053-1** (inch)
- Table top: 130 x 100mm
- Leveling range: ±1.5°
- XY travel: ±12.5mm

Digital leveling table

178-042-1 (mm)
178-052-1 (inch)
- Table top: 130 x 100mm
- Leveling range: ±1.5°
- XY travel: ±12.5mm



Leveling table

178-016
- Table top: 130 x 100mm
- Leveling range: ±1.5°
- Height: 40mm

Calibration stand *1

12AAM100

Calibration stand *2

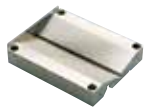
12AAG175

Calibration stand *3

12AAM309

V-block

998291
- Workpiece diameter: 1mm to 160mm
- Can be mounted on a leveling table



Precision vise

178-019
- Max. workpiece size: 36mm
- Can be mounted on a leveling table.

Cross-travel table

218-001 (mm),
218-011 (inch)
- Table top: 280 x 180mm
- XY travel: 100 x 50mm

Cross-travel table

218-041 (mm),
218-051 (inch)
- Table top: 280 x 152mm
- XY travel: 50 x 25mm

Rotary vise

218-003
- Two-slide jaw type.
- Max. workpiece size: ø60mm
- Minimum reading: 1°

Center support

172-142
- Max. workpiece dia.: 120mm
- 60mm riser is optional

Center support riser

172-143
- Used with a center support.
- Max. workpiece dia.: 240mm

Swivel center support

172-197
- Max. workpiece dia.: 80mm*
  *65mm when swiveled 10°
- Max. workpiece length: 140mm

Holder with clamp

176-107
- Used with a cross-travel table or rugged table.
- Max. workpiece height: 35mm


172-234 172-378

V-block with clamp

172-234, 172-378
- Used with a cross-travel table or rugged table.
- Max. workpiece dia.: 50mm (**172-234**), 25mm (**172-378**)

*1: Required for calibrating upward measurement of **CV-3200** series.
*2: Required for calibrating in bulk by mounting straight arm/small-hole stylus arm without using cross-travel table and Y-axis table.
*3: Required for calibrating in bulk by mounting straight arm/eccentric arm/small-hole stylus arm without using cross-travel table and Y-axis table.

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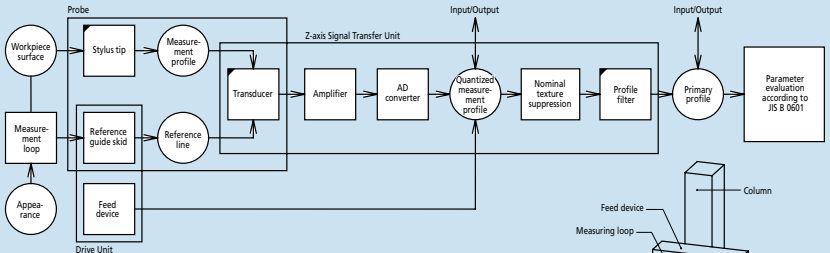
Quick Guide to Precision Measuring Instruments

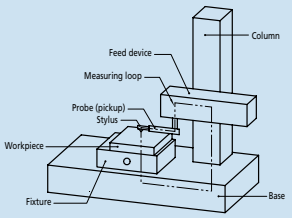
Surftest (Surface Roughness Testers)

- JIS B 0601:2001 Geometric Product Specifications (GPS) –Surface Texture: Profile method– Terms, definitions, and surface texture parameters
- JIS B 0632:2001 Geometric Product Specifications (GPS) –Surface Texture: Profile method– Metrological characterization of phase-correct filters
- JIS B 0633:2001 Geometric Product Specifications (GPS) –Surface Texture: Profile method– Rules and procedures for the assessment of surface texture
- JIS B 0651:2001 Geometric Product Specifications (GPS) –Surface Texture: Profile method– Nominal characteristics of contact (stylus) instruments

Nominal Characteristics of Contact (Stylus) Instruments

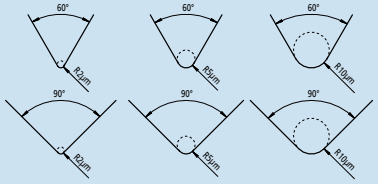
JIS B 0651: 2001 (ISO 3274: 1996)





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
Taper angle of cone: 60°, 90°
In typical surface roughness testers, the taper 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) Note 1	0.2
10		

Note 1: The maximum value of static measuring force at the average position of a stylus is to be 4.0mN for a special structured probe including a replaceable stylus.

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 Note 1	0.5
2.5	8	300	5 Note 2	1.5
8	25	300	10 Note 2	5

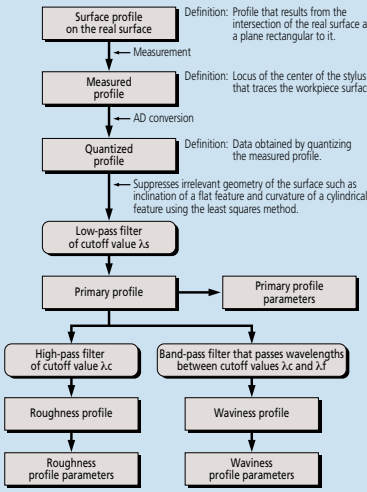
Note 1: For a surface with Ra>0.5µm or Rz>3µm, a significant error will not usually occur in a measurement even if r_{tip}= 5µm.
Note 2: If a cutoff value λs is 2.5µm or 8µm, attenuation of the signal due to the mechanical filtering effect of a stylus with the recommended tip radius appears outside the 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.

Metrological Characterization of Phase Correct Filters

JIS B 0632: 2001 (ISO 11562: 1996)

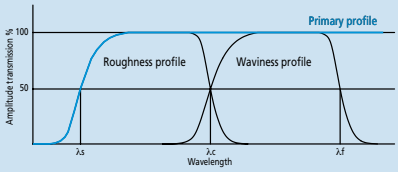
A profile filter is a phase-correct filter without phase delay (cause of profile distortion dependent on wavelength).
The weight function of a phase-correct filter shows a normal (Gaussian) distribution in which the amplitude transmission is 50% at the cutoff wavelength.

Data Processing Flow



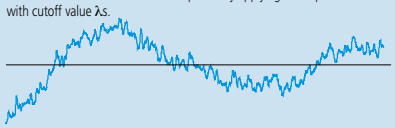
Surface Profiles

JIS B 0601: 2001 (ISO 4287: 1997)



Primary Profile

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

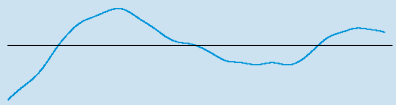


Roughness Profile

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.



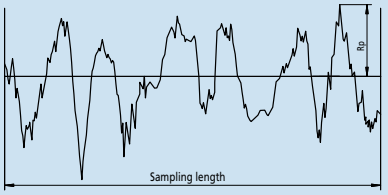
Definition of Parameters

JIS B 0601 : 2001 (ISO 4287 : 1997)

Amplitude Parameters (peak and valley)

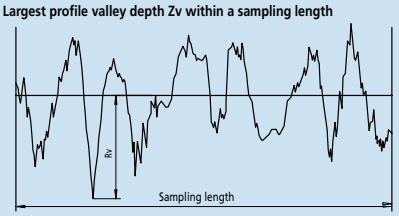
Maximum peak height of the primary profile Pp
Maximum peak height of the roughness profile Rp
Maximum peak height of the waviness profile Wp

Largest profile peak height Zp within a sampling length



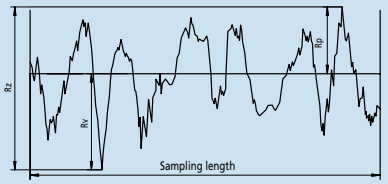
Maximum valley depth of the primary profile Pv
Maximum valley depth of the roughness profile Rv
Maximum valley depth of the waviness profile Wv

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

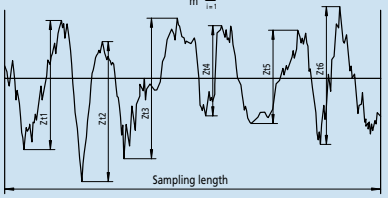


In Old JIS and ISO 4287-1: 1984, Rz was used to indicate the "ten point height of irregularities." Care must be taken because differences between results obtained according to the existing and old standards are not always negligibly small. (Be sure to check whether the drawing instructions conform to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

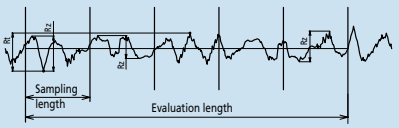
Mean value of the profile element heights Zt within a sampling length

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



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

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

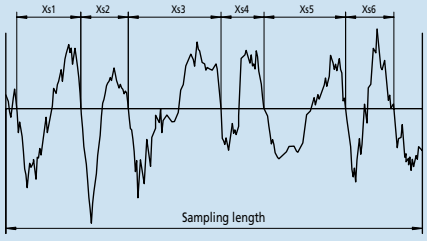
The above equation defines Rku. Pku and Wku are defined in a similar manner. Pku, Rku, and Wku are measures of the sharpness of the probability density function of the ordinate values.

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

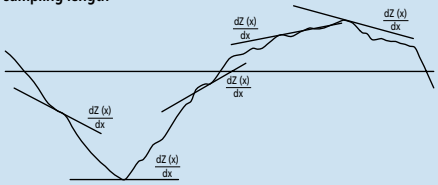
$$PSm, RSm, WSm = \frac{1}{m}\sum_{i=1}^{m} X_{si}$$



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

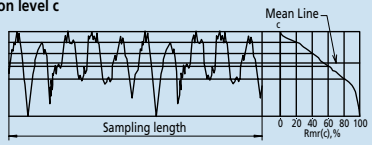
Root mean square value of the ordinate slopes dZ/dX within a sampling length



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)

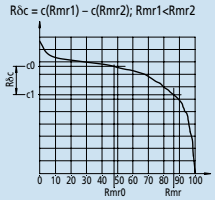
Ratio of the material length of the profile elements Ml(c) at a given level c to the evaluation length

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

Section height difference of the primary profile Pdc
Section height difference of the roughness profile Rdc
Section height difference of the waviness profile Wdc

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

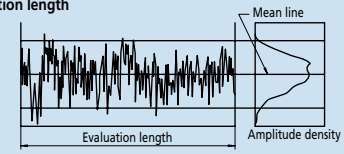
Material ratio determined at a profile section level Rδc (or Pδc or Wδc), related to the reference section level c0

$$Pmr, Rmr, Wmr = Pmr(c1), Rmr(c1), Wmr(c1)$$

where $c1 = c0 - R\delta c(R\delta c, W\delta c)$
$c0 = c(Pm0, Rmr0, Wmr0)$

Probability density function
(profile height amplitude distribution curve)

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

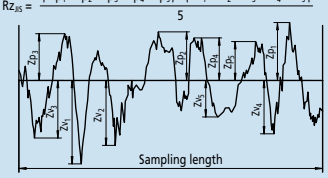


JIS Specific Parameters

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
RzJIS82	Surface profile as measured
RzJIS94	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 λc.

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

Sampling Length for Surface Roughness Parameters

JIS B 0633: 2001 (ISO 4288: 1996)

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

Ra μm	Sampling length lr mm	Evaluation length ln 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 lr mm	Evaluation length ln 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) Rzlmax only used for measurement of Rzlmax, Rvlmax, Rplmax, and Rclmax.

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

Rsm mm	Sampling length lr mm	Evaluation length ln 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

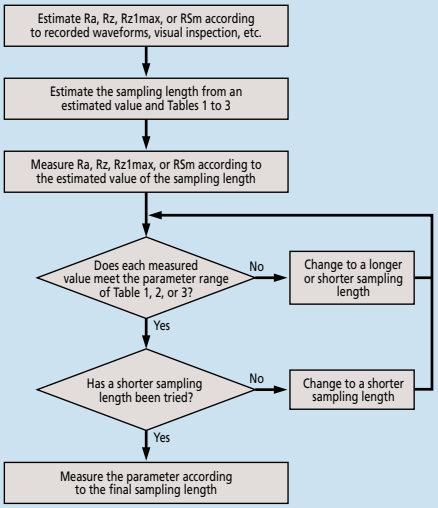


Table.1 Procedure for determining the sampling length of an aperiodic profile if it is not specified.

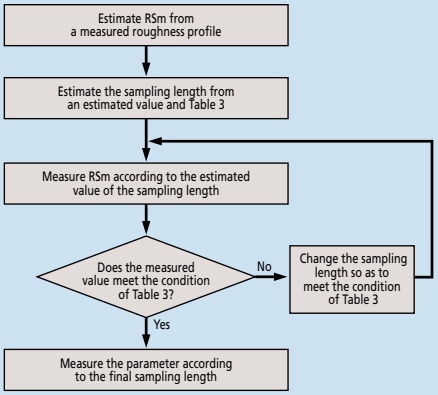


Table 2. Procedure for determining the sampling length of a periodic profile if it is not specified.

Mitutoyo

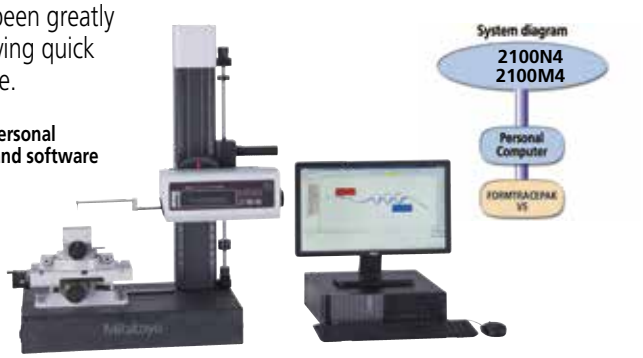
Contracer CV-2100

SERIES 218 — Contour Measuring Instruments

FEATURES

- Newly designed high-precision digital ARC scale improves the Z-axis accuracy and resolution.
- Quick-release grip handle allows for rapid traverse in column Z-axis for CV-2100M4.
- Key operation buttons are now mounted onto the X-axis drive unit, eliminating wired remote box.
- X-axis traverse speed has been greatly improved to 20mm/s allowing quick positioning and set-up time.
- New added function for automatic stylus up/down means high-volume repetitive measurements are now capable with part programming.
- Z-axis detector measuring range has been improved to 50mm for both models.
- CV-2100N4 model can be mounted to optional manual column stand or custom fixture supplied by end user.

CV-2100M4 with personal computer system and software

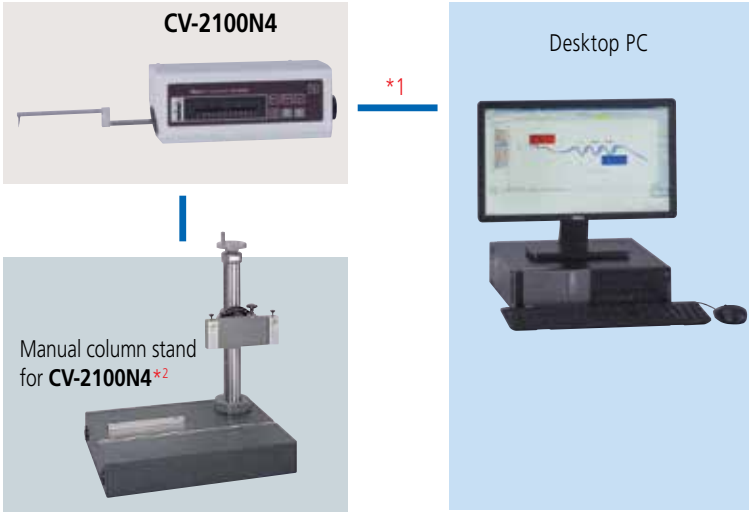


Connected to a personal computer, the FORMTRACEPAK V5 contour analysis program provides various modes of measurement and analysis.
*Printer not included


Centralized front control panel


Quick-vertical motion handle


X-axis jog shuttle



*1: If the **CV-2100N4** is operated without the dedicated manual stand, the measuring range of the Z-axis might be reduced, depending on the installation conditions. If you are considering using the **CV-2100N4** without the stand, contact your local Mitutoyo sales office for advice.

*2: Optional accessory **218-042** manual column stand

Technical Data

X1-axis
- Measuring range: 4" (100mm) (CV-2100)
- Resolution: 3.93µin (0.1µm)
- Measurement method: STVC-10Z
- Drive speed: 0-.79"/s (0-20mm/s)
- Measuring speed: .000787"/s, .2"/s (.02, 5mm/s)
- Measuring direction: Forward / Backward
- Traverse linearity: 98.4µin/4" (2.5µm/100mm) (CV-2100)
- Linear displacement: ±(100+20L)µin ±(2.5+2L/100)µm
  * L = Drive length (mm)
- Inclining range: ±45°

Z2-axis (column)
- Column type: Manual (M4 type)
- Vertical travel: 13.8" (350mm) (M4 type)

Z1-axis (detector unit)
- Measuring range: 2" (50mm)
- Resolution: 3.93µin (0.1µm)
- Measurement method: Digital arc scale
- Linear displacement: ±(100+100h)µin ±(2.5+I0.1HI)µm
- Accuracy (at 20°C) *H: Measurement height from the horizontal position within ±1" (±25mm)
- Stylus up/down operation: Arc movement
- Face of stylus: Downward
- Measuring force: 30±10mN (3gf)
- Traceable angle: Ascent: 77°, descent: 87° (using the standard stylus provided and depending on the surface roughness)

Stylus tip: Radius: 25µm, carbide tip
Base size (W x H): 23.6 x 17.7" (600 x 450mm)
Base material: Granite
Mass: 321 lbs (145.8kg) (CV-2100M4),
Power supply: 100 – 240VAC ±10%, 50/60Hz
Power consumption: 30W (main unit only)

Highly accurate arc scale

This scale directly tracks the arc trajectory of the stylus tip so that the most accurate compensation can be applied to the scale output, which leads to higher accuracy and resolution.

Contracer CV-2100

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Optional Accessories

218-042: Column stand for CV-2100N4 (vertical travel: 250mm, inclination: ±45°)
218-001: Cross-travel table (XY range: 100 x 50mm)
218-011: Cross-travel table (XY range: 4″ x 2")
218-041: Cross-travel table (XY range: 50 x 25mm)
218-051: Cross-travel table (XY range: 2″ x 1")
218-002: Rugged table
176-107: Holder with clamp
218-003: Rotary vise (heavy-duty type)
172-144: Rotary vise
172-234: V-block with clamp (Max. workpiece dia.: 50mm)
172-378: V-block with clamp (Max. workpiece dia.: 25mm)
172-197: Swivel center support
172-142: Center support
172-143: Center support riser
998862: Pin gage unit for calibration (mm)
998861: Pin gage unit for calibration (inch)
———: Arms and styli (See page J-32/33.)
12AAG175: Calibration table
178-047: 3-axis adjustment table

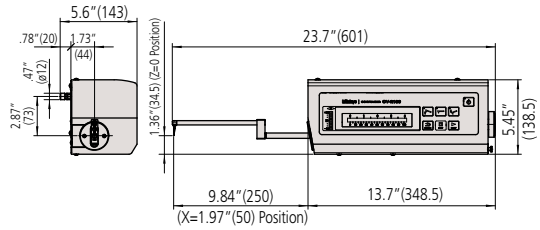
SPECIFICATIONS

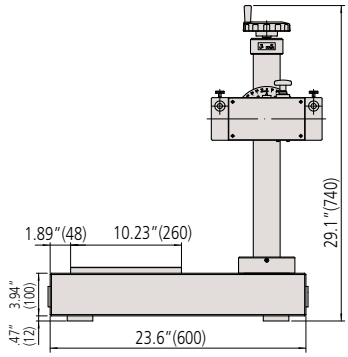
Model		CV-2100M4	CV-2100N4
Order No.		**218-643A**	**218-623A**
Measurement range	X-axis	4"(100mm)	
	Z1-axis (detector unit)	2"(50mm)	
Z2-axis (column) travel range		13.8"(350mm)	—
X-axis inclination angle		±45°	—
Resolution	X-axis	3.93µin (0.1µm)	
	Z1-axis	3.93µin (0.1µm)	
Drive method	X-axis	Motorized drive 0 - 0.79in/s (0 - 20mm/s)	
	Z2-axis (column)	Manual (quick up-and-down motion, fine feed)	—
Measuring speed		.00078 - .2"/sec (0.02 - 5mm/s)	
Linearity accuracy (X-axis horizontal orientation)		98.4µin/4in (2.5µm/100mm)	
Accuracy (20°C)	X-axis	±(100+20L) µin [±(2.5+0.02L) µm)] L = Measurement Length (mm)	
	Z1-axis	±(100+|100H|µin) [±(2.5+|0.1H|) µm] H = Measurementt height from horizontal position within 1"(±25mm)	
Measurement direction		Forward / Backward	
Measurement surface direction		Downward	
Measuring force		(3gf) (30±10mN)	
Stylus traceable angle (Standard accessory stylus)		Ascent 77°, Descent 87° (Depends on the surface condition)	
External dimensions (W×D×H)		29.3 x 17.7 x 34.8" (745×450×885mm)	25.6 x 5.63 x 5.45" (651×143×138.5mm)
Mass		321.43 lbs (145.8 kg)	12.78 lbs (5.8 kg)

DIMENSIONS

Unit: inch(mm)

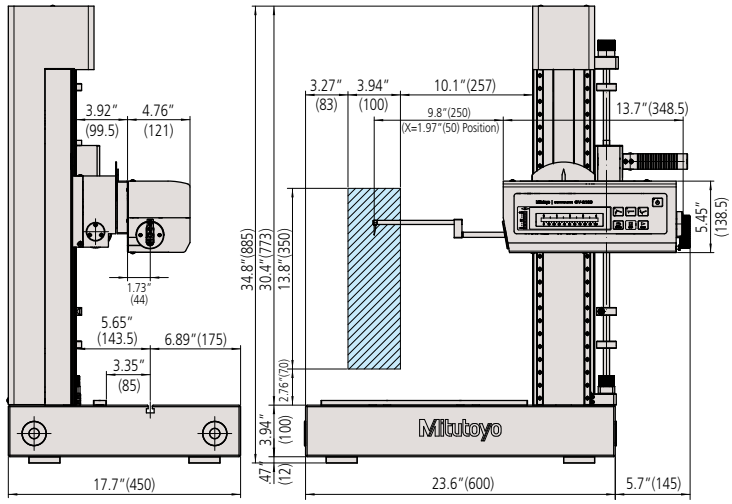
CV-2100N4



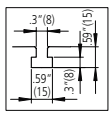


Optional Manual Column Stand for CV-2100N4

CV-2100M4



Measuring area



T-groove dimensions (**CV-2100M4**)

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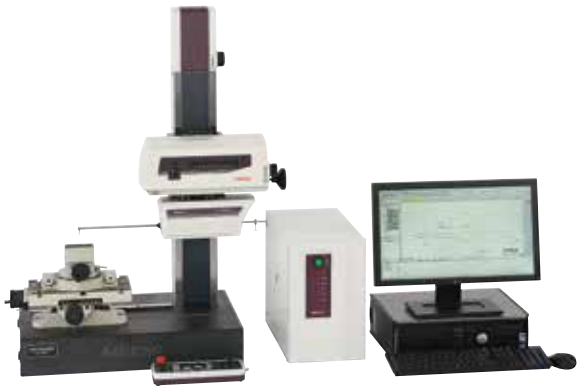
Contracer CV-3200 / CV-4500

SERIES 218 — Contour Measuring Instruments

CV-3200L4 (with options)



CV-3200S4 with personal computer system and software

CV-3200 FEATURES

- Dramatically increased drive speed (X axis: 80 mm/s, Z2 axis: 20 mm/s) further reduces total measurement time.
- In order to maintain the traverse linearity specification for an extended period of time, Mitutoyo has adopted highly rigid ceramic guides that combine the characteristics of smallest secular change and remarkable resistance to abrasion.
- With the support for a wide range of optional peripherals designed for use with the CNC models enables simplified CNC measurement.
- The drive unit (X-axis) and column (Z2-axis) are equipped with a high-accuracy linear encoders (ABS type on Z2-axis). This improves reproducibility of continuous automatic measurement of small holes in the vertical direction and repeated measurement of parts which are difficult to position.
- A newly designed straight arm reduces interference on the workpiece and expands the measurement range in the Z1 axis (height) direction.
- One-touch mounting and removal of the arm.
- X1-axis accuracy: ±(0.8+0.01L)µm*
  Z1-axis accuracy: ±(1.6+l2Hl/100)µm
  Designed to handle workpieces calling for high accuracy.

* CV-3200S4, H4, W4 types, L = Drive length, H = Measurement height (mm)

With the addition of a new function for continuously measuring top and bottom faces, the variable measuring force function has become more useful, enabling a wide variety of efficient, high-precision measurements.

CV-4500 FEATURES

- When combined with the double cone-end stylus (a new product with diametrically opposed contact points), the instrument can continuously measure in the upward and downward directions without the need to change the arm orientation or reset the workpiece fixturing.
- The measuring force can be switched among five levels (upward and downward) from the data-processing program (Formtracepak).
- High-precision and high-speed drive has been achieved, significantly improving measurement efficiency.
- A newly designed straight arm has reduced interference on the workpiece and expanded the measurement range in the Z1 axis (height) direction.
- One-touch mounting and removal of the arm.

Technical Data

X-axis

Measuring range:	4" (100mm) or 8" (200mm)
Resolution:	1.97µin (0.05µm)
Measurement method:	Reflective-type linear encoder
Drive speed:	3.15"/s (80mm/s) and manual
Measuring speed:	.0008 - .79"/s (0.02 - 20mm/s)*

*Recommended speed: under 5mm/s
If using higher speed, stylus tip may be chipped and/or accuracy may be worse, depending on surface condition.

Measuring direction:	Forward / Backward
Traverse linearity:	32µin/4", 80µin/8" (0.8µm/100mm, 2µm/200mm) *with the X axis in horizontal orientation
Linear displacement accuracy (at 20°C):	(31.5+10L)µin {±(.8+0.01L)µm} (CV-3200S4, H4, W4, L4) (32+10L)µin {±(0.8+0.01L)µm} (CV-4500S4, H4, W4, L4) (31.5+20L)µin {±(0.8+0.02L)µm} (CV-3200S8, H8, W8, L8) (32+20L)µin {±(0.8+0.02L)µm} (CV-4500S8, H8, W8, L8) * L = Drive length (mm)
Inclining range:	±45°

Z2-axis (column)

Vertical travel:	10" (300mm) or 20" (500mm)
Resolution:	39.4µin (1µm)
Measurement method:	ABSOLUTE linear encoder
Drive speed:	0 - 1.2"/s (0 - 30mm/s) and manual

Z1-axis (detector unit)

Measuring range:	±1.2" (±30mm)
Resolution:	1.57µin (.04µm) (CV-3200 series), .78µin (0.02µm) (CV-4500 series)
Measurement method:	Rotory arc encoder (CV-3200 series), (CV-4500 series)
Linear displacement Accuracy (at 20°C):	±(63+l20Hl)µin {±(1.4+l2Hl/100)µm} (CV-3200 series) ±(32+l20Hl)µin {±(0.8+l2Hl/100)µm} (CV-4500 series) *H: Measurement height from the horizontal position (mm)
Stylus up/down operation:	Arc movement
Face of stylus:	Upward/downward
Measuring force:	30mN (CV-3200)
Measuring force:	10, 20, 30, 40, 50mN (CV-4500) (Specified from the data-processing program Formtracepak)
Traceable angle:	Ascent: 77°, descent: 83° (using the standard stylus provided and depending on the surface roughness)
Stylus tip	Radius: 25µm, carbide tip
Base size (W x H):	17.7 x 23.6" (450 x 600mm) or 39.4 x 17.7" (1000 x 450mm)
Base material:	Granite
Power supply:	100 – 240VAC ±10%, 50/60Hz
Power consumption:	400W (main unit only)

Refer to Bulletin No. (2177) for more details.

Contracer CV-3200 / CV-4500

SERIES 218 — Contour Measuring Instruments

SPECIFICATIONS

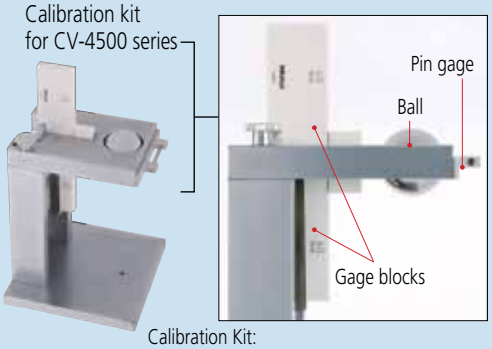
Model No.	CV-3200S4	CV-3200H4	CV-3200W4	CV-3200L4
Order No. (inch)	**218-491-10A**	**218-492-10A**	**218-493-10A**	**218-494-10A**
Model No.	CV-4500S4	CV-4500H4	CV-4500W4	CV-4500L4
Order No. (inch)	**218-451-10A**	**218-452-10A**	**218-453-10A**	**218-454-10A**
X1-axis measuring range	4" (100mm)	4" (100mm)	4" (100mm)	4" (100mm)
Vertical travel	12" (300mm) power column	20" (500mm) power column	20" (500mm) power column	27.6" (700mm) power column
Granite base size (WxD)	23.6 x 17.7" (600 x 450mm)	23.6 x 17.7" (600 x 450mm)	39.4 x 17.7" (1000 x 450mm)	39.4 x 17.7" (1000 x 450mm)
Dimensions (main unit, WxDxH)	29.2 x 17.7 x 35.6" (741 x 450 x 905mm)	29.2 x 17.7 x 43.5" (741 x 450 x 1105mm)	45.5 x 19 x 46.3" (1156 x 482 x 1176mm)	45.5 x 19.4 x 56.5" (1156 x 492 x 1436mm)
Mass (main unit)	309 lbs (140kg)	331 lbs (150kg)	485 lbs (220kg)	595 lbs (270kg)

Model No.	CV-3200S8	CV-3200H8	CV-3200W8	CV-3200L8
Order No. (inch)	**218-496-10A**	**218-497-10A**	**218-498-10A**	**218-499-10A**
Model No.	CV-4500S8	CV-4500H8	CV-4500W8	CV-4500L8
Order No. (inch)	**218-456-10A**	**218-457-10A**	**218-458-10A**	**218-459-10A**
X1-axis measuring range	8" (200mm)	8" (200mm)	8" (200mm)	8" (200mm)
Vertical travel	12" (300mm) power column	20" (500mm) power column	20" (500mm) power column	27.6" (700mm) power column
Granite base size (WxD)	23.6 x 17.7" (600 x 450mm)	23.6 x 17.7" (600 x 450mm)	39.4 x 17.7 (1000 x 450mm)	39.4 x 17.7" (1000 x 450mm)
Dimensions (main unit, WxDxH)	30.2 x 19 x 38" (767 x 482 x 966mm)	30.2 x 19 x46" (767 x 482 x 1166mm)	45.9 x 19 x 46.3" (1166 x 482 x 1176mm)	45.9 x 19.4 x 56.5" (1166 x 492 x 1436mm)
Mass (main unit)	309 lbs (140kg)	331 lbs (150kg)	485 lbs (220kg)	595 lbs (270kg)

Collective Calibration Function

- A dedicated calibration gage enables the user to calibrate the instrument for Z-axis gain, symmetry, stylus-tip radius, etc., in a single procedure.

Calibration kit for CV-4500 series



Calibration Kit:
CV-4500: **12AAQ491**
CV-3200: **12AAQ489** (not shown)

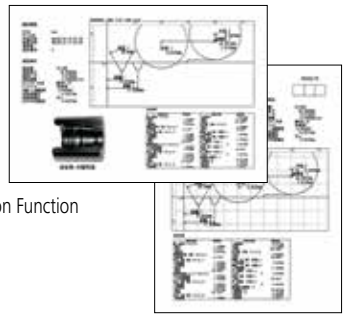
MiCAT
Mitutoyo Intelligent Computer Aided Technology
the standard in world metrology software
FORM

Software

FORMTRACEPAK V5

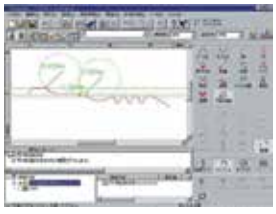
Measurement Control Screen

Profile Analysis Screen

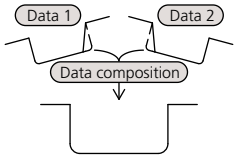


Report Creation Function

Automatic Circle/Line Application Function



Data Composition Function



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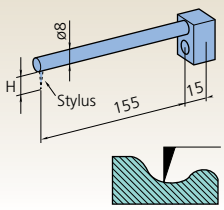
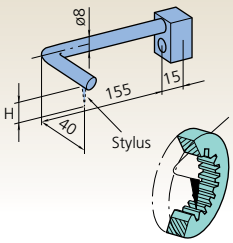
Optional Arms and Styli for Contour Measurement

For CV-2100

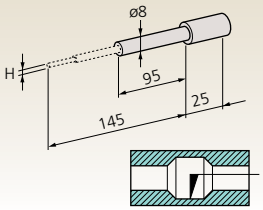
Straight type



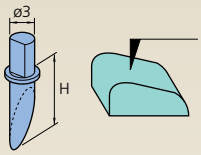
Eccentric type



For small-hole stylus

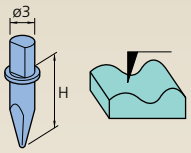


Single bevel



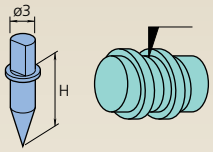
Tip angle: 12°
Tip radius: 25µm
Tip material: Carbide

Cross ground



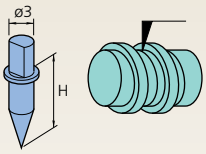
Tip angle: 20°
Tip radius: 25µm
Tip material: Carbide

Cone



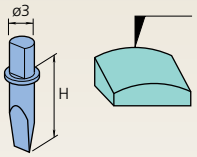
Tip angle: 30°/50°*
Tip radius: 25µm
Tip material: Carbide, Sapphire, Diamond*

Cone



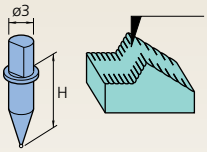
Tip angle: 20°
Tip radius: 25µm
Tip material: Carbide

Knife edge



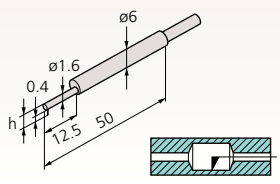
Tip angle: 20°
Edge width: 3mm
Tip radius: 25µm
Tip material: Carbide

Ball



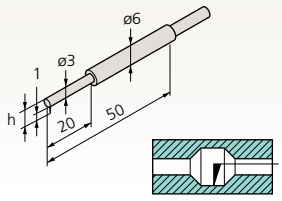
Ball dia: 1mm
Tip material: Carbide

Small hole: 932693 / 12AAE873



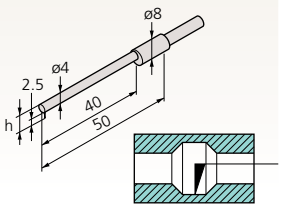
	932693	12AAE873
Tip shape:	Single bevel	Cone
Tip angle:	20°	30°
Tip radius:	25µm	25µm
Tip material:	Carbide	Carbide

Small hole: 932694 / 12AAE874



	932694	12AAE874
Tip shape:	Single bevel	Cone
Tip angle:	20°	30°
Tip radius:	25µm	25µm
Tip material:	Carbide	Carbide

Small hole: 932695 / 12AAE875



	932695	12AAE875
Tip shape:	Single bevel	Cone
Tip angle:	20°	30°
Tip radius:	25µm	25µm
Tip material:	Carbide	Carbide

List of Applicable Arms

Arm name	Order No.	Compatible stylus height
Straight type	935111	H = 6mm
	935112	H = 12mm
	935113	H = 20mm
	935114	H = 30mm
	935115	H = 42mm
Eccentric type	935116	H = 6mm
	935117	H = 12mm
	935118	H = 20mm
	935119	H = 30mm
	935120	H = 42mm
Small hole	935110	H = 0.4, 1, 2.5mm

List of Applicable Styli

Stylus name	Order No.	Stylus height
Single-bevel stylus carbide-tipped	354882	H = 6mm
	354883	H = 12mm
	354884	H = 20mm
	354885	H = 30mm
	354886	H = 42mm
Cross-ground stylus carbide-tipped	354887	H = 6mm
	354888	H = 12mm
	354889	H = 20mm
	354890	H = 30mm
	354891	H = 42mm
Cone stylus carbide-tipped tip angle 20°	12AAE865	H = 6mm
	12AAE866	H = 12mm
	12AAE867	H = 20mm
	12AAE868	H = 30mm
	12AAE869	H = 42mm
Cone stylus sapphire tipped tip angle 30° *Diamond tipped *tip angle 50°	354892	H = 6mm
	354893	H = 12mm
	354894	H = 20mm
	355129*	H = 20mm
	354895	H = 30mm
	354896	H = 42mm
Cone stylus carbide-tipped tip angle 30°	12AAA566	H = 6mm
	12AAA567	H = 12mm
	12AAA568	H = 20mm
	12AAA569	H = 30mm
	12AAA570	H = 42mm
Knife-edge stylus carbide-tipped	354897	H = 6mm
	354898	H = 12mm
	354899	H = 20mm
	354900	H = 30mm
	354901	H = 42mm
Ball stylus carbide-tipped	354902	H = 6mm
	354904	H = 20mm
	354905	H = 30mm
	354906	H = 42mm
Small-hole stylus carbide-tipped single bevel	932693	H = 2mm
	932694	H = 4mm
	932695	H = 6.5mm
Small-hole stylus carbide-tipped cone	12AAE873	H = 2mm
	12AAE874	H = 4mm
	12AAE875	H = 6.5mm

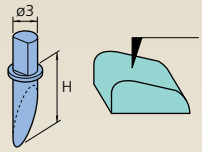
Optional Styli for Contour Measurement

CV-2100, CV-3200, CV-4500, SV-C3200, SV-C4500 and SV-C4500CNC

List of Applicable Styli

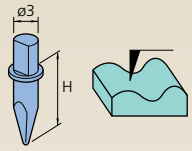
Stylus name	Order No.	Stylus height
Single-bevel cut stylus carbide-tipped	**354882**	H = 6mm
	354883	H = 12mm
	354884	H = 20mm
	354885	H = 30mm
	354886	H = 42mm
Cross-ground stylus carbide-tipped	**354887**	H = 6mm
	354888	H = 12mm
	354889	H = 20mm
	354890	H = 30mm
	354891	H = 42mm
Cone stylus carbide-tipped tip angle 20°	**12AAE865**	H = 6mm
	12AAE866	H = 12mm
	12AAE867	H = 20mm
	12AAE868	H = 30mm
	12AAE869	H = 42mm
Cone stylus sapphire tipped tip angle 30° *Diamond tipped *tip angle 50°	**354892**	H = 6mm
	354893	H = 12mm
	354894	H = 20mm
	355129*	H = 20mm
	354895	H = 30mm
	354896	H = 42mm
Cone stylus carbide-tipped tip angle 30°	**12AAA566**	H = 6mm
	12AAA567	H = 12mm
	12AAA568	H = 20mm
	12AAA569	H = 30mm
	12AAA570	H = 42mm
Knife-edge stylus carbide-tipped	**354897**	H = 6mm
	354898	H = 12mm
	354899	H = 20mm
	354900	H = 30mm
	354901	H = 42mm
Ball stylus carbide-tipped	**354902**	H = 6mm
	354904	H = 20mm
	354905	H = 30mm
	354906	H = 42mm

Single-bevel



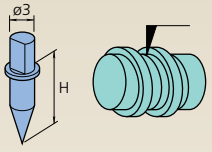
Tip angle: 12°
Tip radius: 25µm
Tip material: Carbide

Cross-ground



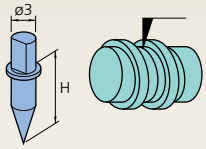
Tip angle: 20°
Tip radius: 25µm
Tip material: Carbide

Cone



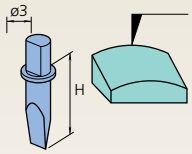
Tip angle: 30°/50°*
Tip radius: 25µm
Tip material: Carbide, Sapphire, Diamond*

Cone



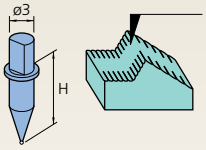
Tip angle: 20°
Tip radius: 25µm
Tip material: Carbide

Knife edge



Tip angle: 20°
Edge width: 3mm
Tip radius: 25µm
Tip material: Carbide

Ball



Ball dia: 1mm
Tip material: Carbide

• Any specified arm and stylus other than above listed can be custom-made for special order.

Arm and Stylus set: 12AAR588

Set for CV-4500 / SV-C4500 / SV-C4500CNC		
Part	**Part No.**	Part Description
Arm	**12AAQ762**	Eccentric arm
	12AAM103	Small-hole arm
Stylus	**354889**	Cross-ground stylus
	354882	Single-bevel cut stylus
	12AAA568	Cone stylus
	12AAM104	Small hole stylus
	12AAM106	Small hole stylus
	12AAM096	Double-sided cone stylus
	12AAM097	Double-sided cone stylus
Integrated arm and stylus	**12AAM109**	Double-sided small hole arm stylus

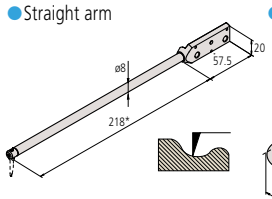
Arm and Stylus set: 12AAR587

Set for CV-3200 /CV-4500 / SV-C3200 / SV-C4500 / SV-C4500CNC		
Part	**Part No.**	Part Description
Arm	**12AAQ762**	Eccentric arm
	12AAM103	Small-hole arm
Stylus	**354889**	Cross-ground stylus
	354882	Single-bevel cut stylus
	12AAA568	Cone stylus
	12AAM104	Small hole stylus
	12AAM106	Small hole stylus

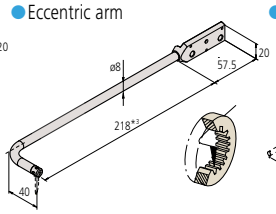
Mitutoyo

Optional Arms and Styli for Contour Measurement
For CV-3200, CV-4500, SV-C3200, SV-C4500 and SV-C4500CNC

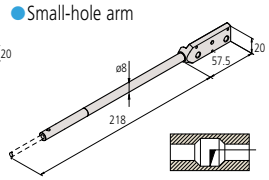
● Straight arm



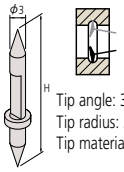
● Eccentric arm



● Small-hole arm

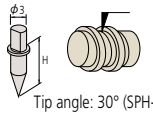


● Double cones



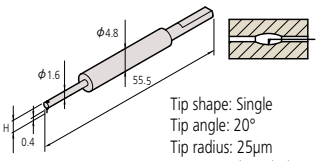
Tip angle: 30°
Tip radius: 25µm
Tip material: Carbide

● Cone



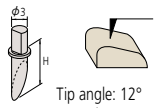
Tip angle: 30° (SPH-79: 50°)
Tip radius: 25µm
Tip material: Carbide,Sapphire
(SPH-79: Diamond)

● Small hole: **12AAM104**



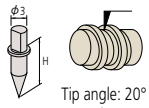
Tip shape: Single
Tip angle: 20°
Tip radius: 25µm
Tip material: Carbide

● Single bevel



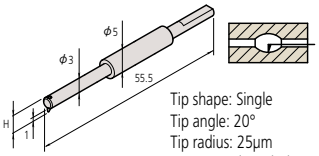
Tip angle: 12°
Tip radius: 25µm
Tip material: Carbide

● Cone



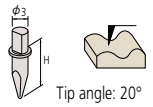
Tip angle: 20°
Tip radius: 25µm
Tip material: Carbide

● Small hole: **12AAM105**



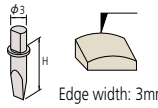
Tip shape: Single
Tip angle: 20°
Tip radius: 25µm
Tip material: Carbide

● Cross ground



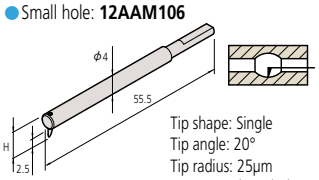
Tip angle: 20°
Tip radius: 25µm
Tip material: Carbide

● Knife-edge



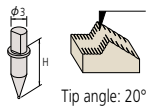
Edge width: 3mm
Tip radius: 25µm
Tip material: Carbide

● Small hole: **12AAM106**



Tip shape: Single
Tip angle: 20°
Tip radius: 25µm
Tip material: Carbide

● Cone Knife-edge Ball



Tip angle: 20°
Tip radius: 25µm
Tip material: Carbide

List of Applicable Arms

Arm Name	Order No.
Straight type	**12AAM101**
Eccentric type	**12AAQ762**
Small hole	**12AAM103**

*1: Standard accessory
*2: Stylus for **CV-4500** series
*3: One-sided cut stylus **SPH-71**(standard accessory) mounting

List of Applicable Styli

Stylus Name	Order No.	H (mm)
Double cones stylus *4	**12AAM095** *5	20
	12AAM096	32
	12AAM097	48
Single-bevel stylus carbide-tipped	**354882**	6
	354883	12
	354884 *6	20
	354885	30
	354886	42
Cross-ground stylus carbide-tipped	**354887**	6
	354888	12
	354889	20
	354890	30
	354891	42
Cone stylus sapphire-tipped tip angle 30°	**354892**	6
	354893	12
	354894	20
	354895	30
	354896	42
Cone stylus carbide-tipped tip angle 30°	**12AAA566**	6
	12AAA567	12
	12AAA568	20
	12AAA569	30
	12AAA570	42
Cone stylus carbide-tipped tip angle 20°	**12AAE865**	6
	12AAE866	12
	12AAE867	20
	12AAE868	30
	12AAE869	42
Cone stylus diamond-tipped tip angle 50°	**355129**	20
Knife-edge stylus carbide-tipped	**354897**	6
	354898	12
	354899	20
	354900	30
	354901	42
Ball stylus carbide-tipped	**354902**	6
	354904	20
	354905	30
	354906	42
Small-hole stylus *7	**12AAM104**	2
	12AAM105	4
	12AAM106	6.5

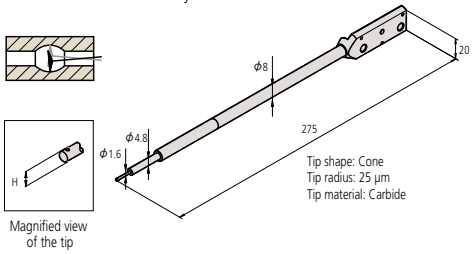
*4: Stylus for **CV-4500** series
*5: Standard accessory of **CV-4500** series
*6: Standard accessory of **CV-3200** series
*7: Styli **SPH-21, 22,** and **23** for **CV-3100/4100** series are not available.

Arm stylus (integrated arm and stylus) only for CV-4500

Arm stylus name	Order No.	H (mm)	Tip angle
Double small-hole arm stylus *8	**12AAT469**	2.4	20°
	12AAT470	5	20°
	12AAM108	2.4	30°
	12AAM109	5	30°
	12AAM110	9	30°

*8: Arm Stylus for **CV-4500, SV-C4500 and SV-C4500CNC series.** series

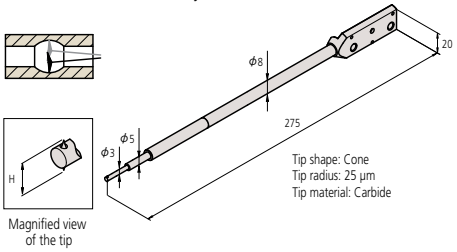
● Double small-hole arm stylus: **12AAM108/12AAT469**



Tip shape: Cone
Tip radius: 25 µm
Tip material: Carbide

Magnified view of the tip

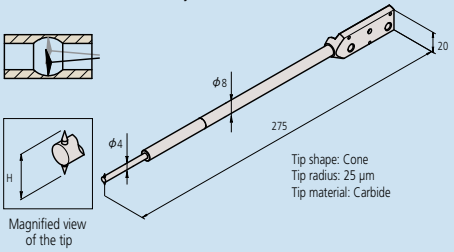
● Double small-hole arm stylus: **12AAM109/12AAT470**



Tip shape: Cone
Tip radius: 25 µm
Tip material: Carbide

Magnified view of the tip

● Double small-hole arm stylus: **12AAM110**



Tip shape: Cone
Tip radius: 25 µm
Tip material: Carbide

Magnified view of the tip

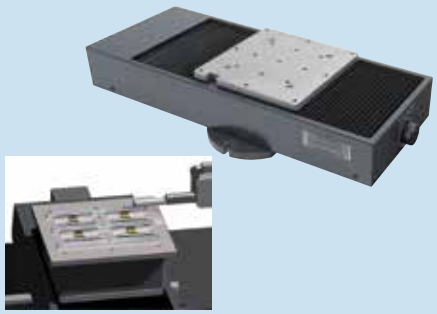
Optional Accessories for Automatic Measurement

Compatible with CV-3200, CV-4500 and CNC Models

Y-axis table*: 178-097

A Y-axis table for both positioning and capable of 3D surface roughness measurement when used withoptional software FTPK-PRO or MCubeMap.**

*Not supporting Y-axis measurements. ** Only for **178-096**

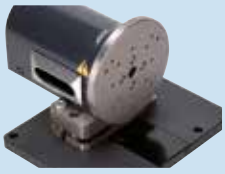


	178-097	178-096
Travel range	8" (200mm)	4" (100mm)
Resolution	1.97µin (0.05µm)	1.97µin (0.05µm)
Positioning accuracy	±3µm	±1µm
Drive speed	Max. 3.15"/s (80mm/s)	Max. .78"/s (20mm/s)
Maximum load	110 lbs (50kg)	33 lbs (50kg)
Mass	62 lbs (28kg)	68 lbs (31kg)

θ2-axis table: 178-078*

You can measure multiple points on a cylindrical workiece and automate front/rear-side measurement.

*θ2-axis mounting plate (**12AAE718**) is required when directly installing on the base of the SV-3100.



Displacement	360°
Resolution	0.0072°
Maximum load (loading moment)	4kg (343N•cm or less)
Rotational speed	Max. 18°/s
Mass	11 lbs (5kg)

Quick chuck: 211-032

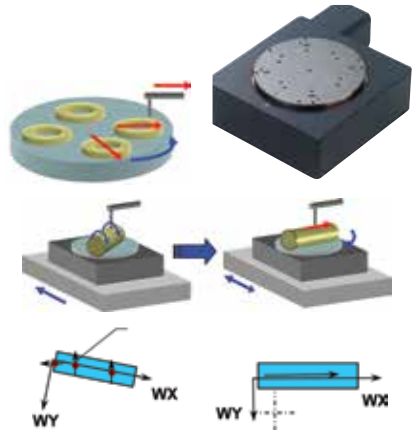
This chuck is useful when measuring small workpieces. You can easily clamp them with its knurled ring.

Retention range	Inner latch	OD: ø .04 - 1.42" (1 - 36mm)
	Inner latch	ID: ø .55 - 2.76" (14 - 70mm)
	Outer latch	OD: ø .04 - 2.95" (1 - 75mm)
Dimensions		ø 4.65 x 1.61" (118 x 41mm)
Mass		2.65 lbs (1.2kg)

θ1-axis table: 12AAD975*

For efficient measurement in the axial/transverse directions. When measuring a cylindrical workpiece, automatic alignment can be performed in combination with the Y-axis table.

*θ1-axis mounting plate (**12AAE630**) is required when directly installing on the base of the SV-3100.



Displacement	360°
Resolution	0.004°
Maximum load	26.5 lbs (12kg)
Rotational speed	Max. 10°/s
Mass	15 lbs (7kg)

Automatic-leveling table:178-087 (SV, CV, CS3200)
Automatic-leveling table:178-037 (CNC Models)

This is a stage that performs fully automatic leveling as measurement starts, freeing the user from this troublesome operation. Fully automatic leveling can be done quickly by anyone. In addition, the operation is easy and reliable.

Inclination adjustment angle	±2°
Maximum load	7kg
Table dimensions	130 x 100mm
Mass	7.7lbs (3.5kg)

Micro-chuck: 211-031

This chuck is suitable for clamping extra-small diameter workpieces (ø1 mm or less), which cannot be retained with the centering chuck.

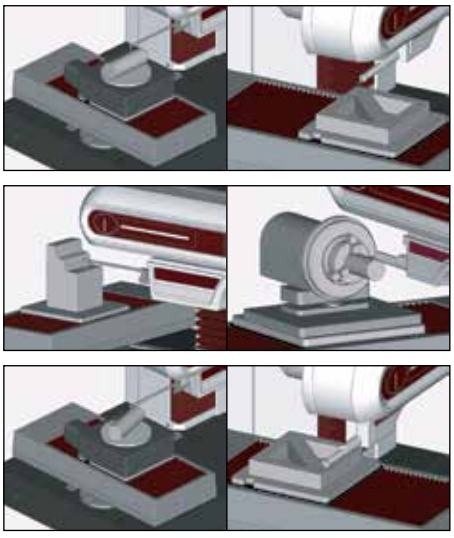
Retention range	OD: ø 0 -.06"(0 - 1.5mm)
Dimensions	ø 4.65" x 1.9" (118 x 48.5mm)
Mass	1.32 lbs (0.6kg)

Examples of optimal combinations of accessories for CNC models

Optional accessory / Function	Y-axis Table	θ1 Table	θ2 Table
Automatic alignment (Patented: Japan)	●	●	—
Multiple workpiece batch measurement	▲	—	—
Multiple-piece measurement in the Y-axis direction (Positioning in the Y-axis direction)	●	—	—
Multiple-piece measurement in the radius direction (Positioning in the rotating direction of XY plane)	▲	●	—
Tracking measurement in the Z-axis direction *	—	—	—
Inclined surface measurement in the X-axis direction	▲	—	—
Inclined hole inside measurement in the X-axis direction	▲	—	—
Multiple cylinder generatrix line measurement	▲	—	●
Measurement of both top and bottom surfaces	▲	—	●
Rotary positioning of large workpiece **	—	—	—
Upward/downward and frontward/backward measurement of large workpiece **	—	—	—

* : Applicable only to form/contour measurement
** : Applicable only for SV-M3000CNC

▲ Recommended ● Essential — Not necessary



Mitutoyo

Optional Accessories for Contracer / Formtracer

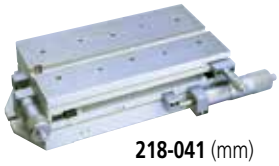
Compatible with Desktop Models of Contracer and Formtracer

Cross-travel table

- Table top: 11″ x 7″(280 x 180mm)
- XY travel: 3.94″ x 1.97″(100 x 50mm)
- Max. load 110 lbs (50kg)

218-001 (mm)
218-011 (inch)

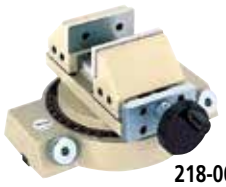
- Table top: 11″ x 5.98″(280 x 152mm)
- XY travel: 1.97″ x .98″(50 x 25mm)
- Max. load 44 lbs (20kg)



218-041 (mm)
218-051 (inch)

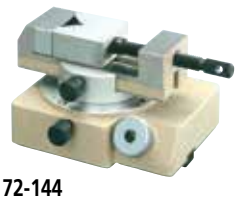
Rotary vise

- Two-slide jaw type.
- Max. workpiece size: ø 2.36″ (60mm)
- Minimum reading: 1°



218-003

- One-slide jaw type.
- Max. workpiece size: ø 2.36″ (60mm)
- Minimum reading: 5°



172-144

Leveling table

- Table top: 5.12″ x 3.94″(130 x 100mm)
- Leveling range: ±1.5°
- Height: 1.57″ (40mm)

178-016

V-block with clamp

- Used with a cross-travel table or rugged table.
- Max. workpiece diameter:1.97″(50mm)
- Max. workpiece diameter: .98″ (25mm)

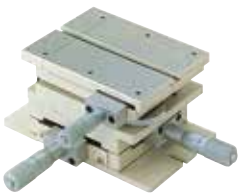
172-378
172-234

- Workpiece diameter: 0.039″ to 6.3″ (1mm to 160mm)
- Can be mounted on a leveling table

998291

Leveling table

- Table top: 5.12″ x 3.94″(130 x 100mm)
- Leveling range: ±1.5°
- XY travel: .49″ ±(12.5mm)



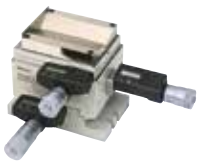
178-043-1 (mm)
178-053-1 (inch)

Digital leveling table

- Table top: 5.12″ x 3.94″(130 x 100mm)
- Leveling range: ±1.5°
- XY travel: .49″ ±(12.5mm)

178-042-1 (mm)

Three-axis adjustment table



178-047
(V-block not included)

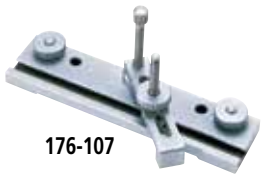
Precision vise

- Max. workpiece size: 1.42″ (36mm)
- Can be mounted on a leveling table.

178-019

Holder with clamp

- Used with a cross-travel table or rugged table.
- Max. workpiece height: 1.38″ (35mm)



176-107

Swivel center support

- Max. workpiece diameter: 3.15″ (80mm)*
  *2.56″ (65mm) when swiveled 10°
- Max. workpiece length: 5.51″(140mm)

172-197

Center support

- Max. workpiece diameter: 4.72″(120mm)
- 2.36″ (60mm) riser is optional (**172-143**)

172-142

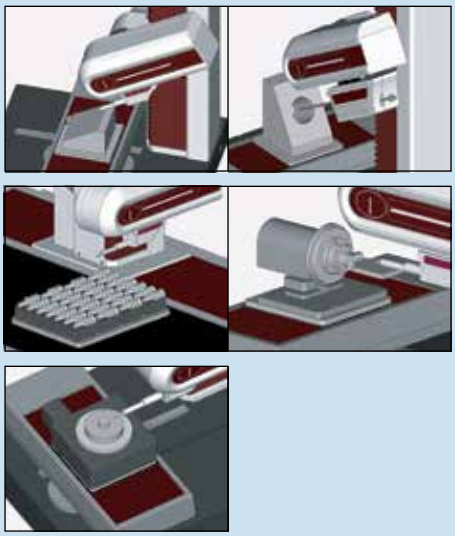
Center support riser

- Used with a center support.
- Max. workpiece diameter: 9.45″ (240mm)

172-143

Drive unit tilting function (Patent pending: Japan)	Large θ Table	Rotary-type detector holder
		
▲	—	—
—	—	—
—	—	—
—	—	—
—	—	—
●	—	—
●	—	—
—	—	—
—	—	—
—	●	—
—	—	●

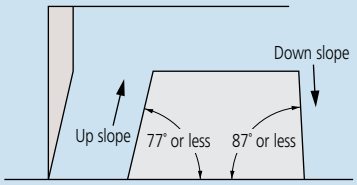
●: Essential ▲: Recommended
—: Not necessary



Three-axis adjustment table

Order No.	178-047
Table top	5.11 x 3.94" (130 x 100mm)
Workpiece weight	33lbs. (15kg) at max.
Workpiece diameter	.04 - 6.3" (1 - 160mm)
Leveling range	±1.5°
Swivel range	±2°
Y-axis adjustment	±0.5" (±12.5mm)
Height	6" (152.5mm)
Mass	19.8lbs. (9kg)
Remarks	V-block (**998291**) not included

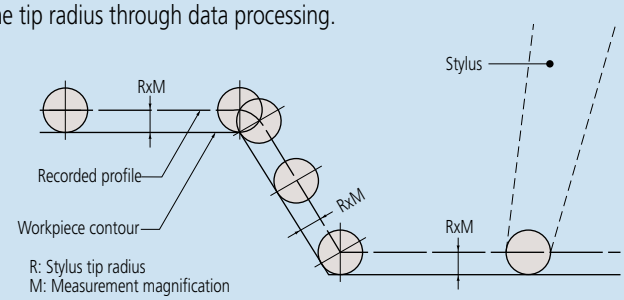
Traceable Angle



The maximum angle at which a stylus can trace upward or downward along the contour of a workpiece, in the stylus travel direction, is referred to as the traceable angle. A one-sided sharp stylus with a tip angle of 12° (as in the above figure) can trace a maximum 77° of up slope and a maximum 87° of down slope. For a conical stylus (30° cone), the traceable angle is smaller. An up slope with an angle of 77° or less overall may actually include an angle of more than 77° due to the effect of surface roughness. Surface roughness also affects the measuring force.
For model CV-3200/4500, the same type of stylus (SPH-71: one-sided sharp stylus with a tip angle of 12°) can trace a maximum 77° of up slope and a maximum 83° of down slope.

Compensating for Stylus Tip Radius

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



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

Compensating for Arm Rotation

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

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

Accuracy

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

Overload Safety Cutout

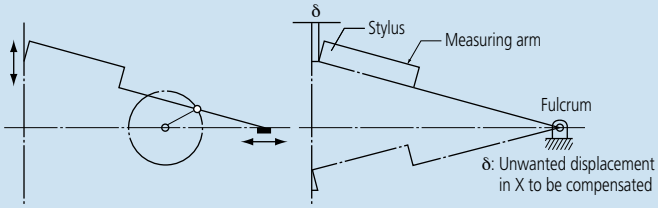
If an excessive force (overload) is exerted on the stylus tip due, perhaps, to the tip encountering a too-steep slope on a workpiece feature, or a burr, etc., a safety device automatically stops operation and sounds an alarm buzzer. This type of instrument is commonly equipped with separate safety devices for the tracing direction (X axis) load and vertical direction (Y axis) load.
For model CV-3200/4500 a safety device functions if the arm comes off the detector mount.

Simple or Complex Arm Guidance

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

Z-axis Measurement Methods

Though the X axis measurement method commonly adopted is by means of a digital scale, the Z axis measurement divides into analog methods (using a differential transformer, etc.) and digital scale methods.
Analog methods vary in Z-axis resolution depending on the measurement magnification and measuring range. Digital scale methods have fixed resolution.
Generally, a digital scale method provides higher accuracy than an analog method.



Contour Analysis Methods

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

1. Data processing section

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.

2. Analysis program

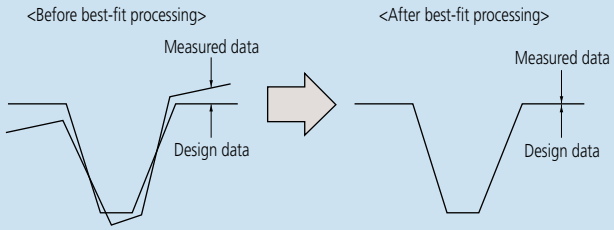
Analysis combining coordinate systems can be easily performed. The graph that goes through stylus radius correction is output to the printer as the recorded profile.

Tolerancing with Design Data

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

Best-fitting

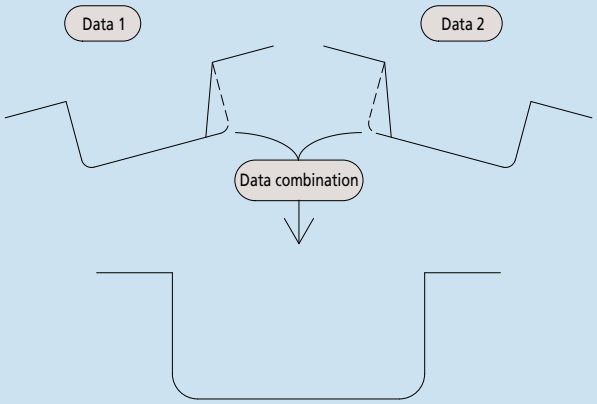
If there is a standard for surface profile data, tolerancing with design data is performed according to the standard. If there is no standard, or if tolerancing only with shape is desired, best-fitting between design data and measurement data can be performed.



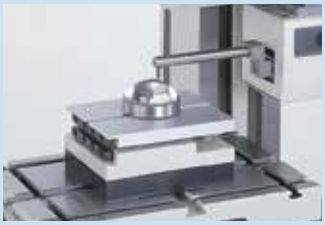
The best-fit processing algorithm searches for deviations between both sets of data and derives a coordinate system in which the sum of squares of the deviations is a minimum when the measured data is overlaid on the design data.

Data Combination

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



Measurement Examples

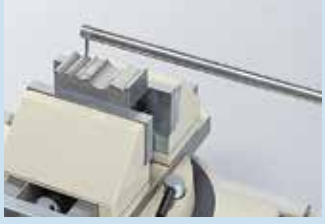

Aspheric lens contour


Inner/outer ring contour of a bearing


Internal gear teeth


Female thread form


Male thread form

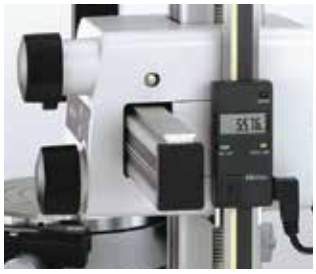

Gage contour

Roundtest RA-120 / 120P

SERIES 211 — Roundness Measuring Instruments

The Roundtest RA-120 / 120P are a compact, affordable, and simple-to-use device for measuring part geometry on the shop floor. It also provides such superb data analysis capabilities as required with laboratory roundness measuring instruments and has a ±1000µm wide range detector and precision turntable with excellent rotation accuracy.

The RA-120 is a dedicated processor-based model which controls all operations via the control panel incorporated in the main unit.



Z-axis scale unit

Optional X-axis stop

RA-120

Order No.: 211-544A (with mechanical mic-heads)
Order No.: 211-543A (with DAT function, inch/mm)

Technical Data

Turntable
- Rotational accuracy: Radial: (0.04+6H/10000)µm (H: Probing height (mm))
  Axial: (0.04+6X/10000)µm (X: Distance from rotation center)
- Rotating speed: 6rpm
- Table top diameter: ø 1.96" (150mm)
- Centering range: ±.12" (3mm)
- Leveling range: ±1°
- Maximum probing diameter: ø 11" (280mm)
- Maximum workpiece diameter: ø 17.3" (440mm)
- Maximum workpiece weight: 55 lbs (25kg)

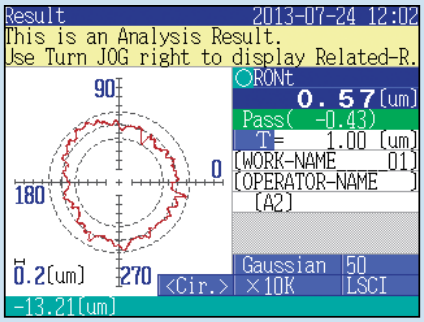
Vertical column (Z-axis)
- Vertical travel: 11" (280mm)
- Feeding: 1.18" (30mm)/rev. (coarse), 0.039" (1mm)/rev. (fine)
- Maximum probing height: 11" (280mm) from the turntable top
- Maximum probing depth: 3.94" (100mm) (min. ID: 1.18"(30mm)

Horizontal arm (X-axis)
- Horizontal travel: 65" (165mm) (Including a protrusion of 1" (25mm) the turntable rotation center)

Probe and stylus
- Measuring range: ±1000µm
- Measuring force: 100mN±30mN
- Standard stylus: 12AAL021, carbide ball, ø1.6mm
- Measuring direction: Two directional
- Stylus angle adjustment: ±45° (with graduations)

Data analysis unit:
- Processing unit: Built-in (PC with Roundpak)*
- Data sampling points: 3,600 points/rotation
- Data analysis items:
  Roundness, Coaxiality, Concentricity, Flatness, Circular runout (radial), Circular runout (axial), Squareness (against axis), Squareness (against plane), Thickness deviation, Parallelism
- Reference circles for roundness evaluation:
  LSC, MZC, MIC, MCC
- Recording device:
  Built-in thermal line printer (optional external printer)*
- Recording magnification:
  X5 to X200,000, Auto (X1 to X500,000)*
- Roughness component reduction:
  Low pass filter, band pass filter
- Filter type:
  2CR-75%, 2CR-50%, 2CRPC-75% (phase corrected), 2CRPC-50% (phase corrected), Gaussian, filter OFF
- Cutoff value;
  15upr, 50upr, 150upr, 500upr, 15-150upr, 15-500upr, 50-500upr, Manual setting*
- Number of measuring sections
  Max. 5-section (100-section)*

*RA-120P



Large color LCD display for RA-120 models

SPECIFICATIONS

Model No.	RA-120*	RA-120D	RA-120P	RA-120PD
Order No.	**211-544A**	**211-543A**	**211-547A**	**211-546A**

* Does not include Z-axis scale unit.

The RA-120P is a PC-based model which controls all operations via ROUNDPAK software (optional).

RA-120P

Order No.: 211-547A (with mechanical mic-heads)
Order No.: 211-546A (with DAT function, inch/mm)

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

Mitutoyo

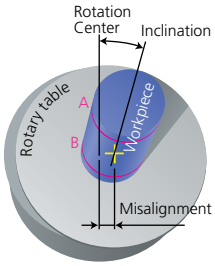
Roundtest RA-120 / 120P

SERIES 211 — Roundness Measuring Instruments

DAT (Digital Adjustment Table) function

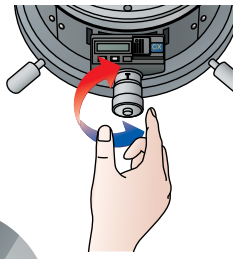
The turntable digitally displays the centering and leveling adjustments, turning what used to be a difficult task into one that is simple enough for even new operators to perform.

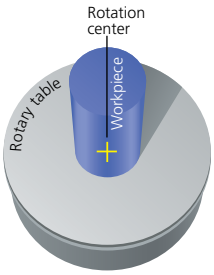
1. Preliminary measurement of two cross sections: A and B.



2. Following preliminary measurement, the centering and leveling adjustment values are displayed on the monitor.

3. Manipulate the digital micrometer heads of the rotary table so that the adjustment values displayed on the monitor are realized.





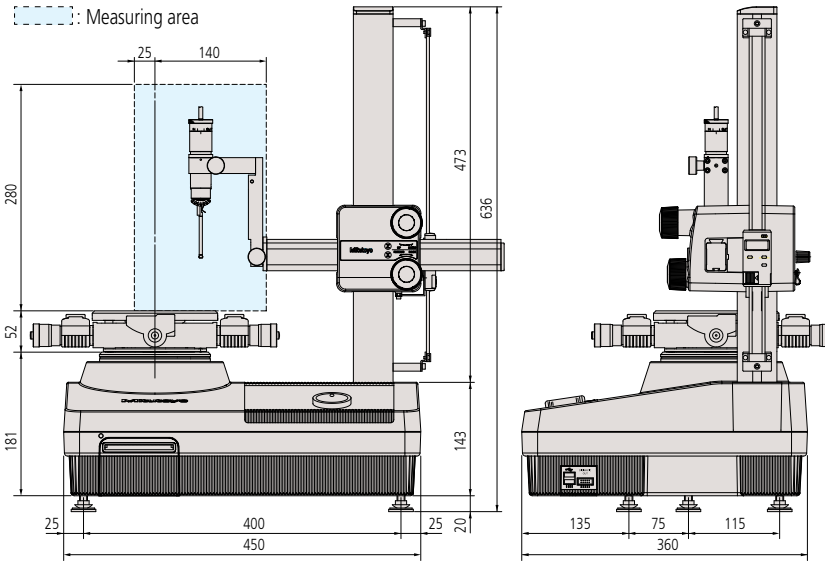
4. Centering and leveling are complete.
   Centering range: ±3mm
   Leveling (inclination) range: ±1°

DIMENSIONS

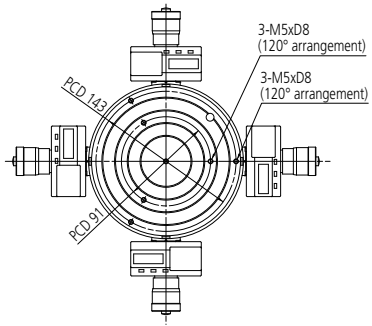
External dimensions

Unit: mm

: Measuring area

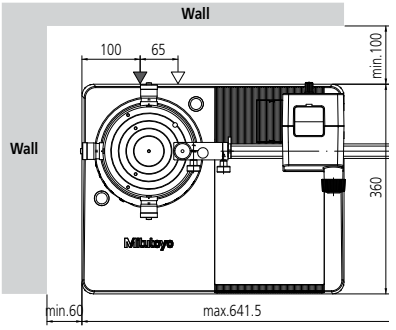


Turntable top view



Installation floor plan

▼Power inlet
▽Air inlet



Functions
- Notched workpiece measurement
- Recalculation of datum/measured data
- Limaçon function compensates for eccentricity
- Rotation of 3D display**
- Real-time display**
- Simplified layout (divided layout)**
- Hair line, auxiliary line, hidden line, fill line**
- Color setting of measured data**
- Offsetting of recorded profile generation**
- Zooming of recorded profile**
- Data deletion**
- Graph analysis (displacement/angle between measured points)**
- Power spectrum analysis**
- Gear tooth analysis**
- Harmonic analysis**
- Text data output (via CSV format)**

**Function of ROUNDPAK software

Air supply
Air pressure: 390kPa
Air consumption: 30L/min.
Power supply: 100V AC – 240V AC, 50/60Hz
Dimensions (W x D x H): 17.7" x 14.2" x 25" (450 x 360 x 636mm)
Mass: 70.5 lbs (32kg) (main unit), 4.4 lbs (2kg) (air regulator)

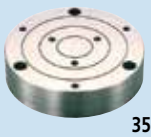
Optional Accessories

211-032:	Quick chuck (OD: 1 - 79mm, ID: 16 - 69mm)
211-014:	Three-Jaw chuck (OD: 2 - 78mm, ID: 25 - 68mm)
211-031:	Micro-chuck (OD: 1.5mm max.)
356038:	Auxiliary stage for a low-height workpiece
211-016:	Reference hemisphere
211-045:	Magnification checking gage
997090:	Gage block set for calibration
12AAH320:	X-axis stop
211-013:	Vibration damping stand
12AAH433:	Z-axis scale unit for RA-120
———:	Interchangeable styli (See page J-49.)

211-032

211-014

211-031

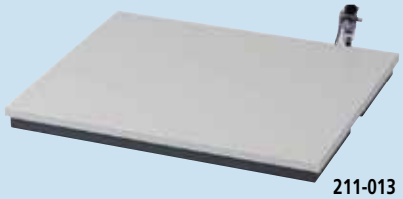


356038

211-016

997090

211-045



211-013

CONSUMABLE PARTS

12AAH181:	Printer paper	10 rolls/set
358592:	Element for air filter	1 pc./set
358593:	Element for air regulator	10 pcs./set

Roundtest RA-1600 / RA-1600M

SERIES 211 — Roundness/Cylindricity Measuring System

Technical Data

Turntable
- Rotational accuracy (radial): (0.02+6H/10000)µm (RA-1600)
- Rotational accuracy (axial): (0.02+6X/10000)µm (RA-1600)
- Rotational accuracy (radial): (0.03+6H/10000)µm (RA-1600M)
- Rotational accuracy (axial): (0.03+6X/10000)µm (RA-1600M)

  H: Probing height (mm), X: Probing radius (mm)
- Rotational speed: 4, 6, 10rpm
- Table top diameter: ø5.9"(150mm)
- Centering range: ±3mm (with DAT function)
- Leveling range: ±1° (with DAT function)
- Maximum probing diameter: ø11"(ø280mm)
- Maximum workpiece diameter: ø22"(ø560mm)
- Maximum table loading: 55lbs (25kg)

Vertical column (Z-axis)
- Vertical travel: 11.8"(300mm)
- Straightness (in narrow range: 0.20µm / 100mm (RA-1600)
- Straightness (in entire range): 0.30µm / 300mm (RA-1600)
- Straightness (in narrow range: 0.40µm / 100mm (RA-1600M)
- Straightness (in entire range): 0.80µm / 100mm (RA-1600M)
- Parallelism with turntable axis: 1.5µm / 300mm
- Positioning speed: Max. 15mm/s
- Measuring speed: 0.5, 1, 2, 5mm/s
- Maximum probing height (ID/OD): 11.8"(300mm)*1
- Maximum probing depth: 91mm (over ø32)
  3.6"(over ø1.26")((91mm (over ø32))
  1.97"(over ø0.27")((50mm (over ø7))

Horizontal arm (X-axis)
- Horizontal travel: 6.5"(165mm) (From table axis -1~±5.5" ((-25mm – ±140mm))
- Positioning speed: Max. 15mm/s
- Measuring speed: 0.5, 1, 2, 5mm/s
- X-axis straightness: 2.7µm/140mm (RA-1600)
- X-axis parallelism to turntable axis: 1.6µm/140mm (RA-1600)

Probe and stylus
- Measuring range: ±400µm / ±40µm / ±4µm
- Measuring force: 10–50mN (5 level switching)
- Standard stylus: **12AAL021**, carbide ball, ø1.6mm
- Measuring direction: Bi-directional
- Stylus angle adjustment: ±45° (with graduations)

Air supply
- Air pressure: 0.39MPa (4kgf/cm²)
- Air consumption: 22L/min.

Power supply: 100V AC – 240V AC, 50/60Hz

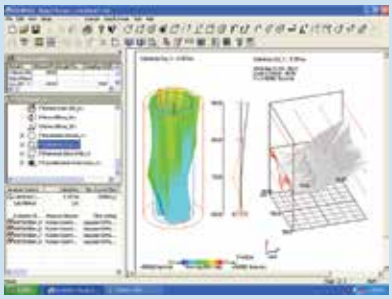
Dimensions (W x D x H): 35 x 19.3 x 33"(890 x 490 x 840mm)

Mass: 375lbs (170kg)

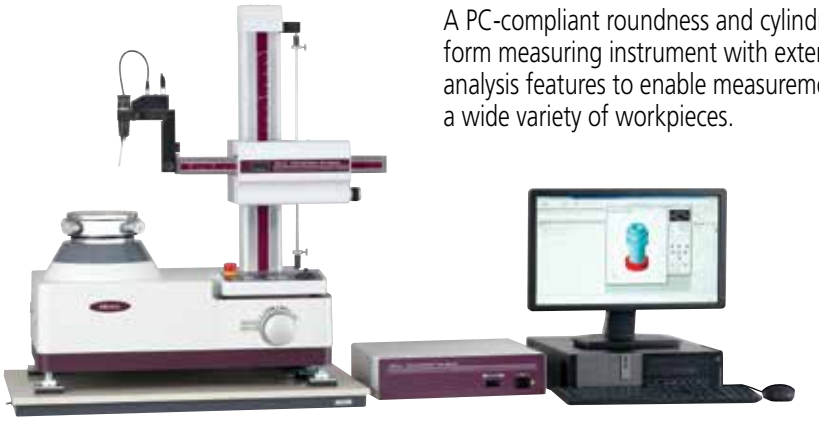
*1 Use an optional auxiliary stage for measuring a workpiece whose height is 20mm or less.

ROUNDPAK

The latest roundness/cylindrical form analysis program



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

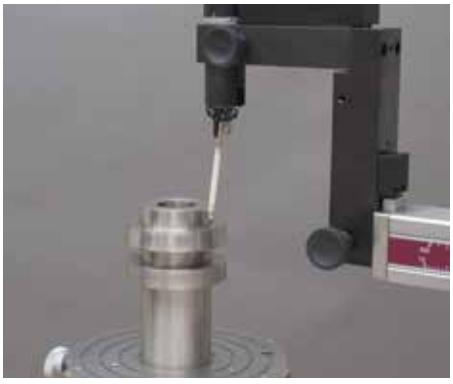


RA-1600 / RA-1600M
with personal computer system and software

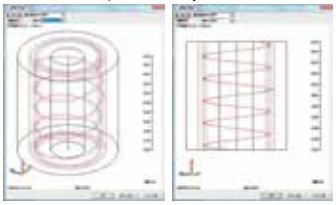
A PC-compliant roundness and cylindrical-form measuring instrument with extensive analysis features to enable measurement of a wide variety of workpieces.

Spiral Measurement/Analysis

The spiral-mode measurement function combines table rotation and rectilinear action allowing cylindricity, coaxiality, and other measurement data to be loaded as a continuous data set.



Spiral-mode cylinder measurement



Safety mechanism provided as a standard feature

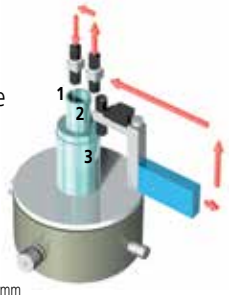
A collision-sensing function has been added to the detector unit (when it is in the vertical orientation) to prevent collision in the Z-axis direction. Additionally, an accidental collision prevention function, which stops the system when the detector displacement exceeds its range, has been added. When an accidental touch is detected, the dedicated analysis software (ROUNDPAK) senses the error and automatically stops the system.

Measurement Through X-axis Tracking

Measurement while tracing is possible through a built-in linear scale in the X-axis. This type of measurement is useful when displacement due to form variation exceeds the measuring range of the detector, and X-axis motion is necessary to maintain contact with the workpiece surface.

Continuous Internal/External Diameter Measurement

Continuous internal/external diameter measurement is possible without changing the detector position.



1), 2) : External diameter measurement
3) : Internal diameter measurement
➡ : Displacement
3) = inner diameter: Up to ø50 mm

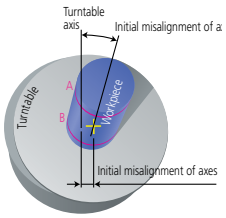
Mitutoyo

Roundtest RA-1600 / RA-1600M

SERIES 211 — Roundness/Cylindricity Measuring System

Centering and Leveling Function

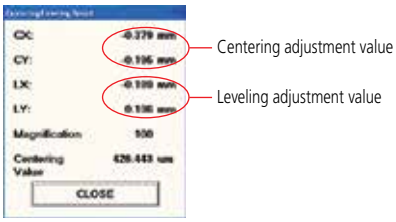
The turntable displays centering and leveling adjustments digitally, making this challenging task simple enough for even a new operator to perform.



1. Preliminary measurement of two cross sections: A and B.

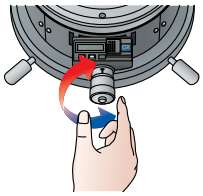
2. Following preliminary measurement, the centering and leveling adjustment values are displayed on the monitor.

For RA-1600

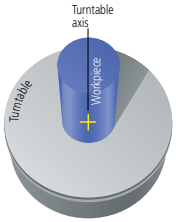


For RA-1600M

3. By adjusting the micrometer heads for the rotary table, the adjustment values or level meter displayed on the monitor can be achieved.



4. Centering and leveling are complete.
   Centering range: ±3mm
   Leveling (inclination) range: ±1°

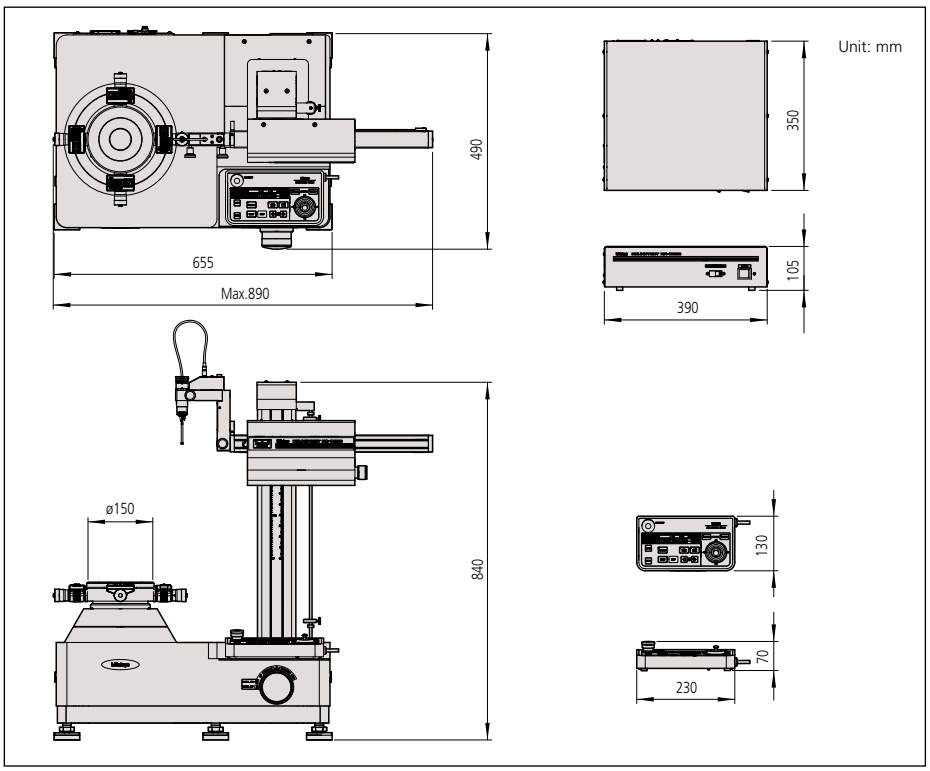


SPECIFICATIONS

Model No.	RA-1600	RA-1600M
Order No. (inch/mm)	**211-733A**	**211-724A**
Mic Heads	Digimatic	Mechanical

DIMENSIONS

Unit: mm



Optional Accessories

350850: Cylindrical square
356038: Auxiliary stage for a low-height workpiece
12AAF203: 2x extension detector holder
12AAF204: Auxiliary detector holder for a large-diameter workpiece
12AAL090: Sliding detector holder
211-045: Magnification checking gage
211-014: Chuck (OD: ø2 - 78mm, ID: ø25 - 68mm)
211-032: Quick chuck (OD: ø1 - 79mm, ID: 16 - 69mm)
211-031: Micro-chuck (OD: ø0.1 - 1.5mm max.)
178-025: Vibration isolator (Desktop type)
64AAB213: Vibration isolation workstation
12AAL019: Side table for PC
———: Interchangeable styli (See page J-49.)

Sliding detector-unit holder (Option) 12AAL090

The detector-unit holder is equipped with a sliding mechanism, enabling one-touch measurement of a workpiece with a deep hole having a thick wall, which has been difficult with the conventional standard arm.

Sliding distance: 4.4" (112mm)

The detector-unit holder can be stopped at a position sufficiently higher than the workpiece along the Z-axis, and then lowered and positioned to make measurements.
Furthermore, internal/external diameters can be easily measured with the continuous internal/external diameter measurement function*.

*: See page 41 for details about the continuous ID and OD measuring function.

Roundtest RA-2200AS / DS / AH / DH

SERIES 211 — Roundness / Cylindricity Measuring System

Technical Data

Turntable
Rotational accuracy (radial): {(0.02+3.5H/10000)µm}
Rotational accuracy (axial): {(0.02+3.5R/10000)µm}
H: Probing height (mm), R: Probing radius (mm)
- Rotating speed: 2, 4, 6, 10rpm
- Tabletop diameter: ø9.2" (235mm) AS / AH models; ø 7.9" (200mm) DS / DH models
- Centering range: ±3mm (±5mm: DS / DH models)
- Leveling range: ±1°
- Maximum probing diameter: ø 11.8" (300mm)
- Maximum workpiece diameter: ø22.8" (580mm)
- Maximum workpiece weight: 66 lbs (30kg)

Vertical column (Z-axis)
- Vertical travel: 11.8" (300mm) (22.8" (500mm): AH/DH models)
- Straightness (λc2.5): 0.10µm / 100mm, 0.15µm / 300mm (0.25µm / 500mm: AH / DH models)
- Parallelism with rotating axis: 0.7µm / 300mm (1.2µm / 500mm: AH / DH models)
- Positioning speed: Max. 50mm/s
- Measuring speed: 0.5, 1, 2, 5mm/s
- Maximum probing height: 11.8" (300mm) (OD / ID) [22.8" (500mm): AH / DH models)
- Maximum probing depth: over ø32: 85mm (w/standard stylus) over ø7: 50mm (w/standard stylus)

Horizontal arm (X-axis)
- Horizontal travel: 6.9" (175mm) (Including a protrusion of 1" (25mm) the turntable rotation center)
- Straightness (λc2.5): 0.7µm / 150mm
- Squareness with rotating axis: 1.0µm / 150mm
- Positioning speed: Max. 30mm/s with joystick operation
- Measuring speed: 0.5, 1, 2, 5mm/s

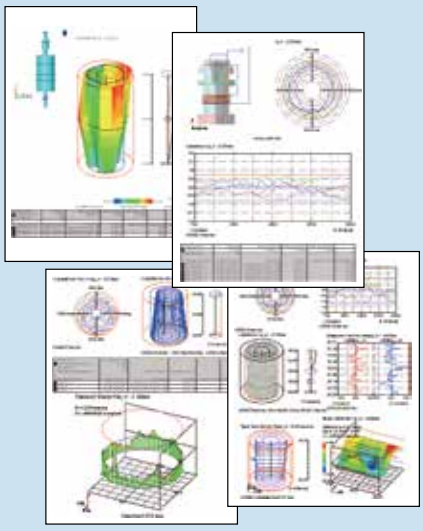
Probe and stylus
- Measuring range: ±400µm/±40µm/±4µm (±5mm: tracking range)
- Measuring force: 10mN~50mN (in 5 steps)
- Standard stylus: **12AAL021**, carbide ball, ø1.6mm
- Measuring direction: Two directional
- Stylus angle adjustment: ±45° (with graduations)

Data analysis system
- Analysis software: Roundpak
- Filter type: 2CRPC-75%, 2CRPC-50%, 2CR-75% (non-phase corrected), 2CR-50% (non-phase corrected), Gaussian, filter OFF
- Cutoff value; 15upr, 50upr, 150upr, 500upr, 1500upr, 15-150upr, 15-500upr, 15-1500upr, 50-500upr, 50-1500upr, 150-1500upr, Manual setting
- Reference circles for roundness evaluation: LSC, MZC, MIC, MCC

Air supply
- Air pressure: 390kPa (4kgf/cm²)
- Air consumption: 30L/min.

Power supply: 100V AC – 240V AC, 50/60Hz
Dimensions (W x D x H): 26.3 x 20 x 35.4" (667 x 510 x 900mm) 26.3 x 20 x 43.3" (667 x 510 x 1100mm: AH / DH models)
Mass: 396 lbs (180kg) 440 lbs (200kg) AH / DH models

Printout



The RA-2200 provides high accuracy, high speed and high performance in roundness measurement. The fully-automatic, or DAT (Digital Adjustment Table), function-aided manual workpiece centering and leveling turns what used to be a difficult task into one that is simple enough for even new users to perform. This facilitates substantial reductions in overall measurement time. The RA-2200 system comes complete with powerful data analysis software ROUNDPAK, which requires only simple manipulation using a mouse and icons, achieving enhanced functionality and ease of operation.

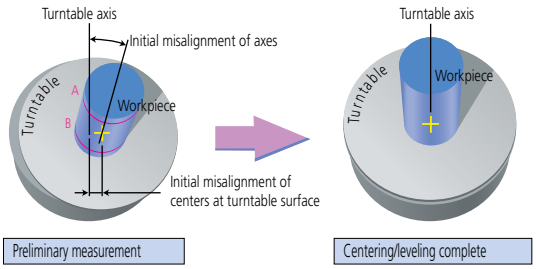
RA-2200AS with personal computer system and software

* Shown with optional vibration isolator and side table for PC

Highly accurate and easy-to-use turntable

With extremely high rotational accuracy, both in the radial and axial directions, the turntable allows high accuracy flatness testing to be performed in addition to roundness and cylindricity measurements.

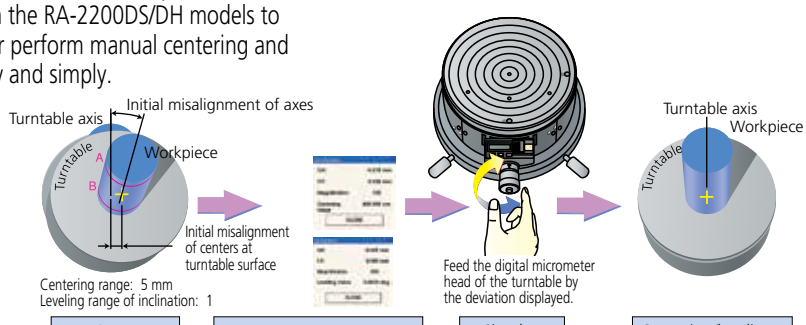
Incorporating an automatic centering/leveling turntable (A.A.T.), the top-of-the-line RA-2200AS/AH models relieve the operator of the bothersome task of workpiece centering and leveling.



Preliminary measurement of two cross-sections A and B.

Preliminary measurement is followed by automatic centering and leveling.

A guidance system (D.A.T.) is incorporated into the turntables on the RA-2200DS/DH models to help the operator perform manual centering and leveling smoothly and simply.



Preliminary measurement of two cross-sections A and B.

Mitutoyo

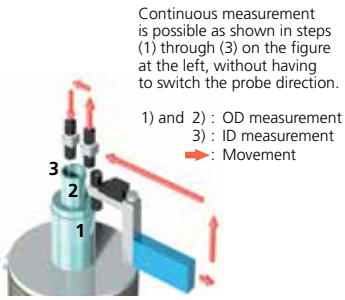
Roundtest RA-2200AS / DS / AH / DH

SERIES 211 — Roundness / Cylindricity Measuring System

Greater productivity by continuous measurement

Both the OD and ID of a workpiece* can be measured in succession without the need for changing the traverse direction of the stylus.

*Inside diameter up to 50 mm.



Continuous measurement is possible as shown in steps (1) through (3) on the figure at the left, without having to switch the probe direction.

1) and 2) : OD measurement
3) : ID measurement
➡: Movement

Highly repeatable measurements with high-accuracy scales Mitutoyo linear scales are used in the X/Z drive unit to guarantee the high precision positioning so vital for repetitive measurement.

Surface roughness measurement function (Surface roughness unit: option)

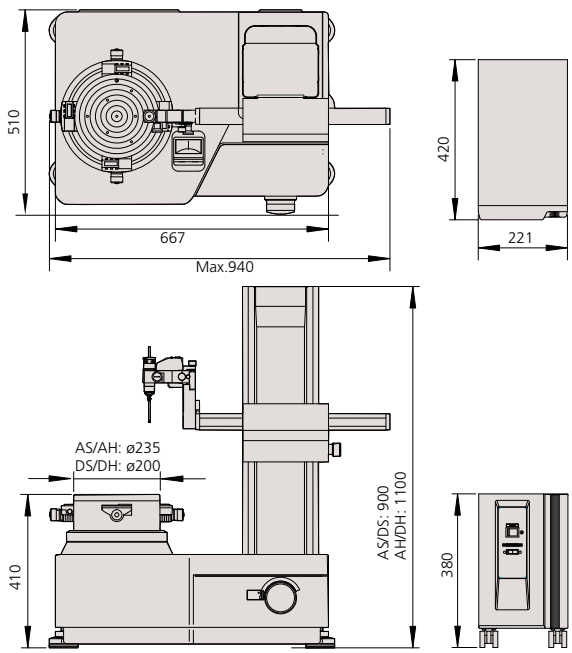
A surface roughness detector, compliant with the relevant International Standards, can be mounted in place of the roundness measuring detector. This creates a multiple sensor system that can not only test the geometrical roundness/ cylindricity of a surface but also the roughness of that surface as well.

SPECIFICATIONS

Model No.	RA-2200AS	RA-2200DS	RA-2200AH	RA-2200DH
Order No.	**211-511A** (mm/inch)	**211-514A** (inch)	**211-512A** (mm/inch)	**211-516A** (inch)
Effective table diameter	9.25" (235mm)	8" (200mm)	9.25" (235mm)	8" (200mm)
Centering/leveling adjustment	A.A.T.	D.A.T.	A.A.T.	D.A.T.
Centering range	±0.118" (±3mm)	±0.197" (±5mm)	±0.118" (±3mm)	±0.197" (±5mm)
Column travel	12" (300mm) (standard column)		20" (500mm) (high column)	
Basic unit mass	396 lbs. (180kg)		440 lbs. (200kg)	

DIMENSIONS

Unit: mm



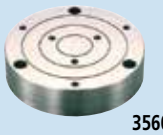
Optional Accessories

350850:	Cylindrical square
356038:	Auxiliary stage for a low-height workpiece
12AAF203:	Extension probe holder (2X higher)
12AAF204:	Auxiliary probe holder for a large diameter workpiece
211-045:	Magnification checking gage
211-014:	Chuck (OD: 1 - 85mm, ID: 33 - 85mm)
211-032:	Quick chuck (OD: 1 - 75mm, ID: 14 - 70mm)
211-031:	Micro-chuck (OD: 1.5mm max.)
178-025:	Vibration isolator
178-024:	Stand for vibration isolator
———:	Interchangeable styli (See page J-49.)
12AAK110:	Vibration isolator
12AAK120:	Monitor arm
12AAL019:	Side table for PC
12AAF353:	Surface roughness detector holder


211-032


211-014


211-031


356038


211-045


350850

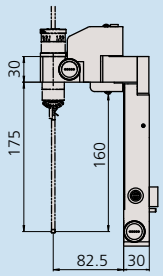
Sliding detector-unit holder (Standard) 12AAL090

The detector-unit holder is equipped with a sliding mechanism, enabling one-touch measurement of a workpiece with a deep hole having a thick wall, which has been difficult with the conventional standard arm.

Sliding distance: 4.4"(112mm)

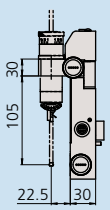
The detector-unit holder can be stopped at a position sufficiently higher than the workpiece along the Z-axis, and then lowered and positioned to make measurements. Furthermore, internal/external diameters can be easily measured with the continuous internal/external diameter measurement function*.

*: See page 41 for details about the continuous ID and OD measuring function.



12AAF203

Unit: mm



12AAF204

Roundtest RA-H5200AS / AH

SERIES 211 — Roundness / Cylindricity Measuring System

Technical Data

Turntable
Rotational accuracy (radial): {(0.02+3.5H/10000)µm}
Rotational accuracy (axial): {(0.02+3.5X/10000)µm}
H: Probing height (mm), X: Distance from the turntable axis (mm)
- Rotating speed: 2, 4, 6, 10rpm (20rpm: auto-centering)
- Table top diameter: ø 11.8" (300mm)
- Centering range: ±5mm
- Leveling range: ±1°
- Maximum probing diameter: ø 15.7" (400mm)
- Maximum workpiece diameter: ø 26.8" (680mm)
- Maximum workpiece weight: 176 lbs (80kg)
  143 lbs (65kg): auto-centering

Vertical column (Z-axis)
- Vertical travel: 13.8" (350mm), (21.7" (550mm): AH model)
- Straightness (λc2.5): 0.05µm / 100mm, 0.14µm / 350mm
  (0.2µm / 550mm: AH model)
- Parallelism with rotating axis: 0.2µm / 350mm
  (0.32µm / 550mm: AH model)
- Positioning speed: Max. 60mm/s
- Measuring speed: 0.5, 1, 2, 5mm/s
- Maximum probing height: 13.8" (350mm) (OD / ID)
  [21.7" (550mm) (OD / ID): AH model)
- Maximum probing depth: over ø32: 85mm (w/standard stylus)
  over ø7: 50mm (w/standard stylus)

Horizontal arm (X-axis)
- Horizontal travel: 8.9" (225mm)
- Straightness (λc2.5): 0.4µm / 200mm
- Squareness with rotating axis: 0.5µm / 200mm
- Positioning speed: Max. 50mm/s
- Measuring speed: 0.5, 1, 2, 5mm/s

Probe and stylus
- Measuring range: ±400µm (±5mm: tracking range)
- Measuring force: 10mN~50mN (in 5 steps)
- Standard stylus: **12AAL021**, carbide ball, ø1.6mm
- Measuring direction: Two directional
- Stylus angle adjustment: ±45° (with graduations)

Data analysis system
- Analysis software: Roundpak
- Filter type:
  2CRPC-75%, 2CRPC-50%, 2CR-75% (non-phase corrected), 2CR-50% (non-phase corrected), Gaussian, filter OFF
- Cutoff value;
  15upr, 50upr, 150upr, 500upr, 1500upr, 15-150upr, 15-500upr, 15-1500upr, 50-500upr, 50-1500upr, 150-1500upr, Manual setting
- Reference circles for roundness evaluation:
  LSC, MZC, MIC, MCC

Air supply
- Air pressure: 390kPa (4kgf/cm²)
- Air consumption: 45L/min.

Power supply: 100V AC – 240V AC, 50/60Hz
Dimensions (W x D x H): 49.6 x 28.0 x 66.9"
(1260 x 710 x 1700mm)
49.6 x 28.0 x 74.8"
(1260 x 710 x 1900mm: AH model)
Mass: Main unit: 1433lbs. (650kg)
1477lbs. (670kg): AH model
Vibration isolator: 375 lbs (170kg)

RA-H5200AS / AH, a roundness/cylindricity measuring system developed to combine world-class accuracy with maneuverability/ high-analysis capability.

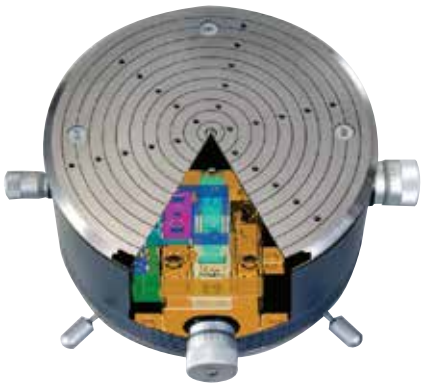
Enhanced detector safety functions, such as accidental touch and collision detection, is installed to minimize damage to both machine and workpieces.

RA-H5200AS with personal computer system and software

* Shown with optional side table for PC.

High-accuracy automatic centering/leveling turntable

A highly accurate, highly rigid turntable has been achieved through exceptional manufacturing accuracy of the critical components, such as the rotor and stator, in addition to an air-bearing incorporating a complex aperture that provides superior rigidity and uniform pressure distribution. As a result, the rotational accuracy (radial), which is the heart of the roundness/ cylindricity measuring system, is a world-class (0.02 +3.5H/10000)µm.



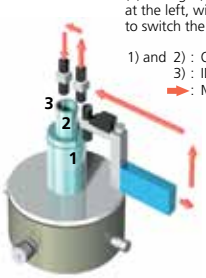
Automatic continuous OD/ID measurement

Automatic measurement can be performed continuously from external diameter to internal diameter without having to change the probe position. This not only reduces measurement time, but eliminates the error factors otherwise involved in changing the probe position, greatly facilitating high-accuracy measurement.

The automatic centering/leveling mechanism incorporates a high-precision glass scale on each axis of the turntable. This allows feedback to be generated that prevents positioning errors from affecting centering/leveling adjustments. The high-speed, automatic, centering/leveling capability achieved greatly contributes to reducing the total measurement time from workpiece setting to workpiece measurement.

Continuous measurement is possible as shown in steps (1) through (3) on the figure at the left, without having to switch the probe direction.

1) and 2) : OD measurement
3) : ID measurement
→ : Movement



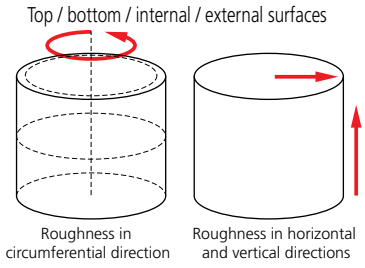
Mitutoyo

Roundtest RA-H5200AS / AH

SERIES 211 — Roundness / Cylindricity Measuring System

X-axis tracking measurement
Because of the linear scale incorporated into the X-axis, measurement can be performed by tracking the workpiece surface (tracking range: ±5mm). This function is effective for measuring a workpiece with a displacement that exceeds the detection range of the probe in measuring roundness/cylindricity or a taper that is determined with slider/column movement.

Surface roughness measurement function (Surface roughness unit: option)
A surface roughness detector, compliant with the relevant international standards, can be mounted in place of the roundness measuring detector. This creates a multiple sensor system that can not only test the geometrical roundness/cylindricity of a surface, but also the roughness of that surface.

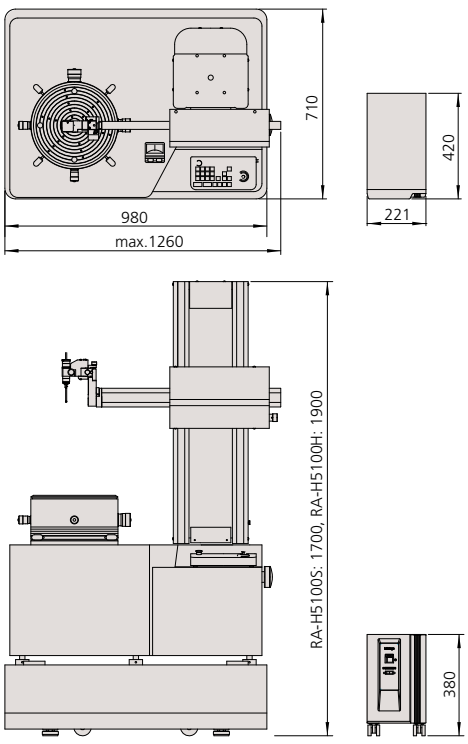


SPECIFICATIONS

Model No.	RA-H5200AS	RA-H5200AH
Order No. * with vibration isolating stand	**211-531A**	**211-532A**
Column travel	13.77" (350mm) (standard column)	21.65" (550mm) (high column)

DIMENSIONS

Unit: mm



Optional Accessories

350850: Cylindrical square
12AAF203: Extension probe holder (2X higher)
12AAF205: Extension probe holder (3X higher)
12AAF204: Auxiliary probe holder for a large diameter workpiece
211-045: Magnification calibration gage
211-014: Chuck (OD: 2 - 78mm, ID: 25 - 68mm)
211-032: Quick chuck (OD: 1 - 79mm, ID: 16 - 69mm)
211-031: Micro-chuck (OD: 0.1~1.5mm max.)
12AAB598: Protective shield
———: Interchangeable styli (See page J-49.)
12AAL019: Side table for PC

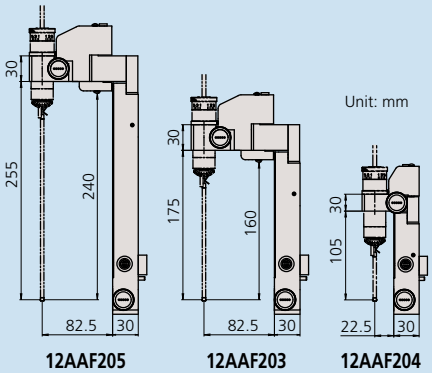
Sliding detector-unit holder (Standard) 12AAL090
The detector-unit holder is equipped with a sliding mechanism, enabling one-touch measurement of a workpiece with a deep hole having a thick wall, which has been difficult with the conventional standard arm.

Sliding distance: 4.4" (112mm)

The detector-unit holder can be stopped at a position sufficiently higher than the workpiece along the Z-axis, and then lowered and positioned to make measurements. Furthermore, internal/external diameters can be easily measured with the continuous internal/external diameter measurement function*.

*: See page 41 for details about the continuous ID and OD measuring function.

Unit: mm



Roundtest Extreme RA-2200CNC / RA-H5200CNC

SERIES 211 — CNC Roundness, Cylindricity and Surface Roughness Measuring System

Mitutoyo offers innovative roundness/ cylindricity measuring systems capable of automated measurement with independent/ simultaneous multi-axis CNC control. In addition to high measuring accuracy and reliability, these CNC models provide excellent inspection productivity. Roundness and surface roughness measurements are both available from a single measuring system so workpiece resetting for roughness measurement is not required. Roughness measurement is possible in the axial and circumferential directions.

Holder-arm orientation switching (vertical position - horizontal position)

Detector rotation mechanism (0 to 290°, in increments of 1°)

RA-2200H CNC
with personal computer system and software

* Shown with optional vibration isolator and side table for PC.

RA-H5200H CNC
with personal computer system and software

* Shown with optional side table for PC.

Technical Data: RA-2200CNC

Turntable
- Rotational accuracy (radial): {(0.02+3.5H/10000)µm}
- Rotational accuracy (axial): {(0.02+3.5X/10000)µm}
  H: Probing height (mm), X: Distance from the turntable axis (mm)
- Rotating speed: 2, 4, 6, 10rpm
- Tabletop diameter: ø 9.25" (235mm)
- Centering range: ±3mm
- Leveling range: ±1°
- Maximum probing diameter: ø 10.1" (256mm)
- Maximum workpiece diameter: ø 22.8" (580mm)
- Maximum workpiece weight: 66 lbs (30kg)

Vertical column (Z-axis)
- Vertical travel: 11.8" (300mm) 19.7" (500mm: 2200H model)
- Straightness (c2.5): 0.10µm / 100mm, 0.15µm / 300mm (0.25µm / 500mm: 2200H model)
- Parallelism with rotating axis: 0.7µm / 300mm (1.2µm / 500mm: 2200H model)
- Positioning speed: Max. 50mm/s
- Measuring speed: 0.5, 1, 2, 5mm/s
- Maximum probing height: 11.8" (300mm) (OD / ID) [19.7" (500mm) (OD / ID): 2200H model]
- Maximum probing depth: over ø32: 104mm (w/standard stylus) over ø12.7: 26mm (w/standard stylus)

Horizontal arm (X-axis)
- Horizontal travel: 6.9" (175mm) (Including a protrusion of 1" (25mm) the turntable rotation center)
- Straightness (c2.5): 0.7µm / 150mm
- Squareness with rotating axis: 1.0µm / 150mm
- Positioning speed: Max. 30mm/s
- Measuring speed: 0.5, 1, 2, 5mm/s

Probe and stylus
- Measuring range: ±400µm/±40µm/±4µm (±5mm: tracking range)
- Measuring force: 40mN (not adjustable)
- Standard stylus: **12AAE301**, carbide ball, ø1.6mm
- Measuring direction: one direction
- Stylus angle adjustment: ±45° (with graduations)

Air supply
- Air pressure: 390kPa (4kgf/cm^2)
- Air consumption: 30L/min.

Power supply: 100V AC – 240V AC, 50/60Hz

Dimensions (W x D x H): 26.3 x 20 x 35.4" (667 x 510 x 900mm) (26.3 x 20 x 43.3" (667 x 510 x 1100mm): 2200H model)

Mass: 397 lbs (180kg) (441 lbs (200kg): 2200H model)

Technical Data: RA-H5200CNC

Turntable
- Rotational accuracy (radial): (.8+.35H)µin {(0.02+3.5H/10000)µm}
- Rotational accuracy (axial): (.8+.35X)µin {(0.02+3.5X/10000)µm}
  H: Probing height (mm), X: Distance from the turntable axis (mm)
- Rotating speed: 2, 4, 6, 10rpm (20rpm: auto-centering)
- Table top diameter: ø300mm
- Centering range: ±5mm
- Leveling range: ±1°
- Maximum probing diameter: ø14" (356mm)
- Maximum workpiece diameter: ø 26.8" (680mm)
- Maximum workpiece weight: 176 lbs (80kg) 143 lbs (65kg): auto-centering

Vertical column (Z-axis)
- Vertical travel: 13.7" (350mm) 21.7" (550mm): H5200H model
- Straightness (λc2.5): 0.05µm / 100mm, 0.14µm / 350mm (0.2µm / 550mm: H5200H model)
- Parallelism with rotating axis: 0.2µm / 350mm (0.32µm / 550mm: H5200H model)
- Positioning speed: Max. 60mm/s
- Measuring speed: 0.5, 1, 2, 5mm/s
- Maximum probing height: 13.7" (350mm) (OD / ID) [21.7" (550mm) (OD / ID): H5200H model)
- Maximum probing depth: over ø32: 104mm (w/standard stylus) over ø12.7: 26mm (w/standard stylus)

Horizontal arm (X-axis)
- Horizontal travel: 8.8" (225mm)
- Straightness (λc2.5): 0.4µm / 200mm
- Squareness with rotating axis: 0.5µm / 200mm
- Positioning speed: Max. 50mm/s
- Measuring speed: 0.5, 1, 2, 5mm/s

Probe and stylus
- Measuring range: ±400µm (±5mm: tracking range)
- Measuring force: 40mN (not adjustable)
- Standard stylus: **12AAE301**, carbide ball, ø1.6mm
- Measuring direction: one direction
- Stylus angle adjustment: ±45° (with graduations)

Air supply
- Air pressure: 390kPa (4kgf/cm^2)
- Air consumption: 45L/min.

Power supply: 100V AC – 240V AC, 50/60Hz

Dimensions (W x D x H): 49.6 x 28.0 x 66.9" (1260 x 710 x 1700mm) 49.6 x 28.0 x 74.8" (1260 x 710 x 1900mm: H5200H model)

Mass: Main unit: 1433 lbs (650kg) 1477 lbs (670kg): H5200H (model)

Vibration isolator: 375 lbs (170kg)

Mitutoyo

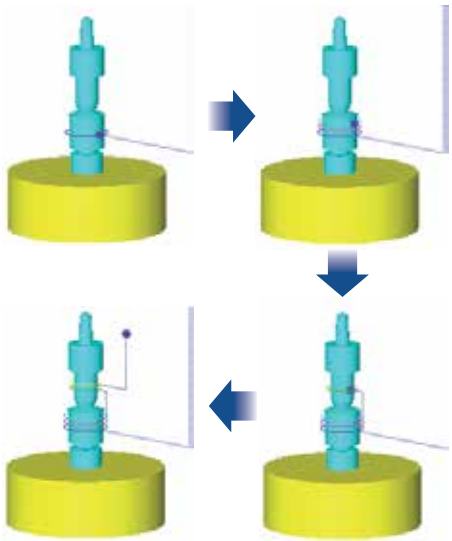
Roundtest Extreme
RA-2200CNC / RA-H5200CNC

SERIES 211 — CNC Roundness, Cylindricity and Surface Roughness Measuring System

ROUNDPAK

Off-line measurement procedure programming function

On-screen virtual 3D simulation measurements can be performed with the incorporated off-line teaching function that allows a part program (measurement procedure) to be created without an objective workpiece. The probe and the holder unit of the Roundtest Extreme can be precisely represented and an alarm can be raised to indicate that there is a collision risk predicted by the simulation.



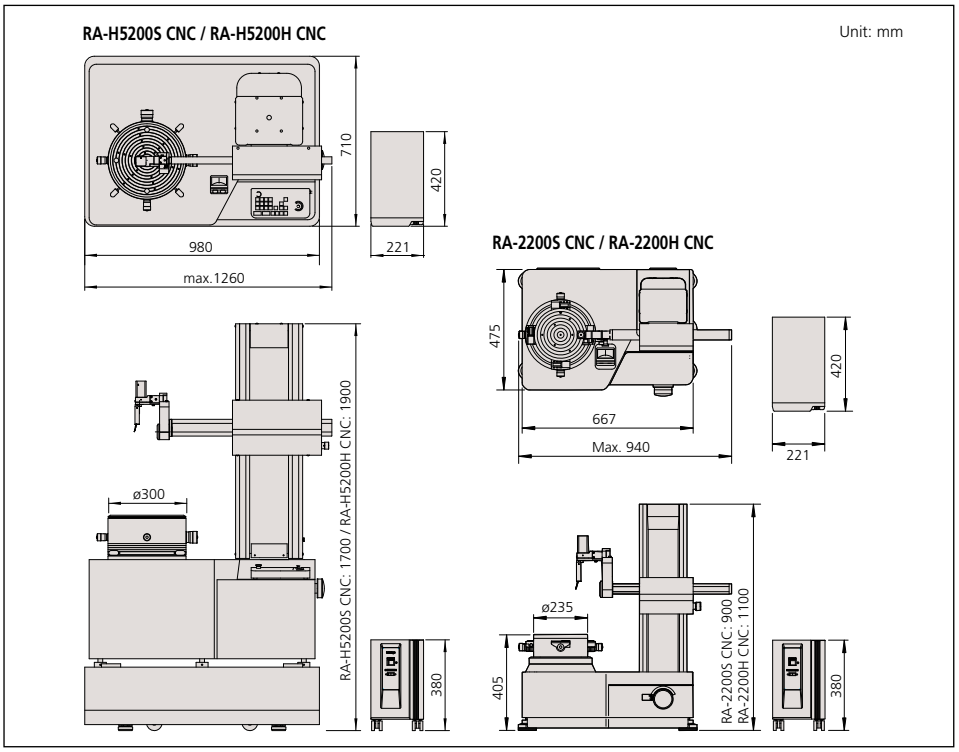
3D simulation screens (work-view windows) can be generated after entering CAD data (in IGES, DXF form) and text data.

SPECIFICATIONS

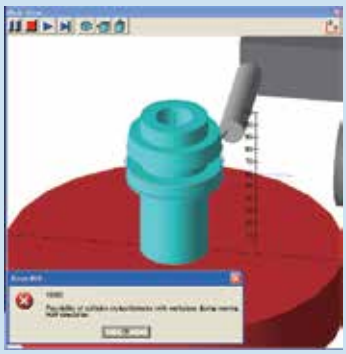
Model No.	EXTREME RA-2200S CNC	EXTREME RA-2200H CNC
Order No.	**211-517A**	**211-518A**
Column travel	11.8″ (300mm) (standard column)	19.7″ (500mm) (high column)

Model No.	EXTREME RA-H5200S CNC	EXTREME RA-H5200H CNC
Order No. with vibration isolating stand	**211-533A**	**211-534A**
Column travel	13.77″ (350mm) (standard column)	21.65″ (550mm) (high column)

DIMENSIONS



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



Optional Accessories

350850: Cylindrical square
211-045: Magnification calibration gage
211-014: Chuck (OD: 1 - 78mm, ID: 25 - 68mm)
211-032: Quick chuck (OD: 1 - 79mm, ID: 16 - 69mm)
211-031: Micro-chuck (OD: 0.1~1.5mm max.)
12AAB598: Protective shield (RA-H5200 only)
———: Interchangeable styli (See page J-49.)
12AAK110: Vibration isolator (RA-2200 only)
12AAK120: Monitor arm (RA-2200 only)
12AAL019: Side table for PC
12AAG419: Surface roughness detector for RA-CNC

64AAB573 Workstation

Dimensions

Overall: 36 x 30 x 24-32″ (W x D x H)
Cord Bin: 4″h x 5-3/8″d (width is 10″ less than table width)
Distance From Front Edge to Cord Bin: 30″d table – 15-1/2″d
Distance Between Legs: 10″ less than the overall table width

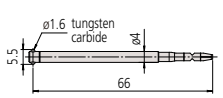
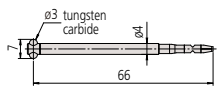
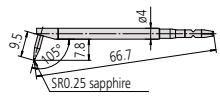
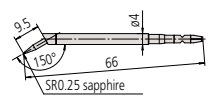
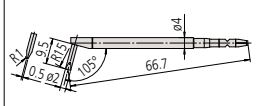
Work surface feature a 1″, 45 lb density, furniture board substrate with attractive Gray laminate tabletop brimmed with bullnose edge band in Quartz gray color. Work surface is height adjustable in one inch increments from 24″ to 32″.

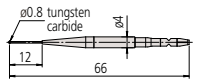
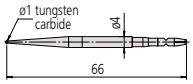
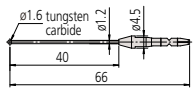
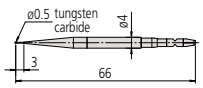
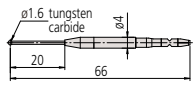
Tabletop incorporates metal threaded inserts on the underside to affix the leg assemblies for added strength and durability. Table comes with 4″ casters with two as locking type for stationary placement.

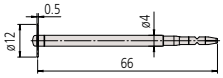
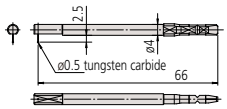
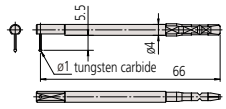
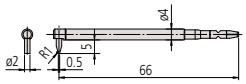
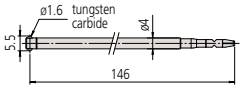
*Laptop PC not included with table.

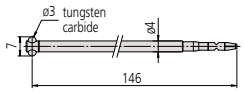
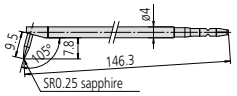
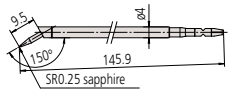
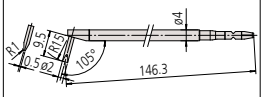
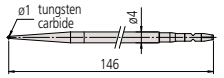
Optional Styli for Roundtest

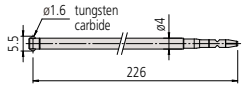
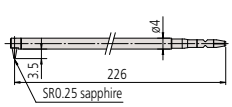
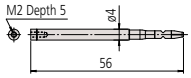
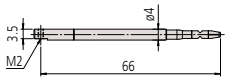
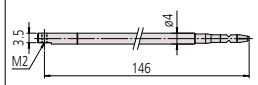
Interchangeable Styli for RA-120, RA-120P, RA-1600/M, RA-2200, RA-H5200

Application/Type	Standard (Standard accessory)	Notch	Deep groove	Corner	Cutter mark
Order No.	**12AAL021***	**12AAL022**	**12AAL023**	**12AAL024**	**12AAL025**
Stylus tip	ø1.6 mm tungsten carbide	ø3 mm tungsten carbide	SR0.25mm sapphire	SR0.25mm sapphire	tungsten carbide
Dimensions (mm)		 Included in 5-pcs. styli set No. 12AAL020	 Included in 5-pcs. styli set No. 12AAL020		

Application/Type	Small hole (ø0.8)	Small hole (ø1.0)	Small hole (ø1.6)	Extra small hole (Depth 3mm)	ø1.6 mm ball
Order No.	**12AAL026**	**12AAL027**	**12AAL028**	**12AAL029**	**12AAL030**
Stylus tip	ø0.8 mm tungsten carbide	ø1 mm tungsten carbide	ø1.6 mm tungsten carbide	ø0.5 mm tungsten carbide	ø1.6 mm tungsten carbide
Dimensions (mm)		 Included in 5-pcs. styli set No. 12AAL020			 Included in 5-pcs. styli set No. 12AAL020

Application/Type	Disk	Crank (ø0.5)	Crank (ø1.0)	Flat surface	2X-long type**
Order No.	**12AAL031**	**12AAL032**	**12AAL033**	**12AAL034**	**12AAL035**
Stylus tip	ø12 mm tungsten carbide	ø0.5 mm tungsten carbide (Depth 2.5 mm)	ø1 mm tungsten carbide (Depth 5.5 mm)	tungsten carbide	ø1.6 mm tungsten carbide
Dimensions (mm)					 Included in 5-pcs. styli set No. 12AAL020

Application/Type	2X-long type notch**	2X-long type deep groove**	2X-long type corner**	2X-long type cutter mark**	2X-long type Small hole**
Order No.	**12AAL036**	**12AAL037**	**12AAL038**	**12AAL039**	**12AAL040**
Stylus tip	ø3 mm tungsten carbide	SR0.25 mm sapphire	SR0.25 mm sapphire	tungsten carbide	ø1 mm tungsten carbide
Dimensions (mm)					

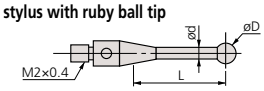
Application/Type	3X-long type**	3X-long type deep groove**	Stylus shank	Stylus shank (standard groove)	Stylus shank (2X-long groove)**
Order No.	**12AAL041**	**12AAL042**	**12AAL043**	**12AAL044**	**12AAL045**
Stylus tip	ø1.6 mm tungsten carbide	SR0.25 mm sapphire	For mounting CMM stylus (mounting thread M2)	For mounting CMM stylus (mounting thread M2)	For mounting CMM stylus (mounting thread M2)
Dimensions (mm)					

* **12AAL021** is a standard accessory for all Roundtest models.
** Not available for RA-10, RA-120/P and RA-220
Measuring is only in the vertical direction. Measuring magnification of 20000X is available using the 2X-long stylus.
Customized special interchangeable styli are available on request. Please contact any Mitutoyo office for more information.
† New design for holding styli is not shown in above illustrations.
New styli for RA-2200 / H5200 are compatible with old RA-2100 / H5100 detectors.
Old styli for RA-2100 / H5100 are NOT compatible with new RA-2200 / H5200 detectors.

5 pc. Stylus set: 12AAL020

Part No.	Part Description
12AAL022	Stylus for notched workpiece
12AAL023	Stylus for deep groove
12AAL027	Stylus for small hole (1.0mm)
12AAL030	1.6mm ball stylus
12AAL035	2X-long type stylus

M2 CMM stylus with ruby ball tip



Unit: mm

K651276
D = ø0.5, d = ø0.34, L = 3.0, Mass = 0.3g

K651236
D = ø0.7, d = ø0.5, L = 4.0 , Mass = 0.3g

K651012
D = ø1.0, d = ø0.7, L = 4.5, Mass = 0.3g

K651013
D = ø1.5, d = ø0.7, L = 4.5, Mass = 0.3g

K651014
D = ø2.0, d = ø1.0, L = 6.0, Mass = 0.3g

K651016
D = ø3.0, d = ø1.5, L = 7.5, Mass = 0.4g

K651017
D = ø4.0, d = ø1.5, L = 10.0, Mass = 0.4g

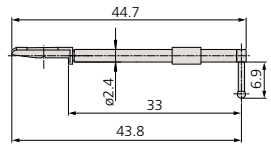
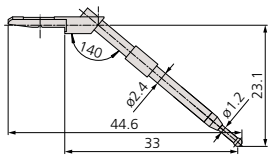
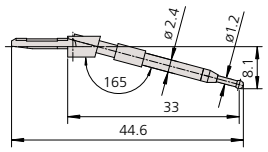
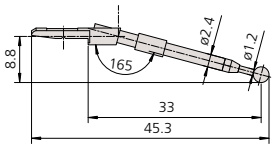
K651018
D = ø5.0, d = ø2.5, R = 10.0, Mass = 0.7g

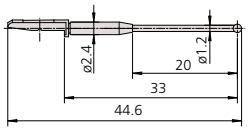
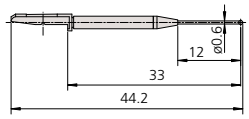
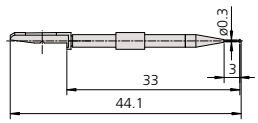
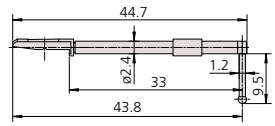
K651024
D = ø6.0, d = ø2.5, R = 10.0, Mass = 0.9g

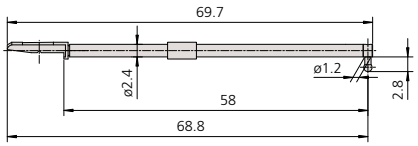
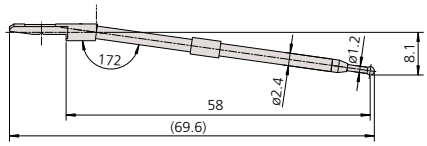
K651025
D = ø8.0, d = ø2.5, R = 11.0, Mass = 1.5g

Optional Styli for Roundtest

Interchangeable Styli for RA-2200 CNC, RA-H5200 CNC

Application/Type	Groove	Flat surface	General purpose	Notch
Order No.	**12AAE310**	**12AAE302**	**12AAE301**	**12AAE309**
Stylus tip	ø1.6 mm tungsten carbide	ø1.6 mm tungsten carbide	ø1.6 mm tungsten carbide	ø3 mm tungsten carbide
Dimensions (mm)				

Application/Type	ø1.6 mm ball	ø0.8 mm ball	ø0.5 mm ball	Deep groove
Order No.	**12AAE303**	**12AAE304**	**12AAE305**	**12AAE308**
Stylus tip	ø1.6 mm tungsten carbide	ø0.8 mm tungsten carbide	ø0.5 mm tungsten carbide	ø1.6 mm tungsten carbide
Dimensions (mm)				

Application/Type	Deep hole A	Deep hole B
Order No.	**12AAE306**	**12AAE307**
Stylus tip	ø1.6 mm tungsten carbide	ø1.6 mm tungsten carbide
Dimensions (mm)		

Analysis options		RA-H5200CNC/ RA-H5200	RA-2200CNC/ RA-2200	RA-1600	RA-1600M	RA-120P	RA-120
Roundness	○	●	●	●	●	●	●
Cylindricity	⌭	●	●	●	●	—	—
Concentricity	◎	●	●	●	●	●	●
Coaxiality	axis-element	◉	●	●	●	●	●	●
	Axis-axis		●	●	●	●	●	—
Flatness	▱	●	●	●	▲	●	●
Parallelism	//	●	●	●	▲	●	●
Perpendicularity	⊥	●	●	●	●	●	●
Runout	↗	●	●	●	●	●	●
Total runout	⌰	●	●	●	▲	—	—
Straightness	—	●	●	●	▲	—	—
Inclination	∠	●	●	●	▲	—	—
Taper	/\	●	●	●	▲	—	—

● Full measurment capability
▲ Limited measurement capability; R-Axis must be stationary.

Usage examples of styli


Cutter mark

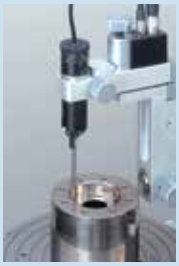

Corner


Small hole


Small hole


Flatness measurement


Notched workpiece measurement


ID measurement

Optional Accessories for Roundtest

Centering chuck (ring operated)
211-032
Suitable for holding small parts with easy-to-operate knurled-ring clamping.
- Holding capacity:
  Internal jaws: OD = 1-36 mm, ID = 14-70 mm.
External jaws: OD = 1-75 mm.
- External dimensions: ø118x41 mm
- Mass: 1.2kg

Centering chuck (key operated)
211-014
Suitable for holding longer parts and those requiring a relatively powerful clamp.
- Holding capacity:
  Internal jaws: OD = 1 - 35mm, ID = 33 - 85mm
  External jaws: OD = 30-80mm.
- External dimensions: ø157 x 76mm
- Mass: 3.8kg

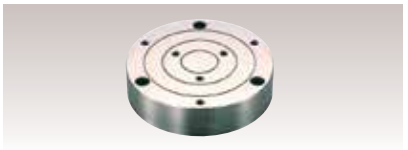
Vibration Isolated frame with work surface

Code No.	Dimensions	Load Capacity
64AAB357	30 x 48 x 30"	1300 lbs

Cylindrical square
350850
- Used for checking and aligning table rotation axis parallel to the Z-axis column.
- Squareness: 3µm
- Straightness: 1µm
- Cylindricity: 2µm
- Roundness: 0.5µm
- Mass: 7.5kg

Micro-chuck
211-031
Used for clamping a workpiece (less than ø1 mm dia.) that the centering chuck cannot handle.
- Holding capacity: up to ø1.5 mm
- External dimensions: ø118x48.5 mm
- Mass: 0.8kg

Magnification calibration gage
211-045
Used for normalizing detector magnification by calibrating detector travel against displacement of a micrometer spindle.
- Maximum calibration range: 400µm
- Graduation: 0.2µm
- Mass: 4kg



Auxiliary workpiece stand
356038
- Used for measuring a workpiece whose diameter is 20mm or shorter and whose height is 20mm or lower.

Magnification checking kit*
997090
- A combination of gage blocks and an optical flat.

* Standard accessory for RA-2200, RA-2200CNC, RA-H5200 and RA-H5200CNC

Origin-point gage*
998382
- A gage for zero setting of the R-axis and Z-axis.

* Standard accessory for RA-2200 and RA-H5200

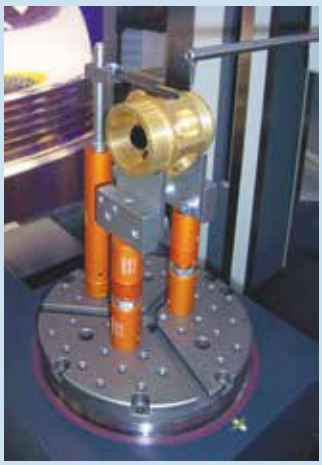
211-016
Reference Hemisphere

Mitutoyo

Eco-Fix Kit Form-S

Mitutoyo ECO-FIX Kit Fixture Systems

Part No.	Qty.	Part name	Part No.	Qty.	Part name
K551038	1	Adaptor plate ø 150mm	**K551069**	1	Flat top ø 12mm
K551024	1	Location pin ø 12 X 13mm	**K550262**	1	V-block mini
K551025	1	Location pin ø 12 X 25mm	**K550261**	2	Cone receiver mini
K551026	1	Location pin ø 12 X 50mm	**K550250**	1	Stopper element mini
K551027	1	Location pin ø 12 X 100mm	**K550247**	1	Back square mini
K551028	1	Location pin ø 20 X 13mm	**K550888**	2	Straight pin Ø 6mm x 20mm
K551029	1	Location pin ø 20 X 25mm	**K550889**	2	Straight pin Ø 6mm x 30mm
K551030	1	Location pin ø 20 X 50mm	**K550890**	2	Straight pin Ø 6mm x 40mm
K551031	1	Location pin ø 20 X 100mm	**K551046**	1	Slotted nut for receiver bracket h=12mm
K551035	1	Receiver bracket small	**K551050**	1	Allen key 2mm
K551036	1	Receiver bracket large	**K551051**	1	Allen key 3mm
K551040	1	Adjustable location pin ø 20mm	**K551052**	1	Allen key 4mm
K551041	1	Adjustable location pin ø 12mm	**K551053**	1	Allen key 5mm
K551042	3	Location pin ø 12mm with bore ø 6mm	**K551054**	1	Double open ended spanner 10-17
K551044	1	Receiver bracket L=90; ø 12mm	**K550591**	1	Washer ø 6,4mm / ø 17mm
K550716	1	Straight pin with thread	**K550110**	8	Cylinder head screw M6 x 20mm
K550279	1	Spring clip, d= 8mm, L= 60mm	**K550563**	6	Cylinder head screw M6 x 25mm
Kit Part No.			**K551133**		



Eco-Fix Kit Form-L

Part No.	Qty.	Part name	Part No.	Qty.	Part name
K551039	1	Adaptor plate ø 200mm	**K550247**	1	Back square mini
K551024	1	Location pin ø 12 X 13mm	**K550058**	1	V-block
K551025	1	Location pin ø 12 X 25mm	**K550365**	2	Cone receiver
K551026	1	Location pin ø 12 X 50mm	**K550982**	1	Stopper element
K551027	2	Location pin ø 12 X 100mm	**K550248**	1	Back square
K551028	2	Location pin ø 20 X 13mm	**K550888**	2	Straight pin Ø 6mm x 20mm
K551029	2	Location pin ø 20 X 25mm	**K550889**	2	Straight pin Ø 6mm x 30mm
K551030	2	Location pin ø 20 X 50mm	**K550890**	2	Straight pin Ø 6mm x 40mm
K551031	1	Location pin ø 20 X 100mm	**K550000**	2	Straight pin Ø 8mm x 30mm
K551035	1	Receiver bracket small	**K550001**	2	Straight pin Ø 8mm x 50mm
K551036	1	Receiver bracket large	**K550002**	2	Straight pin Ø 8mm x 95mm
K551040	2	Adjustable location pin ø 20mm	**K551046**	1	Slotted Nut for receiver bracket h= 12mm
K551041	1	Adjustable location pin ø 12mm	**K551047**	1	Slotted Nut for receiver bracket h= 15mm
K551042	2	Location pin ø 12mm with bore ø 6mm	**K551050**	1	Allen key 2mm
K551043	3	Location pin ø 20mm with bore ø 8mm	**K551051**	1	Allen key 3mm
K551044	1	Receiver bracket L=90; ø 12mm	**K551052**	1	Allen key 4mm
K551045	1	Receiver bracket L=120; ø 20mm	**K551053**	1	Allen key 5mm
K550279	2	Spring clip, d= 8mm, L= 60mm	**K550591**	1	Washer ø 6,4mm / ø 17mm
K550262	1	V-block mini	**K550110**	12	Cylinder head screw M6 x 20mm
K550261	2	Cone receiver mini	**K550563**	6	Cylinder head screw M6 x 25mm
K550250	1	Stopper element mini			
Kit Part No.			**K551134**		

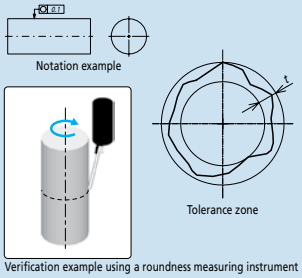
Quick Guide to Precision Measuring Instruments

Roundtest (Roundform Measuring Instruments)

- **JIS B 7451-1997: Roundness measuring instruments**
- **JIS B 0621-1984: Definition and notation of geometric deviations**
- **JIS B 0021-1998: Geometric property specifications touching of products – Geometric tolerance Roundness Testing**

Roundness

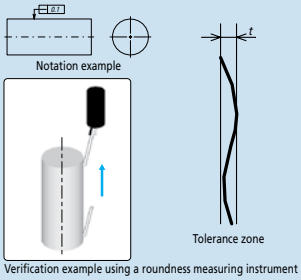
Any circumferential line must be contained within the tolerance zone formed between two coplanar circles with a difference in radii of t



Verification example using a roundness measuring instrument

Straightness

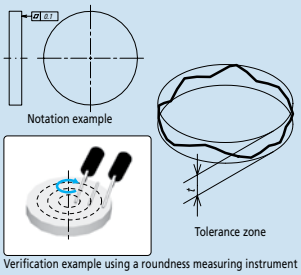
Any line on the surface must lie within the tolerance zone formed between two parallel straight lines a distance t apart and in the direction specified



Verification example using a roundness measuring instrument

Flatness

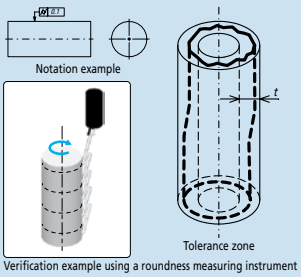
The surface must be contained within the tolerance zone formed between two parallel planes a distance t apart



Verification example using a roundness measuring instrument

Cylindricity

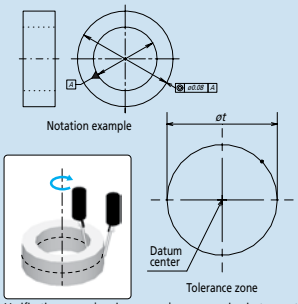
The surface must be contained within the tolerance zone formed between two coaxial cylinders with a difference in radii of t



Verification example using a roundness measuring instrument

Concentricity

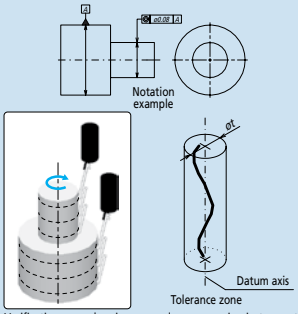
The center point must be contained within the tolerance zone formed by a circle of diameter t concentric with the datum



Verification example using a roundness measuring instrument

Coaxiality

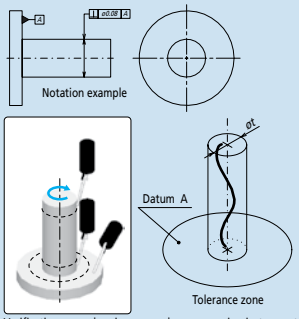
The axis must be contained within the tolerance zone formed by a cylinder of diameter t concentric with the datum



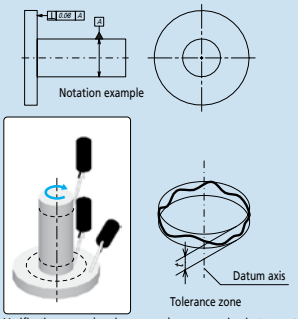
Verification example using a roundness measuring instrument

Perpendicularity

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



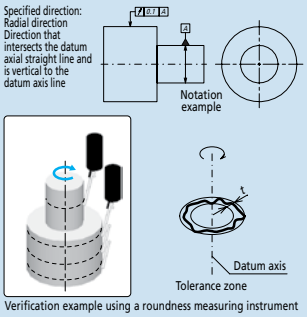
Verification example using a roundness measuring instrument



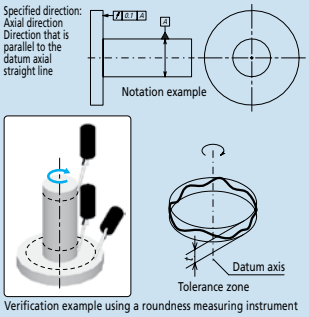
Verification example using a roundness measuring instrument

Circular Runout

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



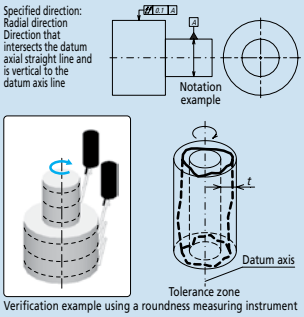
Verification example using a roundness measuring instrument



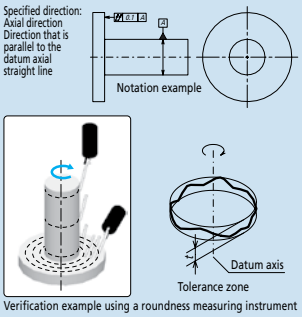
Verification example using a roundness measuring instrument

Total Runout

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



Verification example using a roundness measuring instrument

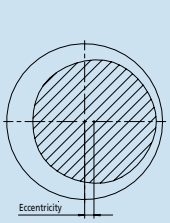


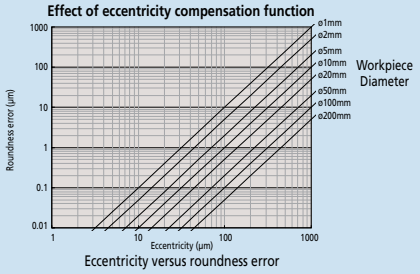
Verification example using a roundness measuring instrument

Adjustment prior to Measurement

Centering

A displacement offset (eccentricity) between the Roundtest's rotary table 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.

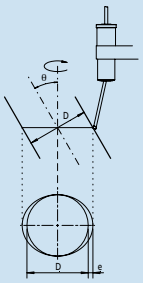


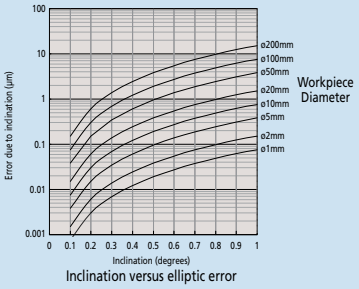


Eccentricity versus roundness error

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

Effect of Filter Settings on the Measured Profile

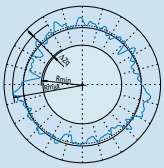
Roundness values as measured are greatly affected by variation of filter cutoff value. It is necessary to set the filter appropriately for the evaluation required.

Evaluating the Measured Profile Roundness

Roundness testers use the measurement data to generate reference circles whose dimensions define the roundness value. There are four methods of generating these circles, as shown below, and each method has individual characteristics so the method that best matches the function of the workpiece should be chosen.

Least Square Circle (LSC) Method

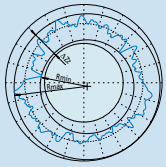
A circle is fitted to the measured profile such that the sum of the squares of the departure of the profile data from this circle is a minimum. The roundness figure is then defined as the difference between the maximum departures of the profile from this circle (highest peak to the lowest valley).



ΔZq = Rmax-Rmin

Minimum Zone Circles (MZC) Method

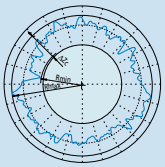
Two concentric circles are positioned to enclose the measured profile such that their radial difference is a minimum. The roundness figure is then defined as the radial separation of these two circles.



ΔZz = Rmax-Rmin

Minimum Circumscribed Circle (MCC) Method

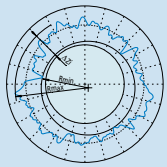
The smallest circle that can enclose the measured profile is created. The roundness figure is then defined as the maximum departure of the profile from this circle. This circle is sometimes referred to as the 'ring gage' circle.



ΔZc = Rmax-Rmin

Maximum inscribed Circle (MIC) Method

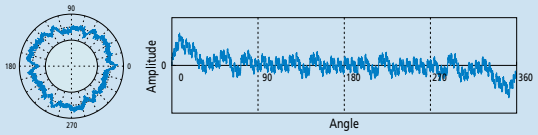
The largest circle that can be enclosed by the profile data is created. The roundness figure is then defined as the maximum departure of the profile from this circle. This circle is sometimes referred to as the `plug gage' circle.



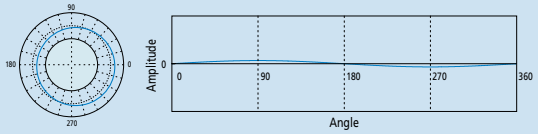
ΔZi = Rmax-Rmin

Undulations Per Revolution (UPR) data in the roundness graphs

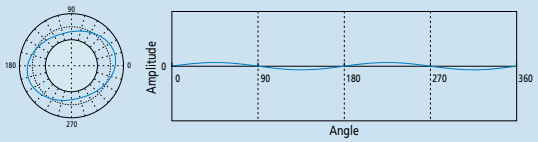
Measurement result graphs



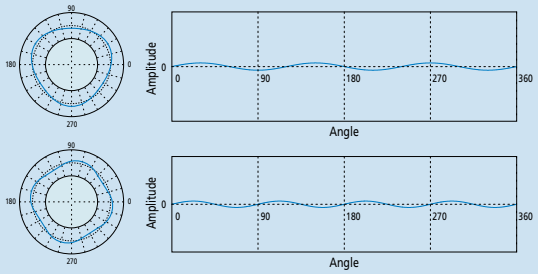
A 1 UPR condition indicates eccentricity of the workpiece relative to the rotational axis of the measuring instrument. The amplitude of undulation components depends on the leveling adjustment.



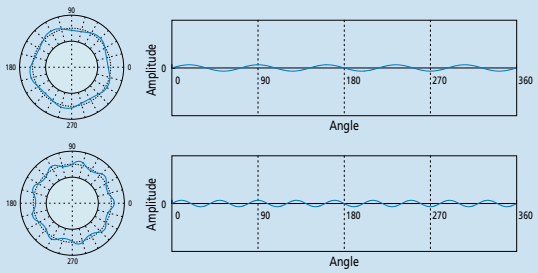
A 2 UPR condition may indicate: (1) insufficient leveling adjustment on the measuring instrument; (2) circular runout due to incorrect mounting of the workpiece on the machine tool that created its shape; (3) the form of the workpiece is elliptical by design as in, for example, an IC-engine piston.



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



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



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