FORM MEASUREMENT

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Form Measurement

Surftest

Formtracer

Contracer

Roundtest

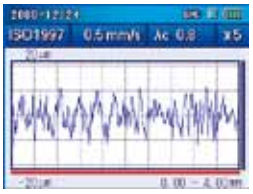
CONTENTS

Mitutoyo

Surftest SJ-210

SERIES 178 – Portable Surface Roughness Tester

- The 2.4-inch colour graphic LCD provides excellent readability and an intuitive display that is easy to navigate. The LCD also includes a backlight for improved visibility in dark environments.
- The Surftest SJ-210 can be operated easily using the buttons on the front of the unit and under the sliding cover.
- Up to 10 setups 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.



Surftest SJ-210

Technical Data

X axis (drive unit)	
Measuring range:	17.5, 5.6 mm (Transverse tracing drive unit type)
Measuring speed:	0.25, 0.5, 0.75 mm/s 1 mm/s (returning)
Detector	
Range:	360 µm (-200 µm to +160 µm)
Measuring method:	Skidded
Measuring force:	0.75 mN or 4 mN
Stylus tip:	Diamond, 90° / R5 µm (60° / R2 µm)
Skid radius of curvature:	40 mm
Skid force:	Less than 400 mN
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:	Memory card (option 12AAL069)
Dimensions (W x D x H)	
Display unit:	52.1 x 65.8 x 160 mm
Drive unit:	115 x 23 x 26 mm
Mass:	About 0.5 kg (Display unit + Drive unit + Standard detector)

Evaluation Capability

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 to customize
Analysis graphs:	Bearning area curve / Amplitude distribution curve
Digital filters:	Gaussian , 2CR75 , PC75
Cutoff length:	lc: 0.08 , 0.25 , 0.8 , 2.5 mm ls: 2.5 , 8 µm
Sampling length:	0.08 , 0.25 , 0.8 , 2.5 mm
Number of sampling lengths (x n):	x1, x2, x3, x4, x5, x6, x7, x8, x9, x10 arbitrary length (0.3 to 16 mm: 0.01 mm interval) x1, x2, x3, x4, x5, x6, x7, x8, x9, x10 arbitrary length (0.3 to 5.6 mm: 0.01 mm interval)*

*Only for Transverse tracing drive unit type

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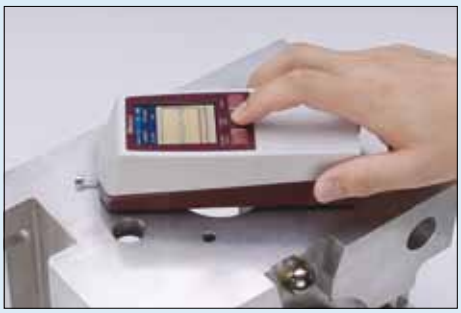
SPECIFICATIONS / CONFIGURATION

Model	**SJ-210**					
Code No. (inch/mm)	**178-561-01E**	**178-561-02E**	**178-563-01E**	**178-563-02E**	**178-565-01E**	**178-565-02E**
Drive unit	Standard type (**178-230-2**)		Retractable type (**178-235**)		Transverse tracing type (**178-233-2**)	
Detector	0.75 mN type (**178-296**)	4 mN type (**178-390**)	0.75 mN type (**178-296**)	4 mN type (**178-390**)	0.75 mN type (**178-387**)	4 mN type (**178-386**)
Display unit	Compact type (178-253*)					
Detector: Conical taper angle	60°	90°	60°	90°	60°	90°
Stylus tip radius	2 µm	5 µm	2 µm	5 µm	2 µm	5 µm
Detector measuring force	0.75 mN	4 mN	0.75 mN	4 mN	0.75 mN	4 mN
Price	**£1280.00**	**£1280.00**	**£1520.00**	**£1520.00**	**£2380.00**	**£2380.00**

Functions

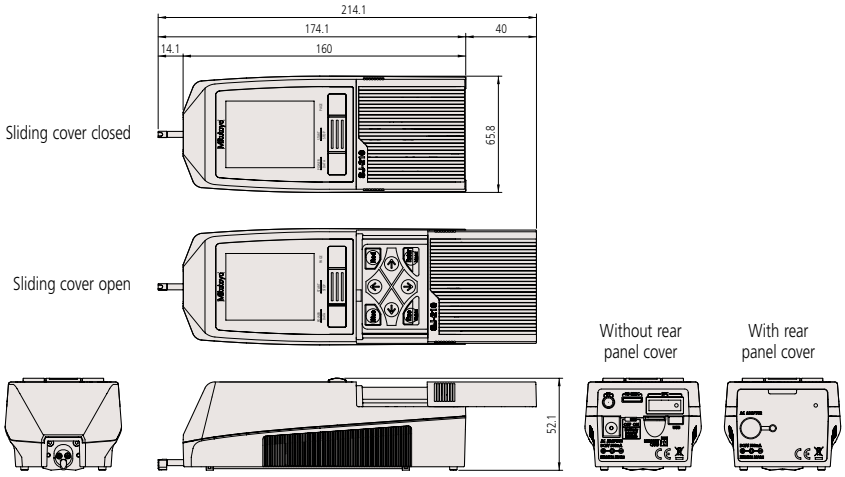
Customization:	Desired parameters can be selected for calculation and display.
GO/NG judgement:	By max value / 16% / Standard deviation
Storage of setups:	Save the setup at power OFF
Storage	
Internal memory:	Setups (10 sets), Measured profile (1 set)
Memory card (option):	500 setups, 10000 measured profiles, 500 display images, text file (setups / 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



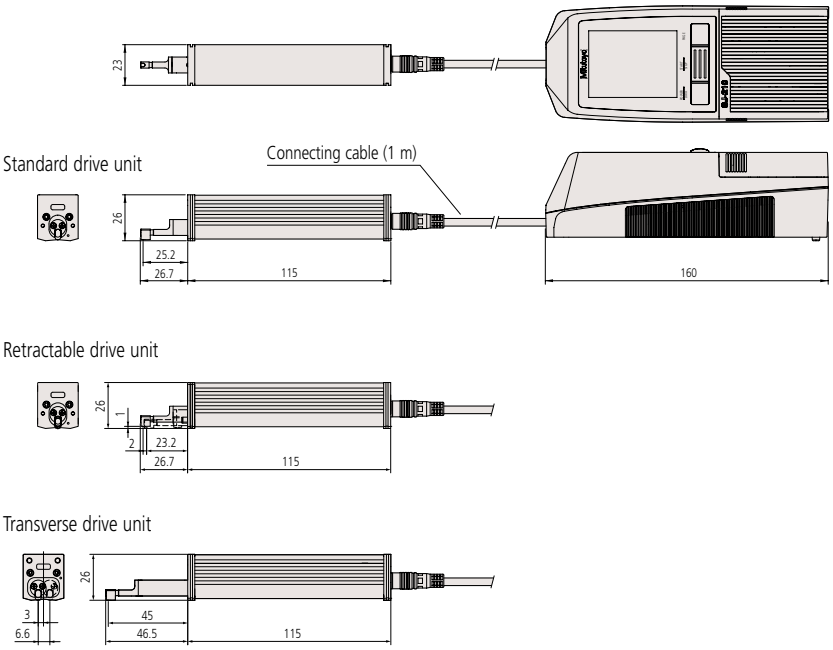
DIMENSIONS: Display unit, drive unit

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

Unit: mm



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



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Surftest SJ-310

SERIES 178 – Portable Surface Roughness Tester

- The handheld data processing unit and the 5.7-inch colour graphic LCD touch-panel provide 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 freely switched.
- 10 setups can be saved in the measurement unit. An optional memory card can save setups and the measured profile.

Surftest SJ-310

Technical Data

X axis (drive unit)
- Measuring range: 17.5, 5.6 mm (Transverse tracing drive unit type)
- Measuring speed: 0.25, 0.5, 0.75 mm/s 1 mm/s (Returning)

Detector
- Range: 360 µm (-200 µm to +160 µm)
- Measuring method: Skidded
- Measuring force: 0.75 mN or 4 mN
- Stylus tip: Diamond, 90° / R5 µm (60° / R2 µm)
- Skid radius of curvature: 40 mm
- Skid force: Less than 400 mN
- 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: Memory card (option 12AAL069)

Dimensions (W x D x H)
- Control unit: 275 x 109 x 198 mm
- Drive unit: 115 x 23 x 26 mm

Mass
- Display unit: Approx. 1.7 kg
- Drive unit: 0.2 kg

Evaluation Capability

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 to customize

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

Digital filter: 2CR, PC75, Gaussian

Cutoff length: lc: 0.08, 0.25, 0.8, 2.5, 8 mm
ls: 2.5, 8 µm

Sampling length: 0.08, 0.25, 0.8, 2.5, 8 mm

Number of sampling lengths (x n): x1, x2, x3, x4, x5, x6, x7, x8, x9, x10 arbitrary length (0.3 to 16.0 mm: 0.01 mm interval)
x1, x2, x3, x4, x5, x6, x7, x8, x9, x10 arbitrary length (0.3 to 5.6 mm: 0.01 mm interval)*

Printer: Thermal type

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

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

* Only for Transverse tracing drive unit type

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SPECIFICATIONS / CONFIGURATION

Model	**SJ-310**					
Code No. (inch/mm)	**178-571-01E**	**178-571-02E**	**178-573-01E**	**178-573-02E**	**178-575-01E**	**178-575-02E**
Drive unit	Standard type (**178-230-2**)		Retractable type (**178-235**)		Transverse tracing type (**178-233-2**)	
Detector	0.75 mM type (**178-296**)	4 mM type (**178-390**)	0.75 mM type (**178-296**)	4 mM type (**178-390**)	0.75 mM type (**178-387**)	4 mM type (**178-386**)
Display unit	Standard type with printer					
Detector: Conical taper angle	60°	90°	60°	90°	60°	90°
Stylus tip radius	2 µm	5 µm	2 µm	5 µm	2 µm	5 µm
Detector measuring force	0.75 mN	4 mN	0.75 mN	4 mN	0.75 mN	4 mN
Price	**£2600.00**	**£2600.00**	**£2500.00**	**£2500.00**	**£3650.00**	**£3650.00**

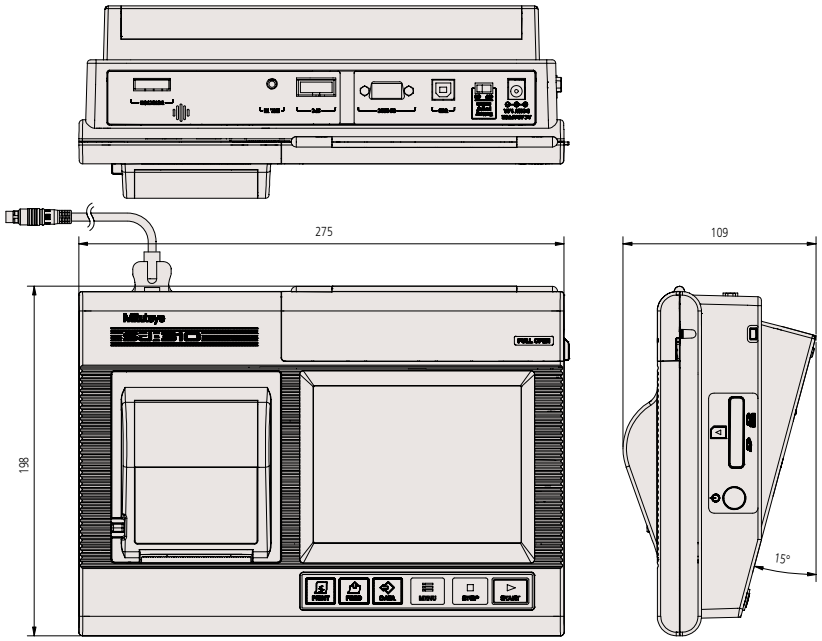
Functions

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/NG judgement:	Maximum value rule, 16% rule, average value rule, standard deviation (1σ, 2σ, 3σ)
Storage	
Internal memory:	Setups (10 sets)
Memory card (option):	500 setups, 10000 measured profiles, 500 display images, text file (setups / 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 shutdown of backlight by ECO mode.

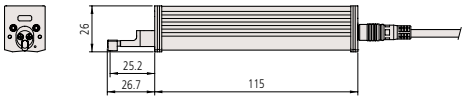
DIMENSIONS: Display unit, drive unit

Display unit

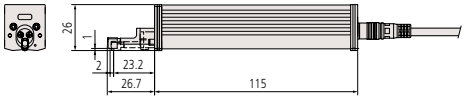
Unit: mm



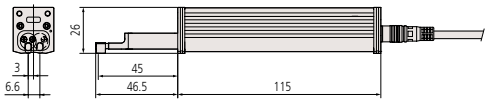
Standard drive unit



Retractable drive unit



Transverse drive unit



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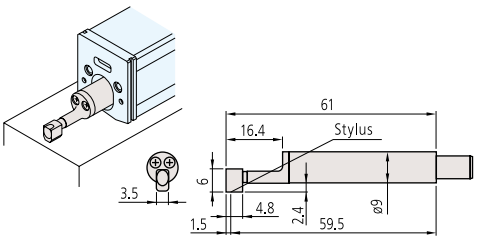
SJ-210/SJ-310 Accessories

Detectors

Standard detectors

Code No.	Measuring force	Stylus profiles*	Applicable drive unit	Price
178-296	0.75 mN	R2 µm/60°	Standard or retractable	£316.00
178-390	4 mN	R5 µm/90°		£413.00
178-387	0.75 mN	R2 µm/60°	Transverse	£380.00
178-386	4 mN	R5 µm/90°		£316.00
178-391	4 mN	R10 µm/90°	Standard or retractable	£413.00

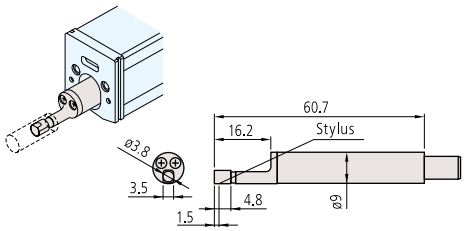
* Tip radius / tip angles



Small hole detectors

Code No.	Measuring force	Stylus profiles*	Min. measurable hole	Price
178-383	0.75 mN	R2 µm/60°	ø4.5 mm	£450.00
178-392	4 mN	R5 µm/90°		£403.00

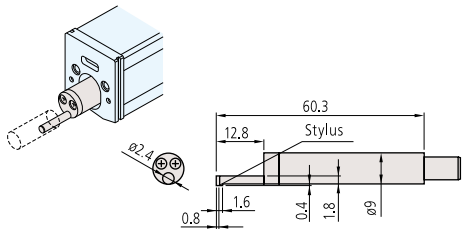
* Tip radius / Tip angles



Extra small hole detectors

Code No.	Measuring force	Stylus profiles*	Min. measurable hole	Price
178-384	0.75 mN	R2 µm/60°	ø2.8 mm	£422.00
178-393	4 mN	R5 µm/90°		£369.00

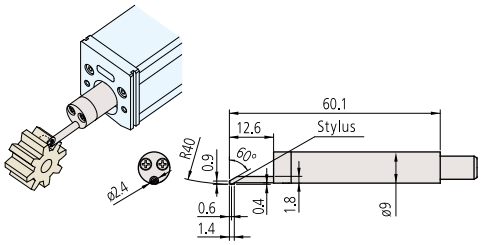
* Tip radius / Tip angles



Gear-tooth surface detectors

Code No.	Measuring force	Stylus profiles*	Price
178-388	0.75 mN	R2 µm/60°	£780.00
178-398	4 mN	R5 µm/90°	£730.00

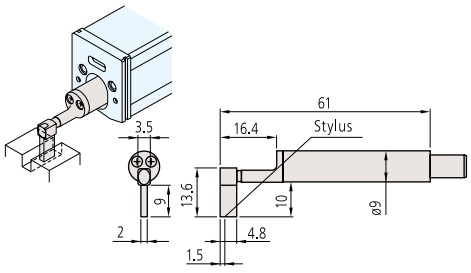
* Tip radius / Tip angles



Deep groove detectors

Code No.	Measuring force	Stylus profiles*	Applicable drive unit	Price
178-385	0.75 mN	R2 µm/60°	Standard or retractable	£430.00
178-394	4 mN	R5 µm/90°		£403.00

* Tip radius / Tip angles



Setting attachments (for standard and retractable drive units only)

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

178-033: V-type for measuring in the cylinder axis direction
£1890.00

The V-width is adjustable to the cylinder diameter facilitating axial measurement of a wide range of cylinder diameters.
• Adjustable range: ø5 - ø150 mm

178-034: Magnetic slider type
£1450.00

The magnet attached to the bottom surface of the frame allows hands-free measurements to be made.

178-035: Inside diameter type
£1700.00

Greatly facilitates measurement of internal wall surfaces of, for example, cylinder-block bores.
• Applicable diameter: ø75 - ø95 mm
• Accessible depth: 30 - 135 mm

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: 93 x 125 x 70 mm) and can run on an internal battery.

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

178-421UK

178-421UK: SJ-Printer for SJ-210
£290.00
270732: Printer paper (5 packs)
£16.40

Example of the connection with SJ-210.

DP-1VR

It is possible to process Digimatic data output from the Surftest SJ series with the DP-1VR. This compact, hand-held device can provide printouts of measurement data and various statistical analyses results such as histograms, D-charts, and X-bar R control charts. With optional output cables, DP-1VR is also capable of RS-232C output of measurement data to a PC (cable 09EAA084) and GO/NG judgement output (cable 965516).

265-504-5E

264-504-5E: DP-1VR
£342.00
936937: Connecting cable (1 m)
£32.90
965014: Connecting cable (2 m)
£39.10

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

Optional Software

SJ-Tools

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

*Microsoft-Excel is not included. To be supplied by the customer.

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

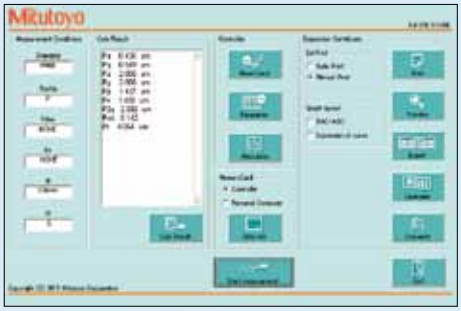
Cables required:

12AAL068: USB PC connecting cable (USB cable) for SJ-210 **£22.90**

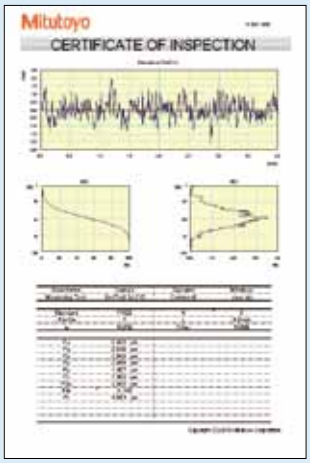
12AAD510: USB PC connecting cable (USB cable) for SJ-310 **£39.50**

12AAL067: RS-232C cable for SJ-210 **£54.50**

12AAA882D: RS-232C cable for SJ-310 **£48.70**



SJ-Tools input mask for Surftest SJ series



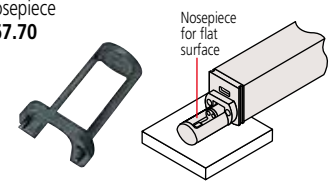
SJ-Tools output record from MS-Excel
This program can be downloaded for free from the Mitutoyo website www.mitutoyo.co.uk

Attachments

Nosepiece for flat surfaces

- SJ-310 standard accessory. (Not for transverse tracing type.)

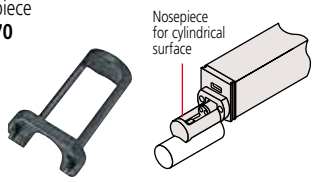
12AAA217: Nosepiece **£67.70**



Nosepiece for cylindrical surfaces

- SJ-310 standard accessory. (Not for transverse tracing type.)

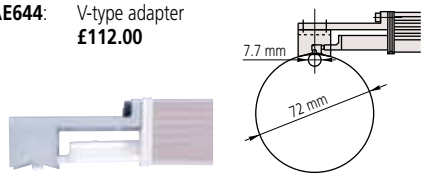
12AAA218: Nosepiece **£67.70**



V-type adapter

- SJ-310 Transverse tracing type standard accessory.

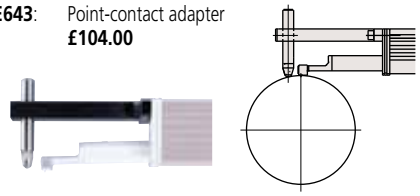
12AAE644: V-type adapter **£112.00**



Point-contact adapter

- SJ-310 Transverse tracing type standard accessory.

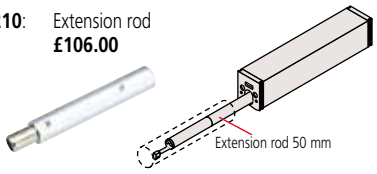
12AAE643: Point-contact adapter **£104.00**



Extension rod (50 mm)

- Not available for the transverse tracing drive unit. (Note: Only one rod can be used.)

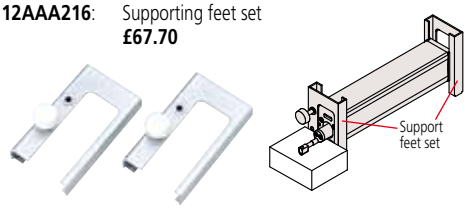
12AAA210: Extension rod **£106.00**



Support feet set

- SJ-301/301R standard accessory.
- Not available for the detector end of the transverse tracing drive unit.

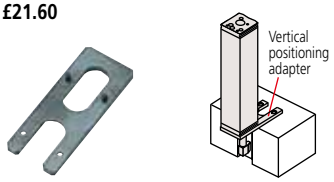
12AAA216: Supporting feet set **£67.70**



Vertical positioning adapter

- Not available for the transverse tracing drive unit.

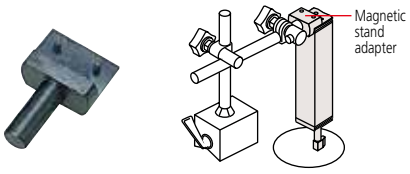
12AAA219: Vertical positioning adapter **£21.60**



Magnetic stand adapter

12AAA221: Magnetic stand adapter (ø8 mm) **£24.30**

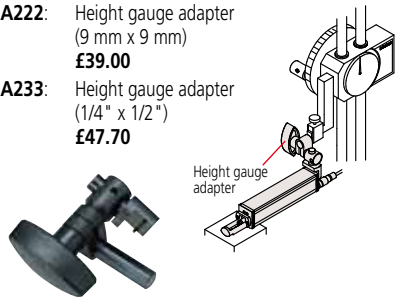
12AAA220: Magnetic stand adapter (ø9.5 mm) **£24.30**



Height gauge adapter

12AAA222: Height gauge adapter (9 mm x 9 mm) **£39.00**

12AAA233: Height gauge adapter (1/4" x 1/2") **£47.70**



Extension cable (1 m)

- Only one cable can be used.

12BAA303: Extension cable **£49.10**

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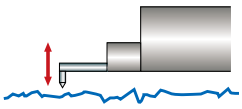
Surftest SJ-410

SERIES 178 – Portable Surface Roughness Tester

- Both skidded and skidless measurement are possible with this series. Measures 46 roughness parameters that conform to the latest ISO, DIN, ANSI, and JIS standards.
- A wide-range, high-resolution detector and efficient drive unit provide superior high-accuracy measurement.
- 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 colour 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 an optional RS-232C or USB cable.
- Digital filter function for accurate roughness profiles.
- GO/NG judgement function.
- Auto-calibration function.
- The display interface supports 16 languages, which can be freely switched.
- Simplified contour analysis function supports 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

Technical Data

X axis (drive unit)
- Traverse direction: Backward
- Traverse straightness: 0.3 µm / 25 mm (SJ-411), 0.5 µm / 50 mm (SJ-412)
- Positioning: ±1.5° (tilting), 10 mm (up/down)

Detector
- Skid radius of curvature: 40 mm
- Type: Differential inductance

Storage
- Internal memory: Setups (10 sets)
- Memory card (option): 500 setups, 10000 measured profiles, 500 display images, text file (setups / measured profile / assessed profile / bearing area curve / amplitude distribution curve), 500 statistical data, etc.

Dimensions (W x D x H)
- Display unit: 275 x 109 x 198 mm
- Height-tilt adjustment unit: 131 x 63 x 99 mm
- Drive unit: 128 x 36 x 47 mm (SJ-411), 155 x 36 x 47 mm (SJ-412)
- Control unit mass: Approx. 1.7 kg
- Height-tilt adjustment unit: Approx. 0.4 kg
- Drive unit: 0.6 kg (SJ-411), 0.7 kg (SJ-412)

Evaluation Capability

- Applicable standards: JIS'82, JIS'94, JIS'01, ISO'97, ANSI, VDA, Free
- Digital filter: 2CR, PC75, Gaussian
- Cutoff length: λc: 0.08, 0.25, 0.8, 2.5, 8 mm; λs: 2.5, 8, 25 µm (availability of switching depends on the selected standard.)
- Sampling length: 0.08, 0.25, 0.8, 2.5, 8, 25*mm; or arbitrary length in range 0.1 to 25 mm (0.1 to 50 mm: SJ-412) in 0.01 mm increments
- Number of sampling lengths: 1, 2, 3, ~20 (limited by traverse range)
- Printer: Thermal type
- Printing width: 48 mm (paper width: 58 mm)

Recording magnification
- Vertical: 10X to 100,000X, auto
- Horizontal: 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
- DAT 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 shutdown of backlight by ECO mode.

*Only for SJ-412

SPECIFICATIONS

Model		SJ-411		SJ-412	
Code No. (inch/mm)		**178-581-01E**	**178-581-02E**	**178-583-01E**	**178-583-02E**
Measuring range		25 mm		50 mm	
Speed		Measuring: 0.05, 0.1, 0.2, 0.5, 1.0 mm/s, Returning: 0.5, 1, 2, 5 mm/s			
Range/resolution		800 µm/0.0125 µm, 80 µm/0.00125 µm, 8 µm/0.000125 µm (up to 2400 µm with an optional stylus)			
Measurement method		Skidless/skidded			
Stylus tip	Angle	60°	90°	60°	90°
	Radius	2 µm	5 µm	2 µm	5 µm
Detector measuring force		0.75 mN	4 mN	0.75 mN	4 mN
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, δq, Lo, Rpm, tp(ANSI), Htp(ANSI), R, Rx, AR, W, AW, Wx, Wte			
Analysis graphs		Bearing Area Curve (BAC), Amplitude Distribution Curve (ADC)			
Power supply		Via AC adapter or rechargeable battery			
Rechargeable battery		Recharge time: 4 hours (for a maximum 1000 measurements without printing)			
Price		**£5140.00**	**£5140.00**	**£6180.00**	**£6180.00**

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Optional Software

SJ-Tools

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

*Microsoft-Excel is not included. To be supplied by the customer.

Complete with exclusive accessories.

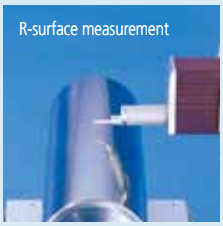
- Measurement device control
- Definition of measurement variables
- Graphic representation of the profile
- Storage of measurement records
- Documentation of measurement results
- Connecting cable

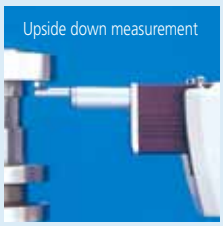
Optional cables are required:

12AAD510: USB PC connecting cable (USB cable) **£39.50**

12AAA882D: RS-232C connecting cable **£48.70**

MEASUREMENT APPLICATIONS



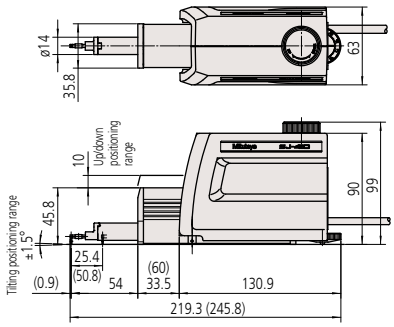


With optional accessories.

DIMENSIONS

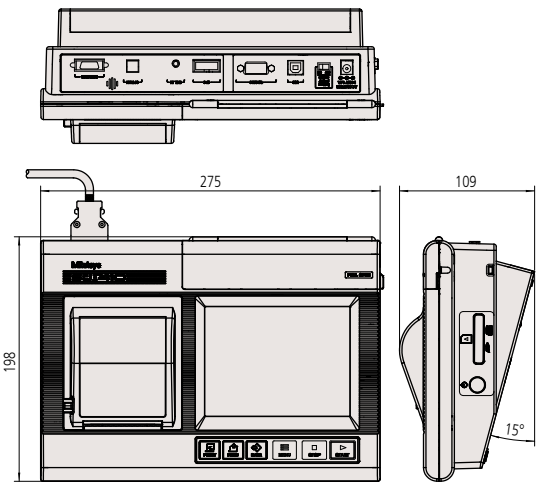
Unit: mm

Drive unit



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

Display unit



Optional Accessories

Code No.	Description	Price
178-611	Reference step specimen (mm)	**£340.00**
178-612	Reference step specimen (mm/inch)	**£344.00**
178-610	Step gauge (step: 1 µm, 2 µm, 5 µm, 10 µm)	**£345.00**
12AAM556	Height/tilt adjustment unit for SJ-410	**£395.00**
178-039	Manual column stand (granite base, vertical travel: 250 mm)	**£500.00**
178-010	Auto-set unit for 178-039	**£1920.00**
178-020	X axis adjustment unit for 178-039	**£986.00**
178-030	Tilting adjustment unit (Inclination adjustment unit) for 178-039	**£1510.00**
12AAB358	Cylindrical surface adapter (workpiece ø15 - 60 mm)	**£115.00**
178-016	Levelling table (tilting: ±1.5°, max. loading: 15 kg)	**£548.00**
178-048	Levelling table with D.A.T function (mm) (tilting: ±1.5°, max. loading: 15 kg)	**£1150.00**
178-058	Levelling table with D.A.T function (inch) (tilting: ±1.5°, max. loading: 15 kg)	**£1150.00**
178-043-1	XY levelling table (25 x 25 mm) (tilting: ±1.5°, max. loading: 15 kg, swivelling: ±3°)	**£2060.00**
178-053-1	XY levelling table (1" x 1") (tilting: ±1.5°, max. loading: 15 kg, swivelling: ±3°)	**£1760.00**
178-042-1	Digital XY levelling table (25 x 25 mm) (tilting: ±1.5°, max. loading: 15 kg, swivelling: ±3°)	**£2670.00**
178-052-1	Digital XY levelling table (1" x 1") (tilting: ±1.5°, max. loading: 15 kg, swivelling: ±3°)	**£1980.00**
178-049	Digital XY levelling table (25 x 25 mm) (max. loading: 15 kg)	**£1210.00**
178-059	Digimatic XY levelling table (1" x 1") (max. loading: 15 kg)	**£1140.00**
178-019	Precision vice for XY levelling table (jaw opening: 36 mm)	**£608.00**
998291	Precision V-block for XY levelling table workpiece ø1 - ø160 mm)	**£555.00**
12AAL069	Memory card	**£23.90**
12AAD510	USB PC connecting cable (USB cable)	**£39.50**
12AAA882D	PC connecting cable (RS-232C cable	**£48.70**
965014	SPC cable (2 m)	**£39.10**
264-012-10	Input tool (USB type)	**£191.00**
264-504-5E	DP-1VR	**£342.00**
Consumable spares		
12AAN040	LCD protective sheet (10 sheets/set)	**£140.00**
12AAA876	Durable printer paper (25 m, 5 rolls/set)	**£17.00**
12AAN046	Replacement battery	**£118.70**
12AAJ088	Footswitch	**£212.00**

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Surftest SJ-500

SERIES 178 – Surface Roughness Tester with Dedicated Control/Display Unit

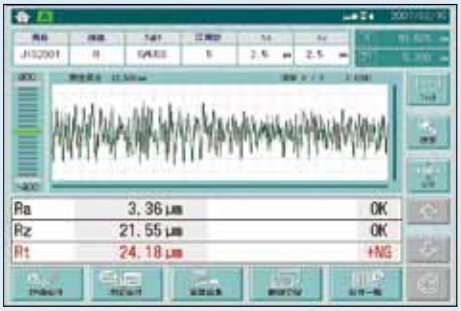
- High-precision/performance surface roughness tester with a dedicated control unit, achieving user-friendly display and simple operation.
- Equipped with a 7.5-inch, colour TFT LCD with backlight, large colour icons and touch panel controls, the display unit is easy to read and simple to operate.
- A built-in joystick in the control unit allows quick and easy positioning. The manual knob allows fine positioning of a small stylus for measuring small holes.
- Simple setup for surface roughness measuring conditions.
- A simple input function is used to calculate according to ISO/JIS roughness standard drawing instruction symbols. Complicated setups can easily be entered by selecting a drawing instruction symbol from the surface roughness menu.
- Built-in thermal printer.

Surftest SJ-500

Evaluation Capability

Assessed profiles:	P (primary profile), R (roughness profile), WC, WCA, WE, WEA, envelope residual profile, roughness motif, waviness motif
Evaluation parameters:	Ra, Rc, Ry, Rz, Rq, Rt, Rmax, Rp, Rv, R3z, Sm, S, Pc, mr(c), δc, mr, tp, Htp, Lo, Ir, Ppi, HSC, Δa, Δq, Ku, Sk, Rpk, Rvk, Rk, Mr1, Mr2, A1, A2, Vo, λa, λq
Roughness motif parameters:	R, AR, Rx
Waviness motif parameters:	W, AW, Wx, Wte
Analysis graphs:	ADC, BAC, power spectrum chart
Digital filter:	2CR-75%, PC-75%, gaussian, robust spline
Cutoff length:	λs: 0.25 µm, 0.8 µm, 2.5 µm, 8 µm, 25 µm, 80 µm, 250 µm, no filter λc*: 0.025 mm, 0.08 mm, 0.25 mm, 0.8 mm, 2.5 mm, 8 mm, 25 mm λf: 0.08 mm, 0.25 mm, 0.8 mm, 2.5 mm, 8 mm, 25 mm, no filter
Sampling length*:	0.025 mm, 0.08 mm, 0.25 mm, 0.8 mm, 2.5 mm, 8 mm, 25 mm
Data compensation functions:	Parabola compensation, hyperbola compensation, ellipse compensation, R-plane (curved surface) compensation, conic compensation, tilt compensation

*An arbitrary length can also be specified in the range from 0.025 mm to the maximum traverse length.



SPECIFICATIONS

Model		SJ-500	
Code No. (mm)		**178-532-01E**	**178-532-02E**
Code No. (inch/mm)		**178-533-01E**	**178-533-02E**
Measuring range		50 mm	
Resolution		0.05 µm	
Scale		Linear encoder	
Drive speed		0 - 20 mm/s	
Measuring speed		0.02 - 5 mm/s	
Traverse direction		Backward	
Traverse straightness		0.2 µm / 50 mm	
Positioning		±1.5° (tilting, with DAT function) 30 mm (up/down)	
Detector range/resolution		800 µm/0.01 µm, 80 µm/0.001 µm, 8 µm/0.0001 µm	
Measurement method		Skidless/skidded	
Stylus tip	Angle	60°	90°
	Radius	2 µm	5 µm
Detector measuring force		0.75 mN	4 mN
Skid radius of curvature		40 mm	
Detector type		Differential inductance	
Drive unit control		Joystick operation with manual adjustment knob	
Display magnification		Horizontal: X0.5 to X10,000 Auto, Vertical: X10 to X500,000 Auto	
Mass		6.7 kg (drive unit: 2.7 kg, control unit: 4 kg)	

Optional Accessory

12AAA876: Durable printer paper (25 m, 5 rolls/set)
£17.00

The SJ-500 can also be mounted on a manual column stand.

Surftest SJ-500P

SERIES 178 – Surface Roughness Tester with PC

- High-precision/performance surface roughness tester that runs under the FORMTRACEPAK sophisticated analysis software package.
- A built-in joystick in the control unit allows quick and easy positioning. The manual knob allows fine positioning of a small stylus for measuring small holes.
- Simple setup for surface roughness measuring conditions.
- A simple input function is used to calculate according to ISO/JIS roughness standard drawing instruction symbols. Complicated setups can easily be entered by selecting a drawing instruction symbol from the surface roughness menu.

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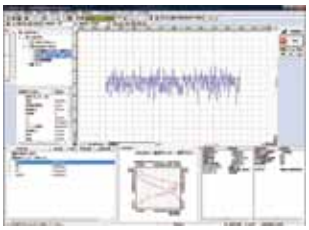
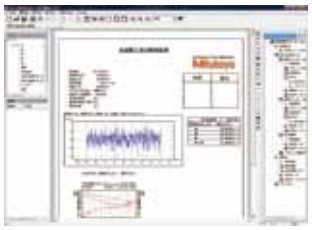
Evaluation Capability: FORMTRACEPAK

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, autocorrelation 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: 0.025 mm, 0.08 mm, 0.25 mm, 0.8 mm, 2.5 mm, 8 mm, 25 mm fl: 0.08 mm, 0.25 mm, 0.8 mm, 2.5 mm, 8 mm, 25 mm fh: 0.08 mm, 0.25 mm, 0.8 mm, 2.5 mm, 8 mm
Sampling length*:	0.025 mm, 0.08 mm, 0.25 mm, 0.8 mm, 2.5 mm, 8 mm, 25 mm
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

*An arbitrary length can also be specified in the range from 0.025 mm to the maximum traverse length.

Surftest SJ-500P





SPECIFICATIONS

Model	SJ-500P	
Code No. (mm)	**178-530-01E**	**178-530-02E**
Code No. (inch/mm)	**178-531-01E**	**178-531-02E**
Measuring range	50 mm	
Resolution	0.05 µm	
Scale	Linear encoder	
Drive speed	0 - 20 mm/s	
Measuring speed	0.02 - 5 mm/s	
Traverse direction	Backward	
Traverse straightness	0.2 µm / 50 mm	
Positioning	±1.5° (tilting, with DAT function) 30 mm (up/down)	
Detector range/resolution	800 µm/0.01 µm, 80 µm/0.001 µm, 8 µm/0.0001 µm	
Measurement method	Skidless/skidded	
Stylus tip Angle	60°	90°
Stylus tip Radius	2 µm	5 µm
Detector measuring force	0.75 mN	4 mN
Skid radius of curvature	40 mm	
Detector type	Differential inductance	
Drive unit control	PC	
Display magnification	Horizontal: X0.5 to X10,000 Auto, Vertical: X10 to X500,000 Auto	
Mass	6.5 kg (main unit 2.7 kg; PC I/F unit 3.8 kg)	

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Surftest SV-2100

SERIES 178 – Surface Roughness Tester with Dedicated Control/Display Unit

- High-precision/performance surface roughness tester with a dedicated control unit, achieving user-friendly display and simple operation.
- Equipped with a 7.5-inch, colour TFT LCD with backlight, large colour icons and touch panel controls, the display unit is easy to read and simple to operate.
- A built-in joystick in the control unit allows quick and easy positioning. The manual knob allows fine positioning of a small stylus for measuring small holes.
- Simple setup for surface roughness measuring conditions.
- A simple input function is used to calculate according to ISO/JIS roughness standard drawing instruction symbols. Complicated setups can easily be entered by selecting a drawing instruction symbol from the surface roughness menu.
- Built-in thermal printer.

Surftest SV-2100M4

Surftest SV-2100S4

SPECIFICATIONS

Model		SV-2100M4		SV-2100S4	
Code No. (mm)		**178-636-01E**	**178-636-02E**	**178-680-01E**	**178-680-02E**
Code No. (inch/mm)		**178-637-01E**	**178-637-02E**	**178-681-01E**	**178-681-02E**
Measuring range		100 mm			
Stylus tip	Angle	60°	90°	60°	90°
	Radius	2 µm	5 µm	2 µm	5 µm
Detector measuring force		0.75 mN	4 mN	0.75 mN	4 mN
Vertical travel		350 mm manual column			
Granite base size (W x D)		600 x 450 mm			
Dimensions (main unit, W x D x H)		716 x 450 x 863 mm		766 x 482 x 966 mm	
Mass		144 kg		147 kg	

Model		SV-2100H4		SV-2100W4	
Code No. (mm)		**178-682-01E**	**178-682-02E**	**178-684-01E**	**178-684-02E**
Code No. (inch/mm)		**178-683-01E**	**178-683-02E**	**178-685-01E**	**178-685-02E**
Measuring range		100 mm			
Stylus tip	Angle	60°	90°	60°	90°
	Radius	2 µm	5 µm	2 µm	5 µm
Detector measuring force		0.75 mN	4 mN	0.75 mN	4 mN
Vertical travel		550 mm manual column			
Granite base size (W x D)		600 x 450 mm		1000 x 450 mm	
Dimensions (main unit, W x D x H)		766 x 482 x 1166 mm		1166 x 482 x 1176 mm	
Mass		157 kg		227 kg	

Technical Data

X1 axis (drive unit)
- Resolution: 0.05 µm
- Scale: Linear encoder
- Drive speed: 0 - 40 mm/s
- Measuring speed: 0.02 - 5 mm/s
- Traverse direction: Backward
- Traverse straightness: 0.15 µm/100 mm

Z2 axis (column)
- Type: Manual operation or power drive
- Resolution*: 1 µm
- Scale type*: Rotary encoder
- Drive speed*: 0 - 20 mm/s

*Only for power drive type

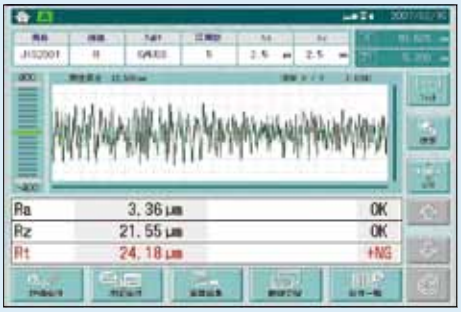
Detector
- Range / resolution: 800 µm/0.01 µm, 80 µm/0.001 µm, 8 µm/0.0001 µm
- Measurement method: Skidless
- Type: Differential inductance

Control unit
- Magnification: Horizontal: X0.5 to X10,000, Auto Vertical: X10 to X500,000, Auto
- Drive unit control: Joystick operation with manual adjustment knob

Evaluation Capability

- Assessed profiles: P (primary profile), R (roughness profile), WC, WCA, WE, WEA, envelope residual profile, roughness motif, waviness motif
- Evaluation parameters: Ra, Rc, Ry, Rz, Rq, Rt, Rmax, Rp, Rv, R3z, Sm, S, Pc, mr(c), δc, mr, tp, Htp, Lo, Ir, Ppi, HSC, Δa, Δq, Ku, Sk, Rpk, Rvk, Rk, Mr1, Mr2, A1, A2, Vo, λa, λq
- Roughness motif parameters: R, AR, Rx
- Waviness motif parameters: W, AW, Wx, Wte
- Analysis graphs: ADC, BAC, power spectrum chart
- Digital filter: 2CR-75%, PC-75%, Gaussian, Robust Spline
- Cutoff length: λs: 0.25 µm, 0.8 µm, 2.5 µm, 8 µm, 25 µm, 80 µm, 250 µm, no filter λc*: 0.025 mm, 0.08 mm, 0.25 mm, 0.8 mm, 2.5 mm, 8 mm, 25 mm, 80 mm λf: 0.08 mm, 0.25 mm, 0.8 mm, 2.5 mm, 8 mm, 25 mm, 80 mm, no filter
- Sampling length*: 0.025 mm, 0.08 mm, 0.25 mm, 0.8 mm, 2.5 mm, 8 mm, 25 mm, 80 mm
- Data compensation functions: Parabola compensation, hyperbola compensation, ellipse compensation, R-plane (curved surface) compensation, conic compensation, tilt compensation

*An arbitrary length can also be specified in the range from 0.025 mm to the maximum traverse length.



Optional Accessory

12AAA876: Durable printer paper (25 m, 5 rolls/set) **£17.00**

Technical Data

X1 axis (drive unit)
- Resolution: 0.05 µm
- Scale: Linear encoder
- Drive speed: 0 - 40 mm/s
- Measuring speed: 0.02 - 5 mm/s
- Traverse direction: Backward
- Traverse straightness: 0.15 µm/100 mm

Z2 axis (column)
- Type: Manual operation

Detector
- Range / resolution: 800 µm/0.01 µm, 80 µm/0.001 µm, 8 µm/0.0001 µm
- Measurement method: Skidless/skidded
- Type: Differential inductance

Drive unit control: PC

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the standard in world metrology software
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Evaluation Capability: FORMTRACEPAK

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, autocorrelation 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: 0.025 mm, 0.08 mm, 0.25 mm, 0.8 mm, 2.5 mm, 8 mm, 25 mm
fl: 0.08 mm, 0.25 mm, 0.8 mm, 2.5 mm, 8 mm, 25 mm
fh: 0.08 mm, 0.25 mm, 0.8 mm, 2.5 mm, 8 mm

Sampling length*: 0.025 mm, 0.08 mm, 0.25 mm, 0.8 mm, 2.5 mm, 8 mm, 25 mm

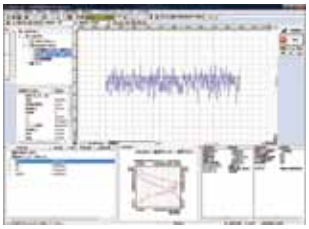
Data compensation functions: Tilt compensation, R-plane (curved surface) compensation, ellipse compensation, parabola compensation, hyperbola compensation, quadric curve automatic compensation, polynomial compensation, polynomial automatic compensation

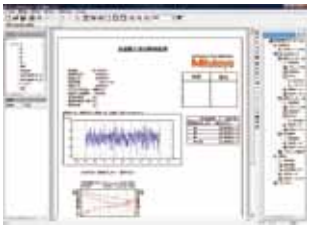
*An arbitrary length can also be specified in the range from 0.025 mm to the maximum traverse length.

SERIES 178 – Surface Roughness Tester with PC

- High-precision/performance surface roughness tester that runs under the FORMTRACEPAK sophisticated analysis software package.
- A built-in joystick in the control unit allows quick and easy positioning. The manual knob allows fine positioning of a small stylus for measuring small holes.
- Simple setup for surface roughness measuring conditions.
- A simple input function is used to calculate according to ISO/JIS roughness standard drawing instruction symbols. Complicated setups can easily be entered by selecting a drawing instruction symbol from the surface roughness menu.

Surftest SV-2100M4 (PC type)





SPECIFICATIONS

Model		SV-2100M4 (PC type)	
Code No. (mm)		**178-634-01E**	**178-634-02E**
Code No. (inch/mm)		**178-635-01E**	**178-635-02E**
Measuring range		100 mm	
Stylus tip	Angle	60°	90°
	Radius	2 µm	5 µm
Detector measuring force		0.75 mN	4 mN
Vertical travel		350 mm manual column	
Granite base size (W x D)		600 x 450 mm	
Dimensions (main unit, W x D x H)		716 x 450 x 863 mm	
Mass		144 kg (main unit 140 kg; PC I/F unit 3.8 kg)	

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Mitutoyo

Surftest SV-3100

SERIES 178 – Surface Roughness Tester

- Mitutoyo's Surftest SV-3100 Series provides highly accurate, high level, multi-functional analysis and measurement of fine contour, as well as conventional surface roughness measurement.
- Peripheral devices such as the auto-levelling table are available to enhance operability and enable automatic measurement.
- Includes FORMTRACEPAK data analysis software. FORMTRACEPAK provides data management in a consistent format, from the work site to the laboratory.
- The X1-axis drive unit guide is made of superbly anti-abrasive ceramic and provides a choice of traverse distance of 100 or 200 mm, according to model. No lubrication is required.
- High-accuracy glass scales, built-in on the X1 axis (resolution: 0.05 µm) and Z2 axis (column, resolution: 1 µm) ensure high-accuracy positioning. The SV-3100 series produces high-reliability, particularly in horizontal roughness parameters (S, Sm), that require high-accuracy X1-axis travel.
- Equipped with a highly accurate detector stylus.
- Capabilities include a *straightness compensation* function, which improves the straightness of the X1-axis; a *circular compensation* function for the vertical movement of the stylus; and a *stylus-tip-radius compensation* function.
- The stylus and the skid are easily replaced. Optional styli and skids are available for a wide variety of roughness measurement applications, such as measurement of small holes, deep holes, etc.
- Comes with an easy-to-operate remote box independent of the main unit allowing positioning, measurement start/stop, retraction, and other operations to be performed remotely. The Drive Unit up/down position and the X1-axis traverse can be finely controlled manually.

Surftest SV-3100H4 with PC

Technical Data

X1 axis (drive unit)	
Resolution:	0.05 µm
Scale:	Linear encoder
Drive speed:	0 - 80 mm/s
Measuring speed:	0.02 - 5 mm/s
Inclination range:	±45° (with X1-axis inclination unit)
Z2 axis (column)	
Resolution:	1 µm
Scale:	ABSOLUTE linear encoder
Drive speed:	0 - 20 mm/s
Detector	
Range/resolution:	800 µm/0.01 µm, 80 µm/0.001 µm, 8 µm/0.0001 µm (up to 2400 µm with an optional stylus)
Measurement method:	Skidless/skidded
Type:	Differential inductance

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Evaluation Capability: FORMTRACEPAK

Conformable standards:	JIS1982/JIS1994/JIS2001/ISO1997/ANSI/VDA
Assessed profiles:	Primary profile, roughness profile, envelope residual curve, filtered waviness curve, band pass waviness curve, waviness curve, rolling circle waviness curve, roughness motif, waviness motif, DIN4776 curve
Parameters:	Ra, Rq, Sk, Ku, Rp, Rv, Ry, RyDIN, RzDIN, Rt, Rc, Rz, R3z, R3y, S, Δa, Δq, λa, λq, Lo, lr, Rk, Rpk, Rvk, Mr1, Mr2, A1, A2, Sm, Pc, HSC, mr, mrd, δc, Vo, Rx, AR, R, NR, NCRX, CPM, SR, SAR, Wx, AW, W, Wte, NW, SW, SAW
Graphs:	Amplitude distribution graphs, BAC1, BAC2, power spectrum curve, auto correlation curve, inclination angle distribution curve, peek point height distribution curve, parameter distribution curve
Waviness motif parameters:	Wte, Wx, W, AW, SW, SAW, NW
Analysis graphs:	ADC, BAC1, BAC2, power spectrum chart, autocorrelation 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%
Data compensation:	Tilt compensation, R-surface compensation, ellipse compensation, parabola compensation, hyperbolic compensation, polynomial compensation, conic automatic compensation
Filters:	Gaussian filter, 2CRPC75, 2CRPC50, 2CR75, 2CR50, robust spline filter
Cutoff length:	λc: 0.025, 0.08, 0.25, 0.8, 2.5, 8, 25, 80 mm arbitrary λs: 0.8, 2.5, 8, 25, 80, 250, 800 µm arbitrary
Supported languages:	Japanese, English, German, French, Italian, Spanish, Polish, Hungarian, Swedish, Czech, Simplified Chinese, Traditional Chinese, Korean, Turkish, Portuguese

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Optional Accessories

178-611: Step gauge (2 µm, 10 µm)
£340.00

178-612: Step gauge (2 µm, 10 µm, 79 µinch, 394 µinch)
£344.00

178-610: Metric 4-step gauge (1 µm, 2 µm, 5 µm, 10 µm)
£345.00

178-047: Three-axis adjustment table (998291 is incl.)
£3170.00

178-016: Levelling table
£548.00

178-042-1: Digimatic XY levelling table (25 x 25 mm)
£2670.00

178-052-1: Digimatic XY levelling table (1" x 1")
£1980.00

178-043-1: XY levelling table (25 x 25 mm)
£2060.00

178-053-1: XY levelling table (1" x 1")
£1760.00

178-019: Precision vice*
£608.00

998291: Precision V-block*
£555.00

181-902-10: V-block set with clamp (max. workpiece ø25 mm)
£124.00

181-901-10: V-block set with clamp (max. workpiece ø1")
£124.00

178-023: Vibration isolator
£2530.00

178-024: Stand for vibration isolator
£647.00

218-007: Workbench
£1040.00

166-215: Workbench (with drawers)
£1550.00

218-010: Auxiliary desk
£580.00

218-008: Auxiliary desk
£340.00

* Use with an XY levelling table

Simplified CNC Function

Support for a wide range of optional peripherals designed for use with the CNC models enables automatic measurement.


Using Y-axis table


Using rotary table θ1


Using rotary table θ2

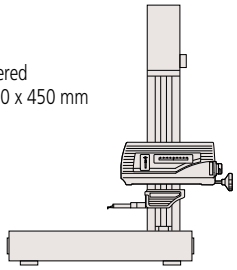
SPECIFICATIONS

Model		SV-3100S4		SV-3100H4		SV-3100W4	
Code No. (mm)		**178-471-1E**	**178-471-2E**	**178-472-1E**	**178-472-2E**	**178-473-1E**	**178-473-2E**
		178-451-1E*	**178-451-2E***	**178-452-1E***	**178-452-2E***	**178-453-1E***	**178-453-2E***
Code No. (inch)		**178-481-1E**	**178-481-2E**	**178-482-1E**	**178-482-2E**	**178-483-1E**	**178-483-2E**
		178-461-1E*	**178-461-2E***	**178-462-1E***	**178-462-2E***	**178-463-1E***	**178-463-2E***
Stylus tip	Angle	60°	90°	60°	90°	60°	90°
	Radius	2 µm	5 µm	2 µm	5 µm	2 µm	5 µm
Detector measuring force		0.75 mN	4 mN	0.75 mN	4 mN	0.75 mN	4 mN
X1-axis measuring range		100 mm					
X1-axis traverse straightness		(0.05+1L/1000) µm L = measured length (mm)					
Dimensions (main unit, W x D x H)		756 x 482 x 966 mm		756 x 482 x 1166 mm		1156 x 482 x 1176 mm	
Mass (main unit)		140 kg		150 kg		220 kg	

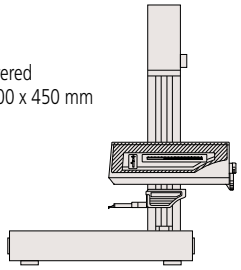
Model		SV-3100S8		SV-3100H8		SV-3100W8	
Code No. (mm)		**178-476-1E**	**178-476-2E**	**178-477-1E**	**178-477-2E**	**178-478-1E**	**178-478-2E**
		178-456-1E*	**178-456-2E***	**178-457-1E***	**178-457-2E***	**178-458-1E***	**178-458-2E***
Code No. (inch)		**178-486-1E**	**178-486-2E**	**178-487-1E**	**178-487-2E**	**178-488-1E**	**178-488-2E**
		178-466-1E*	**178-466-2E***	**178-467-1E***	**178-467-2E***	**178-468-1E***	**178-468-2E***
Stylus tip	Angle	60°	90°	60°	90°	60°	90°
	Radius	2 µm	5 µm	2 µm	5 µm	2 µm	5 µm
Detector measuring force		0.75 mN	4 mN	0.75 mN	4 mN	0.75 mN	4 mN
X1-axis measuring range		200 mm					
X1-axis traverse straightness		0.5 µm/200 mm					
Dimensions (main unit, W x D x H)		766 x 482 x 966 mm		766 x 482 x 1166 mm		1166 x 482 x 1176 mm	
Mass (main unit)		140 kg		150 kg		220 kg	

* Without X1-axis inclination function

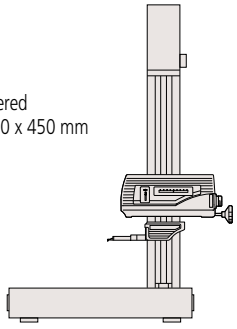
SV-3100S4
Vertical travel: 300 mm powered
Granite base size (W x D): 600 x 450 mm



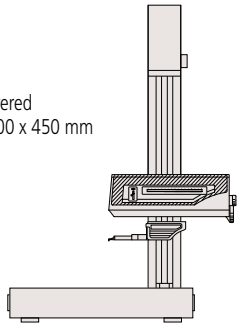
SV-3100S8
Vertical travel: 300 mm powered
Granite base size (W x D): 600 x 450 mm



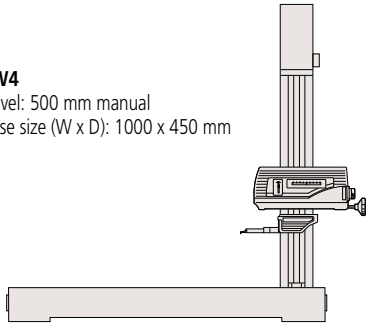
SV-3100H4
Vertical travel: 500 mm powered
Granite base size (W x D): 600 x 450 mm



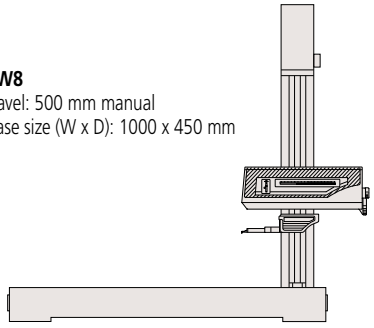
SV-3100H8
Vertical travel: 500 mm powered
Granite base size (W x D): 600 x 450 mm



SV-3100W4
Vertical travel: 500 mm manual
Granite base size (W x D): 1000 x 450 mm



SV-3100W8
Vertical travel: 500 mm manual
Granite base size (W x D): 1000 x 450 mm



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Surftest Extreme SV-3000CNC

SERIES 178 – CNC Surface Roughness Testers

- A highly accurate measuring instrument that allows CNC measurement of surface roughness and fine contour.
- Each axis has a maximum drive speed of 200 mm/s, permitting high-speed positioning for increased throughput of multiple-profile/multiple-workpiece measurement tasks.
- For models equipped 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.
- With optional rotary tables for axes θ1 and θ2, designed for use with the CNC models, it is possible to expand the CNC measurement application range.
- Inclined plane measurement is possible through simultaneous control of the X1 and Z2-axes.
- The Z1 axis incorporates an anti-collision safety device to automatically stop the detector unit if it collides with a workpiece or jig.
- An easy-to-operate Remote Box enables the user to 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.

Surftest Extreme SV-3000CNC

Technical Data

X1 axis
- Measuring range: 200 mm
- Resolution: 0.05 µm
- Scale: Reflective-type linear encoder
- Drive speed: Max. 200 mm/s (CNC)
  0 - 60 mm/s (joystick)
- Measuring speed: 0.02 - 2 mm/s
- Traverse straightness: 0.5 µm / 200 mm

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

Z2 axis (column)
- Vertical travel: 300 mm (500 mm)*
- Resolution: 0.05 µm
- Scale: Reflective-type linear encoder
- Drive speed: Max. 200 mm/s (CNC)
  0 - 60 mm/s (joystick)
- Base size (W x D): 750 x 600 mm

Detector
- Range / resolution: 800 µm / 0.01 µm, 80 µm / 0.001 µm, 8 µm / 0.0001 µm
- Measuring force: 4 mN (178-397-2)
  0.75 mN (low force type 178-396-2)
- Stylus tip: Diamond, 90° / R5 µm
  (60° / R2 µm: low force type)
- Dimension (W x D x H): 800 x 651 x 1000 mm
  (800 x 651 x 1200 mm)*
- Mass: 240 kg (250 kg)*

* Tall-column model

Optional Accessories

Vibration isolation stand
- Vibration isolation mechanism: Diaphragm air spring
- Natural frequency : 2.5 - 3.5 Hz
- Damping mechanism: Orifice
- Levelling mechanism: Automatic control with mechanical valves
- Air supply pressure: 0.4 MPa
- Allowable loading capacity: 350 kg
- Dimension (WxDxH): 1000 x 895 x 715 mm
- Mass: 315 kg

Y-axis table unit
- Measuring range: 200 mm
- Resolution: 0.05 µm
- Scale unit: Reflective-type linear encoder
- Drive speed: 200 mm/s (max., CNC)
  0 - 60 mm/s (joystick)
- Maximum loading capacity: 20 kg
- Traverse straightness: 0.5 µm / 200 mm
- Accuracy (at 20°C): ±(2+2L/100), L : dimension between two measured points (mm)
- Table size: 200 x 200 mm
- Dimension (WxDxH): 320 x 646 x 105 mm
- Mass: 35 kg

SPECIFICATIONS

Model	SV-3000CNC							
Code No. (100V - 120V)	**178-521-1E**	**178-541-1E**	**178-522-1E**	**178-542-1E**	**178-523-1E**	**178-543-1E**	**178-524-1E**	**178-544-1E**
Code No. (200V - 240V)	**178-521-2E**	**178-541-2E**	**178-522-2E**	**178-542-2E**	**178-523-2E**	**178-543-2E**	**178-524-2E**	**178-544-2E**
X1-axis measuring range	200 mm							
Z2-axis vertical travel	300 mm	500 mm	300 mm	500 mm	300 mm	500 mm	300 mm	500 mm
Y-axis table unit	—				Installed			
α-axis unit	—		Installed		—		Installed	

Surftest Extreme SV-M3000CNC

SERIES 178 – CNC Surface Roughness Testers

- A CNC Surface Roughness Tester that handles measurement of large/heavy workpieces such as engine blocks, crankshafts, etc.
- Combined with the surface roughness detector swivelling unit, S-3000AR (optional), continuous measurement over the bottom, top and side surfaces of a workpiece is possible.
- With an optional large table for supporting a load of 100 kg, or a large θ2 table, continuous automatic measurement of larger workpieces is possible.
- Suitable for automatic surface roughness measurement on large and heavy workpieces.
- A moving column configuration eliminates workpiece size constrictions. Advantageous for measuring large, heavy workpieces such as engine blocks, crankshafts, etc.
- An 800 mm Y-axis stroke makes measurement of multiple profiles on large workpieces possible.
- The load table has a self-contained structure ensuring that variously sized workpieces, and standard and custom jigs, auto-feed devices, etc., are easily accommodated.

Technical Data

X1 axis
- Traverse straightness: 0.5 µm/200 mm
  0.7 µm/200 mm (long-type detector)
  0.5 µm/200 mm (rotary-type detector, up/down direction)
  0.7 µm/200 mm rotary-type detector, forward/backward direction)

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

Y axis
- Measuring range: 800 mm
- Resolution: 0.05 µm
- Scale: Reflective-type linear encoder
- Traverse straightness: 0.5 µm/50 mm, 2 µm/800 mm
  0.7 µm/50 mm, 3 µm/800 mm (long-type detector)
  0.7 µm/50 mm, 3 µm/800 mm (rotary-type detector, up/down direction)

Base unit
- Loading capacity: 300 kg

Detector
- Range / resolution: 800 µm/0.01 µm, 80 µm/0.001 µm, 8 µm/0.0001 µm (up to 2400 µm with an optional stylus)

Measuring force: 4 mN (178-397-2)
0.75 mN (low force type 178-396-2)

Stylus tip: Diamond, 90° / R5 µm
(60° / R2 µm: low force type)

Type: Differential inductance

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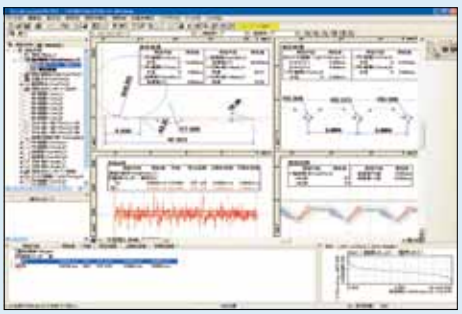
Standard Software

FORMTRACEPAK

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.



Surftest Extreme SV-M3000CNC

SPECIFICATIONS

Model	**SV-M3000CNC**		
Code No. (100V - 120V)	**178-549-1E**		
Code No. (200V - 240V)	**178-549-2E**		
X1-axis measuring range	200 mm		
Detector holder type (essential option)	Standard S-3000 **178-071**	Long-type S-3000L **178-072**	Rotary-type S-3000 **178-073**
Resolution	0.05 µm		
Scale	Reflective-type linear encoder		
Drive speed	Max. 200 mm/s (CNC), 0 - 50 mm/s (joystick)		
Measuring speed	0.02 - 2 mm/s		
Z2-axis vertical travel	500 mm		
Y-axis travel range	800 mm		
α-axis inclination angle	-45° (CCW), +10° (CW)		
Steel base size (W x D)	600 x 1500 mm		
Dimension (W x D x H)	1085 x 1695 x 1922 mm		
Mass (main unit)	1600 kg (including vibration isolation unit)		

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Formtracer SV-C3200/SV-C4500

SERIES 525 – Surface Roughness / Contour Measuring System

- A highly accurate measuring system that allows measurement of surface roughness and contour with just one instrument.
- Dramatically increased drive speed (X1 axis: 80 mm/s, Z2 axis column: 30 mm/s) further reduces total measurement time.
- Mitutoyo has adopted highly rigid ceramic guides, combining small secular change and remarkable resistance to abrasion, to maintain the outstanding traverse straightness specification for an extended period of time.
- The drive unit (X1 axis) and column (Z2 axis) are equipped with highly accurate linear encoders (ABS type on the 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.
- Measurement accuracy specifications for the drive unit and column are exceptional, as is that for the drive unit traverse straightness – all excellent characteristics for handling workpieces calling for high accuracy.

Formtracer SV-C3200S4

Surface Roughness Detector

- Compliant with JIS '82/'94/'01, ISO, ANSI, DIN, VDA, and other international surface roughness standards.
- The standard surface roughness detector supplied is the high-accuracy model (0.75 mN/4 mN measuring force) that provides a resolution down to 0.0001 µm.

Contour Detector

- The contour detector of the SV-C4500 series instruments can continuously measure in the upward and downward directions without the need to change the arm orientation or reposition the workpiece, when combined with the double cone-end stylus (a new product with contact points in the upward and downward directions).

Technical Data

X1 axis (drive unit)	
Resolution:	0.05 µm
Scale:	Reflective-type linear encoder
Drive speed:	0 - 80 mm/s and manual
Measuring speed:	0.02 - 5 mm/s
Measuring direction:	Forward/backward Note: As for SV-C4500, set the measurement force with Formtracepak
Accuracy (at 20°C):	±(0.8+L/100) µm (SV-C3200S4/H4/W4; SV-C4500S4/H4/W4), ±(0.8+2L/100) µm (SV-C3200S8/H8/W8; SV-C4500S8/H8/W8) L = drive length (mm)
Inclination range:	±45° (with X1 axis inclination unit)
Traverse straightness:	(0.05+0.1L/100) µm (S4, H4, W4 types), 0.5 µm / 200 mm (S8, H8, W8 types) Note: with the X1 axis in the horizontal orientation
Z1 axis (contour detector)	
Measuring range:	±30 mm
Resolution:	0.04 µm (SV-C3200), 0.02 µm (SV-C4500)
Scale:	Rotary arc encoder
Accuracy (at 20°C):	±(1.6+|2H|/100) µm (SV-C3200) ±(0.8+|2H|/100) µm (SV-C4500) Note: 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:	30 mN (SV-C3200) 10, 20, 30, 40, 50 mN (SV-C4500) Note: 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:	Carbide, R25 µm
Z1 axis (surface finish detector)	
Range / resolution:	800 µm / 0.01 µm, 80 µm / 0.001 µm, 8 µm / 0.0001 µm (up to 2400 µm with an optional stylus)
Stylus tip:	Diamond, 90° / R5 µm (60° / R2 µm: low force type)
Type:	Differential inductance
Z2 axis (column)	
Resolution:	1 µm
Scale:	ABSOLUTE linear encoder
Drive speed:	0 - 30 mm/s and manual
Mass	
Controller unit:	14 kg
Remote control box:	0.9 kg
Power supply:	100 - 120, 200 - 240V AC, 50/60Hz
Power consumption:	400 W (main unit only)

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Standard Software

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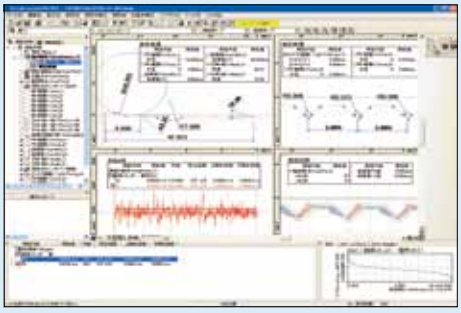
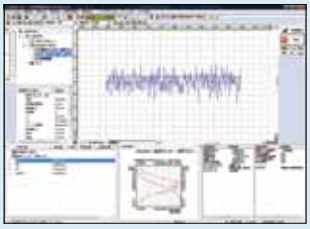
Enables control of the optional motor-driven Y-axis table and rotary table for realizing efficient measurement automation. You can also perform contour evaluation that allows free analysis of level differences, angle, pitch, area and other characteristics based on surface roughness data. In addition,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



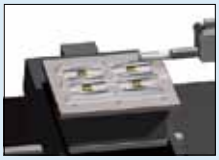


Contour measurement screen

Surface roughness measurement screen

Simplified CNC Function

With support for a wide range of optional peripherals designed for use with the CNC models enables automatic measurement.



Using Y-axis table

Using rotary table θ1

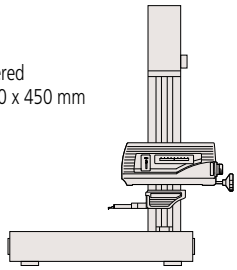
Using rotary table θ2

SPECIFICATIONS

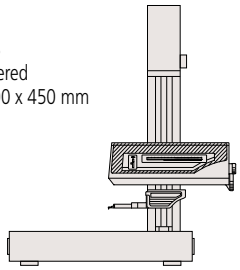
Model	SV-C3200S4		SV-C3200H4		SV-C3200W4	
Code No. (mm)	**525-481-1E**	**525-481-2E**	**525-482-1E**	**525-482-2E**	**525-483-1E**	**525-483-2E**
Code No. (inch)	**525-491-1E**	**525-491-2E**	**525-492-1E**	**525-492-2E**	**525-493-1E**	**525-493-2E**
Model	**SV-C4500S4**		**SV-C4500H4**		**SV-C4500W4**	
Code No. (mm)	**525-441-1E**	**525-441-2E**	**525-442-1E**	**525-442-2E**	**525-443-1E**	**525-443-2E**
Code No. (inch)	**525-451-1E**	**525-451-2E**	**525-452-1E**	**525-452-2E**	**525-453-1E**	**525-453-2E**
X1-axis measuring range	100 mm					
Detector measuring force	0.75 mN	4 mN	0.75 mN	4 mN	0.75 mN	4 mN
Dimensions (main unit, W x D x H)	996 x 575 x 966 mm		996 x 575 x 1176 mm		1396 x 575 x 1176 mm	
Mass (main unit)	140 kg		150 kg		220 kg	

Model	SV-C3200S8		SV-C3200H8		SV-C3200W8	
Code No. (mm)	**525-486-1E**	**525-486-2E**	**525-487-1E**	**525-487-2E**	**525-488-1E**	**525-488-2E**
Code No. (inch)	**525-496-1E**	**525-496-2E**	**525-497-1E**	**525-492-2E**	**525-498-1E**	**525-498-2E**
Model	**SV-C4500S8**		**SV-C4500H8**		**SV-C4500W8**	
Code No. (mm)	**525-446-1E**	**525-446-2E**	**525-447-1E**	**525-447-2E**	**525-448-1E**	**525-448-2E**
Code No. (inch)	**525-456-1E**	**525-456-2E**	**525-457-1E**	**525-457-2E**	**525-458-1E**	**525-458-2E**
X1-axis measuring range	200 mm					
Detector measuring force	0.75 mN	4 mN	0.75 mN	4 mN	0.75 mN	4 mN
Dimensions (main unit, W x D x H)	1006 x 575 x 966 mm		1006 x 575 x 1176 mm		1406 x 575 x 1176 mm	
Mass (main unit)	140 kg		150 kg		220 kg	

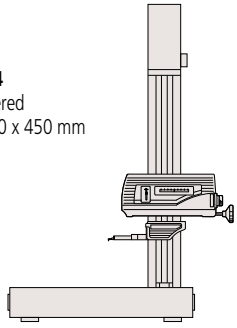
SV-C3200S4 / SV-C4500S4
Vertical travel: 300 mm powered
Granite base size (W x D): 600 x 450 mm



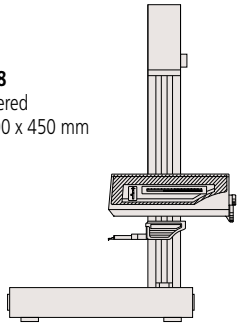
SV-C3200S8 / SV-C4500S8
Vertical travel: 300 mm powered
Granite base size (W x D): 600 x 450 mm



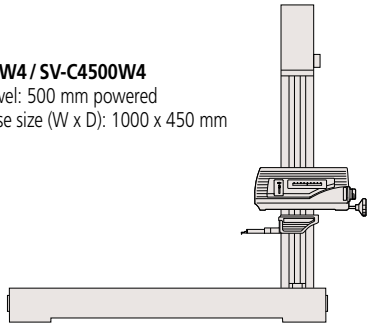
SV-C3200H4 / SV-C4500H4
Vertical travel: 500 mm powered
Granite base size (W x D): 600 x 450 mm



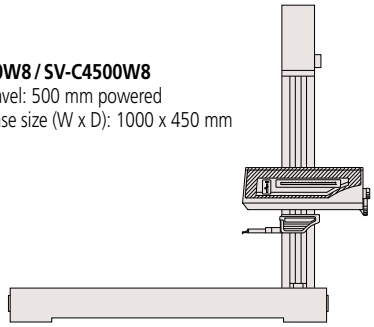
SV-C3200H8 / SV-C4500H8
Vertical travel: 500 mm powered
Granite base size (W x D): 600 x 450 mm



SV-C3200W4 / SV-C4500W4
Vertical travel: 500 mm powered
Granite base size (W x D): 1000 x 450 mm



SV-C3200W8 / SV-C4500W8
Vertical travel: 500 mm powered
Granite base size (W x D): 1000 x 450 mm



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Formtracer Extreme SV-C3000CNC/SV-C4000CNC

SERIES 525 – Surface Roughness / Contour Measuring System

- A high-accuracy CNC measuring system that enables measurement of surface roughness and form/contour with just one instrument.
- Each axis has a maximum drive speed of 200 mm/s, which permits high-speed positioning that potentially offers 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.
- The contour drive unit of SV-C4000CNC series is equipped with a Laser Hologage detector giving excellent narrow- and wide-range accuracy and resolution in the Z1 axis.
- Enables inclined plane measurements through simultaneous control of the X1 and Z2 axes.
- If the contour detector is replaced with that for surface roughness measurement, or vice versa, it is a simple, one-touch replacement without rerouting of the connecting cables.
- The Z1 axis incorporates an anti-collision safety device to automatically stop the detector if it collides with a workpiece or jig.
- Supplied with an easy-to-operate Remote Box, from which 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.

Formtracer Extreme SV-C3000CNC

Surface roughness detector

Contour detector

Technical Data

X1 axis (drive unit)

Resolution:	0.05 µm
Scale:	Reflective-type linear encoder
Accuracy (at 20°C):	±(1+4L/200) µm (SV-C3000CNC), ±(0.8+4L/200) µm (SV-C4000CNC)
Drive speed:	200 mm/s (max., CNC), 0 - 60 mm/s (joystick)
Measuring speed:	0.02 - 2 mm/s
Measuring direction:	Forward/backward
Traverse straightness:	2 µm / 200 mm Note: with the X1 axis in the horizontal orientation

Z1 axis (contour detector)

Measuring range:	±25 mm
Resolution:	0.2 µm (SV-C3000CNC), 0.05 µm (SV-C4000CNC)
Scale type:	Linear encoder (SV-C3000CNC), Laser Hologage (SV-C4000CNC)
Accuracy (at 20°C):	±(2+|4H|/100) µm (SV-C3000CNC), +/-(0.8+|0.5H|/25) µm (SV-C4000CNC) Note: H = Measurement height from the horizontal position (mm)
Stylus up/down operation:	Arc movement
Face of stylus:	Downward
Measuring force:	30 mN
Traceable angle:	Ascent 70°, descent 70° (using the standard stylus provided and depending on the surface roughness)
Stylus tip:	Carbide, R25 µm

Z1 axis (surface roughness detector)

Range / resolution:	800 µm / 0.01 µm, 80 µm / 0.001 µm, 8 µm / 0.0001 µm (up to 2400 µm with optional stylus)
Measuring force:	4 mN or 0.75 mN (low force type)
Stylus tip:	Diamond, 90° / R5 µm (60° / R2 µm: low force type)
Detecting method:	Differential inductance

Z2 axis (column)

Vertical travel:	300 mm or 500 mm
Resolution:	0.05 µm
Scale type:	Reflective-type linear encoder
Drive speed:	200 mm/s (max., CNC), 0 - 60 mm/s (joystick)

α axis

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

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Optional Accessories

Vibration isolation stand

Vibration isolation mechanism:	Diaphragm air spring
Natural frequency :	2.5 - 3.5 Hz
Damping mechanism:	Orifice
Levelling mechanism:	Automatic control with mechanical valves
Air supply pressure:	0.4 MPa
Allowable loading capacity:	350 kg
Dimension (WxDxH):	1000 x 895 x 715 mm
Mass:	315 kg

Y-axis table unit

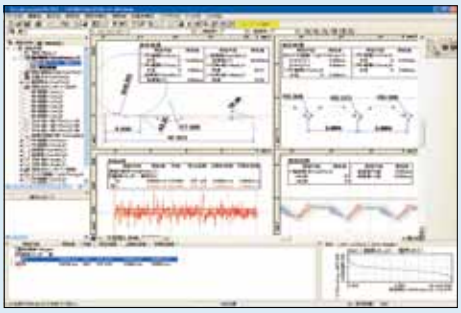
Measuring range:	200 mm
Resolution:	0.05 µm
Scale unit:	Reflective-type linear encoder
Drive speed:	200 mm/s (max., CNC), 0 - 60 mm/s (joystick)
Maximum loading capacity:	20 kg
Traverse straightness:	0.5 µm/200 mm
Accuracy (at 20°C):	±(2+2L/100) µm, L = measured length (mm)
Table size:	200 x 200 mm
Dimension (WxDxH):	320 x 646 x 105 mm
Mass:	35 kg

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

Software

FORMTRACEPAK

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.



SPECIFICATIONS

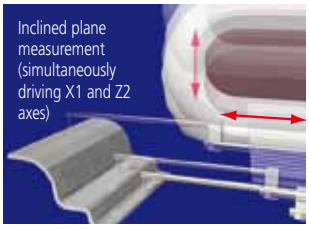
Model	SV-C3000CNC			
Code No. (100V - 120V)	**525-521-1E**	**525-522-1E**	**525-523-1E**	**525-524-1E**
Code No. (200V - 240V)	**525-521-2E**	**525-522-2E**	**525-523-2E**	**525-524-2E**
X1-axis measuring range	200 mm			
Z2-axis vertical travel	300 mm			
Y-axis table unit	—		Installed	
α-axis unit	—	Installed	—	Installed
Granite base size (WxD)	750 x 600 mm			
Dimensions (main unit, WxDxH)	800 x 651 x 1000 mm			
Mass (main unit)	240 kg			

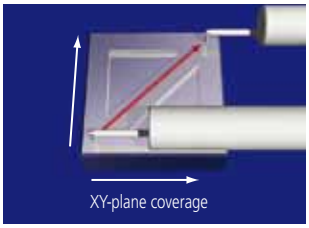
Model	SV-C3000CNC			
Code No. (100V - 120V)	**525-541-1E**	**525-542-1E**	**525-543-1E**	**525-544-1E**
Code No. (200V - 240V)	**525-541-2E**	**525-542-2E**	**525-543-2E**	**525-544-2E**
X1-axis measuring range	200 mm			
Z2-axis vertical travel	500 mm			
Y-axis table unit	—		Installed	
α-axis unit	—	Installed	—	Installed
Granite base size (WxD)	750 x 600 mm			
Dimensions (main unit, WxDxH)	800 x 651 x 1200 mm			
Mass (main unit)	250 kg			

Model	SV-C4000CNC			
Code No. (100V - 120V)	**525-621-1E**	**525-622-1E**	**525-623-1E**	**525-624-1E**
Code No. (200V - 240V)	**525-621-2E**	**525-622-2E**	**525-623-2E**	**525-624-2E**
X1-axis measuring range	200 mm			
Z2-axis vertical travel	300 mm			
Y-axis table unit	—		Installed	
α-axis unit	—	Installed	—	Installed
Granite base size (WxD)	750 x 600 mm			
Dimensions (main unit, WxDxH)	800 x 651 x 1000 mm			
Mass (main unit)	240 kg			

Model	SV-C4000CNC			
Code No. (100V - 120V)	**525-641-1E**	**525-642-1E**	**525-643-1E**	**525-644-1E**
Code No. (200V - 240V)	**525-641-2E**	**525-642-2E**	**525-643-2E**	**525-644-2E**
X1-axis measuring range	200 mm			
Z2-axis vertical travel	500 mm			
Y-axis table unit	—		Installed	
α-axis unit	—	Installed	—	Installed
Granite base size (WxD)	750 x 600 mm			
Dimensions (main unit, WxDxH)	800 x 651 x 1200 mm			
Mass (main unit)	250 kg			

MEASUREMENT APPLICATIONS





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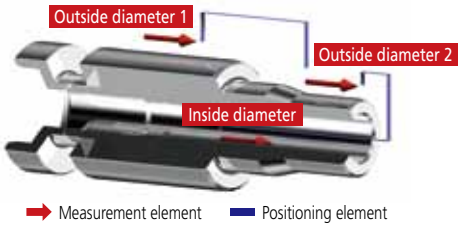
Mitutoyo

Formtracer CS-3200

SERIES 525 – Surface Roughness / Contour Measuring System

- The drive unit (X1 axis) and column (Z2 axis) are equipped with high-accuracy linear scales (ABS type) enabling fully automatic measurement combining vertical and horizontal movement. This improves reproducibility of continuous automatic measurement of small holes in the vertical direction and repeated measurement of parts which are difficult to position.



Continuous measurement example
(Outside diameter 1→Outside diameter 2→Inside diameter)

- Dramatically increased drive speed (X1 axis: 80 mm/s, Z2 axis: 20 mm/s) further reduces total measurement time. Small holes can be efficiently measured using the fine-feed knobs on the X and Z2 axes.
- The detector unit can be extended to avoid interference between the drive unit and workpiece. 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.
- Measuring range in the Z1-axis (height) direction is dramatically increased from 5 mm to 50 mm when contour detector units 3000, or 4000, are specified. (Both are factory installed options.)
- The drive unit (X1 axis) tilting function is a great help with measurements on inclined planes and when working with heavy workpieces that are not easily moved.

Formtracer CS-3200S4

Technical Data

X1 axis
- Measuring range: 100 mm
- Resolution: 0.05 µm
- Drive speed: 0 - 80 mm/s and manual
- Measuring speed: 0.02, 0.05, 0.1, 0.2 mm/s (surface roughness measurement) 0.02, 0.05, 0.1, 0.2, 0.5, 1, 2 mm/s (contour measurement)
- Measuring direction: Forward / backward
- Traverse straightness: 0.2 µm / 100 mm (0.4 µm / 100 mm: at the extended detector position) with the X1 axis in horizontal orientation
- Accuracy (at 20°C): ±(0.8+L/100) µm, L = drive length (mm)
- Inclination range: ±45°

Z1 axis
- Measuring range: 5 mm
- Resolution: 80 nm (5 mm range) 8 nm (0.5 mm range) 0.8 nm (0.05 mm range)
- Accuracy (at 20°C): ±(1.5+|2H|/100) µm, H = measured height from the horizontal position (mm)
- Measuring force: 0.75 mN
- Traceable angle: Ascent: 65°, Descent: 65° (using the standard chisel-cut stylus and depending on the surface roughness)
- Stylus tip (standard): Diamond, 60° / R2 µm
- Stylus tip (cone): Sapphire, 30° / R25 µm
- Face of stylus: Downward

Z2 axis (column)
- Column travel: 300 mm
- Resolution: 1 µm
- Drive speed: 0 - 20 mm/s and manual

Base size (W x D): 600 x 450 mm
Base material: Granite
Dimension (W x D x H): 756 x 482 x 966 mm (main unit)
Mass: 140 kg (main unit)
Power supply: 100 - 240V AC ±10%, 50/60Hz
Power consumption: 400 W (main unit only)

Main Unit Startup System

A start-up system (relocation detection sensor) is an integral security feature of this machine and will disable its operation if subject to relocation or strong vibration. Please be advised to contact your nearest Mitutoyo Service Centre as soon as possible or in advance of such circumstance.

SPECIFICATIONS

Model	**CS-3200S4**
Code No. (mm)	**525-401E**
Code No. (inch)	**525-411E**
X1-axis measuring range	100 mm
Z2-axis vertical travel	300 mm
Y-axis travel range	Optional
α-axis unit	Installed

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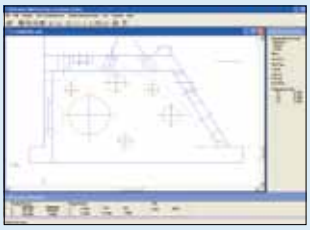
FORM

Software
FORMTRACEPAK-6000

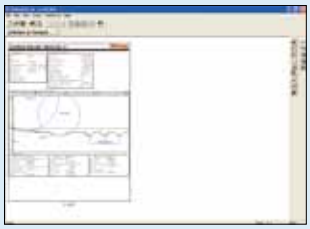
Measuring instrument control

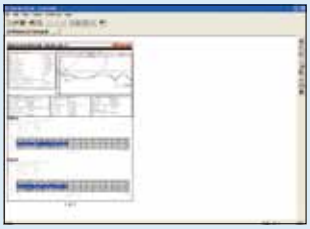
Contour analysis



CAD import

Inspection certificate creation

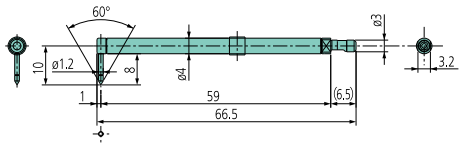




Inspection certificate creation

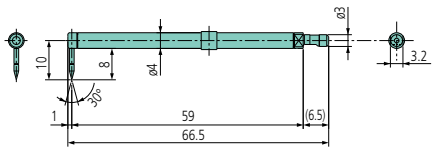
Stylus

12AAD554: Standard stylus (Standard accessory)
- For contour/surface roughness measurement



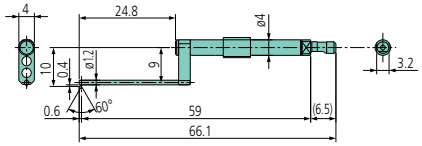
Tip radius: 2 µm
Tip material: Diamond

12AAD552: Cone stylus (Standard accessory)
- For contour measurement



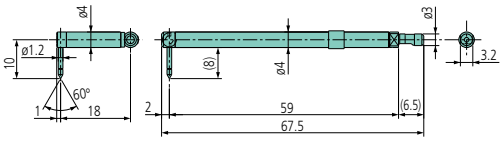
Tip radius: 25 µm
Tip material: Sapphire

12AAD556: Small hole stylus
- For contour/surface roughness measurement



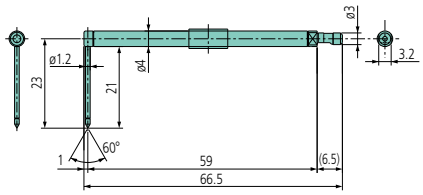
Tip radius: 2 µm
Tip material: Diamond

12AAD558: Eccentric type stylus
- For contour/surface roughness measurement



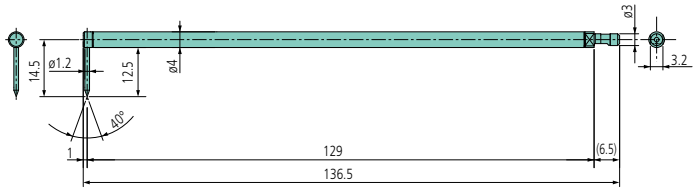
Tip radius: 2 µm
Tip material: Diamond

12AAD560: Deep groove stylus
- For contour/surface roughness measurement



Tip radius: 2 µm
Tip material: Diamond

12AAD562: 2x-long stylus*
- For contour/surface roughness measurement



Tip radius: 5 µm
Tip material: Diamond
*Measuring force is 4 mN and the Z1 measuring range and resolution is double that of the standard stylus.

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Formtracer Extreme CS-5000CNC/CS-H5000CNC

SERIES 525 – CNC Form Measuring Instruments

- High-accuracy stylus type CNC Surface Measuring Instrument that allows simultaneous measurement of surface roughness and form/contour.
- The X1 and Z2 axes have maximum drive speeds of 40 mm/s and 200 mm/s, respectively. This permits high-speed positioning that potentially offers a large increase in the throughput of multiple-profile/multiple-workpiece measurement tasks.
- Mitutoyo Laser Holoscales are incorporated in the X1 and Z1 axes to provide sufficiently high resolution for simultaneous measurement of form/contour and surface roughness, which is vital for batch working.
- 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.
- The Z1 axis incorporates an anti-collision safety device to automatically stop the detector unit if it collides with a workpiece or jig.
- The CS-5000CNC model has an α axis, enabling continuous measurement over horizontal and inclined surfaces by power-tilting the detector unit.
- Models with the Y-axis table installed allow greater coverage of larger workpieces and enable multiple workpieces to be measured at one setup.
- Supplied with the easy-to-operate Remote Box by which the user can control any movement by selecting the required axis using the two joysticks.
- Uses USB for communicating with the Data Processing/Analysis Unit (optional).

Formtracer Extreme CS-H5000CNC

Remote box

Technical Data

X1 axis	
Measuring range:	200 mm
Resolution:	0.00625 µm
Scale type:	Laser Holoscale
Drive speed:	Max. 40 mm/s (in CNC mode) 0 - 40 mm/s (in joystick control mode)
Measuring speed:	0.02 - 0.2 mm/s (surface roughness) 0.02 - 2 mm/s (form/contour)
Measuring direction:	Forward/backward direction
Traverse straightness:	CS-5000CNC: (0.1+0.0015L) µm - standard stylus (0.2+0.0015L) µm - 2X-long stylus CS-H5000CNC: (0.05+0.0003L) µm - standard stylus (0.1+0.0015L) µm - 2X-long stylus
Accuracy (at 20°C):	CS-5000CNC: ±(0.3+0.002L) µm CS-H5000CNC: ±(0.16+0.001L) µm L = measured length (mm)
Z1 axis	
Measuring range:	12 mm (with standard stylus) 24 mm (with 2X-long stylus)
Resolution:	CS-5000CNC: 0.004 µm (with standard stylus) 0.008 µm (with 2X-long stylus) CS-H5000CNC: 0.001 µm (with standard stylus) 0.002 µm (with 2X-long stylus)
Stylus movement:	Arc
Scale type:	Laser Holoscale
Accuracy (at 20°C):	CS-5000CNC: ±(0.3+|0.02H|) µm CS-H5000CNC: ±(0.07+|0.02H|) µm H = measured height (mm)
Measuring force:	4 mN (with standard stylus) 0.75 mN (with 2X-long stylus)
Traceable angle:	60° for ascent, 60° for descent (Depending on the workpiece surface condition)
Face of stylus:	Downward
Z2 axis (column unit)	
Traverse range:	300 mm or 500 mm* *Not for CS-H5000CNC
Resolution:	0.05 µm
Scale type:	Reflective-type linear encoder
Drive speed:	Max. 200 mm/s (in CNC mode) 0 - 50 mm/s (in joystick control mode)
Base size (W x D):	750 x 600 mm
Base material:	Granite
Y axis	
Measuring range:	200 mm
Resolution :	0.05 µm
Drive speed:	Max.200 mm/s (in CNC mode) 0~50 mm/s (in joystick control mode)
Max.workpiece load:	20 kg
Traverse linearity:	0.5 µm/200 mm
Accuracy (at 20°C):	±(2+2L/100) µm L = measured length (mm)
Dimension (W x D x H):	800 x 620 x 1000 mm (800 x 620 x 1200 mm: tall-column type)
Mass:	240 kg (250 kg: tall-column type)

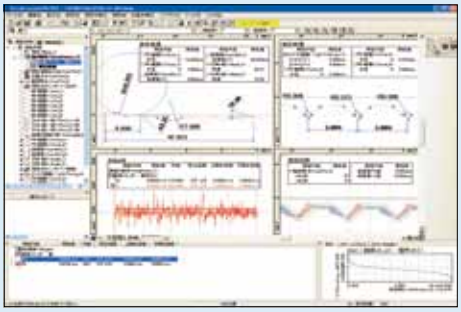
Wide range detector employing active control technology.

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

Software

FORMTRACEPAK

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.



ASLPAK

Aspherical lens analysis program

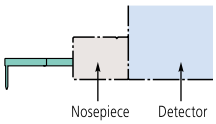
SPECIFICATIONS

Model	CS-5000CNC			
Code No. (100V - 120V)	**525-721-1E**	**525-722-1E**	**525-723-1E**	**525-724-1E**
Code No. (200V - 240V)	**525-721-2E**	**525-722-2E**	**525-723-2E**	**525-724-2E**
X1-axis measuring range	200 mm			
Z2-axis vertical travel	300 mm			
Y-axis table unit	—		Installed	
α-axis unit	—	Installed	—	Installed

Model	CS-5000CNC			
Code No. (100V - 120V)	**525-741-1E**	**525-742-1E**	**525-743-1E**	**525-744-1E**
Code No. (200V - 240V)	**525-741-2E**	**525-742-2E**	**525-743-2E**	**525-744-2E**
X1-axis measuring range	200 mm			
Z2-axis vertical travel	500 mm			
Y-axis table unit	—		Installed	
α-axis unit	—	Installed	—	Installed

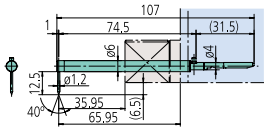
Model	CS-H5000CNC	
Code No. (100V - 120V)	**525-761-1E**	**525-763-1E**
Code No. (200V - 240V)	**525-761-2E**	**525-763-2E**
X1-axis measuring range	200 mm	
Z2-axis vertical travel	300 mm	
Y-axis table unit	—	Installed
α-axis unit	—	

Stylus



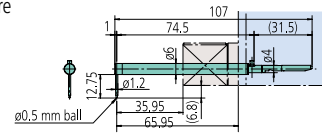
12AAD543*1: Standard-length stylus
12AAJ037*2: Standard-length stylus

Tip radius: 5 µm
Tip material: Diamond



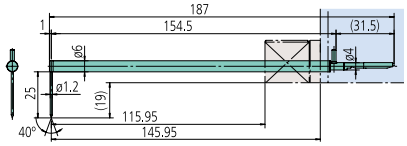
12AAD544*1*2: Standard-length ball stylus

Tip material: Sapphire



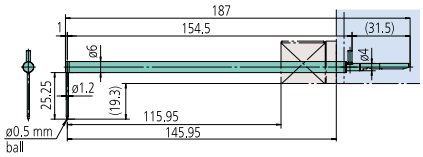
12AAD545*1: Double-length stylus
12AAJ039*2: Double-length stylus

Tip radius: 5 µm, Tip material: Diamond



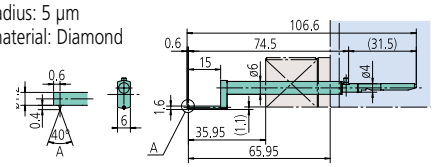
12AAD546*1*2: Double-length ball stylus

Tip material: Sapphire



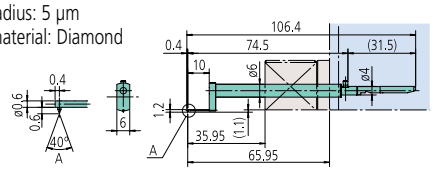
12AAD651: Standard-length stylus for small hole

Tip radius: 5 µm
Tip material: Diamond



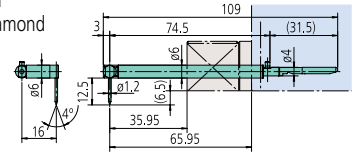
12AAD652: Standard-length stylus for extra-small hole

Tip radius: 5 µm
Tip material: Diamond



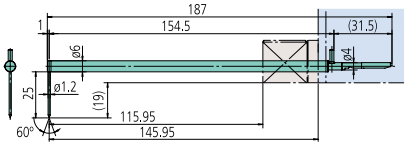
12AAD653: Standard-length eccentric stylus

Tip radius: 5 µm
Tip material: Diamond



12AAJ041*2: Double-length stylus

Tip radius: 2 µm, Tip material: Diamond



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

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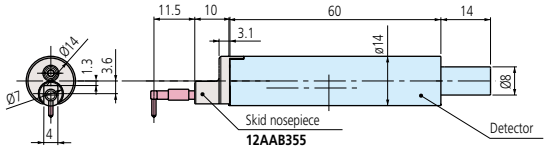
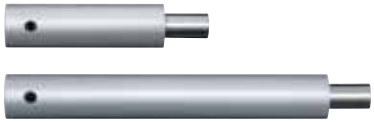
Mitutoyo

Optional Styli

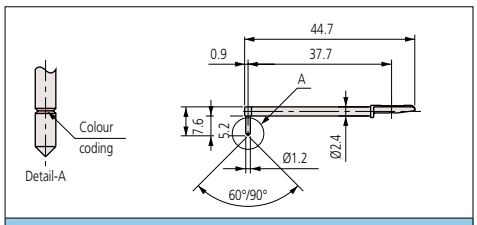
Compatible with SJ-410, SJ-500, SV-2100, SV-3100, SV-C3200, SV-C4500 series



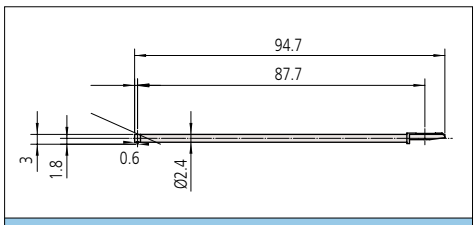
178-396-2 Detector (0.75 mN)
178-397-2 Detector (4 mN)



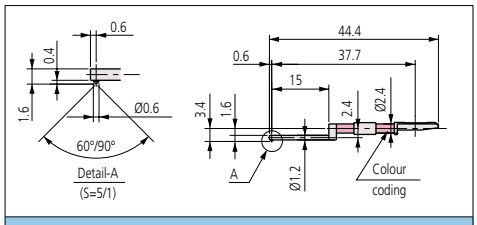
12AAG202 50 mm extension rod
12AAG203 100 mm extension rod



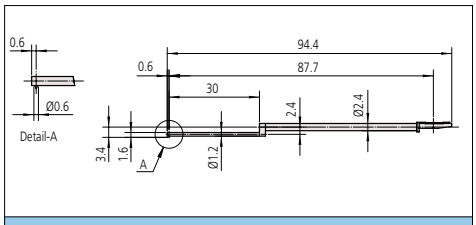
1. Standard stylus



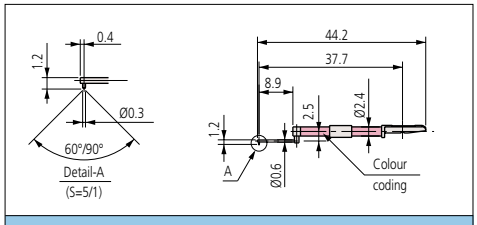
2. Double length for deep hole*3



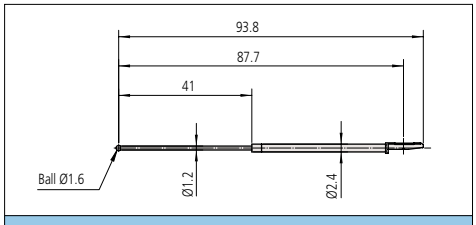
3. For small hole



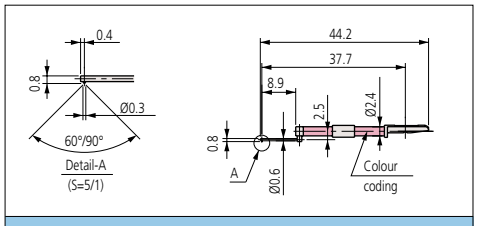
4. For small hole/double length for deep hole*3



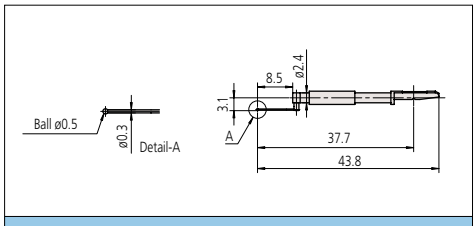
5. For very small hole



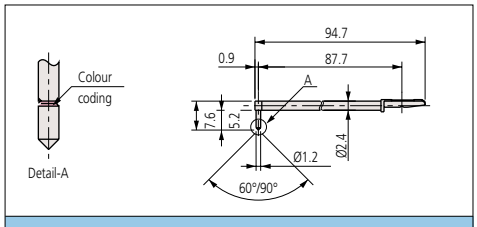
6. For small hole*3*4



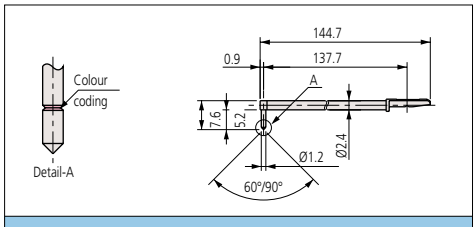
7. For extra-small hole



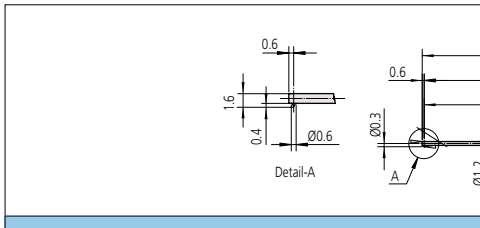
8. For ultra-small hole*3*4



9. For deep hole (double length)*3



10. For deep hole (triple length)*3



11. For small slotted hole*3

Technical Data

1. Standard stylus
   - **12AAE882** (1 µm)*1
   - **12AAE924** (1 µm)*2
   - **12AAC731** (2 µm)*1
   - **12AAB403** (5 µm)*2
   - **12AAB415** (10 µm)*2
   - **12AAE883** (250 µm)*1
2. Double length for deep hole
   - **12AAE898** (2 µm)*1
   - **12AAE914** (5 µm)*2
3. For small hole
   - **12AAC732** (2 µm)*1
   - **12AAB404** (5 µm)*2
   - **12AAB416** (10 µm)*2
4. For small hole/double length for deep hole
   - **12AAE892** (2 µm)*1
   - **12AAE908** (5 µm)*2
5. For very small hole
   - **12AAC733** (2 µm)*1
   - **12AAB405** (5 µm)*2
   - **12AAB417** (10 µm)*2
6. For small hole
   - **12AAE884** (0.8 mm)
7. For extra-small hole
   - **12AAC734** (2 µm)*1
   - **12AAB406** (5 µm)*2
   - **12AAB418** (10 µm)*2
8. For ultra-small hole
   - **12AAJ662** (250 µm)
9. For deep hole (double length)
   - **12AAC740** (2 µm)*1
   - **12AAB413** (5 µm)*2
   - **12AAB425** (10 µm)*2
10. For deep hole (triple length)
    - **12AAC741** (2 µm)*1
    - **12AAB414** (5 µm)*2
    - **12AAB426** (10 µm)*2
11. For small slotted hole
    - **12AAE938** (2 µm)*1
    - **12AAE940** (5 µm)*2

Tip radius	1 µm	2 µm	5 µm	10 µm	250 µm
Colour coding	White	Black	No colour	Yellow	No notch or colour

( ) tip radius
*1 60° tip angle
*2 90° tip angle
*3 For downward-facing measurement only
*4 Used for calibration, a standard step gauge (**178-611** optional accessory) is also required.

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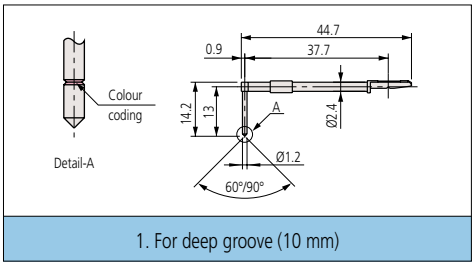
Technical Data

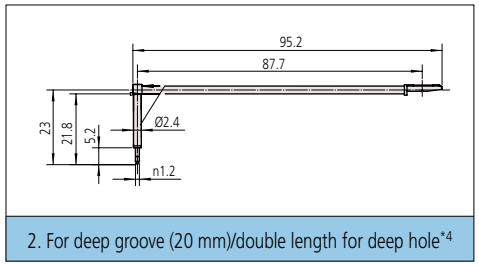
1. For deep groove (10 mm)
   12AAC735 (2 µm)*1
   12AAB409 (5 µm)*2
   12AAB421 (10 µm)*2
2. For deep groove (20 mm)/double length for deep hole
   12AAE893 (2 µm)*1
   12AAE909 (5 µm)*2
3. For deep groove (20 mm)
   12AAC736 (2 µm)*1
   12AAB408 (5 µm)*2
   12AAB420 (10 µm)*2
4. For deep groove (40 mm)
   12AAE895 (2 µm)*1
   12AAE911 (5 µm)*2
5. For deep groove (30 mm)
   12AAC737 (2 µm)*1
   12AAB407 (5 µm)*2
   12AAB419 (10 µm)*2
6. For deep groove (30 mm)/double length for deep hole
   12AAE894 (2 µm)*1
   12AAE910 (5 µm)*2
7. For gear tooth
   12AAB339 (2 µm)*1
   12AAB410 (5 µm)*1
   12AAB422 (10 µm)*1
8. For gear tooth/double length for deep hole
   12AAE896 (2 µm)*1
   12AAE912 (5 µm)*1
9. For rolling circle waviness surface
   12AAB338 (0.8 mm)
10. For rolling circle waviness/double length for deep hole
    12AAE886 (250 µm)
11. For knife-edge detector
    12AAC738 (2 µm)*1
    12AAB411 (5 µm)*2
    12AAB423 (10 µm)*2
12. For corner hole/double length for deep hole
    12AAM601 (2 µm)*1
    12AAM603 (5 µm)*1
13. For eccentric arm
    12AAC739 (2 µm)*1
    12AAB412 (5 µm)*2
    12AAB424 (10 µm)*2
14. For bottom surface
    12AAE899 (2 µm)*1
    12AAE915 (5 µm)*2

Tip radius	1 µm	2 µm	5 µm	10 µm	250 µm
Colour coding	White	Black	No colour	Yellow	No notch or colour

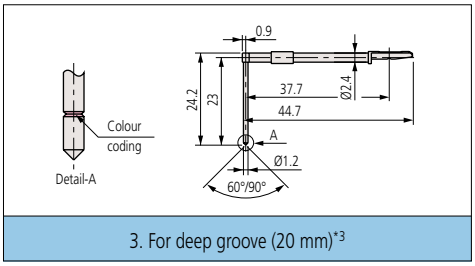
( ) tip radius
*1 60° tip angle
*2 90° tip angle
*3 For downward-facing measurement only
*4 Used for calibration, a standard step gauge (**178-611** optional accessory) is also required.



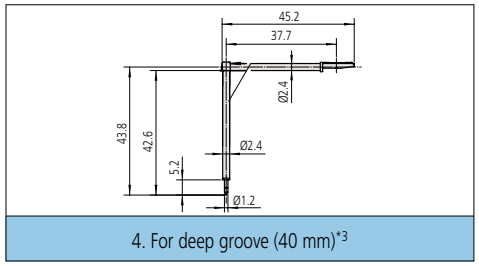
1. For deep groove (10 mm)



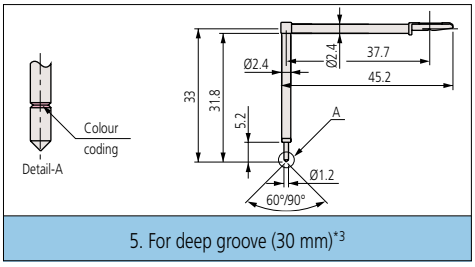
2. For deep groove (20 mm)/double length for deep hole*4



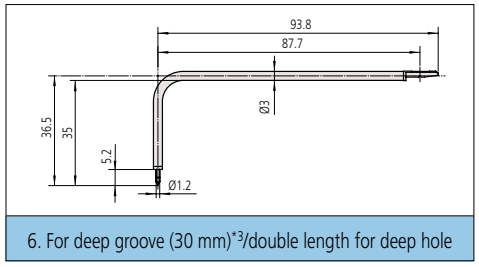
3. For deep groove (20 mm)*3



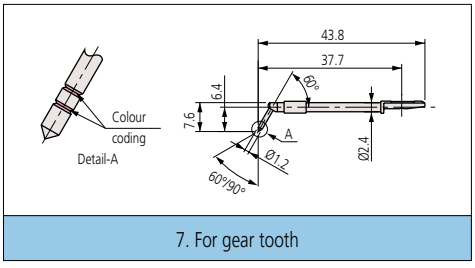
4. For deep groove (40 mm)*3



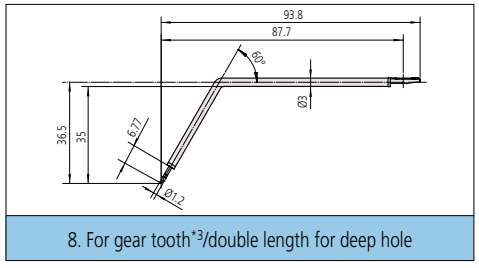
5. For deep groove (30 mm)*3



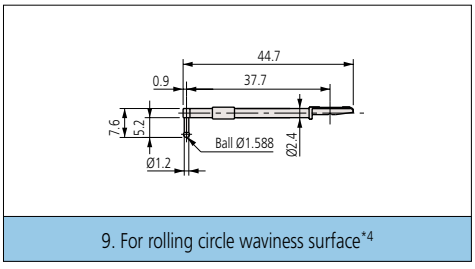
6. For deep groove (30 mm)*3/double length for deep hole



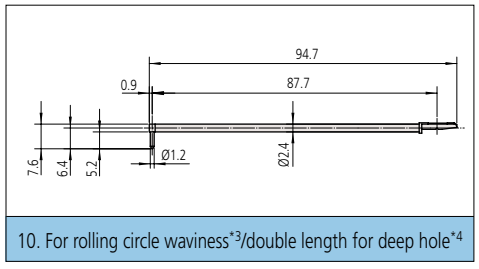
7. For gear tooth



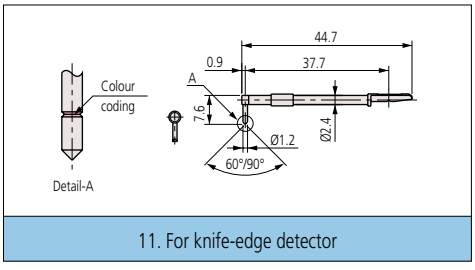
8. For gear tooth*3/double length for deep hole



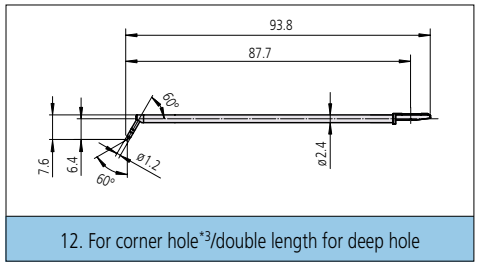
9. For rolling circle waviness surface*4



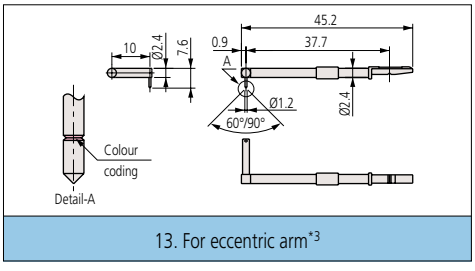
10. For rolling circle waviness*3/double length for deep hole*4



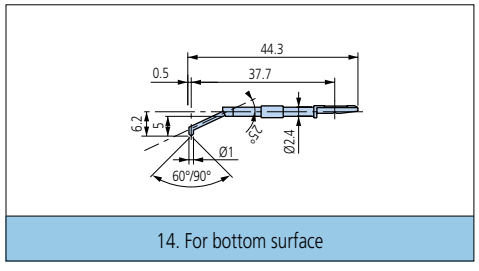
11. For knife-edge detector



12. For corner hole*3/double length for deep hole



13. For eccentric arm*3



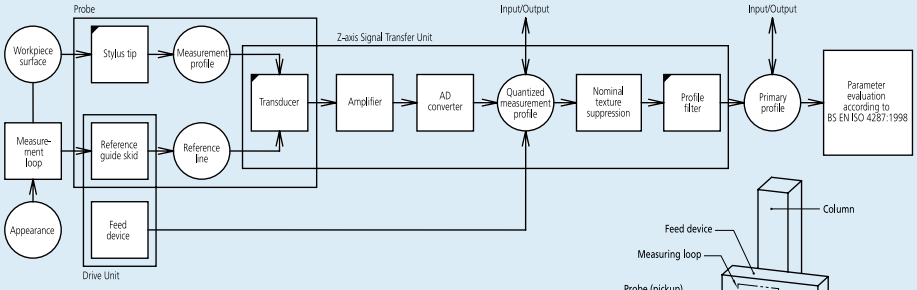
14. For bottom surface

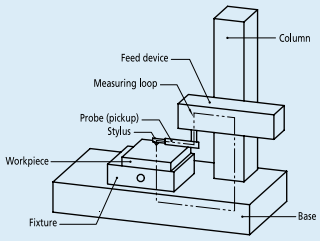
Quick Guide to Precision Measuring Instruments

Surftest (Surface Roughness Testers)

Nominal Characteristics of Contact (Stylus) Instruments

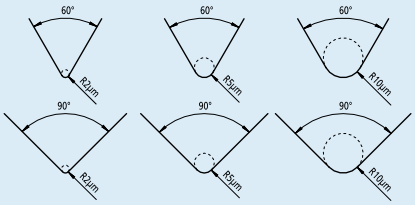
BS EN ISO 3274:1998





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		

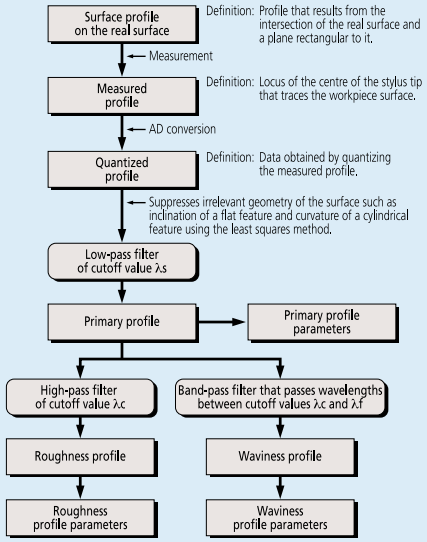
Note 1: The maximum value of static measuring force at the average position of a stylus is to be 4.0mN for a special structured probe including a replaceable stylus.

Metrological Characterization of Phase Correct Filters

BS EN ISO 11562:1997

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

Data Processing Flow



Relationship between Cutoff Value and Stylus Tip Radius

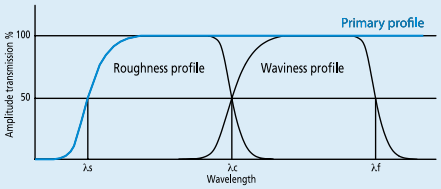
The following table lists the relationship between the roughness profile cutoff value λc, stylus tip radius r_{tip}, and cutoff ratio λc/λs.

λc mm	λs µm	λc/λs	Maximum r_{tip} µm	Maximum sampling length mm
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.

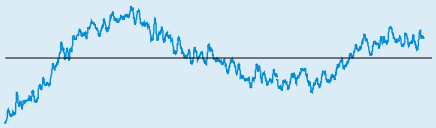
Surface Profiles

EN ISO 4287: 1998



Primary Profile

Profile obtained from the measured profile by applying a low-pass filter with cutoff value λs to remove the shortest wavelength components that are of no relevance to measurement.

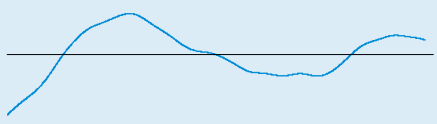


Roughness Profile

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.

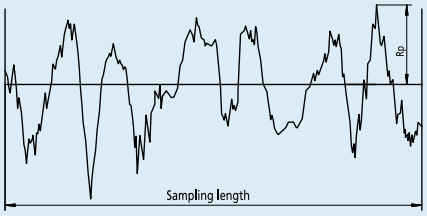


Definition of Parameters

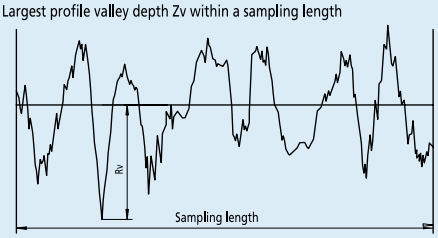
BS EN ISO 4287:1998

Amplitude Parameters (peak and valley)

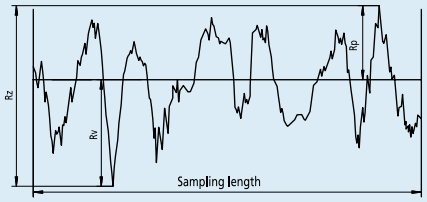
Maximum peak height of the primary profile Pp
Maximum peak height of the roughness profile Rp
Maximum peak height of the waviness profile Wp
Largest profile peak height Zp within a sampling length



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



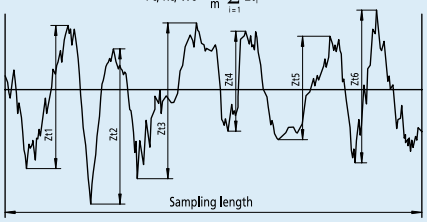
Maximum height of the primary profile Pz
Maximum height of the roughness profile Rz
Maximum height of the waviness profile Wz
Sum of height of the largest profile peak height Zp and the largest profile valley depth Zv within a sampling length



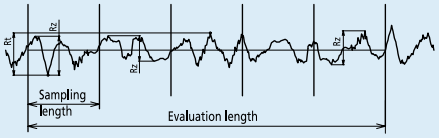
In ISO 4287-1: 1984, Rz was used to indicate the *ten point height of irregularities*. Care must be taken because differences between results obtained according to current and old standards are not always negligibly small. (Be sure to check whether the drawing instructions conform to current or old standards.)

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



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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

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

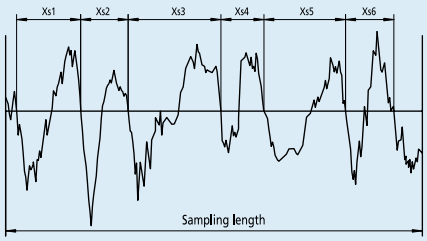
The above equation defines Rku. Pku and Wku are defined in a similar manner. Pku, Rku, and Wku are measures of the sharpness of the probability density function of the ordinate values.

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

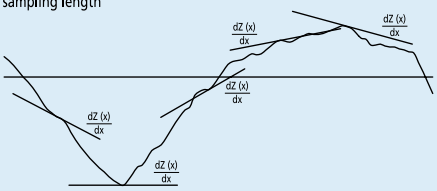
$$PSm, RSm, WSm = \frac{1}{m}\sum_{i=1}^{m} X_{si}$$



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

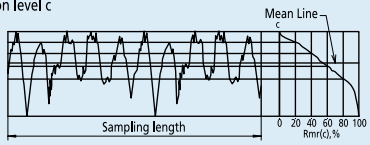
Root mean square value of the ordinate slopes dZ/dX within a sampling length



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)

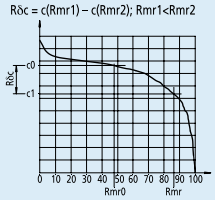
Ratio of the material length of the profile elements Ml(c) at a given level c to the evaluation length

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

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

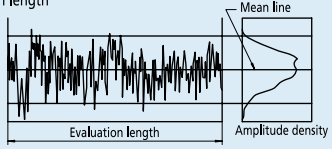
Material ratio determined at a profile section level Rdc (or Pdc or Wdc), related to the reference section level c0

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

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

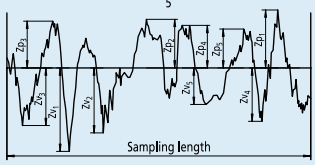


JIS Specific Parameters

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 lc.

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

Sampling Length for Surface Roughness Parameters

BS EN ISO 4288:1998

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) RzImax only used for measurement of RzImax, RvImax, RpImax, and RcImax.

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

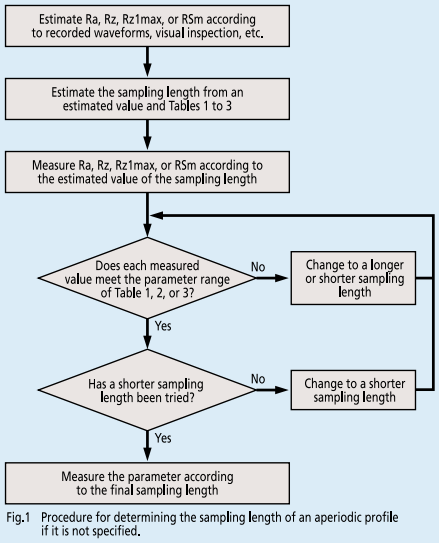


Fig.1 Procedure for determining the sampling length of an aperiodic profile if it is not specified.

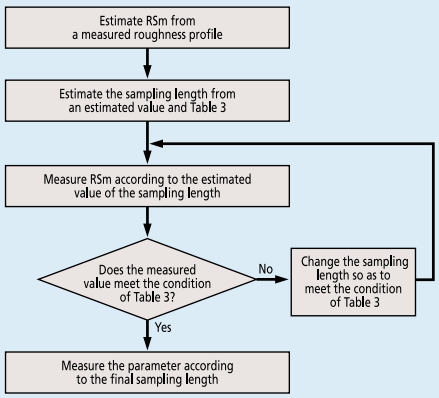


Fig.2 Procedure for determining the sampling length of a periodic profile if it is not specified.

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Mitutoyo

Contracer CV-1000/CV-2000

SERIES 218 – Contour Measuring Instruments

- A digital arc scale is equipped in the Z-axis detecting unit. This gives you a wider range of measurement with higher resolution. No more reliance on measurement magnification.
- A data analysis system (PC system and FORMTRACEPAK software) is available.
- The CV-1000 is portable and can be carried to the machine shop for measurement of large workpieces.

Contracer CV-1000N2

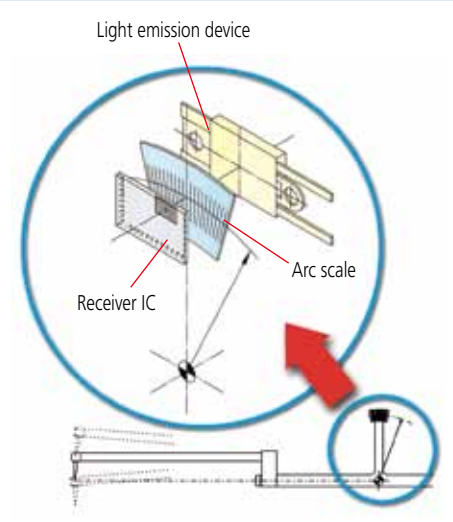
Contracer CV-2000M4

Contracer CV-2000S4

Technical Data

X1 axis	
Measuring range:	50 mm (CV-1000) or 100 mm (CV-2000)
Resolution:	0.2 µm
Scale type:	Reflective-type linear encoder
Drive speed:	0.2, 1 mm/s and manual
Measuring speed:	0.2, 0.5 mm/s
Measuring direction:	Backward
Traverse straightness:	3.5 µm/50 mm (CV-1000), 3.5 µm/100 mm (CV-2000) with the X1 axis in horizontal orientation
Accuracy (at 20°C):	±(3.5+2L/100) µm, L = Drive length (mm)
Inclination range:	±45° (CV-2000)
Z2 axis (column, CV-2000 only)	
Column type:	Power drive (S4 type) or Manual (M4 type)
Vertical travel:	250 mm (S4 type), 320 mm (M4 type)
Drive speed:	1 - 5 mm/s and manual
Z1 axis (detector unit)	
Measuring range:	25 mm (CV-1000) or 40 mm (CV-2000)
Resolution:	0.4 µm (CV-1000) or 0.5 µm (CV-2000)
Scale type:	Arc encoder
Accuracy (at 20°C):	±(3.5+l4Hl/25) µm, H: measurement height from the horizontal position (mm)
Stylus movement:	Arc
Stylus orientation:	Downward
Measuring force:	10 - 30 mN
Traceable angle:	Ascent: 77°, descent: 87° using the standard stylus provided and depending on the surface roughness
Stylus tip	Carbide, R25 µm
Base size (W x H):	600 x 450 mm (CV-2000)
Base material:	Granite (CV-2000)
Mass:	5 kg (CV-1000N2), 115 kg (CV-2000M4), 130 kg (CV-2000S4)
Power supply:	100 - 240V AC ±10%, 50/60Hz

Arc scale on the Z-axis



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Optional Accessories

218-024: Column stand for CV-1000 (vertical travel: 320 mm, inclination: ±45°) **£2960.00**

218-001: Cross-travel table (XY range: 100 x 50 mm) **£1610.00**

218-011: Cross-travel table (XY range: 4" x 2") **£1880.00**

218-041: Cross-travel table (XY range: 50 x 25 mm) **£1980.00**

218-051: Cross-travel table (XY range: 2" x 1") **£1850.00**

218-002: Rugged table **£1070.00**

176-107: Holder with clamp **£148.00**

218-003: Rotary vice (heavy-duty type) **£986.00**

172-144: Rotary vice **£533.00**

172-234: V-block with clamp (max. workpiece ø50 mm) **£259.00**

172-378: V-block with clamp (max. workpiece ø25 mm) **£194.00**

172-197: Swivel centre support **£348.00**

172-142: Centre support **£509.00**

172-143: Centre support riser **£205.00**

178-023: Vibration isolator **£2530.00**

178-024: Vibration isolator stand **£647.00**

998862: Pin gauge unit for calibration (mm) **£204.00**

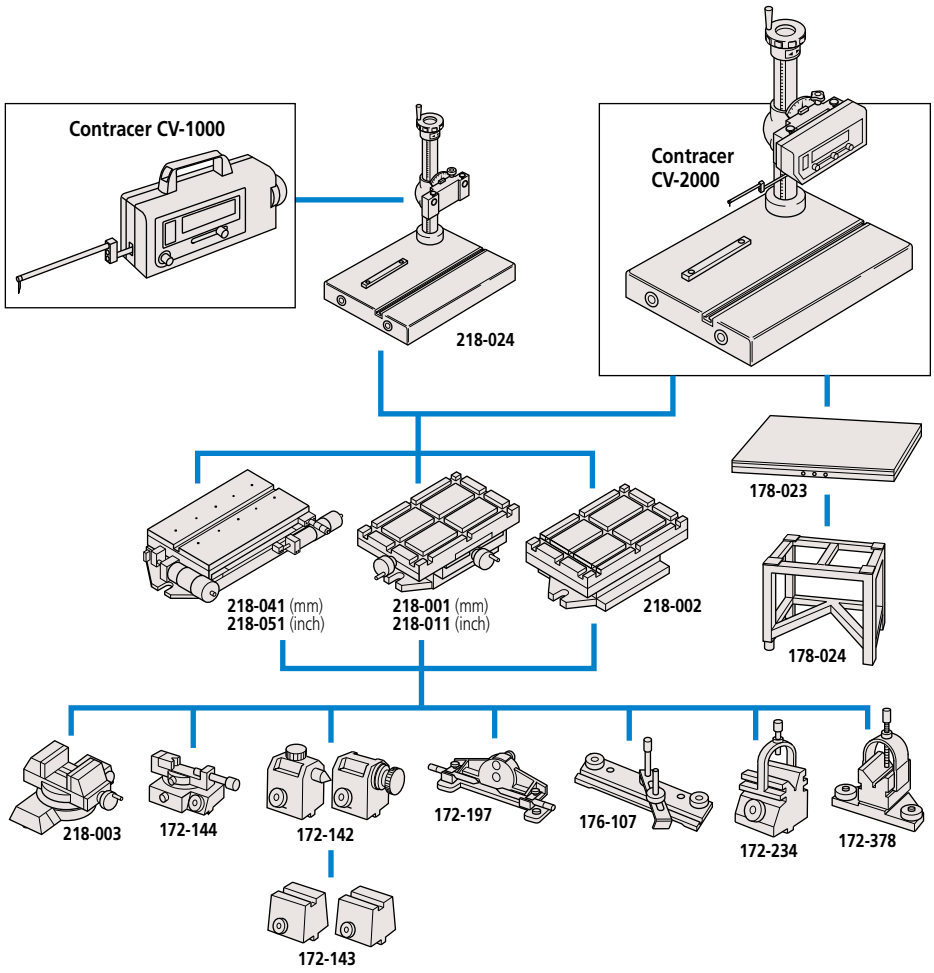
998861: Pin gauge unit for calibration (inch) **£204.00**

CV-1000N2 can be attached to the optional column stand.

SPECIFICATIONS

Model	CV-1000N2	CV-2000M4	CV-2000S4
Code No. (mm)	**218-611E**	**218-631E**	**218-632E**
Code No. (inch/mm)	**218-621E**	**218-641E**	**218-642E**
X1-axis measuring range	50 mm	100 mm	
Z1-axis measuring range	25 m	40 mm	
Z2-axis vertical travel	—	320 mm	250 mm

SYSTEM DIAGRAM



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Contracer CV-3200/CV-4500

SERIES 218 – Contour Measuring Instruments

- Dramatically increased drive speed (X1 axis: 80 mm/s, Z2 axis: 30 mm/s) further reduces total measurement time.
- In order to maintain the traverse straightness 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 (X1 axis) and column (Z2 axis) are equipped with 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 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.
- Designed to handle workpieces calling for high accuracy

CV-4500 only:

- 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.
- 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).

CV-4500 double cone end stylus

Contracer CV-3200S4

Simplified CNC Function

With support for a wide range of optional peripherals designed for use with the CNC models enables automatic measurement.

Using Y-axis table

Using rotary table θ1

Using rotary table θ2

Technical Data

X1 axis	
Resolution:	0.05 µm
Scale type:	Linear encoder
Drive speed:	0 - 80 mm/s and manual
Measuring speed:	0.02 - 5 mm/s
Measuring direction:	Forward/backward
Traverse straightness:	0.8 µm/100 mm, 2 µm/200 mm with the X1 axis in horizontal orientation
Accuracy (at 20°C):	±(0.8+0.01L) µm (CV-3200/4500 S4, H4, W4) ±(0.8+0.02L) µm (CV-3200/4500S8, H8, W8) L = drive length (mm)
Inclination range:	±45°
Z2 axis (column)	
Resolution:	1 µm
Scale type:	ABSOLUTE linear encoder
Drive speed:	0 - 30 mm/s and manual
Z1 axis (detector unit)	
Measuring range:	±30 mm
Resolution:	0.04 µm (CV-3200) 0.02 µm (CV-4500)
Scale type:	Rotary arc encoder
Accuracy (at 20°C):	±(1.6+l2Hl/100) µm (CV-3200) ±(0.8+l2Hl/100) µm (CV-4500) H: measurement height from the horizontal position (mm)
Stylus orientation:	Upward/downward
Measuring force:	30 mN (CV-3200) 10, 20, 30, 40, 50 mN (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	Carbide, R25 µm (CV-3200)
Base material:	Granite
Mass	
Main unit:	See table
Controller unit:	14 kg
Remote control box:	0.9 kg
Power supply:	100 - 120V AC ±10%, 200 - 240V AC ±10%, 50/60 Hz
Power consumption:	400 W (main unit only)

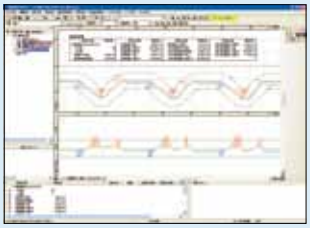
Combined Calibration Gauge

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

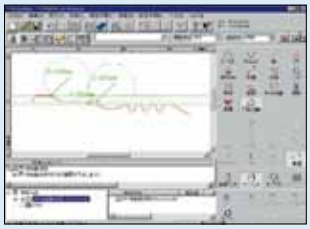
MiCAT
Mitutoyo Intelligent Computer Aided Technology
the standard in world metrology software
FORM

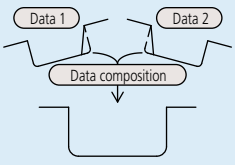
Software
FORMTRACEPAK V5

Measuring control screen



Automatic circle/line application function





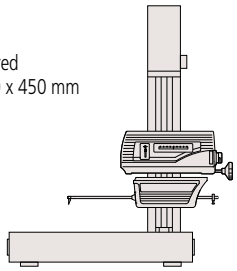
Data composition function

SPECIFICATIONS

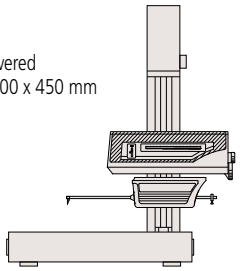
Model	CV-3200S4	CV-3200H4	CV-3200W4
Code No. (mm)	218-481E	218-482E	218-483E
Code No. (inch)	218-491E	218-492E	218-493E
Model	**CV-4500S4**	**CV-4500H4**	**CV-4500W4**
Code No. (mm)	218-441E	218-442E	218-443E
Code No. (inch)	218-451E	218-452E	218-453E
X1-axis measuring range	100 mm		
Dimensions (main unit, W x D x H)	756 x 482 x 966 mm	756 x 482 x 1166 mm	1156 x 482 x 1176 mm
Mass (main unit)	140 kg	150 kg	220 kg

Model	CV-3200S8	CV-3200H8	CV-3200W8
Code No. (mm)	218-486E	218-487E	218-488E
Code No. (inch)	218-496E	218-497E	218-498E
Model	**CV-4500S8**	**CV-4500H8**	**CV-4500W8**
Code No. (mm)	218-446E	218-447E	218-448E
Code No. (inch)	218-456E	218-457E	218-458E
X1-axis measuring range	200 mm		
Dimensions (main unit, W x D x H)	756 x 482 x 966 mm	756 x 482 x 1166 mm	1156 x 482 x 1176 mm
Mass (main unit)	140 kg	150 kg	220 kg

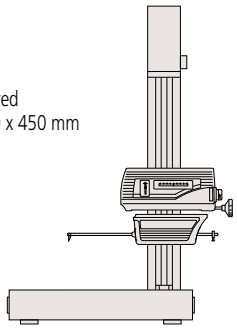
CV-3200S4 / CV-4500S4
Vertical travel: 300 mm powered
Granite base size (W x D): 600 x 450 mm



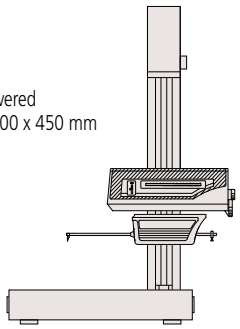
CV-3200S8 / CV-4500S8
Vertical travel: 300 mm powered
Granite base size (W x D): 600 x 450 mm



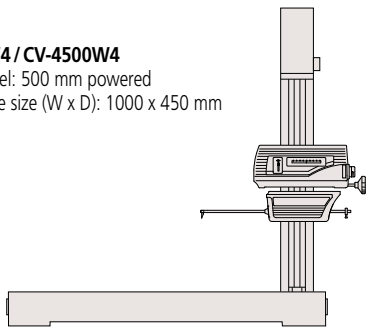
CV-3200H4 / CV-4500H4
Vertical travel: 500 mm powered
Granite base size (W x D): 600 x 450 mm



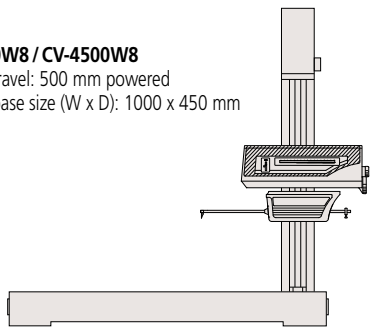
CV-3200H8 / CV-4500H8
Vertical travel: 500 mm powered
Granite base size (W x D): 600 x 450 mm



CV-3200W4 / CV-4500W4
Vertical travel: 500 mm powered
Granite base size (W x D): 1000 x 450 mm



CV-3200W8 / CV-4500W8
Vertical travel: 500 mm powered
Granite base size (W x D): 1000 x 450 mm



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Mitutoyo

Contracer Extreme CV-3000CNC/CV-4000CNC

SERIES 218 – CNC Contour Measuring Instruments

- High-accuracy CNC contour/form measuring instrument.
- The X1, Y and Z2 axes have a maximum drive speed of 200 mm/s, which permits high-speed positioning that potentially offers 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.
- The drive unit of the CV-4000CNC series is equipped with a Laser Hologage detector giving excellent narrow/wide range accuracy and resolution in the Z1 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.
- Enables inclined plane measurements through 2-axis simultaneous control in the X- and Y-axis directions.
- The Z1 axis incorporates an anti-collision safety device to automatically stop the detector unit if it collides with a workpiece or jig.
- Supplied with an easy-to-operate Remote Box, on which 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.

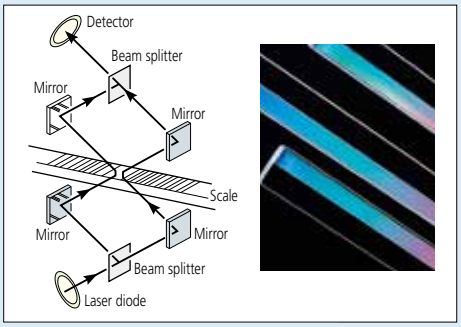
Contracer Extreme CV-3000CNC

Technical Data

X1 axis	
Measuring range:	200 mm
Resolution:	0.05 µm
Scale type:	Reflective-type linear encoder
Drive speed:	200 mm/s (max., CNC) 0 - 60 mm/s (joystick)
Measuring speed:	0.02 - 2 mm/s
Measuring direction:	Forward/backward
Traverse straightness:	2 µm/200 mm, with the X1 axis in horizontal orientation
Accuracy (at 20°C):	±(1+4L/200) µm (CV-3000CNC), ±(0.8+4L/200) µm (CV-4000CNC) L = drive length (mm)
α axis	
Inclination angle:	-45° (CCW) to +10° (CW)
Resolution:	0.000225°
Inclination:	1 rpm
Z2 axis (column)	
Vertical travel:	300 mm or 500 mm
Resolution:	0.05 µm
Scale type:	Reflective-type linear encoder
Drive speed:	200 mm/s (max., CNC) 0 - 60 mm/s (joystick)
Base size (W x H):	750 x 600 mm
Base material:	Granite
Z1 axis (detector unit)	
Measuring range:	±25 mm
Resolution:	0.2 µm (CV-3000CNC), 0.05 µm (CV-4000CNC)
Scale type:	Linear encoder (CV-3000CNC) Laser Hologage (CV-4000CNC)
Accuracy (at 20°C):	±(2+l4Hl/100) µm (CV-3000CNC) ±(0.8+l0.5Hl/25) µm (CV-4000CNC) H: measurement height from the horizontal position (mm)
Stylus movement:	Arc
Stylus orientation:	Upward/downward
Measuring force:	30 mN
Traceable angle:	Ascent: 70°, descent: 70° (using the standard stylus provided and depending on the surface roughness)
Stylus tip	Carbide, R25 µm
Y axis	
Measuring range:	200 mm
Resolution:	0.05 µm
Drive speed:	Max.200 mm/s (in CNC mode) 0~60 mm/s (in joystick control mode)
Max. table loading:	20 kg
Traverse straightness:	2 µm/200 mm
Accuracy (at 20°C):	±(2+2L/100) µm, L = length between arbitrary two point (mm)
Mass:	240 kg (250 kg tall-column type), the Y-axis table and a vibration isolation stand are excluded
Power supply:	100 - 240VAC ±10%, 50/60Hz
Power consumption:	500 W (main unit only)

Hologage system

Mitutoyo's innovative Laser Hologage technology provides near interferometer-grade accuracy using the interference phenomenon of diffracted light, coupled with a resolution of 0.05 µm over the entire detecting range of 50 mm.



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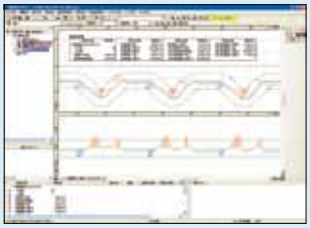
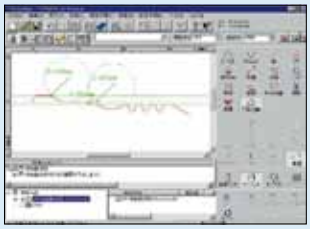
MiCAT
Mitutoyo Intelligent Computer Aided Technology
the standard in world metrology software
FORM

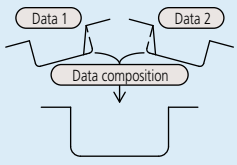
Software
FORMTRACEPAK V5

Measuring control screen



Automatic circle/line application function





Data composition function

SPECIFICATIONS

Model	CV-3000CNC			
Code No. (100V - 120V)	**218-521-1E**	**218-522-1E**	**218-523-1E**	**218-524-1E**
Code No. (200V - 240V)	**218-521-2E**	**218-522-2E**	**218-523-2E**	**218-524-2E**
X1-axis measuring range	200 mm			
Z2-axis vertical travel	300 mm			
Y-axis table unit*1	—		Installed	
α-axis unit	—	Installed	—	Installed
Vibration isolation stand*2	Installed			
Granite base size (W x D)	750 x 600 mm			
Dimensions (main unit, W x D x H)	800 x 620 x 1000 mm			
Mass (main unit)	240 kg			

Model	CV-3000CNC			
Code No. (100V - 120V)	**218-541-1E**	**218-542-1E**	**218-543-1E**	**218-544-1E**
Code No. (200V - 240V)	**218-541-2E**	**218-542-2E**	**218-543-2E**	**218-544-2E**
X1-axis measuring range	200 mm			
Z2-axis vertical travel	500 mm			
Y-axis table unit*1	—		Installed	
α-axis unit	—	Installed	—	Installed
Vibration isolation stand*2	Installed			
Granite base size (W x D)	750 x 600 mm			
Dimensions (main unit, W x D x H)	800 x 620 x 1200 mm			
Mass (main unit)	250 kg			

Model	CV-4000CNC			
Code No. (100V - 120V)	**218-561-1E**	**218-562-1E**	**218-563-1E**	**218-564-1E**
Code No. (200V - 240V)	**218-561-2E**	**218-562-2E**	**218-563-2E**	**218-564-2E**
X1-axis measuring range	200 mm			
Z2-axis vertical travel	300 mm			
Y-axis table unit*1	—		Installed	
α-axis unit	—	Installed	—	Installed
Vibration isolation stand*2	Installed			
Granite base size (W x D)	750 x 600 mm			
Dimensions (main unit, W x D x H)	800 x 620 x 1000 mm			
Mass (main unit)	240 kg			

Model	CV-4000CNC			
Code No. (100V - 120V)	**218-581-1E**	**218-582-1E**	**218-583-1E**	**218-584-1E**
Code No. (200V - 240V)	**218-581-2E**	**218-582-2E**	**218-583-2E**	**218-584-2E**
X1-axis measuring range	200 mm			
Z2-axis vertical travel	500 mm			
Y-axis table unit*1	—		Installed	
α-axis unit	—	Installed	—	Installed
Vibration isolation stand*2	Installed			
Granite base size (W x D)	750 x 600 mm			
Dimensions (main unit, W x D x H)	800 x 620 x 1200 mm			
Mass (main unit)	250 kg			

***1 Y-axis table unit**

Measuring range:	200 mm
Resolution :	0.05 µm
Scale unit:	Reflective-type linear encoder
Drive speed:	Max. 200 mm/s (CNC) 0 - 50 mm/s (joystick)
Max. loading capacity:	20 kg
Traverse straightness:	0.5 µm/200 mm (surface roughness) 2 µm/200 mm (contour)
Accuracy (at 20°C):	±(2+2L/100) µm, contour mode L: Dimension between two measured points (mm)
Table size:	200 x 200 mm
Dimensions (W x D x H):	320 x 646 x 105 mm
Mass:	35 kg

***2 Vibration isolation stand**

Vibration isolation mechanism:	Diaphragm air spring
Natural frequency:	2.5 - 3.5 Hz
Damping mechanism:	Orifice
Levelling mechanism:	Automatic control with mechanical valves
Air supply pressure:	390 kPa
Max. loading capacity:	350 kg
Dimensions (W x D x H):	1000 x 895 x 718 mm
Mass:	290 kg

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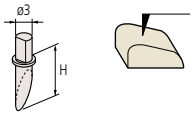
Optional Arms and Styli

For CV-1000 and CV-2000

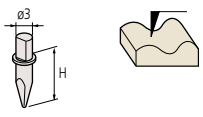
Styli

Single bevel



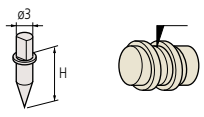
Tip angle: 12°
Tip radius: 25 µm
Tip material: Carbide

Cross ground



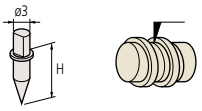
Tip angle: 20°
Tip radius: 25 µm
Tip material: Carbide

Cone



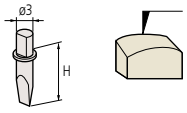
Tip angle: 20°
Tip radius: 25 µm
Tip material: Carbide

Cone



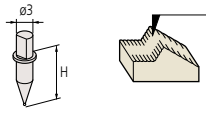
Tip angle: 30° (SPH-79: 50°)
Tip radius: 25 µm
Tip material: Carbide, Sapphire (SPH-79: Diamond)

Knife edge



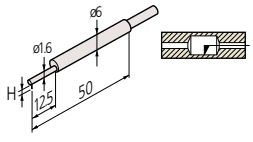
Tip angle: 20°
Edge width: 3 mm
Tip radius: 25 µm
Tip material: Carbide

Ball



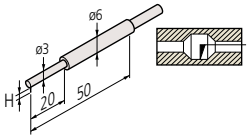
Ball diameter: 1 mm
Tip material: Carbide

Small hole: 932693/12AAE873



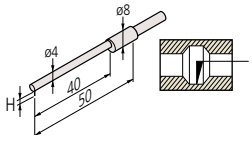
	932693	12AAE873
Tip shape:	Single	Bevel cone
Tip angle:	20°	30°
Tip radius:	25 µm	25 µm
Tip material:	Carbide	Carbide

Small hole: 932694/12AAE874



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

Small hole: 932695/12AAE875



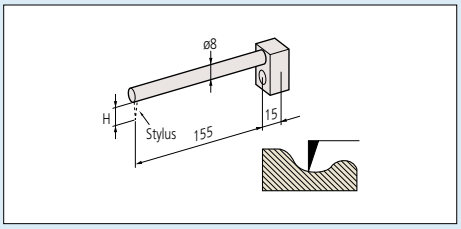
	932695	12AAE875
Tip shape:	Single	Bevel cone
Tip angle:	20°	30°
Tip radius:	25 µm	25 µm
Tip material:	Carbide	Carbide

Stylus No.	Code No.	Compatible arm No.	H (mm)
Single-bevel stylus carbide-tipped			
SPH-51	**354882**	AB-51, 52	6
SPH-61	**354883**	AB-61, 62	12
SPH-71*	**354884**	AB-71, 72	20
SPH-81	**354885**	AB-81, 82	30
SPH-91	**354886**	AB-91, 92	42
Cross-ground stylus carbide-tipped			
SPH-52	**354887**	AB-51, 52	6
SPH-62	**354888**	AB-61, 62	12
SPH-72	**354889**	AB-71, 72	20
SPH-82	**354890**	AB-81, 82	30
SPH-92	**354891**	AB-91, 92	42
Cone stylus carbide-tipped tip angle 20°			
SPH-57	**12AAE865**	AB-51, 52	6
SPH-67	**12AAE866**	AB-61, 62	12
SPH-77	**12AAE867**	AB-71, 72	20
SPH-87	**12AAE868**	AB-81, 82	30
SPH-97	**12AAE869**	AB-91, 92	42
Cone stylus sapphire-tipped tip angle 30°			
SPH-53	**354892**	AB-51, 52	6
SPH-63	**354893**	AB-61, 62	12
SPH-73	**354894**	AB-71, 72	20
SPH-83	**354895**	AB-81, 82	30
SPH-93	**354896**	AB-91, 92	42
Cone stylus diamond-tipped tip angle 50°			
SPH-79	**355129**	AB-71, 72	20

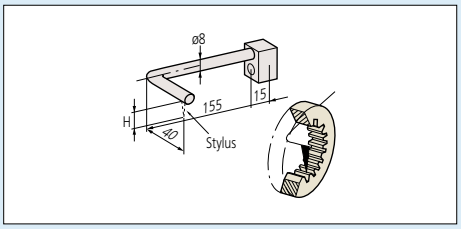
*Supplied as standard

Stylus No.	Code No.	Compatible arm No.	H (mm)
Cone stylus carbide-tipped tip angle 30°			
SPH-56	**12AAA566**	AB-51, 52	6
SPH-66	**12AAA567**	AB-61, 62	12
SPH-76	**12AAA568**	AB-71, 72	20
SPH-86	**12AAA569**	AB-81, 82	30
SPH-96	**12AAA570**	AB-91, 92	42
Knife-edge stylus carbide-tipped			
SPH-54	**354897**	AB-51, 52	6
SPH-64	**354898**	AB-61, 62	12
SPH-74	**354899**	AB-71, 72	20
SPH-84	**354900**	AB-81, 82	30
SPH-94	**354901**	AB-91, 92	42
Ball stylus carbide-tipped			
SPH-55	**354902**	AB-51, 52	6
SPH-65	**354903**	AB-61, 62	12
SPH-75	**354904**	AB-71, 72	20
SPH-85	**354905**	AB-81, 82	30
SPH-95	**354906**	AB-91, 92	42
Small-hole stylus carbide-tipped one-sided cut			
SP-11	**932693**	AB-11	0.4
SP-12	**932694**		1
SP-13	**932695**		2.5
Small-hole stylus carbide-tipped cone			
SP-31	**12AAE873**	AB-11	0.4
SP-32	**12AAE874**		1
SP-33	**12AAE875**		2.5

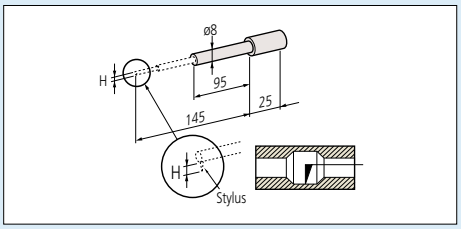
Arms



Straight type



Eccentric type



For small-hole stylus

Arm No.	Code No.	Compatible stylus No.	H (mm)
Straight type			
AB-51	**935111**	SPH-5x	6
AB-61	**935112**	SPH-6x	12
AB-71*	**935113**	SPH-7x	20
AB-81	**935114**	SPH-8x	30
AB-91	**935115**	SPH-9x	42
Eccentric type			
AB-52	**935116**	SPH-5x	6
AB-62	**935117**	SPH-6x	12
AB-72	**935118**	SPH-7x	20
AB-82	**935119**	SPH-8x	30
AB-92	**935120**	SPH-9x	42
Small hole			
AB-11	**9351216**	SP-11, 31	0.4
		SP-12, 32	1
		SP-13, 33	2.5

*Supplied as standard

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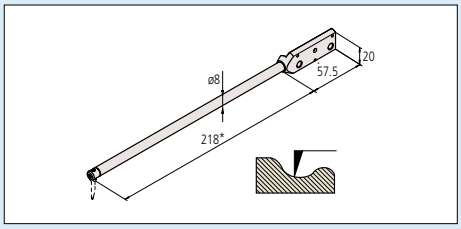
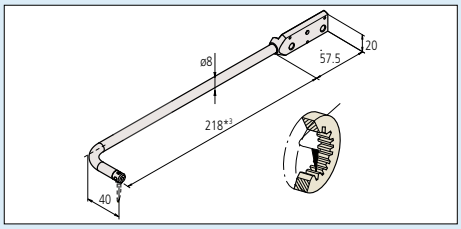
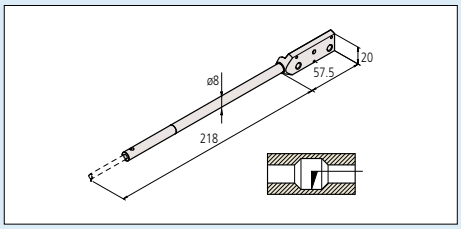
Arms



Straight type



Eccentric type



For small-hole stylus

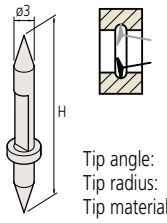
Arm No.	Code No.	Compatible stylus No.
Straight type		
AB-31*1	**12AAM101**	SPH-5x, 6x, 7x, 8x, 9x SPHW*2-56, 66, 76
Eccentric type		
AB-32*3	**12AAM102**	SPH-5x, 6x, 7x, 8x, 9x SPHW*2-56, 66, 76
Small hole		
AB-33	**12AAM103**	SPH-41, 41, 43

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

For CV-3200 and CV-4500

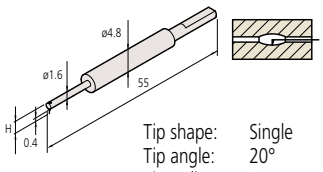
Styli

Double cone



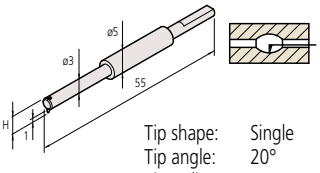
Tip angle: 30°
Tip radius: 25 µm
Tip material: Carbide

Small hole: SPH-41



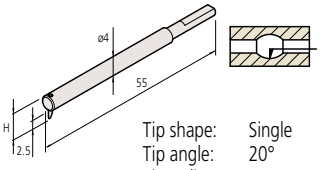
Tip shape: Single
Tip angle: 20°
Tip radius: 25 µm
Tip material: Carbide

Small hole: SPH-42



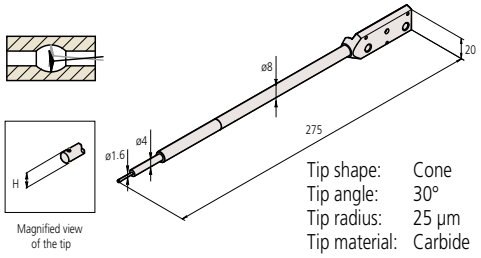
Tip shape: Single
Tip angle: 20°
Tip radius: 25 µm
Tip material: Carbide

Small hole: SPH-43



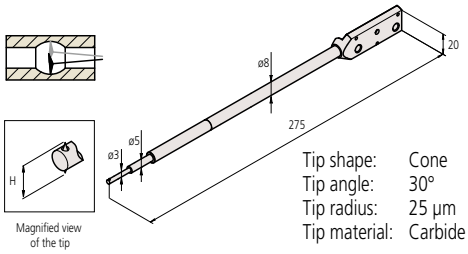
Tip shape: Single
Tip angle: 20°
Tip radius: 25 µm
Tip material: Carbide

Double small-hole arm stylus: SPHW-31



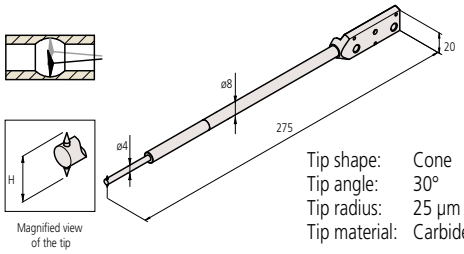
Tip shape: Cone
Tip angle: 30°
Tip radius: 25 µm
Tip material: Carbide

Double small-hole arm stylus: SPHW-32



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

Double small-hole arm stylus: SPHW-33



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

Stylus No.	Code No.	Compatible arm No.	H (mm)
Double-cone stylus *4			
SPHW-56	**12AAM095***5	AB-31, 32	20
SPHW-66	**12AAM096**		32
SPHW-76	**12AAM097**		48
Single-bevel stylus carbide-tipped			
SPH-51	**354882**	AB-31, 32	6
SPH-61	**354883**		12
SPH-71	**354884***6		20
SPH-81	**354885**		30
SPH-91	**354886**		42
Cross-ground stylus carbide-tipped (see page opposite)			
SPH-52	**354887**	AB-31, 32	6
SPH-62	**354888**		12
SPH-72	**354889**		20
SPH-82	**354890**		30
SPH-92	**354891**		42
Cone stylus sapphire-tipped tip angle 30° (see page opposite)			
SPH-53	**354892**	AB-31, 32	6
SPH-63	**354893**		12
SPH-73	**354894**		20
SPH-83	**354895**		30
SPH-93	**354896**		42
Cone stylus carbide-tipped tip angle 30° (see page opposite)			
SPH-56	**12AAA566**	AB-31, 32	6
SPH-66	**12AAA567**		12
SPH-76	**12AAA568**		20
SPH-86	**12AAA569**		30
SPH-96	**12AAA570**		42

*4 Stylus for CV-4500 series
*5 Standard accessory of CV-4500 series
*6 Standard accessory of CV-3200 series

Stylus No.	Code No.	Compatible arm No.	H (mm)
Cone stylus carbide-tipped tip angle 20° (see page opposite)			
SPH-57	**12AAE865**	AB-31, 32	6
SPH-67	**12AAE866**		12
SPH-77	**12AAE867**		20
SPH-87	**12AAE868**		30
SPH-97	**12AAE869**		42
Cone stylus diamond-tipped tip angle 50° (see page opposite)			
SPH-79	**355129**	AB-31, 32	20
Knife-edge stylus carbide-tipped (see page opposite)			
SPH-54	**354897**	AB-31, 32	6
SPH-64	**354898**		12
SPH-74	**354899**		20
SPH-84	**354900**		30
SPH-94	**354901**		42
Ball stylus carbide-tipped (see page opposite)			
SPH-55	**354902**	AB-31, 32	6
SPH-65	**354903**		12
SPH-75	**354904**		20
SPH-85	**354905**		30
SPH-95	**354906**		42
Small-hole stylus*7			
SPH-41	**12AAM104**	AB-33	2
SPH-42	**12AAM105**		4
SPH-43	**12AAM106**		6.5
Double small-hole arm stylus*8 (integrated arm and stylus) only for CV-4500			
SPHW-31	**12AAM108**	—	2.4
SPHW-32	**12AAM109**		5
SPHW-33	**12AAM110**		9

*7 Styli SPH-21, 22, and 23 for CV-3100/4100 series are not available.
*8 Arm stylus for CV-4500 series

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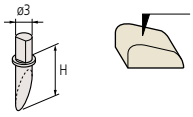
Mitutoyo

Optional Arms and Styli

For CV-3000CNC, CV-4000CNC, SV-C3000CNC and SV-C4000CNC

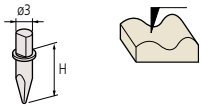
Styli

Single bevel



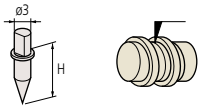
Tip angle: 12°
Tip radius: 25 µm
Tip material: Carbide

Cross ground



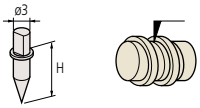
Tip angle: 20°
Tip radius: 25 µm
Tip material: Carbide

Cone



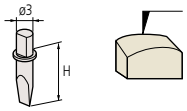
Tip angle: 20°
Tip radius: 25 µm
Tip material: Carbide

Cone



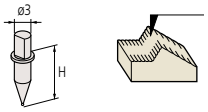
Tip angle: 30° (SPH-79: 50°)
Tip radius: 25 µm
Tip material: Carbide, Sapphire (SPH-79: Diamond)

Knife edge



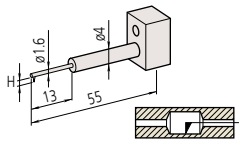
Tip angle: 20°
Edge width: 3 mm
Tip radius: 25 µm
Tip material: Carbide

Ball



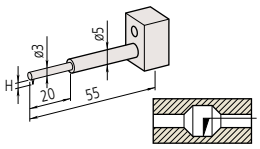
Ball diameter: 1 mm
Tip material: Carbide

Small hole: 12AAE297



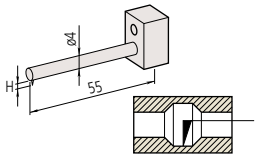
Tip shape: Single bevel
Tip angle: 20°
Tip radius: 25 µm
Tip material: Carbide

Small hole: 12AAE298



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

Small hole: 12AAE299



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

Stylus No.	Code No.	Compatible arm No.	H (mm)
Single-bevel stylus carbide-tipped			
SPH-51	**354882**	ABH-52, 53	6
SPH-61	**354883**	ABH-62, 63	12
SPH-71*	**354884**	ABH-71, 72	20
SPH-81	**354885**	ABH-81, 82	30
SPH-91	**354886**	ABH-91, 92	42
Cross-ground stylus carbide-tipped			
SPH-52	**354887**	ABH-52, 53	6
SPH-62	**354888**	ABH-62, 63	12
SPH-72	**354889**	ABH-71, 72	20
SPH-82	**354890**	ABH-81, 82	30
SPH-92	**354891**	ABH-91, 92	42
Cone stylus carbide-tipped tip angle 20°			
SPH-57	**12AAE865**	ABH-52, 53	6
SPH-67	**12AAE866**	ABH-62, 63	12
SPH-77	**12AAE867**	ABH-71, 72	20
SPH-87	**12AAE868**	ABH-81, 82	30
SPH-97	**12AAE869**	ABH-91, 92	42
Cone stylus sapphire-tipped tip angle 30°			
SPH-53	**354892**	ABH-52, 53	6
SPH-63	**354893**	ABH-62, 63	12
SPH-73	**354894**	ABH-71, 72	20
SPH-83	**354895**	ABH-81, 82	30
SPH-93	**354896**	ABH-91, 92	42
Cone stylus diamond-tipped tip angle 50°			
SPH-79	**355129**	ABH-52, 53	20

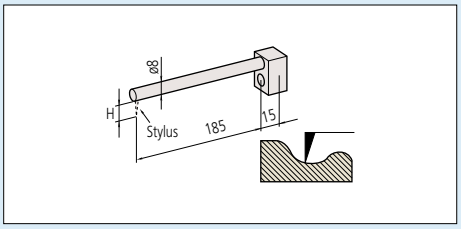
*Supplied as standard

Stylus No.	Code No.	Compatible arm No.	H (mm)
Cone stylus carbide-tipped tip angle 30°			
SPH-56	**12AAA566**	ABH-52, 53	6
SPH-66	**12AAA567**	ABH-62, 63	12
SPH-76*	**12AAA568**	ABH-71, 72	20
SPH-86	**12AAA569**	ABH-81, 82	30
SPH-96	**12AAA570**	ABH-91, 92	42
Knife-edge stylus carbide-tipped			
SPH-54	**354897**	ABH-52, 53	6
SPH-64	**354898**	ABH-62, 63	12
SPH-74	**354899**	ABH-71, 72	20
SPH-84	**354900**	ABH-81, 82	30
SPH-94	**354901**	ABH-91, 92	42
Ball stylus carbide-tipped			
SPH-55	**354902**	ABH-52, 53	6
SPH-65	**354903**	ABH-62, 63	12
SPH-75	**354904**	ABH-71, 72	20
SPH-85	**354905**	ABH-81, 82	30
SPH-95	**354906**	ABH-91, 92	42
Small-hole stylus carbide-tipped cone			
SPH-21	**12AAE297**	ABH-21	0.4
SPH-22	**12AAE298**		1
SPH-23	**12AAE299**		2.5

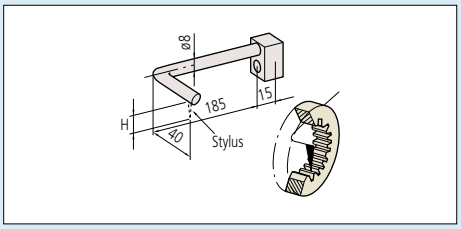
*Supplied as standard

Note: Any specified arm and stylus other than those listed above can be custom made to special order.

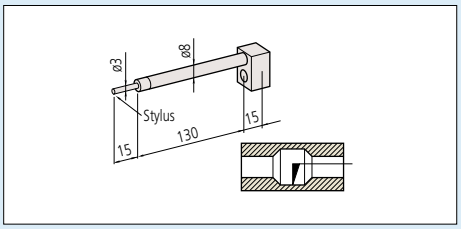
Arms



Straight type



Eccentric type



For small-hole stylus

Arm No.	Code No.	Compatible stylus No.	H (mm)
Straight type			
ABH-53	**12AAE294**	SPH-5x	6
ABH-63	**12AAE295**	SPH-6x	12
ABH-71*	**996506**	SPH-7x	20
ABH-81	**996507**	SPH-8x	30
ABH-91	**996508**	SPH-9x	42
Eccentric type			
ABH-52	**996509**	SPH-5x	6
ABH-62	**996510**	SPH-6x	12
ABH-72	**996511**	SPH-7x	20
ABH-82	**996512**	SPH-8x	30
ABH-92	**996513**	SPH-9x	42
Small hole			
ABH-21	**12AAE296**	SPH-2x	—

*Supplied as standard

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Optional Accessories

For Surftest, Formtracer and Contracer

Rotary vice

- Two-slide jaw type.
- Max. workpiece size: ø60 mm
- Resolution: 1°

218-003: Rotary vice
£986.00

Centre support

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

172-142: Centre support
£509.00

Centre support riser

- Used with a centre support.
- Max. workpiece dia.: 240 mm

172-143: Centre support riser
£205.00

Swivel centre support

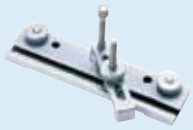
- Max. workpiece dia.: 80 mm*
  *65 mm when swivelled 10°
- Max. workpiece length: 140 mm

172-197: Swivel centre support
£348.00

Holder with clamp

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

176-107: Holder with clamp
£148.00



V-block with clamp

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

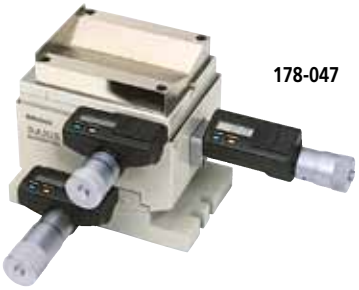
172-234: V-block with clamp
£259.00

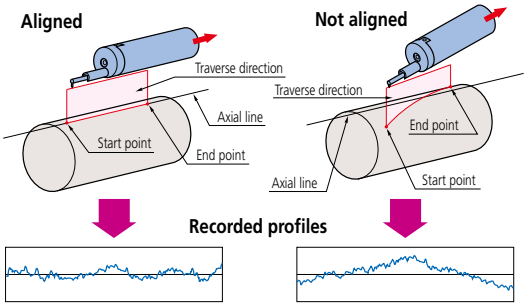
172-378: V-block with clamp
£194.00

3-axis adjustment table

This table helps make the alignment adjustments required 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 can also be levelled with this table.

178-047: 3-axis adjustment table
£3170.00





Levelling table

- Table top: 130 x 100 mm
- Levelling range: ±1.5°
- XY travel: ±12.5 mm

178-043-1: Levelling table (mm)
£2060.00

178-053-1: Levelling table (inch)
£1760.00

Digital levelling table

- Table top: 130 x 100 mm
- Levelling range: ±1.5°
- XY travel: ±12.5 mm

178-042-1: Digital levelling table (mm)
£2670.00

Cross-travel table

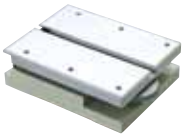
- Table top: 280 x 180 mm
- XY travel: 100 x 50 mm

218-001: Cross-travel table (mm)
£1610.00

Levelling table

- Table top: 130 x 100 mm
- Levelling range: ±1.5°
- Height: 40 mm

178-016: Levelling table
£548.00

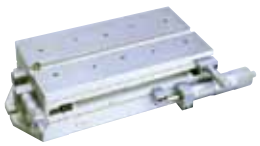


Cross-travel table

- Table top: 280 x 152 mm
- XY travel: 50 x 25 mm

218-041: Cross-travel table (mm)
£1980.00

218-051: Cross-travel table (inch)
£1850.00



V-block

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

998291: V-block
£500.00

Precision vice

- Max. workpiece size: 36 mm
- Can be mounted on a levelling table

178-019: Precision vice
£608.00

Calibration stand

Required for calibrating upward measurement of CV-3200 series.

12AAM100: Calibration stand
£POA

Calibration stand

Required for calibrating in bulk by mounting straight arm/small-hole stylus arm without using cross-travel table and Y-axis table.

12AAG175: Calibration stand
£250.00

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Mitutoyo

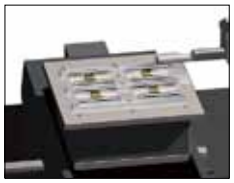
Optional Accessories

For Surftest, Formtracer and Contracer

Y-axis table

178-097

Enables efficient, automatic measurement of multiple aligned workpieces and multiple points on a single measurement surface. Allows semi-automatic measurement with a manually operated machine. (Not for CNC models.)



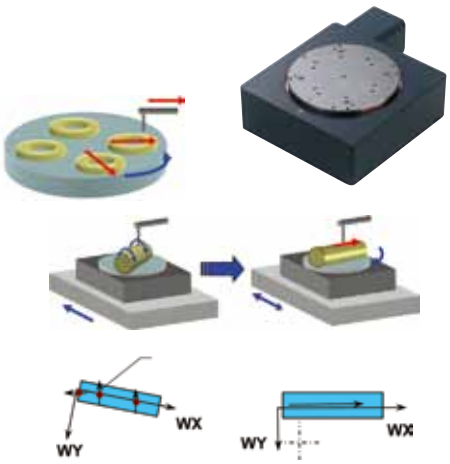
Travel range	200 mm
Resolution	0.05 µm
Positioning accuracy	±3 µm
Drive speed	Max. 80 mm/s
Maximum load	50 kg
Mass	28 kg
Price	**£POA**

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.

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



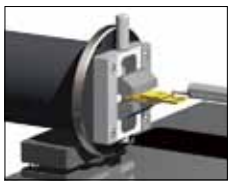
Displacement	360°
Resolution	0.004°
Maximum load	12 kg
Rotational speed	Max. 10°/s
Mass	7 kg
Price	**£POA**

θ2-axis table

178-078

You can measure multiple points on a cylindrical workpiece and automate front/rear-side measurement. Allows semi-automatic measurement with a manually operated machine.

Note: 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)	4 kg
Rotational speed	Max. 18°/s
Mass	5 kg
Price	**£POA**

Automatic-levelling table

178-087 (SV, CV, CS3200)
178-037 (CNC models)

This is a stage that performs fully automatic levelling as measurement starts, freeing the user from this troublesome operation. Fully automatic levelling can be done quickly, easily and reliably.

Code No.	**178-087**	**178-037**
Inclination adjustment angle	±2°	
Maximum load	7 kg	
Table dimensions	130 x 100 mm	
Mass	3.5 kg	
Price	**£POA**	**£POA**

Quick chuck

211-032

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

Holding capacity	Internal jaws	OD: ø1 - ø36 mm
	Internal jaws	ID: ø14 - ø70 mm
	External jaws	OD: ø25 - ø79 mm
Dimensions		ø118 x 41 mm
Mass		1.2 kg
Price		**£1220.00**

Micro-chuck

211-031

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

Holding capacity	OD: ø0.1 - ø1.5 mm
Dimensions	ø118 x 48.5 mm
Mass	0.6 kg
Price	**£941.00**

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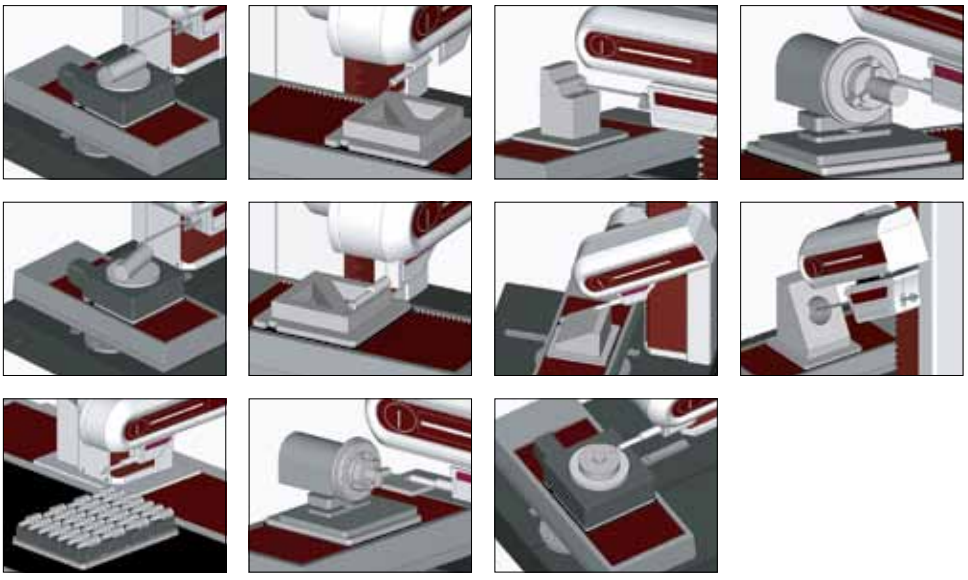
Examples of optimal combinations of accessories for CNC models

Function	Optional accessory					
	Y-axis table	θ1 axis table	θ2 axis table	Drive unit tilting function (Patent pending: Japan) 	Large θ table 	Rotary-type detector holder 
Automatic levelling	—	—	—	●	—	—
Automatic alignment (Patent registered: Japan)	●	●	—	▲	—	—
Multiple workpiece batch measurement	▲	—	—	—	—	—
Measurement in the Y-axis direction	●	—	—	—	—	—
Oblique measurement in the 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 radial direction (rotary positioning in the 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***	—	—	—	—	—	●

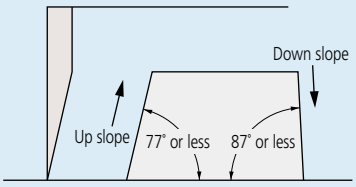
● Highly suitable
▲ Suitable
— Not required
* Applicable only to surface roughness measurement
** Applicable only to form/contour measurement
*** Applicable only for SV-M3000CNC

For the combinations and the specifications of various optional accessories described in this catalogue, contact your nearest Mitutoyo sales office.



Mitutoyo

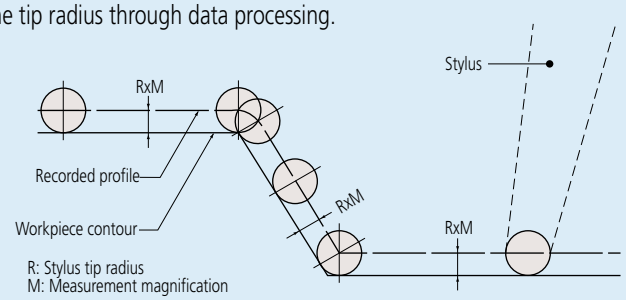
Traceable Angle



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

Compensating for Stylus Tip Radius

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

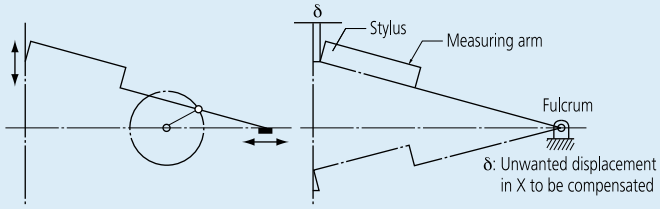


If a profile is read from the recorder through a template or scale, it is necessary to compensate for the stylus tip radius beforehand according to the applied measurement magnification.

Compensating for Arm Rotation

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

1: Mechanical compensation
2: Electrical compensation



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

Accuracy

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

Overload Safety Cutout

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

Simple or Complex Arm Guidance

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

Z axis Measurement Methods

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

Contour Analysis Methods

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

Data processing section and analysis program

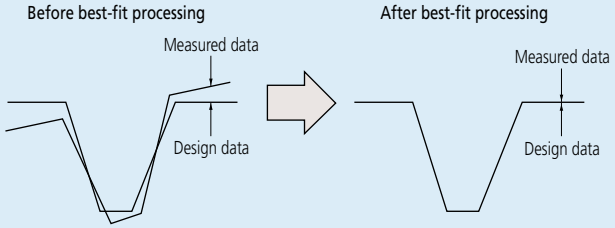
The measured contour is input into the data processing section in real time and a dedicated program performs the analysis using the mouse and/or keyboard. The angle, radius, step, pitch and other data are directly displayed as numerical values. Analysis combining coordinate systems can be easily performed.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

Tolerancing with Design Data

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

Best-Fitting

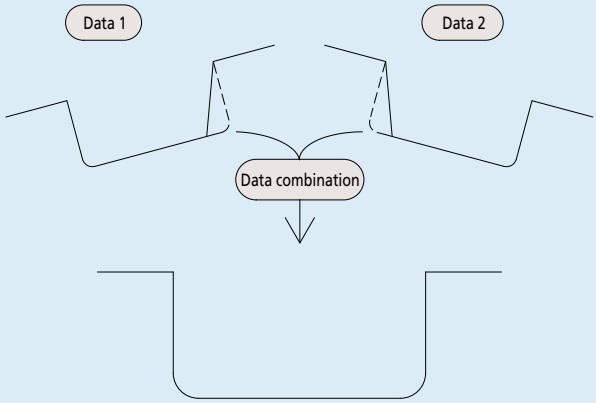
If there is a standard for surface profile data, tolerancing with design data is performed according to the standard. If there is no standard, or if tolerancing only with shape is desired, best-fitting between design data and measurement data can be performed.



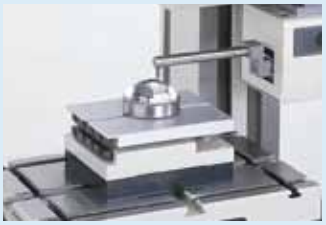
The best-fit processing algorithm searches for deviations between both sets of data and derives a coordinate system in which the sum of squares of the deviations is a minimum when the measured data is overlaid on the design data.

Data Combination

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



Measurement Examples



Aspheric lens contour

Inner/outer ring contour of a bearing

Internal gear teeth

Female thread form

Male thread form

Gauge contour

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Mitutoyo

Roundtest RA-10

SERIES 211 – Roundness Measuring Instruments

- Compact roundness tester combines outstanding cost and performance with full measurement capabilities and user-friendly operation.
- The control panel has large keys and an intuitive layout for easy operation.
- One-touch setup recall function: Complex setups can be stored in advance and recalled with a single keystroke.
- Zero-set function: The detector level can be set to zero (0) with a single keystroke, thus relieving the user of the need for meticulous detector positioning.
- The positioning handles for vertical direction (Z axis) and radial direction (X axis) adjustments have been placed on the slider for best operability.
- Despite being a low-priced model, the turntable with air bearings offers rotational accuracy as high as (0.04+6H/10000) µm, thus assuring a precision that compares well with that of higher-priced models.
- Measurement results and recorded profiles are easy-to-view with the large LCD panel display.
- The machine has a compact body with integrated electronics and printer making it ideal for tight inspection areas.

Roundtest RA-10 with optional X-axis stop and Z-axis scale unit.

SPECIFICATIONS

Model	RA-10
Code No.	211-601E

Optional X-axis stop

Optional Z-axis scale unit

Technical Data

Turntable
- Rotational accuracy: (0.04+6H/10000) µm
  H: probing height (mm)
- Rotational speed: 6 rpm
- Table diameter: 150 mm
- Max. probing diameter: 100 mm
- Max. workpiece diameter: 320 mm
- Max. table loading: 10 kg

Vertical column (Z-axis)
- Vertical travel: 117 mm
- Max. probing height: 152 mm from the turntable surface
- Max. probing depth: 100 mm (min. ID: 30 mm)

Horizontal arm (X-axis)
- Horizontal travel: 75 mm (Including a protrusion of 25 mm over the turntable axis)

Probe and stylus
- Measuring range: ±1000 µm
- Measuring force: 70 to 100 mN
- Standard stylus: 12AAL021, carbide ball, ø1.6 mm
- Measuring direction: Bi-directional
- Stylus angle adjustment: ±45° (with graduations)

Data analysis unit
- Processing unit: Built-in
- Data sampling points: Max. 3600 points/rotation
- Data analysis items: Roundness, Coaxiality, Concentricity, Flatness, Circular runout (radial)
- Types of roundness evaluation: LSC, MZC, MIC, MCC
- Recording device: Built-in thermal line printer (optional external printer)
- Recording magnification: X5 to X200,000 (15-step)
- 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 values: 15 upr, 50 upr, 150 upr, 500 upr, 15-150 upr, 15-500 upr, 50-500 upr
- Number of measuring sections: 1-section to 5-section: Roundness, Coaxiality, Flatness
  1-section to 3-section: Circular runout (radial)
  2-section: Concentricity

Air supply
- Air pressure: 390 kPa
- Air consumption: 30 L/min.

Power supply: 100V AC - 240V AC, 50/60Hz
Dimensions (W x D x H): 450 x 360 x 486 mm
Mass: 26 kg

Consumables

12AAH181: Printer paper (10 rolls/set) **£60.40**

358592: Element for air filter (1 pc./set) **£39.40**

358593: Element for air regulator (10 pcs./set) **£55.80**

Optional Accessories

211-016: Reference hemisphere
£650.00

12AAH420: Spacer for reference hemisphere
£51.00

997090: Gauge block set for calibration
£208.00

211-045: Magnification checking gauge
£1980.00

211-032: Quick chuck (OD: 1 - 79 mm, ID: 16 - 69 mm)*
£1220.00

211-031: Micro-chuck (OD: 0.1 - 1.5 mm)*
£941.00

356038: Auxiliary stage for a low-height workpiece*
£264.00

12AAH425: Alignment table with DAT function (mm)
£2010.00

12AAH426: Alignment table with DAT function (inch/mm)
£2010.00

211-052: Quick chuck (OD: 1 - 79 mm, ID: 16 - 69 mm)
£1200.00

211-053: V-block jig A (for ø50 mm)
£750.00

211-054: V-block jig B (for ø50 mm)
£900.00

211-055: OD/ID mating jig (for ø10 mm)
£900.00

211-051: Collet chuck (OD: 0.5 - 10 mm)
£860.00

12AAH402: Collet (ø0.5 - 1.0 mm)
£140.00

12AAH403: Collet (ø1.0 - 1.5 mm)
£140.00

12AAH404: Collet (ø1.5 - 2.0 mm)
£110.00

12AAH405: Collet (ø2.0 - 2.5 mm)
£110.00

12AAH406: Collet (ø2.5 - 3.0 mm)
£100.00

12AAH407: Collet (ø3.0 - 3.5 mm)
£100.00

12AAH408: Collet (ø3.5 - 4.0 mm)
£100.00

12AAH409: Collet (ø4.0 - 5.0 mm)
£100.00

12AAH410: Collet (ø5.0 - 6.0 mm)
£100.00

12AAH411: Collet (ø6.0 - 7.0 mm)
£100.00

12AAH412: Collet (ø7.0 - 8.0 mm)
£100.00

12AAH413: Collet (ø8.0 - 9.0 mm)
£100.00

12AAH414: Collet (ø9.0 - 10.0 mm)
£100.00

12AAH320: X-axis stop
£80.00

12AAH318: Z-axis scale unit
£240.00

938882: SR44 (for Z-axis scale unit and alignment table head)
£3.40

211-013: Vibration damping stand
£2930.00

*Can be installed on the alignment table (12AAH425/6/7) only.

211-016

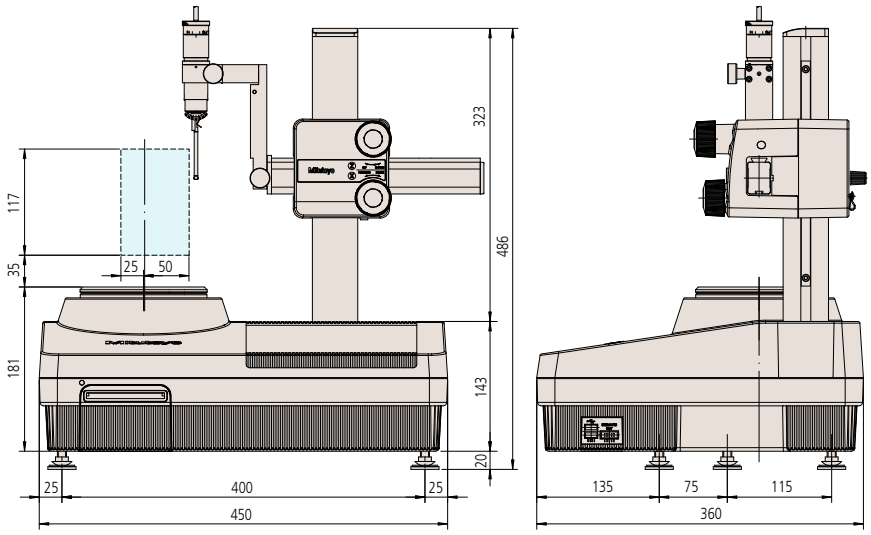
997090

DIMENSIONS

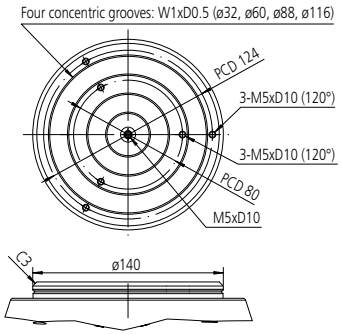
Unit: mm

External dimensions

: Measuring area

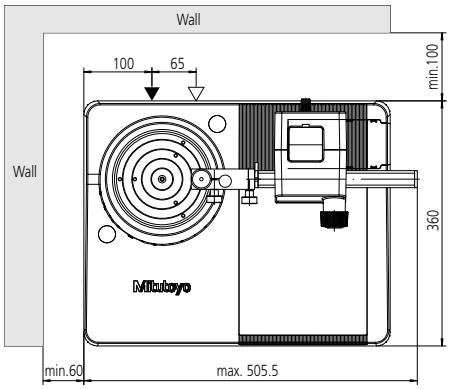


Turntable top view



Installation floor plan

▼Power inlet
▽Air inlet



211-052

211-055

211-053

211-054

211-051

211-032

211-031

356038

211-045

12AAH425

211-013

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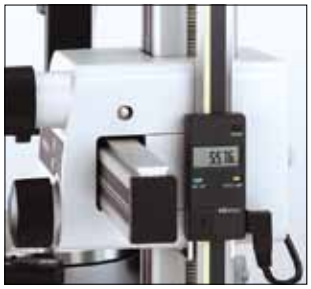
Mitutoyo

Roundtest RA-120

SERIES 211 – Roundness Measuring Instruments

- The Roundtest RA-120/120P are compact, affordable, and simple-to-use devices for measuring part geometry on the shop floor.
- They provide the outstanding data analysis capabilities required of a laboratory roundness measuring instrument having a ±1000 µm wide range detector and a precision turntable with excellent rotational accuracy.
- The RA-120 model has a dedicated processor and control panel incorporated in the main unit for controlling operations.
- The RA-120P is a PC-based model with all operations controlled via ROUNDPAK software (optional).

Optional X-axis stop



Optional Z-axis scale unit

Roundtest RA-120

SPECIFICATIONS

Model	RA-120		
Code No.	211-621E	211-622E	211-623E
Remarks	With mechanical table	With DAT function (mm)	With DAT function (inch/mm)

Roundtest RA-120P

SPECIFICATIONS

Model	RA-120P		
Code No.	211-625E	211-626E	211-627E
Remarks	With mechanical table	With DAT function (mm)	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: probing radius (mm)
- Rotational speed: 6 rpm
- Table diameter: 150 mm
- Centering range: ±3 mm
- Levelling range: ±1°
- Max. probing diameter: 280 mm (380 mm when the detector orientation is changed to the vertical position, only samples up to 50 mm from the table surface can be measured.)
- Max. workpiece diameter: 440 mm
- Max. table loading: 25 kg

Vertical column (Z-axis)
- Vertical travel: 280 mm
- Max. probing height: 280 mm from the turntable surface
- Max. probing depth: 100 mm (min. ID: 30 mm)

Horizontal arm (X-axis)
- Horizontal travel: 165 mm (Including a protrusion of 25 mm over the turntable axis)

Probe and stylus
- Measuring range: ±1000 µm
- Measuring force: 70 to 100 mN
- Standard stylus: 12AAL021, carbide ball, ø1.6 mm
- Measuring direction: Bi-directional
- Stylus angle adjustment: ±45° (with graduations)

Data analysis unit
- Processing unit: Built-in (PC with Roundpak-120P)*
- Data sampling points: Max. 3600 points/rotation
- Types of roundness evaluation: LSC, MZC, MIC, MCC
- Recording device: Built-in thermal line printer (optional external printer)*
- Recording magnification: X5 to X200,000 (15-steps), 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 values: 15 upr, 50 upr, 150 upr, 500 upr, 15-150 upr, 15-500 upr, 50-500 upr, Manual setting*
- Number of measuring sections: Max. 5-section (100-section)*

Air supply
- Air pressure: 390 kPa
- Air consumption: 30 L/min.

Power supply: 100V AC - 240V AC, 50/60Hz
Dimensions (W x D x H): 450 x 360 x 636 mm
Mass: 32 kg (main unit), 2 kg (air regulator)

*RA-120P

Optional Accessories

211-032: Quick chuck (OD: 1 - 79 mm, ID: 16 - 69 mm)
£1220.00

211-014: Three-Jaw chuck (OD: 2 - 78 mm, ID: 25 - 68 mm)
£487.00

211-031: Micro-chuck (OD: 0.1 - 1.5 mm)
£941.00

211-061: Collet chuck (OD: 0.5 - 10 mm)
£670.00

356038: Auxiliary stage for a low-height workpiece
£264.00

211-016: Reference hemisphere
£650.00

211-045: Magnification checking gauge
£1980.00

997090: Gauge block set for calibration
£208.00

12AAH320: X-axis stop
£80.00

211-013: Vibration damping stand
£2930.00

Consumables

12AAH181: Printer paper (10 rolls/set)
£60.40

358592: Element for air filter (1 pc./set)
£39.40

358593: Element for air regulator (10 pcs./set)
£55.80

211-032

211-014

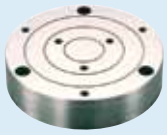
211-031

211-061

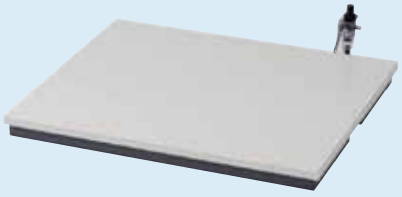
211-016

997090

211-045



356038

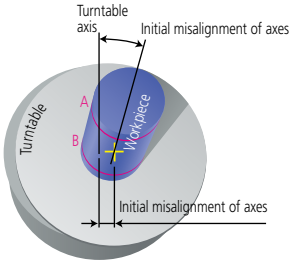


211-013

DAT (Digital Adjustment Table) function

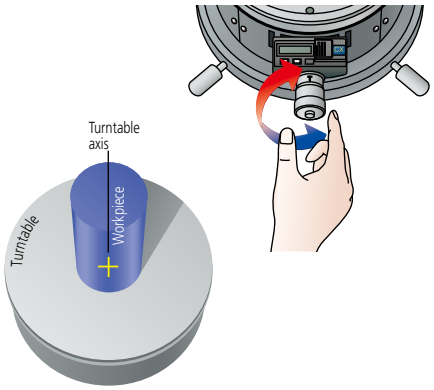
The turntable displays centering and levelling adjustments digitally, making this challenging task simple enough for even an untrained operator to perform.

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



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

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



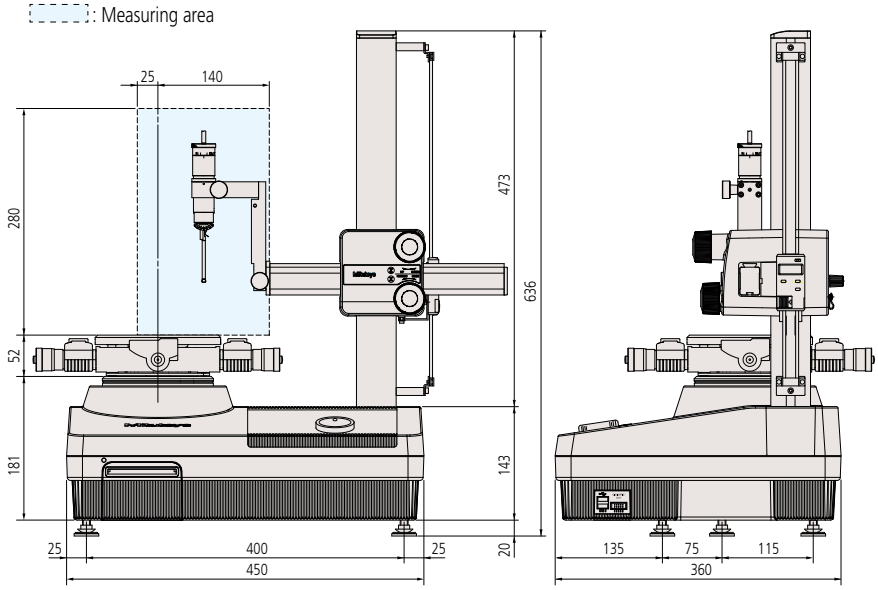
4. Centering and levelling is complete.
Centering range: ±3 mm
Levelling (inclination) range: ±1°

DIMENSIONS

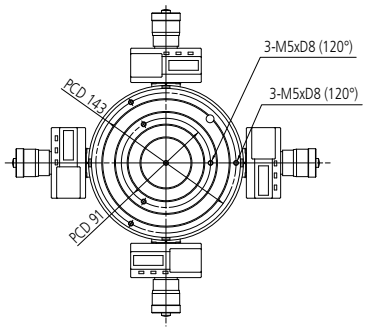
Unit: mm

External dimensions

: Measuring area

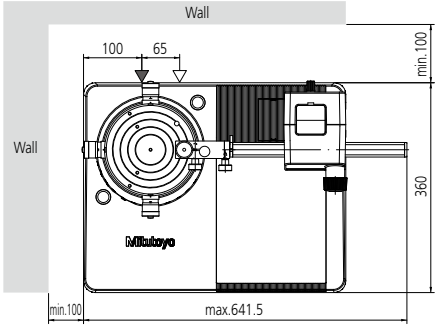


Turntable top view



Installation floor plan

▼Power inlet
▽Air inlet



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Mitutoyo

Roundtest RA-220

SERIES 211 – Roundness Measuring Instruments

- The RA-220 is a small, manual type Roundness/Cylindricity measuring instrument.
- Exceptional analysis capabilities and easy operation.
- X/Z axes fine-adjustment mechanism.
- Scale incorporated in the Z axis.
- Inside/outside diameter continuous measurement function.
- DAT function.
- Wide-range detector.
- Compact and highly accurate (equipped with premium quality air-bearing).

Roundtest RA-220

SPECIFICATIONS

Model	RA-220
Code No. (mm)	**211-642E**
Code No. (inch/mm)	**211-643E**

Technical Data

Turntable
- Rotational accuracy
  - Radial: (0.04+6H/10000) µm
    H: probing height (mm)
  - Axial: (0.04+6X/10000) µm
    X: Probing radius (mm)
- Rotational speed: 6 rpm
- Table diameter: 150 mm
- Centering range: ±3 mm
- Levelling range: ±1°
- Max. probing diameter: 280 mm (380 mm when the detector orientation is changed to the vertical position, only samples up to 50 mm from the table surface can be measured)
- Max. workpiece diameter: 470 mm
- Max. table loading: 25 kg

Vertical column (Z-axis)
- Vertical travel: 280 mm
- Straightness (in narrow range): 0.2 µm/20 mm
- Straightness (in entire range): 0.5 µm/100 mm
- Parallelism with turntable axis: 0.5 µm/100 mm
- Max. probing height: 280 mm from the turntable surface
- Max. probing depth: 100 mm (min. ID: ø30 mm)

Horizontal arm (X-axis)
- Horizontal travel: 165 mm (including a protrusion of 25 mm over the turntable axis)

Probe and stylus
- Measuring range: ±1000 µm (±30%)
- Measuring force: 70 to 100 mN (±30%)
- Standard stylus: 12AAL021, carbide ball, ø1.6 mm
- Measuring direction: Bi-directional
- Stylus angle adjustment: ±45° (with graduations)

Data analysis unit
- Processing unit: Built-in

Types of roundness evaluation: LSC, MZC, MIC, MCC

Recording device: Built-in thermal line printer (optional external printer)

Recording magnification: X5, X10, X20, X50, X100, X200, X500, X1k, X2k, X5k, X10k, X20k, X50k, X100k, X200k (15 step)

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 values: 15 upr, 50 upr, 150 upr, 500 upr, 15-150 upr, 15-500 upr, 50-500 upr

Number of measuring sections
- (1) 1-5 cross sections: Roundness, Coaxiality, Flatness
- (2) 1-3 cross sections: Radial runout, Perpendicularity (axis reference)
- (3) 2 cross sections: Concentricity, Thickness deviation, Parallelism
- (4) 3 cross sections: Perpendicularity (plane reference)
- (5) 3-5 cross sections: Cylindricity

Air supply
- Air pressure: 390 kPa
- Air consumption: 30 L/min

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

Dimensions (W x D x H): 585.5 x 546 x 775 mm

Mass: 151 kg (main unit), 2 kg (air regulator)

Optional Accessories

211-032: Quick chuck (OD: 1 - 79 mm, ID: 16 - 69 mm)
£1220.00

211-014: Three-Jaw chuck (OD: 2 - 78 mm, ID: 25 - 68 mm)
£487.00

211-031: Micro-chuck (OD: 0.1 - 1.5 mm)
£941.00

211-061: Collet chuck (OD: 0.5 - 10 mm)
£670.00

356038: Auxiliary stage for a low-height workpiece
£264.00

211-045: Magnification checking gauge
£1980.00

997090: Gauge block set for calibration
£208.00

12AAH320: X-axis stop
£80.00

178-025: Vibration damping table
£4790.00

Consumables

12AAH181: Printer paper (10 rolls/set)
£60.40

358592: Element for air filter (1 pc./set)
£39.40

358593: Element for air regulator (10 pcs./set)
£55.80

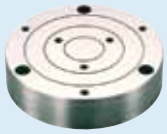
211-032

211-014

211-031

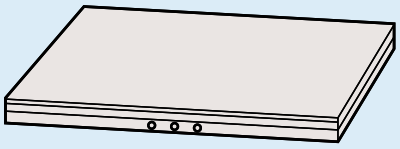
211-061

211-045



356038

997090

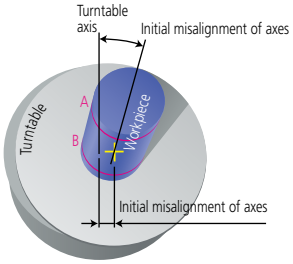


178-025

DAT (Digital Adjustment Table) function

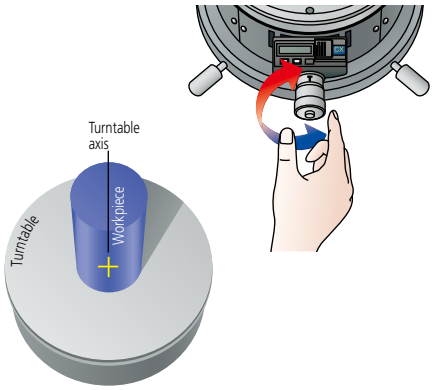
The turntable displays centering and levelling adjustments digitally, making this challenging task simple enough for even an untrained operator to perform.

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



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

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



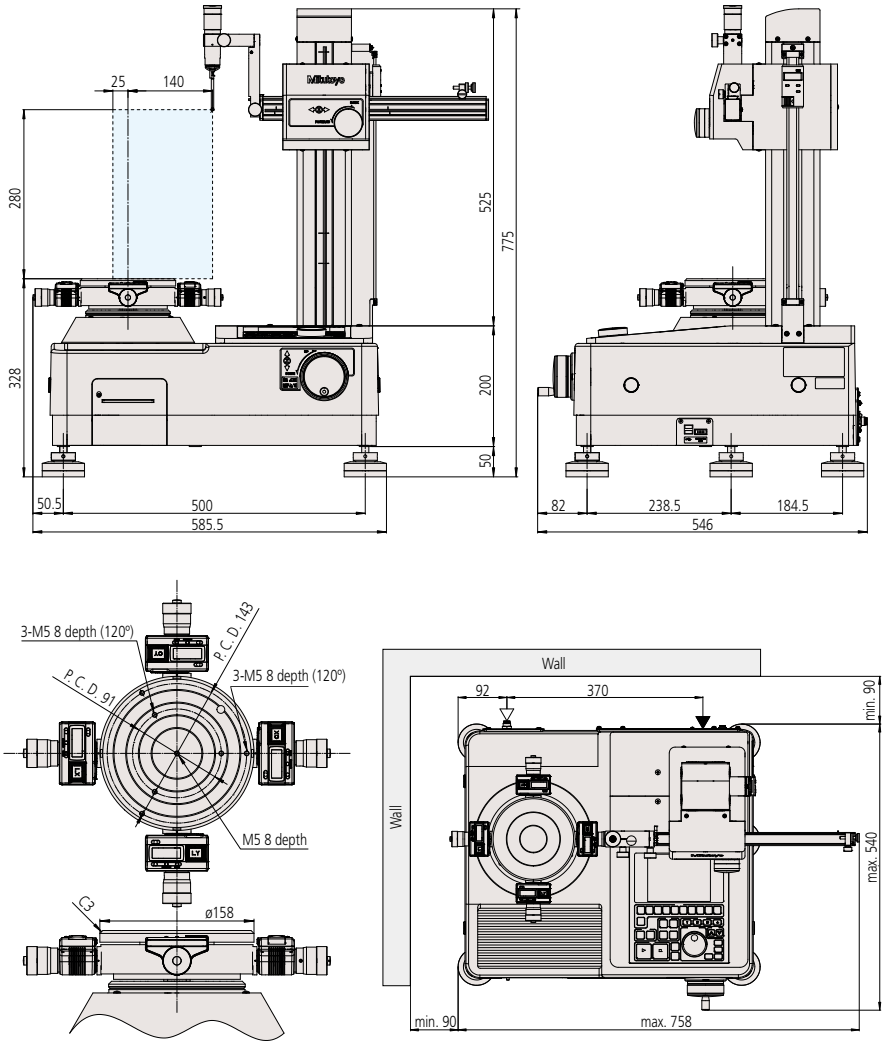
4. Centering and levelling is complete.
Centering range: ±3 mm
Levelling (inclination) range: ±1°

DIMENSIONS

External dimensions

Unit: mm

: Measuring area



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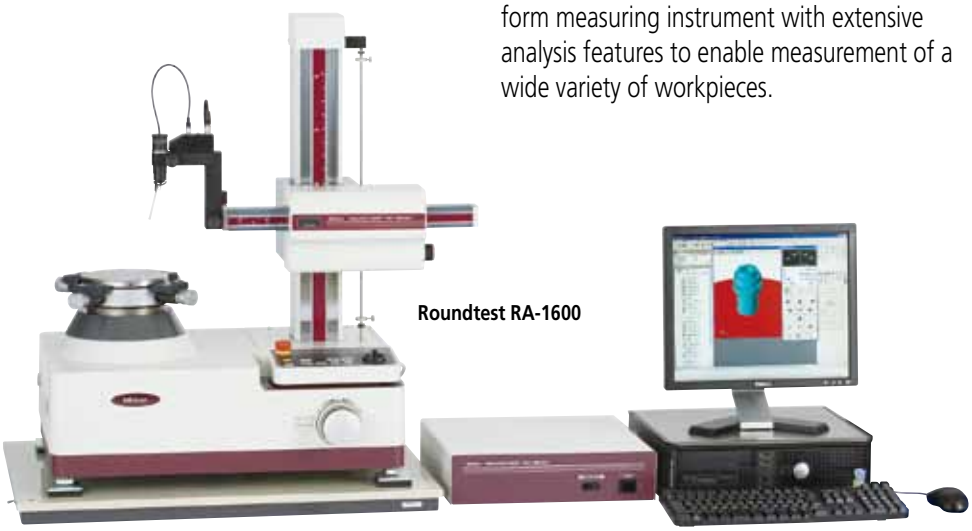
Roundtest RA-1600

SERIES 211 – Roundness / Cylindricity Measuring System

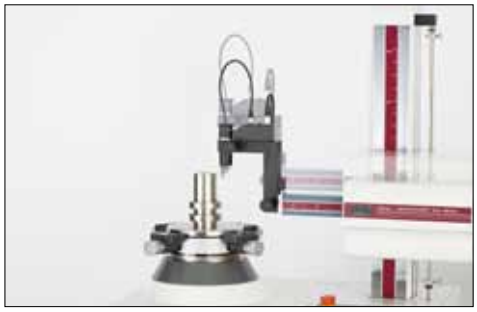
A new PC-compliant roundness and cylindrical form measuring instrument with extensive analysis features to enable measurement of a wide variety of workpieces.



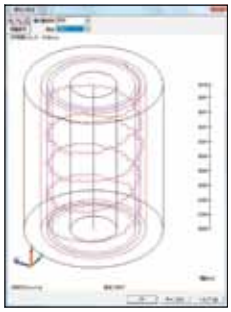
Roundtest RA-1600

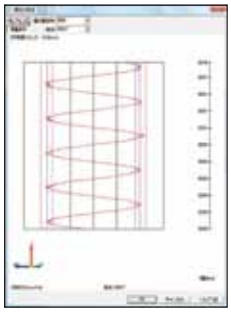
Spiral measurement / analysis

The spiral-mode measurement function combines table rotation and rectilinear action allowing cylindricity, coaxiality, and similar measurements to be performed based on whole-surface data.



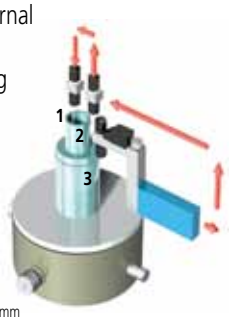
Spiral-mode cylindricity measurement





Continuous internal / external diameter measurement

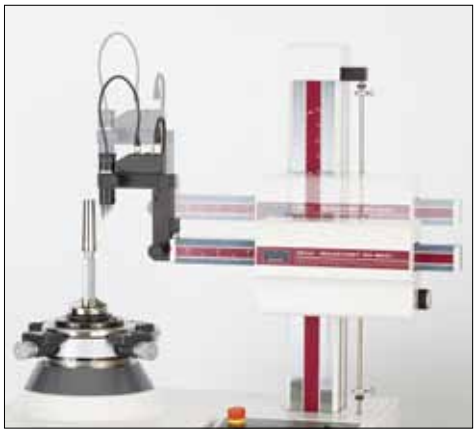
Continuous internal / external diameter measurement is possible without changing the detector position.



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

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.



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.

Technical Data

Turntable	
Rotational accuracy (radial):	(0.02+6H/10000) µm H: Probing height (mm)
Rotational accuracy (axial):	(0.02+6X/10000) µm X: probing radius (mm)
Rotational speed:	4, 6, 10 rpm
Table diameter:	150 mm
Centering range:	±3 mm (with DAT function)
Levelling range:	±1° (with DAT function)
Max. probing diameter:	280 mm
Max. workpiece diameter:	560 mm
Max. table loading:	25 kg
Vertical column (Z-axis)	
Vertical travel:	300 mm
Straightness (in narrow range):	0.20 µm / 100 mm
Straightness (in entire range):	0.30 µm / 300 mm
Parallelism with turntable axis:	1.5 µm / 300 mm
Positioning speed:	Max. 15 mm/s
Measuring speed:	0.5, 1, 2, 5 mm/s
Max. probing height (ID/OD):	300 mm*
Max. probing depth:	91 mm (over ø32) 50 mm (over ø7)
Horizontal arm (X-axis)	
Horizontal travel:	165 mm (from table axis -25 mm~ ±140 mm)
Positioning speed:	Max. 15 mm/s
Measuring speed:	0.5, 1, 2, 5 mm/s
Probe and stylus	
Measuring range:	±400 µm / ±40 µm / ±4 µm
Measuring force:	10 to 50 mN (5 level switching)
Standard stylus:	12AAL021, carbide ball, ø1.6 mm
Measuring direction	Bi-directional
Stylus angle adjustment:	±45° (with graduations)
Air supply	
Air pressure:	0.39 MPa (4 kgf/cm^2)
Air consumption:	22 L/min.
Power supply:	100V AC - 240V AC, 50/60Hz
Dimensions (W x D x H):	890 x 490 x 840 mm
Mass:	170 kg

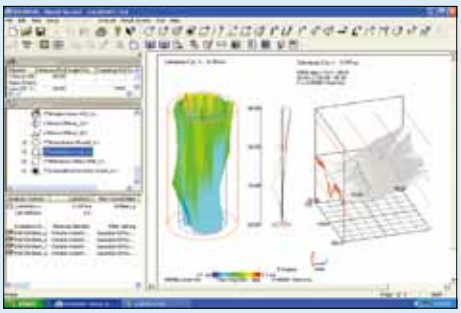
*Use an optional auxiliary stage for measuring a workpiece whose height is 20 mm or less.

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

Software

ROUNDPAK

The latest roundness/cylindrical form analysis program.



Optional Accessories

350850: Cylindrical square
£337.00

356038: Auxiliary stage for a low-height workpiece
£264.00

12AAF203: 2X extension detector holder
£1720.00

12AAF204: Auxiliary detector holder for a large-diameter workpiece
£1350.00

12AAL090: Sliding detector holder
£1300.00

211-045: Magnification checking gauge
£1980.00

211-014: Chuck (OD: ø2 - 78 mm, ID: ø25 - 68 mm)
£487.00

211-032: Quick chuck (OD: 1 - 79 mm, ID: 16 - 69 mm)
£1220.00

211-031: Micro-chuck (OD: 0.1 - 1.5 mm)
£941.00

178-025: Vibration isolator (desktop type)
£4790.00

12AAK110: Vibration isolator (desk type)
£POA

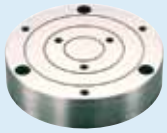
12AAK120: Monitor arm (for 12AAK110)
£POA

12AAL019: Side table (for 12AAK110)
£POA

211-032

211-014

211-031



356038

211-045

350850

Sliding detector-unit holder provided as a standard feature (Option)

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: 112 mm

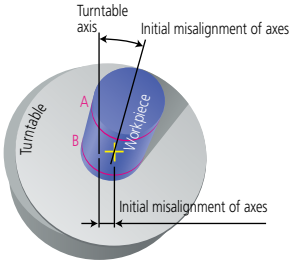
The detector-unit holder can be stopped at a position sufficiently higher than the workpiece along the Z axis, and then lowered and positioned to make measurements. Furthermore, internal/external diameters can be easily measured with the continuous internal/external diameter measurement function*.

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

DAT (Digital Adjustment Table) function

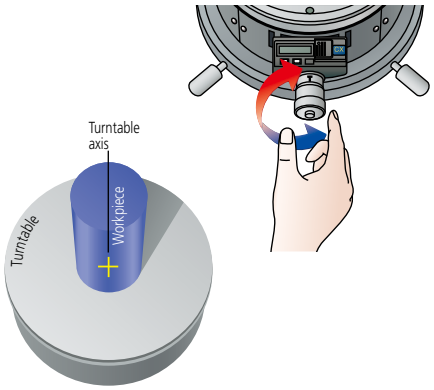
The turntable displays centering and levelling adjustments digitally, making this challenging task simple enough for even an untrained operator to perform.

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



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

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

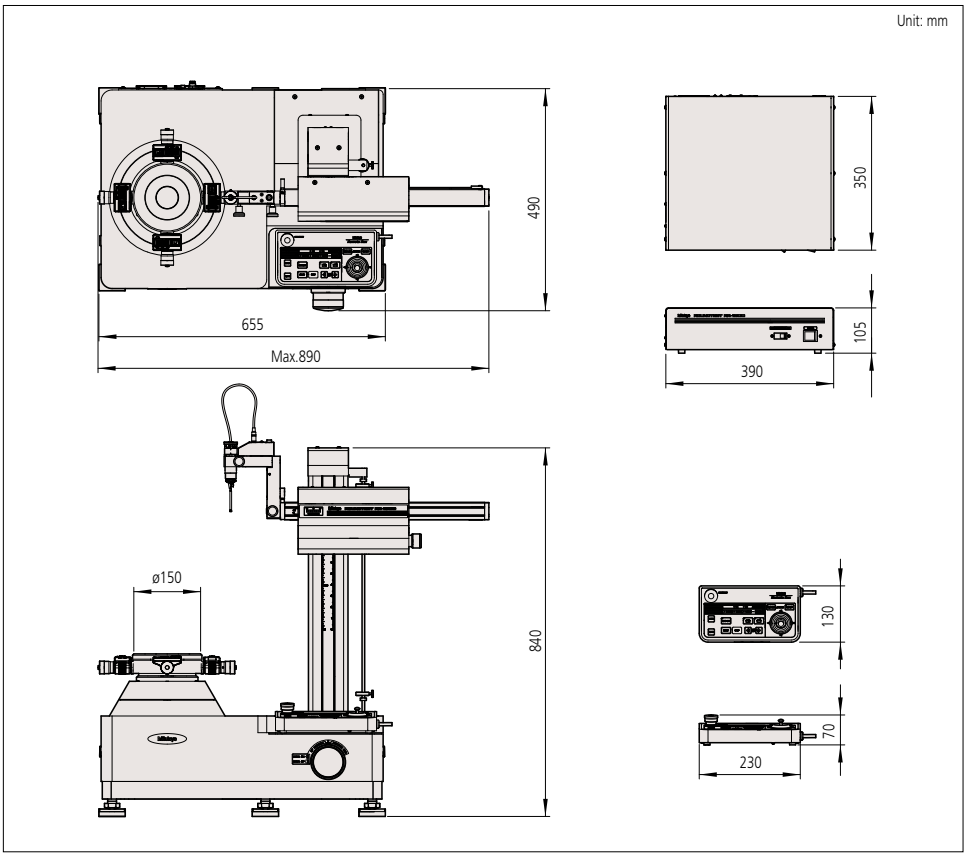


4. Centering and levelling is complete.
Centering range: ±3 mm
Levelling (inclination) range: ±1°

SPECIFICATIONS

Model	RA-1600
Code No. (mm)	**211-723E**
Code No. (inch/mm)	**211-733E**

DIMENSIONS



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Mitutoyo

Roundtest RA-2200

SERIES 211 – Roundness / Cylindricity Measuring System

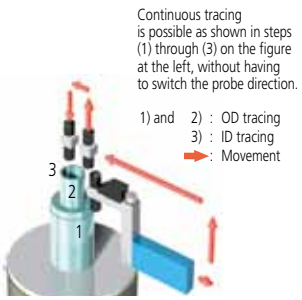
- The RA-2200 provides high accuracy, high speed and high performance roundness measurement.
- The fully-automatic or DAT (Digital Adjustment Table) function aids manual workpiece centering and levelling, turning a once challenging task into something simple enough for even the untrained user and substantially reducing overall measurement time.
- The RA-2200 system comes with the powerful ROUNDPAK data analysis software, with enhanced functionality and easy operation through the use of the mouse and icon selection.

Roundtest RA-2200AS and vibration isolator with side table

Greater productivity by continuous measurement

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

*Inside diameter up to 50 mm



Mitutoyo uses high accuracy, highly repeatable linear scales in the X/Z drive unit to guarantee the high-precision positioning vital for repetitive measurement.

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.

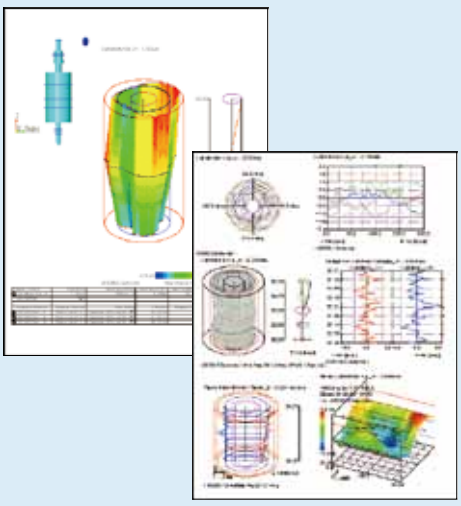
Unique design allows system upgrading

The system can be upgraded to CNC operation by replacing and adjusting the detector unit. (This task should be performed by a Mitutoyo technician.)

Technical Data

Turntable		
Rotational accuracy		
	Radial:	(0.02+3.5H/10000) µm H: Probing height (mm)
	Axial:	(0.02+3.5X/10000) µm R: probing radius (mm)
Rotational speed:		2, 4, 6, 10 rpm
Table diameter:		235 mm (200 mm: DS, DH models)
Centering range:		±3 mm (±5 mm: DS, DH models)
Levelling range:		±1°
Max. probing diameter:		300 mm
Max. workpiece diameter:		580 mm
Max. table loading:		30 kg
Vertical column (Z-axis)		
Vertical travel:		300 mm (500 mm: AH, DH models)
Straightness (λc2.5):		0.10 µm/100 mm, 0.15 µm/300 mm (0.25 µm/500 mm: AH, DH models)
Parallelism with turntable axis:		0.7 µm/300 mm (1.2 µm/500 mm: AH, DH models)
Positioning speed:		Max. 50 mm/s
Measuring speed:		0.5, 1, 2, 5 mm/s
Max. probing height:		300 mm (OD), 300 mm (ID) [500 mm: AH, DH models]
Max. probing depth:		85 mm for ø32 mm or more, 50 mm for ø7 mm or more
Horizontal arm (X-axis)		
Horizontal travel:		175 mm (from table axis -25 mm ~ +150 mm)
Straightness (λc2.5):		0.7 µm/150 mm
Squareness with turntable axis:		1.0 µm/150 mm
Positioning speed:		Max. 30 mm/s with joystick operation
Measuring speed:		0.5, 1, 2, 5 mm/s
Probe and stylus		
Measuring range:		±400 µm/±40 µm/±4 µm
Measuring force:		10 to 50 mN (5 level switching)
Standard stylus:		12AAL021, carbide ball, ø1.6 mm
Measuring direction:		Bi-directional
Stylus angle adjustment:		±45° (with graduations)
Air supply		
Air pressure:		0.39 MPa
Air consumption:		30 L/min.
Power supply:		100V AC - 240V AC, 50/60Hz
Dimensions (W x D x H):		940 x 510 x 900 mm: AS models 910 x 510 x 900 mm: DS models 940 x 510 x 1100 mm: AH models 910 x 510 x 1100 mm: DH models
Mass:		180 kg (200 kg: AH, DH models)

Printout



Optional Accessories

350850: Cylindrical square
£337.00

12AAF203: 2X extension detector holder
£1720.00

12AAF204: Auxiliary detector holder for a large-diameter workpiece
£1350.00

211-045: Magnification checking gauge
£1980.00

211-014: Chuck (OD: ø2 - 78 mm, ID: ø25 - 68 mm)
£487.00

211-032: Quick chuck (OD: 1 - 79 mm, ID: 16 - 69 mm)
£1220.00

211-031: Micro-chuck (OD: 0.1 - 1.5 mm)
£941.00

178-025: Vibration isolator (desktop type)
£4790.00

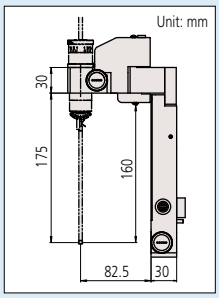
178-024: Stand for vibration isolator
£647.00

211-032

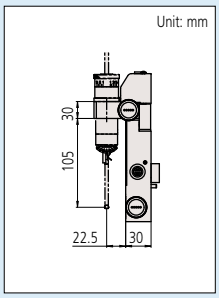
211-014

211-031

211-045



12AAF203

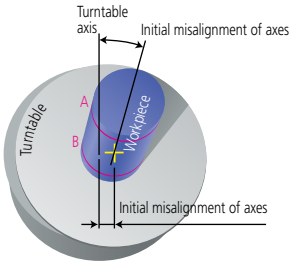


12AAF204

DAT (Digital Adjustment Table) function

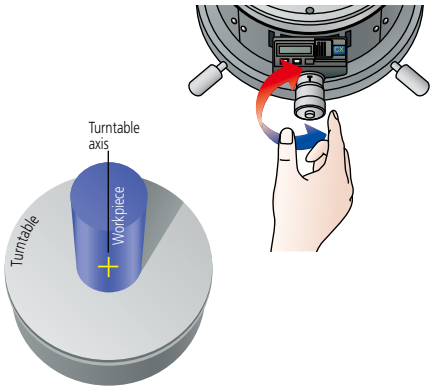
A guidance system (DAT) is incorporated into the turntable on the RA-2200DS/DH models to help the operator perform manual centering and levelling smoothly and simply.

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



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

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



4. Centering and levelling is complete.
Centering range: ±3 mm
Levelling (inclination) range: ±1°

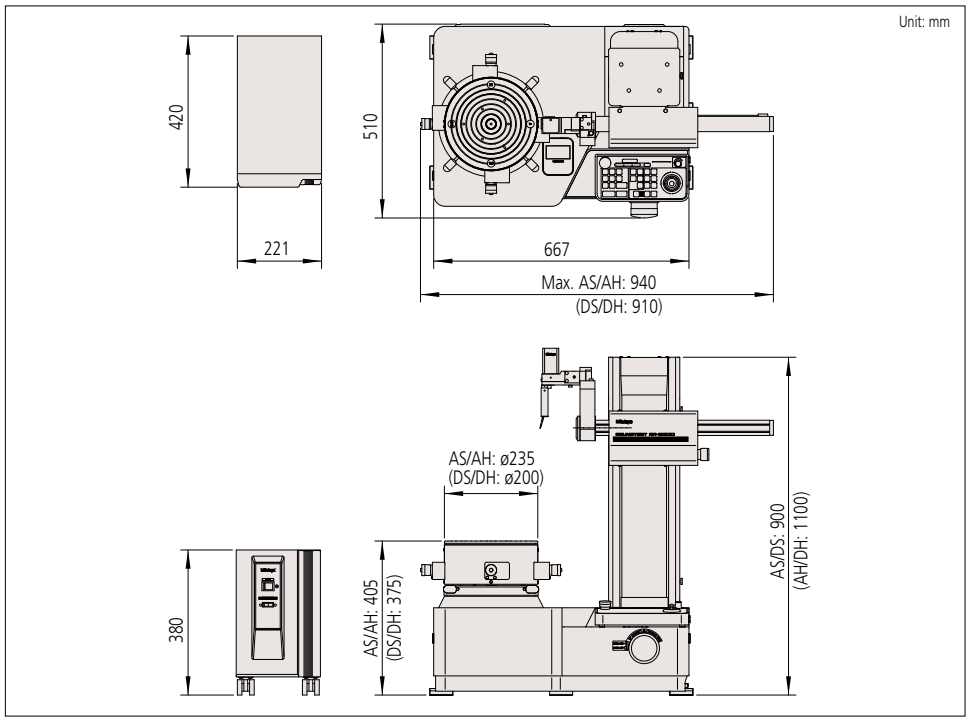
AAT (Automatic Adjustment Table) function

Incorporating an Automatic Adjustment Table (AAT), the top-of-the-line RA-2200AS/AH models relieve the operator of workpiece centering and levelling.

SPECIFICATIONS

Model	RA-2200AS	RA-2200DS	RA-2200AH	RA-2200DH
Code No.	**211-511E** (mm)	**211-513E** (mm) **211-514E** (inch)	**211-512E** (mm)	**211-515E** (mm) **211-516E** (inch)
Effective table diameter	235 mm	200 mm	235 mm	200 mm
Centering/levelling adjustment*	AAT (Automatic Adjustment Table)	(DAT) Digital Adjustment Table	AAT (Automatic Adjustment Table)	(DAT) Digital Adjustment Table
Centering range	±3 mm	±5 mm	±3 mm	±5 mm
Column travel	300 mm (standard column)		500 mm (tall column)	
Basic unit mass	180 kg		200 kg	

DIMENSIONS



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Roundtest RA-H5200

SERIES 211 – Roundness/Cylindricity Measuring System

- RA-H5200AS/AH, a roundness/cylindricity measuring system developed to combine world-class accuracy with manoeuvrability and high analysis capability.
- Enhanced measurement functions include tracking measurement and automatic OD/ID measurement capabilities.
- Also capable of roughness measurement (both in circumferential and axial directions).

Roundtest RA-5200AH

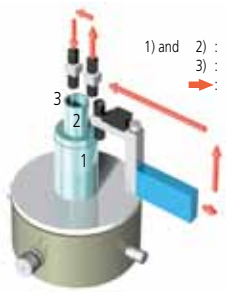
High-accuracy automatic centering / levelling turntable

A highly accurate, highly rigid turntable has been created through exceptional manufacturing accuracy of critical components, such as the rotor and stator. In addition, an air bearing incorporating a complex aperture provides superior rigidity and uniform pressure distribution. All resulting in an industry leading (0.02+3.5H/10000)µm rotational accuracy (radial).

Automatic continuous OD / ID measurement

Continuous automatic measurement can be performed from external diameter to internal diameter without changing probe position. This reduces measurement time and also eliminates errors associated with probe position changes, greatly facilitating high-accuracy measurement.

The automatic centering / levelling mechanism incorporates a high-precision glass scale on each axis of the turntable. This generates feedback preventing positioning errors from affecting centering / levelling adjustments.



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

Technical Data

Turntable	
Rotational accuracy	
Radial:	(0.02+3.5H/10000) µm H: Probing height (mm)
Axial:	(0.02+3.5X/10000) µm X: distance from the turntable axis (mm)
Rotational speed:	2, 4, 6, 10 rpm (20 rpm: auto-centering)
Table diameter:	300 mm
Centering range:	±5 mm
Levelling range:	±1°
Max. probing diameter:	400 mm
Max. workpiece diameter:	680 mm
Max. table loading:	80 kg (65 kg: auto-centering)
Vertical column (Z-axis)	
Vertical travel:	350 mm: AS model; 550 mm: AH model
Straightness (λc2.5)	
AS model:	0.05 µm/100 mm, 0.14 µm/350 mm
AH model:	0.05 µm/100 mm, 0.2 µm/550 mm
Parallelism with turntable axis	
AS model:	0.2 µm/350 mm
AH model:	0.32 µm/550 mm
Positioning speed:	Max. 60 mm/s
Measuring speed:	0.5, 1, 2, 5 mm/s
Max. probing height:	350 mm (OD), 350 mm (ID) [550 mm (OD / ID): AH model]
Max. probing depth:	85 mm for ø32 mm or more, 50 mm for ø7 mm or more
Horizontal arm (X-axis)	
Horizontal travel:	225 mm
Straightness (λc2.5):	0.4 µm/200 mm
Squareness with turntable axis:	0.5 µm/200 mm
Positioning speed:	Max. 50 mm/s
Measuring speed:	0.5, 1, 2, 5 mm/s
Probe and stylus	
Measuring range:	±400 µm/±40 µm/±4 µm
Measuring force:	10 to 50 mN (5 level switching)
Standard stylus:	12AAL021, carbide ball, ø1.6 mm
Measuring direction:	Bi-directional
Stylus angle adjustment:	±45° (with graduations)
Air supply	
Air pressure:	0.39 MPa
Air consumption:	45 L/min.
Power supply:	100V AC - 240V AC, 50/60Hz
Dimensions (W x D x H):	1260 x 710 x 1700 mm (1260 x 710 x 1900 mm: AH model)
Mass:	650 kg: AS model; 670 kg: AH model with vibration isolation stand:170 kg

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Optional Accessories

350850: Cylindrical square
£337.00

12AAF203: 2X extension detector holder
£1720.00

12AAF205: 3X extension detector holder
£1870.00

12AAF204: Auxiliary detector holder for a large-diameter workpiece
£1350.00

211-045: Magnification checking gauge
£1980.00

211-014: Chuck (OD: ø2 - 78 mm, ID: ø25 - 68 mm)
£487.00

211-032: Quick chuck (OD: 1 - 79 mm, ID: 16 - 69 mm)
£1220.00

211-031: Micro-chuck (OD: 0.1 - 1.5 mm)
£941.00

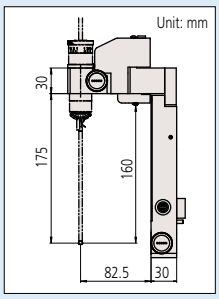
12AAB598: Protective shield
£1270.00

211-032

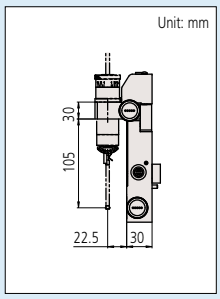
211-014

211-031

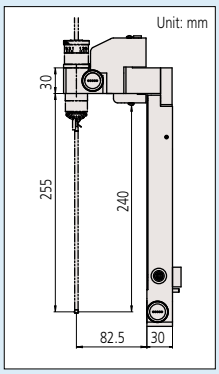
211-045



12AAF203



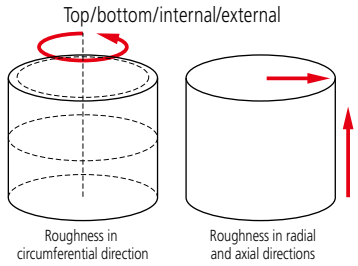
12AAF204



12AAF205

X-axis tracking measurement

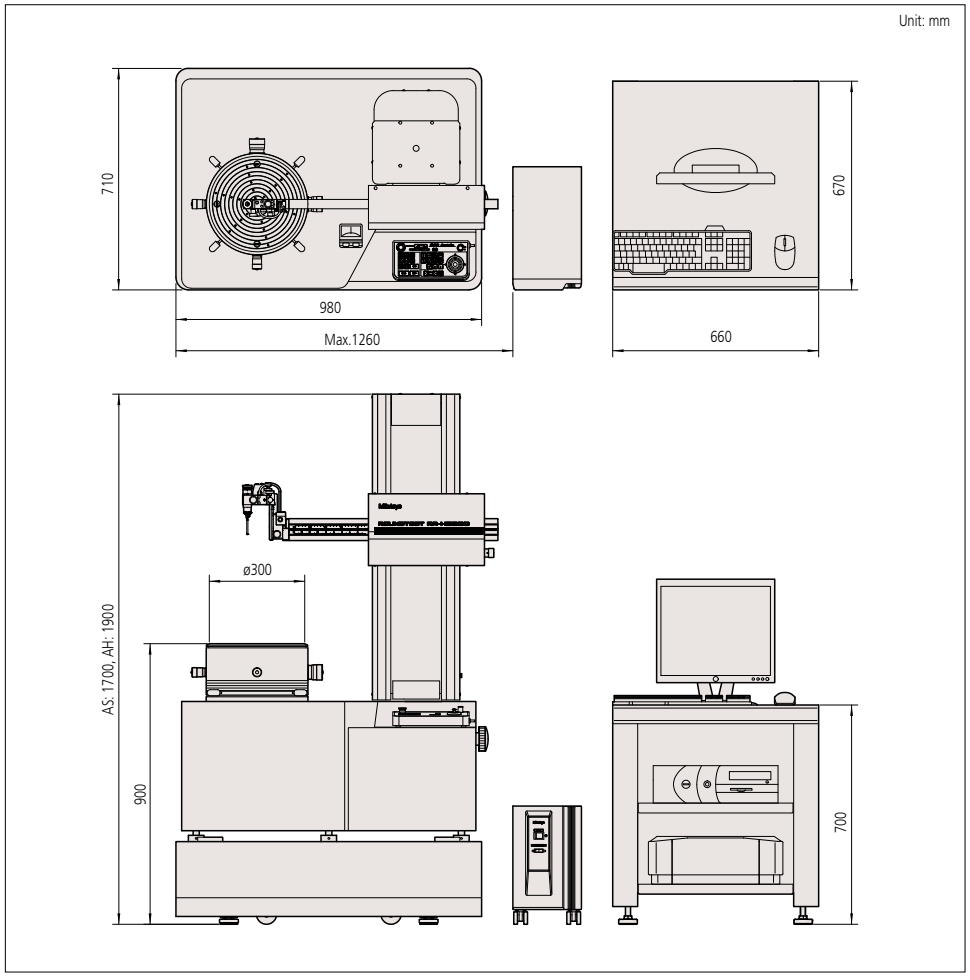
A linear scale incorporated into the X axis enables measurement to be extended by tracking the workpiece surface (tracking range: ±5 mm). This capability is effective for measuring a workpiece with a displacement that exceeds the detection range of the probe when measuring roundness/ cylindricity or a taper that is determined with slider/ column movement.



SPECIFICATIONS

Model	RA-H5200AS	RA-H5200AH
Code No. (with vibration isolation stand)	**211-531E**	**211-532E**
Column travel	350 mm (standard column)	550 mm (tall column)

DIMENSIONS



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Mitutoyo

Roundtest Extreme RA-2200CNC

SERIES 211 – CNC Roundness/Cylindricity 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.

Roundtest RA-2200CNC and vibration isolator with side table

Technical Data

Turntable
- Rotational accuracy
  - Radial: (0.02+3.5H/10000) µm
    H: Probing height (mm)
  - Axial: (0.02+3.5X/10000) µm
    X: distance from the turntable axis (mm)
- Rotational speed: 2, 4, 6, 10 rpm
- Table diameter: 235 mm
- Centering range: ±3 mm
- Levelling range: ±1°
- Max. probing diameter: 256 mm
- Max. workpiece diameter: 580 mm
- Max. table loading: 30 kg

Vertical column (Z-axis)
- Vertical travel: 300 mm (500 mm)*
- Straightness (λc2.5): 0.10 µm/100 mm, 0.15 µm/300 mm (0.25 µm/500 mm)*
- Parallelism with turntable axis: 0.7 µm/300 mm (1.2 µm/500 mm)*
- Positioning speed: Max. 50 mm/s
- Measuring speed: 0.5, 1, 2, 5 mm/s
- Max. probing height: 300 mm (OD), 300 mm (ID) [500 mm (OD / ID)]*
- Max. probing depth: 104 mm (ø32 mm or more) 26 mm (ø12.7 mm or more)

Horizontal arm (X-axis)
- Horizontal travel: 175 mm (from table axis -25 mm ~ +150 mm)
- Straightness (λc2.5): 0.7 µm/150 mm
- Squareness with turntable axis: 1.0 µm/150 mm
- Positioning speed: Max. 30 mm/s
- Measuring speed: 0.5, 1, 2, 5 mm/s

Probe and stylus
- Measuring range: ±400 µm (±5 mm: tracking range)
- Measuring force: 40 mN
- Standard stylus: 12AAE301, carbide ball, ø1.6 mm
- Measuring direction: Bi-directional
- Stylus angle adjustment: Fixed

Air supply
- Air pressure: 0.39 MPa
- Air consumption: 30 L/min.

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

Dimensions (W x D x H): 940 x 510 x 900 mm (940 x 510 x 1100 mm)*

Mass: 180 kg (200 kg)*

*Tall-column type

SPECIFICATIONS

Model	**RA-2200CNC**	
Code No. (with vibration isolation stand)	**211-517E**	**211-518E**
Column travel	300 mm (standard column)	500 mm (tall column)

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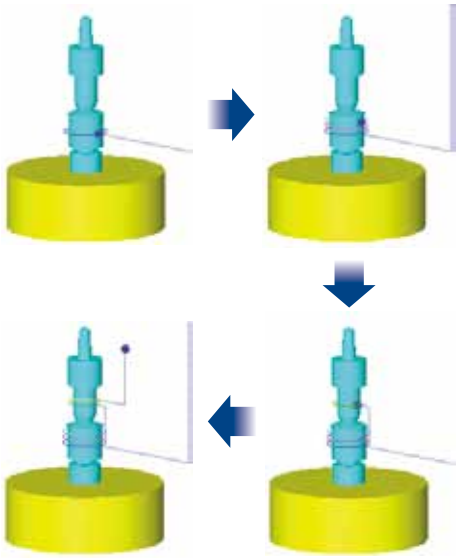
Off-line measurement procedure programming function

On-screen, virtual 3D simulation measurements can be performed with an integrated 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 accurately represented in the simulation making the prediction of collision risks and warning alarms possible.



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

Optional Accessories

350850: Cylindrical square
£337.00

211-045: Magnification checking gauge
£1980.00

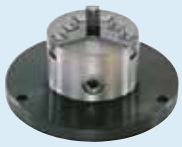
211-014: Chuck (OD: ø2 - 78 mm, ID: ø25 - 68 mm)
£487.00

211-032: Quick chuck (OD: 1 - 79 mm, ID: 16 - 69 mm)
£1220.00

211-031: Micro-chuck (OD: 0.1 - 1.5 mm)
£941.00

12AAB598: Protective shield
£1270.00

211-032



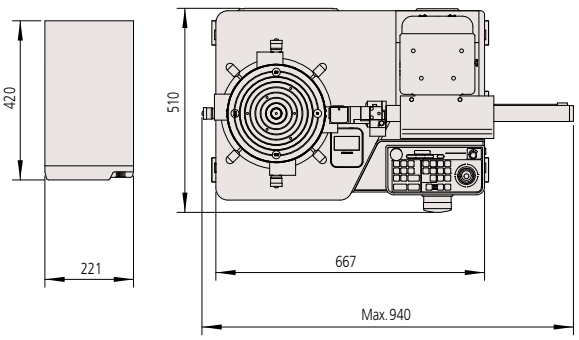
211-014

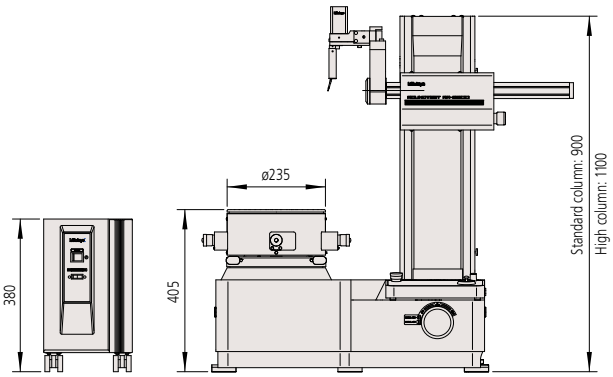
211-031

211-045

DIMENSIONS

Unit: mm





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Roundtest Extreme RA-H5200CNC

SERIES 211 – CNC Roundness/Cylindricity 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.

Roundtest RA-H5200CNC

Technical Data

Turntable
- Rotational accuracy
  - Radial: (0.02+3.5H/10000) µm
    H: probing height (mm)
  - Axial: (0.02+3.5X/10000) µm
    X: distance from the turntable axis (mm)
- Rotational speed: 2, 4, 6, 10 rpm (20 rpm: auto-centering)
- Table diameter: 300 mm
- Centering range: ±5 mm
- Levelling range: ±1°
- Max. probing diameter: 356 mm
- Max. workpiece diameter: 680 mm
- Max. table loading: 80 kg (65 kg: auto-centering)

Vertical column (Z-axis)
- Vertical travel: 350 mm (550 mm)*
- Straightness (λc2.5): 0.05 µm/100 mm, 0.14 µm/350 mm (0.2 µm/550 mm)*
- Parallelism with turntable axis: 0.2 µm/350 mm (0.32 µm/550 mm)*
- Positioning speed: Max. 60 mm/s
- Measuring speed: 0.5, 1, 2, 5 mm/s
- Max. probing height: 350 mm (OD), 350 mm (ID) [550 mm (OD / ID)]*
- Max. probing depth: 104 mm (ø32 mm or more) 26 mm (12.7 mm or more)

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

Probe and stylus
- Measuring range: ±400 µm/±40 µm/±4 µm (±5 mm: tracking range)
- Measuring force: 40 mN
- Standard stylus: 12AAE301, carbide ball, ø1.6 mm
- Measuring direction: Bi-directional
- Stylus angle adjustment: Fixed

Air supply
- Air pressure: 0.39 MPa
- Air consumption: 45 L/min.

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

Dimensions (W x D x H): 1260 x 710 x 1700 mm (1260 x 710 x 1900 mm)*

Mass: 650 kg (670 kg)* with vibration isolation stand: 170 kg

*Tall-column type

SPECIFICATIONS

Model	RA-H5200CNC	
Code No. (with vibration isolation stand)	**211-533E**	**211-534E**
Column travel	350 mm (standard column)	550 mm (tall column)

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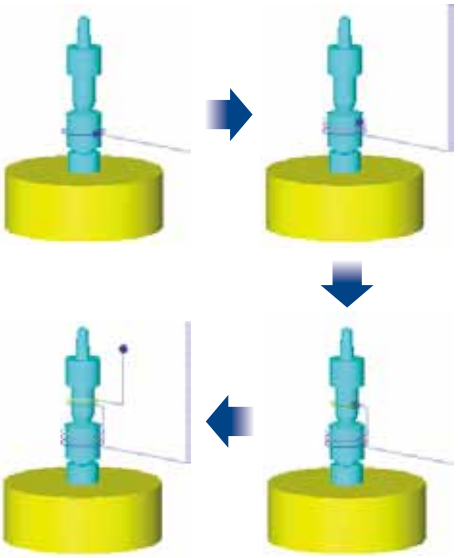
the standard in world metrology software
FORM

ROUNDPAK

Off-line measurement procedure programming function

On-screen, virtual 3D simulation measurements can be performed with an integrated 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 accurately represented in the simulation making the prediction of collision risks and warning alarms possible.



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

Optional Accessories

350850: Cylindrical square
£337.00

211-045: Magnification checking gauge
£1980.00

211-014: Chuck (OD: ø2 - 78 mm, ID: ø25 - 68 mm)
£487.00

211-032: Quick chuck (OD: 1 - 79 mm, ID: 16 - 69 mm)
£1220.00

211-031: Micro-chuck (OD: 0.1 - 1.5 mm)
£941.00

12AAB598: Protective shield
£1270.00

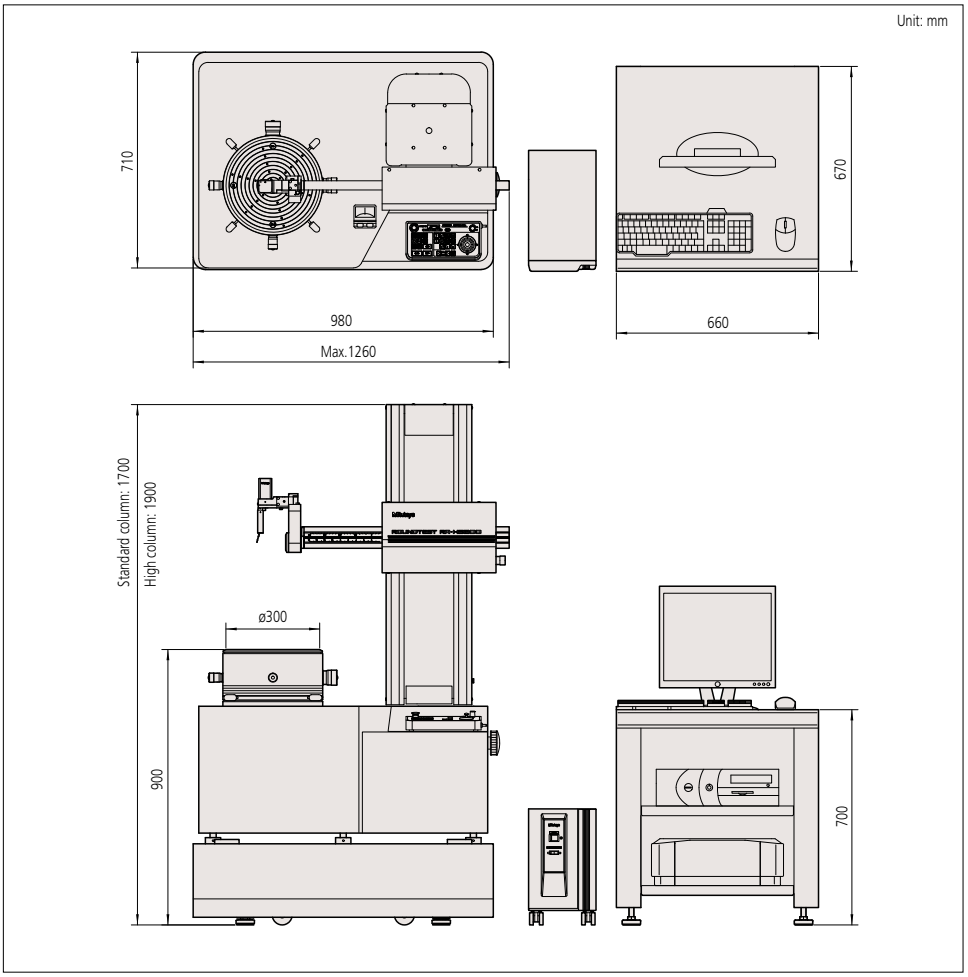
211-032

211-014

211-031

211-045

DIMENSIONS



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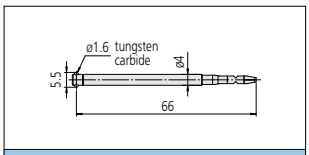
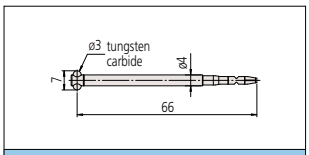
Mitutoyo

Optional Styli

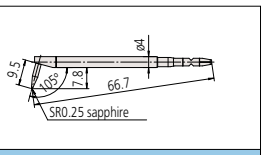
Compatible with non-CNC Roundness Measuring Instruments



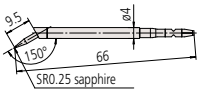
1. Standard (standard accessory)*



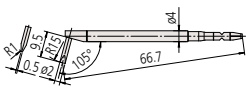
2. Notch



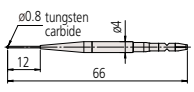
3. Deep groove



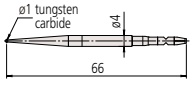
4. Corner



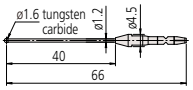
5. Cutter mark



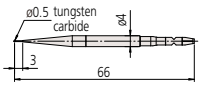
6. Small hole (ø0.8)



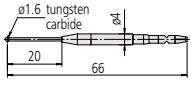
7. Small hole (ø1.0)



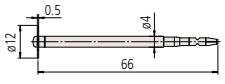
8. Small hole (ø1.6)



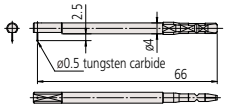
9. Extra small hole (depth 3 mm)



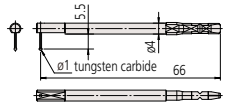
10. ø1.6 mm ball



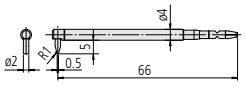
11. Disk



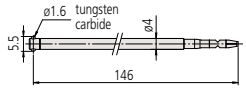
12. Crank (ø0.5)



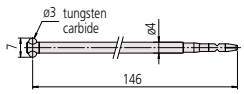
13. Crank (ø1.0)



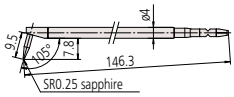
14. Flat surface



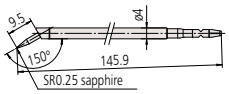
15. 2X-long type**



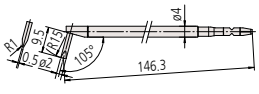
16. 2X-long type notch**



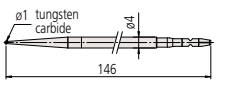
17. 2X-long type deep groove**



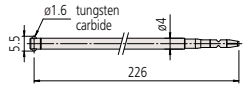
18. 2X-long type corner**



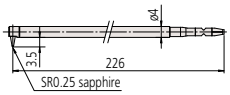
19. 2X-long type cutter mark**



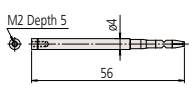
20. 2X-long type small hole**



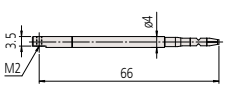
21. 3X-long type**



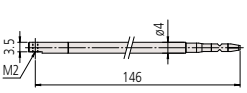
22. 3X-long type deep groove**



23. Stylus shank



24. Stylus shank (standard groove)



25. Stylus shank (2X-long groove)**

Unit: mm

* Standard accessory for all Roundtest models.
** Measuring is only possible in the vertical direction.
Not available for RA-10, RA-120, RA-120P, RA-220.

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

Technical Data

1. Standard (standard accessory)*
   12AAL021 ø1.6 mm tungsten carbide
2. Notch
   12AAL022 ø3 mm tungsten carbide
3. Deep groove
   12AAL023 SR0.25 mm sapphire
4. Corner
   12AAL024 SR0.25 mm sapphire
5. Cutter mark
   12AAL025 Tungsten carbide
6. Small hole (ø0.8)
   12AAL026 ø0.8 mm tungsten carbide
7. Small hole (ø1.0)
   12AAL027 ø1 mm tungsten carbide
8. Small hole (ø1.6)
   12AAL028 ø1.6 mm tungsten carbide
9. Extra small hole (depth 3 mm)
   12AAL029 ø0.5 mm tungsten carbide
10. ø1.6 mm ball
    12AAL030 ø1.6 mm tungsten carbide
11. Disk
    12AAL031 ø12 mm tungsten carbide
12. Crank (ø0.5)
    12AAL032 ø0.5 mm tungsten carbide (depth 2.5 mm)
13. Crank (ø1.0)
    12AAL033 ø1 mm tungsten carbide (depth 5.5 mm)
14. Flat surface
    12AAL034 Tungsten carbide
15. 2X-long type**
    12AAL035 ø1.6 mm tungsten carbide
16. 2X-long type notch**
    12AAL036 ø3 mm tungsten carbide
17. 2X-long type deep groove**
    12AAL037 SR0.25 mm sapphire
18. 2X-long type corner**
    12AAL038 SR0.25 mm sapphire
19. 2X-long type cutter mark**
    12AAL039 Tungsten carbide
20. 2X-long type small hole**
    12AAL040 ø1 mm tungsten carbide
21. 3X-long type**
    12AAL041 ø1.6 mm tungsten carbide
22. 3X-long type deep groove**
    12AAL042 SR0.25 mm sapphire
23. Stylus shank
    12AAL043 For mounting CMM stylus (mounting thread M2)
24. Stylus shank(standard groove)
    12AAL044 For mounting CMM stylus (mounting thread M2)
25. Stylus shank(2X-long groove)**
    12AAL045 For mounting CMM stylus (mounting thread M2)

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Technical Data

1. Deep groove
   12AAE310 ø1.6 mm tungsten carbide
2. Flat surface
   12AAE302 ø1.6 mm tungsten carbide
3. Standard
   12AAE301 ø1.6 mm tungsten carbide
4. Deep hole A
   12AAE306 ø1.6 mm tungsten carbide
5. Deep hole B
   12AAE307 ø1.6 mm tungsten carbide
6. Notch
   12AAE309 ø3 mm tungsten carbide
7. ø1.6 mm ball
   12AAE303 ø1.6 mm tungsten carbide
8. ø0.8 mm ball
   12AAE304 ø0.8 mm tungsten carbide
9. ø0.5 mm ball
   12AAE305 ø0.5 mm tungsten carbide
10. Deep groove
    12AAE308 ø1.6 mm tungsten carbide

Usage examples of various styli

Cutter mark

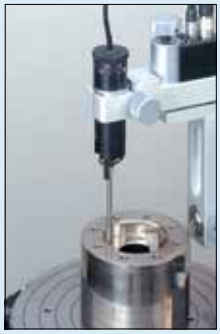
Corner

Small hole

Small hole

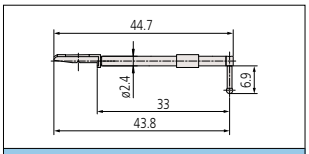
Flatness measurement

Notched workpiece measurement

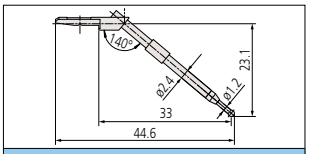


ID measurement

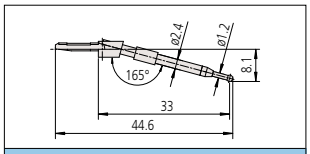
Compatible with CNC Roundness Measuring Instruments



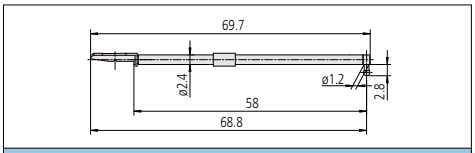
1. Deep groove



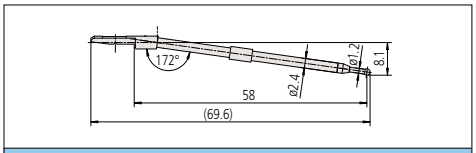
2. Flat surface



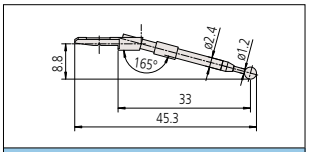
3. Standard



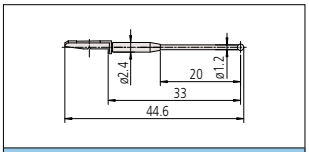
4. Deep hole A



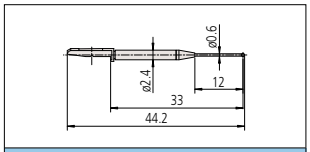
4. Deep hole B



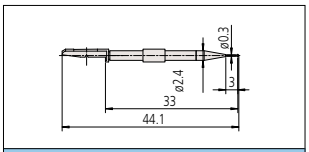
6. Notch



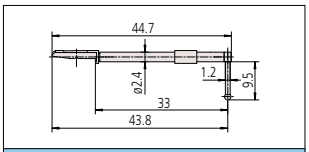
7. ø1.6 mm ball



8. ø0.8 mm ball



9. ø0.5 mm ball



10. Deep groove

Analyzing items		Models						
		RA-H5200CNC / RA-H5200	RA-2200CNC / RA-2200	RA-1600	RA-220	RA-120P	RA-120	RA-10
○ Roundness		●	●	●	●	●	●	●
⌭ Cylindricity		●	●	●	●	—	—	—
◎ Concentricity		●	●	●	●	●	●	●
◉ Coaxiality	Axis-element	●	●	●	●	●	●	●
	Axis-axis	●	●	●	—	●	—	—
▱ Flatness		●	●	●	●	●	●	●
// Parallelism		●	●	●	●	●	●	—
⊥ Perpendicularity		●	●	●	●	●	●	—
↗ Runout		●	●	●	●	●	●	●
⌰ Total runout		●	●	●	—	—	—	—
— Straightness		●	●	●	—	—	—	—
∠ Inclination		●	●	●	—	—	—	—
/\ Taper		●	●	●	—	—	—	—

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Optional Accessories

For Roundness Measuring Instruments

Collet chuck

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

Code No.	211-061
Holding capacity	OD: 0.5~10 mm*1
Centering error	50 µm or less *2
Mass	1.4 kg
Price	**£670.00**

*1 Collets compatible with the workpiece are optional.
*2 When measured with a ø5 mm pin gauge at the measurement height of 30 mm.

Centering chuck (ring operated)

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

Code No.		211-032
Holding capacity	Internal jaws	OD: 1~36 mm ID: 16~69 mm
	External jaws	OD: 35~78 mm
External dimensions (D x H)		ø118 x 41 mm
Mass		1.2 kg
Price		**£1220.00**

Micro-chuck

- Used for clamping a workpiece (less than ø1 mm) that the centering chuck cannot handle.

Code No.	211-031
Holding capacity	OD: ~1.5 mm
External dimensions (D x H)	ø107 x 48.5 mm
Mass	0.6 kg
Price	**£941.00**

Magnification checking kit*4

- A combination of gauge blocks and an optical flat.

Code No.	997090
Price	**£208.00**

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

Collets

- Individual collets for the collet chuck.*3

Code No.	Holding capacity	Price
12AAH402	OD: 0.5~1.0 mm	**£140.00**
12AAH403	OD: 1.0~1.5 mm	**£140.00**
12AAH404	OD: 1.5~2.0 mm	**£110.00**
12AAH405	OD: 2.0~2.5 mm	**£110.00**
12AAH406	OD: 2.5~3.0 mm	**£100.00**
12AAH407	OD: 3.0~3.5 mm	**£100.00**
12AAH408	OD: 3.5~4.0 mm	**£100.00**
12AAH409	OD: 4.0~5.0 mm	**£100.00**
12AAH410	OD: 5.0~6.0 mm	**£100.00**
12AAH411	OD: 6.0~7.0 mm	**£100.00**
12AAH412	OD: 7.0~8.0 mm	**£100.00**
12AAH413	OD: 8.0~9.0 mm	**£100.00**
12AAH414	OD: 9.0~10.0 mm	**£100.00**

*3 Collet chuck holder is necessary to fix the individual collets on the rotary table.

Centering chuck (handle operated)

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

Code No.		211-014
Holding capacity	Internal jaws	OD: 2~35 mm ID: 25~68 mm
	External jaws	OD: 35~78 mm
External dimensions (D x H)		ø157 x 70.6 mm
Mass		3.8 kg
Price		**£487.00**

Magnification calibration gauge

- Used for normalizing detector magnification by calibrating detector travel against displacement of a micrometer spindle.

Code No.	211-045
Max. calibration range	400 µm
Graduation	0.2 µm
External dimensions (W x D x H)	235 (max) x 185 x 70 mm
Mass	4 kg
Price	**£1980.00**

Recording paper set

- For the RA-10, RA-120 and RA-220 thermal printers.

Code No.	12AAH181
Number of rolls	10 (25 m per roll)
Price	**£60.40**

Cylindrical square

- Only for models capable of measuring cylindricity.

Code No.	350850
Cylindricity	2 µm
Straightness	1 µm
External dimensions (D x H)	ø70 x 250 mm
Mass	7.5 kg
Price	**£337.00**

Origin-point gauge*6

- For zero setting the R- and Z-axes.

Code No.	998382
Price	**£269.00**

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

Vibration isolator

- Desk type compatible with RA-2200.

Code No.	12AAK110
Vibration isolation method	Diaphragm isolation system
External dimensions (W x D x H)	830 x 800 x 700 mm
Price	**£POA**

Optional accessories used with this vibration isolator
- Monitor arm (**12AAK120**)
- Side table (**12AAL019**)

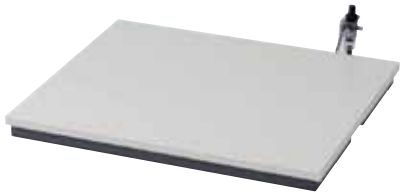
Auxiliary workpiece stand*5

Code No.	356038
Loading diameter	100 mm
External dimensions (D x H)	ø105 x 25 mm
Mass	1.7 kg
Price	**£264.00**

*5 Supplied with RA-H5200 as standard.

Vibration isolator

- Air suspension system.



For RA-220 and RA-1600

Code No.	178-025
Vibration isolation method	Diaphragm isolation system
External dimensions (W x D x H)	750 x 550 x 57 mm
Price	**£4790.00**

Optional accessory used with this vibration isolator: Stand (**178-024**)

For RA-10, RA-120 and RA-120P

Code No.	211-013
Vibration isolation method	Diaphragm isolation system
External dimensions (W x D x H)	615 x 515 x 51 mm
Price	**£2930.00**

3X extension detector holder

- For the measurement of deep holes with the RA-H200.

Code No.	12AAF205
Mass	1.3 kg
Price	**£1870.00**

2X extension detector holder

- For the measurement of deep holes with the RA-1600, RA-2200 and RA-H200.

Code No.	12AAF203
Mass	1.1 kg
Price	**£1720.00**

Sliding detector holder

- For the RA-1600 (supplied with RA-H5200/ RA-2200 as standard).

Code No.	12AAL090
Price	**£1300.00**

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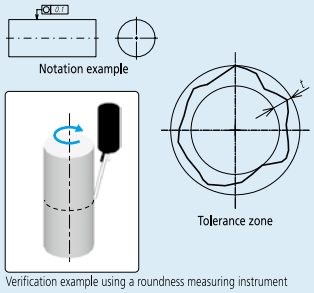
Quick Guide to Precision Measuring Instruments

Roundtest (Roundform Measuring Instruments)

○ Roundness

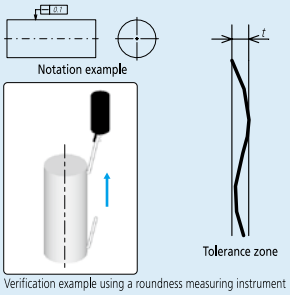
Any circumferential line must be contained within the tolerance zone formed between two coplanar circles with a difference in radii of t



Verification example using a roundness measuring instrument

— Straightness

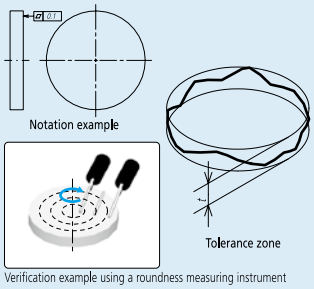
Any line on the surface must lie within the tolerance zone formed between two parallel straight lines a distance t apart and in the direction specified



Verification example using a roundness measuring instrument

▱ Flatness

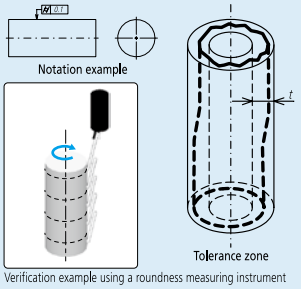
The surface must be contained within the tolerance zone formed between two parallel planes a distance t apart



Verification example using a roundness measuring instrument

⌭ Cylindricity

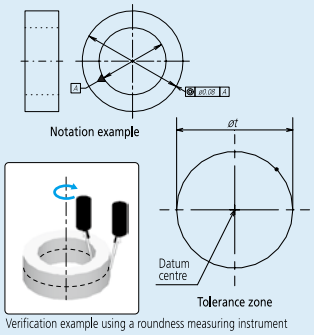
The surface must be contained within the tolerance zone formed between two coaxial cylinders with a difference in radii of t



Verification example using a roundness measuring instrument

◎ Concentricity

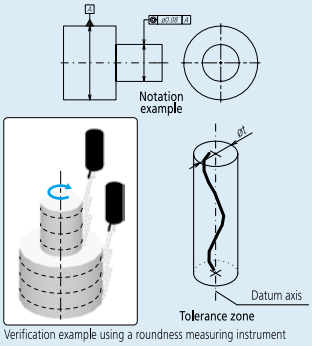
The centre point must be contained within the tolerance zone formed by a circle of diameter t concentric with the datum



Verification example using a roundness measuring instrument

◎ Coaxiality

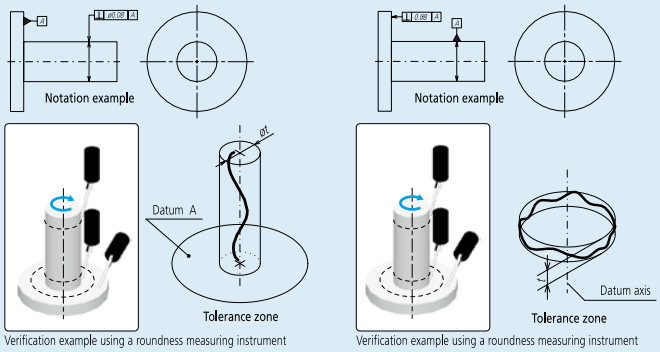
The axis must be contained within the tolerance zone formed by a cylinder of diameter t concentric with the datum



Verification example using a roundness measuring instrument

⊥ Perpendicularity

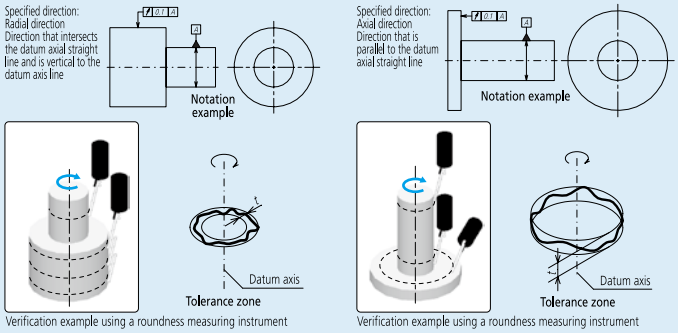
The line or surface must be contained within the tolerance zone formed between two planes a distance t apart and perpendicular to the datum



Verification example using a roundness measuring instrument

↗ Circular Runout

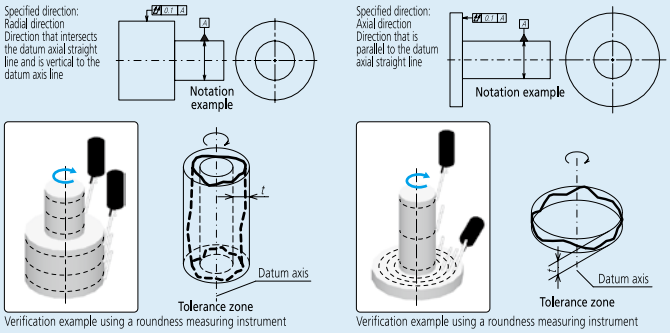
The line must be contained within the tolerance zone formed between two coplanar and/or concentric circles a distance t apart concentric with or perpendicular to the datum



Verification example using a roundness measuring instrument

⌰ Total Runout

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

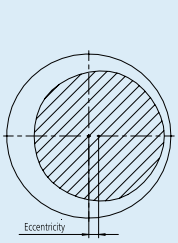


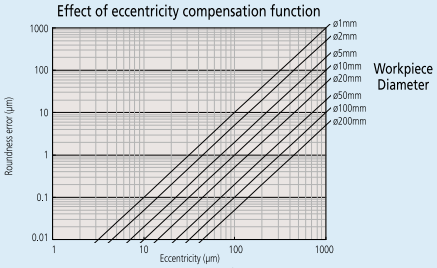
Verification example using a roundness measuring instrument

Adjustment prior to Measurement

Centering

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

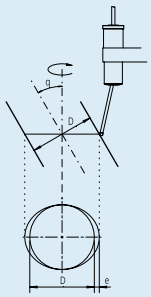


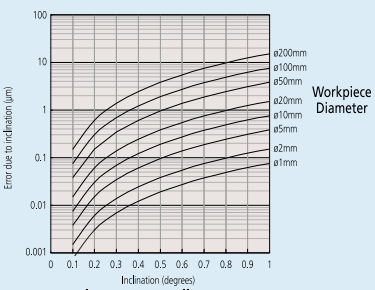


Eccentricity versus roundness error

Levelling

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





Inclination versus elliptic error

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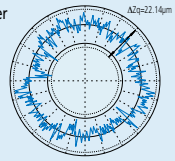
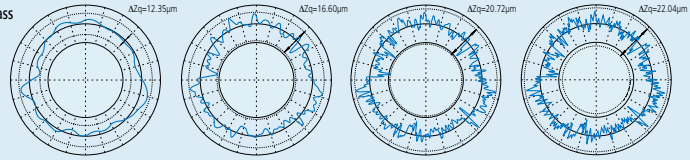
Effect of Filter Settings on the Measured Profile

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.

No filter

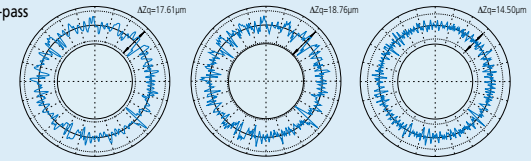


Low-pass filter



15 upr　50 upr　150 upr　500 upr

Band-pass filter



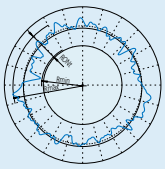
15-150 upr　15-500 upr　50-500 upr

Evaluating the Measured Profile Roundness

Roundness testers (RONt) 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

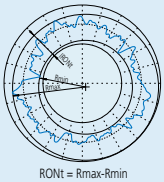
A circle is fitted to the measured profile such that the sum of the squares of the departure of the profile data from this circle is a minimum. The roundness figure is then defined as the difference between the maximum departures of the profile from this circle (highest peak to the lowest valley).



RONt = Rmax-Rmin

Minimum Zone Circles (MZC) Method

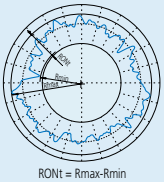
Two concentric circles are positioned to enclose the measured profile such that their radial difference is a minimum. The roundness figure is then defined as the radial separation of these two circles.



RONt = Rmax-Rmin

Minimum Circumscribed Circle (MCC) Method

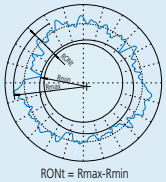
The smallest circle that can enclose the measured profile is created. The roundness figure is then defined as the maximum departure of the profile from this circle. This circle is sometimes referred to as the 'ring gauge' circle.



RONt = Rmax-Rmin

Maximum inscribed Circle (MIC) Method

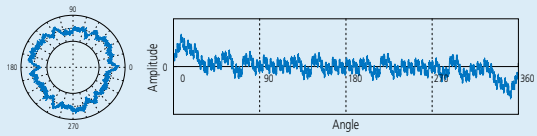
The largest circle that can be enclosed by the profile data is created. The roundness figure is then defined as the maximum departure of the profile from this circle. This circle is sometimes referred to as the 'plug gauge' circle.



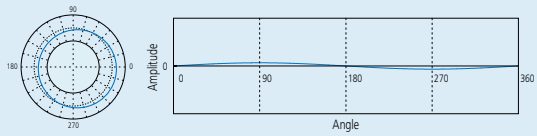
RONt = Rmax-Rmin

Undulations Per Revolution (UPR) data in the roundness graphs

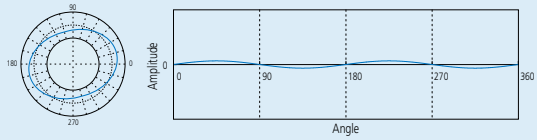
Measurement result graphs



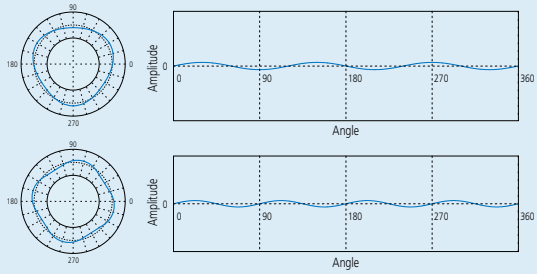
A 1 UPR condition indicates eccentricity of the workpiece relative to the rotational axis of the measuring instrument. The amplitude of undulation components depends on the levelling adjustment.



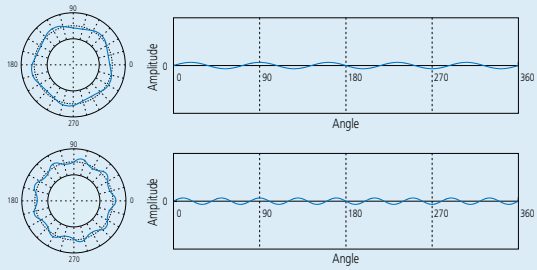
A 2 UPR condition may indicate: (1) insufficient levelling adjustment on the measuring instrument; (2) circular runout due to incorrect mounting of the workpiece on the machine tool that created its shape; (3) the form of the workpiece is elliptical by design as in, for example, an IC-engine piston.



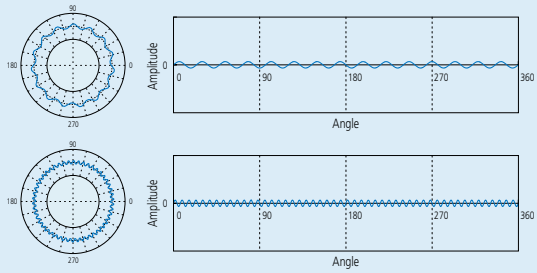
A 3 to 5 UPR condition may indicate: (1) Deformation due to over-tightening of the holding chuck on the measuring instrument; (2) Relaxation deformation due to stress release after unloading from the holding chuck on the machine tool that created its shape.



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.



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Mitutoyo