Surftest SJ-210

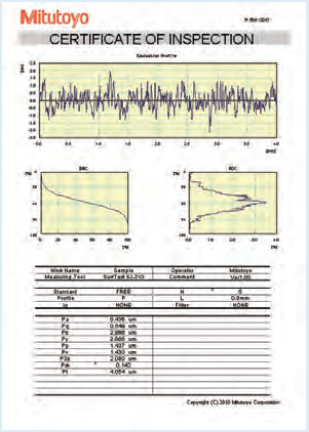
Series 178 - Portable Surface Roughness Measuring Instrument

This is a portable measuring instrument that allows you to easily and accurately measure surface roughness.
The Surftest SJ-210 offers you the following benefits:

- It works independently of mains power, allowing you to make on-site measurements.
- The **6.0 cm** [2.4"] colour graphic, back-lit LCD gives you excellent readability.
- It complies with many standards including EN ISO, VDA, ANSI, JIS as well as customised settings.
- Different drivers expanding the range of applications.
- Calculation results, assessed profiles, bearing and amplitude curves can be displayed.
- Support of 16 languages.
- Operation by keys on the front and under the sliding cover.

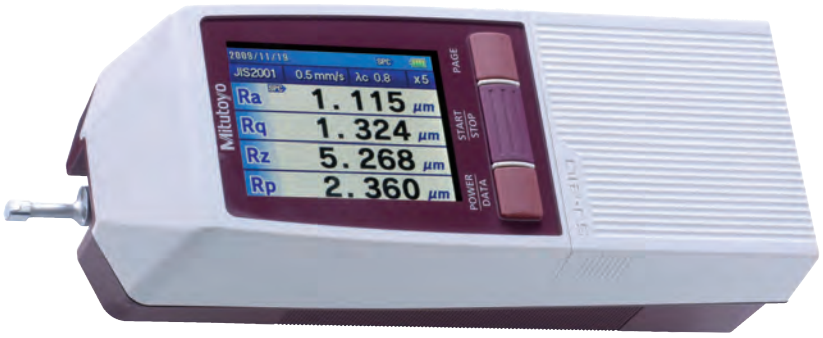
Specifications

Drive unit	
Measuring range	16 mm 4,8 mm [S-type]
Traverse	17,5 mm 5,6 mm [S-type]
Measuring speed	0,25 mm/s ; 0,5 mm/s; 0,75 mm/s
Detector	
Measuring method	Differential inductance
Range	360 µm
Stylus	Diamond Tip
Skid radius	40 mm
Display unit	
Profiles	Roughness Profile (R), R-Motif, DF-Profile and more
Roughness standards	EN ISO, VDA, JIS, ANSI and customize settings
Digital filter	Gauss, 2CR75, PC75
Cut-off length	λc : 0,08 mm; 0,25 mm; 0,8 mm; 2,5 mm λs : 2,5 µm; 8 µm
Tolerance	Colored upper / lower limit
Interface	USB, Digimatic, RS-232C, Foot switch
Power supply	AC adapter or rechargeable battery
Mass	500g



Software
USB COMMUNICATION TOOL
as a free download on www.mitutoyo.eu
(refer to page
Optional Software USB Communication Tool)

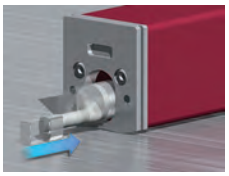
Refer to Surftest SJ-210 brochure



SJ-210

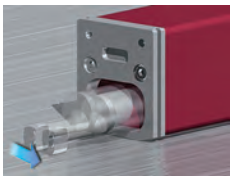
Metric

No.	Detector measuring force [mN]	Stylus Tip angle	Stylus Tip radius [µm]	Description
178-560-01D	0,75	60°	2	SJ-210 model
178-562-01D	0,75	60°	2	SJ-210R model
178-564-01D	0,75	60°	2	SJ-210S model



Standard

R-type



S-type

Surftest SJ-210

Series 178 - Portable Surface Roughness Measuring Instrument

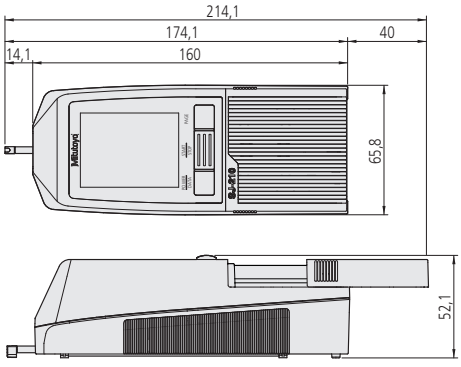
The SJ-210R – Retract System is a portable measuring instrument for surface roughness that includes a safety system.

- The detector starts in a safety position, not in contact with the workpiece surface. When measurement starts, the detector is lowered onto the workpiece while the drive unit moves in X measuring direction. During the return movement, the detector lifts up from the workpiece surface before returning to the start position. This is useful for avoiding stylus damage in applications where you cannot easily see the test surface.

SJ-210S (detailed information further on in this chapter)

- The SJ-210S model is a portable measuring instrument for surface roughness that has a transverse drive capability. This allows you to test shrouded surfaces in the transverse direction, such as crankshaft bearing surfaces, flanged features or deep grooves.

SJ-210



Dimensions

178-029 (displayed with SJ-210)

Additional Specifications

Other accessories	Other optional and standard accessories are listed later in this section

Optional accessories

No.	Description	Price €
178-029	Granite stand (12AAA221 is needed for SJ-210/310)	716.00
178-033	Measuring device for cylindrical workpieces	2,750.00
178-034	Measuring device as universal fixture	2,112.00
178-035	Measuring device for measuring in pipes	2,472.00
12AAA221	Adapter for magnetic stand	43.50
178-230-2	Standard drive unit 17,5 mm	649.00
178-235	R-Type drive unit 17,5 mm	1,257.00
178-233-2	S-Type drive unit 5,6 mm	2,318.00
12BAK699	Carrying case	50.50
936937	Digimatic cable (1 m)	43.50
965014	Digimatic cable (2 m)	57.50
02AZD790D	Connecting cable U-Wave	85.00
06ADV380D	USB Input Tool Direct cable (2 m)	100.00
12BAA303	Connecting cable for extension 1 m	72.50

Keyboard protective cover open

Back view

Surftest SJ-310

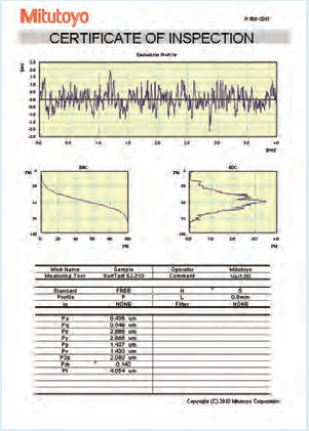
Series 178 - Portable Surface Roughness Measuring Instrument

This is a portable measuring instrument that allows you to easily and accurately measure surface roughness.
The Surftest SJ-310 offers you the following benefits:

- Skid system with touch-screen functionality and built-in printer.
- It works independently of mains power, allowing you to make on-site measurements.
- Easy and intuitive menu navigation.
- The large **14.5cm** [5.7"] colour LCD gives you high visibility.
- It complies with many standards including EN ISO, VDA, ANSI, JIS as well as customised settings.
- You can store up to 10 different measuring conditions inside the SJ-310, and up to 500 with an optional SD card.
- Statistical analysis and coloured tolerance judgement.
- 2 different evaluation conditions within 1 measurement adjustable.
- You can separately password protect many functions.
- It comes with support for 16 languages.

Specifications

Drive unit	
Measuring range	16 mm 4,8 mm [S-type]
Traverse	17,5 mm 5,6 mm [S-type]
Measuring speed	0,25 mm/s; 0,5 mm/s; 0,75 mm/s
Detector	
Measuring method	Differential inductance
Range	360 µm
Stylus	Diamond Tip
Skid radius	40 mm
Display unit	
Profiles	Roughness Profile (R), R-Motif, DF-Profile and more
Roughness standards	EN ISO, VDA, JIS, ANSI and customize settings
Digital filter	Gauss, 2CR75, PC75
Cut-off length	λc : 0,08 mm; 0,25 mm; 0,8 mm; 2,5 mm; 8 mm λs : 2,5 µm; 8 µm
Printer	Thermal Printer
Tolerance	Colored upper / lower limit
Interface	USB, Digimatic, RS-232C, Foot switch
Power supply	AC adapter or rechargeable battery



Software
USB COMMUNICATION TOOL
as a free download on www.mitutoyo.eu
(refer to page
Optional Software USB Communication Tool)

Refer to Surftest SJ-310 brochure

SJ-310

Metric

No.	Detector measuring force [mN]	Stylus Tip angle	Stylus Tip radius [µm]	Description
178-570-01D	0,75	60°	2	SJ-310 model
178-572-01D	0,75	60°	2	SJ-310R model
178-574-01D	0,75	60°	2	SJ-310S model

Standard

R-type

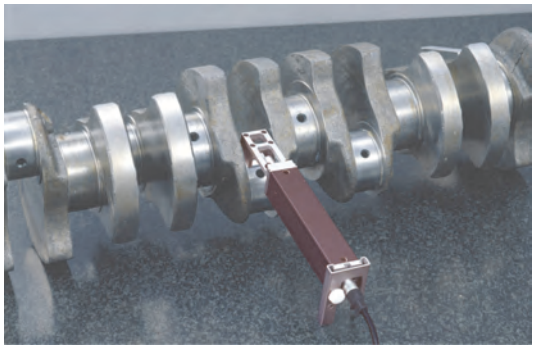
S-type

Surftest SJ-210 and SJ-310 - S-Type

Series 178 – Portable Transverse Measurement with S-Type Drive Unit

This is an S-Type drive unit for the Surftest SJ-210 and SJ-310 that provides portable transverse measurement.
It offers you the following benefits:

- It is compatible with the conventional drive units of the Surftest SJ-210 and SJ-310.
- You can simply connected it to the display unit.
- A typical application would be to position the S-Type unit on a crankshaft journal bearing, as shown in the photograph below. Once started the S-Type drive will track the stylus across the surface transversely to its own axis and reliably measure surface roughness in the direction of the crankshaft axis. Transverse tracking simplifies the measurement of surface roughness even in very confined situations, which has long been a problem with conventional instruments which allow only longitudinal measurement.

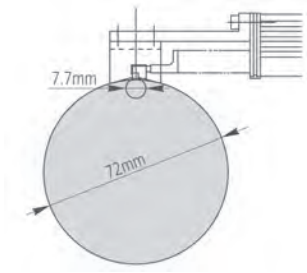


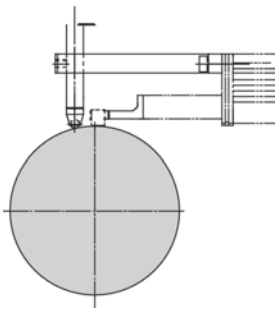
S - Type Drive Unit Set: [incl. 178-233-2 - 12AAE644 - 12AAE643]

No.	Traverse [mm]	Detector measuring force [mN]	Stylus Tip angle	Stylus Tip radius [µm]	Price [€]
178-234-2	5,6 mm	0,75	60°	2	**2,421.00**

12AAE644
V-type adapter

12AAE643
Point - contact adapter



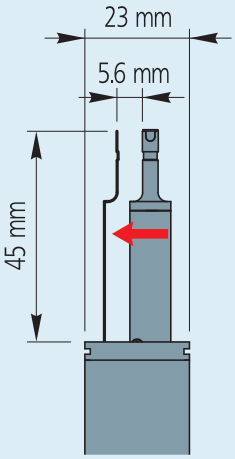


Specifications

Traverse	5,6 mm
Measuring speed	0,25 mm/s; 0,5 mm/s; 0,75 mm

Optional accessories

No.	Description	Pr
178-029	Granite stand (12AAA221 is needed for SJ-210/310)	71
12AAA221	Adapter for magnetic stand	4
178-230-2	Standard drive unit 17,5 mm	64
178-235	R-Type drive unit 17,5 mm	1,25
178-233-2	S-Type drive unit 5,6 mm	2,31



Linear movement of S-Type

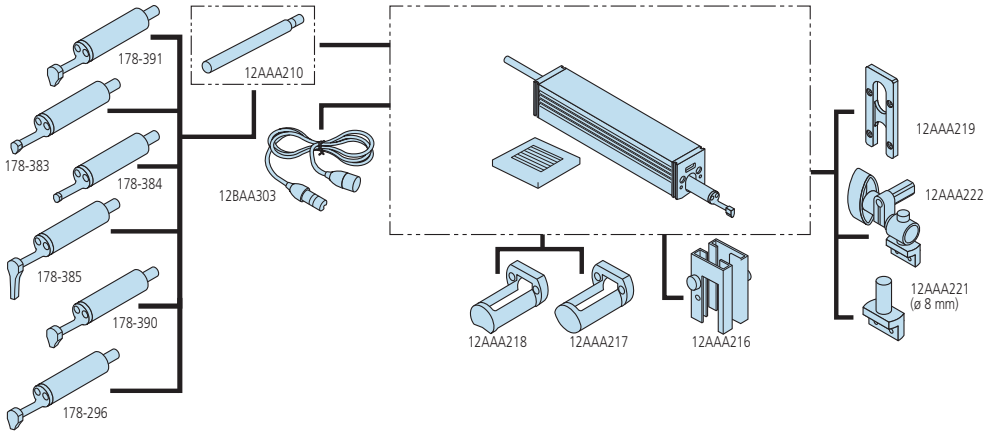
Accessories for SJ-210 and SJ-310

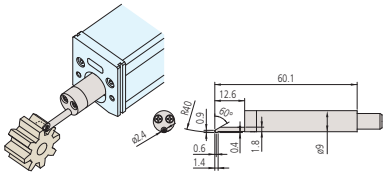
Series 178 - Standard and Optional Accessories for Surftest SJ-210 / SJ-310

Model			Surftest SJ-210		Surftest SJ-210R		Surftest SJ-210S		Surftest SJ-310		Surftest SJ-310R		Surftest SJ-310S	
No.	Price €	Description	Std	Opt	Std	Opt	Std	Opt	Std	Opt	Std	Opt	Std	Opt
12AAA210	214.00	Extension rod length 50 mm		●						●		●		●
12AAA216	129.00	Height adjustment feet		●		●		●	●		●		●	
12AAA217	87.00	Nosepiece (flat)		●					●		●			
12AAA218	87.00	Nosepiece (cylindrical)		●					●		●			
12AAA219	43.50	Adapter for vertical position		●		●		●		●		●		
12AAA221	43.50	Adapter for magnetic stand		●		●		●		●		●		●
12AAA222	87.50	Height gauge adapter		●		●		●		●		●		●
12AAD510	71.00	USB cable for SJ-310 / SJ-410								●		●		●
12AAE643	210.00	Point - contact adapter					●						●	
12AAE644	228.00	V-type adapter					●						●	
12AAJ088	212.00	Footswitch		●		●		●		●		●		●
12AAL066	20.50	Protective sheets for display		●		●		●						
12AAL067	78.50	RS-232C cable for printer		●		●		●						
12AAL068D	13.00	USB cable for SJ-210		●		●		●						
12AAL069	34.00	Memory card		●		●		●		●		●		●
12AAN040		Protective film								●		●		●
12AAN046	170.00	Battery							●		●		●	
12BAA303	72.50	Connecting cable for extension 1 m	●		●		●			●		●		●
12BAG834	3.00	Touch pen							●		●		●	
12BAK700	4.00	Calibration table	●		●		●		●		●		●	
12BAK728	60.00	AC adapter	●		●		●							
12BAL402		Touch Panel Protection							●		●		●	
357651	75.50	AC Adapter							●		●		●	
178-029	716.00	Granite stand		●		●		●		●		●		●
178-230-2	649.00	Standard Drive unit 17,5 mm	●			●		●	●			●		●
178-233-2	2,318.00	S-Type drive unit 5,6 mm		●		●	●			●		●	●	
178-235	1,257.00	R-Type drive unit 17,5 mm		●	●			●		●	●			●
178-296	577.00	Standard detector 2 µm; 0,75 mN	●		●			●	●		●			●
178-383	700.00	Detector for small holes Ø4,5 mm; 2 µm; 0,75 mN		●		●		●		●		●		●
178-384	700.00	Detector for small holes		●		●		●		●		●		●
178-385	700.00	Deep groove detector 2 µm; 0,75 mN		●		●				●		●		
178-386	556.00	Detector for S-drive 5 µm; 4 mN		●		●	●			●		●	●	
178-387	618.00	Detector for S-drive 2 µm; 0,75 mN		●		●	●			●		●	●	
178-388	1,185.00	Detector for gear tooth surface 2 µm; 0,75 mN		●		●				●		●		
178-390	464.00	Detector 5 µm; 4 mN		●		●				●		●		
178-391	464.00	Detector for soft materials 10 µm; 4 mN		●		●		●		●		●		●
178-392	618.00	Detector for small holes Ø4,5 mm; 5 µm; 4 mN		●		●		●		●		●		●
178-393	618.00	Detector for small holes Ø2,8 mm; 5 µm; 4 mN		●		●		●		●		●		●
178-394	618.00	Deep groove detector 5 µm; 4 mN		●		●				●		●		
178-398	1,112.00	Detector for gear tooth surface 5 µm; 4 mN; 90°		●		●		●		●		●		●
178-421DDS	597.00	Printerset for SJ-210		●		●		●						
178-601	294.00	Roughness specimen Ra 3 µm	●		●			●	●		●		●	
178-604	324.00	Roughness specimen Ra 0,5 µm /3 µm		●		●		●		●		●		●
178-605	778.00	Roughness specimen Ra 1 µm		●		●	●			●		●		●
270732	28.00	Printer papers (5 rolls)		●		●		●		●		●		●

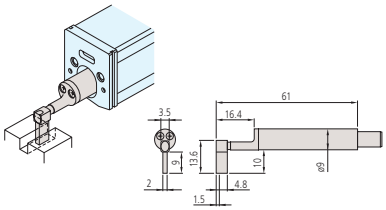
Accessories for SJ-210 and SJ-310

Series 178

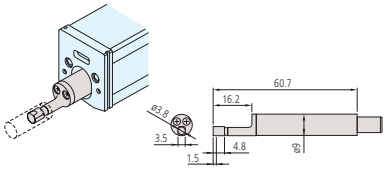




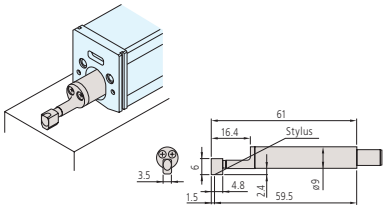
178-388/178-398



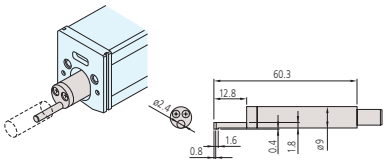
178-385/178-394



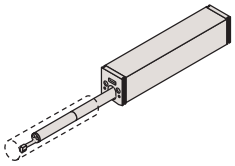
178-383/178-392



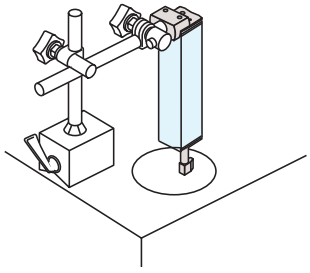
178-390/178-387
178-296/178-386



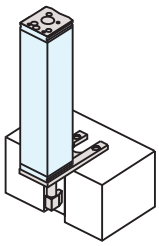
178-384/178-393



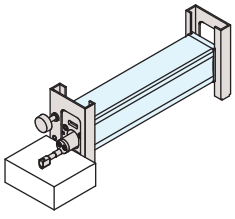
12AAA210



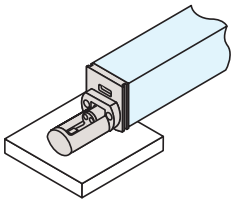
12AAA221



12AAA219



12AAA216



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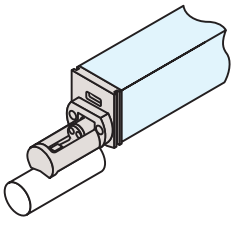
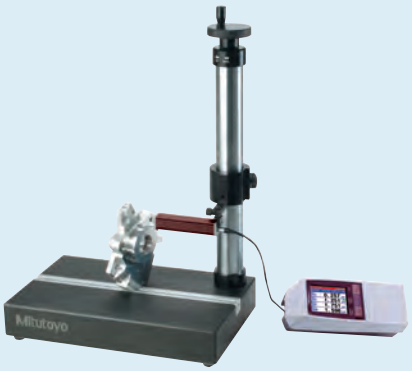


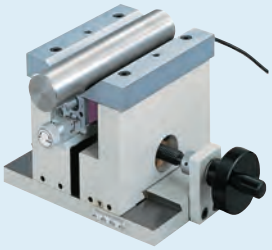
12AAA218

Optional accessories

No.	Description	Price €
178-033	Measuring device for cylindrical workpieces	2,750.00
178-034	Measuring device as universal fixture	2,112.00
178-035	Measuring device for measuring in pipes	2,472.00



178-029
(displayed with 12AAA221 + SJ-210)



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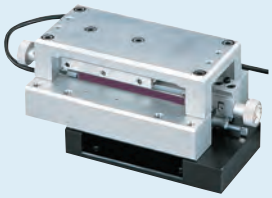


178-034

178-035

Surftest SJ-410

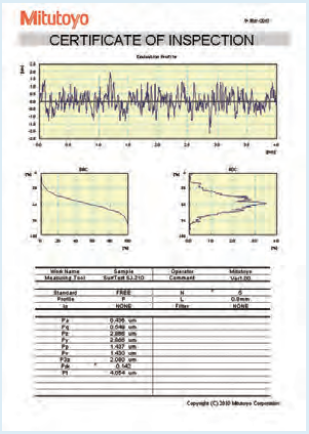
Series 178 - Portable Surface Roughness Measuring Instrument

This is a portable measuring instrument that allows you to easily and accurately measure surface roughness.
The Surftest SJ-410 offers you the following benefits:

- Skidless system with touch-screen functionality and built-in printer.
- It works independently of mains power, allowing you to make on-site measurements.
- Easy and intuitive menu navigation.
- The large **14.5cm** [5.7"] colour LCD gives you high visibility.
- The skidless detector allows you to measure the primary profile (P), roughness profile (R), waviness profile (W) and more.
- Surface compensation of curved, radial and tilted surfaces.
- It complies with many standards including EN ISO, VDA, ANSI, JIS as well as customised settings.
- You can store up to 10 different measuring conditions inside the SJ-410, and up to 500 with an optional SD card.
- It allows two different evaluation conditions within one measurement adjustable.
- You can separately password protect many functions.
- It comes with support for 16 languages.
- Available options include an auto-set unit, X-axis fine adjustment and digital levelling unit.

Specifications

Drive unit	
Traverse	SJ-411: 25 mm SJ-412: 50 mm
Measuring speed	0,05 mm/s; 0,1 mm/s; 0,2 mm/s; 0,5 mm/s; 1,0 mm/s
Detector	
Measuring method	Skidless - Differential inductance
Range	800 µm; 80 µm; 8 µm (up to 2,4 mm with an optional stylus)
Positioning	±1,5° (tilting), 10 mm (up/down)
Display unit	
Profiles	Primary Profile (P), Roughness Profile (R), Waviness (W), MOTIF (R, W) and more
Standards	EN ISO, VDA, JIS, ANSI and customize settings
Analysis graphs	BAC, ADC
Digital filter	Gauss, 2CR75, PC75
Cut-off length	λc : 0,08 mm; 0,25 mm; 0,8 mm; 2,5 mm; 8 mm λs : 2,5 µm; 8 µm; 25 µm
Printer	Thermal Printer
Tolerance	Colored upper / lower limit
Interface	USB, Digimatic, RS-232C, Foot switch
Power supply	AC adapter or rechargeable battery



Software
USB COMMUNICATION TOOL
as a free download on www.mitutoyo.eu
(refer to page
Optional Software USB Communication Tool)

Refer to Surftest SJ-410 brochure

SJ-410

Surftest SJ-411
Traverse : 25 mm
Traverse straightness : 0,3 µm / 25 mm

No.	Detector measuring force [mN]	Stylus Tip angle	Stylus Tip radius [µm]
178-580-01D	0,75	60°	2
178-580-02D	4	90°	5
178-581-01D	0,75	60°	2

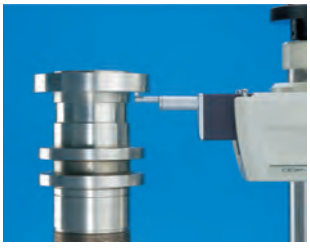
Surftest SJ-412
Traverse : 50 mm
Traverse straightness : 0,5 µm / 50 mm

No.	Detector measuring force [mN]	Stylus Tip angle	Stylus Tip radius [µm]
178-582-01D	0,75	60°	2
178-582-02D	4	90°	5

Surftest SJ-410

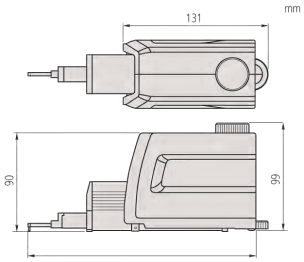
Series 178 - Portable Surface Roughness Measuring Instrument

Deep groove measurement



Upside down measurement

R-surface measurement



SJ-411: 207,5 mm / SJ-412: 234 mm
Drive unit

Optional:
- Autoset unit 178-010
- X-axis adjustment 178-020
- Tilting adjustment unit 178-030

Scope of delivery

178-039
(displayed with SJ-411)

Additional Specifications

Optional accessories	Other optional and standard accessories are listed later in different sections for accessories and styli.

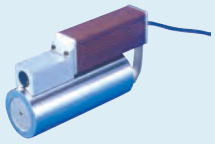
Optional accessories

No.	Description	Price €
178-396-2	Detector 0,75 mN	906.00
178-397-2	Detector 4 mN	906.00
178-047	Three-axis adjustment table	4,326.00
178-048	Leveling table D.A.T.	2,194.00
178-042-1	Digimatic XY leveling table 25 mm x 25 mm	3,142.00
178-043-1	XY leveling table 25 mm x 25 mm	2,493.00
178-605	Roughness specimen Ra = 1 µm	778.00
178-610	Step gauge (1, 2, 5, 10) µm	608.00
178-611	Reference step specimen (2, 10) µm	453.00
178-019	Precision vice	592.00
12AAB358	Cylinder attachment ø15 - 60 mm	232.00
936937	Digimatic cable (1 m)	43.50
965014	Digimatic cable (2 m)	57.50
02AZD790D	Connecting cable U-Wave	85.00
12AAD510	USB cable for SJ-310 / SJ-410	71.00
12AAL069	Memory card	34.00
12AAG202	Extension rod 50 mm	383.00
12AAG203	Extension rod 100 mm	441.00
Stands		
178-039	Granite stand	711.00

Consumable spares

No.	Description	Price €
12AAB355	Nosepiece	115.00
12BAG834	Touch pen	3.00
12BAL402	Touch Panel Protection	
12AAN046	Battery	170.00
270732	Printer paper (5 rolls)	28.00

178-048
Leveling table D.A.T.



12AAB358
Cylinder attachment

Surftest SJ-500

Series 178 - Surface Roughness Measuring Instrument

This is a portable measuring instrument that allows you to easily and accurately measure surface roughness.
The Surftest SJ-500 offers you the following benefits:

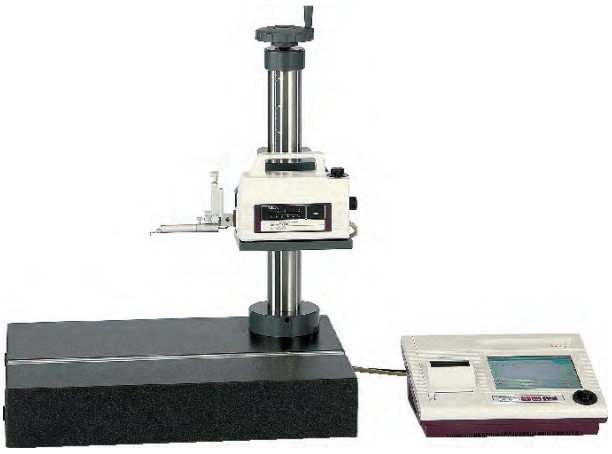
- The skidless detector allows you to measure the primary profile (P), roughness profile (R), waviness profile (W) and more.
- User friendly control unit for high precision surface roughness measurement.
- The large **19cm** [7.5"] colour TFT LCD with touch-screen functionality gives you high visibility and ease of use.
- The display menu is easy to read and simple to operate.
- It complies with many standards including EN ISO, VDA, ANSI, JIS as well as customised settings.
- The built-in joystick on the control unit enables quick and easy positioning. The manual adjustment knob allows you to finely position a small stylus to measure the inside surface of small holes.
- The detector unit allows a 90° displacement of the stylus, which is ideal for crankshaft and narrow space measurement.
- You can use the instrument stand-alone or mounted on a stand.

Specifications

Drive unit	
Traverse	50 mm
Measuring speed	0,02 - 5 mm/s
Drive speed	0 - 20 mm/s or joystick operation
Traverse straightness	0,2 µm / 50 mm
Detector	
Measuring method	Skidless - Differential inductance
Range	800 µm; 80 µm; 8 µm (up to 2,4 mm with an optional stylus)
Positioning	±1.5° (tilting) 30 mm (up/down)
Display unit	
Profiles	Primary Profile (P), Roughness Profile (R), Waviness (W), MOTIF (R, W) and more
Standards	EN ISO, VDA, JIS, ANSI and customize setting
Analysis graphs	BAC, ADC
Digital filter	Gauss, 2CR75, PC75, RobustSpline
Cut-off length	λc : 0,025 mm; 0,08 mm; 0,25 mm; 0,8 mm; 2,5 mm; 8 mm; 25 mm λs : 0,25 µm; 0,8 µm; 2,5 µm; 8 µm; 25 µm; 80µm; 250µm; None λf : 0,08mm; 0,25mm; 0,8mm; 2,5mm; 8mm; 25mm; None
Printer	Thermal printer

SJ-500

No.	Detector measuring force [mN]	Stylus Tip angle	Stylus Tip radius [µm]
178-532-01D	0,75	60°	2
178-532-02D	4	90°	5

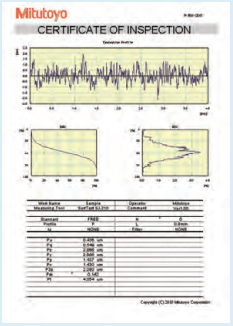


SJ-500 with optional manual column stand

Preview

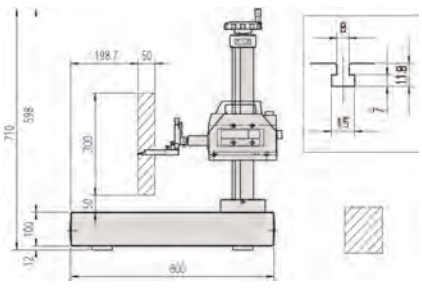
Optional accessories

No.	Description	Price €
178-396-2	Detector 0,75 mN	906.00
178-397-2	Detector 4 mN	906.00
178-085	Granite stand 600x450x710 mm	3,801.00
178-089	Granite stand 400x250x578 mm	1,679.00
178-047	Three-axis adjustment table	4,326.00
178-048	Leveling table D.A.T.	2,194.00
178-042-1	Digimatic XY leveling table 25 mm x 25 mm	3,142.00
178-043-1	XY leveling table 25 mm x 25 mm	2,493.00
12AAG202	Extension rod 50 mm	383.00
12AAG203	Extension rod 100 mm	441.00

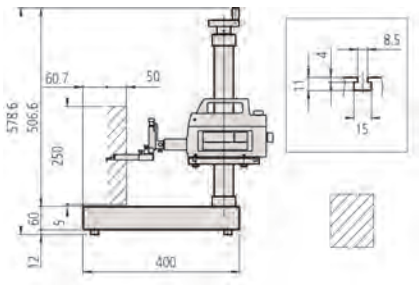


Software
USB COMMUNICATION TOOL
as a free download on www.mitutoyo.eu
(refer to page
Optional Software USB Communication Tool)

Refer to SURFACE MEASUREMENT brochure



178-085
600x450x710 mm



178-089
400x250x578 mm

Mitutoyo

Surftest SV-2100

Series 178 - Surface Roughness Measuring Instrument

This is a stationary measuring instrument that allows you to easily and accurately measure surface roughness.
The Surftest SV-2100 offers you the following benefits:

- It is mounted on a granite base with a manual or power column.
- The large **19cm** [7.5"] colour TFT LCD gives you high visibility and touch-screen functionality.
- It has a user friendly display unit for high precision surface roughness measurement.
- It complies with many standards including EN ISO, VDA, ANSI, JIS as well as customised settings.
- Designed for usage in workshop areas.

SV-2100S4

SV-2100M4

SV-2100H4 model
Vertical travel : 550 mm power column
Granite base size (WxD) : 600 x 450 mm

No.	Detector measuring force [mN]	Stylus Tip angle	Stylus Tip radius [µm]
178-682-01D	0,75	60°	2
178-682-02D	4	90°	5

SV-2100M4 model
Vertical travel : 350 mm manual column
Granite base size (WxD) : 600 x 450 mm

No.	Detector measuring force [mN]	Stylus Tip angle	Stylus Tip radius [µm]
178-636-01D	0,75	60°	2
178-636-02D	4	90°	5

SV-2100S4 model
Vertical travel : 350 mm power column
Granite base size (WxD) : 600 x 450 mm

No.	Detector measuring force [mN]	Stylus Tip angle	Stylus Tip radius [µm]
178-680-01D	0,75	60°	2
178-680-02D	4	90°	5

SV-2100W4 model
Vertical travel : 550 mm power column
Granite base size (WxD) : 1000 x 450 mm

No.	Detector measuring force [mN]	Stylus Tip angle	Stylus Tip radius [µm]
178-684-01D	0,75	60°	2
178-684-02D	4	90°	5

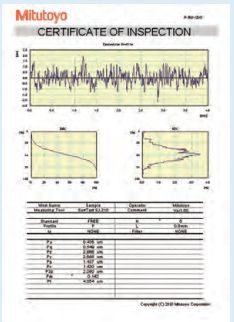
Specifications

Drive unit	
Traverse	100 mm
Measuring speed	0,02 - 5 mm/s
Drive speed	X = 0-40 mm/s Z2 = 0-20 mm/s or joystick operation
Traverse straightness	0,15 µm / 100 mm
Detector	
Measuring method	Skidless - Differential inductance
Range	800 µm; 80 µm; 8 µm (up to 2,4 mm with an optional stylus)
Display unit	
Profiles	Primary Profile (P), Roughness Profile (R), Waviness (W), MOTIF (P, R, W) and more
Standards	EN ISO, VDA, JIS, ANSI and customize settings
Analysis graphs	BAC, ADC
Digital filter	Gauss, 2CR75, PC75, RobustSpline
Cut-off length	λc : 0,025 mm; 0,08 mm; 0,25 mm; 0,8 mm; 2,5 mm; 8 mm; 25 mm; 80 mm λs : 0,25 µm; 0,8 µm; 2,5 µm; 8 µm; 25 µm; 80 µm; 250 µm; none λf : 0,08 mm; 0,25 mm; 0,8 mm; 2,5 mm; 8 mm; 25 mm; 80 mm; none
Printer	Thermal printer

Optional accessories

No.	Description	Price €
12AAG202	Extension rod 50 mm	383.00
12AAG203	Extension rod 100 mm	441.00
218-001	Cross-travel table XY range : 100x50 mm	2,470.00
218-003	Rotary vice (heavy-duty type)	1,400.00

Preview



Software
USB COMMUNICATION TOOL
as a free download on www.mitutoyo.eu
(refer to page
Optional Software USB Communication Tool)

Refer to SURFACE MEASUREMENT brochure

Surftest SJ-500P - SV-2100P

Series 178 - Surface Roughness Measuring Instruments with Software FORMTRACEPAK

These are surface roughness measuring instruments with software FORMTRACEPAK.
Software FORMTRACEPAK offers you the following benefits:

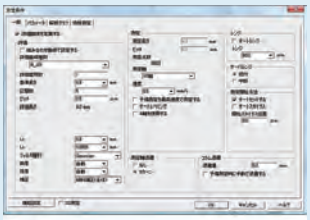
- It supports all standard conform analyses including EN ISO, VDA, ANSI, JIS as well as customised settings.
- It can be used for contour calculation within the measuring range.
- It offers total support for measurement system control, analysis and inspection report.
- All advantages of the SJ-500 and SV-2100 also apply to the P Type.

SJ-500P

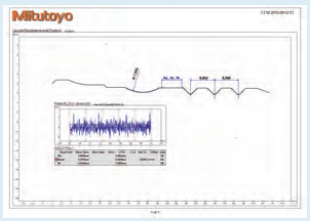
No.	Detector measuring force [mN]	Stylus Tip angle	Stylus Tip radius [µm]
178-530-01D	0,75	60°	2
178-530-02D	4	90°	5

Specifications

Drive unit	
Traverse	50 mm
Measuring speed	0,02 - 5 mm/s
Drive speed	0-20 mm/s
Traverse straightness	0,2 µm / 50 mm
Detector	
Measuring method	Skidless - Differential inductance
Range	800 µm; 80 µm; 8 µm (up to 2,4 mm with an optional stylus)
Positioning	±1,5° (tilting) 30 mm (up/down)
Software	**FORMTRACEPAK**



Measurement conditions



Formtracepak layout

Surftest SV-2100M4P

SV-2100P

No.	Detector measuring force [mN]	Stylus Tip angle	Stylus Tip radius [µm]
178-634-01D	0,75	60°	2
178-634-02D	4	90°	5

Specifications

Drive unit	
Traverse	100 mm
Measuring speed	0,02 - 5 mm/s
Drive speed	X = 0-40 mm/s Z2 = 0-20 mm/s
Traverse straightness	0,15 µm / 100 mm
Detector	
Measuring method	Skidless - Differential inductance
Range	800 µm; 80 µm; 8 µm (up to 2,4 mm with an optional stylus)
Software	**FORMTRACEPAK**

Refer to the SURFACE MEASUREMENT brochure

Surftest SV-3100

Series 178 - Surface Roughness Measuring Instrument

This is a stationary surface roughness measuring instrument with software FORMTRACEPAK that allows you to take highly accurate measurements.
The Surftest SV-3100 offers you the following benefits:

- It complies with many standards including EN ISO, VDA, ANSI, JIS as well as customised settings.
- It also supports contour calculation within the measuring range of the styli software.
- Part programing as well as motorised axes give you many features of a CNC instrument.
- The X-axis uses a superbly anti-abrasive ceramic drive unit guideway, so you don't need any lubrication.
- You can choose from a huge number of styli that are easy to replace.
- It has an easy-to-operate remote box with many functionalities.

SV-3100

X-axis measuring range : 100 mm
X-axis Traverse straightness : (0.05+1L/100) µm, L = Measurement length (mm)

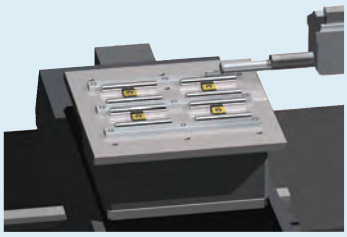
Model	SV-3100S4	SV-3100S4.	SV-3100H4	SV-3100H4.	SV-3100W4	SV-3100W4.
No.	**178-471D-1**	**178-471D-2**	**178-472D-1**	**178-472D-2**	**178-473D-1**	**178-473D-2**
Detector measuring force [mN]	0,75	4	0,75	4	0,75	4
Stylus Tip angle	60°	90°	60°	90°	60°	90°
Stylus Tip radius [µm]	2	5	2	5	2	5
Vertical travel [mm]	300	300	500	500	500	500
Granite base size (WxD) [mm]	600x450	600x450	600x450	600x450	1000x450	1000x450

X-axis measuring range : 200 mm
X-axis Traverse straightness : 0.5 µm/200 mm

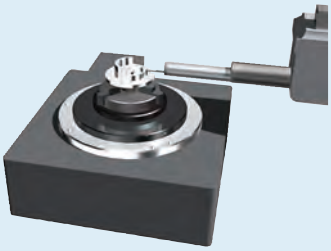
Model	SV-3100S8	SV-3100S8.	SV-3100H8	SV-3100H8.	SV-3100W8	SV-3100W8.
No.	**178-476D-1**	**178-476D-2**	**178-477D-1**	**178-477D-2**	**178-478D-1**	**178-478D-2**
Detector measuring force [mN]	0,75	4	0,75	4	0,75	4
Stylus Tip angle	60°	90°	60°	90°	60°	90°
Stylus Tip radius [µm]	2	5	2	58	2	5
Vertical travel [mm]	300	300	500	500	500	500
Granite base size (WxD) [mm]	600 x 450	600 x 450	600 x 450	600 x 450	1000 x 450	1000 x 450

Specifications

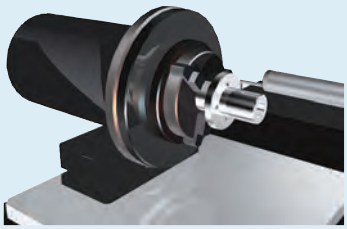
Traverse	100 mm / 200 mm
Range	800 µm; 80 µm; 8 µm (up to 2,4 mm with an optional stylus)
Drive speed	X = 0 - 80 mm/s Z2 = 0 - 20 mm/s
Measuring speed	0,02 - 5 mm/s
Inclining range	±45°
Profiles	Primary Profile (P), Roughness Profile (R), Waviness (W), MOTIF (P, R, W) and more
Standards	EN ISO, VDA, JIS, ANSI and customize setting
Software	**FORMTRACEPAK** Enables control of all axes and rotary table for realizing efficient measurement automation. You can also perform contour evaluation that allows free analysis of level differences, angles, pitch, area and other characteristics as well as surface roughness evaluation. In addition, you can create an original inspection certificate by setting the print format to suit your particular requirements.



Optional Y-axis - 178-097



Optional Rotary Table θ1 - 12AAD975



Optional Rotary Table θ2 - 178-078

Refer to SURFACE MEASUREMENT brochure

Surftest SV-3100

Series 178 - Surface Roughness Measuring Instrument

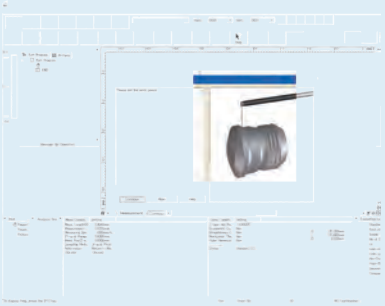
Dimensions and Optional accessories

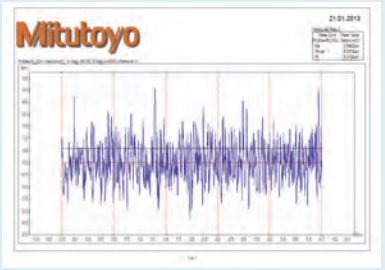
Additional Specifications

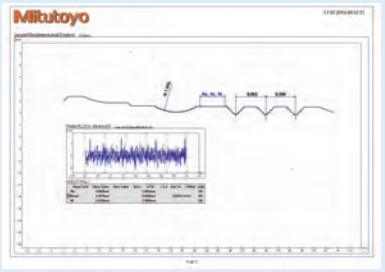
Optional accessories	Other optional and standard accessories are listed later in different sections for accessories and styli.

Optional accessories

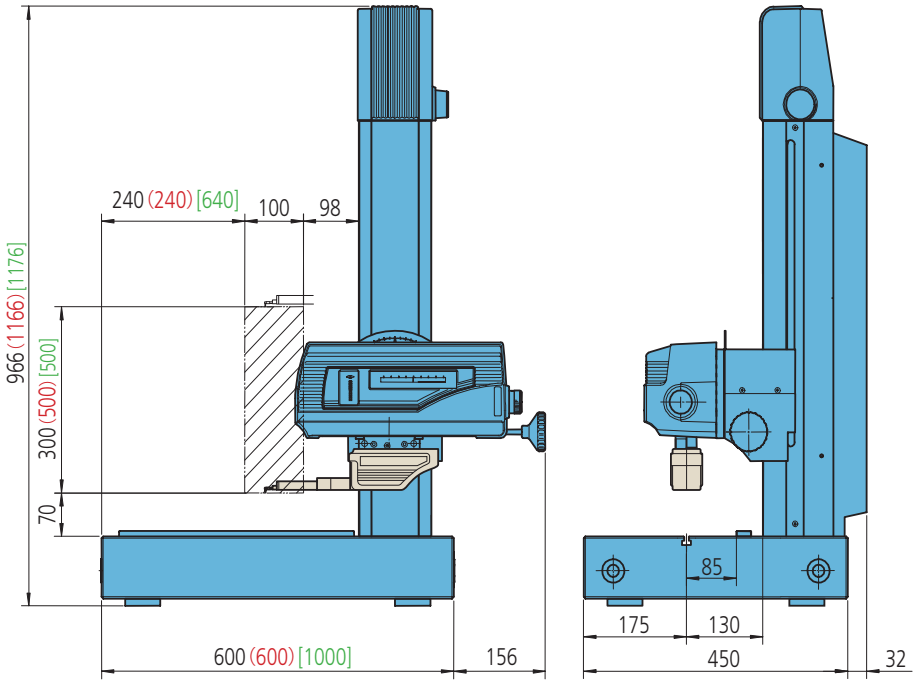
No.	Description	Price €
178-097	Y-axis table	
12AAD975	θ1-axis table	
178-078	θ2-axis table	
178-023	Manual vibration isolator	3,554.00
178-024	Stand for vibration isolator	
178-025	Dynamic vibration isolator	
218-001	Cross-travel table XY range : 100x50 mm	2,470.00
218-003	Rotary vice (heavy-duty type)	1,400.00
12AAG202	Extension rod 50 mm	383.00
12AAG203	Extension rod 100 mm	441.00
178-611	Reference step specimen (2, 10) µm	453.00
178-087	Automatic leveling table SV-, CV-series, CS-3200	





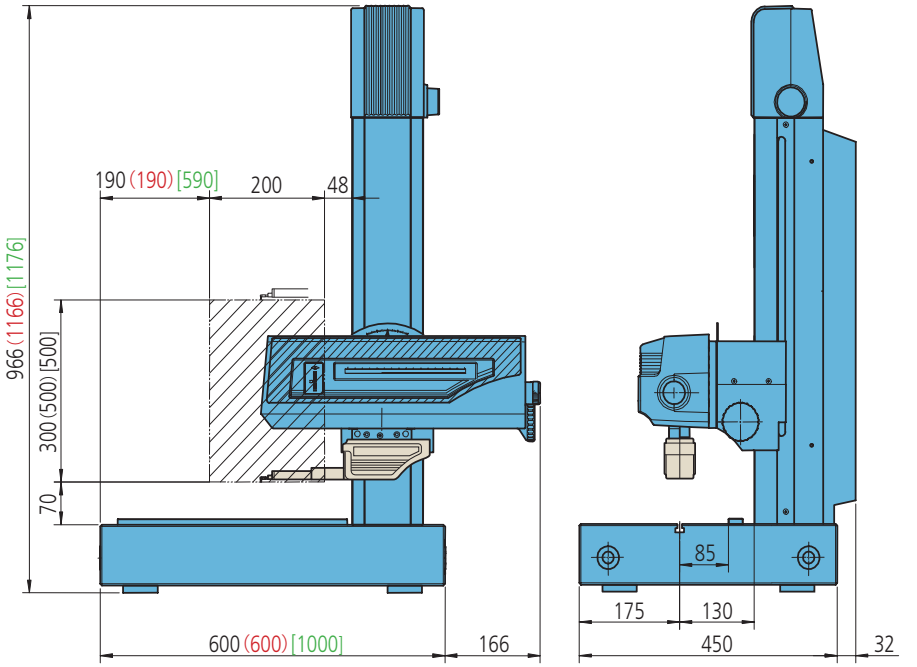


FORMTRACEPAK



( ) SV-3100H4
[ ] SV-3100W4

SV-3100S4 - SV-3100H4 - SV3100W4



( ) SV-3100H8
[ ] SV-3100W8

SV-3100S8 - SV-3100H8 - SV-3100W8

Mitutoyo

Surftest Extreme SV-3000CNC

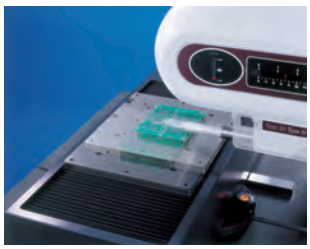
Series 178 – CNC Surface Roughness Measuring Instrument

These is a fully CNC surface roughness measuring instrument with powerful software FORMTRACEPAK.
The Surftest Extreme SV-3000CNC offers you the following benefits:

- It is perfectly made for increased throughput of multiple profile and workpiece measurement tasks.
- Each axis has a drive speed of up to 200 mm/s.
- You can take continuous measurement over horizontal and inclined surfaces by power-tilting the drive unit.
- Within the measuring range of the styli software FORMTRACEPAK supports contour calculation
- 3D topography measurement as option available
- Inclined plane measurement is possible through 2-axis simultaneous control in the X and Y directions.
- The detector unit incorporates an anti-collision safety device, causing it to automatically stop if its main body collides with a workpiece or jig.

SV-3000CNC

Model	SV-3000CNC-S	SV-3000CNC-H	SV-3000CNC-S.	SV-3000CNC-H.
No.	**178-522-2**	**178-542-2**	**178-524-2**	**178-544-2**
Z2-axis vertical travel [mm]	300	500	300	500
Y-axis table unit	-	-	Installed	Installed
α-axis unit	Installed	Installed	Installed	Installed
Measuring force	0,75 mN (**178-396-2**) 4 mN (**178-397-2**)	0,75 mN (**178-396-2**) 4 mN (**178-397-2**)	0,75 mN (**178-396-2**) 4 mN (**178-397-2**)	0,75 mN (**178-396-2**) 4 mN (**178-397-2**)



Automatic measurement

Specifications

Traverse	X = 200 mm Y = 200mm
Range	800 µm; 80 µm; 8 µm (up to 2,4 mm with an optional stylus)
Measuring speed	0,02 - 2 mm/s
Drive speed	CNC mode: max. 200 mm/s Joystick mode: 0 - 60 mm/s
Traverse straightness	0,5 µm / 200 mm
Inclining range	+45° (CCW) to -10° (CW)
Profiles	Primary Profile (P), Roughness Profile (R), Waviness (W), MOTIF (P, R, W) and more
Standards	EN ISO, VDA, JIS, ANSI and customize setting
Software	**FORMTRACEPAK-6000** Allows control of all axis, optional motor-driven Y-axis table and rotary table for efficient automated measurement. Surface roughness analysis and contour evaluation can be performed using analysis of level differences, angle, pitch, area and contour tolerancing as standard. An inspection certificate can be created by setting the print format as required.

Additional Specifications

Optional accessories	Other optional and standard accessories are listed later in different sections for accessories and styli.

Optional accessories

No.	Description
12AAD975	θ1-axis table
178-078	θ2-axis table
178-037	Automatic leveling table CNC
178-077	3D leveling table
12AAE032	Vibration isolator stand
12AAE449	Cabin for H-type

Refer to SURFACE MEASUREMENT brochure

Surftest Extreme SV-M3000CNC

Series 178 - CNC Surface Roughness Measuring Instrument

This is a top performance CNC surface roughness measuring instrument with powerful software FORMTRACEPAK.
The Surftest Extreme SV-M3000CNC offers you the following benefits:

- You can measure large and heavy workpieces such as engine blocks and crankshafts.
- It has an 800mm moving column configuration to largely eliminate workpiece size restrictions.
- Each axis has a drive speed of up to 200 mm/s.
- When combined with the optional detector swivelling unit, continuous measurement over the bottom, top and side surface of a workpiece is possible.
- The huge load table has a self-contained structure ensuring that you can easily accommodate various size workpieces, standard and custom jigs, and auto-feed devices.

Specifications

Traverse	X = 200 mm Y = 800 mm Z2 = 500 mm
Range	800 µm; 80 µm; 8 µm (up to 2,4 mm with an optional stylus)
Measuring speed	0,02 - 2 mm/s
Drive speed	CNC mode: max. 200 mm/s Joystick mode: 0 - 50 mm/s
Traverse straightness	X = 0,5 µm / 200 mm (standard) X = 0,7 µm / 200 mm (long-type detector) X = 0,5 µm / 200 mm (rotary-type detector) Y = 0,5 µm / 50 mm; 2 µm / 800 mm (standard) Y = 0,7 µm / 50 mm; 3 µm / 800 mm (long-type detector) Y = 0,7 µm / 50 mm; 3 µm / 800 mm (rotary-type detector)
Inclining range	-45° (CCW) to +10° (CW)
Profiles	Primary Profile (P), Roughness Profile (R), Waviness (W), MOTIF (P, R, W) and more
Standards	EN ISO, VDA, JIS, ANSI and customize setting
Loading weight	300 kg
Software	**FORMTRACEPAK** Enables control of all axes for realizing efficient measurement automation. You can also perform contour evaluation that allows free analysis of level differences, angles, pitch, area and other characteristics as well as surface roughness evaluation. In addition, you can create an original inspection certificate by setting the print format to suit your particular requirements.

Additional Specifications

Optional accessories	Other optional and standard accessories are listed later in different sections for accessories and styli.

Refer to SURFACE MEASUREMENT brochure

No.	Detector hold type (Essential option)	Model
178-549-2	Standard	178-071
	Long type	178-072
	Rotary type	178-073

Typical measurement task

Mitutoyo

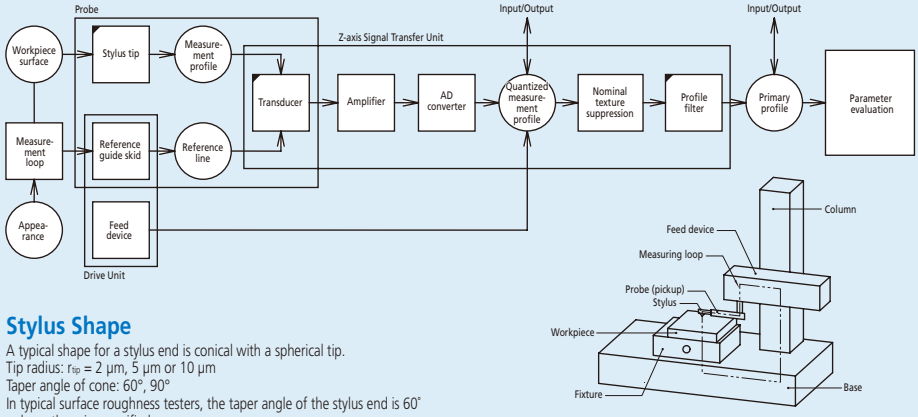
Quick Guide to Precision Measuring Instruments

Surftest (Surface Roughness Testers)

- ISO 1302: 2002 Notation method of surface texture
- ISO 4287: 1997 Geometrical Product Specifications (GPS) –Surface Texture: Profile method– Terms, definitions, and surface texture parameters
- ISO 4288: 1996 Geometrical Product Specifications (GPS) –Surface Texture: Profile method– Rules and procedures for the assessment of surface texture
- ISO 3274: 1996 Geometrical Product Specifications (GPS) –Surface Texture: Profile method– Nominal characteristics of contact (stylus) instruments

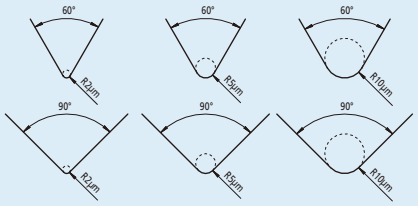
Nominal Characteristics of Contact (Stylus) Instruments

ISO 3274: 1996



Stylus Shape

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



Static Measuring Force

Nominal radius of curvature of stylus tip: µm	Static measuring force at the mean position of stylus: mN	Tolerance on static measuring force variations: mN/µm
2	0.75	0.035
5	0.75 (4.0) Note 1	0.2
10		

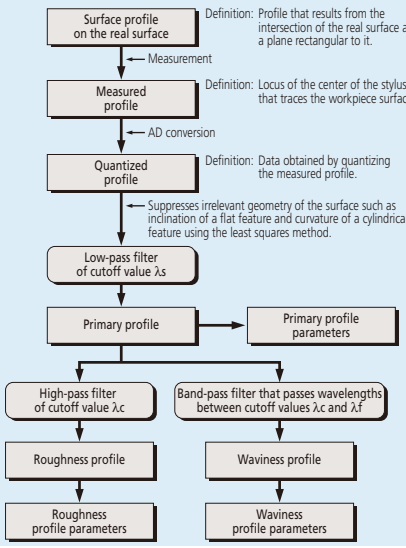
Note 1: The maximum value of static measuring force at the average position of a stylus is to be 4.0mN for a special structured probe including a replaceable stylus.

Metrological Characterization of Phase Correct Filters

ISO 11562: 1996

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

Data Processing Flow



Relationship between Cutoff Value and Stylus Tip Radius

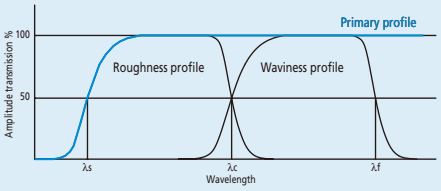
The following table lists the relationship between the roughness profile cutoff value λc, stylus tip radius r_{tip}, and cutoff ratio λc/λs.

λc mm	λs µm	λc/λs	Maximum r_{tip} µm	Measuring point distance µm
0.08	2.5	30	2	0.5
0.25	2.5	100	2	0.5
0.8	2.5	300	2 Note 1	0.5
2.5	8	300	5 Note 2	1.5
8	25	300	10 Note 2	5

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

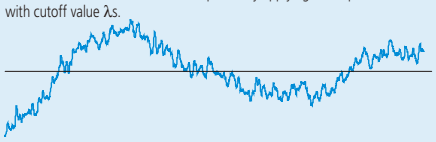
Surface Profiles

ISO 4287: 1997



Primary Profile

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

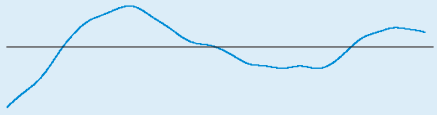


Roughness Profile

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

Waviness Profile

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



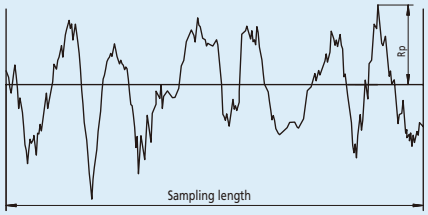
Definition of Parameters

ISO 4287 : 1997

Amplitude Parameters (peak and valley)

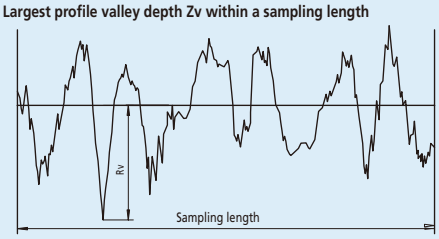
Maximum peak height of the primary profile Pp
Maximum peak height of the roughness profile Rp
Maximum peak height of the waviness profile Wp

Largest profile peak height Zp within a sampling length



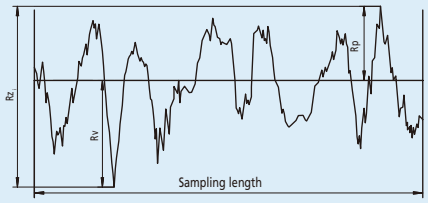
Maximum valley depth of the primary profile Pv
Maximum valley depth of the roughness profile Rv
Maximum valley depth of the waviness profile Wv

Largest profile valley depth Zv within a sampling length



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

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

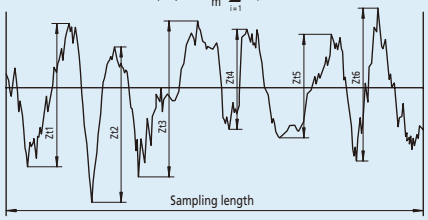


In Old JIS and ISO 4287-1: 1984, Rz was used to indicate the "ten point height of irregularities". Care must be taken because differences between results obtained according to the existing and old standards are not always negligibly small. (Be sure to check whether the drawing instructions conform to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

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

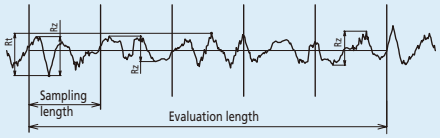
Mean value of the profile element heights Zt within a sampling length

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



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

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



Amplitude Parameters (average of ordinates)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

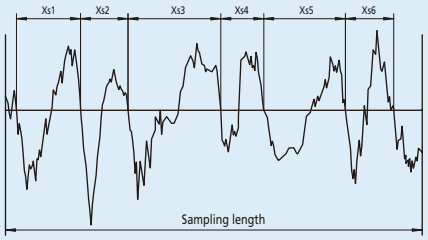
The above equation defines Rku. Pku and Wku are defined in a similar manner. Pku, Rku, and Wku are measures of the sharpness of the probability density function of the ordinate values.

Spacing Parameters

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

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

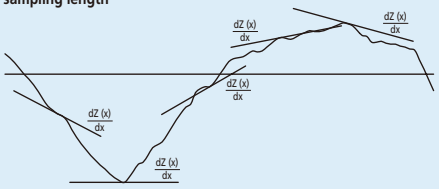
$$PSm, RSm, WSm = \frac{1}{m}\sum_{i=1}^{m} X_{si}$$



Hybrid Parameters

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

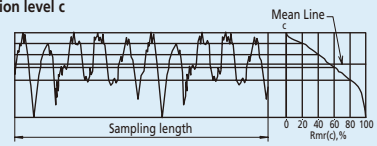
Root mean square value of the ordinate slopes dZ/dX within a sampling length



Curves, Probability Density Function, and Related Parameters

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

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



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

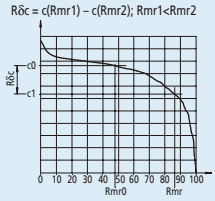
Ratio of the material length of the profile elements Ml(c) at a given level c to the evaluation length

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

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

Vertical distance between two section levels of a given material ratio

Rδc = c(Rmr1) – c(Rmr2); Rmr1<Rmr2



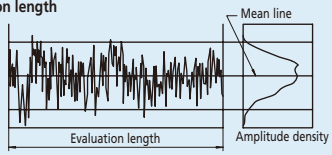
Relative material ratio of the primary profile Pmr
Relative material ratio of the roughness profile Rmr
Relative material ratio of the waviness profile Wmr

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

Pmr, Rmr, Wmr = Pmr(c1), Rmr(c1), Wmr(c1)
where c1 = c0 – Rδc(Rδc, Wδc)
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

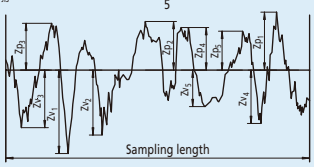


JIS Specific Parameters

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 λc and λs.

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



Symbol	Used profile
RzJIS82	Surface profile as measured
RzJIS94	Roughness profile derived from the primary profile using a phase-correct high-pass filter

Arithmetic mean deviation of the profile Ra_{75}

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

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

Sampling Length for Surface Roughness Parameters

ISO 4288: 1996

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

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

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

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

1) Rz is used for measurement of Rz, Rv, Rp, Rc, and Rt.
2) Rzlmax only used for measurement of Rzlmax, Rvlmax, Rplmax, and Rclmax.

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

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

Procedure for determining a sampling length if it is not specified

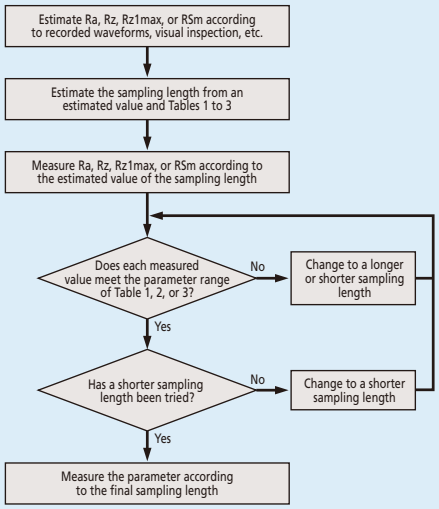


Fig.1 Procedure for determining the sampling length of an aperiodic profile if it is not specified.

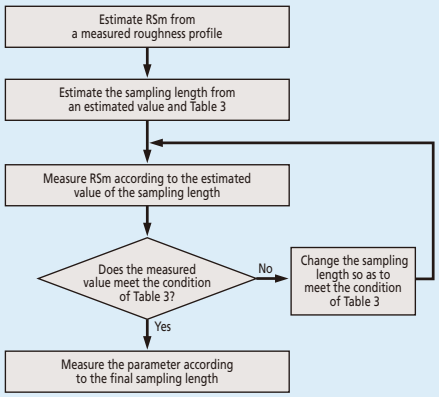


Fig.2 Procedure for determining the sampling length of a periodic profile if it is not specified.

Mitutoyo

Contracer CV-1000 and CV-2000

Series 218 - Contour Measuring Instruments

These are contour measuring instruments with mobile or stationary measurement.
The Contracer CV-1000 and CV-2000 offer you the following benefits:

- Manual positioning meets fully automatic measurement routines.
- You can easily perform part programming as well as single measurement with software FORMTRACEPAK.
- Automatic evaluation, best fit of contours, CAD comparison and many more features come as standard.
- You can optionally mount the CV-1000 on a granite base with a manual column.
- You can optionally mount the CV-2000 mounted on a granite base with a manual or power column.

CV-1000 N2

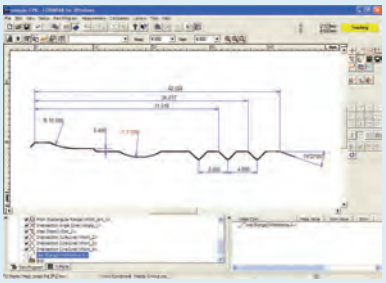
CV-1000N2 mounted on optional granite column 218-024

CV-2000M4
Stationary contour measuring system with manual column.

CV-2000S4
Stationary contour measuring system with motorized column.

Specifications

Measuring range	**CV-1000 :** Z1 = 25 mm **CV-1000 :** X = 50 mm **CV-2000 :** Z1 = 40mm **CV-2000 :** X = 100mm
Measuring speed	0,2 mm/s; 0,5 mm/s
Accuracy	X = (3,5+2L/100) µm [L : drive length (mm)] Z1 = (3,5+I4HI/ 25) µm [H : Measurement height from the horizontal position (mm)]
Traverse straightness	**CV-1000 :** 3,5 µm / 50 mm **CV-2000 :** 3,5 µm / 100 mm
Column type	**CV-2000:** Power drive = 250 mm (S4) Manual = 320 mm (M4)
Software	**FORMTRACEPAK** Allows control of measuring conditions for efficient automated measurement. Contour evaluation can be performed using analysis of level differences, angle, pitch, area and contour tolerancing as standard. An inspection certificate can be created by setting the print format as required.



FORMTRACEPAK

Refer to CONTOUR MEASUREMENT brochure

Contracer CV-1000 and CV-2000

Series 218 - Contour Measuring Instruments

Specifications and accessories

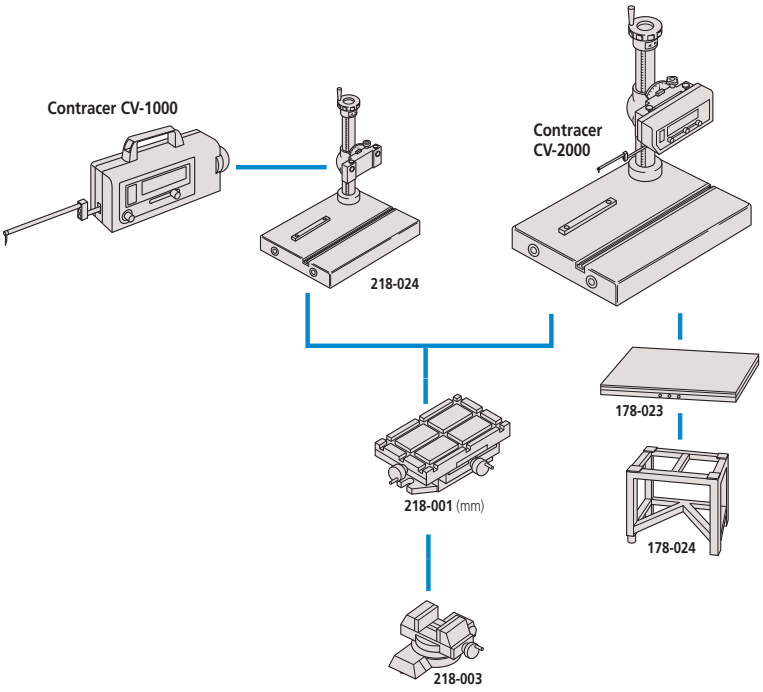
Additional Specifications

Other optional accessories	Other optional and standard accessories are listed later in different sections for accessories and styli.

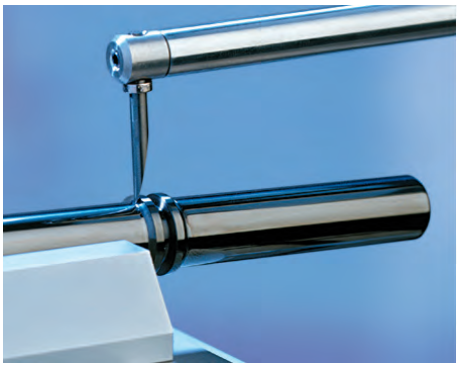
Optional accessories

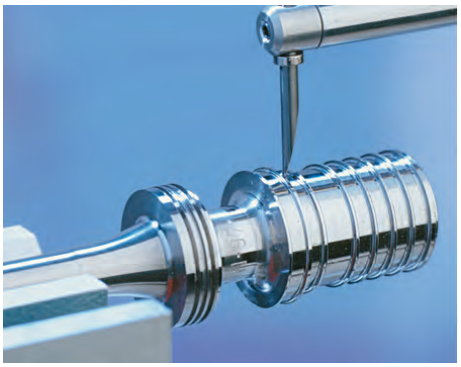
No.	Description	Price €
218-001	Cross-travel table XY range : 100x50 mm	2,470.00
218-003	Rotary vice (heavy-duty type)	1,400.00
178-023	Manual vibration isolator	3,554.00
178-024	Stand for vibration isolator	
218-024	Column stand for CV-1000 (vertical travel 320mm, inclination ±45°)	3,810.00

Model	CV-1000N2	CV-2000M4	CV-2000S4
No.	**218-611D**	**218-631D**	**218-632D**
Z2-axis vertical travel [mm]	-	320	250
Z1-axis measuring range [mm]	25	40	40
Z2-axis column type	Optional: Manual	Manual	Power
X1-axis measuring range [mm]	50	100	100



Accessories





Application examples

Mitutoyo

Contracer CV-3200 and CV-4500

Series 218 - Contour Measuring Instruments

These are high accuracy semi-automatic contour measuring instruments equipped with powerful software FORMTRACEPAK.

The Contracer CV-3200 offers you the following benefits:

- Huge measuring range of Z=60 mm comes as standard.
- Easy exchange of magnetic stylus arm gives you excellent flexibility.
- The CV-3200 provides excellent accuracy and resolution in Z1-axis measurement.
- Its high positioning speed reduces the total measurement time.
- It has a fully automatic calibration routine.

The Contracer CV-4500 offers you the following benefits:

- It has a dual stylus system for upward/downward measurement at double sided contours.
- Variable measuring force is controlled by software FORMTRACEPAK.
- Easy exchange of magnetic stylus arm gives you excellent flexibility.
- The CV-4500 provides the highest accuracy and resolution possible.
- The motorised axes have a high positioning speed.
- The dual stylus system has a fully automatic calibration routine.

Contracer CV-3200
(CV-4500 equipped with dual stylus system)

Drive unit CV-3200

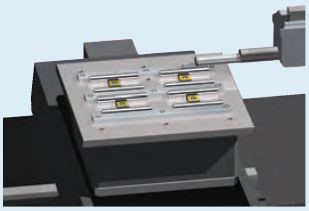
Drive unit CV-4500

Specifications

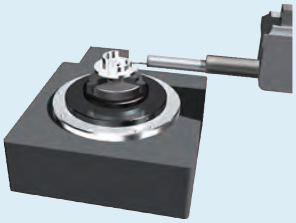
Traverse	Z2 = 300 mm / 500 mm
Measuring range	Z1 = 60 mm X = 100 mm / 200 mm
Measuring speed	0,02 - 5 mm/s
Drive speed	X = 0 - 80 mm/s Z2 = 0 - 30 mm/s
Accuracy	X = (0,8+0,01L) µm (S4, H4, W4 model) X = (0,8+0,02L) µm (S8, H8, W8 model) [L : Drive length (mm)] **CV-3200 :** Z1 = (1,6+I2HI/100) µm **CV-4500 :** Z1 = (0,8+I2HI/100) µm [H : Measurement height from the horizontal position (mm)]
Inclining range	±45°
Software	**FORMTRACEPAK**

Additional Specifications

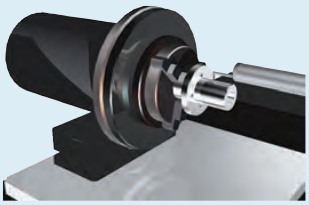
Optional accessories	Other optional and standard accessories are listed later in different sections for accessories and styli.



Optional Y-axis - 178-097



Optional Rotary Table θ1 - 12AAD975



Optional Rotary Table θ2 - 178-078

Refer to Contracer CV-3200 / CV-4500 brochure

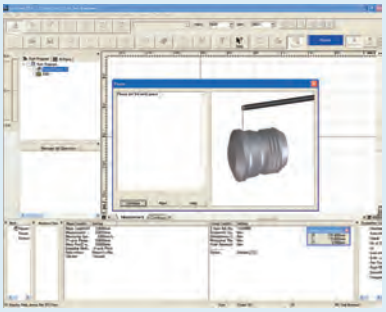
Contracer CV-3200 and CV-4500

Series 218 - Contour Measuring Instruments

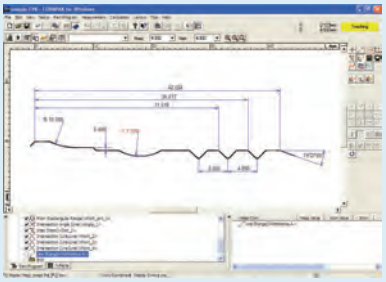
Specifications

Software

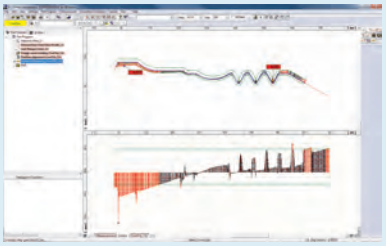
FORMTRACEPAK
Allows control of all axis, optional motor-driven Y-axis table and rotary table for efficient automated measurement.
Contour evaluation can be performed using analysis of level differences, angle, pitch, area and contour tolerancing as standard.
An inspection certificate can be created by setting the print format as required.



Measurement control screen



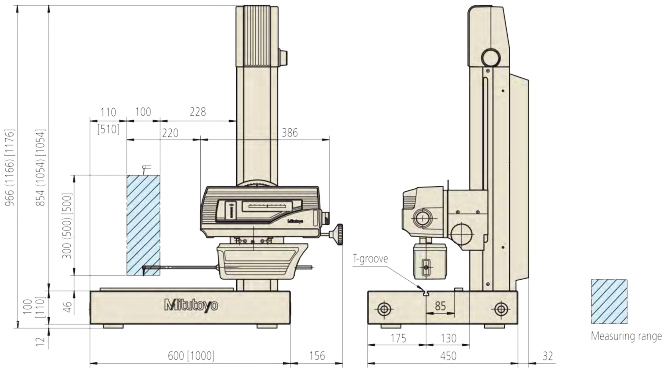
Contour analysis screen



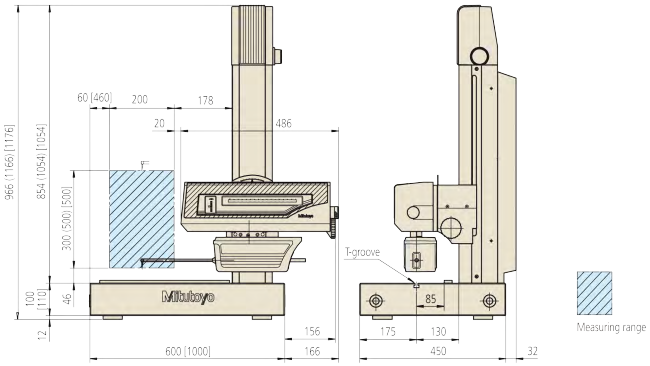
Contour comparison

FORMTRACEPAK

Dimensions and specifications



S4, (H4), [W4] - mm



S8, (H8), [W8] - mm

CV-3200

Model	CV-3200S4	CV-3200H4	CV-3200W4	CV-3200S8	CV-3200H8	CV-3200W8
No.	**218-481D**	**218-482D**	**218-483D**	**218-486D**	**218-487D**	**218-488D**
Dimensions main unit (WxDxH) [mm]	756x482x966	756x482x1166	1156x482x1176	766x482x966	768x482x1166	1166x482x1176
X1-axis measuring range [mm]	100	100	100	200	200	200
Vertical travel [mm]	300	500	500	300	500	500
Granite base size (WxD) [mm]	600x450	600x450	1000x450	600x450	600x450	1000x450

CV-4500

Model	CV-4500S4	CV-4500H4	CV-4500W4	CV-4500S8	CV-4500H8	CV-4500W8
No.	**218-441D**	**218-442D**	**218-443D**	**218-446D**	**218-447D**	**218-448D**
Dimensions main unit (WxDxH) [mm]	756x482x966	756x482x1166	1156x482x1176	766x482x966	768x482x1166	1166x482x1176
X1-axis measuring range [mm]	100	100	100	200	200	200
Vertical travel [mm]	300	500	500	300	500	500
Granite base size (WxD) [mm]	600x450	600x450	1000x450	600x450	600x450	1000x450

Mitutoyo

Contracer Extreme CV-3000CNC and CV-4000CNC

Series 218 - CNC Contour Measuring Instruments

- Fully CNC contour measuring instrument with powerful software FORMTRACEPAK.
- Perfectly made for increased throughput of multiple-profiles / -workpieces measurement tasks.
- Drive speed for each axis up to 200 mm/s.
- Continuous measurement over horizontal and inclined surfaces by power-tilting the drive unit.
- The drive unit of the CV-4000CNC series is equipped with a Laser Hologage detector giving excellent accuracy and resolution in the Z1-axis.
- Inclined plane measurement through 2-axis simultaneous control in the X and Y directions.
- The detector unit incorporates an anti-collision safety device, causing the detector unit to automatically stop if its main body collides with a workpiece or jig.

CV-3000CNC

Specifications

Measuring range	Z1 = 50 mm X = 200 mm Y = 200 mm Z2 = 300 mm / 500 mm
Measuring speed	0,02 - 2 mm/s
Drive speed	CNC mode: max .200 mm/s Joystick mode: 0 - 60 mm/s
Accuracy	**CV-3000CNC :** X = (1+0,02L) µm Y = 200 mm Z1 = (2+I4HI/100) µm **CV-4000CNC :** X = (0,8+0,02L) µm Z1 = (0,8+I0,5HI/25) µm [L : Drive length (mm)] [H : Measurement height from the horizontal position (mm)]
Inclining range	+45° (CCW) to -10° (CW)
Software	**FORMTRACEPAK**

Series 218 - CNC Contour Measuring Instrument

CV-3000CNC

Model	CV-3000CNC-S	CV-3000CNC-S.	CV-3000CNC-H	CV-3000CNC-H.
No.	**218-522-2**	**218-524-2**	**218-542-2**	**218-544-2**
Dimensions main unit (WxDxH) [mm]	800x620x1000	800x620x1000	800x620x1200	800x620x1200
Z2-axis vertical travel [mm]	300	300	500	500
Y-axis table unit	-	Installed	-	Installed
α-axis unit	Installed	Installed	Installed	Installed

CV-4000CNC

Model	CV-4000CNC-S	CV-4000CNC-S.
No.	**218-562-2**	**218-564-2**
Dimensions main unit (WxDxH) [mm]	800x620x1000	800x620x1000
Z2-axis vertical travel [mm]	300	300
Y-axis table unit	-	Installed
α-axis unit	Installed	Installed

CV-4000CNC Extreme

Model	CV-4000CNC-H	CV-4000CNC-H.
No.	**218-582-2**	**218-584-2**
Dimensions main unit (WxDxH) [mm]	800x620x1200	800x620x1200
Z2-axis vertical travel [mm]	500	500
Y-axis table unit	-	Installed
α-axis unit	Installed	Installed

Specifications

Optional Accessories	Vibration isolation stand
Mechanism	Diaphragm air spring
Natural frequency Hz (dann range)	2,5 - 3,5
Leveling	Automatic control with mechanical valves
Max. loading capacity	350 kg
Air pressure	390 kPa
Mass	280kg
Dimensions (WxDxH)	1000 x 895 x 715 mm

Additional Specifications

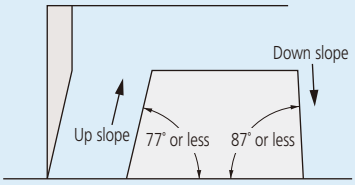
Optional accessories	Other optional and standard accessories are listed later in different sections for accessories and styli.

Refer to CONTOUR MEASUREMENT brochure

Quick Guide to Precision Measuring Instruments

Contracer (Contour Measuring Instruments)

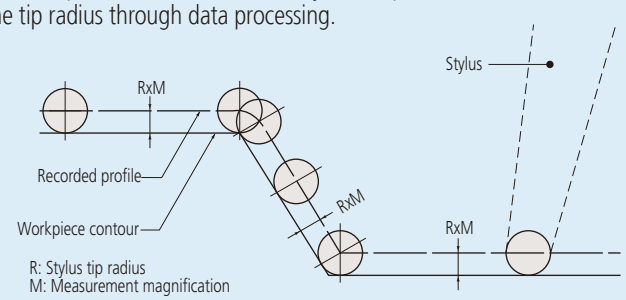
Traceable Angle



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

Compensating for Stylus Tip Radius

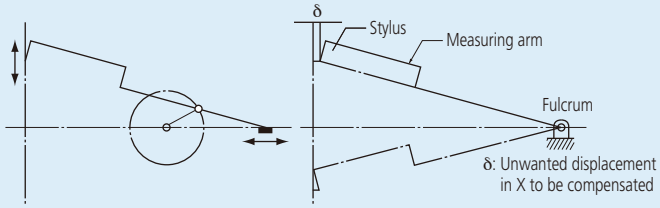
A recorded profile represents the locus of the center of the ball tip rolling on a workpiece surface. (A typical radius is 0.025mm.) Obviously this is not the same as the true surface profile so, in order to obtain an accurate profile record, it is necessary to compensate for the effect of the tip radius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



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.

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.

Mitutoyo

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

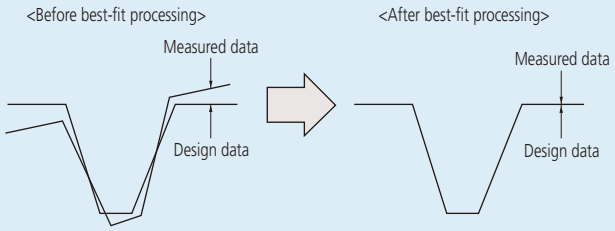
The measured contour is input into the data processing section in real time and a dedicated program performs the analysis using the mouse and/or keyboard. The angle, radius, step, pitch and other data are directly displayed as numerical values. Analysis combining coordinate systems can be easily performed.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

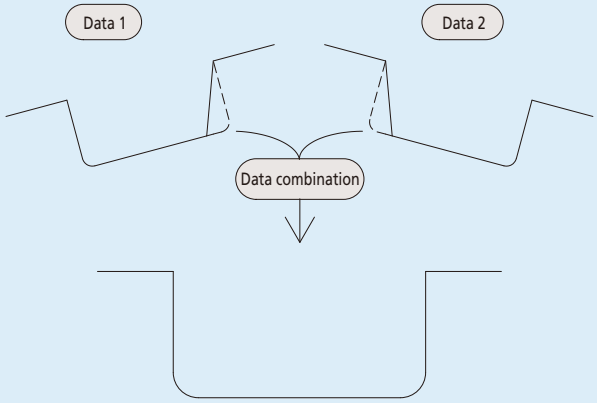
If there is a standard for surface profile data, tolerancing with design data is performed according to the standard. If there is no standard, or if tolerancing only with shape is desired, best-fitting between design data and measurement data can be performed.



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.

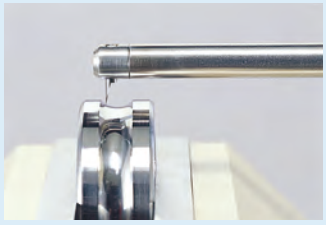
Data Combination

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

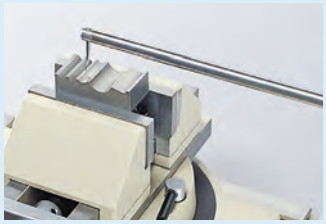

Dual stylus for upward and downward measurement


Inner/outer ring contour of a bearing


Internal gear teeth


Female thread form


Male thread form


Gage contour

Formtracer SV-C3200 and SV-C4500

Series 525 - Surface and Contour Measuring System

These are high accuracy semi-automatic contour and roughness measuring instruments equipped with powerful software FORMTRACEPAK.

The Formtracer SV-C3200 offers you the following benefits:

- It is as powerful as two separate, specialised instruments.
- It economically combines roughness & contour measurement into a single device.
- You have access to a huge contour measuring range of Z=60mm as standard, and a roughness measurement range of 800µm as standard.
- Easy exchange of the magnetic contour stylus arm gives you excellent flexibility.
- The SV-C3200 provides you with excellent accuracy and resolution in Z1-axis measurement.

The Formtracer SV-C4500 offers you the following benefits:

- It economically combines roughness & dual stylus upward/downward contour measurement into a single device.
- You have access to a huge contour measuring range of Z=60mm as standard, and a roughness measurement range of 800µm as standard.
- Its variable measuring force is controlled by software FORMTRACEPAK.
- Easy exchange of the magnetic contour stylus arm gives you excellent flexibility.
- The SV-C4500 provides you with high accuracy and resolution.

Specifications

Traverse	Z2 = 300 mm / 500 mm
Measuring range	X = 100 mm / 200 mm **Contour:** Z1 = 60 mm **Roughness:** Z1 = 800 µm; 80 µm; 8 µm (up to 2,4 mm with an optional stylus)
Measuring speed	0,02 - 5 mm/s
Drive speed	X = 0 - 80 mm/s Z2 = 0 - 30 mm/s
Accuracy	X = (0,8+0,01L) µm (S4, H4, W4 model) X = (0,8+0,02L) µm (S8, H8, W8 model) [L : Drive length (mm)] **SV-C3200 :** Z1 = (1,6+I2HI/100) µm **SV-C4500 :** Z1 = (0,8+I2HI/100) µm [H : Measurement height from the horizontal position (mm)]
Inclining range	±45°
Software	**FORMTRACEPAK**

Additional Specifications

Optional accessories	Other optional and standard accessories are listed later in different sections for accessories and styli.

Refer to Formtracer SV-C3200 / 4500 brochure

Formtracer SV-C3200

Surface Roughness drive unit

[Surface Roughness Measurement : Compliant with EN ISO, VDA, JIS, ANSI and other international surface roughness standards.]

Contour drive unit SV-C3200

Contour drive unit SV-C4500

Formtracer SV-C3200 and SV-C4500

Series 525 - Surface and Contour Measuring System

Metric

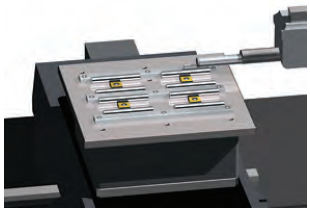
SV-C3200

No.	Model	Detector 0,75 mN	Detector 4 mN	Z2-axis 300 mm	Z2-axis 500 mm	X-axis 100 mm	X-axis 200 mm
525-481D-1	SV-C3200S4	●		●		●	
525-481D-2	"		●	●		●	
525-482D-1	SV-C3200H4	●			●	●	
525-482D-2	"		●		●	●	
525-483D-1	SV-C3200W4	●			●	●	
525-483D-2	"		●		●	●	
525-486D-1	SV-C3200S8	●		●			●
525-486D-2	"		●	●			●
525-487D-1	SV-C3200H8	●			●		●
525-487D-2	"		●		●		●
525-488D-1	SV-C3200W8	●			●		●
525-488D-2	"		●		●		●

Metric

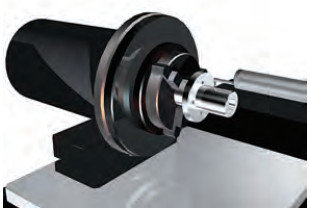
SV-C4500

No.	Model	Detector 0,75 mN	Detector 4 mN	Z2-axis 300 mm	Z2-axis 500 mm	X-axis 100 mm	X-axis 200 mm
525-441D-1	SV-C4500S4	●		●		●	
525-441D-2	"		●	●		●	
525-442D-1	SV-C4500H4	●			●	●	
525-442D-2	"		●		●	●	
525-443D-1	SV-C4500W4	●			●	●	
525-443D-2	"		●		●	●	
525-446D-1	SV-C4500S8	●		●			●
525-446D-2	"		●	●			●
525-447D-1	SV-C4500H8	●			●		●
525-447D-2	"		●		●		●
525-448D-1	SV-C4500W8	●			●		●
525-448D-2	"		●		●		●



Using Y-axis table

Using rotary table θ1

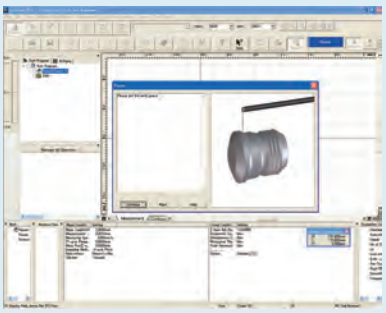


Using rotary Table θ2

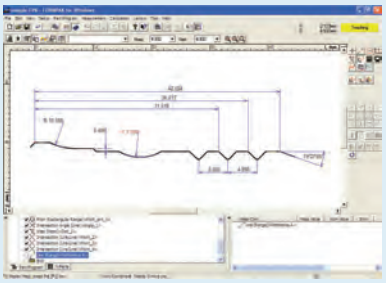
Specifications

Software

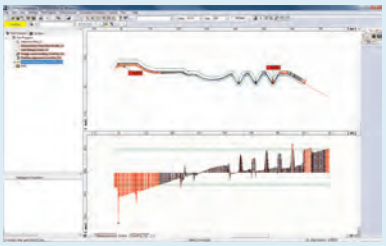
FORMTRACEPAK
Allows control of all axis, optional motor-driven Y-axis table and rotary table for efficient automated measurement. Surface roughness analyisis and contour evaluation can be performed using analysis of level differences, angle, pitch, area and contour tolerancing as standard. An inspection certificate can be created by setting the print format as required.



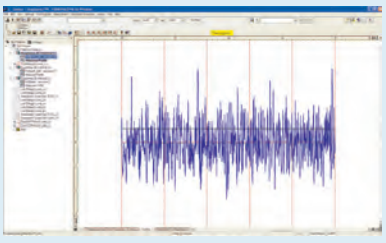
Measurement control screen



Contour analysis screen



Contour comparison



Roughness analysis

Formtracer CS-3200

Series 525 - Surface and Contour Measuring System

This provides all-in-one surface roughness and contour measurement within one drive unit.
The Formtracer CS-3200 offers you the following benefits:

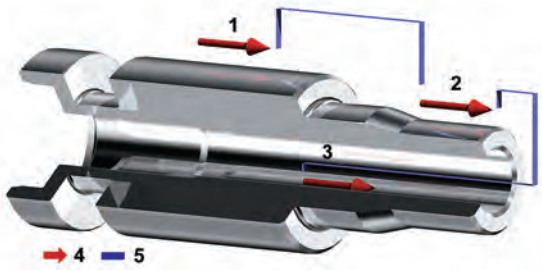
- You can carrying out simultaneous analysis of roughness and contour with one measurement.
- It complies with many standards including EN ISO, VDA, ANSI and JIS as well as customised settings.
- It gives you the best measuring condition with a vibration stand as standard.
- The high drive speed reduces the total measurement time.
- The detector unit can be extended to avoid interference between the drive unit and workpiece.

Specifications

Traverse	Z2 = 300 mm
Measuring range	X = 100 mm Z1 = 5 mm (up to 10 mm with an optional stylus)
Measuring speed	Roughness measurement: 0,02 / 0,05 / 0,1 / 0,2 mm/s Contour measurement: 0,02 / 0,05 / 0,1 / 0,2 / 0,5 / 1 / 2 mm/s
Drive speed	X = 0 - 80 mm/s Z2 = 0 - 20 mm/s
Accuracy	X = (0,8+0,01L) µm [L : Drive length (mm)] Z1 = (1,5+I2HI/100) µm H : Measurement height from the horizontal position (mm)
Inclining range	±45°
Traverse straightness	X = 0,2 µm / 100 mm
Software	**FORMTRACEPAK-6000** Allows control of all axis, optional motor-driven Y-axis table and rotary table for efficient automated measurement. Surface roughness analyisis and contour evaluation can be performed using analysis of level differences, angle, pitch, area and contour tolerancing as standard. An inspection certificate can be created by setting the print format as required.

Refer to Formtracer CS-3200 brochure

CS3200S4
(with optional Y-axis 178-097)



1: Outside diameter
2: Outside diameter
3: Inside diameter
4: Measurement element
5: Positioning element

Continuous measurement example:

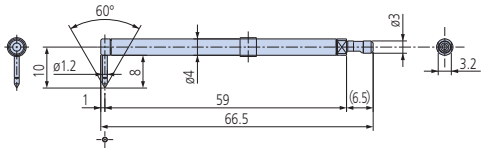
The drive unit (X-axis) and column (Z2-axis) are equipped with high-accuracy linear scales (ABS type) enabling fully automatic measurement combining vertical and horizontal movement. This improves reproducibility of continuous automatic measurement of small holes in the vertical direction and repeated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

Formtracer CS-3200

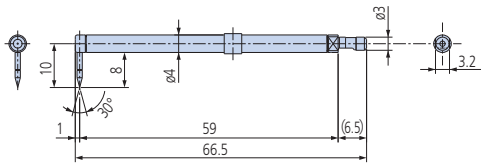
Series 525 - Surface and Contour Measuring System

Specifications and Styli

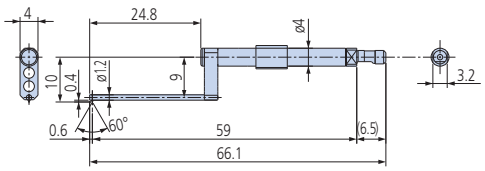
Model	CS-3200S4
No.	**525-401D**
Z2-axis vertical travel [mm]	300
X1-axis measuring range [mm]	100



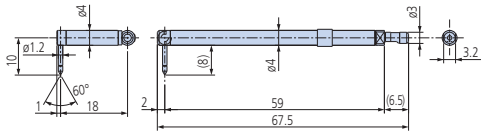
12AAD554
Standard stylus
Radius of tip curvature = 2 µm
Tip Material: Diamond



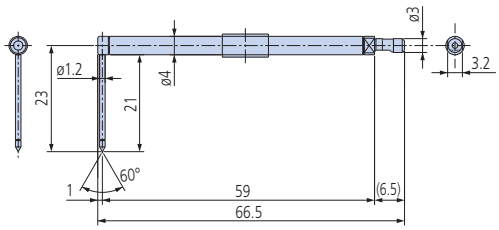
12AAD552
Cone stylus
Radius of tip curvature = 25 µm
Tip Material: Sapphire



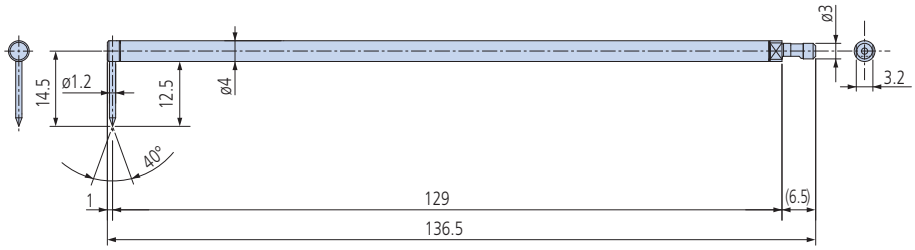
12AAD556
Small hole stylus
Radius of tip curvature = 2 µm
Tip Material: Diamond



12AAD558
Eccentric type stylus
Radius of tip curvature = 2 µm
Tip Material: Diamond



12AAD560
Deep groove stylus
Radius of tip curvature = 2 µm
Tip Material: Diamond

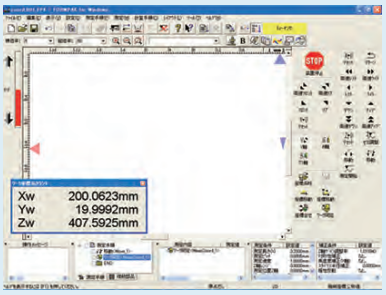


12AAD562
2x-long stylus*1
Radius of tip curvature = 5 µm
Tip Material: Diamond

***1: Measuring force is 4mN and the Z1 measuring and resolution is double that of the standard stylus.**

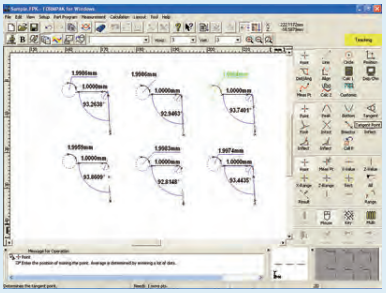
Additional Specifications

Optional accessories	Other optional and standard accessories are listed later in different sections for accessories and styli.

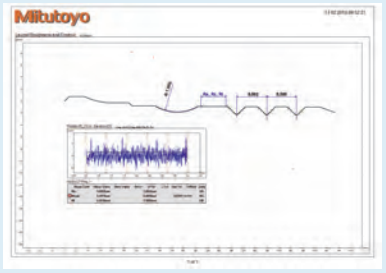


Measuring instrument control

Contour analysis screen



Contour analysis screen



Contour and roughness layout

Formtracer Extreme
SV-C3000CNC and SV-C4000CNC

Specifications

Traverse	Z2 = 300 mm / 500 mm
Measuring range	X = 200 mm Y = 200 mm **Contour :** Z1 = 50 mm **Roughness :** Z1 = 800 µm; 80 µm; 8 µm (up to 2,4 mm with an optional stylus)
Measuring speed	0,02 - 2 mm/s
Drive speed	CNC mode: max. 200 mm/s Joystick mode: 0 - 60 mm/s
Accuracy	X = (1+0,02L) µm [L : Drive length (mm)] **SV-C3000CNC :** Z1 = (2+I4HI/100) µm **SV-C4000CNC :** Z1 = (0,8+I0,5HI/25) µm [H : Measurement height from the horizontal position (mm)]
Inclining range	+45° (CCW) to -10° (CW)
Measuring force	0,75 mN / 4 mN models
Software	**FORMTRACEPAK**

Refer to CONTOUR AND SURFACE MEASUREMENT brochure

Series 525 - Surface and Contour Measuring Instrument

These are high accuracy fully CNC surface and contour measuring instruments.
The Formtracer Extreme SV-C3000CNC/SV-C4000CNC offer you the following benefits:

- They are as powerful as two separate, fully CNC instruments.
- Each axis has a drive speed of up to 200 mm/s.
- They are perfectly made for increased throughput of multiple profile and workpiece measurement tasks.
- You can take continuous measurement over horizontal and inclined surfaces by power-tilting the drive unit.
- The contour drive unit of SV-C4000CNC series is equipped with a Laser Hologage detector giving you excellent narrow/wide range accuracy and resolution in the Z1-axis.
- The detector unit incorporates an anti-collision safety device, causing it to automatically stop if its main body collides with a workpiece or jig.
- It is supplied with an easy-to-operate remote box.

SV-C3000CNC

Surface Roughness drive unit

Contour drive unit

Formtracer Extreme
SV-C3000CNC and SV-C4000CNC

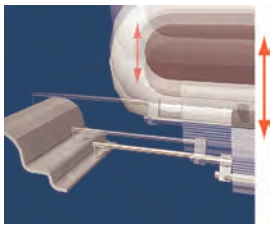
Series 525 - Surface and Contour Measuring Instrument

SV-C3000CNC

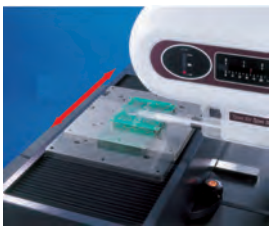
Model	SV-C3000CNC-S	SV-C3000CNC-S.	SV-C3000CNC-H	SV-C3000CNC-H.
No.	**525-522-2**	**525-524-2**	**525-542-2**	**525-544-2**
Z2-axis vertical travel [mm]	300	300	500	500
Y-axis table unit	-	Installed	-	Installed
α-axis unit	Installed	Installed	Installed	Installed

SV-C4000CNC

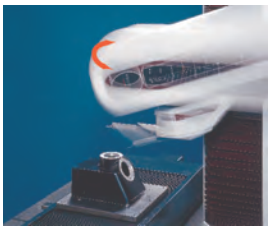
Model	SV-C4000CNC-S	SV-C4000CNC-S.	SV-C4000CNC-H	SV-C4000CNC-H.
No.	**525-622-2**	**525-624-2**	**525-642-2**	**525-644-2**
Z2-axis vertical travel [mm]	300	300	500	500
Y-axis table unit	-	Installed	-	Installed
α-axis unit	Installed	Installed	Installed	Installed



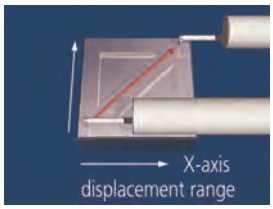
Z2-axis



Y-axis

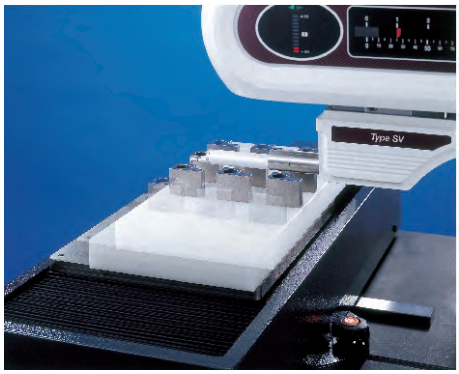


α-axis



Through 2-axis simultaneous control in the X and Y directions

Multiple measurements

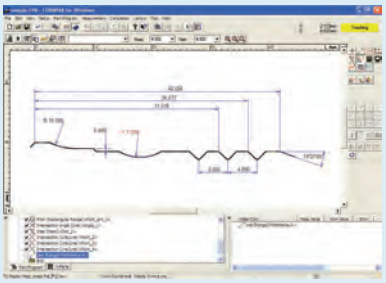


Specifications

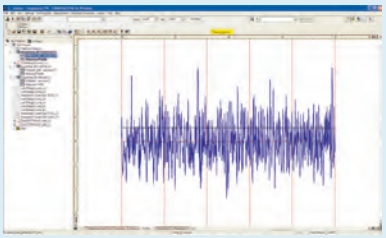
Optional Accessories	Vibration isolation stand
Mechanism	Diaphragm air spring
Natural frequency Hz (dann range)	2,5 - 3,5
Leveling	Automatic control with mechanical valves
Max. loading capacity	350 kg
Dimensions (WxDxH)	1000 x 895 x 715 mm
Air pressure	390 KPa

Additional Specifications

Optional accessories	Other optional and standard accessories are listed later in different sections for accessories and styli.
Software	**FORMTRACEPAK** Allows control of all axis, optional motor-driven Y-axis table and rotary table for efficient automated measurement. Contour evaluation can be performed using analysis of level differences, angle, pitch, area and contour tolerancing as standard. An inspection certificate can be created by setting the print format as required.



Contour analysis



Roughness analysis

Formtracer Extreme CS-5000CNC and CS-H5000CNC

Series 525 - CNC Surface and Contour Measuring Instruments

This is the highest-accuracy stylus type CNC surface roughness and contour measuring instrument. The Formtracer Extreme CS-5000CNC / CS-H5000CNC offers you the following benefits:

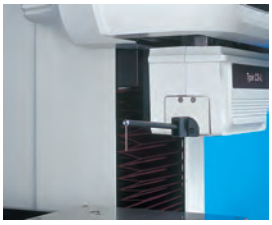
- It meets the highest demands of accuracy and repeatability.
- You can carry out simultaneous analysis of roughness and contour within one measurement.
- It cabin includes a vibration stand as standard to avoid external influences.
- A Mitutoyo Laser Holoscale is incorporated in the X1- and Z1-axes so you can achieve high resolution of X1-axis : 6.25 nm and Z1-axis : 4nm/8nm.
- The X1 and Z2-axis have maximum drive speeds of 40mm/s and 200mm/s respectively.

Specifications

Traverse	Z2 = 300 mm / 500 mm
Measuring range	X = 200mm Z1 = 12 mm [standard lenght stylus] Z1 = 24 mm [double lenght stylus]
Measuring speed	Roughness measurement: 0,02 - 0,2 mm/s Contour measurement: 0,02 - 2 mm/s
Drive speed	CNC mode: max. 200 mm/s Joystick mode 0 - 50 mm/s
Accuracy	**CS-5000CNC:** X = (0,3+0,002L) µm Z1 = (0,3+I0,02HI) µm **CS-H5000CNC:** X = (0,16+0,001L) µm Z1 = (0,07+I0,02HI) µm [L : Drive length (mm)] [H : Measurement height from the horizontal position (mm)]
Traverse straightness	**CS-5000CNC:** X = (0,1+0,0015L) µm [standard stylus] X = (0,2+0,0015L) µm [double length stylus] **CS-H5000CNC:** X = (0,05+0,0003L) µm [standard stylus] X = (0,1+0,0015L) µm [double length stylus]
Resolution [µm]	X = 0,00625 µm **CS-5000CNC:** Z1 = 0,004 µm [standard stylus] Z1 = 0,008 µm [double length stylus] **CS-H5000CNC:** Z1 = 0,001 µm [standard stylus] Z1 = 0,002 µm [double length stylus]
Software	**FORMTRACEPAK**

Refer to CONTOUR AND SURFACE MEASUREMENT brochure

CS-H5000CNC



Mitutoyo

Formtracer Extreme CS-5000CNC and CS-H5000CNC

Series 525 - CNC Surface and Contour Measuring Instruments

Specifications and Styli

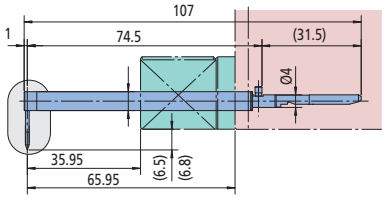
CS-5000CNC

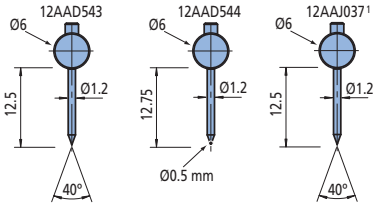
Model	CS-5000CNC-1S	CS-5000CNC-2S	CS-5000CNC-3S	CS-5000CNC-4S
No.	**525-721-2**	**525-722-2**	**525-723-2**	**525-724-2**
Z2-axis vertical travel [mm]	300	300	300	300
Y-axis table unit	-	-	Installed	Installed
α-axis unit	-	Installed	-	Installed

Model	CS-5000CNC-1H	CS-5000CNC-2H	CS-5000CNC-3H	CS-5000CNC-4H
No.	**525-741-2**	**525-742-2**	**525-743-2**	**525-744-2**
Z2-axis vertical travel [mm]	500	500	500	500
Y-axis table unit	-	-	Installed	Installed
α-axis unit	-	Installed	-	Installed

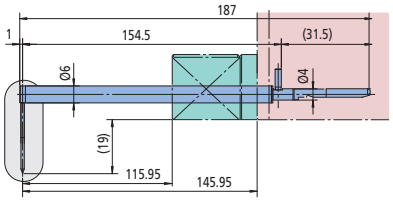
CS-H5000CNC

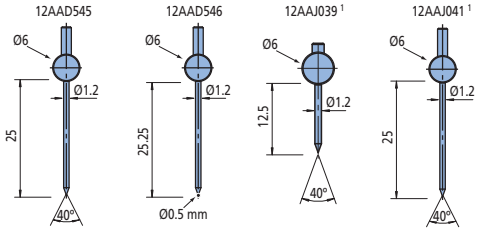
Model	CS-H5000CNC-1S	CS-H5000CNC-2S
No.	**525-761-2**	**525-763-2**
Z2-axis vertical travel [mm]	300	300
Y-axis table unit	-	Installed
α-axis unit	-	-



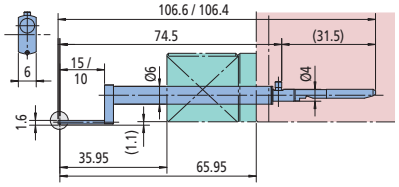


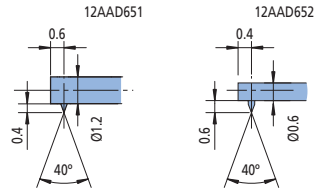
Standard



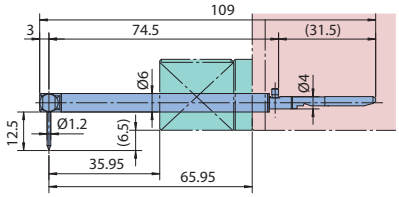


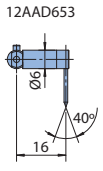
Double length



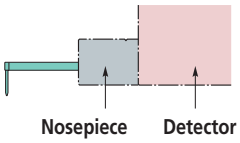


For small holes





Eccentric

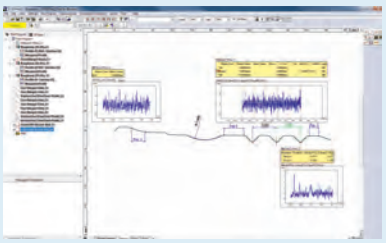


1 = additional for CS-H5000CNC

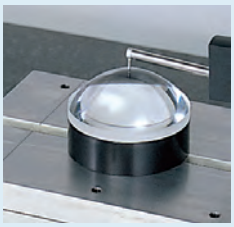
Specifications

Software

FORMTRACEPAK
Allows control of all axis, optional motor-driven Y-axis table and rotary table for efficient automated measurement. Surface roughness analysis and contour evaluation can be performed using analysis of level differences, angle, pitch, area and contour tolerancing as standard. An inspection certificate can be created by setting the print format as required.



Contour and roughness analysis

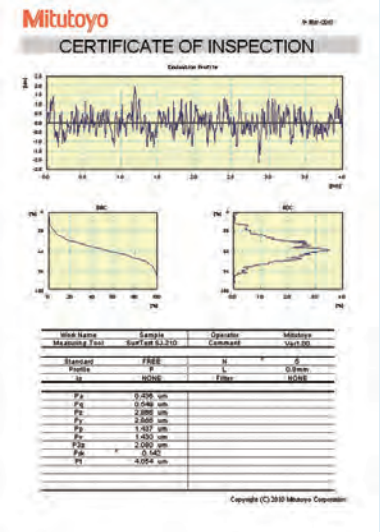


Optional:
Aspherical lens analysis program
ASLPAK

Optional Software USB Communication Tool

Optional accessories

No.	Description	Price €
12AAL068D	USB cable for SJ-210	13.00
12AAD510	USB cable for SJ-310 / SJ-410	71.00
12AAH490	USB cable for SJ-500 / SV-2100	

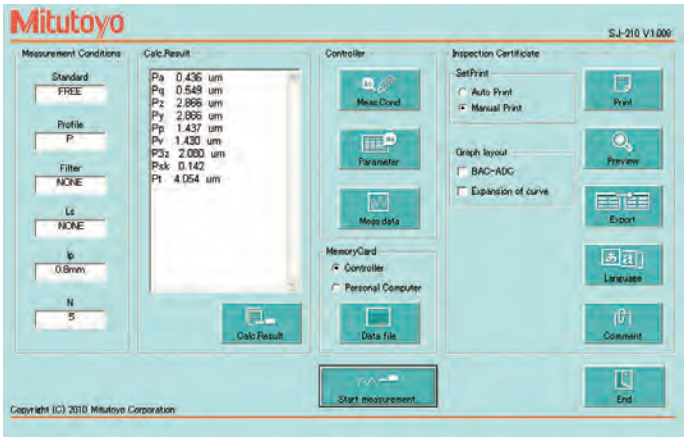


Output record from Microsoft® Excel®

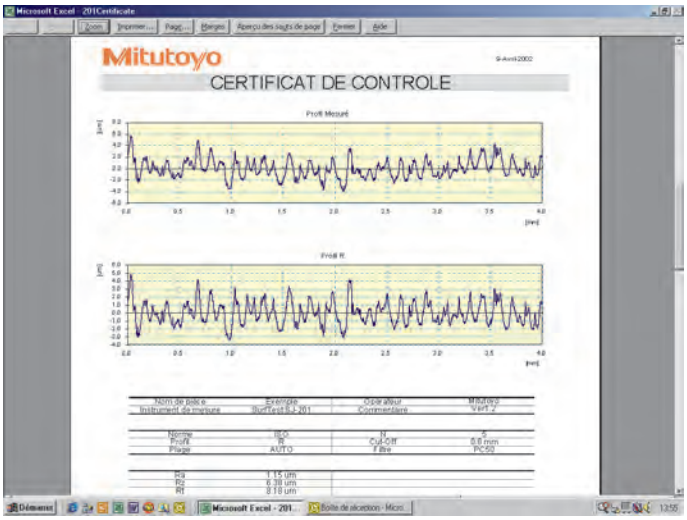
Series 178 - Control Software for SJ series, SV-2100

This is control software for Surftest SJ-210 / SJ-310 / SJ-410 / SJ-500 and SV-2100 which offers you the following benefits:

- It is available as a free download on www.mitutoyo.eu.
- Output software is based on Microsoft® Excel® for controlling the devices, reproducing and storing measurement data.
- Measurement device control.
- It provides definition of measurement variables.
- Graphic representation of the profile.
- Storage of measurement records.
- Documentation of measurements result.
- A USB connecting cable is necessary.

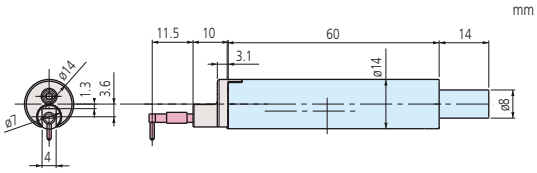


Input mask for Surftest SJ series



Output record from Microsoft® Excel® in 18 languages as standard.

Optional Styli
for Surftest and Formtracer SV-C series



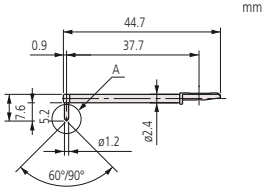
178-396-2 : Detector 0.75 mN
178-397-2 : Detector 4 mN

Specifications

Probes	**178-396-2**: 0,75 mN measuring force with the standard stylus 12AAC731 (radius 2 µm, angle 60°) **178-397-2**: 4 mN measuring force with stylus 12AAB403 (radius 5 µm, angle 90°)

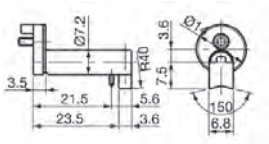
Stylus

Standard



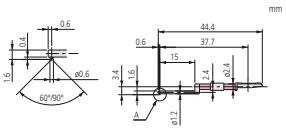
No.	Radius	Angle	Price €
12AAE882	1 µm	60°	**1,254.00**
12AAE924	1 µm	90°	**1,494.00**
12AAC731	2 µm	60°	**256.00**
12AAB403	5 µm	90°	**248.00**
12AAB415	10 µm	90°	**266.00**
12AAE883	250 µm	60°	**931.00**

Nose pad

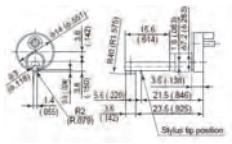


No.	Price €
12AAB345	**304.00**

For small hole

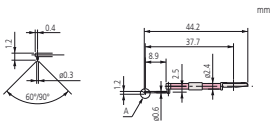


No.	Radius	Angle	Price €
12AAC732	2 µm	60°	**317.00**
12AAB404	5 µm	90°	**305.00**
12AAB416	10 µm	90°	**334.00**

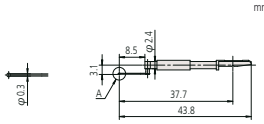


No.
12AAB346

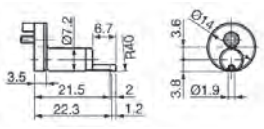
For extra small hole



No.	Radius	Angle	Price €
12AAC733	2 µm	60°	**443.00**
12AAB405	5 µm	90°	**305.00**
12AAB417	10 µm	90°	**334.00**



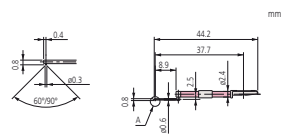
No.	Radius	Angle	Price €
12AAJ662	250 µm	-	**460.00**



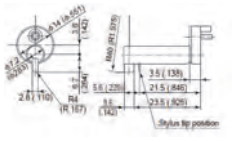
No.	Price €
12AAB347	**647.00**

Ultra small hole

For extra minute hole



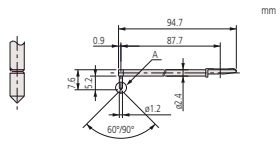
No.	Radius	Angle	Price €
12AAC734	2 µm	60°	**410.00**
12AAB406	5 µm	90°	**389.00**
12AAB418	10 µm	90°	**432.00**



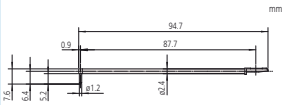
No.
12AAB344

Optional Styli
for Surftest and Formtracer SV-C series

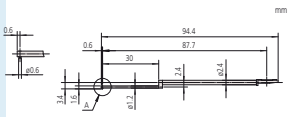
For deep hole (double-length)



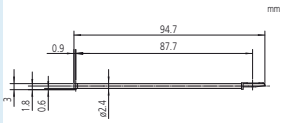
No.	Radius	Angle	Price €
12AAC740	2 µm	60°	**469.00**
12AAB413	5 µm	90°	**447.00**
12AAB425	10 µm	90°	**504.00**



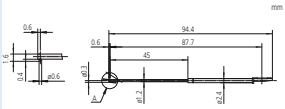
No.	Radius	Angle	Price €
12AAE886	250 µm	60°	**1,292.00**



No.	Radius	Angle	Price €
12AAE892	2 µm	60°	**613.00**
12AAE908	5 µm	90°	**565.00**

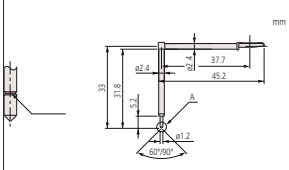


No.	Radius	Angle	Price €
12AAE898	2 µm	60°	**813.00**
12AAE914	5 µm	90°	**701.00**



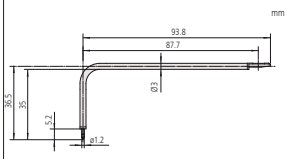
No.	Radius	Angle	Price €
12AAE938	2 µm	60°	**907.00**
12AAE940	5 µm	90°	**801.00**

Stylus for deep groove 30/40 mm



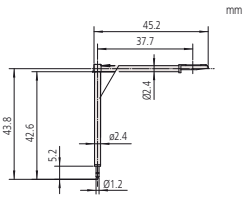
No.	Radius	Angle	Price €
12AAC737	2 µm	60°	**527.00**
12AAB407	5 µm	90°	**516.00**
12AAB419	10 µm	90°	**583.00**

30 mm



No.	Radius	Angle	Price €
12AAE894	2 µm	60°	**244.00**
12AAE910	5 µm	90°	**248.00**

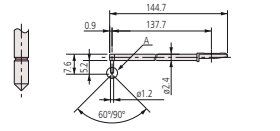
30 mm
Double-length



No.	Radius	Angle	Price €
12AAE895	2 µm	60°	**244.00**
12AAE911	5 µm	90°	**248.00**

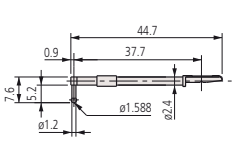
40 mm

For deep hole (triple-length)

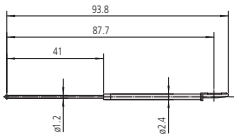


No.	Radius	Angle	Price €
12AAC741	2 µm	60°	**465.00**
12AAB414	5 µm	90°	**464.00**
12AAB426	10 µm	90°	**547.00**

Stylus for rolling circle waviness surface roughness (178-611 required)

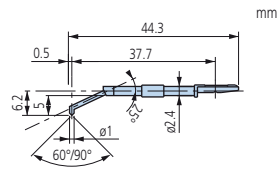


No.	Radius	Price €
12AAB338	0.8 mm	**268.00**



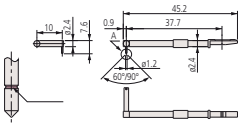
No.	Radius	Price €
12AAE884	0.8 mm	**406.00**

For bottom surface



No.	Radius	Angle	Price €
12AAE899	2 µm	60°	**1,446.00**
12AAE915	5 µm	90°	**1,401.00**

Stylus for eccentric arm



No.	Radius	Angle	Price €
12AAC739	2 µm	60°	**469.00**
12AAB412	5 µm	90°	**464.00**
12AAB424	10 µm	90°	**518.00**

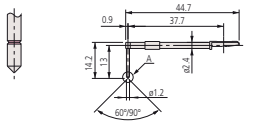
For corner hole

No.	Radius	Angle	Price €
12AAM601	2 µm	60°	**450.00**
12AAM603	5 µm	60°	**345.00**

Mitutoyo

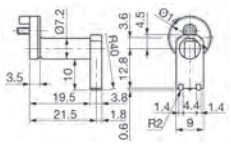
Optional Styli
for Surftest and Formtracer SV-C series

For deep groove 10

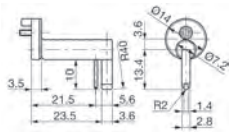


No.	Radius	Angle	Price €
12AAC735	2 µm	60°	**278.00**
12AAB409	5 µm	90°	**269.00**
12AAB421	10 µm	90°	**287.00**

Nose pad

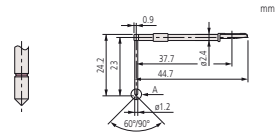


No.	Price €
12AAB349	**248.00**

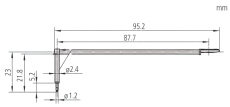


No.	Price €
12AAC755	**248.00**

For deep groove 20

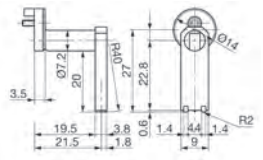


No.	Radius	Angle	Price €
12AAC736	2 µm	60°	**278.00**
12AAB408	5 µm	90°	**269.00**
12AAB420	10 µm	90°	**283.00**



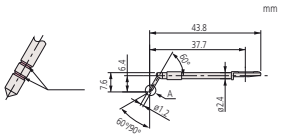
No.	Radius	Angle	Price €
12AAE893	2 µm	60°	**240.00**
12AAE909	5 µm	90°	**248.00**

Nose pad

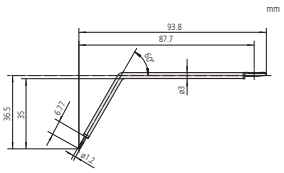


No.	Price €
12AAB348	**248.00**

For gear teeth



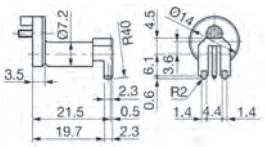
No.	Radius	Angle	Price €
12AAB339	2 µm	60°	**268.00**
12AAB410	5 µm	90°	**269.00**
12AAB422	10 µm	90°	**287.00**



No.	Radius	Angle	Price €
12AAE896	2 µm	60°	**240.00**
12AAE912	5 µm	90°	**318.00**

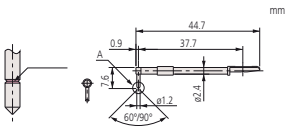
Double-length

Nose pad



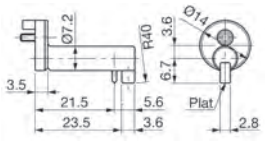
No.	Price €
12AAB353	**248.00**

For Knife edge detector



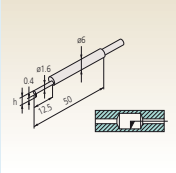
No.	Radius	Angle	Price €
12AAC738	2 µm	60°	**410.00**
12AAB411	5 µm	90°	**407.00**
12AAB423	10 µm	90°	**453.00**

Nose pad

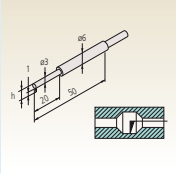


No.	Price €
12AAC756	**230.00**

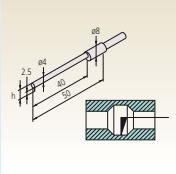
Optional Styli and Arms for Contracer and Formtracer SV-C Series



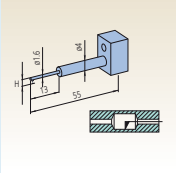
Small hole : 932693 / 12AAE873
Tip shape : Single bevel / Cone
Tip angle : 20° / 30°
Tip radius : 25 µm / 25 µm
Tip material : Carbide / Carbide



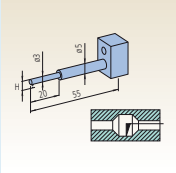
Small hole : 932694 / 12AAE874
Tip shape : Single bevel / Cone
Tip angle : 20° / 30°
Tip radius : 25 µm / 25 µm
Tip material : Carbide / Carbide



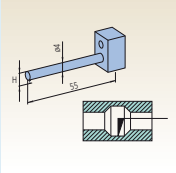
Small hole : 932695 / 12AAE875
Tip shape : Single bevel / Cone
Tip angle : 20° / 30°
Tip radius : 25 µm / 25 µm
Tip material : Carbide / Carbide



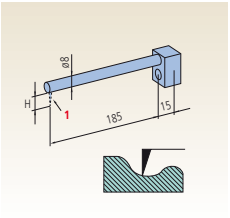
Small hole : 12AAE297
Tip shape : Single bevel
Tip angle : 20°
Tip radius : 25 µm
Tip material : Carbide



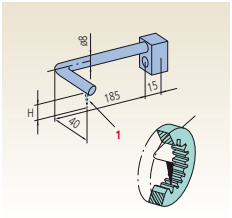
Small hole : 12AAE298
Tip shape : Single bevel
Tip angle : 20°
Tip radius : 25 µm
Tip material : Carbide



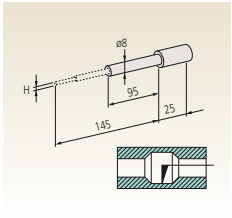
Small hole : 12AAE299
Tip shape : Single bevel
Tip angle : 20°
Tip radius : 25 µm
Tip material : Carbide



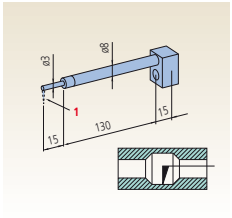
Arm Straight type
CV-1000/2000



Arm Eccentric type
CV-1000/2000



Arm for small-hole stylus
CV-1000/2000



Arm for small-hole stylus
CV-1000/2000

Applicable Arms for CV-1000 and CV-2000

No.	Arm	Compatible stylus height (H) [mm]	Price [€]
935110	Small hole	0,4 / 1 / 2,5	83.50
935111	Straight type	6	95.00
935112	Straight type	12	95.00
935113	Straight type	20	98.00
935114	Straight type	30	100.00
935115	Straight type	42	111.00
935116	Eccentric type	6	117.00
935117	Eccentric type	12	117.00
935118	Eccentric type	20	119.00

Applicable Arms for CV-3000CNC/4000CNC and SV-C3000CNC/4000CNC

No.	Arm	Compatible stylus height (H) [mm]	Price [€]
12AAE294	Straight type	6	134.00
12AAE295	Straight type	12	134.00
996506	Straight type	20	158.00
996507	Straight type	30	161.00
996508	Straight type	42	163.00
996509	Eccentric type	6	196.00
996510	Eccentric type	12	199.00
996511	Eccentric type	20	203.00
996512	Eccentric type	30	207.00
996513	Eccentric type	42	208.00
12AAE296	Small hole	Small-hole stylus	134.00

Applicable Arms for CV-3200 / CV-4500 and SV-C3200 / SV-C4500

No.	Arm	Compatible stylus height (H) [mm]
12AAM101	Straight type	all
12AAM102	Eccentric type	all
12AAM103	Small hole	Small-hole stylus

Applicable Styli for CV-1000 and CV-2000

No.	Stylus	Stylus height (H) [mm]	Price [€]
932693	Small hole, carbide-tipped one-sided cut	2	118.00
932694	Small hole, carbide-tipped one-sided cut	4	124.00
932695	Small hole, carbide-tipped one-sided cut	6,5	130.00
12AAE873	Small hole, carbide-tipped cone	2	228.00
12AAE874	Small hole, carbide-tipped cone	4	228.00
12AAE875	Small hole, carbide-tipped cone	6,5	228.00

Applicable Styli for CV-3000CNC/4000CNC and SV-C3000CNC/4000CNC

No.	Stylus	Stylus height (H) [mm]	Price [€]
12AAE297	Small hole, carbide tipped one-sided cut	2	199.00
12AAE298	Small hole, carbide tipped one-sided cut	4	199.00
12AAE299	Small hole, carbide tipped one-sided cut	6,5	201.00

Mitutoyo

Optional Styli and Arms for Contracer and Formtracer SV-C Series

Styli

Applicable Styli for
CV-1000/2000, CV-3200/4500, CV-3000CNC/4000CNC, SV-C3200/4500 and SV-C3000CNC/4000CNC

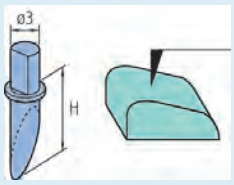
No.	Stylus	Stylus height (H) [mm]	Price [€]
354882	Single bevel, carbide tipped	6	122.00
354883	Single bevel, carbide tipped	12	122.00
354884	Single bevel, carbide tipped	20	147.00
354885	Single bevel, carbide tipped	30	172.00
354886	Single bevel, carbide tipped	42	175.00
354887	Cross ground, carbide tipped	6	139.00
354888	Cross ground, carbide tipped	12	139.00
354889	Cross ground, carbide tipped	20	163.00
354890	Cross ground, carbide tipped	30	172.00
354891	Cross ground, carbide tipped	42	175.00
12AAE865	Cone, carbide-tipped angle 20°	6	168.00
12AAE866	Cone, carbide-tipped angle 20°	12	163.00
12AAE867	Cone, carbide-tipped angle 20°	20	163.00
12AAE868	Cone, carbide-tipped angle 20°	30	212.00
12AAE869	Cone, carbide-tipped angle 20°	42	212.00
354892	Cone, sapphire-tipped angle 30°	6	80.50
354893	Cone, sapphire-tipped angle 30°	12	80.50
354894	Cone, sapphire-tipped angle 30°	20	80.50
355129	Cone, diamond-tipped angle 50°	20	324.00
354895	Cone, sapphire-tipped angle 30°	30	80.50
354896	Cone, sapphire-tipped angle 30°	42	82.50
12AAA566	Cone, carbide-tipped angle 30°	6	118.00
12AAA567	Cone, carbide-tipped angle 30°	12	118.00
12AAA568	Cone, carbide-tipped angle 30°	20	118.00
12AAA569	Cone, carbide-tipped angle 30°	30	170.00
12AAA570	Cone, carbide-tipped angle 30°	42	170.00
354897	Knife edge, carbide tipped	6	160.00
354898	Knife edge, carbide tipped	12	160.00
354899	Knife edge, carbide tipped	20	160.00
354900	Knife edge, carbide tipped	30	162.00
354901	Knife edge, carbide tipped	42	162.00
354902	Ball, carbide tipped	6	71.50
354903	Ball, carbide tipped	12	71.50
354904	Ball, carbide tipped	20	71.50
354905	Ball, carbide tipped	30	71.50
354906	Ball, carbide tipped	42	73.50

Applicable Styli for CV-3200 / 4500 and SV-C3200 / 4500

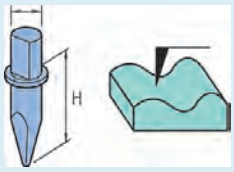
No.	Stylus	Stylus height (H) [mm]
12AAM104	Small hole, carbide tipped one sided cut	2
12AAM105	Small hole, carbide tipped one sided cut	4
12AAM106	Small hole, carbide tipped one sided cut	6,5

Applicable Styli for only CV-4500 and SV-C4500

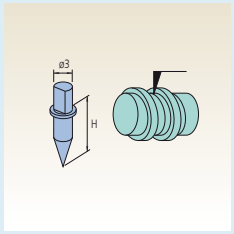
No.	Stylus	Stylus height (H) [mm]
12AAM095	Both sides conical stylus	20
12AAM096	Both sides conical stylus	32
12AAM097	Both sides conical stylus	48
12AAM108	Both sides small hole arm stylus	2,4
12AAM109	Both sides small hole arm stylus	5
12AAM110	Both sides small hole arm stylus	9



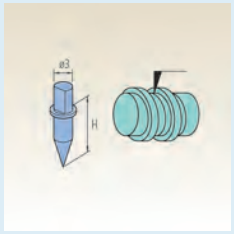
Single bevel
Tip angle : 12°
Tip radius : 25 µm
Tip material : Carbide



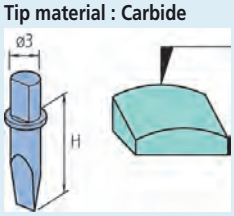
Cross ground
Tip angle : 20°
Tip radius : 25 µm
Tip material : Carbide



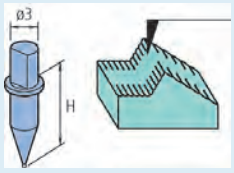
Cone
Tip angle : 30/50°
Tip radius : 25 µm
Tip material : Carbide/Sapphire/Diamond
(355129 : 50°, Diamond)



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



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



Ball
Ball : ø1 mm
Tip material : Carbide

Optional Accessories for Surftest, Contracer and Formtracer

For SV series, SV-C series, CV series, CS series and CNC Models

178-087

Using 178-087

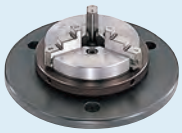
Automatic-leveling table : 178-087 (for SV, CV, SV-C, CS)
Automatic-leveling table : 178-037 (for CNC Models)
This is a stage that performs fully automatic leveling as measurement starts, freeing the user from this troublesome operation. Fully automatic leveling can be done quickly by anyone. In addition, the operation is easy and reliable.

No.	Inclination adjustment angle	Maximum load [kg]	Table dimensions [mm]
178-087	± 2°	7	130 x 100
178-037	± 2°	7	130 x 100

211-031

Micro-chuck
This chuck is suitable for clamping extra-small diameter workpieces (ø1.5 mm or less), which cannot be retained with the centering chuck.

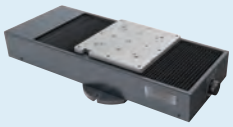
No.	Dimensions [mm]	Retention range [mm]
211-031	ø118 x 48,5	OD : ø0 - ø1,5



211-032

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

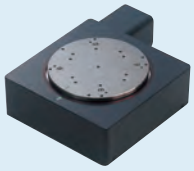
No.	Dimensions [mm]	Retention range [mm]
211-032	ø118 x 41	Inner latch : OD ø1 - ø36 Inner latch : ID ø16 - ø69 outer latch : OD ø25 - ø79



178-097

Y-axis table
for SV-3100, SV-C, CS and CV models (not CNC models)
Enables efficient, automatic measurement of multiple aligned workpieces and multiple points on a single measurement surface. It allows semi-automatic measurement with a semi-automatic with non CNC models by using these items.

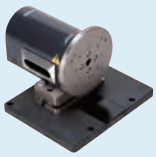
No.	Resolution [µm]	Travel range [mm]	Positioning accuracy [µm]	Maximum load [kg]	Drive speed
178-097	0,05	200	±3	50	Max. 80 mm/s



12AAD975

θ1-axis:*1
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.
*1 = **12AAE630** mounting plate is required when directly installing on the base of the machine.

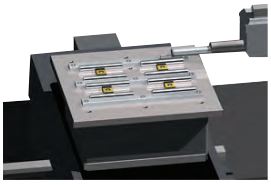
No.	Resolution	Rotational speed	Displacement	Maximum load [kg]
12AAD975	0,004°	Max. 10°/s	360°	12



178-078

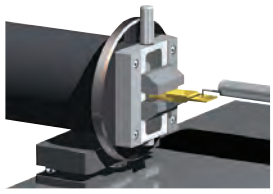
θ2-axis:*1
For efficent measurment of multiple points on a cylindrical workpiece and automate front/rear-side measurement.
*1 = **12AAE718** mounting plate is required when directly installing on the base of the machine.
*1 = **12AAE705** attachment plate is required when installing on θ1-axis table.
*1 = **12AAE707** mounting plate is required when directly installing on Y-axis table with automatic leveling table.

No.	Resolution	Rotational speed	Displacement	Maximum load [kg]
178-078	0,0072°	Max. 18°/s	360°	4



178-097
using Y-axis

12AAD975
using θ1-axis



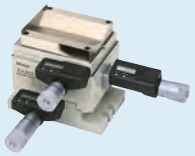
178-078
using θ2-axis

Mitutoyo

Optional Accessories for Surftest, Contracer and Formtracer

3 - Axis Adjustment Table

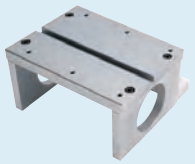
No.	Description	Price [€]
178-047	This table helps make the alignment adjustments required when measuring cylindrical surfaces. The corrections for the pitch angle and the swivel angle are determined from a preliminary measurement and the Digimatic micrometers are adjusted accordingly. A flat-surfaced workpiece can also be leveled with this table.	4,326.00



178-047

Calibration Stand

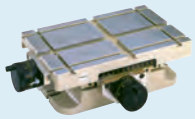
No.	Description	Price [€]
12AAG175	For mounting a roughness specimen or step gauge during calibration	348.00



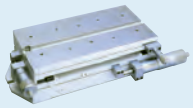
12AAG175

Cross-travel Table

No.	Table top [mm]	XY travel [mm]	Price [€]
218-001	280 x 180	100 x 50	2,470.00
218-041	280 x 152	50 x 25	2,390.00



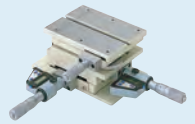
218-001



218-041

Digital Leveling Table

No.	Table top [mm]	XY travel [mm]	Leveling range	Price [€]
178-042-1	130 x 100	±12,5	±1,5°	3,142.00

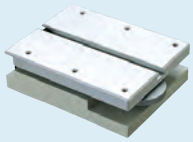


178-042-1

Leveling Table

No.	Table top [mm]	XY travel [mm]	Leveling range	Price [€]
178-043-1	130 x 100	±12,5	±1,5°	2,493.00
178-016	130 x 100	40	±1,5°	783.00

178-043-1



178-016

Precision Vise

No.	Description	Price [€]
178-019	Max. workpiece size : 36 mm Can be mounted on a leveling table	592.00

178-019

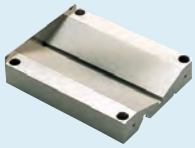
Rotary Vice

No.	Description	Price [€]
218-003	Two-slide jaw type Max. workpiece size : ø60 mm Minimum reading : 1°	1,400.00

218-003

V-Block

No.	Description	Price [€]
998291	Workpiece diameter : 1 mm to 160 mm Can be mounted on a leveling table	659.00



998291

Roundtest RA-10

Series 211 - Form Measuring Instrument

This is a compact and affordable form measuring instrument.
The Roundtest RA-10 offers you the following benefits:

- It combines outstanding cost and performance with full measurement capabilities.
- The machine has a compact body with integrated electronics and printer, making it ideal for installation in space-restricted locations.
- Despite being a low-priced model, the turntable with air bearings gives you rotational accuracy as high as (0.04+0.0006H)µm, assuring a precision that compares well with that of higher priced models.
- The control panel has large keys and an intuitive layout for easy operation.
- One-touch setup recall.
- Zero-set function.
- You can easily view measurement results and recorded profiles on the large LCD panel display.

Specifications

Turntable	
Rotational accuracy	**Radial:** (0,04+0,0006H)µm H: Measuring height from turntable surface (mm) **Axial:** (0,04+0,0006X)µm X: Radial distance from center (mm)
Max. probing Ø	100 mm
Max. workpiece Ø	320 mm
Max. turntable loading	10 kg
Vertical column	
Vertical travel	117 mm
Max. probing height	152 mm
Display unit	
Data analysis items	Roundness, Coaxiality, Concentricity, Flatness, Runout radial
Printer	Built-in thermal line printer

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

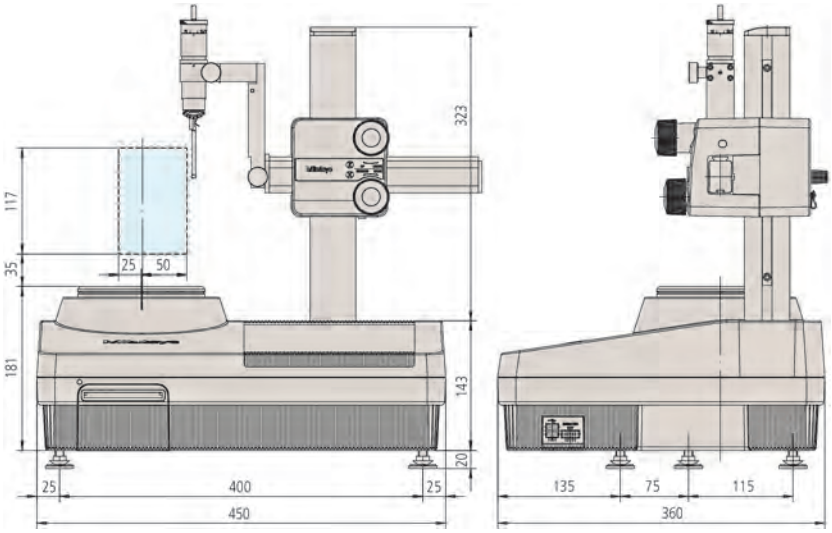
Z-axis scale unit

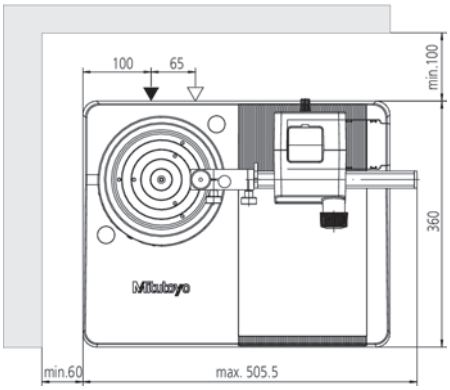
X-axis stop

Roundtest RA-10

Series 211 - Form Measuring Instrument

Dimensions and accessories





211-031

211-032

211-051

211-052

211-053

211-054

211-055

12AAH425

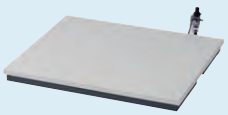
No.	Model	Max. workpiece ø [mm]	Max. probing Ø [mm]	Max. turntable loading [kg]
211-601D	RA-10	320	100	10

Optional accessories

No.	Description
12AAH402	Collet (ø0,5-1,0 mm)
12AAH403	Collet (ø1,0-1,5 mm)
12AAH404	Collet (ø1,5-2,0 mm)
12AAH405	Collet (ø2,0-2,5 mm)
12AAH406	Collet (ø2,5-3,0 mm)
12AAH407	Collet (ø3,0-3,5 mm)
12AAH408	Collet (ø3,5-4,0 mm)
12AAH409	Collet (ø4,0-5,0 mm)
12AAH410	Collet (ø5,0-6,0 mm)
12AAH411	Collet (ø6,0-7,0 mm)
12AAH412	Collet (ø7,0-8,0 mm)
12AAH413	Collet (ø8,0-9,0 mm)
12AAH414	Collet (ø9,0-10,0 mm)
211-013	Vibration damping stand
211-016	Reference hemisphere
211-031	Micro-chuck OD: 1-1,5 mm
211-032	Quick chuck OD: 1-79, ID: 16-79 mm
211-045	Magnification checking gauge
211-051	Collet chuck (OD : 0,5- 10 mm)
211-052	Quick chuck
211-053	V-block jig A (for ø50 mm)
211-054	V-block jig B (for ø50 mm)
12AAH420	Spacer for reference hemisphere
12AAH425	Alignment table with D.A.T. (mm)
12AAH427	Alignment table with mechanical heads
12AAH318	Z-axis scale unit
12AAH320	X-axis stop
356038	Auxiliary stage for a low-height workpiece
997090	Gauge block set for calibration

Consumable spares

No.	Description
12AAH181	Printer paper (10 rolls)



211-013

Roundtest RA-120 and RA-120P

Series 211 - Form Measuring Instrument

These are compact, affordable and simple-to-use instruments for measuring roundform geometry. The Roundtest RA-120 and 120P offer you the following benefits:

- The turntable accuracy of (0.04+0.0006H)µm provides high level form analysis.
- The RA-120 has a compact body with integrated electronics and printer, making it ideal for installation in space-restricted locations.
- The RA-120P is a PC based model with all operations controlled via powerful ROUNDPAK software.
- Software ROUNDPAK gives you excellent possibilities for single measurement and part programming.

Specifications

Turntable	
Rotational accuracy	**Radial:** (0,04+0,0006H)µm H: Measuring height from turntable surface (mm) **Axial:** (0,04+0,0006X)µm X: Radial distance from center (mm)
Max. probing Ø	280 mm
Max. workpiece Ø	440 mm
Max. turntable loading	25 kg
Centering range	±3 mm
Leveling range	±1°
Vertical column	
Vertical travel	280 mm
Max. probing height	280 mm above turntable surface 480 mm in reverse position
Max. probing depth	100 mm (minimum ID: 30 mm)
Display unit	Only RA-120 (Roundpak-120P with PC)
Data analysis items	Roundness, Coaxiality, Flatness, Runout (radial), Runout (axial), Thickness deviation, Parallelism, Perpendicularity
Printer	Built-in thermal line printer
Software	**ROUNDPAK** (only RA-120P)

RA-120

RA-120P

Z-axis scale unit (optional)

X-axis stop

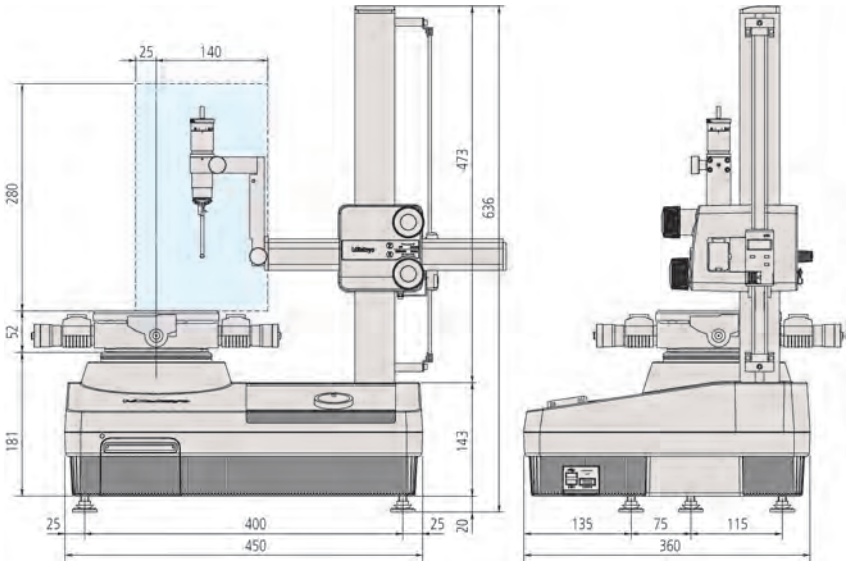
Roundtest RA-120 and RA-120P

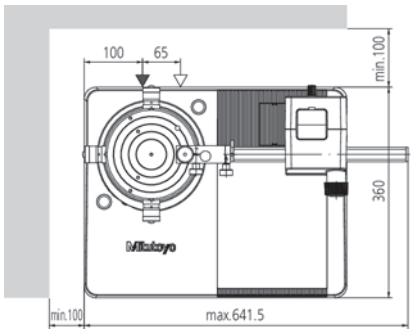
Series 211 - Form Measuring Instrument

The is a compact roundness tester with D.A.T. (Digital Adjustment Table) function.
The Roundtest RA-120 and 120P give you the following benefits:

- The turntable displays centering and leveling adjustments digitally, making this challenging task easy enough for even an untrained operator to perform, through these four simple steps:

1. Preliminary measurement of two cross sections on the workpiece.
2. The centering and leveling adjustment values are displayed.
3. The digital micrometer heads on the rotary table are adjusted to match the values displayed.
4. Centering and leveling is complete. [Centering range : ±3 mm - Leveling range : ±1°]





No.	Model	Max. workpiece ø [mm]	Max. probing Ø [mm]	Max. turntable loading [kg]
211-621D	RA-120 with mechanical turntable	440	280	25
211-622D	RA-120 with D.A.T. function	440	280	25
211-625D	RA-120P with mechanical turntable	440	280	25
211-626D	RA-120P with D.A.T. function	440	280	25

Additional Specifications

Optional accessories	Other optional and standard accessories are listed later in this section for accessories and styli.

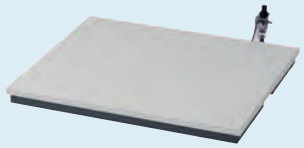
Optional accessories

No.	Description
211-013	Vibration damping stand
211-014	Three jaw chuck OD: 2-78, ID: 25-68 mm
211-016	Reference hemisphere
211-031	Micro-chuck OD: 1-1,5 mm
211-032	Quick chuck OD: 1-79, ID: 16-79 mm
211-045	Magnification checking gauge
211-061	Collet chuck OD: 0,5-10 mm
12AAH320	X-axis stop
356038	Auxiliary stage for a low-height workpiece
997090	Gauge block set for calibration

Consumable spares

No.	Description
12AAH181	Printer paper (10 rolls)

211-016



211-013

Roundtest RA-1600

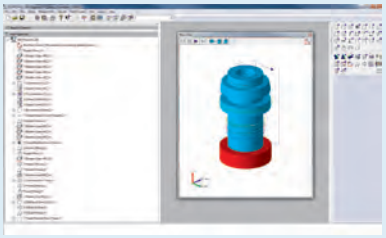
Series 211 - Form Measuring System

This is a PC-compliant form measuring system which allows you to measure roundform geometry like cylindricity.
The Roundtest RA-1600 offers the following benefits:

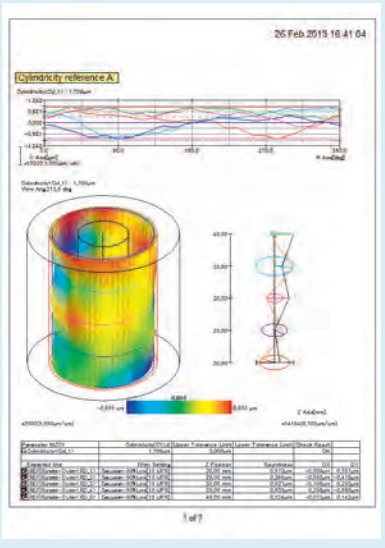
- It is equipped with a high accurate turntable accuracy of (0.02+0.0006H)µm.
- You can carry out simple & accurate centering and leveling of the workpiece with D.A.T. (Digital Adjustment Table).
- The user friendly software, ROUNDPAK, gives you easy drag and drop usage.
- ROUNDPAK also has easy-to-use part programming and single measurement functions.
- A remote control box is including allowing you easy operation.
- There is also an auto follow function for easy and quick pre-centering of the workpiece.

Specifications

Turntable	
Rotational accuracy	**Radial:** (0,02+0,0006H)µm H: Measuring height from turntable surface (mm) **Axial:** (0,02+0,0006X)µm X: Radial distance from center (mm)
Rotational speed	4, 6, 10 rpm
Max. probing Ø	280 mm
Max. workpiece Ø	560 mm
Max. turntable loading	25 kg
Centering range	±3 mm
Leveling range	±1°
Vertical column	
Max. probing height	300 mm above turntable surface
Max. probing depth	91 mm (minimum ID : ø32 mm) 50 mm (minimum ID : ø7 mm)
Straightness	0,20 µm / 100 mm 0,30 µm / 300 mm
Parallelism with turntable axis	1,50 µm / 300 mm
Software	**ROUNDPAK**



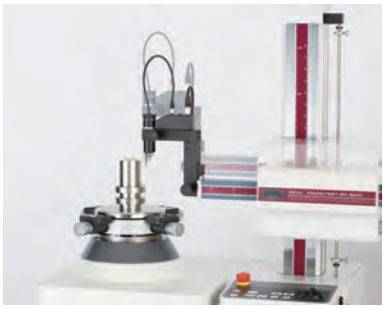
Measuring screen



Result screen

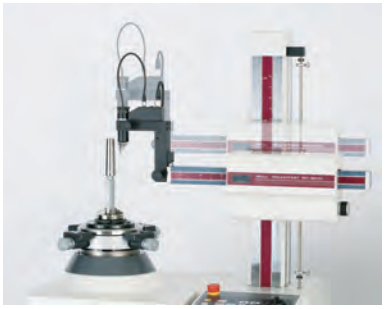
ROUNDPAK

RA-1600



Spiral Measurement/Analysis (RA-1600)

Provided with a spiral measurement function that combines turntable rotation and rectilinear motion allowing cylindricity, coaxiality and other form characteristics to be measured in continuous data stream mode.



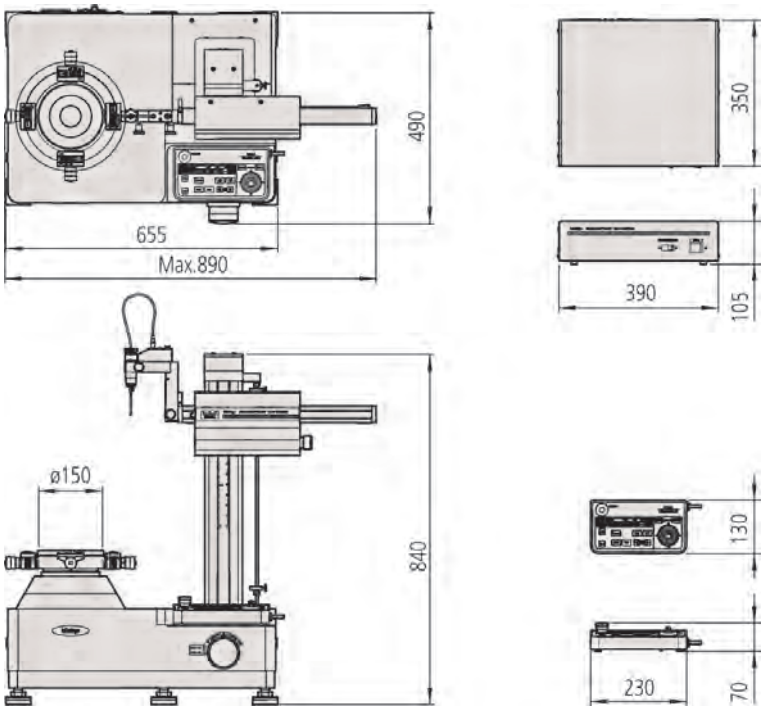
Measurement through X - axis tracking

Measurement while tracing is possible through a built-in linear scale in the X - axis.

Mitutoyo

Roundtest RA-1600

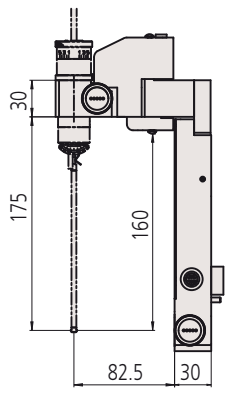
Series 211 - Roundness Measuring System



Dimensions

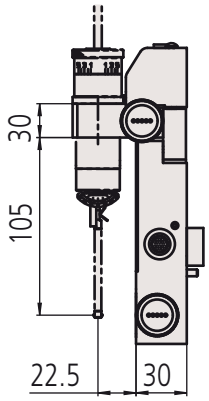
No.	Description	Max. workpiece ø [mm]	Max. probing Ø [mm]	Max. turntable loading [kg]
211-723D	RA-1600	560	280	25

mm



12AAF203

mm



12AAF204

Additional Specifications

Optional accessories	Other optional and standard accessories are listed later in this section for accessories and styli.

Optional accessories

No.	Description
211-014	Three jaw chuck OD: 2-78, ID: 25-68 mm
211-031	Micro-chuck OD: 1-1,5 mm
211-032	Quick chuck OD: 1-79, ID: 16-79 mm
211-045	Magnification checking gauge
211-061	Collet chuck OD: 0,5-10 mm
12AAL019	Side table
12AAL090	Sliding detector holder
12AAF203	Double length detector holder
12AAF204	Large diameter detector holder
12AAK110	Vibration isolator
12AAK120	Monitor arm
356038	Auxiliary stage for a low-height workpiece
997090	Gauge block set for calibration

Roundtest RA-2200

Series 211 - Form Measuring Instrument

This is a highly accurate form measuring system which allows you to measure roundform geometry like cylindricity.
The Roundtest RA-2200 offers the following benefits:

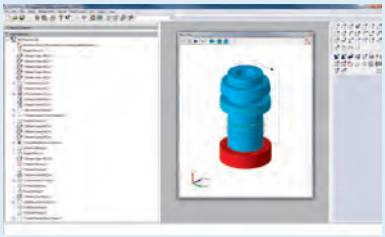
- It has fully motorised axes movement.
- Its extremely high turntable accuracy of (0.02+0.00035H)µm gives you excellent form analysis.
- The user friendly software, ROUNDPAK, gives you easy drag and drop usage and a wide range of parameters.
- ROUNDPAK also has easy-to-use part programming and single measurement functions.
- A huge number of styli provides you with maximum flexibility.
- There is an auto follow function for easy and quick pre-centering of the workpiece.

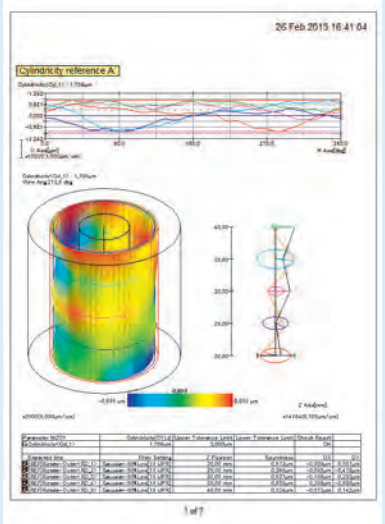
There is a wide variety of models available to suit any application.
RA-2200DS/DH: These models have a navigation function supplied as standard, to quickly and simply guides you through the centering and leveling task. The models are equipped with the D.A.T. (Digital Adjustment Table).

RA-2200AS/AH: The models have an automatic centering and leveling turntable supplied as standard , freeing you from the centering and leveling task. The models are equipped with the A.A.T. (Automatic Adjustment Table).

Specifications

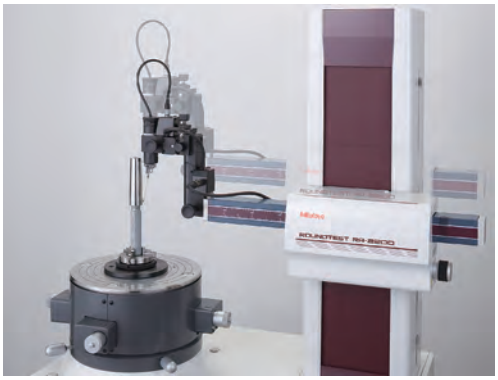
Turntable	
Rotational accuracy	**Radial:** (0,02+0,00035H)µm H: Measuring height from turntable surface (mm) **Axial:** (0,02+0,00035X)µm X: Radial distance from center (mm)
Rotational speed	2, 4, 6, 10 rpm
Max. probing Ø	300 mm
Max. workpiece Ø	580 mm
Max. turntable loading	30 kg
Centering range	**DS / DH:** ±5 mm **AS / AH:** ±3 mm
Leveling range	±1°
Vertical column	
Max. probing height	**AS / DS :** 300 mm **AH / DH:** 500 mm above turntable surface
Max. probing depth	85 mm (minimum ID : ø32 mm) 50 mm (minimum ID : ø7 mm)
Straightness	**AS / DS :** 0,10 µm / 100 mm **AS / DS :** 0,15µm / 300 mm **AH / DH:** 0,25 µm / 500 mm
Parallelism with rotation center	**AS / DS :** 0,7 µm / 300 mm **AH / DH:** 1,2µm / 500 mm
Horizontal axis	
Straightness	0,7 µm / 300 mm
Perpendicularity to rotation center	1 µm / 150mm
Software	**ROUNDPAK** FORMTRACEPAK-RA (optional for roughness detection unit)





ROUNDPAK
Simple to operate even with a full set of parameters and analysis functions.

RA-2200



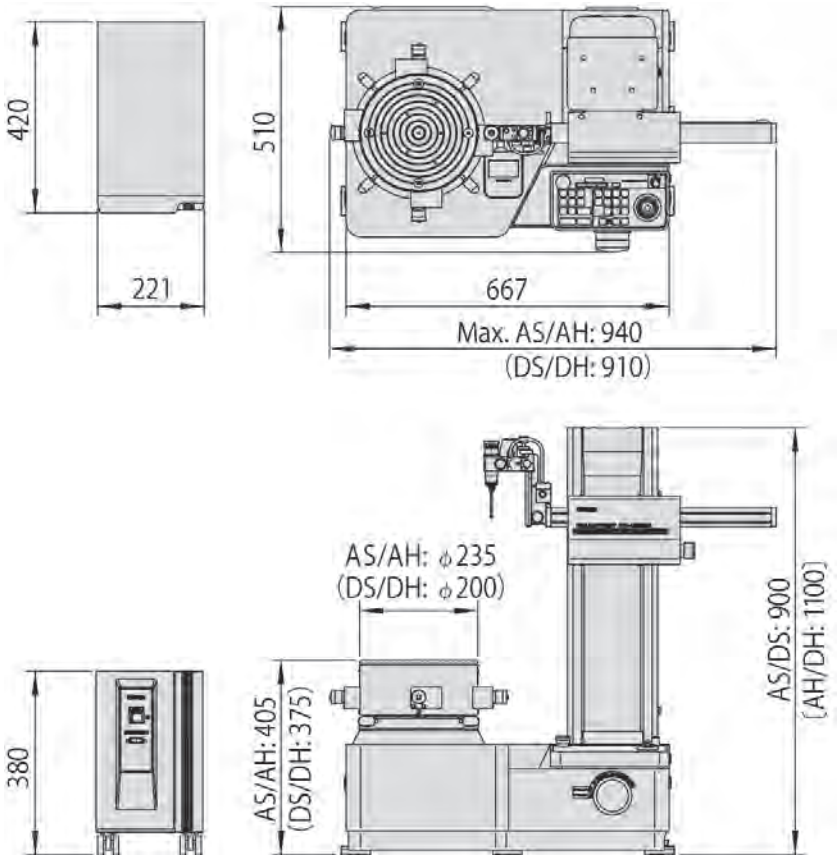
Automatic measurement

Mitutoyo

Roundtest RA-2200

Series 211 - Roundness/Cylindricity Measuring System

Accessories and dimensions



No.	Model	Centering/leveling adjustment 1*	Vertical travel [mm]	Max. workpiece ø [mm]	Max. probing Ø [mm]	Max. turntable loading [kg]
211-511D	RA-2200AS	AAT	300	580	300	30
211-512D	RA-2200AH	AAT	500	580	300	30
211-513D	RA-2200DS	DAT	300	580	300	30
211-515D	RA-2200DH	DAT	500	580	300	30

1* AAT : Automatic Adjustment Table
DAT : Digital Adjustment Table

Additional Specifications

Optional accessories	Other optional and standard accessories are listed later in this section for accessories and styli.

Optional accessories

No.	Description	Price €
211-014	Three jaw chuck OD: 2-78, ID: 25-68 mm	
211-031	Micro-chuck OD: 1-1,5 mm	
211-032	Quick chuck OD: 1-79, ID: 16-79 mm	
211-045	Magnification checking gauge	
12AAL019	Side table	
12AAF203	Double length detector holder	
12AAF204	Large diameter detector holder	
12AAK110	Vibration isolator	
12AAK120	Monitor arm	
356038	Auxiliary stage for a low-height workpiece	
12AAF353	Roughness detection unit	
178-396-2	Detector 0,75 mN	906.00

Roundtest RA-H5200

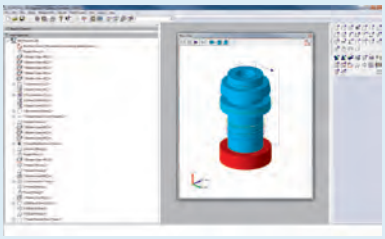
Series 211 - High-precision Form Measuring Instrument

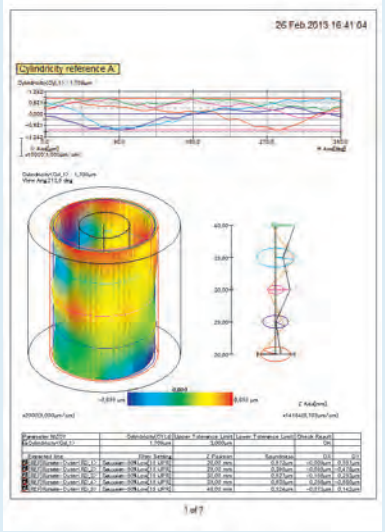
This is a highly accurate, precision form measuring system developed to give you the highest accuracy as well as high flexibility and analytical capability.
The Roundtest RA-H5200 offers the following benefits:

- Its integrated vibration isolator helps you to measure within the best conditions.
- It has a high measuring range and loading mass.
- The user friendly software, ROUNDPAK, gives you easy drag and drop usage and a wide range of parameters.
- ROUNDPAK also has easy-to-use part programming and single measurement functions.
- A.A.T. (Automatic Adjustment Table) gives you fully automatic centering and leveling.
- There is an auto follow function for easy and quick pre-centering of the workpiece.

Specifications

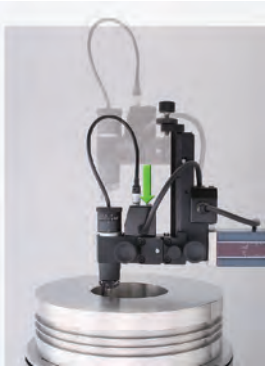
Turntable	
Rotational accuracy	**Radial:** (0,02+0,00035H)µm H: Measuring height from turntable surface (mm) **Axial:** (0,02+0,00035X)µm X: Radial distance from center (mm)
Rotational speed	2, 4, 6, 10 rpm
Max. probing Ø	400 mm
Max. workpiece Ø	680 mm
Max. turntable loading	65 kg 80 kg without auto centering
Centering range	±5 mm
Leveling range	±1°
Vertical column	
Max. probing height	**AS :** 350 mm **AH:** 550 mm above turntable surface
Max. probing depth	85 mm (minimum ID : ø32 mm) 50 mm (minimum ID : ø7 mm)
Straightness	**AS / AH :** 0,05 µm / 100 mm **AS :** 0,14µm / 350 mm **AH :** 0,20 µm / 550 mm
Parallelism with rotation center	**AS :** 0,20 µm / 350 mm **AH :** 0,32µm / 550 mm
Horizontal axis	
Straightness	0,4 µm / 200 mm
Perpendicularity to rotation center	0,5 µm / 200 mm
Software	**ROUNDPAK** FORMTRACEPAK-RA (optional for roughness detection unit)





ROUNDPAK
Simple to operate even with a full set of parameters and analysis functions.

Highly accurate, automatic centering/leveling turntable
The performance of this turntable has been achieved through exceptional manufacturing accuracy of the critical components, in addition to a high-accuracy air-bearing that provides superior rigidity. The resulting rotational accuracy, the heart of a Roundtest measuring system, is world-class at 0.02+0.00035H µm.



Sliding detector-unit holder provided as a standard feature
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.

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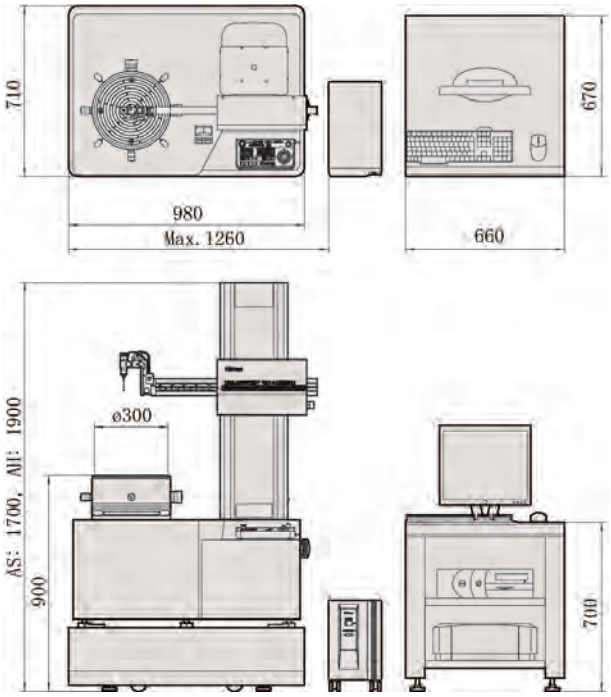
Roundtest RA-H5200

Series 211

Dimensions and accessories

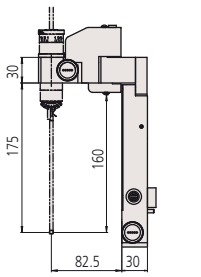


Dimensions

No.	Model	Centering/leveling adjustment 1*	Vertical travel [mm]	Max. workpiece ø [mm]	Max. probing Ø [mm]	Max. turntable loading [kg]
211-531D	RA-H5200AS	AAT	350	680	400	65
211-532D	RA-H5200AH	AAT	550	680	400	65

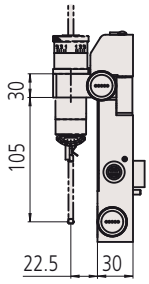
1* AAT : Automatic Adjustment Table

mm



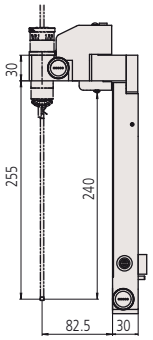
12AAF203

mm



12AAF204

mm



12AAF205

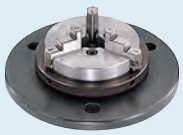
Additional Specifications

Optional accessories	Other optional and standard accessories are listed later in this section for accessories and styli.

Optional accessories

No.	Description	Price €
211-014	Three jaw chuck OD: 2-78, ID: 25-68 mm	
211-031	Micro-chuck OD: 1-1,5 mm	
211-032	Quick chuck OD: 1-79, ID: 16-79 mm	
211-045	Magnification checking gauge	
12AAL019	Side table	
12AAF203	Double length detector holder	
12AAF204	Large diameter detector holder	
12AAF205	Triple length holder for extra-deep holes	
12AAF353	Roughness detection unit	
178-396-2	Detector 0,75 mN	906.00

211-014



211-032

211-031

211-045

Roundtest Extreme RA-2200CNC

Series 211 - High-precision Form Measuring Instrument

This is a fully automatic CNC form measuring instrument that gives highly accurate results.
The Roundtest Extreme RA-2200CNC offers you the following benefits:

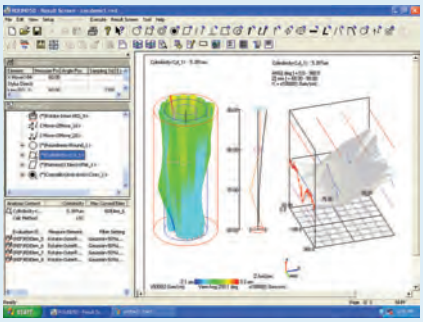
- It has a CNC controlled measuring system with orientation steps of 1°.
- The extremely high turntable accuracy of (0.02+0.00035H)µm gives you highly accurate form analysis.
- The user friendly software, ROUNDPAK, gives you easy drag and drop usage and a wide range of parameters.
- ROUNDPAK also has easy-to-use part programming and single measurement functions.
- An automatic centering and leveling turntable A.A.T. (Automatic Adjustment Table) is supplied as standard, freeing you from the centering and leveling task.

Specifications

Rotational accuracy	**Radial:** (0,02+0,00035H)µm H: Measuring height from turntable surface (mm) **Axial:** (0,02+0,00035X)µm X: Radial distance from center (mm)
Rotational speed	2, 4, 6, 10 rpm
Max. probing Ø	256 mm
Max. workpiece Ø	580 mm
Max. turntable loading	30 kg
Centering range	±3 mm
Leveling range	±1°
Vertical column	
Max. probing height	**AS :** 300 mm **AH:** 500 mm above turntable surface
Max. probing depth	104 mm (minimum ID : ø32 mm) 26 mm (minimum ID : ø12,7 mm)
Straightness	**AS / AH :** 0,10 µm / 100 mm **AS :** 0,15 µm / 300 mm **AH :** 0,25 µm / 500 mm
Parallelism with rotation center	**AS :** 0,70 µm / 300 mm **AH :** 1,20 µm / 500 mm
Horizontal axis	
Straightness	0,7 µm / 150 mm
Perpendicularity to rotation center	1,0 µm / 150 mm
Software	**ROUNDPAK** FORMTRACEPAK-RA (optional for roughness detection unit)

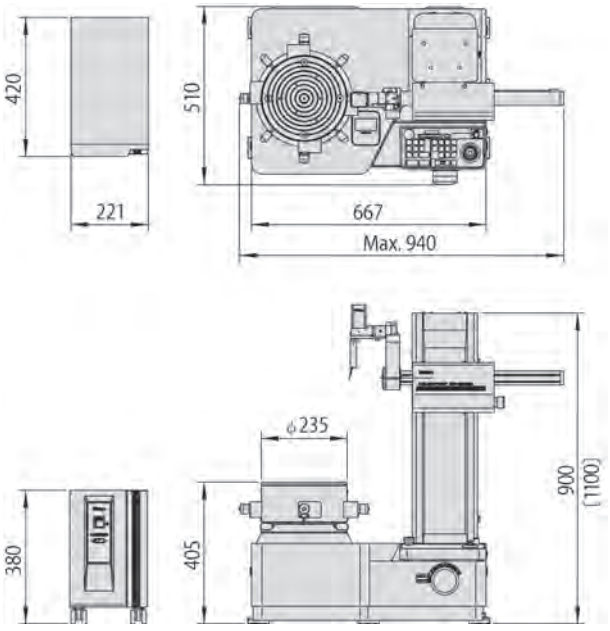
Optional accessories

No.	Description
12AAL019	Side table
12AAK110	Vibration isolator
12AAK120	Monitor arm
12AAG419	Roughness detection unit CNC (0,75mN)



ROUNDPAK
Simple to operate even with a full set of parameters and analysis functions.

RA-2200 CNC
+ optional vibration isolator [12AAK110]
and side table [12AAL019]



No.	Centering/leveling adjustment 1*	Vertical travel [mm]	Max. work-piece ø [mm]	Model	Max. probing Ø [mm]	Max. turntable loading [kg]
211-517D	AAT	300	580	RA-2200CNC AS	256	30
211-518D	AAT	500	580	RA-2200CNC AH	256	30

1* AAT : Automatic Adjustment Table

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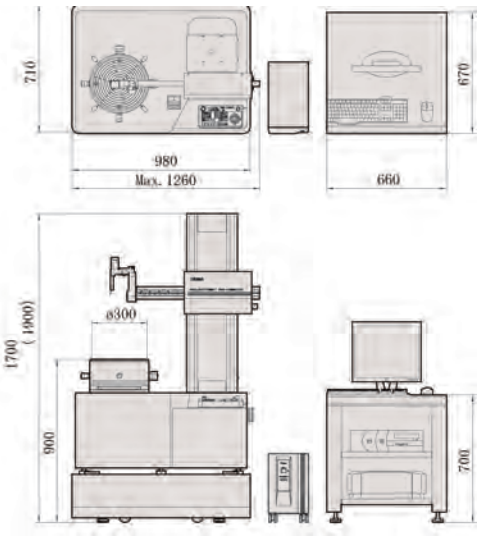
Roundtest Extreme RA-H5200CNC

Series 211 - High-precision Roundness/Cylindricity Measuring System

This is a CNC form measuring instrument that combines high accuracy with automatic CNC measurements.
The Roundtest Extreme RA-5200CNC offers you the following benefits:

- An integrated vibration isolator helps you to measure within best conditions.
- It will greatly improve your productivity and efficiency.
- You can take highly accurate, fast and operator-free measurements.
- The user friendly software, ROUNDPAK, gives you easy drag and drop usage and a wide range of parameters.
- ROUNDPAK also has easy-to-use part programming and single measurement functions.
- An automatic centering and leveling turntable A.A.T. (Automatic Adjustment Table) is supplied as standard, freeing you from the centering and leveling task.

RA-H5200CNC
+ side table [12AAL019]



Dimensions

No.	Model	Centering/leveling adjustment 1*	Vertical travel [mm]	Max. work-piece ø [mm]	Max. probing Ø [mm]	Max. turntable loading [kg]
211-533D	RA-H5200CNC AS	AAT	350	680	356	65
211-534D	RA-H5200CNC AH	AAT	550	680	356	65

1* AAT : Automatic Adjustment Table

Specifications

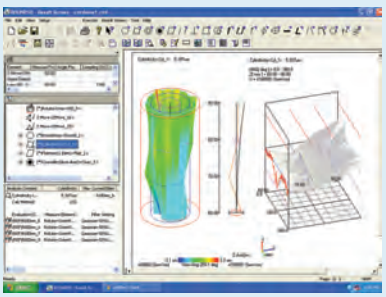
Turntable	
Rotational accuracy	**Radial:** (0,02+0,00035H)µm H: Measuring height from turntable surface (mm) **Axial:** (0,02+0,00035X)µm X: Radial distance from center (mm)
Rotational speed	2, 4, 6, 10 rpm Auto centering: 20 rpm
Max. probing Ø	356 mm
Max. workpiece Ø	680 mm
Max. turntable loading	65 kg 80 kg without auto centering
Centering range	±5 mm
Leveling range	±1°
Vertical column	
Max. probing height	**AS :** 350 mm **AH:** 550 mm above turntable surface
Max. probing depth	104 mm (minimum ID : ø32 mm) 26 mm (minimum ID : ø12,7 mm)
Parallelism with rotation center	**AS :** 0,20 µm / 350 mm **AH :** 0,32 µm / 550 mm
Horizontal axis	
Straightness	0,4 µm / 200 mm
Perpendicularity to rotation center	0,5 µm / 200 mm
Software	**ROUNDPAK** FORMTRACEPAK-RA (optional for roughness detection unit)

Additional Specifications

Optional accessories	Other optional and standard accessories are listed later in this section for accessories and styli.

Optional accessories

No.	Description
12AAL019	Side table
12AAG419	Roughness detection unit CNC (0,75mN)



ROUNDPAK
Simple to operate even with a full set of parameters

Optional Styli for Roundtest

Interchangeable styli for RA-10, RA-120, RA-120P, RA-1600, RA-2200, RA-H5200

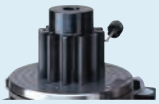
Standard accessories

No.	Description
12AAL021	Stylus standard type

Optional accessories

No.	Description
12AAL022	Stylus for notches
12AAL023	Stylus for deep grooves
12AAL024	Stylus for corner
12AAL025	Stylus for cutter marks
12AAL026	Stylus ø0,8 mm for small holes
12AAL027	Stylus ø1 mm for small holes
12AAL028	Stylus ø1,6 mm for small holes
12AAL029	Stylus ø0,5 mm for extra small holes
12AAL030	Stylus ø1,6 mm ball type
12AAL031	Stylus disc type
12AAL032	Stylus ø0,5 mm for cranks
12AAL033	Stylus ø1 mm for cranks
12AAL034	Stylus for flat surfaces
12AAL035	Stylus 2x-long standard type *1
12AAL036	Stylus 2X-long type for notches *1
12AAL037	Stylus 2X-long type for deep grooves *1
12AAL038	Stylus 2X-long type for corners *1
12AAL039	Stylus 2X-long type for cutter marks *1
12AAL040	Stylus 2X-long type ø1 mm for small holes *1
12AAL041	Stylus 3X-long standard type *1 *2
12AAL042	Stylus 3X-long type for deep grooves *1 *2
12AAL043	Stylus shank
12AAL044	Stylus shank for grooves
12AAL045	Stylus shank 2X-long type for grooves *1

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


Notches


Flat surface

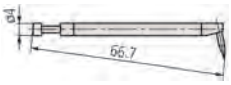

Cutter marks


Corner

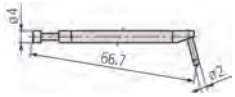

Small hole

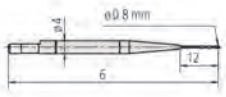

12AAL021 - Standard
ø 1,6 mm tungsten carbide


12AAL022 - Notch
ø 3 mm tungsten carbide

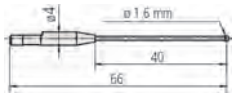

12AAL023 - Deep groove
R 0,25 mm sapphire

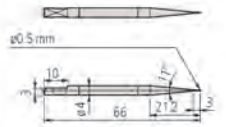

12AAL024 - Corner
R 0,25 mm sapphire

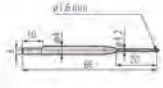

12AAL025 - Cutter mark
R 15 mm tungsten carbide

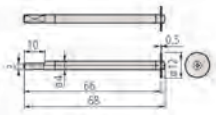

12AAL026 - Small hole
ø 0,8 mm tungsten carbide


12AAL027- Small hole
ø 1 mm tungsten carbide


12AAL028 - Small hole
ø 1,6 mm tungsten carbide

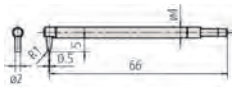

12AAL029- Extra small hole
ø 0,5 mm tungsten carbide

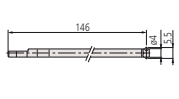

12AAL030- ø 1,6 mm ball
ø 1,6 mm tungsten carbide


12AAL031- Disc
ø 12 mm


12AAL032- Crank
ø 0,5 mm tungsten carbide

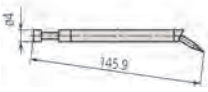

12AAL033- Crank
ø 1 mm tungsten carbide


12AAL034- Flat surface
Tungsten carbide


12AAL035- 2X-long standard
ø 1,6 mm tungsten carbide

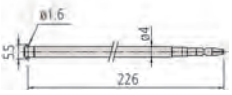

12AAL036- 2X-long notch
ø 3 mm tungsten carbide

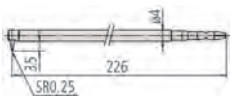

12AAL037- 2X-long deep groove
R 0,25 mm sapphire

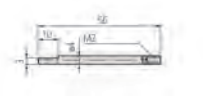

12AAL038- 2X-long corner
R 0,25 mm sapphire


12AAL039- 2X-long type cutter mark
R 15 mm tungsten carbide


12AAL040- 2X-long small hole
ø 1 mm tungsten carbide


12AAL041- 3X-long standard
ø 1,6 mm tungsten carbide


12AAL042- 3X-long deep groove
R 0,25 mm sapphire


12AAL043- Stylus shank
for mounting M2 - CMM stylus


12AAL044- Stylus shank groove
for mounting M2 - CMM stylus


12AAL045- Stylus shank 2X groove
for mounting M2 - CMM stylus

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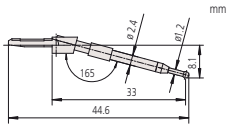
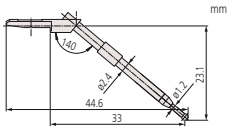
Optional Styli for Roundtest

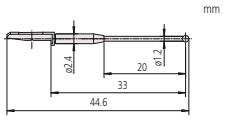
Interchangeable styli for RA-2200CNC, RA-H5200CNC



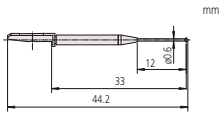
12AAE301 - Standard
ø 1,6 mm tungsten carbide



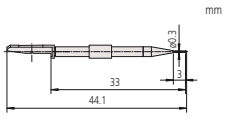
12AAE302 - Flat surface
ø 1,6 mm tungsten carbide



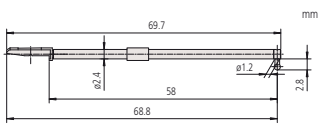
12AAE303 - ø 1,6 mm ball
ø 1,6 mm tungsten carbide



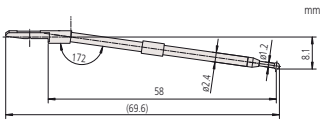
12AAE304 - ø 0,8 mm ball
ø 0,8 mm tungsten carbide



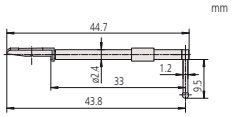
12AAE305 - ø 0,5 mm ball
ø 0,5 mm tungsten carbide



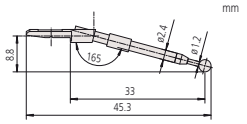
12AAE306 - Deep hole
ø 1,6 mm tungsten carbide



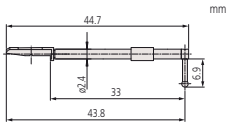
12AAE307 - Deep hole
ø 1,6 mm tungsten carbide



12AAE308 - Deep groove
ø 1,6 mm tungsten carbide



12AAE309 - Notch
ø 3 mm tungsten carbide



12AAE310 - Groove
ø 1,6 mm tungsten carbide

Standard accessories

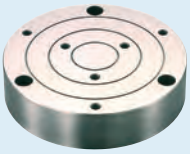
No.	Description
12AAE301	Stylus standard type for CNC
12AAE302	Stylus for flat surfaces for CNC

Optional accessories

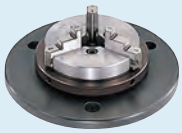
No.	Description	Price €
12AAE303	Stylus ball ø1,6 mm for CNC	418.00
12AAE304	Stylus ball ø0,8 mm for CNC	418.00
12AAE305	Stylus ball ø0,5 mm for CNC	418.00
12AAE306	Stylus for deep holes for CNC	418.00
12AAE307	Stylus for deep holes for CNC	418.00
12AAE308	Stylus for deep grooves for CNC	418.00
12AAE309	Stylus for notches for CNC	418.00
12AAE310	Stylus for grooves for CNC	418.00

Optional Accessories for Roundtest

Optional accessories for Roundtest and Roundtest Extreme



356038

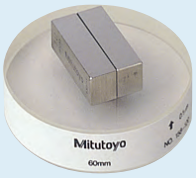


211-032

211-031

211-014

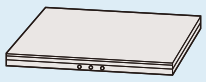
350850



997090

211-045

998382



178-025

Auxiliary stage for a low-height workpiece

No.	Description
356038	Used for measuring a workpiece whose diameter is 40 mm or less and whose height is 20 mm or less

Chuck - Quick chuck

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

No.	Holding capacity [mm]	External dimensions [mm]
211-032.	Internal jaw: ID = ø 16 - 69 External jaw: OD = ø 1 - 79	ø118 x 41
211-031.	Internal jaw: ø 0,1 - 1,5	ø 107 x 48,5

Chuck - Three jaw chuck (key operated)

No.	Holding capacity [mm]	External dimensions [mm]
211-014	Internal jaw: ID = ø 25 - 68 Internal jaw: OD = ø 2 - 35 External jaw: OD = ø 35 - 78	ø157 x 70,6

Cylindric square

No.	Cylindricity [µm]	Roundness [µm]	Squareness [µm]	Straightness [µm]
350850	2	0,5	3	1

Gauge block set for calibration

No.	Description
997090	Standard accessory for RA-2200,RA-2200CNC Standard accessory for RA-H5200 and RA-H5200CNC

Magnification checking gauge

No.	Max. calibration range [µm]	Graduation [µm]
211-045	400	0,2

Origin point gauge

No.	Description
998382	Standard accessory for RA-1600, RA-2200 and RA-H5200

Vibrator isolator and accessories

No.	Vibration isolation method	External dimensions [mm]	Description
178-025	Air suspension Diaphragm isolation system	(WxDxH) 750x550x59	For RA-2200 and RA-2200CNC
178-024			Stand for RA-2200 and RA-2200CNC
12AAL019		660 x 670 x 700	Side table
12AAK110		830 x 800 x 700	Vibration isolator
12AAK120			Monitor arm

12AAK110 + 12AAK120

12AAK110 + 12AAL019

Mitutoyo

Quick Guide to Precision Measuring Instruments

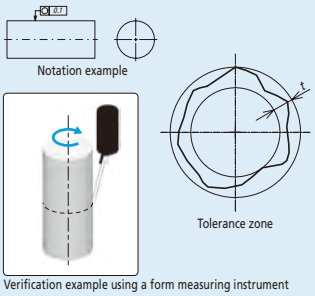
Roundtest (Form Measuring Instruments)

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

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

Roundness

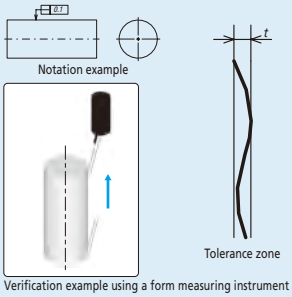
Any circumferential line must be contained within the tolerance zone formed between two coplanar circles with a difference in radii of t



Verification example using a form measuring instrument

Straightness

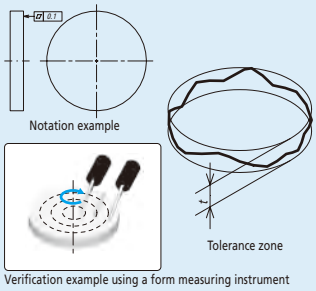
Any line on the surface must lie within the tolerance zone formed between two parallel straight lines a distance t apart and in the direction specified



Verification example using a form measuring instrument

Flatness

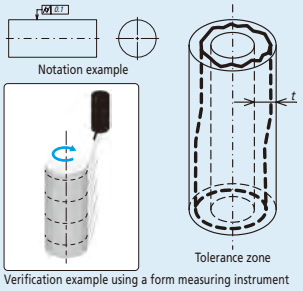
The surface must be contained within the tolerance zone formed between two parallel planes a distance t apart



Verification example using a form measuring instrument

Cylindricity

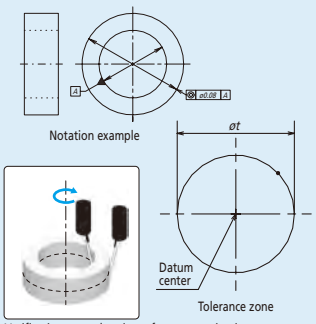
The surface must be contained within the tolerance zone formed between two coaxial cylinders with a difference in radii of t



Verification example using a form measuring instrument

Concentricity

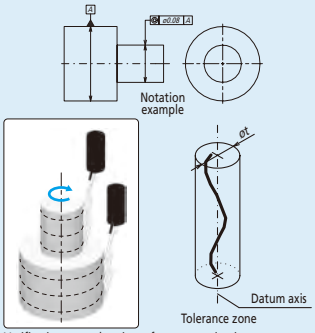
The center point must be contained within the tolerance zone formed by a circle of diameter t concentric with the datum



Verification example using a form measuring instrument

Coaxiality

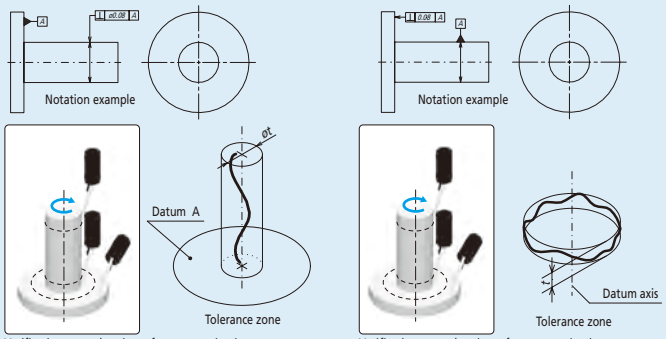
The axis must be contained within the tolerance zone formed by a cylinder of diameter t concentric with the datum



Verification example using a form measuring instrument

Perpendicularity

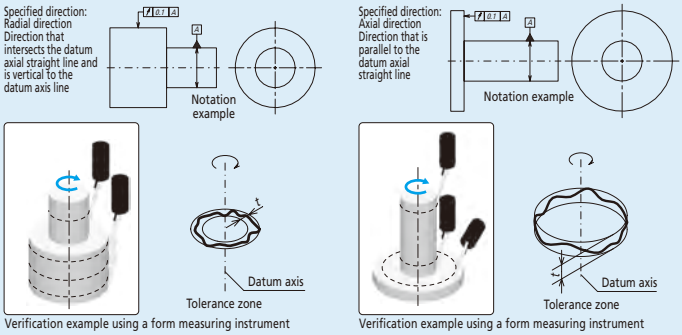
The line or surface must be contained within the tolerance zone formed between two planes a distance t apart and perpendicular to the datum



Verification example using a form measuring instrument

Circular Runout

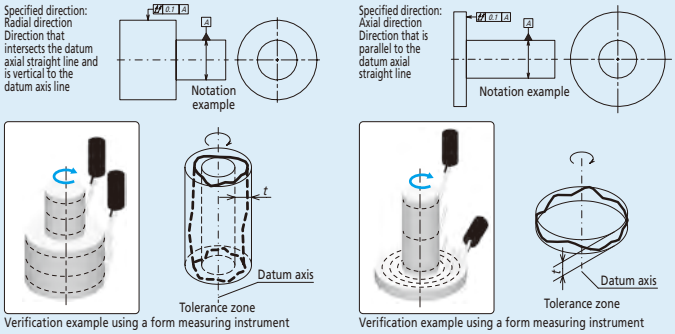
The line must be contained within the tolerance zone formed between two coplanar and/or concentric circles a distance t apart concentric with or perpendicular to the datum



Verification example using a form 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

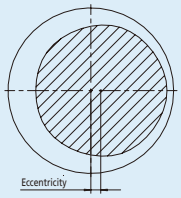


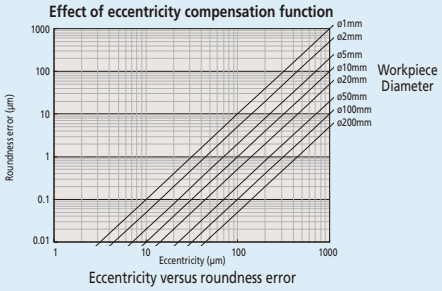
Verification example using a form measuring instrument

Adjustment prior to Measurement

Centering

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

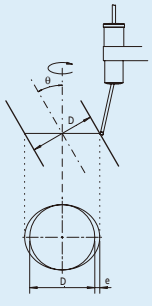


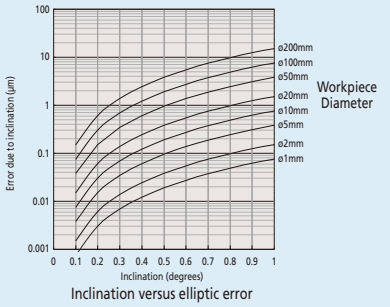


Eccentricity versus roundness error

Leveling

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



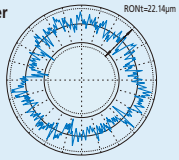


Inclination versus elliptic error

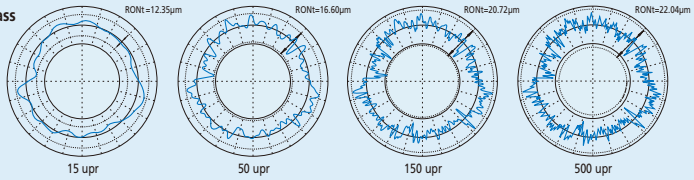
Effect of Filter Settings on the Measured Profile

Roundness (RONt) 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

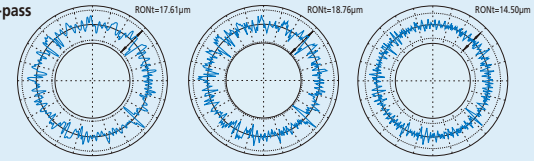


Low-pass filter



15 upr　50 upr　150 upr　500 upr

Band-pass filter



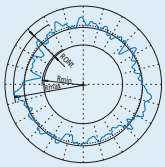
15-150 upr　15-500 upr　50-500 upr

Evaluating the Measured Profile Roundness

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

Least Square Circle (LSCI) Method

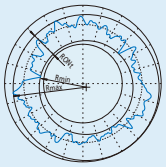
A circle is fitted to the measured profile such that the sum of the squares of the departure of the profile data from this circle is a minimum. The roundness figure is then defined as the difference between the maximum departures of the profile from this circle (highest peak to the lowest valley).



RONt = Rmax-Rmin

Minimum Zone Circles (MZCI) Method

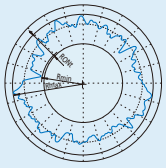
Two concentric circles are positioned to enclose the measured profile such that their radial difference is a minimum. The roundness figure is then defined as the radial separation of these two circles.



RONt = Rmax-Rmin

Minimum Circumscribed Circle (MCC) Method

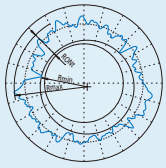
The smallest circle that can enclose the measured profile is created. The roundness figure is then defined as the maximum departure of the profile from this circle. This circle is sometimes referred to as the 'ring gage' circle.



RONt = Rmax-Rmin

Maximum inscribed Circle (MICI) Method

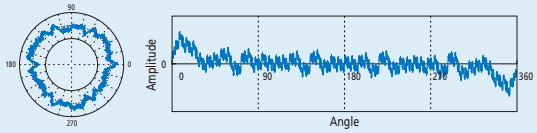
The largest circle that can be enclosed by the profile data is created. The roundness figure is then defined as the maximum departure of the profile from this circle. This circle is sometimes referred to as the 'plug gage' circle.



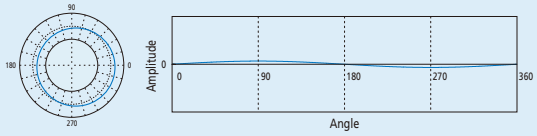
RONt = Rmax-Rmin

Undulations Per Revolution (UPR) data in the roundness graphs

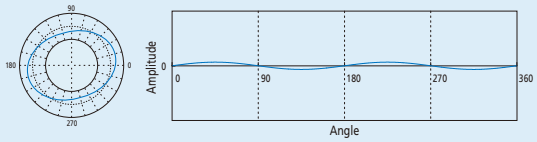
Measurement result graphs



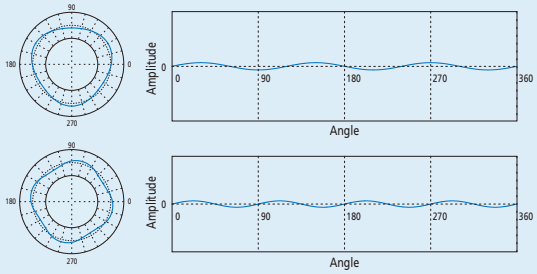
A 1 UPR condition indicates eccentricity of the workpiece relative to the rotational axis of the measuring instrument. The amplitude of undulation components depends on the leveling adjustment.



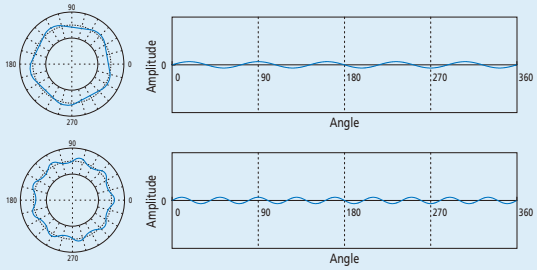
A 2 UPR condition may indicate: (1) insufficient leveling adjustment on the measuring instrument; (2) circular runout due to incorrect mounting of the workpiece on the machine tool that created its shape; (3) the form of the workpiece is elliptical by design as in, for example, an IC-engine piston.



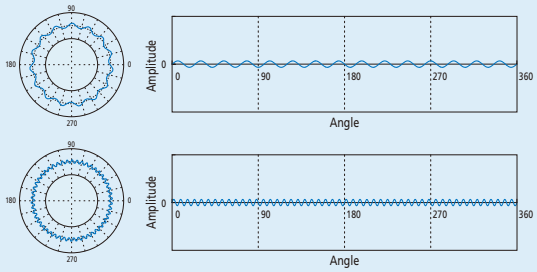
A 3 to 5 UPR condition may indicate: (1) Deformation due to over-tightening of the holding chuck on the measuring instrument; (2) Relaxation deformation due to stress release after unloading from the holding chuck on the machine tool that created its shape.



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



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



Mitutoyo