

# Surftest SJ-400

Bulletin No. 2013



Portable Surface Roughness Tester

**Mitutoyo**

# Surftest SJ-400 Series

Revolutionary New Portable Surface Roughness Testers Make Their Debut  
Long-awaited performance and functionality are here: compact design, skidless and high-accuracy roughness measurements, multi-functionality and ease of operation.

## Requirement

# 1

### High-accuracy measurements with a hand-held tester

A wide range, high-resolution detector and an ultra-straight drive unit provide class-leading accuracy.

#### Detector

Measuring range: 800 $\mu$ m  
Resolution: 0.000125 $\mu$ m (on 8 $\mu$ m range)

#### Drive unit

Straightness/traverse length  
SJ-401: 0.3 $\mu$ m/.98" (25mm)  
SJ-402: 0.5 $\mu$ m/1.96" (50mm)



## Requirement

# 3

### Cylinder surface roughness measurements with a hand-held tester

The skidless measurement and R-surface compensation functions make it possible to evaluate cylinder surface roughness.



## Requirement

# 2

### Roughness parameters that conform to international standards

The SJ-400 Series can evaluate 36 kinds of roughness parameters conforming to the latest ISO, DIN, and ANSI standards, as well as to JIS standards (1994/1982).

## Requirement

# 4

### Measurement/evaluation of stepped features and straightness

Ultra-fine steps, straightness and waviness are easily measured by switching to skidless measurement mode. The ruler function enables simpler surface feature evaluation on the LCD monitor.

**Mitutoyo**

## Requirement

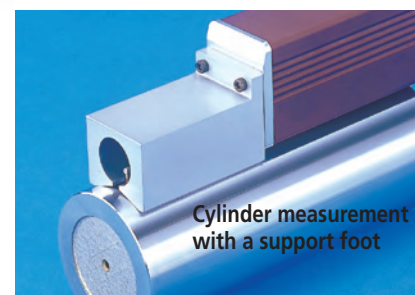
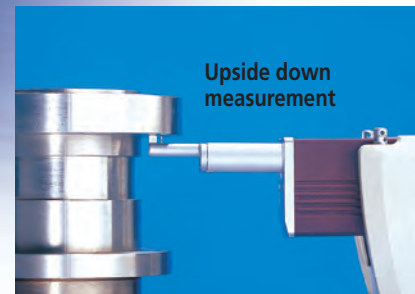
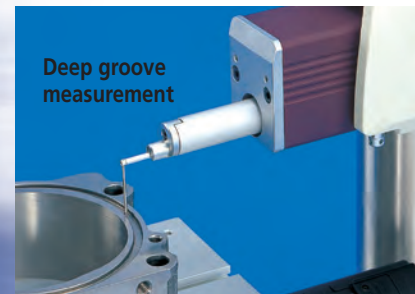
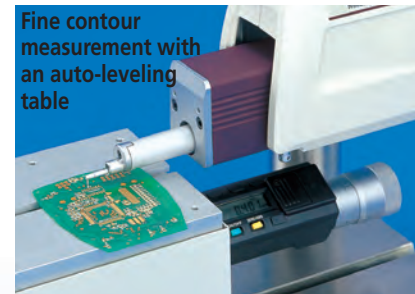
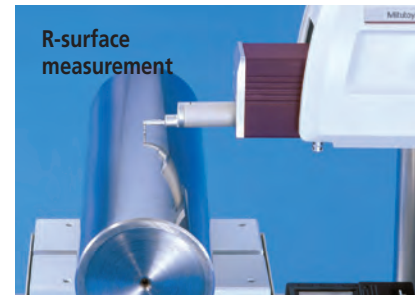
# 5

### Advanced data processing with extended analysis

The SJ-400 Series allows data processing identical to that in the high-end class. These data analysis and report creation capabilities are achieved using the surface roughness analysis program FORMTRACEPAK V5 or SJ-Tools.



## Measurement Applications

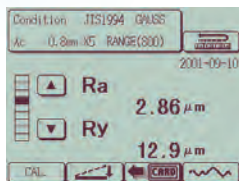


## Requirement

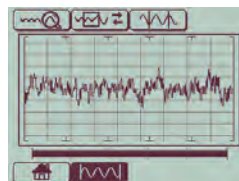
# 6

### Confirmation of measurement results and assessed profiles without a printout

The large, integrated, touch-panel LCD monitor clearly displays evaluation results and measured profiles.



Calculation Result Screen



Measured Profile Screen

# The SJ-400 Series Performs Skidless Measurements

The SJ-400 Series detector uses interchangeable nosepieces that allow skid or skidless measurements to suit the type of measurement required.

### Skidless measurement

- Skidless measurement is where surface features are measured relative to the drive unit reference surface. This measures waviness and finely stepped features accurately, in addition to surface roughness, but range is limited to the stylus travel available.
- The SJ-400 series supports a variety of surface feature measurements simply by replacing the stylus.

### Skidded measurement

- In skidded measurements, surface features are measured with reference to a skid following close behind the stylus. This cannot measure waviness and stepped features exactly but measuring range is greater because the skid tracks the workpiece surface contour.

### Tilt compensation function

- The Tilt Compensation Datum Points are selectable from all of the profile (choose P1 and P2) or any arbitrary two sections on the profile (choose P1, P2, P3 and P4), as required. If you choose adjacent sections for tilt compensation then the characteristics of features of interest between these sections, such as scratch depth, etc, can be measured directly.

Datum Point	Distance (mm)
P1	1.00
P2	1.50
P3	2.50
P4	3.00

### Simplified surface feature evaluation with the ruler function

- This function determines the coordinate difference between two arbitrary points so feature characteristics, such as step height and width, etc, can be measured.

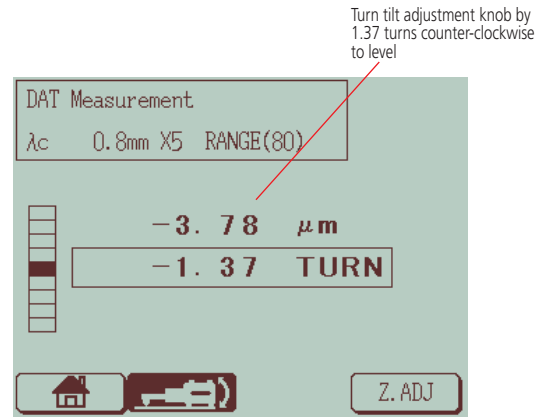
**Ruler Analysis Screen**

Coordinate difference: X=0.99mm, Z=38.53µm

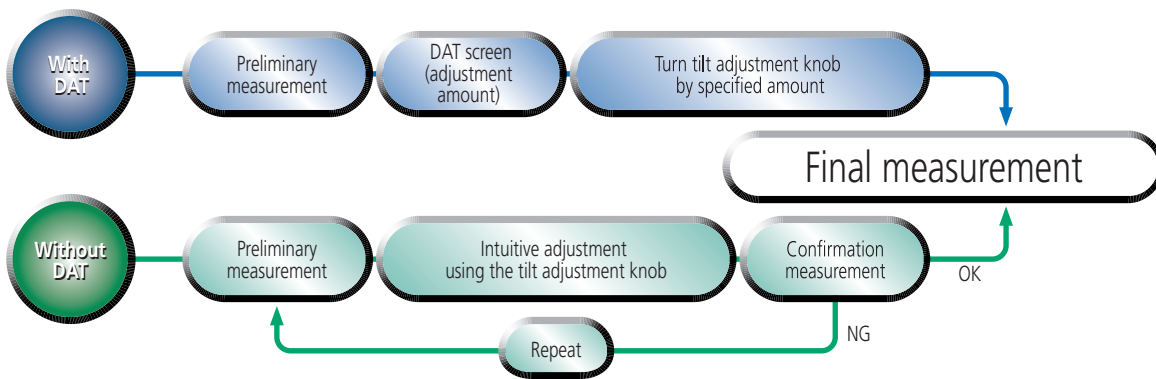
# Powerful Support for Leveling

The height/tilt adjustment unit comes as standard for leveling the drive unit prior to making skidless measurements and, supported by guidance from the unique DAT function, makes it easy to achieve highly accurate alignment.

## The DAT Function



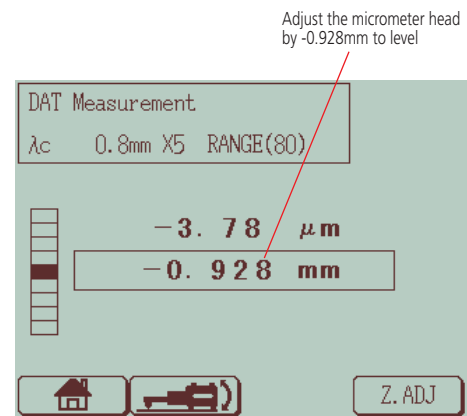
DAT screen guides the user when leveling



## DAT Function for the optional leveling table



With the SJ-400 mounted on a stand, the DAT function also works with the optional leveling table.

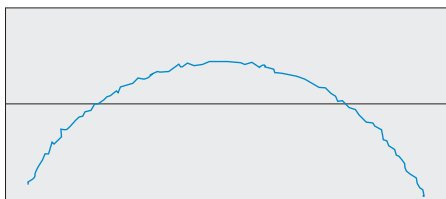


DAT screen guides the user when leveling

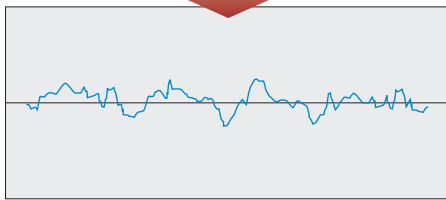
# More Measuring Functions Than Expected From a Compact Tester

## Measuring curved-surface roughness (skidless measurement)

Usually, a spherical or cylindrical surface (R-surface) cannot be evaluated, but, by removing the radius with a filter, R-surface data is processed as if taken from a flat surface.



Actual profile  
R-Surface compensation

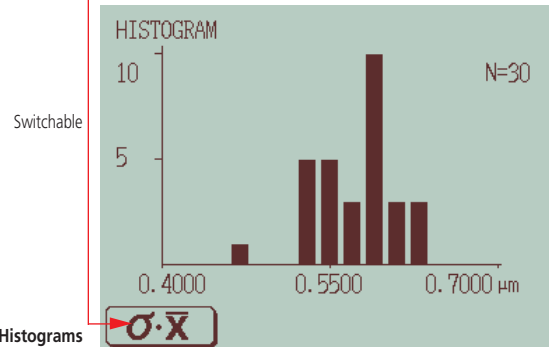


Filtered profile

## Statistics

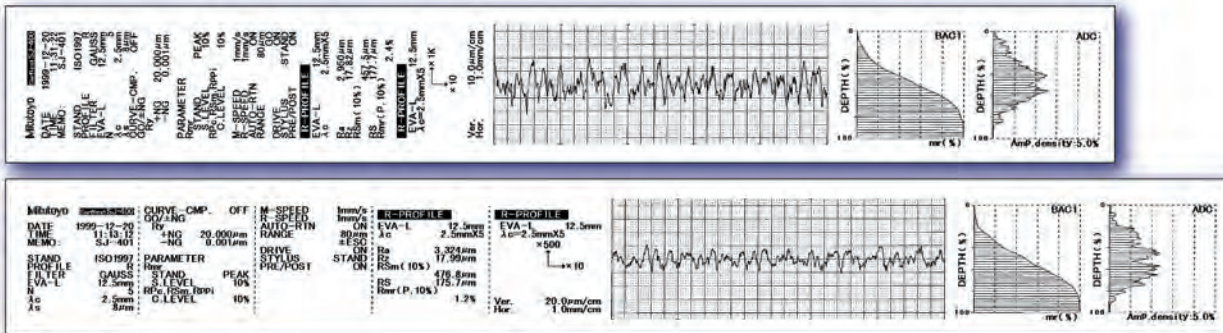
Statistical processing can be performed on multiple measurements for one roughness parameter. Histograms can be displayed and printed in addition to statistical results (mean, standard deviation, maximum/minimum value and acceptance ratio).

Statistics		2000-02-16
<b>Ra</b>		SAMPLE NUM (030)
$\bar{x}$		0.575 $\mu\text{m}$
$\sigma$		0.034 $\mu\text{m}$
MAX		0.631 $\mu\text{m}$
MIN		0.477 $\mu\text{m}$
PASS RATIO		100.0%



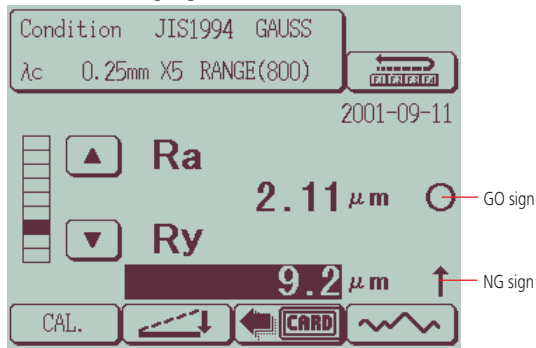
## Built-in thermal printer

A high quality, high-speed thermal printer prints out measured results. It can also print a BAC curve or an ADC curve as well as calculated results and assessed profiles. These results and profiles are printed out in landscape format, just as they appear on the LCD, in easy-to-understand form.



## GO/NG indication

Upper and lower tolerance limits can be set for up to 3 roughness parameters. A GO/NG indication is displayed after a measurement. The calculation result is highlighted if NG.



Calculation Result Screen with GO / NG judgment result

## Real sampling

This function samples stylus displacement for a specified time without engaging detector traverse. This function has a wide range of uses, such as a simplified vibration meter or a displacement gage incorporated in another system.

## Recalculating

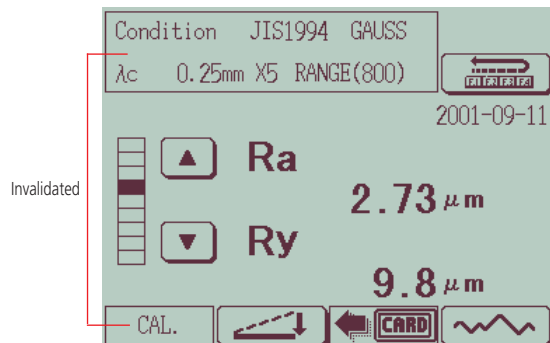
Previously measured data can be recalculated for use in other evaluations by changing the current standard, assessed profile and roughness parameters.

## Arbitrary length measurement

This function allows a sampling length to be arbitrarily set in .004" (0.1mm) increments SJ-401: .004" to .98" (0.1mm to 25mm), SJ-402: .004" to 1.96" (0.1mm to 50mm). It also allows the SJ-400 Series to make both narrow and wide range measurements.

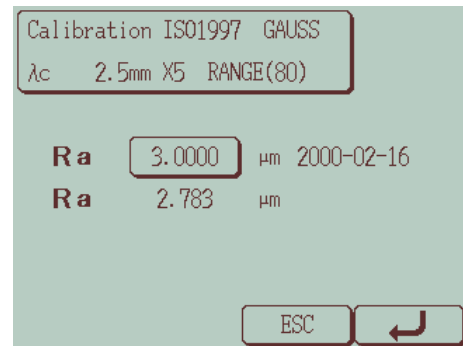
## Key masking

Locks out input from the touch panel keys. This eliminates the possibility of the operator accidentally changing the calibration or measurement conditions.



## Auto-Calibration

The SJ-400 Series is equipped with Ra calibration and step calibration methods for detector calibration (gain adjustment). In both calibration methods only the calibrated value of the precision specimen needs to be entered. No other operations are required to calibrate the tester.



Calibration Screen

## Storing/recalling measured data and conditions

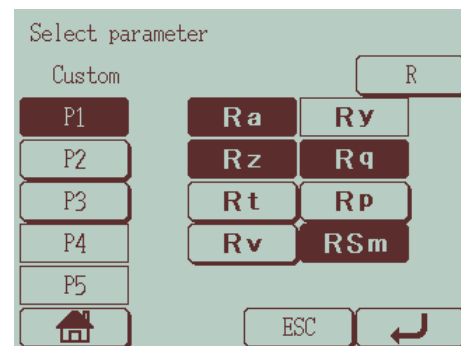
The measurement conditions and data can be stored in the control unit or memory card (optional) and recalled as required. Batch printout of data after on-site measurement improves measuring efficiency.

### Storage capacity

Measurement conditions	Control unit: 5 conditions Memory card: 20 conditions
Measurement data	Memory card: 50 or more pieces of data

## Customizing

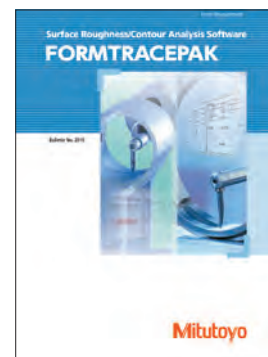
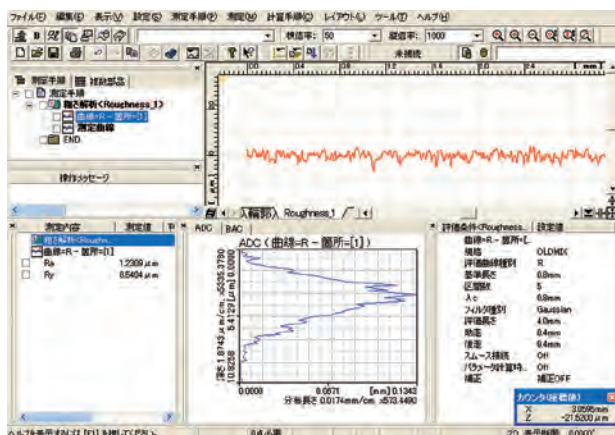
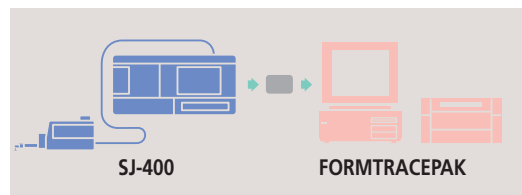
The SJ-400 Series can be set up to calculate and display only a subset of the roughness parameters available. Parameters can be added later for recalculation, if required.



Customized Screen

# Wide Choice of Evaluation Possibilities with Analyzing Program FORMTRACEPAK V5

SJ-400 Series measurement data can be transferred into FORMTRACEPAK V5 by using a memory card (Optional) for detailed analysis.



See the FORMTRACEPAK brochure (Bulletin No. 2010) for more details.

## Simplified Communication Program (SJ Tools)

One of the various functions of the SurfTest SJ-400 Series is the ability to use RS-232 with a simplified communication program that allows the transfer of measurement data into a calculation software. The program must be used with Microsoft Excel to generate the inspection report and/or certificate.

This program can be downloaded for free from the Mitutoyo website.  
<http://www.mitutoyo.co.jp>

### Required environment:

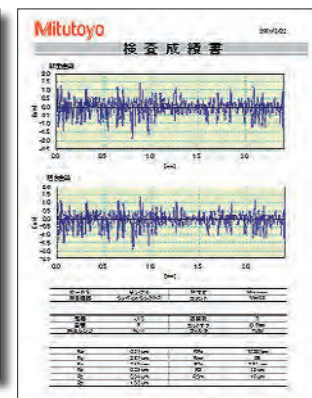
- \* OS: Windows 2000-SP4
- \* OS: Windows XP
- \* OS: Windows Vista
- \* OS: Windows 7
- \* Spreadsheet software: Microsoft Excel 2000
- \* Spreadsheet software: Microsoft Excel 2002
- \* Spreadsheet software: Microsoft Excel 2003
- \* Spreadsheet software: Microsoft Excel 2007

\*Windows OS & Microsoft Excel are products of Microsoft Corporation.

### Requires RS-232C cable (Optional)

SJ-400 Series RS-232C cable                      Order No. **12AAA882**

- \*RS-232C cable D-sub9pin x 2 (store purchase) is a straight cable.
- \*RS-232C ⇄ cannot be used in a USB connector.







Carrying case  
is a standard accessory

Inch/Metric

## Specification

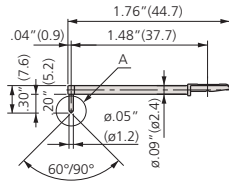
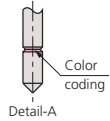
Order No.	SJ-401	178-947-4A (inch/mm)	178-957-4A (inch/mm)
	SJ-402	178-945-4A (inch/mm)	178-959-4A (inch/mm)
Measuring method	Skidless/Skidded measurement		
Measuring range	Z-axis	32000µin, 3200µin, 320µin (800µm, 80µm, 8µm) (Up to 2,400µm with an option stylus)	
	X-axis	SJ-401: 1" (25mm) SJ-402: 2" (50mm)	
Drive method	Straightness	SJ-401: 12µin/1" (0.3µm/25mm) SJ-402: 20µin/2" (0.5µm/50mm)	
	Measuring speed	.002", .004", .02", .04"/s (0.05, 0.1, 0.5, 1.0mm/s)	
	Return speed	.02", .04", .08"/s (0.5, 1.0, 2.0 mm/s)	
Height-Tilt adjustment unit	Tilt adjustment range	±1.5°	
	Height adjustment amount	.39" (10mm)	
Assessed profile	Primary profile (P), Roughness profile (R), Filtered waviness profile (W), DIN4776, MOTIF (R, W)		
Evaluation parameters	Ra, Ry, Rz, Rq, Pc, R3z, mr, Rt, Rp, Rv, Sm, S, δc, Rk, Rpk, Rvk, Mr1, Mr2, A1, A2, Lo, Ppi, R, AR, Rx, Δa, Δq, Ku, HSC, mrd, Sk, W, AW, Wte, Wx, Vo		
Analysis graphs	Bearing Area Curve (BAC), Amplitude Distribution Curve (ADC)		
Number of sampling length	X1, X3, X5, XL* (*=arbitrary length)		
Arbitrary length	SJ-401: .01" to 1" (.01" increments) [0.1 to 25mm (0.1mm increments)] SJ-402: .04" to 2" (.01" increments) [0.1 to 50mm (0.1mm increments)]		
Sampling length (L)	.003", .01", .03", .1", .3" (0.08, 0.25, 0.8, 2.5, 8mm)		
Printing width	1.89" (48mm)/paper width: 2.28" (58mm)		
Recording magnification	Vertical magnification	10 to 100K magnification, Auto	
	Horizontal magnification	1 to 1K magnification, Auto	
Detector	Detection method	Differential inductance method	
	Minimum resolution	.005µin (320µin range)/0.000125µm (8µm range)	
	Stylus tip	Cone 90°, Radius 5µm, Diamond	Cone 60°, Radius 2µm, Diamond
	Measuring force	4mN	0.75mN
	Radius of skid	1.57" (40mm)	
	Skid force	Less than 400mN	
Function	Customize	Display/Roughness parameter selectable	
	Data compensation	R-surface, Tilt compensation	
	Ruler function	Displays the coordinate difference of any two points	
	D.A.T. function	Helps to adjust leveling during skidless measurement	
	Displacement detection mode	Enables the stylus displacement to be input while the drive unit is stopped	
	Statistical processing	Maximum value, Minimum value, Mean value, Standard deviation (s), Pass ratio, Histogram	
	Tolerance judgment	Upper and lower limit values for three parameters can be specified	
	Measuring Condition storage	Five sets of measuring conditions (control unit)	
Printer	Thermal printer		
Cut-off length	.003", .01", .03", .1", .3" (0.08, 0.25, 0.8, 2.5, 8mm)		
Digital filter	2CR, PC75 (phase corrected), Gaussian		
Calibration	Ra, Step (Automatic calibration entering the value of roughness specimen)		
Power supply	Via AC adapter, built-in rechargeable battery (Ni-H)		
Battery	Charging time	15 hours	
	Number of measurements	600 maximum without printing	
Power consumption	43W (max.)		
Dimension	Control unit	12.09" x 6.50" x 3.7" (307 x 165 x 94mm)	
	Height-Tilt adjustment unit	5.16" x 2.48" x 3.90" (131 x 63 x 99mm)	
	Drive unit	SJ-401: 5.04" x 1.42" x 1.85" (128 x 36 x 47mm) SJ-402: 6.08" x 1.41" x 1.84" (155 x 36 x 47mm)	
Roughness standard	JIS (JIS B0601-2001/1994/1982), DIN, ISO, ANSI		
LCD size	Touch panel		
Data output	RS-232C input/output, SPC output		
External control	Connection to data processing system (option)		
Mass	Control unit	2.64lbs. (1.2kg)	
	Height-Tilt adjustment unit	1.88lbs. (0.4kg)	
	Drive unit	SJ-401: 1.32lbs. (0.6kg) SJ-402: 1.41lbs. (0.64kg)	
Standard accessories	AC adapter, Carrying case, Printing paper, Touch pen, Protect sheet, Skidless nosepiece, User's manual, one-sheet manual, tools		

# Optional Accessories

## Styli

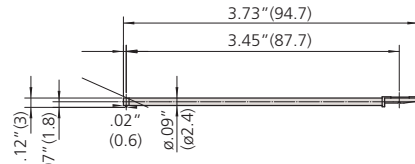
Unit: Inch(mm)

### Standard stylus



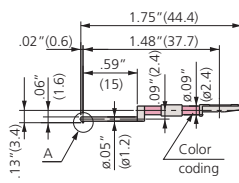
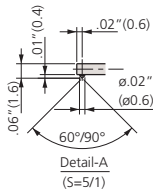
**12AAE882** [1μm]\*  
**12AAE924** [1μm]\*\*  
**12AAC731** [2μm]\*  
**12AAB403** [5μm]\*\*  
**12AAB415** [10μm]\*\*  
**12AAE883** [250μm]  
 [ ] : Tip radius  
 \*Tip angle: 60° \*\*Tip angle: 90°

### 2X long for deep hole



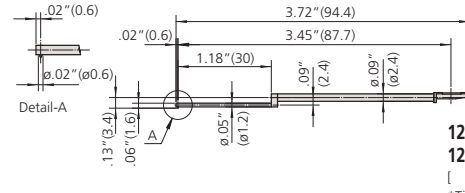
**12AAE898** [2μm]\*  
**12AAE914** [5μm]\*\*  
 [ ] : Tip radius  
 \*Tip angle: 60° \*\*Tip angle: 90°

### For small hole



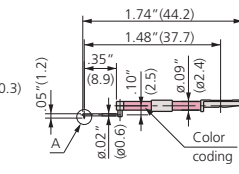
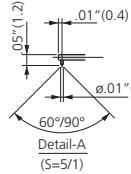
**12AAC732** [2μm]\*  
**12AAB404** [5μm]\*\*  
**12AAB416** [10μm]\*\*  
 [ ] : Tip radius  
 \*Tip angle: 60° \*\*Tip angle: 90°

### For small hole/2X long for deep hole



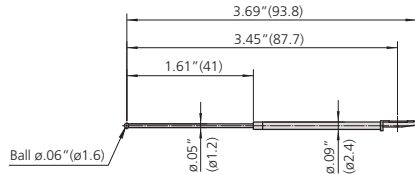
**12AAE892** [2μm]\*  
**12AAE908** [5μm]\*\*  
 [ ] : Tip radius  
 \*Tip angle: 60° \*\*Tip angle: 90°

### For extra small hole



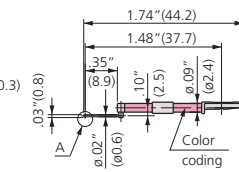
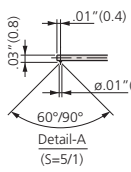
**12AAC733** [2μm]\*  
**12AAB405** [5μm]\*\*  
**12AAB417** [10μm]\*\*  
 [ ] : Tip radius  
 \*Tip angle: 60° \*\*Tip angle: 90°

### For small hole



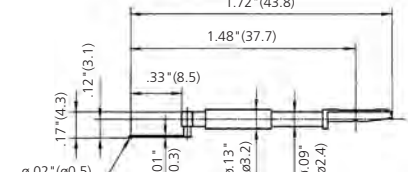
**12AAE884**  
 [.03" (0.8mm)]  
 [ ] : Tip radius

### For extra minute hole



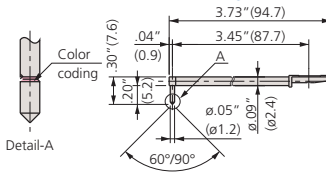
**12AAC734** [2μm]\*  
**12AAB406** [5μm]\*\*  
**12AAB418** [10μm]\*\*  
 [ ] : Tip radius  
 \*Tip angle: 60° \*\*Tip angle: 90°

### For ultra small hole

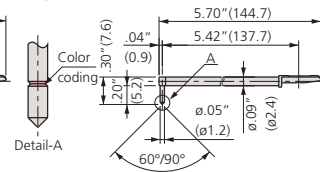


**12AAJ662**  
 [.01" (0.25mm)]  
 [ ] : Tip radius

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

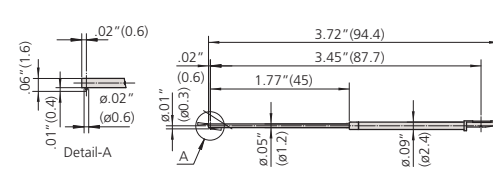


2X stylus  
**12AAC740** [2μm]\*  
**12AAB413** [5μm]\*\*  
**12AAB425** [10μm]\*\*  
 [ ] : Tip radius  
 \*Tip angle: 60° \*\*Tip angle: 90°



3X stylus  
**12AAC741** [2μm]\*  
**12AAB414** [5μm]\*\*  
**12AAB426** [10μm]\*\*  
 [ ] : Tip radius  
 \*Tip angle: 60° \*\*Tip angle: 90°

### For small slotted hole

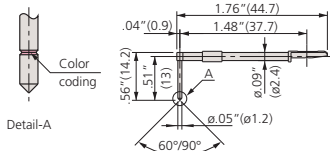


**12AAE938** [2μm]\*  
**12AAE940** [5μm]\*\*  
 [ ] : Tip radius  
 \*Tip angle: 60° \*\*Tip angle: 90°

## Styli

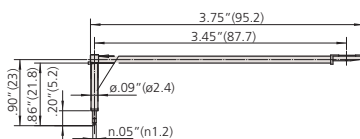
Unit: Inch(mm)

### For deep groove .39"(10mm)



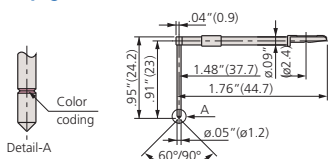
**12AAC735** [2µm]\*  
**12AAB409** [5µm]\*\*  
**12AAB421** [10µm]\*\*  
 [ ] : Tip radius  
 \*Tip angle: 60° \*\*Tip angle: 90°

### For deep groove .78"(20mm)/2X Long for deep hole



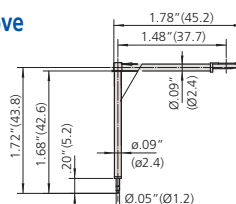
**12AAE893** [2µm]\*  
**12AAE909** [5µm]\*\*  
 [ ] : Tip radius  
 \*Tip angle: 60° \*\*Tip angle: 90°

### For deep groove .78"(20mm)



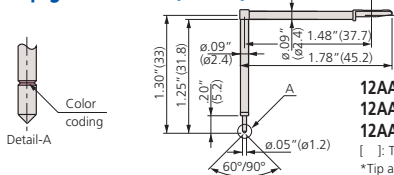
**12AAC736** [2µm]\*  
**12AAB408** [5µm]\*\*  
**12AAB420** [10µm]\*\*  
 [ ] : Tip radius  
 \*Tip angle: 60° \*\*Tip angle: 90°

### For deep groove 1.57"(40mm)



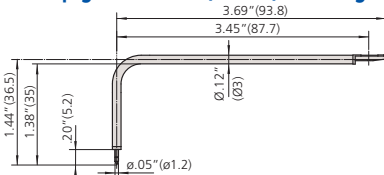
**12AAE895** [2µm]\*  
**12AAE911** [5µm]\*\*  
 [ ] : Tip radius  
 \*Tip angle: 60° \*\*Tip angle: 90°

### For deep groove 1.18"(30mm)



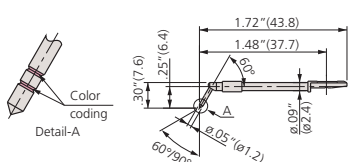
**12AAC737** [2µm]\*  
**12AAB407** [5µm]\*\*  
**12AAB419** [10µm]\*\*  
 [ ] : Tip radius  
 \*Tip angle: 60° \*\*Tip angle: 90°

### For deep groove 1.18"(30mm)/2X Long for deep hole



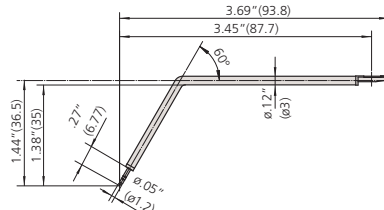
**12AAE894** [2µm]\*  
**12AAE910** [5µm]\*\*  
 [ ] : Tip radius  
 \*Tip angle: 60° \*\*Tip angle: 90°

### For gear tooth



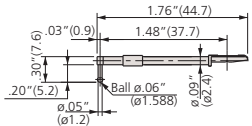
**12AAB339** [2µm]\*  
**12AAB410** [5µm]\*\*  
**12AAB422** [10µm]\*\*  
 [ ] : Tip radius  
 \*Tip angle: 60° \*\*Tip angle: 90°

### For gear tooth/2X Long for deep hole



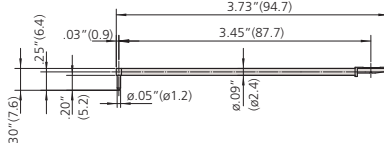
**12AAE896** [2µm]\*  
**12AAE912** [5µm]\*\*  
 [ ] : Tip radius

### For rolling circle waviness surface



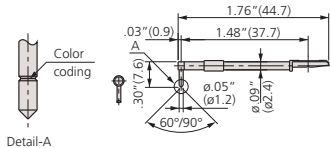
**12AAB338** [.03"(0.8mm)]  
 [ ] : Tip radius

### For rolling circle waviness/2X Long for deep hole



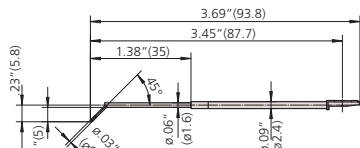
**12AAE886** [.01"(0.25mm)]  
 [ ] : Tip radius

### For knife-edge detector



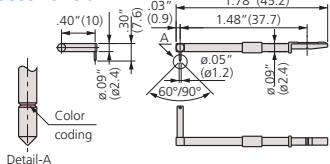
**12AAC738** [2µm]\*  
**12AAB411** [5µm]\*\*  
**12AAB423** [10µm]\*\*  
 [ ] : Tip radius  
 \*Tip angle: 60° \*\*Tip angle: 90°

### For corner hole/2X Long for deep hole



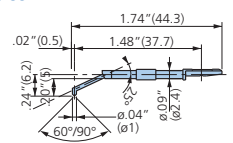
**12AAE897** [2µm]\*  
**12AAE913** [5µm]\*\*  
 [ ] : Tip radius  
 \*Tip angle: 60° \*\*Tip angle: 90°

### For eccentric arm



**12AAC739** [2µm]\*  
**12AAB412** [5µm]\*\*  
**12AAB424** [10µm]\*\*  
 [ ] : Tip radius  
 \*Tip angle: 60° \*\*Tip angle: 90°

### For bottom surface

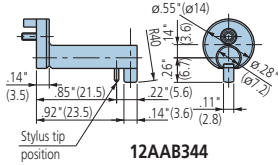


**12AAE899** [2µm]\*  
**12AAE915** [5µm]\*\*  
 [ ] : Tip radius  
 \*Tip angle: 60° \*\*Tip angle: 90°

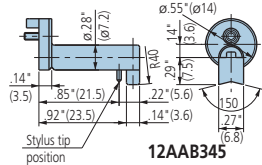
# Optional Accessories

## Applicable skid nosepiece

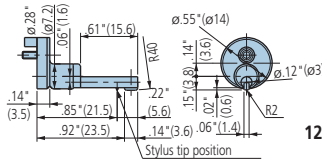
Inch(mm)



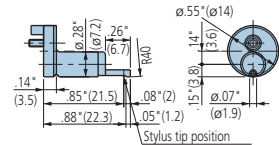
12AAB344



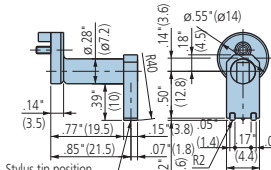
12AAB345



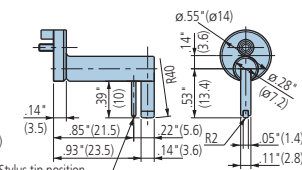
12AAB346



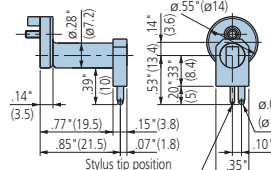
12AAB347



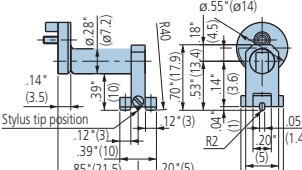
12AAB349



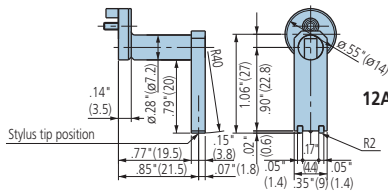
12AAB350



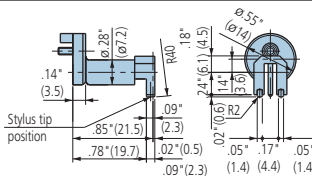
12AAB351



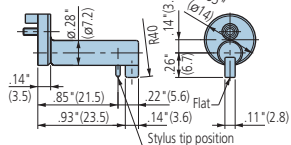
12AAB352



12AAB348



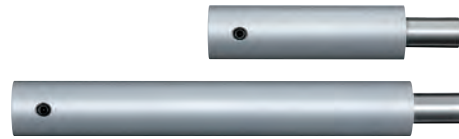
12AAB353



12AAB354

## Extension Rods

(12AAG202: 1.97" (50mm), 12AAG203: 3.94" (100mm))

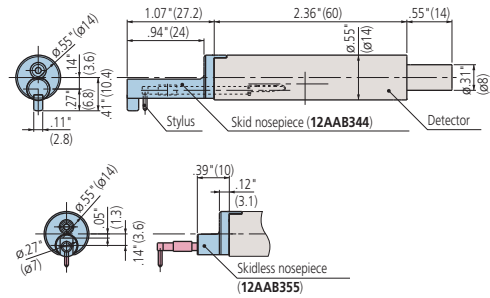


## Detector

178-396-2: 0.75mN measuring force, with 12AAC731 standard type stylus (2μm tip radius)

178-397-2: 4mN measuring force, with 12AAB403 standard type stylus (5μm tip radius)

## Set configuration/Dimensions



## Stand, Tables

### XY leveling tables



178-042-1 (mm)

178-052-1 (inch/mm)

178-043-1 (mm)

178-053-1 (inch/mm)

178-049 (mm)

178-059 (inch/mm)

Inch(mm)

Order No.	178-042-1,178-052-1	178-043-1,178-053-1	178-049,178-059
Table size	5.12" x 3.94" (130 x 100mm)		
Maximum loading	15kgf		
Inclination angle	±1.5°		
Horizontal rotating angle	±3°		
X, Y axis displacement	±.49" (12.5mm)	±.49" (12.5mm)	±.49" (12.5mm)
Min. reading of the micrometer head	.00005" (0.001mm)*	.001" (0.001mm)*	.00005" (0.001mm)*
Dimension	10.31" x 9.17" x 3.27" (262x233x83mm)	8.66" x 7.44" x 3.27" (220x189x83mm)	10.31" x 9.17" x 2.16" (262x233x55mm)
Mass	13.89 lbs. (6.3kg)	13.22 lbs. (6kg)	11.02 lbs. (5kg)

\* Digital display

### Precision vise

- Can be used with the XY leveling table.

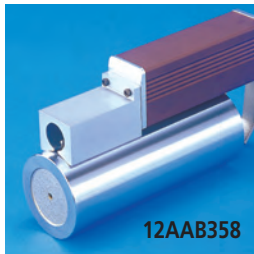


178-019

Order No	178-019
Clamping method	Sliding jaws
Jaw opening	1.42" (36mm)
Jaw width	1.73" (44mm)
Jaw depth	.63" (16mm)
Height	1.50" (38mm)

### Cylinder attachment

Used to attach on a cylinder  
Diameter:  $\phi$ .59" up to 2.36" ( $\phi$ 15mm up to 60mm)



12AAB358

### Leveling table (for D.A.T. function)

- Can be used with the XY leveling tables.  
Table swivels:  $\pm 1.5^\circ$   
Table size: 5.12" x 3.94"  
(130x100mm)  
Max. Loading: 15kgf

### Manual column stand

Column travel: 7.87" (200mm)  
Dimensions: 14.57" x 7.87" x 29.13"  
(370x200x740mm)  
Mass: 28.66 lbs. (13kg)



178-009

178-048 (mm)

178-058 (inch/mm)

### Measuring data output

#### Input tool

Data input device for spreadsheet software.



264-005

#### SPC connecting cables

Connects a control unit with DP-1VR.

3'(1m): 936937

6'(2m): 965014

#### DP-1VR

Performs various statistical processing

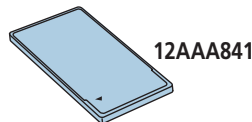


264-503A (120V)

### Others

#### Memory card

Stores/recalls the measuring conditions (up to 20), measured data, and statistical data.  
Memory: 8MB



12AAA841

#### Reference step specimen

Used to calibrate detector sensitivity.  
Step nominal value: 2 $\mu$ m/10 $\mu$ m

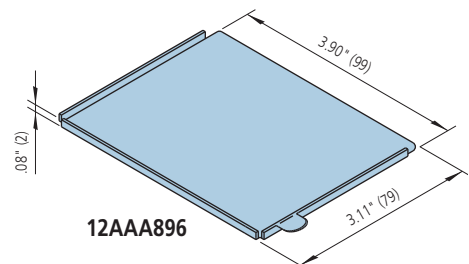


178-611 (mm)

178-612 (inch/mm)

#### LCD protective sheet

For touch panel protection  
(10 sheet set)



12AAA896

#### Printer paper

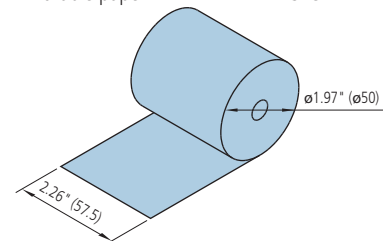
Five rolls 984'(25m)

Standard paper:

270732

Durable paper:

12AAA879





Specifications are subject to change without notice.

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