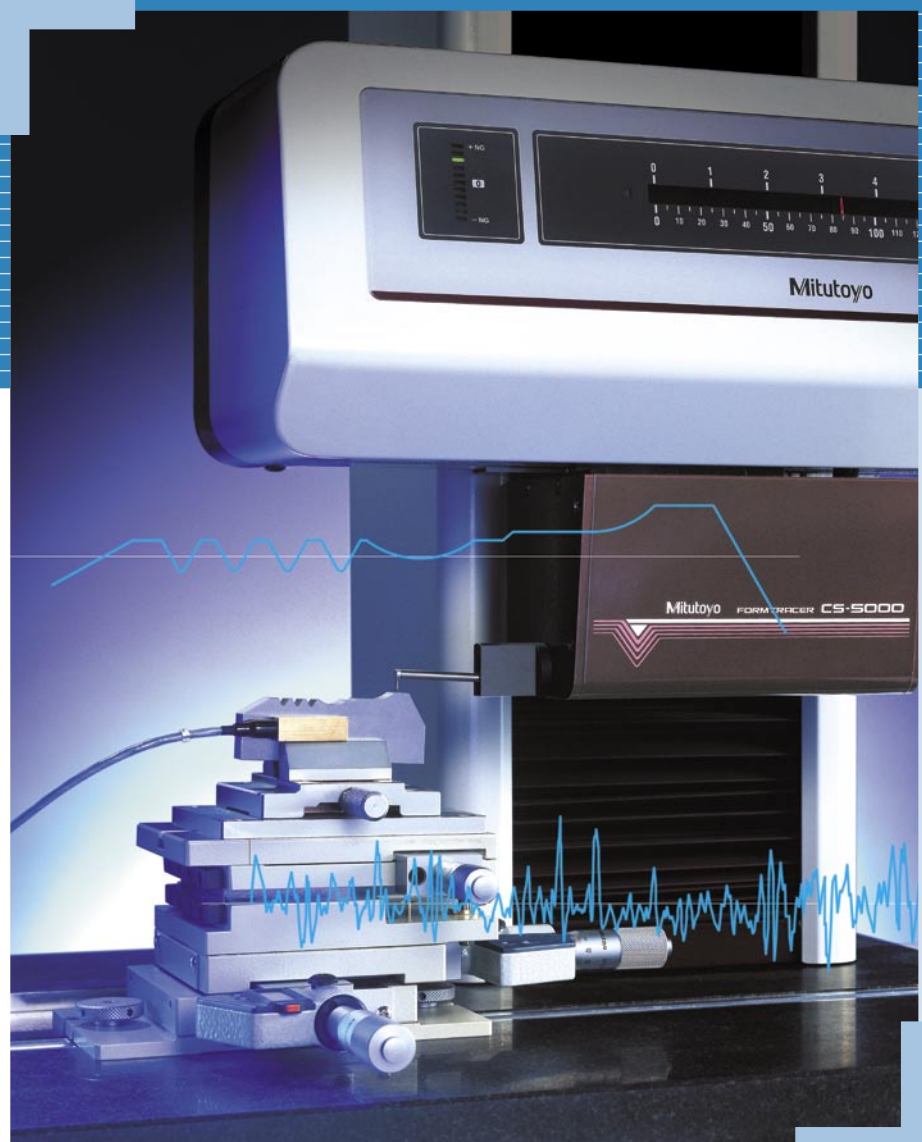


# Hybrid Surface Contour Measuring Machine **FORMTRACER<sup>®</sup> CS-5000**

CATALOG No. E4220-525



A hybrid surface contour measuring machine that combines "contour and surface roughness" measurements and analyses

**Mitutoyo**

# “Wide-range & high-resolution” detector!

- Patent registered (Japan, U.S.A., England)
- Patent pending (Japan, U.S.A., Germany, England)

## FORMTRACER CS-5000 / CS-5000L

Employing Active Control Method, which reduces the variation of the dynamic measuring force to improve traceability and to thereby allow measurements with high-accuracy. The X- and Z- axes are equipped with the Laser Holescale, which boasts excellent narrow-range accuracy.

### Z-AXIS Newly Developed Detector

- Measuring range [resolution]
  - > Standard stylus:
    - 6mm (.24") [0.002 $\mu$ m (.08 $\mu$ inch)]
    - 12mm (.47") [0.004 $\mu$ m (.16 $\mu$ inch)]\*
  - > Double-length stylus:
    - 12mm (.47") [0.004 $\mu$ m (.16 $\mu$ inch)]
    - 24mm (.94") [0.008 $\mu$ m (.32 $\mu$ inch)]\*
- Measuring accuracy:
  - > Standard stylus:
    - $\pm(0.2+|0.001H|)\mu\text{m}$  [(7.8+|H|) $\mu$ inch]
    - $\pm(0.3+|0.02H|)\mu\text{m}$  [(12+|20H|) $\mu$ inch]\*
  - > Double-length stylus:
    - $\pm(0.2+|0.005H|)\mu\text{m}$  [(7.8+|5H|) $\mu$ inch]
    - $\pm(0.3+|0.02H|)\mu\text{m}$  [(12+|20H|) $\mu$ inch]\*

\*CS-5000L

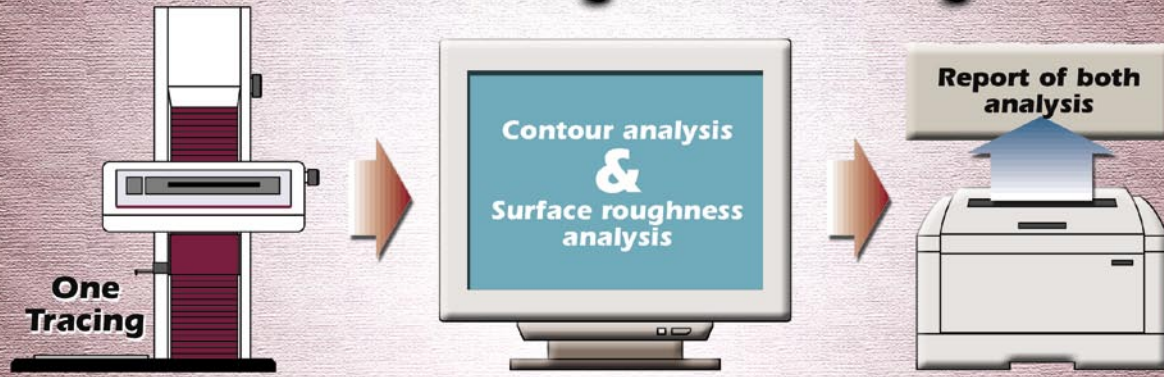
### X-AXIS

- Measuring range [resolution]:  
200mm(8") [0.00625 $\mu$ m (.25 $\mu$ inch)]
- Measuring accuracy:  
 $\pm(0.2+0.001L)\mu\text{m}$  [ $\pm(7.8+L)\mu$ inch]

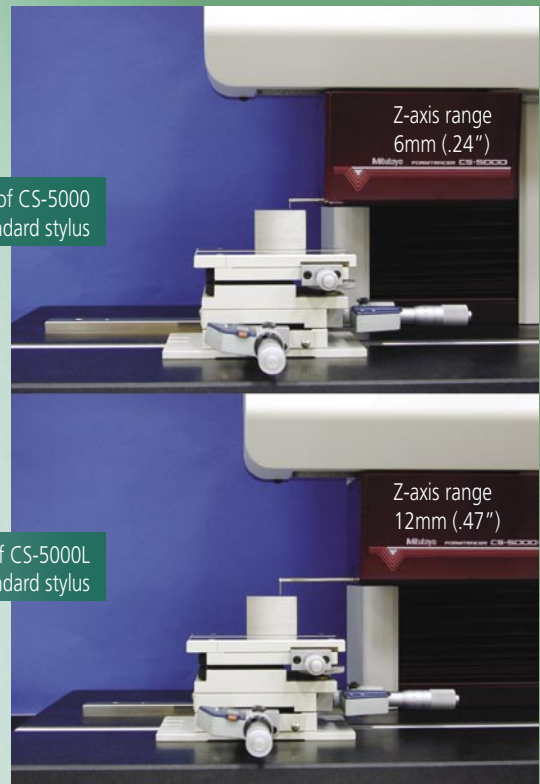
**Mitutoyo**



# Measures and analyzes both "Contour" and "Surface roughness" altogether

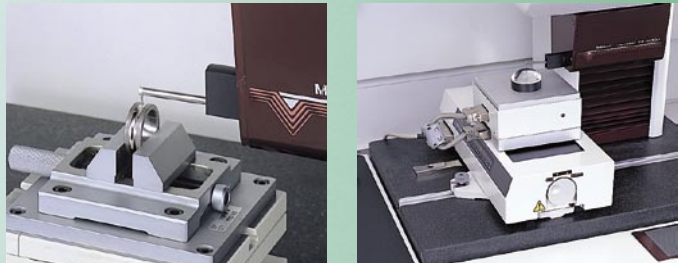


Detectors of CS-5000  
Standard stylus



Detectors of CS-5000L  
Standard stylus

Measuring example



**"An analyzing program that integrates contour and surface roughness evaluations"**

•Patent pending (Japan)

"FORMPAK-1000" and "SURFPAK-SV", the popular contour analysis program and surface roughness analysis program are combined into FORMTRACEPAK!

# Integration

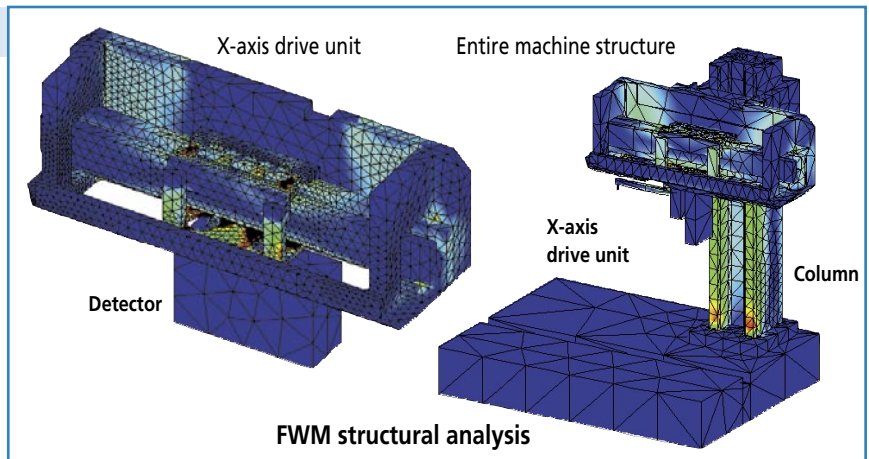
Today in various industrial fields, where technologies are constantly advancing, even higher accuracy is required in measuring fine contours, as is seen in the machining industry and in fiber optics used in the information / communication equipment industries, to name a few.

The CS-5000 series Formtracer is a high-accuracy, hybrid surface contour measuring machine that offers the world's highest level of accuracy and high-operability. It has been developed with the latest design engineering and production technologies of Mitutoyo, to answer the needs of these industries that employ the latest technologies.

## Body with high-rigidity

### Optimal design using the FEM analysis

In pursuit of a machine with a higher measuring accuracy, Mitutoyo combined the base, column, and the X-axis drive unit, and using a FEM structural-analytical simulation, the stress yielded in each member was thoroughly analyzed. Measurements with high-accuracy were thus made possible by the optimal structural design.



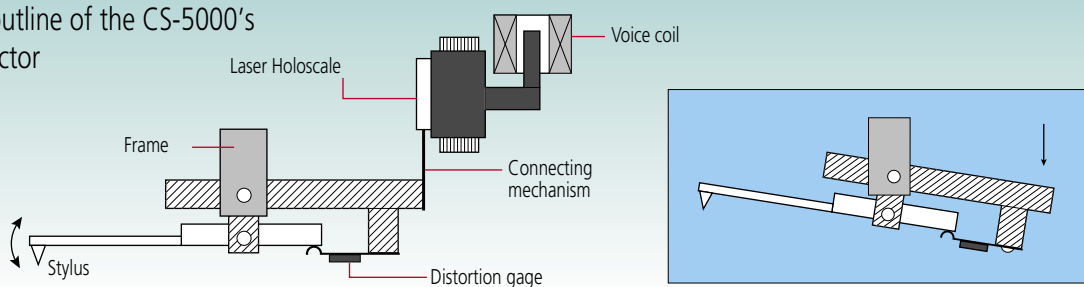
## Active control detection system

### The newly developed detector •Patent pending (Japan, U.S.A., Germany, England)

- > Traces the workpiece surface while detecting the surface roughness, with high-accuracy.
- > Offers high-traceability even on very steep inclined planes.
- > Prevents variation of the measuring force in the entire measuring range of the Z-axis.

The resistance of the distortion gage changes when a displacement (vertical movement) of the stylus occurs, as shown in the figure on the right. The Voice coil controls the vertical movement of the stylus to keep the resistance of the distortion gage constant.

### Structure outline of the CS-5000's Z-axis detector

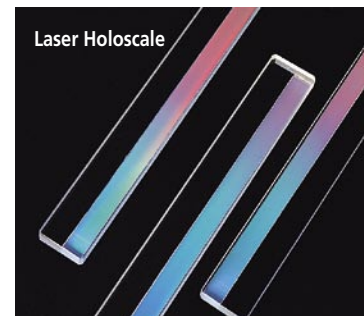
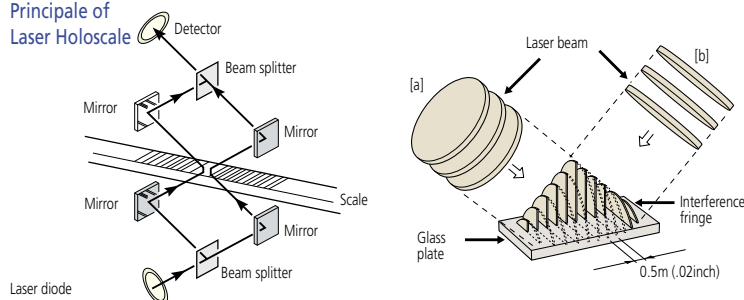


## Hight-resolution

Equipped with Laser holoscale •Patent pending (Japan, U.S.A., Germany, England)

The X-axis and Z-axis detectors are equipped with the Laser Holoscale, a scale that use the interference of diffracted light, and boasts excellent accuracy in wide and narrow ranges. The Laser Holoscale offers the highest level of resolution in the world: X-axis  $0.00625\mu\text{m}$  (.25 $\mu\text{inch}$ ), Z-axis  $0.002\mu\text{m}$  (.079 $\mu\text{inch}$ ).

### Principle of Laser Holoscale



### What is the Laser Holoscale?

The laser Holoscale uses intersecting laser beams [a] and [b] to create an interference fringe, which is recorded on the glass plate (scale). This means that the wavelength of the light is transferred directly onto the scale, allowing the scale pitches in order and the entire scale length to be exposed altogether. Thus, extremely high cumulative accuracy and linear accuracy with uniform pitches can be achieved at the same time, unlike with the Step & Repeat method, which produces uneven pitches, in the lithographic process using an original reduction exposure.

## X-axis guide with high-rigidity and high-accuracy

Ceramic guide •Patent pending (Japan, U.S.A., Germany, England)

The X-axis employs a square pillar guide made of ceramics.

The slider is attached by a wire at the center of gravity of the frictional force generated by a sliding motion, to reduce the transmission of the vibration caused by the drive motor, thus minimizing hysteresis\* and thereby allowing high-accuracy traversing straightness of the drive unit. To accommodate this driving mechanism, the guide is shaped in a special form.

\*Hysteresis: a phenomenon in which the load and distortion that occur in a one-way travel do not match those of the return travel.

<b>Straightness</b>	<b>Standard stylus:</b>	<b><math>(0.05+0.0006L)\mu\text{m}</math> [(2+0.5L)<math>\mu\text{inch}</math>]</b>	<b><math>(0.1+0.0015L)\mu\text{m}</math> [(4+1.5L)<math>\mu\text{inch}</math>]*</b>
	<b>Long stylus:</b>	<b><math>(0.1*0.0006L)\mu\text{m}</math> [(4+0.5L)<math>\mu\text{inch}</math>]</b>	<b><math>(0.2+0.0015L)\mu\text{m}</math> [(8+1.5L)<math>\mu\text{inch}</math>]*</b>
<b>Measuring accuracy</b>	<b><math>\pm(0.2+0.001L)\mu\text{m}</math> [(12+2L)<math>\mu\text{inch}</math>]</b>		<b>*CS-5000L</b>

## Compensation technology

Ultra-high accuracy •Patent pending (Japan, U.S.A., Germany, England)

### > X-axis measuring accuracy compensation

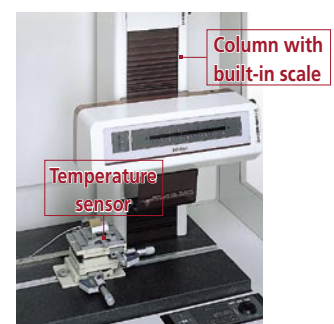
The scale that is built-in in the column detects the height of the X-axis drive unit to compensate for a microscopic "distortion of the column", which occurs depending on the detector position on the X-axis.

(X-axis accuracy of  $(0.2+0.001L)\mu\text{m}$  [(7.8+L) $\mu\text{inch}$ ] is guaranteed at any detector position on the (vertical) column.)

### > Temperature compensation

Each of the X- and Z-axis scales are equipped with a built-in temperature sensor, which detects the ambient temperature as well as the workpiece temperature to allow temperature compensation.

(Allows contour measurements without the influence of workpiece and ambient temperatures.)



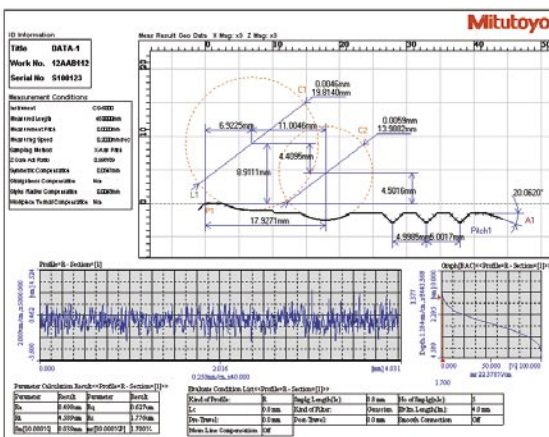
# FORMTRACEPAK

FORMTRACEPAK is a program that analyzes both "contour and surface roughness" by one measurement. Mitutoyo's popular "FORMKPAK®-1000", a form / contour analysis program known for its high-functionality and excellent operability, and "SURFPAK®-SV", a surface roughness analysis program have been improved and combined as "FORMTRACEPAK".

## Report making

One report for both analyses

The layout editing function allows both form / contour analysis and surface roughness analysis to be printed out in one report.



## Contour analysis

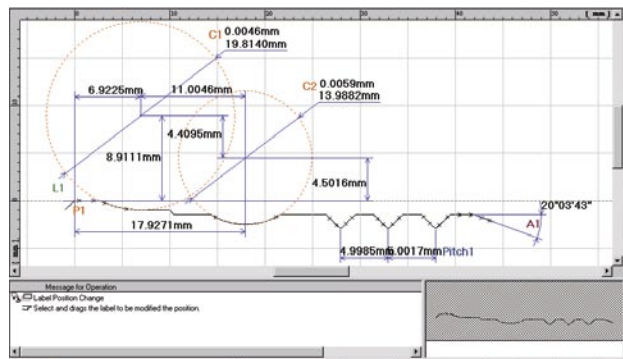
Multiple analyses and high-functionality

For various dimensional measurements such as "radius", "distance", "angle", etc.

The "design value generation function" and the "contour tolerancing function" are standard features.

Measurement assistance function

Supports "Auto-leveling table" and "3-axes adjustment table" to facilitate "leveling" and "finding the axis of a cylindrical workpiece"!



## Surface roughness analysis

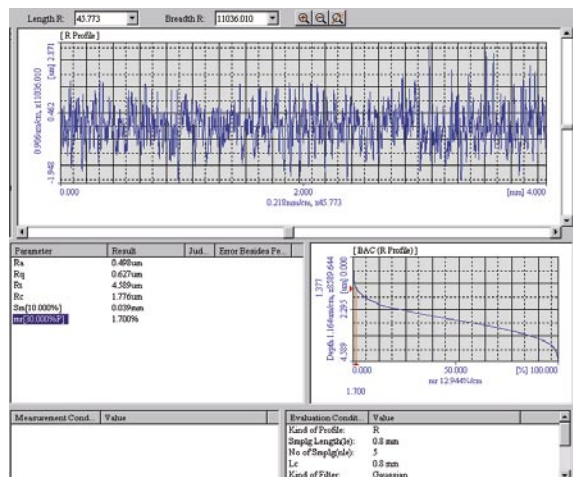
Conforming to various surface roughness standards

Conforming to the following standards:

JIS1982 / JIS1994 / JIS2001 / DIN / ISO / CONOMO / MOTIF

Supports a wide range of parameters

FORMTRACEPAK supports as many as 80 different parameters including: parameters related to Ra, Ry, Rz, S, Sm, mr, Pc, Rq, Rv, Rk, and motif-related parameters, etc.



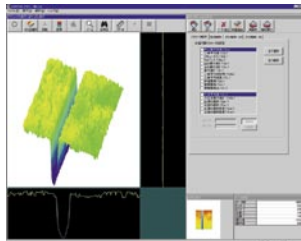
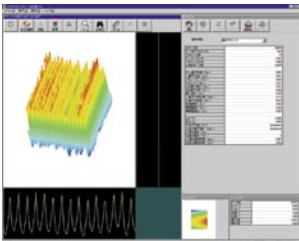
Surface roughness analysis screen

# CS-5000-3D / CS-5000L-3D

## High-accuracy three dimensional topography

Supports three-dimensional surface texture measurement and analysis

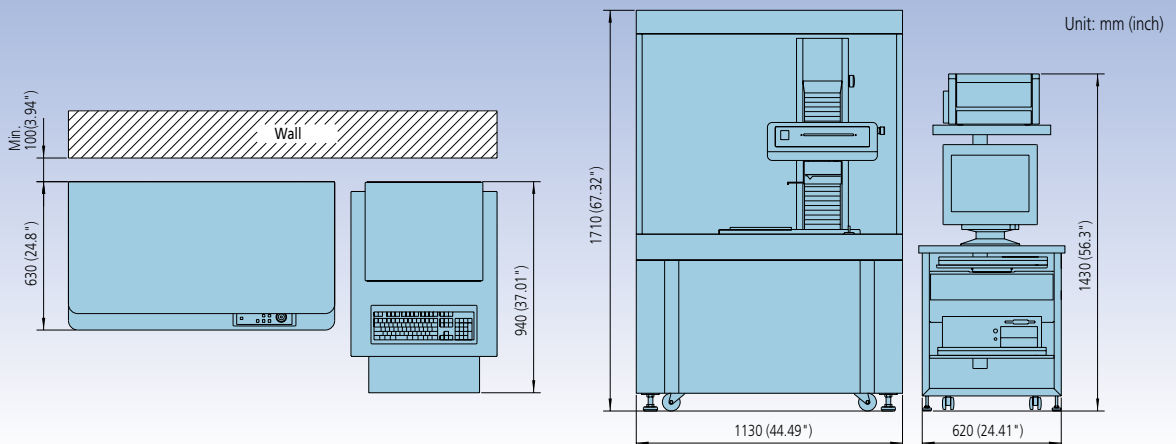
- > CS-5000-3D / CS-5000L-3D provides a variety of graphics methods and evaluation parameters for various surface texture evaluations from the three-dimensional topography data.
- > A desired topographic profile can be analyzed two-dimensionally, thus allowing the evaluation of fine contour and fine texture at the same time.



Y-axis table + three-dimensional auto-leveling table



## Dimensions



# CS-5000 Stylus

## Standard accessories

**Standard stylus**  
 Length of stylus tip: 6.5mm  
 Tip material: diamond  
 Tip form: 40° cone  
 Radius of tip curvature: 5m

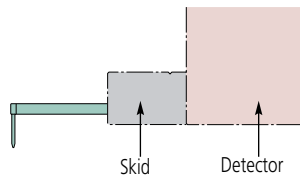
12AAC261

**Double-length stylus**  
 Length of stylus tip: 12.5mm  
 Tip material: diamond  
 Tip form: 40° cone  
 Radius of tip curvature: 5m

12AAC262

**Double-length ball stylus**  
 Length of stylus tip: 12.75mm  
 Tip material: sapphire  
 Radius of tip curvature: ø0.5mm ball

12AAC263



## Optional accessories

Unit: mm

**Small hole stylus**  
 Length of stylus tip: 15mm  
 Tip material: diamond  
 Tip form: 40° cone  
 Radius of tip curvature: 5m

12AAD647

**Extra small hole stylus**  
 Length of stylus tip: 10mm  
 Tip material: diamond  
 Tip form: 40° cone  
 Radius of tip curvature: 5m

12AAD648

**Deep groove stylus**  
 Length of stylus tip: 26mm  
 Tip material: diamond  
 Tip form: 40° cone  
 Radius of tip curvature: 5m

12AAD649

**Eccentric stylus**  
 Length of stylus tip: 6.5mm  
 Tip material: diamond  
 Tip form: 40° cone  
 Radius of tip curvature: 5m

12AAD650



# CS-5000L Stylus

## Standard accessories

**Standard stylus**  
 Length of stylus tip: 12.5mm  
 Tip material: diamond  
 Tip form: 40° cone  
 Radius of tip curvature: 5m

**Ball stylus**  
 Length of stylus tip: 12.75mm  
 Tip material: Sapphire  
 Radius of tip curvature:  $\varnothing 0.5\text{mm}$  ball

**Double-length stylus**  
 Length of stylus tip: 25mm  
 Tip material: diamond  
 Tip form: 40° cone  
 Radius of tip curvature: 5m

**Double-length ball stylus**  
 Length of stylus tip: 25.25mm  
 Tip material: diamond  
 Radius of tip curvature:  $\varnothing 0.5\text{mm}$  ball

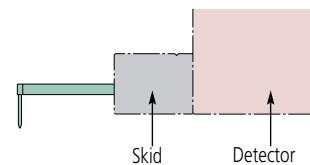
## Optional accessories

Unit: mm

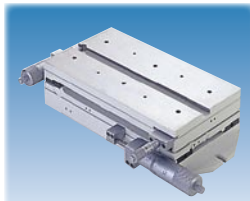
**Length of stylus tip: 15mm**  
 Tip material: diamond  
 Tip form: 40° cone  
 Radius of tip curvature: 5m

**Extra small hole stylus**  
 Length of stylus tip: 10mm  
 Tip material: diamond  
 Tip form: 40° cone  
 Radius of tip curvature: 5m

**Eccentric stylus**  
 Length of stylus tip: 12.5mm  
 Tip material: diamond  
 Tip form: 40° cone  
 Radius of tip curvature: 5m



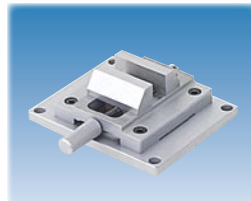
# Optional Accessories



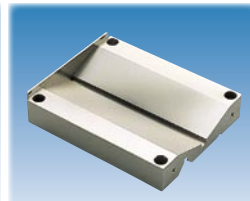
Cross travel table  
**218-003**



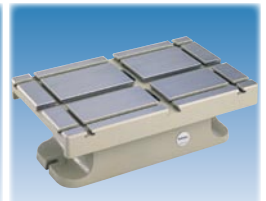
Rotary vise (two-slide jaw)  
**218-041 (metric)**  
**218-051 (inch)**



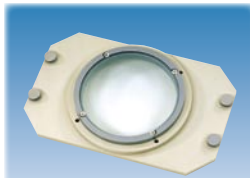
Rotary vise (two-slide jaw)  
**218-041 (metric)**  
**218-051 (inch)**



V-block  
**998291**



Rugged table  
**218-002**



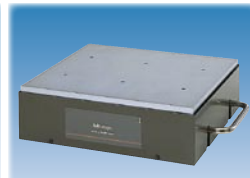
Rotary table  
**172-196**



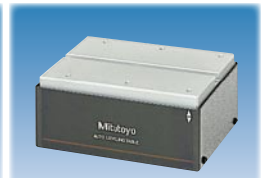
Holder with clamp  
**176-107**



Swivel center support  
**172-197**



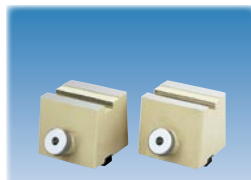
Large size auto-leveling table  
**178-028**  
•Patent registered (Japan)



Auto-leveling table  
**178-027**  
•Patent registered (Japan)



Center Support  
**172-142**



Center Support riser  
**172-142**



V-block with clamp  
**172-234**



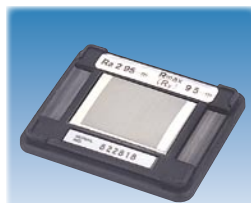
V-block with clamp  
**172-378**



V-block set  
**182-902 (mm)**  
**182-901 (inch)**



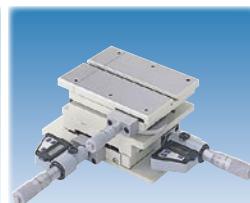
Step reference specimen  
**178-611 (mm)**  
**178-612 (inch)**



Roughness reference specimen  
**178-601 (mm)**  
**178-602 (inch)**



Three-axis adjustment table  
**178-047**  
•Patent registered (Japan)



XY leveling table with swivel  
**178-042-1 (metric)**  
**178-052-1 (inch)**  
(standard accessory)

# Specifications

Model		CS-5000		CS-5000L	
Type		mm	mm/inch	mm	mm/inch
Order No.		525-886	525-896	525-905	525-915
Measuring Rang	X-axis	200mm (8")			
	Z-axis	6mm (.24")/12mm (.47")*		12mm (.16inch)/24mm (.94inch)*	
Column		250mm (10")			
Resolution	X-axis	0.00625μm (.25μinch)			
	Z-axis	0.002μm (.08μinch)/0.004μm (.016μinch)*		0.004μm (.16μinch)/0.008μm (.32μinch)*	
Accuracy (at 20°C)	X-axis	(0.2+0.001L)μm [(7.8+L)μinch] L=traverse length			
	Z-axis	±(0.2+ 0.001H )μm [±(7.8+ H )μinch ±(0.2+ 0.005H )μm [±(7.8+ 5H )μinch]* H=measuring height		(0.3+ 0.02H )μm [(±12+ 20H )μinch] H=measuring height	
Straightness X-axis	X-axis	(0.05+0.0015L)μm [(2+1.5L)μinch] (0.1+0.0015L)μm [(4+1.5L)μinch]* L=traverse length		(0.1+0.0015L)μm [(4+1.5L)μinch (8+1.5L)μinch*L=traverse length	
Detection method	X- and Z-axis	Laser Hologscale			
Measuring speed	Surface roughness	0.02mm/s(.0008"/s) to 0.2mm/s(.008"/s), can be specified by 4 steps			
	Contour	0.02mm/s(.0008"/s) to 2mm/s(.08"/s), can be specified by 7 steps			
Traverse speed	X-axis	0.1mm/s(.004"/s) to 1.5mm/s(0.06"/s), can be adjusted manually with a joystick box 0.1mm/s(.004"/s) to 3mm/s(.12"/s)*, can be adjusted manually with a joystick box		0.1mm/s(.004"/s) to 3mm/s(.12"/s), can be adjusted manually with a joystick box	
	Column	0.1mm/s(.004"/s) to 2mm/s(.08"/s). can be adjusted manually with a joystick box 0.1mm/s(.004"/s) to 4mm/s(.16"/s)*, can be adjusted manually with a joystick box		0.1mm/s(.004"/s) to 4mm/s(.16"/s), can be adjusted manually with a joystick box	
Digital data output		via GPIB interface			
Stylus tip orientation		Downward			
Feed direction		Both backward and forward			
Measuring force		4mN(constant)		4mN(constant)/0.75mN(constant)*	
Max.number of measuring points		125,000 points			
Vertical travel distance of drive unit		250mm (10")			
Power supply		AC100 - 240V			
Power consumption		Max. 150VA (except for PC and printer)			
Operation temperature		15 - 25°C			
Dimension	Measuring unit	765x450x890mm (30.1"x17.7"x35")			
	Control unit	250x380x300mm (9.8"x15"x11.8") **			
	Vibration isolator	1130x630x760mm (44.5"x24.8"x30")			
Mass	Measuring unit	140kg (308 lbs.)			
	Control unit	7kg (15.4 lbs.) ***			
	Vibration isolator	130kg (286 lbs.) **			

NOTE: To denote your AC line voltage add the following suffixes (e.g. **525-886A**). **A** for 120V, **C** for 110V, **D** for 220V, **E** for 240V, No suffix is required for 100V

\* When using a double length stylus

\*\* Stored inside the vibration isolator

\*\*\* Including the windshield cover

Coordinate Measuring Machines	=====
Vision Measuring Systems	=====
Form Measurement	=====
Optical Measuring	=====
Sensor Systems	=====
Test Equipment and Seismometers	=====
Digital Scale and DRO Systems	=====
Small Tool Instruments and Data Management	=====



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<http://www.mitutoyo.co.jp>

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