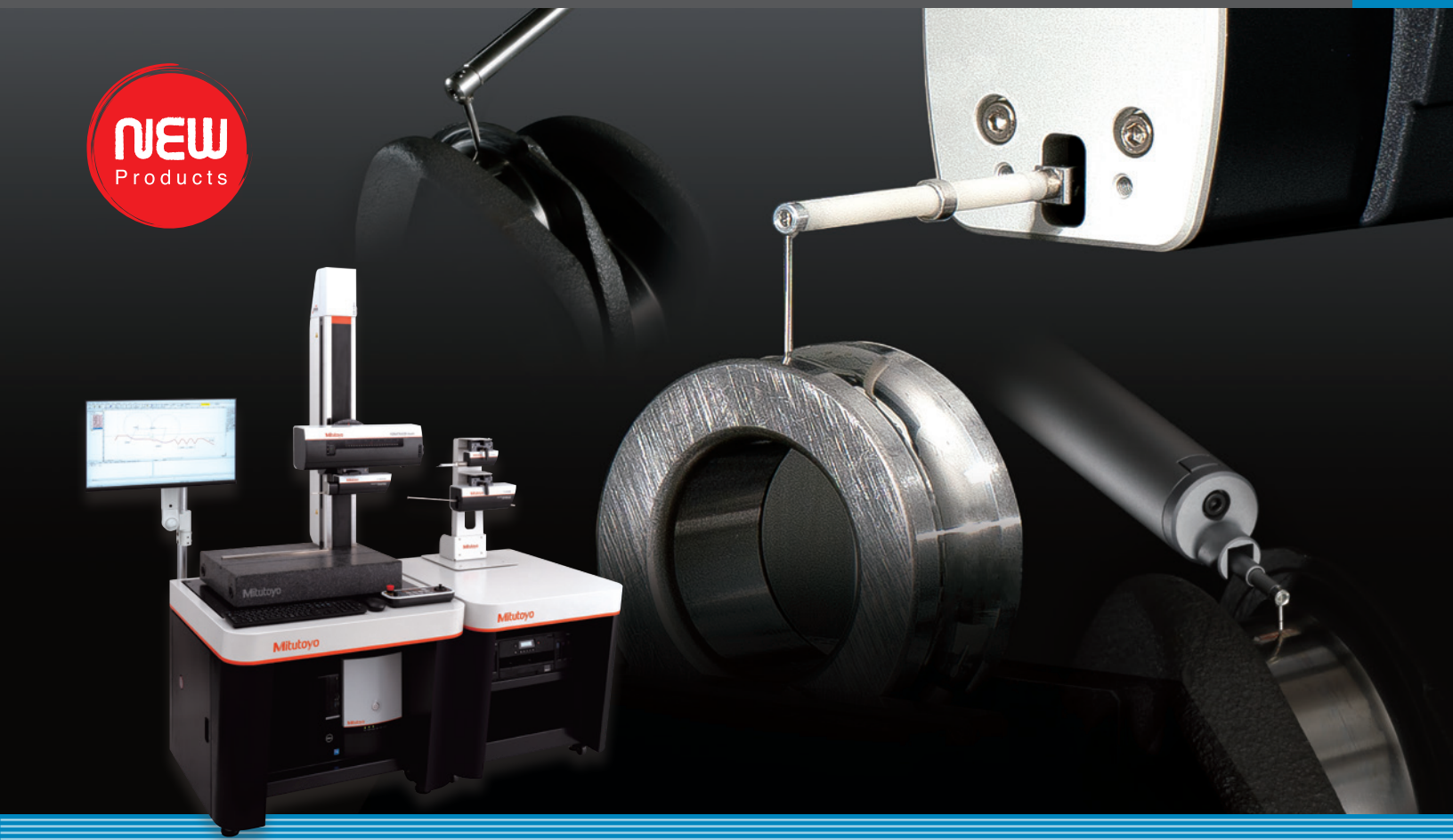
Mitutoyo

Mitutoyo Quality

# Contour and Surface Roughness Measuring Systems
# FORMTRACER Avant Series

Form Measurement

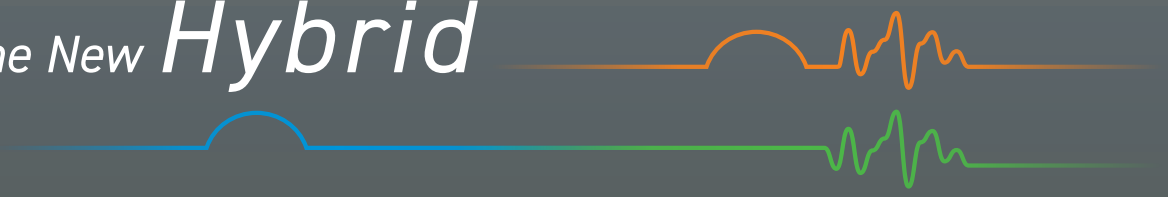



Catalog No.E15030-US

Mitutoyo

*Advance even higher.*

## *The New Hybrid*



# *FORMTRACER Avant SERIES*

*Contour and Surface Roughness Measuring Systems*

## Speed and operability like never before.
## A revolutionary measuring system that defies conventional thinking.

The FORMTRACER Avant Series, which provides contour and surface roughness measurement in a single unit, now includes the addition of the H-3000 Detector, a hybrid detector that can measure both roughness and contour simultaneously within a single trace. Designed with “Speed” enabling higher measurement efficiency, “Operability” with automation and a wide variety of features, and “Expandability” allowing upgrade to a complex system by integrating a detector, revolutionizes contour and surface roughness measurement.


Mitutoyo
Mitutoyo
FORMTRACER Avant
Mitutoyo
H-3000
CONTOUR AND SURFACE ROUGHNESS
MEASURING SYSTEM

Mitutoyo

# FORMTRACER

## Contour & Surface Roughness

Equipped with a newly developed high resolution arc scale.
Capable of simultaneously measuring contour and surface roughness with a single trace with high accuracy and across a wide range.
Can be added to FTA series equipment that you already have, allowing you to perform flexible and highly efficient measurements.


Contour & Roughness Detector
H-3000

# CONTRACER

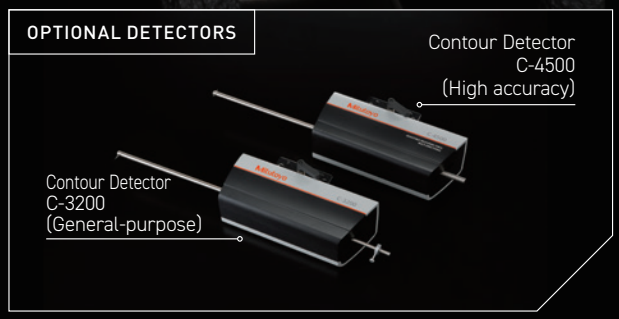
## Contour

Our lineup features two types of contour detectors to choose from.

C-3200: general purpose detector
C-4500: high-performance, high-accuracy detector

- Upper/lower surface continuous measurement function that enables measurement of effective diameter of screw threads
- Measuring force can be adjusted with software

**OPTIONAL DETECTORS**

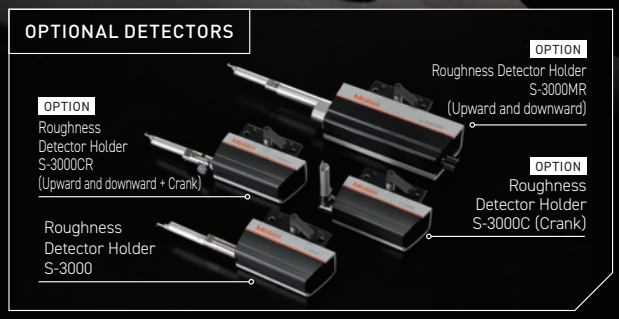



# SURFTEST

## Surface Roughness

Compliant with JIS, ISO, ANSI, VDA, and other industrial surface roughness standards. Optional detector holders that can meet various challenging workpiece features and accessabilty resulting in high throughput and improved cycle-time.

**OPTIONAL DETECTORS**



# With the machine being able to measure both contours and surface roughness, a feature-rich lineup covers every purpose.

Choose a main unit in a size to match your measurement needs.
Then add a detector later and expand your measurement possibilities.
Our drive units come in a standard lineup of 100-mm / 200-mm models.

100 mm Drive Unit, Standard Base Model
Surface Roughness Tester
FTA-S4S3000

100 mm Drive Unit, Standard Base Model
Contour Instruments
FTA-S4C3000


## Standard Base Model

Base size (W × D): 600×450 mm
Z2-axis (column) range: 300 mm

200 mm Drive Unit, High-column Model
Contour & Surface Roughness
Measuring Instrument
FTA-H8H3000

200 mm Drive Unit, Large-sized Base Instrument
with Long Column Model
Surface Roughness Tester
FTA-L8S3000


## High-column Model

The base instrument is the same size as the Standard Model, except the column is higher.
Base size (W × D): 600×450 mm
Z2-axis (column) range: 500 mm
The extra depth allows a wider range of measurements in the vertical direction.

## Large Base Model

This is the Large-sized Model with the maximum-size base and column.
Base size (W × D): 1000×450 mm
Z2-axis (column) range: 700 mm
It can efficiently measure heavy and/or long workpieces.

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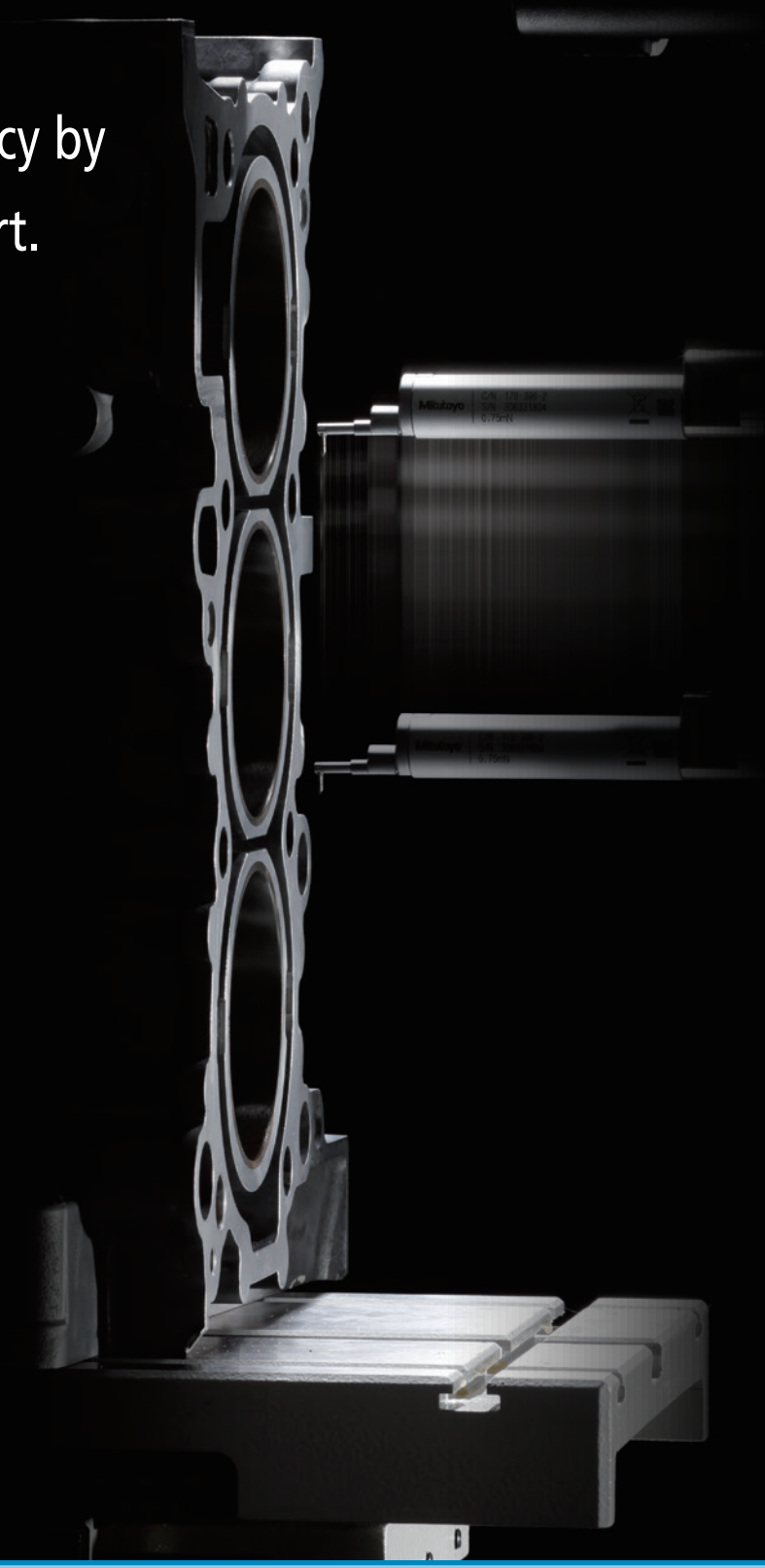
# HIGH EFFICIENCY

## Helps improve work efficiency by reducing measurement effort.

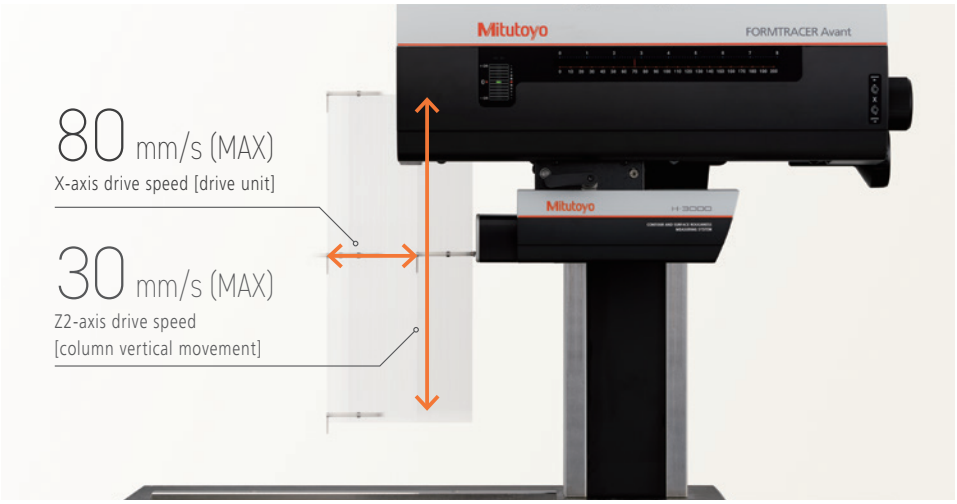
As a new addition to our series of contour detectors and roughness detectors, we have introduced a hybrid detector capable of simultaneously measuring both contour and roughness in one trace. Both roughness and contour can be measured with a single machine, reducing setup work-hours, measurement time, and space needed for installation. The best-in-class measurement range can be further extended by using an optional stylus. The stylus can be easily attached and detached without the use of tools. The unit is equipped with a newly developed arc scale to achieve unprecedented measurement accuracy. This new model supports efficient measurement work.



- Contour & roughness detector
- Contour detector
- Roughness detector

# New functions enable highly efficient measurement

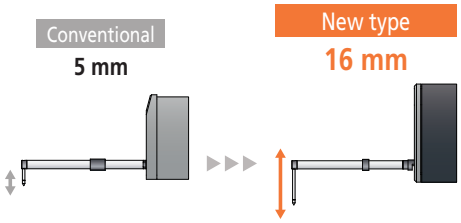
## High-speed positioning drastically improves measurement cycle-time



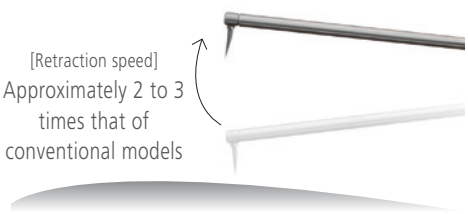

## Measurement of contour and surface roughness in one trace


Equipped with a newly developed arc scale, this is a wide-range, high-resolution detector.
Both contour and surface roughness can be evaluated simultaneously with just one trace without the need to change the detector, thereby helping to reduce measurement time.

Z-axis measurement range: 16 mm
(3.2 times wider than conventional models)




## Improved total measurement cycle-time




The stylus-up (retraction) speed has been improved compared to conventional models, while the speed at which the stylus comes down to touch the workpiece has been made slower in consideration of measurement safety.
Contact with the workpiece is automatically detected allowing for quick measurement starts.
By shortening the total measurement time, measurement efficiency is increased.

*Approximately 3 times faster when measuring contour
Approximately double when measuring contour and roughness simultaneously

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# WORKABILITY

## Remarkably improved workability with outstanding features

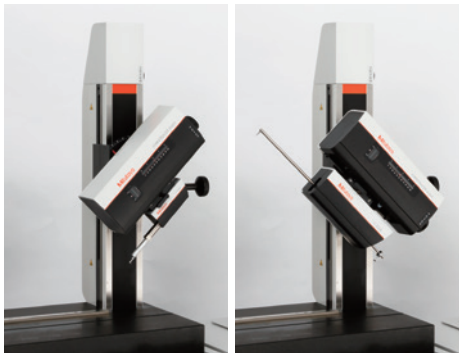
This system uses a cable-less design allowing measurements without having to worry about snagging unprotected detector cables while the drive section is an X-axis inclinable drive unit. The inclination range is a wide ±45°, allowing inclined surfaces on workpieces to be more easily measured without using an inclination jig. In addition, to perform the hot swap, it's necessary to click through a couple of menu items to let the software know you are swapping heads. Such outstanding features drastically improve work efficiency.

## X-axis Inclinable Drive Unit

To measure inclined surfaces efficiently, an X-axis inclinable drive unit which can measure surfaces within a range of ±45° is mounted. When mounting the contour detector C-4500, the measuring force can be varied in 5 steps by using the software provided (FORMTRACEPAK), eliminating the need to adjust the measuring force by switching weights or through positional adjustment. This system can also maintain the specified measuring force even when inclined.

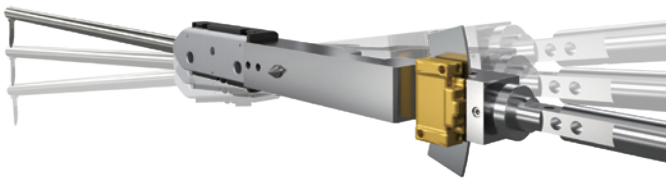
[X-axis drive unit inclination range]

±45°



## Arc Scale

The system features a built-in precision arc scale that allows the circular trajectory of the stylus tip to be read directly, eliminating the need for an arc direct conversion mechanism, which often causes measurement error on the detector. It allows precision measurement over a wide range even if the arm is not in the horizontal attitude. You can perform precision measurements without worrying about the measurement range.



## Cable-less

All detector and drive unit cables are housed inside the main unit to eliminate any risk of abrasion or snagging, guaranteeing precision measurements and rapid movements.

## Hot Swapping

There is no requirement to turn the controller power off when replacing the detector with another detector, or moreover, the tool-less replacement mechanism (thumb-turn clamp lever) greatly reduces the replacement time by approx. 1/4 (approx. 30 seconds) compared to a conventional model. Furthermore, positioning using the guide pin improves reproductivity when replacing detectors and allows efficient operation of the automatic measuring program.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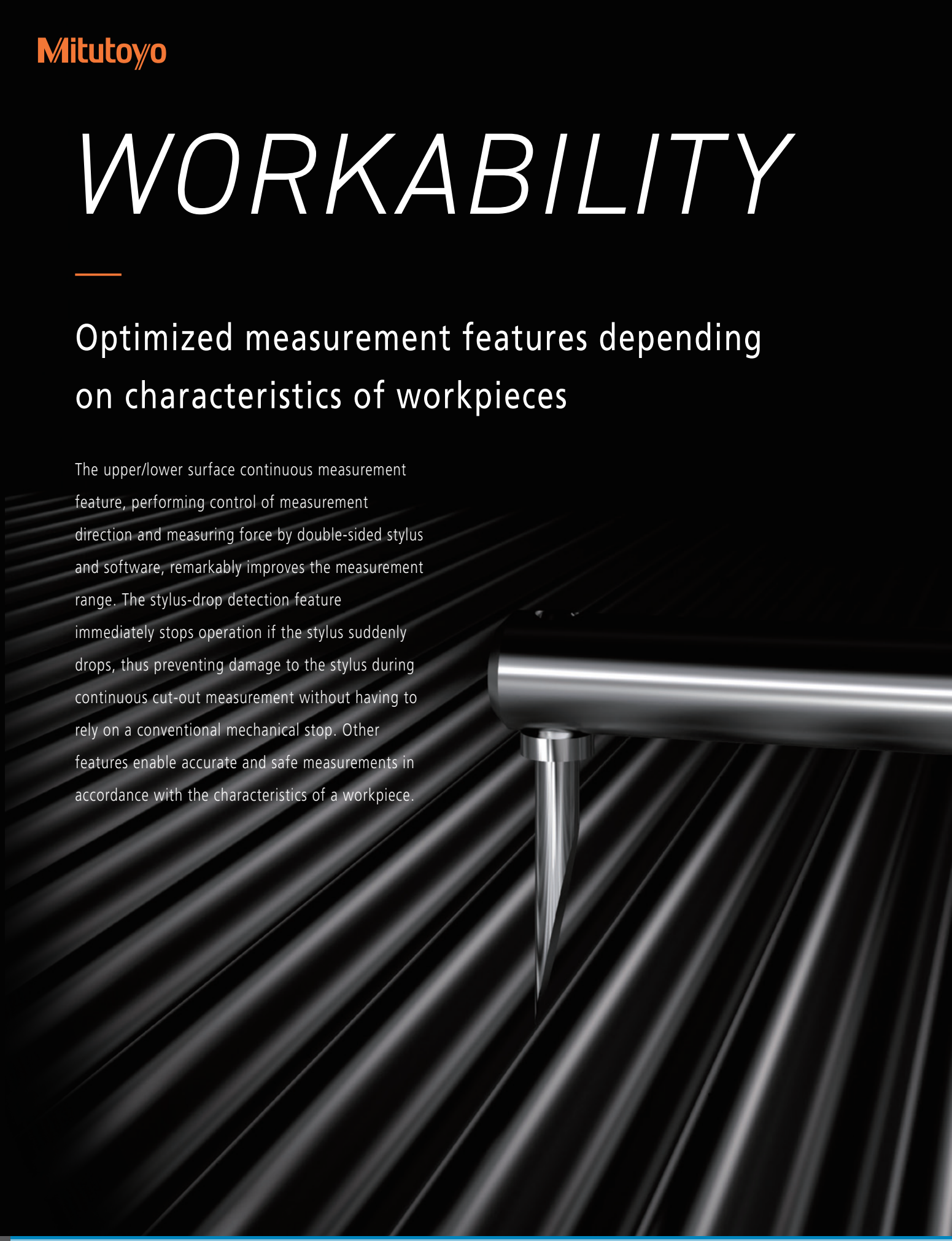
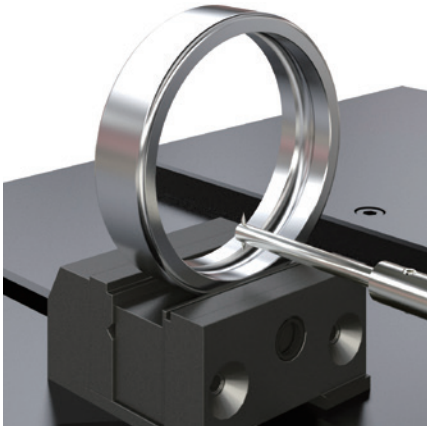
# WORKABILITY

## Optimized measurement features depending on characteristics of workpieces

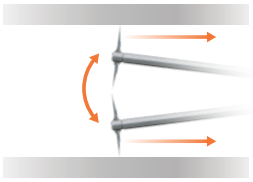
The upper/lower surface continuous measurement feature, performing control of measurement direction and measuring force by double-sided stylus and software, remarkably improves the measurement range. The stylus-drop detection feature immediately stops operation if the stylus suddenly drops, thus preventing damage to the stylus during continuous cut-out measurement without having to rely on a conventional mechanical stop. Other features enable accurate and safe measurements in accordance with the characteristics of a workpiece.



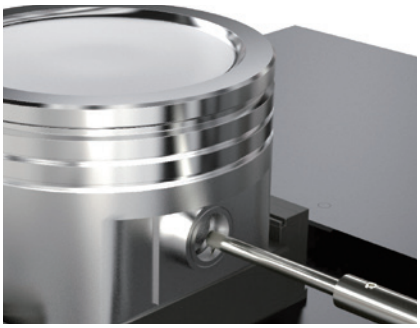
## Upper/lower Surface Continuous Measurement



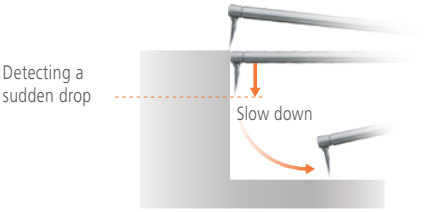
Upper/lower surfaces can be measured continuously by using the Mitutoyo's double-sided conical stylus. This continuous measurement data can be used to facilitate analysis of features that were difficult to measure before, such as the effective diameter of an internal screw-thread. The collision monitoring feature for the magnet arm and the detector cover ensures safe measurement even during high-speed movemen. In addition, optional accessories for automatic measurement automate processes from the setup to the measurement.
Note: When mounting contour detector C-4500



## Stylus Drop Detection Feature

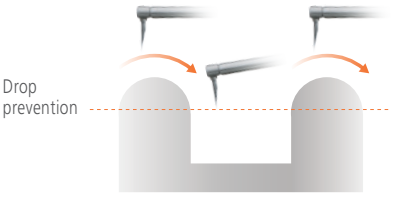


Detects sudden drop of the stylus from a measurement surface and stops the measurement operation. It also controls the dropping rate to avoid breakage of stylus.
Note: When mounting contour detector C-4500




## Continuous Cut-out Measurement Feature

The detector hold position can be registered, allowing measurement to be performed without dropping below the preset position. This feature allows continuous measurement of interrupted surface features on workpieces without needing to use mechanical stoppers.




Real One POINT

### Reduces positioning distance for surface roughness measurement

The positioning distance from the start of measurement to the start of measurement data acquisition is reduced to the absolute minimum of 0.05 mm. The system vigorously supports the measurement of edges and narrow parts where it is difficult to secure sufficient measurement distance.

# DESIGN

## Coexistence of form and functional beauty with no compromise on detail

Visual beauty, functional rationality, and reliable measurement accuracy. When it comes to detail and functionality, the FORMTRACER Avant H-3000 is designed without compromise to provide form measurement innovation and easier operability with great accuracy.

In addition to coloring, the new design adds improvements and insightful features that considers the whole product structure and enables ease of use.

1


3


4


2

1 In addition to coloring, the new design considers both usability and innovation. While inheriting the contracer and surftest tradition, one also senses a leading innovative benefit.

2 Ergonomically designed by applying an angle to the front surface of the vibration isolator and side table makes it easier on users who work while standing.

3 Improved operability thanks to added new features, such as the override control for adjusting the driving speed in real-time and part program key that assists creation of part programs.

4 All detector and drive unit cables are housed inside the main unit to eliminate any risk of abrasion and guarantee precision measurement and rapid movement.

# SOFTWARE

## Backup for the unified management and sharing of measurement data, and visualization of quality

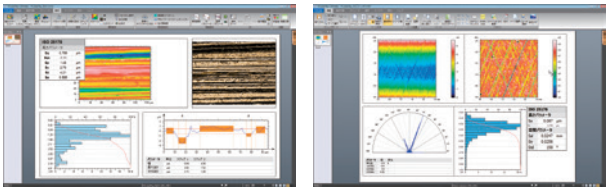
FORMTRACEPAK is equipped with a wide variety of features such as control of the contour and surface roughness measuring systems, data analysis and comparison, and report creation. etc. MCubeMap visualizes the analysis data in detail by using various graphical technologies.
MeasurLink® integrates measured data to a server via a networking system. Mitutoyo supports the realization of quality improvement by preventing defective products being produced, utilizing unified management and sharing of information.


### 3D Surface Property Analyzing Software

### MCubeMap

Parameter analysis is available for not only the vertical directions of Sa and Sq, but also spaces, compounds, and features. A wide variety of graphical technologies help visualize the analyzed data in detail.

Note: The Y-axis table for 3D measurement is required separately.

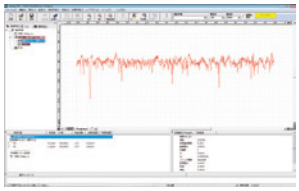


An example of 3D analysis

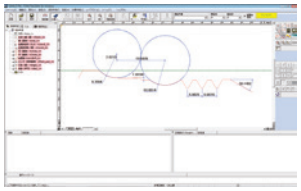
### Surface Texture Analysis Program

### FORMTRACEPAK

This is software that offers total support with such standard functions as form measuring instrument control to surface roughness analysis, contour analysis, contour matching, and inspection report creation. It also supports a status monitor to allow you to monitor the operating status of the measuring instrument.



Surface roughness analysis

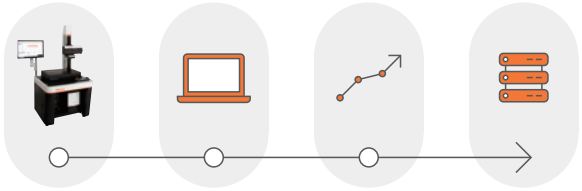


Contour analysis

### Measurement Data Network System

### MeasurLink®

MeasurLink® networks each measuring system and aggregates the measurement data in a server. The real-time aggregation enables "Visible quality" meaning the unified management and sharing of information relevant to quality.



Individual measuring instrument

Real-time measurement data aggregation and analysis
||
Visible data

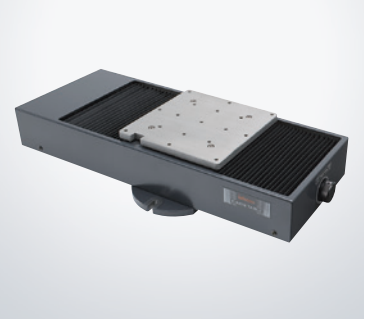
Improvement of accuracy and quality

Upstream system
(customer's own system)

# ACCESSORIES

## Optional accessories for automatic measurement

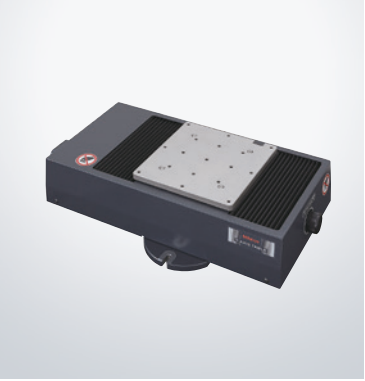
Mitutoyo offers a wide variety of optional accessories supporting the major reduction of total measurement time, from setup and measurement to evaluation, by enabling quicker implementation of operations such as measurement of multiple points, alignment of cylindrical workpieces and leveling for surface roughness measurement.



## Y-axis Table | No.178-097

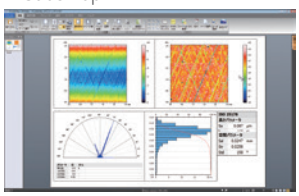
Enables efficient, automatic measurement of multiple aligned workpieces and multiple points on a single surface.

Travel range: 200 mm
Resolution: 0.05 µm
Positioning accuracy: ±3 µm
Drive speed: 0 - 80 mm/s
Maximum load: 50 kg
Mass: 28 kg



## Y-axis Table for 3D Measurement | No.178-096

3D roughness measurement is possible by combining it with 3D-ALT. Additionally, 3D surface texture analysis is possible using MCubeMap.

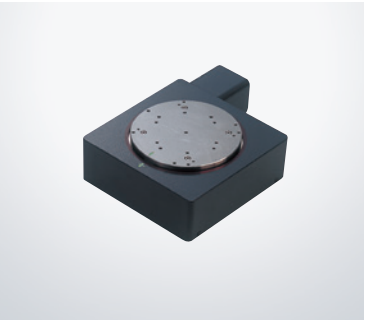


3D surface texture analysis software: MCubeMap

Travel range: 100 mm
Resolution: 0.05 µm
Straightness accuracy (static): 0.3 µm/100 mm
Drive speed: 0 - 20 mm/s
Maximum load: 15 kg
Mass: 31 kg

Inclination adjustment angle: ±2° in all directions
Maximum load (on Y axis): 10 kg
Stage surface dimensions: 139x139 mm
Mass: 4.5 kg

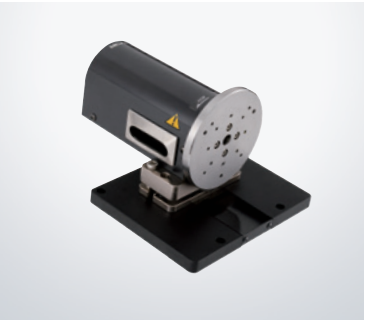
**3D-ALT 178-077**



## Rotary Table | θ 1-axis Table | No.12AAD975

For efficient measurement in the axial/transverse directions. When measuring a cylindrical workpiece, automatic alignment can be performed in combination with the Y-axis table.
(* θ 1-axis Mounting Plate <Option: **12AAE630**> is required when directly installing on the base of the FORMTRACER Avant.)

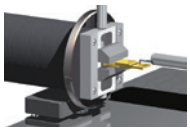
Displacement: 360°
Resolution: 0.004°
Maximum load: 12 kg
Rotational speed: Max 10°/s
Mass: 7 kg



## Rotary Table | θ 2-axis Unit | No.178-078

You can measure multiple points on a cylindrical workpiece and automate front/rear-side measurement.
(* θ 2-axis Mounting Plate <Option: **12AAE718**> is required when directly installing on the base of the FORMTRACER Avant.)

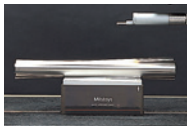
Displacement: 360°
Resolution: 0.0072°
Maximum load (loading moment): 4 kg (moment 343 N·cm or less)
Rotational speed: Max 18°/s
Mass: 5 kg



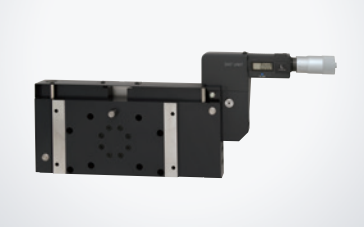

## Auto Leveling Table | No.178-087

This table performs fully automatic leveling adjustment roughness measurement surfaces at the start of measurement. Full automation ensures rapid measurement regardless of the skill level of the operator.

Inclination adjustment angle: ±2°
Maximum load: 7 kg
Table dimensions: 130×100 mm
Mass: 3.5 kg



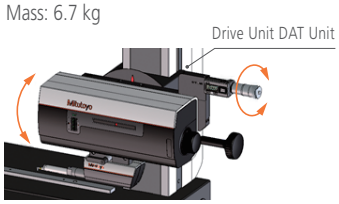
## Drive Unit DAT Unit | **No.178-050**



This optional unit supports leveling of measurement surfaces by inclining the drive unit. This makes leveling easy when working with large workpieces that are hard to place on the auto-leveling table.

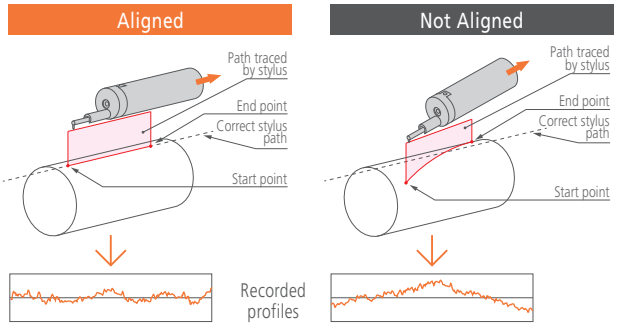
*Cannot be used in combination with FTA-H3000.

Inclination range: ±1.5°
Mass: 6.7 kg




## 3-axis Adjustment Table | **No.178-182**


This table helps make the 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. By using a Mitutoyo's 3-axis adjustment table, the workpiece can be aligned and leveled easily, simply by following the FORMTRACEPAK guidance. No experience or special expertise is required.




## Centering Chuck (Ring Operated) | **No.211-032**

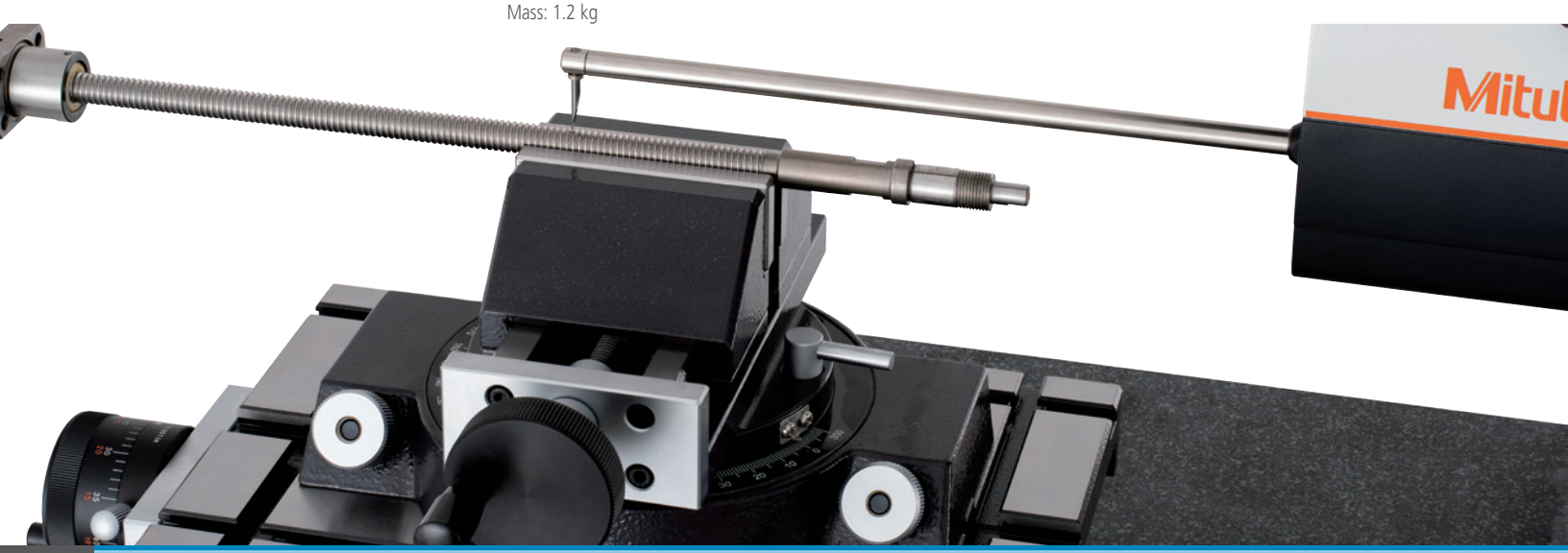
This chuck is useful when measuring small workpieces.
You can easily clamp them with its knurled ring.

Holding range: Inner jaws OD: ϕ1 - ϕ36 mm
Inner jaws ID: ϕ16 - ϕ69 mm
Outer jaws OD: ϕ25 - ϕ79 mm
Dimensions (D × H): ϕ118×41 mm
Mass: 1.2 kg

## Micro-chuck | **No.211-031**

This chuck is suitable for clamping extra-small diameter workpieces (ϕ1 mm or less), which cannot be retained with the centering chuck.

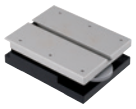
Holding range: OD: ϕ0.2 - ϕ1.5 mm
Dimensions (D × H): ϕ107×48.5 mm
Mass: 0.6 kg



## Table and Fixture Systems

Leveling Table
(Vernier Type)
**No.178-183**

Digital Leveling Table
(Digimatic Type)
**No.178-185**

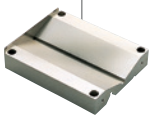


Leveling Table
**No.178-195**

Leveling Table
(for D.A.T.)
**No.178-196**

Calibration Stand*1
**No.12AAM100**

Calibration Stand*2
**No.12AAG175**



V-block
**No.998291**

Precision Vise
**No.178-019**

Cross-travel Table
**No.218-171**

Rotary Vise
**No.218-173**

Center
Supports
**No.172-600**

Center
Support Risers
**No.172-601**

Swivel Center
Support
**No.172-604**

Holder with
Clamp
**No.176-107**

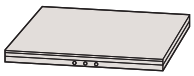
V-block with
Clamp
**No.172-603**

V-block with
Clamp
**No.172-378**

## Desktop Type Vibration Isolators

Automatically Charged
Pneumatic Type*3
**No.178-025**

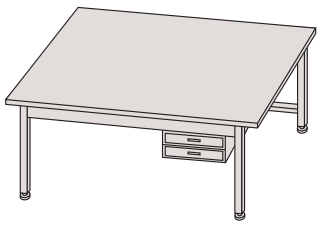
Automatically Charged
Pneumatic Type*4
**No.178-115**



Measurement Workbench
(for Wide Base)
**No.12AAQ583**

● Stand for Desktop type for **178-115**.

External size (W × D × H) : 1500×900×740 mm
Maximum loading : 800 kg



Air Isolation Work Station
**No.64AAB357**

External size (W × D × H) : 762×1219×762 mm
Maximum loading : 589 kg

## Desk Type Vibration Isolators

Desk Type*3
(Stand Integrated Type,
Air System)
**No.178-188**

Side Table*5
**No.178-181**

Desk
(No.178-188)

Side Table

Example combination:
with side table but no monitor arm
(tester and PC not included)

Desk Type*4
(Stand Integrated Type,
Air System)
**No.178-189**

Monitor Arm*5
**No.12AAK120**

Monitor
Arm

Desk
(No.178-189)

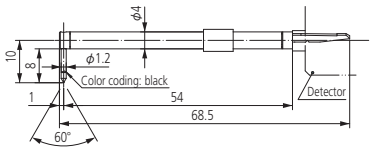
Example combination:
with monitor arm but no side table*6
(tester and PC not included)

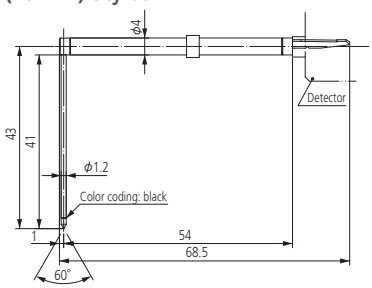
*1 Required for calibrating upward measurement of FTA-**C3000/**D3000 series. (Contour measurement)
*2 Required for calibrating in bulk by mounting straight arm / small-hole stylus arm without using cross-travel table and Y-axis table. (Contour measurement)
*3 For models with a product code that ends in S4, S8, H4, or H8.
*4 For models with a product code that ends in W4, W8, L4 or L8 (wide base models).
*5 Used together with desk types (**178-188** or **178-189**).
*6 User to provide a printer rack.

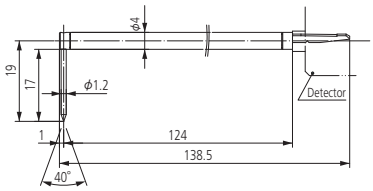
## For Contour & Roughness Measurement | Styli for H-3000 Detector

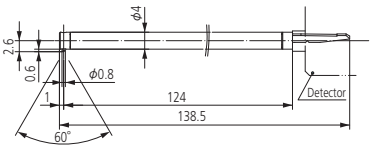
| Stylus name | Order No. | Specifications | | | |
|---|---|---|---|---|---|
| **Standard Stylus** | **12AAY442** | **Measurement** | ☑ Roughness<br>☑ Contour | **Measuring force*1** | 0.75 mN |
| | | **Tip radius** | 2 µm | **Tracing angle*2** | 50° |
| | | **Tip angle** | 60° | **Calibration tool** | Calibration kit<br>16 mm gage block |
| | | **Tip material** | Diamond | **Note** | Standard accessories for FTA-H3000 |
| | | **Stroke** | ±8 mm | | |
| **Cone Stylus** | **12AAY443** | **Measurement** | ☐ Roughness<br>☑ Contour | **Measuring force*1** | 0.75 mN |
| | | **Tip radius** | 25 µm | **Tracing angle*2** | 65° |
| | | **Tip angle** | 30° | **Calibration tool** | Calibration kit<br>16 mm gage block |
| | | **Tip material** | Sapphire | **Note** | Standard accessories for FTA-H3000 |
| | | **Stroke** | ±8 mm | | |
| **ϕ0.5 Ball Stylus** | **12AAY444** | **Measurement** | ☐ Roughness<br>☑ Contour | **Measuring force*1** | Approx. 4 mN |
| | | **Tip radius** | 250 µm (ball) | **Tracing angle*2** | 60° |
| | | **Tip angle** | 30° | **Calibration tool** | Calibration kit<br>16 mm gage block |
| | | **Tip material** | Sapphire | **Note** | Measuring force above is only when the X-axis angle is 0° |
| | | **Stroke** | ±8 mm | | |
| **Stylus for Small Hole** | **12AAY445** | **Measurement** | ☑ Roughness<br>☐ Contour | **Measuring force*1** | 0.75 mN |
| | | **Tip radius** | 2 µm | **Tracing angle** | — |
| | | **Tip angle** | 60° | **Calibration tool** | Roughness specimen (optional) or Step gage (optional) |
| | | **Tip material** | Diamond | **Note** | Measuring force above is only when the X-axis angle is 0° |
| | | **Stroke** | ±8 mm | | |
| **Eccentric Stylus** | **12AAY446** | **Measurement** | ☑ Roughness<br>☑ Contour | **Measuring force*1** | 0.75 mN |
| | | **Tip radius** | 2 µm | **Tracing angle*2** | 50° |
| | | **Tip angle** | 60° | **Calibration tool** | Calibration kit<br>16 mm gage block |
| | | **Tip material** | Diamond | **Note** | |
| | | **Stroke** | ±8 mm | | |
| **Stylus for Gear Tooth** | **12AAY447** | **Measurement** | ☑ Roughness<br>☐ Contour | **Measuring force*1** | 0.75 mN |
| | | **Tip radius** | 2 µm | **Tracing angle** | — |
| | | **Tip angle** | 60° | **Calibration tool** | Roughness specimen (optional) or Step gage (optional) or 2 mm gage block (optional) |
| | | **Tip material** | Diamond | **Note** | |
| | | **Stroke** | ±8 mm | | |

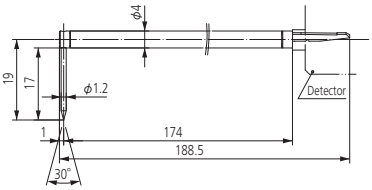
| Stylus name | Part No. | Specifications | | | |
|---|---|---|---|---|---|
| **Stylus for Groove (7 mm)** | **12AAY448** | **Measurement** | ☑ Roughness<br>☑ Contour | **Measuring force*1** | 0.75 mN |
| | | **Tip radius** | 2 µm | **Tracing angle*2** | 50° |
| | | **Tip angle** | 60° | **Calibration tool** | Calibration kit<br>16 mm gage block |
| | | **Tip material** | Diamond | **Note** | |
| | | **Stroke** | ±8 mm | | |
| **Stylus for Deep Groove (40 mm) Stylus** | **12AAY449** | **Measurement** | ☑ Roughness<br>☐ Contour | **Measuring force*1** | 0.75 mN |
| | | **Tip radius** | 2 µm | **Tracing angle** | — |
| | | **Tip angle** | 60° | **Calibration tool** | Roughness specimen (optional)<br>or Step gage (optional) |
| | | **Tip material** | Diamond | **Note** | Measuring force above is only when the X-axis angle is 0° |
| | | **Stroke** | ±8 mm | | |
| **Double-length Stylus** | **12AAY450** | **Measurement** | ☑ Roughness<br>☑ Contour | **Measuring force*1** | Approx. 4 mN |
| | | **Tip radius** | 5 µm | **Tracing angle*2** | 35° |
| | | **Tip angle** | 40° | **Calibration tool** | Calibration kit<br>30 mm gage block (optional gage block) |
| | | **Tip material** | Diamond | **Note** | |
| | | **Stroke** | ±16 mm | | |
| **Double-length Stylus for Deep Hole** | **12AAY451** | **Measurement** | ☑ Roughness<br>☐ Contour | **Measuring force*1** | Approx. 4 mN |
| | | **Tip radius** | 5 µm | **Tracing angle** | — |
| | | **Tip angle** | 60° | **Calibration tool** | Roughness specimen (optional)<br>or Step gage (optional) |
| | | **Tip material** | Diamond | **Note** | |
| | | **Stroke** | ±16 mm | | |
| **2.7x-length Stylus** | **12AAY452** | **Measurement** | ☐ Roughness<br>☑ Contour | **Measuring force*1** | Approx. 7 mN |
| | | **Tip radius** | 25 µm | **Tracing angle*2** | 35° |
| | | **Tip angle** | 30° | **Calibration tool** | Calibration kit<br>40 mm gage block (optional gage block) |
| | | **Tip material** | Sapphire | **Note** | |
| | | **Stroke** | ±21.5 mm | | |



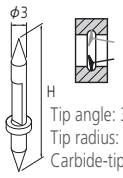




*1: The measuring force is the nominal value at the mid-stroke position.
*2: Indicates the tracing angle in the stroke ±5mm range. It is also subject to changes depending on the surface texture.

## For Contour Measurement | Styli

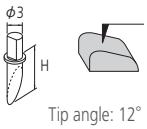
| Stylus name | Stylus No. | Order No. | Application arm No. | H (mm) |
|---|---|---|---|---|
| **Double-sided Conical Stylus*1** | **SPHW-56** | **12AAM095*2** | **AB-31, AB-37** | 20 |
| | **SPHW-66** | **12AAM096** | **AB-31, AB-37** | 32 |
| | **SPHW-76** | **12AAM097** | **AB-31, AB-37** | 48 |
| **One-sided Cut Stylus** | **SPH-51** | **354882** | **AB-31, AB-37** | 6 |
| | **SPH-61** | **354883** | **AB-31, AB-37** | 12 |
| | **SPH-71** | **354884*2*3** | **AB-31, AB-37** | 20 |
| | **SPH-81** | **354885** | **AB-31, AB-37** | 30 |
| | **SPH-91** | **354886** | **AB-31, AB-37** | 42 |
| **Intersecting Cut Stylus** | **SPH-52** | **354887** | **AB-31, AB-37** | 6 |
| | **SPH-62** | **354888** | **AB-31, AB-37** | 12 |
| | **SPH-72** | **354889** | **AB-31, AB-37** | 20 |
| | **SPH-82** | **354890** | **AB-31, AB-37** | 30 |
| | **SPH-92** | **354891** | **AB-31, AB-37** | 42 |
| **Cone Stylus Tip Angle 30° Sapphire Tipped** | **SPH-53** | **354892** | **AB-31, AB-37** | 6 |
| | **SPH-63** | **354893** | **AB-31, AB-37** | 12 |
| | **SPH-73** | **354894** | **AB-31, AB-37** | 20 |
| | **SPH-83** | **354895** | **AB-31, AB-37** | 30 |
| | **SPH-93** | **354896** | **AB-31, AB-37** | 42 |
| **Cone Stylus Tip Angle 30° Carbide-tipped** | **SPH-56** | **12AAA566** | **AB-31, AB-37** | 6 |
| | **SPH-66** | **12AAA567** | **AB-31, AB-37** | 12 |
| | **SPH-76** | **12AAA568** | **AB-31, AB-37** | 20 |
| | **SPH-86** | **12AAA569** | **AB-31, AB-37** | 30 |
| | **SPH-96** | **12AAA570** | **AB-31, AB-37** | 42 |
| **Cone Stylus Tip Angle 20° Carbide-tipped** | **SPH-57** | **12AAE865** | **AB-31, AB-37** | 6 |
| | **SPH-67** | **12AAE866** | **AB-31, AB-37** | 12 |
| | **SPH-77** | **12AAE867** | **AB-31, AB-37** | 20 |
| | **SPH-87** | **12AAE868** | **AB-31, AB-37** | 30 |
| | **SPH-97** | **12AAE869** | **AB-31, AB-37** | 42 |
| **Cone Stylus Tip Angle 50° Diamond Tipped** | **SPH-79** | **355129** | **AB-31, AB-37** | 20 |
| **Knife Edge Stylus** | **SPH-54** | **354897** | **AB-31, AB-37** | 6 |
| | **SPH-64** | **354898** | **AB-31, AB-37** | 12 |
| | **SPH-74** | **354899** | **AB-31, AB-37** | 20 |
| | **SPH-84** | **354900** | **AB-31, AB-37** | 30 |
| | **SPH-94** | **354901** | **AB-31, AB-37** | 42 |
| **Ball Stylus** | **SPH-55** | **354902** | **AB-31, AB-37** | 6 |
| | **SPH-65** | **354903** | **AB-31, AB-37** | 12 |
| | **SPH-75** | **354904** | **AB-31, AB-37** | 20 |
| | **SPH-85** | **354905** | **AB-31, AB-37** | 30 |
| | **SPH-95** | **354906** | **AB-31, AB-37** | 42 |
| **Small Hole Stylus** | **SPH-41** | **12AAM104** | **AB-33** | 2 |
| | **SPH-42** | **12AAM105** | **AB-33** | 4 |
| | **SPH-43** | **12AAM106** | **AB-33** | 6.5 |

### Double-sided conical stylus



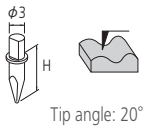

Tip angle: 30°
Tip radius: 25 µm
Carbide-tipped

### One-sided cut stylus



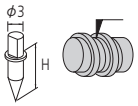

Tip angle: 12°
Tip radius: 25 µm
Carbide-tipped

### Intersecting cut stylus

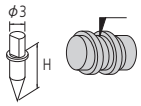



Tip angle: 20°
Tip radius: 25 µm
Carbide-tipped

### Cone stylus

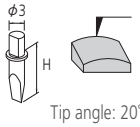



Tip angle: 30° (SPH-79: 50°)
Tip radius: 25 µm
Sapphire, Carbide-tipped
(SPH-79:Diamond tipped)



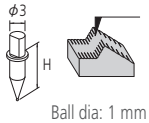

Tip angle: 20°
Tip radius: 25 µm
Carbide-tipped

### Knife edge stylus



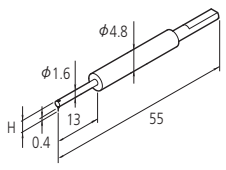

Tip angle: 20°
Edge width: 3 mm
Tip radius: 25 µm
Carbide-tipped

### Ball stylus



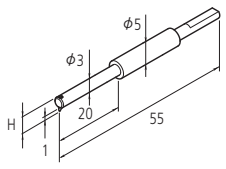

Ball dia: 1 mm
Carbide-tipped

### Small hole stylus SPH-41



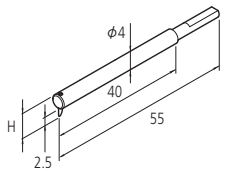

Tip shape:
One-sided cut
Tip angle: 20°
Tip radius: 25 µm
Carbide-tipped

### Small hole stylus SPH-42




Tip shape:
One-sided cut
Tip angle: 20°
Tip radius: 25 µm
Carbide-tipped

### Small hole stylus SPH-43

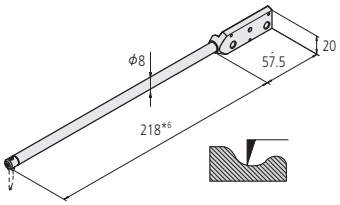



Tip shape:
One-sided cut
Tip angle: 20°
Tip radius: 25 µm
Carbide-tipped

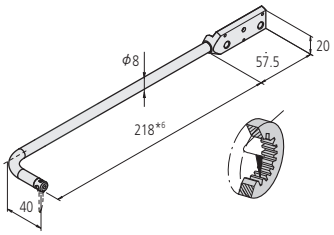
## For Contour Measurement | Arms

| Arm name | Arm No. | Parts No. | Applicable stylus No. |
|---|---|---|---|
| **Straight Arm** | **AB-31*4** | **12AAM101** | **SPH-5＊, 6＊, 7＊, 8＊, 9＊、SPHW*5 - 56, 66, 76** |
| **Eccentric Arm** | **AB-37** | **12AAQ762** | **SPH-5＊, 6＊, 7＊, 8＊, 9＊、SPHW*5 - 56, 66, 76** |
| **Small-hole Arm** | **AB-33** | **12AAM103** | **SPH-41, 42, 43** |

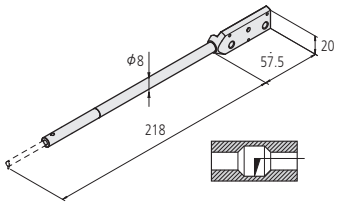
Straight Arm AB-31




Eccentric Arm AB-37



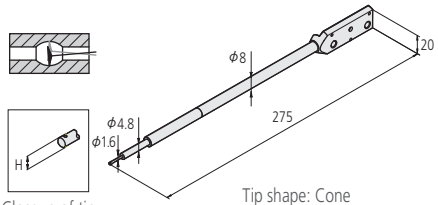

Small-hole Arm AB-33




## For Contour Measurement | Arm Styli (Comprising an Arm and Stylus)

| Arm stylus name | Stylus No. | Parts No. | H (mm) |
|---|---|---|---|
| **Double-sided Small Hole Arm Stylus*7** | **SPHW-21** | **12AAT469** | 2.4 |
| | **SPHW-22** | **12AAT470** | 5 |
| | **SPHW-31** | **12AAM108** | 2.4 |
| | **SPHW-32** | **12AAM109** | 5 |
| | **SPHW-33** | **12AAM110** | 9 |

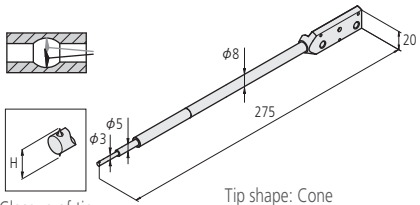
Double-sided Small Hole Arm Stylus SPHW-21/31




Closeup of tip

Tip shape: Cone
Tip angle: 20° (SPHW-21)
30° (SPHW-31)
Tip radius: 25 μm
Carbide-tipped

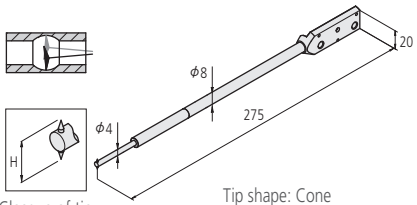
Double-sided Small Hole Arm Stylus SPHW-22/32




Closeup of tip

Tip shape: Cone
Tip angle: 20° (SPHW-22)
30° (SPHW-32)
Tip radius: 25 μm
Carbide-tipped

Double-sided Small Hole Arm Stylus SPHW-33

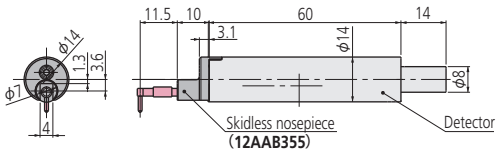



Closeup of tip

Tip shape: Cone
Tip angle: 30°
Tip radius: 25 μm
Carbide-tipped

*1 Stylus for contour detector C-4500. *2 Standard accessory of FTA-**C4000/D4000 series. *3 Standard accessory of FTA-**C3000/D3000 series.
*4 Standard accessory of FTA-**C3000/C4000/D3000/D4000 series. *5 Stylus for FTA-**C4000/D4000 series. *6 One-sided cut stylus SPH-71 (standard accessory) mounting.
*7 Arm Stylus for FTA-**C4000/D4000 series.

## For Surface Roughness Measurement | Detectors




| Order No. | Measuring force | |
|---|---|---|
| **178-396-2** | 0.75 mN | Detectors that comply with ISO 4278 |
| **178-397-2** | 4 mN | Detectors that comply with previous standards, for general use. |

## For Surface Roughness Measurement | Extension Rods

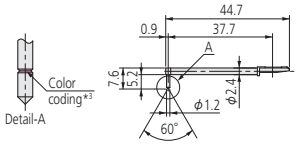
**Extension Rod 50 12AAG202** Extension length 50 mm

**Extension Rod 100 12AAG203** Extension length 100 mm

Note: No more than one extension rod can be connected.

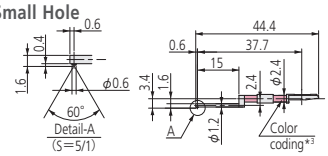
## For Surface Roughness Measurement | Styli

**Standard Stylus**



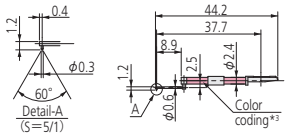

**12AAE882** (1 µm)
**12AAE924** (1 µm) *1
**12AAC731** (2 µm)
**12AAB403** (5 µm) *1
**12AAB415** (10 µm) *1
**12AAE883** (250 µm) *4
( ): Tip radius

**For Small Hole**



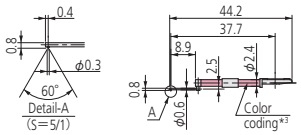

**12AAC732** (2 µm)
**12AAB404** (5 µm) *1
**12AAB416** (10 µm) *1
( ): Tip radius

**For Extra-small Hole**



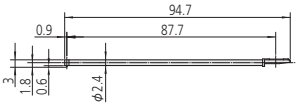

**12AAC733** (2 µm)
**12AAB405** (5 µm) *1
**12AAB417** (10 µm) *1
( ): Tip radius

**For Extra-minute Hole**



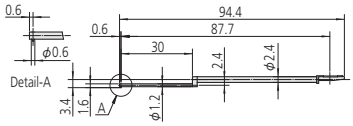

**12AAC734** (2 µm)
**12AAB406** (5 µm) *1
**12AAB418** (10 µm) *1
( ): Tip radius

**Double-length for Deep Hole*2**



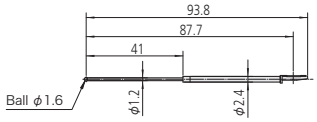

**12AAE898** (2 µm)
**12AAE914** (5 µm) *1
( ): Tip radius

**For Small Hole/Double-length for Deep Hole*2**



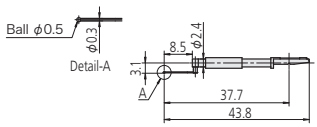

**12AAE892** (2 µm)
**12AAE908** (5 µm) *1
( ): Tip radius

**For Small Hole*2 *4**



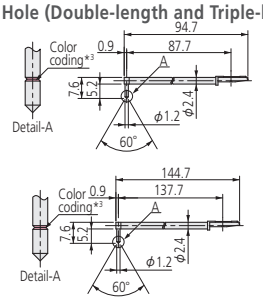

**12AAE884** (ϕ1.6 mm)

**For Ultra-small Hole*4**




**12AAJ662** (ϕ0.5 mm)

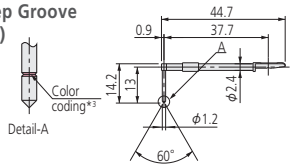
**For Deep Hole (Double-length and Triple-length)*2**




2倍
**12AAC740** (2 µm)
**12AAB413** (5 µm) *1
**12AAB425** (10 µm) *1
( ): Tip radius

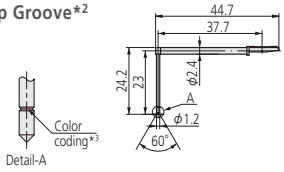
3倍
**12AAC741** (2 µm)
**12AAB414** (5 µm) *1
**12AAB426** (10 µm) *1
( ): Tip radius

**For Deep Groove (10 mm)**



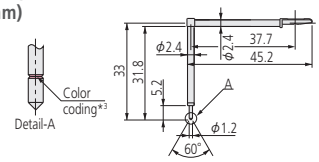

**12AAC735** (2 µm)
**12AAB409** (5 µm) *1
**12AAB421** (10 µm) *1
( ): Tip radius

**For Deep Groove*2 (20 mm)**



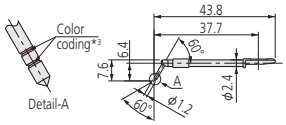

**12AAC736** (2 µm)
**12AAB408** (5 µm) *1
**12AAB420** (10 µm) *1
( ): Tip radius

**For Deep Groove*2 (30 mm)**



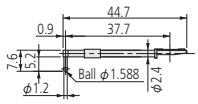

**12AAC737** (2 µm)
**12AAB407** (5 µm) *1
**12AAB419** (10 µm) *1
( ): Tip radius

**For Gear Tooth**



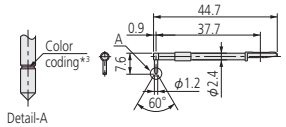

**12AAB339** (2 µm)
**12AAB410** (5 µm)
**12AAB422** (10 µm)
( ): Tip radius

**For Rolling Circle Waviness Surface*4**



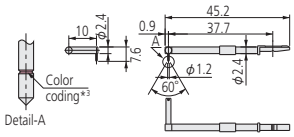

**12AAB338** (ϕ1.588)

**For Knife-edge**



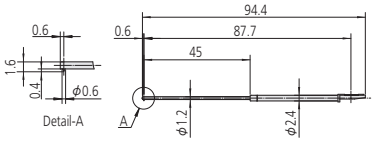

**12AAC738** (2 µm)
**12AAB411** (5 µm) *1
**12AAB423** (10 µm) *1
( ): Tip radius

**For Eccentric Arm*2**



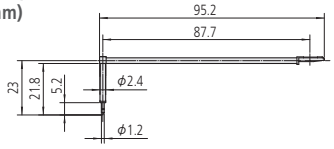

**12AAC739** (2 µm)
**12AAB412** (5 µm) *1
**12AAB424** (10 µm) *1
( ): Tip radius

**For Small Slotted Hole*2**



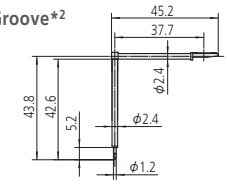

**12AAE938** (2 µm)
**12AAE940** (5 µm) *1

**For Deep Groove*2 (20 mm)**



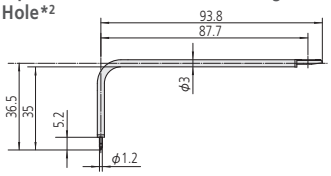

**12AAE893** (2 µm)
**12AAE909** (5 µm) *1
( ): Tip radius

**For Deep Groove*2 (40 mm)**



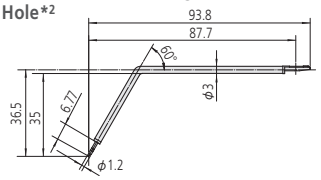

**12AAE895** (2 µm)
**12AAE911** (5 µm) *1
( ): Tip radius

**For Deep Groove (30 mm) / Double-length for Deep Hole*2**



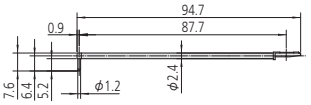

**12AAE894** (2 µm)
**12AAE910** (5 µm) *1
( ): Tip radius

**For Gear Tooth / Double-length for Deep Hole*2**



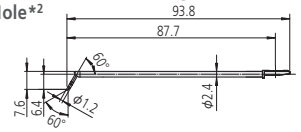

**12AAE896** (2 µm)
**12AAE912** (5 µm)
( ): Tip radius

**For Rolling Circle Waviness / Double-length for Deep Hole*2 *4**



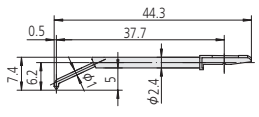

**12AAE886** (250 µm)

**For Corner Hole / Double-length for Deep Hole*2**




**12AAM601** (2 µm)
**12AAM603** (5 µm)
( ): Tip radius

**For Bottom Surface**




**12AAE899** (2 µm)
**12AAE915** (5 µm) *1
( ): Tip radius

*1 Tip angle 90°

*2 For downward-facing measurement only.

*3

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

*4 Used for calibration, a standard step gauge (178-611, option) is also required

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

# APPLICATION

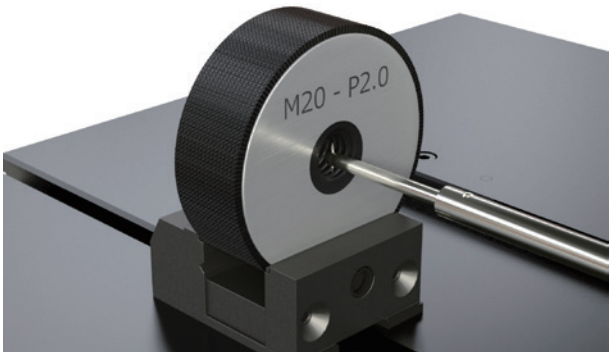
## Efficient precision measurement for practically any workpiece

FORMTRACER Avant Series has applications supporting measurements for a wide variety of workpieces. For example, a part-program (automatic measuring program) creation support key equipped with the remote box allows rapid creation of programs, and the contour sensor allows immediate measurement by creating a measurement-ready state once the sensor contacts a workpiece. Furthermore, this series features stylus-up significantly faster than conventional models, along with high-speed axis travel. By combining these elements into a single system, efficient and accurate measurements are realized.

### PET bottle  Preform measurement

The thread of a familiar PET bottle requires precision measurement, since leaks will occur if it is too loose, or the cap cannot be tightened if it is too tight. The "sectional form of thread" of such PET bottles can be measured without cutting the product by using a cone stylus. Angle and pitch can be measured efficiently.

### Screw gauge  Ring measurement

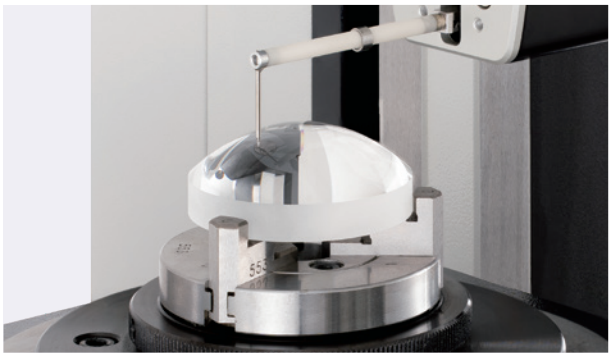



Upper/lower surface continuous measurement and measurement adjustable feature on the C-4500 detector allows simultaneous measurements of the effective diameter of screw or ring gages, together with thread angle and pitch. Since a part-program (automatic measuring program) for measuring and analysis can be created, effective diameter, which requires high accuracy in micrometer threads, can be accurately and efficiently measured.

## Bearing measurement

Bearing rings (outer ring/inner ring) are required to have a shape and surface roughness that will allow the lubricating oil to work as an effective preventive measure against seizure and wear. The H-3000 detector has both a wide measurement range and high resolution, allowing contour and surface roughness to be evaluated efficiently and with high accuracy in a single measurement.

## Lens measurement

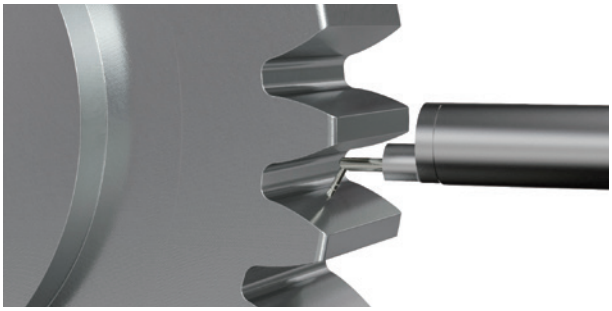


Lens measurements require a high level of shape accuracy to achieve the necessary optical performance. The H-3000 detector achieves high-accuracy and high-resolution shape measurement, allowing accurate and precise evaluation of PV values by comparison with design values. It also supports analysis of surface roughness and various dimensional analysis functions.

## Golf club face groove form measurement

Groove pitches, groove intervals, and edge shapes are strictly determined by golf club standards. By using the part-program (automatic measuring program) as a standard feature and automating analysis, efficient evaluation is possible with precision measurement.

## Surface roughness test for tooth faces of gears



The surface roughness of gear teeth may affect strength and torque transfer efficiency. By using a stylus for gear teeth, it is possible to measure over the full face of a tooth, right down to the root. FORMTRACER Avant Series, which can cut off the positioning distance to its limit (0.05 mm), helps evaluate the surface roughness of gear teeth.

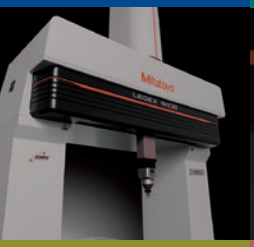
## Can pull-top groove measurement

If the pull-top groove is too shallow, the pull-top cannot be opened, and if it is too deep, it will be opened easily, resulting in leakage during transportation due to vibration or shock. The groove dimensions of products can be efficiently controlled or measured where high accuracy is required.

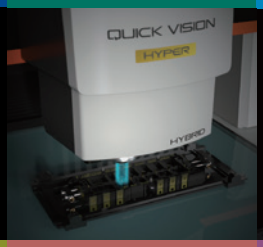
## Surface roughness test for tablet molds

Durability is required for tablet molds to ensure the detachability of pharmaceutical powder and reduction of production cost. FORMTRACER Avant Series, which can cut off the positioning distance to its limit, helps evaluate the surface roughness of molds with accuracy and precision as it can measure products with high accuracy from edge to edge.

Coordinate Measuring Machines



Vision Measuring Systems




Form Measurement

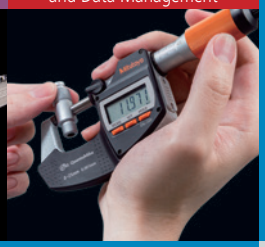
Optical Measuring

Sensor Systems

Test Equipment

Digital Scale and DRO Systems

Small Tool Instruments and Data Management



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Mitutoyo is not only a manufacturer of top quality measuring products but one that also offers qualified support for the lifetime of the equipment, backed up by comprehensive services that ensure your staff can make the very best use of the investment.

Apart from the basics of calibration and repair, Mitutoyo offers product and metrology training, as well as IT support for the sophisticated software used in modern measuring technology. We can also design, build, test and deliver measuring solutions and even, if deemed cost-effective, take your critical measurement challenges in-house on a sub-contract basis.

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