

Contracer CV-2100

SERIES 218 — Contour Measuring Instruments

FEATURES

- Newly designed high-precision digital ARC scale improves the Z-axis accuracy and resolution.
- Quick-release grip handle allows for rapid traverse in column Z-axis for CV-2100M4.
- Key operation buttons are now mounted onto the X-axis drive unit, eliminating wired remote box.
- X-axis traverse speed has been greatly improved to 20mm/s allowing quick positioning and set-up time.
- New added function for automatic stylus up/down means high-volume repetitive measurements are now capable with part programming.
- Z-axis detector measuring range has been improved to 50mm for both models.
- CV-2100N4 model can be mounted to optional manual column stand or custom fixture supplied by end user.

CV-2100M4 with personal computer system and software



Connected to a personal computer, the FORMTRACPAK V5 contour analysis program provides various modes of measurement and analysis.
*Printer not included



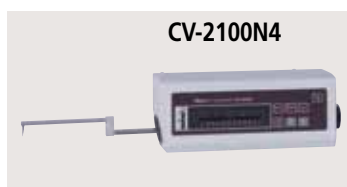
Centralized front control panel



Quick-vertical motion handle



X-axis jog shuttle



CV-2100N4

*1



Desktop PC



Manual column stand for CV-2100N4*2

*1: If the CV-2100N4 is operated without the dedicated manual stand, the measuring range of the Z-axis might be reduced, depending on the installation conditions. If you are considering using the CV-2100N4 without the stand, contact your local Mitutoyo sales office for advice.

*2: Optional accessory 218-042 manual column stand

Technical Data

X1-axis

Measuring range:	4" (100mm) (CV-2100)
Resolution:	3.93μin (0.1μm)
Measurement method:	STVC-10Z
Drive speed:	0-.79"/s (0-20mm/s)
Measuring speed:	.000787"/s, .2"/s (.02, 5mm/s)
Measuring direction:	Forward / Backward
Traverse linearity:	98.4μin/4" (2.5μm/100mm) (CV-2100)
Linear displacement:	±(100+20L)μin ±(2.5+2L/100)μm
	* L = Drive length (mm)
Inclining range:	±45°
Z2-axis (column)	
Column type:	Manual (M4 type)
Vertical travel:	13.8" (350mm) (M4 type)

Z1-axis (detector unit)

Measuring range:	2" (50mm)
Resolution:	3.93μin (0.1μm)
Measurement method:	Digital arc scale
Linear displacement:	±(100+100h)μin ±(2.5+0.1H)μm
Accuracy (at 20°C):	*H: Measurement height from the horizontal position within ±1" (±25mm)

Stylus up/down operation: Arc movement

Face of stylus:	Downward
Measuring force:	30±10mN (3gf)
Traceable angle:	Ascent: 77°, descent: 87° (using the standard stylus provided and depending on the surface roughness)

Stylus tip

Base size (W x H):	Radius: 25μm, carbide tip
Base material:	23.6 x 17.7" (600 x 450mm)
Mass:	Granite
Power supply:	321 lbs (145.8kg) (CV-2100M4),
Power consumption:	100 – 240VAC ±10%, 50/60Hz
	30W (main unit only)

Highly accurate arc scale



This scale directly tracks the arc trajectory of the stylus tip so that the most accurate compensation can be applied to the scale output, which leads to higher accuracy and resolution.

Contracer CV-2100

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Optional Accessories

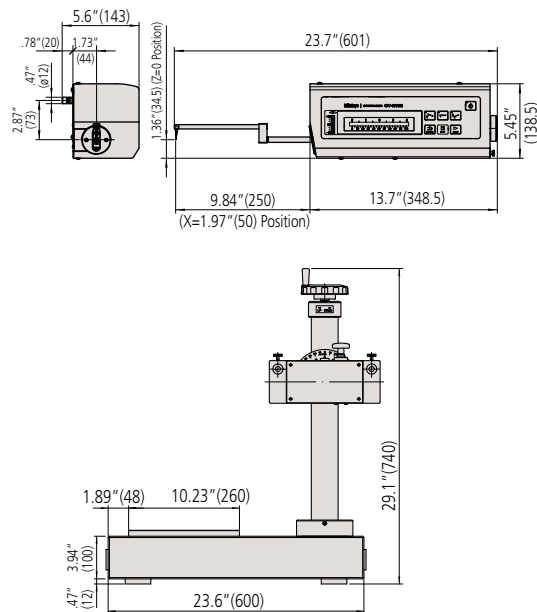
- 218-042:** Column stand for CV-2100N4
(vertical travel: 250mm, inclination: $\pm 45^\circ$)
- 218-001:** Cross-travel table (XY range: 100 x 50mm)
- 218-011:** Cross-travel table (XY range: 4" x 2")
- 218-041:** Cross-travel table (XY range: 50 x 25mm)
- 218-051:** Cross-travel table (XY range: 2" x 1")
- 218-002:** Rugged table
- 176-107:** Holder with clamp
- 218-003:** Rotary vise (heavy-duty type)
- 172-144:** Rotary vise
- 172-234:** V-block with clamp
(Max. workpiece dia.: 50mm)
- 172-378:** V-block with clamp
(Max. workpiece dia.: 25mm)
- 172-197:** Swivel center support
- 172-142:** Center support
- 172-143:** Center support riser
- 998862:** Pin gage unit for calibration (mm)
- 998861:** Pin gage unit for calibration (inch)
- 998861:** Arms and styli (See page J-32/33.)
- 12AAG175:** Calibration table
- 178-047:** 3-axis adjustment table

SPECIFICATIONS

Model		CV-2100M4	CV-2100N4
Order No.		218-643A	218-623A
Measurement range	X-axis	4" (100mm)	
	Z1-axis (detector unit)	2" (50mm)	
Z2-axis (column) travel range		13.8" (350mm)	—
X-axis inclination angle		$\pm 45^\circ$	—
Resolution	X-axis	3.93 μ in (0.1 μ m)	
	Z1-axis	3.93 μ in (0.1 μ m)	
Drive method	X-axis	Motorized drive 0 - 0.79in/s (0 - 20mm/s)	
	Z2-axis (column)	Manual (quick up-and-down motion, fine feed)	—
Measuring speed		.00078 - .2" / sec (0.02 - 5mm/s)	
Linearity accuracy (X-axis horizontal orientation)		98.4 μ in/4in (2.5 μ m/100mm)	
Accuracy (20°C)	X-axis	$\pm(100+20L) \mu$ in [$\pm(2.5+0.02L) \mu$ m]] L = Measurement Length (mm)	
	Z1-axis	$\pm(100+ 100H) \mu$ in [$\pm(2.5+ 0.1H) \mu$ m]] H = Measurement height from horizontal position within 1" (± 25 mm)	
Measurement direction		Forward / Backward	
Measurement surface direction		Downward	
Measuring force		(3gf) (30 \pm 10mN)	
Stylus traceable angle (Standard accessory stylus)		Ascent 77°, Descent 87° (Depends on the surface condition)	
External dimensions (WxDxH)		29.3 x 17.7 x 34.8" (745x450x885mm)	25.6 x 5.63 x 5.45" (651x143x138.5mm)
Mass		321.43 lbs (145.8 kg)	12.78 lbs (5.8 kg)

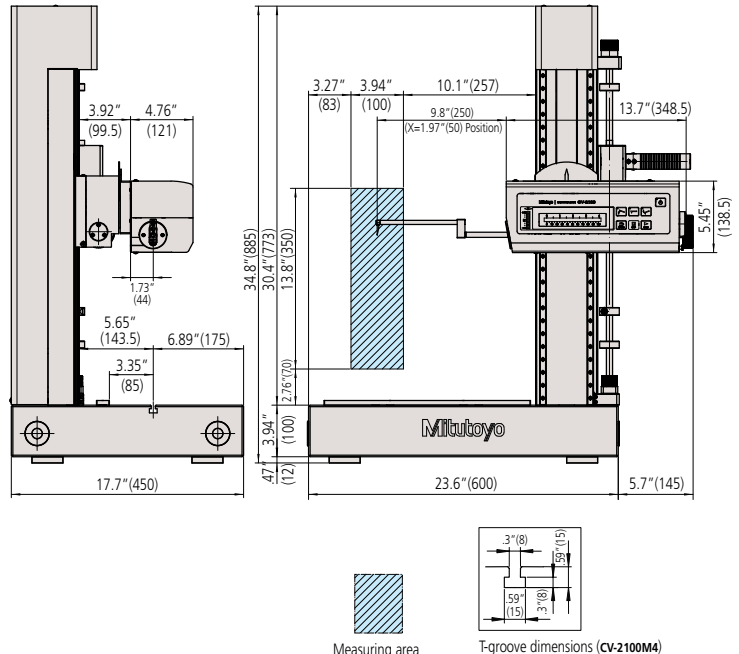
DIMENSIONS

CV-2100N4



Optional Manual Column Stand for CV-2100N4

CV-2100M4



Unit: inch(mm)

Measuring area

T-groove dimensions (CV-2100M4)

Contracer CV-3200 / CV-4500

SERIES 218 — Contour Measuring Instruments



CV-3200L4 (with options)



CV-3200S4 with personal computer system and software

CV-3200 FEATURES

- Dramatically increased drive speed (X axis: 80 mm/s, Z2 axis: 20 mm/s) further reduces total measurement time.
- In order to maintain the traverse linearity specification for an extended period of time, Mitutoyo has adopted highly rigid ceramic guides that combine the characteristics of smallest secular change and remarkable resistance to abrasion.
- With the support for a wide range of optional peripherals designed for use with the CNC models enables simplified CNC measurement.
- The drive unit (X-axis) and column (Z2-axis) are equipped with a high-accuracy linear encoders (ABS type on Z2-axis). This improves reproducibility of continuous automatic measurement of small holes in the vertical direction and repeated measurement of parts which are difficult to position.
- A newly designed straight arm reduces interference on the workpiece and expands the measurement range in the Z1 axis (height) direction.
- One-touch mounting and removal of the arm.
- X1-axis accuracy: $\pm(0.8+0.01L)\mu\text{m}$ *
Z1-axis accuracy: $\pm(1.6+12HI/100)\mu\text{m}$
Designed to handle workpieces calling for high accuracy.

* CV-3200S4, H4, W4 types, L = Drive length, H = Measurement height (mm)

With the addition of a new function for continuously measuring top and bottom faces, the variable measuring force function has become more useful, enabling a wide variety of efficient, high-precision measurements.

CV-4500 FEATURES

- When combined with the double cone-end stylus (a new product with diametrically opposed contact points), the instrument can continuously measure in the upward and downward directions without the need to change the arm orientation or reset the workpiece fixturing.
- The measuring force can be switched among five levels (upward and downward) from the data-processing program (Formtracepak).
- High-precision and high-speed drive has been achieved, significantly improving measurement efficiency.
- A newly designed straight arm has reduced interference on the workpiece and expanded the measurement range in the Z1 axis (height) direction.
- One-touch mounting and removal of the arm.



Technical Data

X-axis

Measuring range: 4" (100mm) or 8" (200mm)
Resolution: 1.97 μm (0.05 μm)
Measurement method: Reflective-type linear encoder
Drive speed: 3.15"/s (80mm/s) and manual
Measuring speed: .0008 - .79"/s (0.02 - 20mm/s)*

*Recommended speed: under 5mm/s
If using higher speed, stylus tip may be chipped and/or accuracy may be worse, depending on surface condition.

Measuring direction: Forward / Backward
Traverse linearity: 32 $\mu\text{m}/4"$, 80 $\mu\text{m}/8"$
(0.8 $\mu\text{m}/100\text{mm}$, 2 $\mu\text{m}/200\text{mm}$)
*with the X axis in horizontal orientation

Linear displacement: (31.5+10L) μm
accuracy (at 20°C) { $\pm(8+0.01L)\mu\text{m}$ } (CV-3200S4, H4, W4, L4)
(32+10L) μm
{ $\pm(0.8+0.01L)\mu\text{m}$ } (CV-4500S4, H4, W4, L4)
(31.5+20L) μm
{ $\pm(0.8+0.02L)\mu\text{m}$ } (CV-3200S8, H8, W8, L8)
(32+20L) μm
{ $\pm(0.8+0.02L)\mu\text{m}$ } (CV-4500S8, H8, W8, L8)
* L = Drive length (mm)

Inclining range: $\pm 45^\circ$
Z2-axis (column)
Vertical travel: 10" (300mm) or 20" (500mm)
Resolution: 39.4 μm (1 μm)
Measurement method: ABSOLUTE linear encoder
Drive speed: 0 - 1.2"/s (0 - 30mm/s) and manual

Z1-axis (detector unit)

Measuring range: $\pm 1.2"$ ($\pm 30\text{mm}$)
Resolution: 1.57 μm (0.04 μm) (CV-3200 series),
.78 μm (0.02 μm) (CV-4500 series)

Measurement method: Rotary arc encoder (CV-3200 series),
(CV-4500 series)

Linear displacement
Accuracy (at 20°C): $\pm(63+120HI)\mu\text{m}$ ($\pm(1.4+12HI/100)\mu\text{m}$)
(CV-3200 series)
 $\pm(32+120HI)\mu\text{m}$ ($\pm(0.8+12HI/100)\mu\text{m}$)
(CV-4500 series)
*H: Measurement height from the horizontal position (mm)

Stylus up/down operation: Arc movement
Face of stylus: Upward/downward
Measuring force: 30mN (CV-3200)
Measuring force: 10, 20, 30, 40, 50mN (CV-4500)
(Specified from the data-processing program)

Formtracepak
Traceable angle: Ascent: 77°, descent: 83°
(using the standard stylus provided and depending on the surface roughness)

Stylus tip
Base size (W x H): Radius: 25 μm , carbide tip
17.7 x 23.6" (450 x 600mm) or
39.4 x 17.7" (1000 x 450mm)

Base material: Granite
Power supply: 100 - 240VAC $\pm 10\%$, 50/60Hz
Power consumption: 400W (main unit only)



Refer to Bulletin No. (2177) for more details.

Contracer CV-3200 / CV-4500

SERIES 218 — Contour Measuring Instruments

SPECIFICATIONS

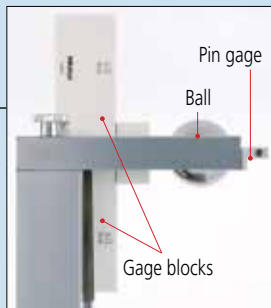
Model No.	CV-3200S4	CV-3200H4	CV-3200W4	CV-3200L4
Order No. (inch)	218-491-10A	218-492-10A	218-493-10A	218-494-10A
Model No.	CV-4500S4	CV-4500H4	CV-4500W4	CV-4500L4
Order No. (inch)	218-451-10A	218-452-10A	218-453-10A	218-454-10A
X1-axis measuring range	4" (100mm)	4" (100mm)	4" (100mm)	4" (100mm)
Vertical travel	12" (300mm) power column	20" (500mm) power column	20" (500mm) power column	27.6" (700mm) power column
Granite base size (WxD)	23.6 x 17.7" (600 x 450mm)	23.6 x 17.7" (600 x 450mm)	39.4 x 17.7" (1000 x 450mm)	39.4 x 17.7" (1000 x 450mm)
Dimensions (main unit, WxDxH)	29.2 x 17.7 x 35.6" (741 x 450 x 905mm)	29.2 x 17.7 x 43.5" (741 x 450 x 1105mm)	45.5 x 19 x 46.3" (1156 x 482 x 1176mm)	45.5 x 19.4 x 56.5" (1156 x 492 x 1436mm)
Mass (main unit)	309 lbs (140kg)	331 lbs (150kg)	485 lbs (220kg)	595 lbs (270kg)

Model No.	CV-3200S8	CV-3200H8	CV-3200W8	CV-3200L8
Order No. (inch)	218-496-10A	218-497-10A	218-498-10A	218-499-10A
Model No.	CV-4500S8	CV-4500H8	CV-4500W8	CV-4500L8
Order No. (inch)	218-456-10A	218-457-10A	218-458-10A	218-459-10A
X1-axis measuring range	8" (200mm)	8" (200mm)	8" (200mm)	8" (200mm)
Vertical travel	12" (300mm) power column	20" (500mm) power column	20" (500mm) power column	27.6" (700mm) power column
Granite base size (WxD)	23.6 x 17.7" (600 x 450mm)	23.6 x 17.7" (600 x 450mm)	39.4 x 17.7" (1000 x 450mm)	39.4 x 17.7" (1000 x 450mm)
Dimensions (main unit, WxDxH)	30.2 x 19 x 38" (767 x 482 x 966mm)	30.2 x 19 x 46" (767 x 482 x 1166mm)	45.9 x 19 x 46.3" (1166 x 482 x 1176mm)	45.9 x 19.4 x 56.5" (1166 x 492 x 1436mm)
Mass (main unit)	309 lbs (140kg)	331 lbs (150kg)	485 lbs (220kg)	595 lbs (270kg)

Collective Calibration Function

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

Calibration kit
for CV-4500 series



Calibration Kit:
CV-4500: **12AAQ491**
CV-3200: **12AAQ489** (not shown)

Software

FORMTRACEPAK V5

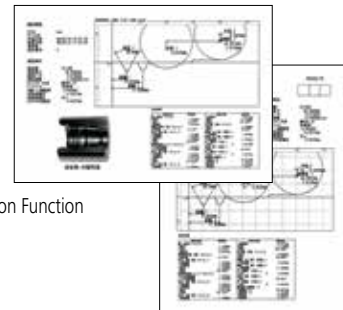


Measurement Control Screen

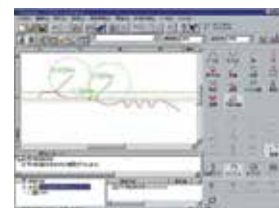


Profile Analysis Screen

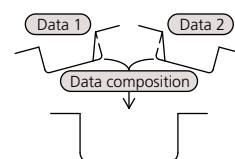
Report Creation Function



Automatic Circle/Line
Application Function



Data Composition
Function



MiCAT
Mitutoyo Intelligent Computer Aided Technology

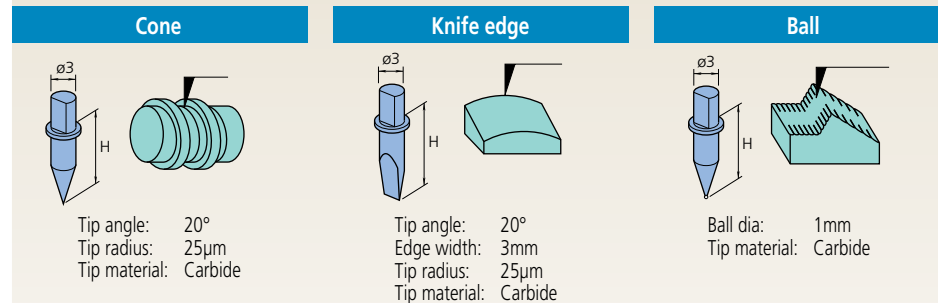
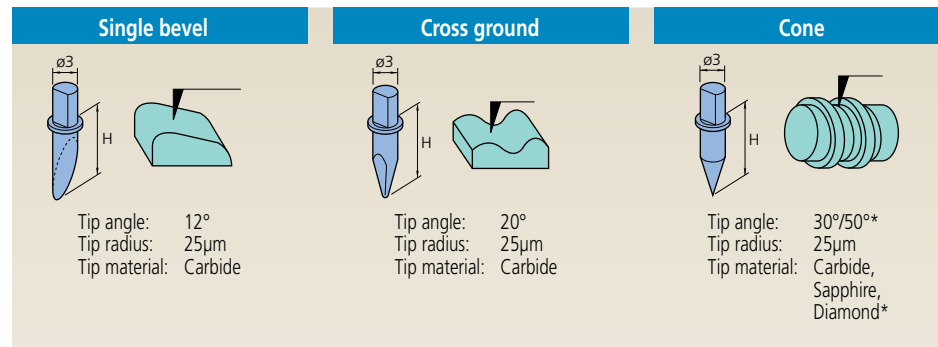
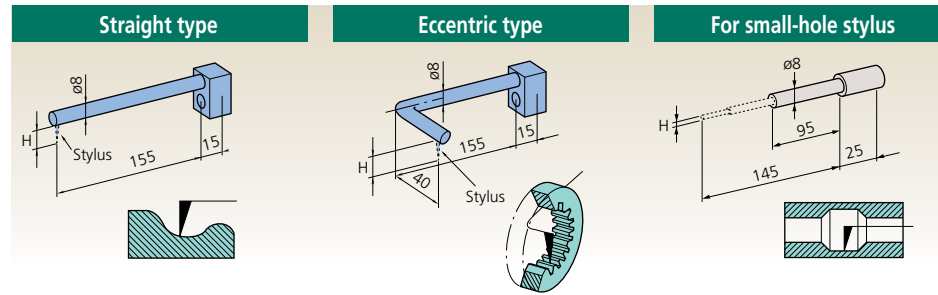
the standard in world
metrology software

FORM

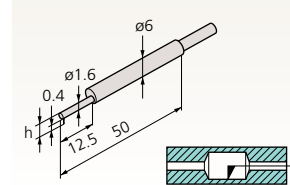
Mitutoyo

Optional Arms and Styli for Contour Measurement

For CV-2100

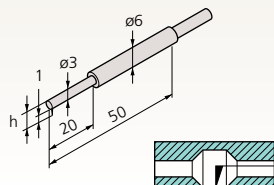


Small hole: 932693 / 12AAE873



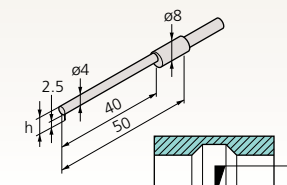
932693 **12AAE873**
 Tip shape: Single bevel Cone
 Tip angle: 20° 30°
 Tip radius: 25µm 25µm
 Tip material: Carbide Carbide

Small hole: 932694 / 12AAE874



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

Small hole: 932695 / 12AAE875



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

List of Applicable Arms

Arm name	Order No.	Compatible stylus height
Straight type	935111	H = 6mm
	935112	H = 12mm
	935113	H = 20mm
	935114	H = 30mm
	935115	H = 42mm
Eccentric type	935116	H = 6mm
	935117	H = 12mm
	935118	H = 20mm
	935119	H = 30mm
	935120	H = 42mm
Small hole	935110	H = 0.4, 1, 2.5mm

List of Applicable Styli

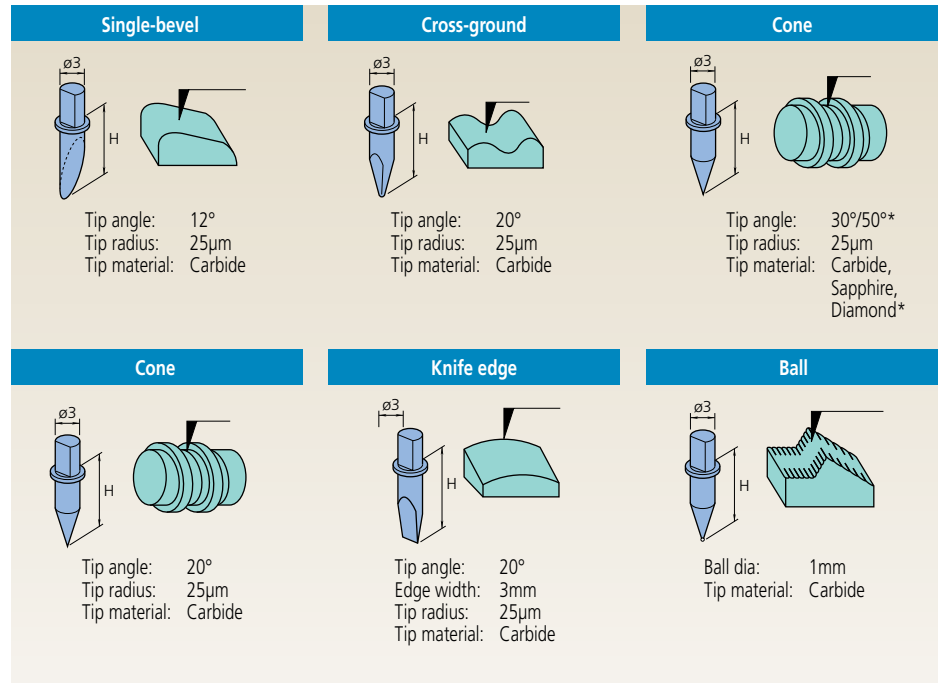
Stylus name	Order No.	Stylus height
Single-bevel carbide-tipped	354882	H = 6mm
	354883	H = 12mm
	354884	H = 20mm
	354885	H = 30mm
	354886	H = 42mm
Cross-ground stylus carbide-tipped	354887	H = 6mm
	354888	H = 12mm
	354889	H = 20mm
	354890	H = 30mm
	354891	H = 42mm
Cone stylus carbide-tipped tip angle 20°	12AAE865	H = 6mm
	12AAE866	H = 12mm
	12AAE867	H = 20mm
	12AAE868	H = 30mm
	12AAE869	H = 42mm
Cone stylus sapphire tipped tip angle 30° *Diamond tipped *tip angle 50°	354892	H = 6mm
	354893	H = 12mm
	354894	H = 20mm
	355129*	H = 20mm
	354895	H = 30mm
	354896	H = 42mm
	12AAA566	H = 6mm
Cone stylus carbide-tipped tip angle 30°	12AAA567	H = 12mm
	12AAA568	H = 20mm
	12AAA569	H = 30mm
	12AAA570	H = 42mm
Knife-edge stylus carbide-tipped	354897	H = 6mm
	354898	H = 12mm
	354899	H = 20mm
	354900	H = 30mm
	354901	H = 42mm
	354902	H = 6mm
Ball stylus carbide-tipped	354904	H = 20mm
	354905	H = 30mm
	354906	H = 42mm
Small-hole stylus carbide-tipped single bevel	932693	H = 2mm
	932694	H = 4mm
	932695	H = 6.5mm
Small-hole stylus carbide-tipped cone	12AAE873	H = 2mm
	12AAE874	H = 4mm
	12AAE875	H = 6.5mm

Optional Styli for Contour Measurement

CV-2100, CV-3200, CV-4500, SV-C3200, SV-C4500 and SV-C4500CNC

List of Applicable Styli

Stylus name	Order No.	Stylus height
Single-bevel cut stylus carbide-tipped	354882	H = 6mm
	354883	H = 12mm
	354884	H = 20mm
	354885	H = 30mm
	354886	H = 42mm
Cross-ground stylus carbide-tipped	354887	H = 6mm
	354888	H = 12mm
	354889	H = 20mm
	354890	H = 30mm
	354891	H = 42mm
Cone stylus carbide-tipped tip angle 20°	12AAE865	H = 6mm
	12AAE866	H = 12mm
	12AAE867	H = 20mm
	12AAE868	H = 30mm
	12AAE869	H = 42mm
Cone stylus sapphire tipped tip angle 30° *Diamond tipped *tip angle 50°	354892	H = 6mm
	354893	H = 12mm
	354894	H = 20mm
	355129*	H = 20mm
	354895	H = 30mm
Cone stylus carbide-tipped tip angle 30°	354896	H = 42mm
	12AAA566	H = 6mm
	12AAA567	H = 12mm
	12AAA568	H = 20mm
	12AAA569	H = 30mm
Cone stylus carbide-tipped tip angle 30°	12AAA570	H = 42mm
Knife-edge stylus carbide-tipped	354897	H = 6mm
	354898	H = 12mm
	354899	H = 20mm
	354900	H = 30mm
	354901	H = 42mm
Ball stylus carbide-tipped	354902	H = 6mm
	354904	H = 20mm
	354905	H = 30mm
	354906	H = 42mm



- Any specified arm and stylus other than above listed can be custom-made for special order.

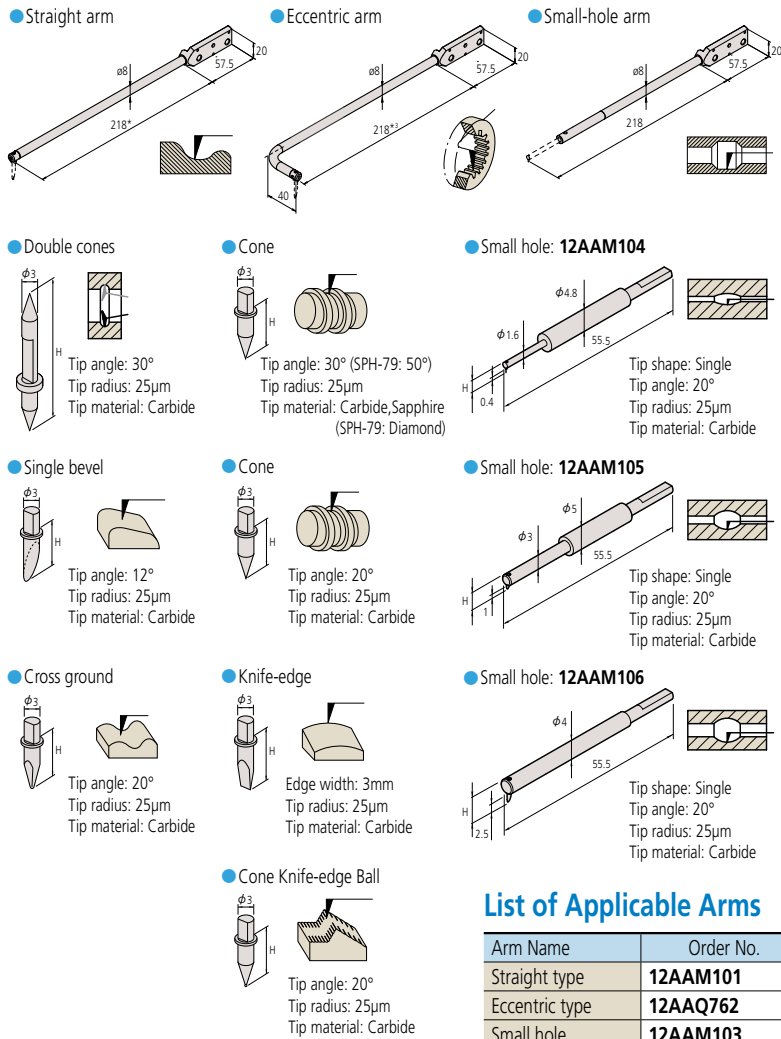
Arm and Stylus set: 12AAR588

Set for CV-4500 / SV-C4500 / SV-C4500CNC		
Part	Part No.	Part Description
Arm	12AAQ762	Eccentric arm
	12AAM103	Small-hole arm
Stylus	354889	Cross-ground stylus
	354882	Single-bevel cut stylus
	12AAA568	Cone stylus
	12AAM104	Small hole stylus
	12AAM106	Small hole stylus
	12AAM096	Double-sided cone stylus
Integrated arm and stylus	12AAM097	Double-sided cone stylus
	12AAM109	Double-sided small hole arm stylus

Arm and Stylus set: 12AAR587

Set for CV-3200 / CV-4500 / SV-C3200 / SV-C4500 / SV-C4500CNC		
Part	Part No.	Part Description
Arm	12AAQ762	Eccentric arm
	12AAM103	Small-hole arm
Stylus	354889	Cross-ground stylus
	354882	Single-bevel cut stylus
	12AAA568	Cone stylus
	12AAM104	Small hole stylus
	12AAM106	Small hole stylus

Optional Arms and Styli for Contour Measurement For CV-3200, CV-4500, SV-C3200, SV-C4500 and SV-C4500CNC



List of Applicable Arms

Arm Name	Order No.
Straight type	12AAM101
Eccentric type	12AAQ762
Small hole	12AAM103

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

List of Applicable Styli

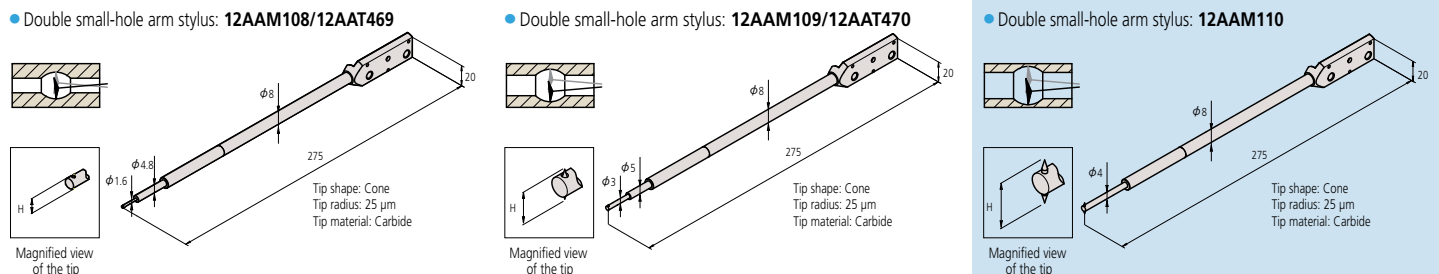
Stylus Name	Order No.	H (mm)
Double cones stylus *4	12AAM095 *5	20
	12AAM096	32
	12AAM097	48
Single-bevel stylus carbide-tipped	354882	6
	354883	12
	354884 *6	20
	354885	30
	354886	42
Cross-ground stylus carbide-tipped	354887	6
	354888	12
	354889	20
	354890	30
	354891	42
Cone stylus sapphire-tipped tip angle 30°	354892	6
	354893	12
	354894	20
	354895	30
	354896	42
Cone stylus carbide-tipped tip angle 30°	12AAA566	6
	12AAA567	12
	12AAA568	20
	12AAA569	30
	12AAA570	42
Cone stylus carbide-tipped tip angle 20°	12AAE865	6
	12AAE866	12
	12AAE867	20
	12AAE868	30
	12AAE869	42
Cone stylus diamond-tipped tip angle 50°	355129	20
Knife-edge stylus carbide-tipped	354897	6
	354898	12
	354899	20
	354900	30
	354901	42
Ball stylus carbide-tipped	354902	6
	354904	20
	354905	30
	354906	42
	12AAM104	2
Small-hole stylus *7	12AAM105	4
	12AAM106	6.5

*4: Stylus for CV-4500 series
*5: Standard accessory of CV-4500 series
*6: Standard accessory of CV-3200 series
*7: Styli SPH-21, 22, and 23 for CV-3100/4100 series are not available.

Arm stylus (integrated arm and stylus) only for CV-4500

Arm stylus name	Order No.	H (mm)	Tip angle
Double small-hole arm stylus *8	12AAT469	2.4	20°
	12AAT470	5	20°
	12AAM108	2.4	30°
	12AAM109	5	30°
	12AAM110	9	30°

*8: Arm Stylus for CV-4500, SV-C4500 and SV-C4500CNC series. series



Optional Accessories for Automatic Measurement

Compatible with CV-3200, CV-4500 and CNC Models

Y-axis table*: 178-097

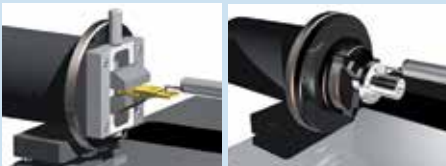
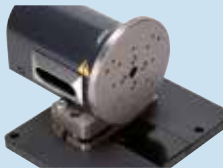
A Y-axis table for both positioning and capable of 3D surface roughness measurement when used with optional software FTPK-PRO or MCubeMap.**
*Not supporting Y-axis measurements. ** Only for 178-096



	178-097	178-096
Travel range	8" (200mm)	4" (100mm)
Resolution	1.97μin (0.05μm)	1.97μin (0.05μm)
Positioning accuracy	±3μm	±1μm
Drive speed	Max. 3.15"/s (80mm/s)	Max. .78"/s (20mm/s)
Maximum load	110 lbs (50kg)	33 lbs (50kg)
Mass	62 lbs (28kg)	68 lbs (31kg)

θ2-axis table: 178-078*

You can measure multiple points on a cylindrical workpiece and automate front/rear-side measurement.
*θ2-axis mounting plate (12AAE718) is required when directly installing on the base of the SV-3100.



Displacement	360°
Resolution	0.0072°
Maximum load (loading moment)	4kg (343N•cm or less)
Rotational speed	Max. 18°/s
Mass	11 lbs (5kg)

Quick chuck: 211-032

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

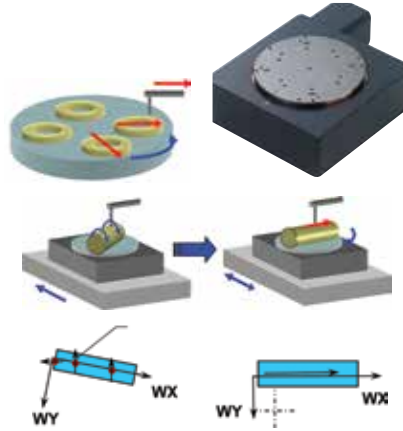


Retention range	Inner latch	OD: ø .04 - 1.42" (1 - 36mm)
	Inner latch	ID: ø .55 - 2.76" (14 - 70mm)
	Outer latch	OD: ø .04 - 2.95" (1 - 75mm)
Dimensions	ø 4.65 x 1.61" (118 x 41mm)	
Mass	2.65 lbs (1.2kg)	

θ1-axis table: 12AAD975*

For efficient measurement in the axial/transverse directions. When measuring a cylindrical workpiece, automatic alignment can be performed in combination with the Y-axis table.

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



Displacement	360°
Resolution	0.004°
Maximum load	26.5 lbs (12kg)
Rotational speed	Max. 10°/s
Mass	15 lbs (7kg)

Automatic-leveling table:178-087 (SV, CV, CS3200)

Automatic-leveling table:178-037 (CNC Models)

This is a stage that performs fully automatic leveling as measurement starts, freeing the user from this troublesome operation. Fully automatic leveling can be done quickly by anyone. In addition, the operation is easy and reliable.



Inclination adjustment angle	±2°
Maximum load	7kg
Table dimensions	130 x 100mm
Mass	7.7lbs (3.5kg)

Micro-chuck: 211-031

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



Retention range	OD: ø 0 - .06" (0 - 1.5mm)
Dimensions	ø 4.65" x 1.9" (118 x 48.5mm)
Mass	1.32 lbs (0.6kg)

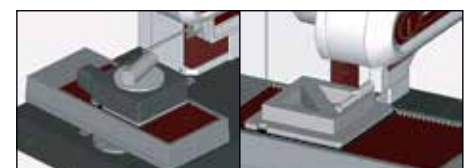
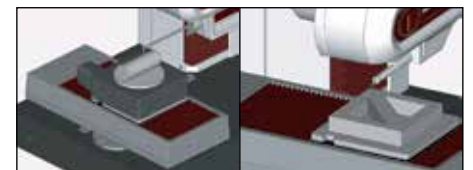
Examples of optimal combinations of accessories for CNC models

Optional accessory	Y-axis Table	θ1 Table	θ2 Table
Function			
Automatic alignment (Patented: Japan)	●	●	—
Multiple workpiece batch measurement	▲	—	—
Multiple-piece measurement in the Y-axis direction (Positioning in the Y-axis direction)	●	—	—
Multiple-piece measurement in the radius direction (Positioning in the rotating direction of XY plane)	▲	●	—
Tracking measurement in the Z-axis direction *	—	—	—
Inclined surface measurement in the X-axis direction	▲	—	—
Inclined hole inside measurement in the X-axis direction	▲	—	—
Multiple cylinder generatrix line measurement	▲	—	●
Measurement of both top and bottom surfaces	▲	—	●
Rotary positioning of large workpiece **	—	—	—
Upward/downward and frontward/backward measurement of large workpiece **	—	—	—

* : Applicable only to form/contour measurement

** : Applicable only for SV-M3000CNC

▲ Recommended ● Essential — Not necessary



Mitutoyo

Optional Accessories for Contracer / Formtracer

Compatible with Desktop Models of Contracer and Formtracer

Cross-travel table

- Table top: 11" x 7" (280 x 180mm)
- XY travel: 3.94" x 1.97" (100 x 50mm)
- Max. load 110 lbs (50kg)



218-001 (mm)
218-011 (inch)

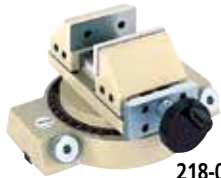
- Table top: 11" x 5.98" (280 x 152mm)
- XY travel: 1.97" x .98" (50 x 25mm)
- Max. load 44 lbs (20kg)



218-041 (mm)
218-051 (inch)

Rotary vise

- Two-slide jaw type.
- Max. workpiece size: \varnothing 2.36" (60mm)
- Minimum reading: 1°



218-003

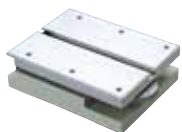
- One-slide jaw type.
- Max. workpiece size: \varnothing 2.36" (60mm)
- Minimum reading: 5°



172-144

Leveling table

- Table top: 5.12" x 3.94" (130 x 100mm)
- Leveling range: $\pm 1.5^\circ$
- Height: 1.57" (40mm)



178-016

V-block with clamp

- Used with a cross-travel table or rugged table.
- Max. workpiece diameter: 1.97" (50mm)
- Max. workpiece diameter: .98" (25mm)



172-234
172-378

- Workpiece diameter: 0.039" to 6.3" (1mm to 160mm)
- Can be mounted on a leveling table



998291

Leveling table

- Table top: 5.12" x 3.94" (130 x 100mm)
- Leveling range: $\pm 1.5^\circ$
- XY travel: .49" \pm (12.5mm)



178-043-1 (mm)
178-053-1 (inch)

Digital leveling table

- Table top: 5.12" x 3.94" (130 x 100mm)
- Leveling range: $\pm 1.5^\circ$
- XY travel: .49" \pm (12.5mm)



178-042-1 (mm)

Three-axis adjustment table



178-047
(V-block not included)

Precision vise

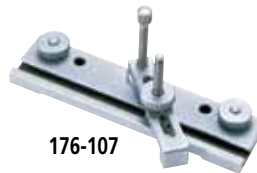
- Max. workpiece size: 1.42" (36mm)
- Can be mounted on a leveling table.



178-019

Holder with clamp

- Used with a cross-travel table or rugged table.
- Max. workpiece height: 1.38" (35mm)



176-107

Swivel center support

- Max. workpiece diameter: 3.15" (80mm)*
*2.56" (65mm) when swiveled 10°
- Max. workpiece length: 5.51" (140mm)



172-197

Center support

- Max. workpiece diameter: 4.72" (120mm)
- 2.36" (60mm) riser is optional (172-143)



172-142

Center support riser

- Used with a center support.
- Max. workpiece diameter: 9.45" (240mm)



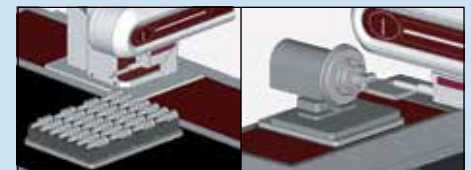
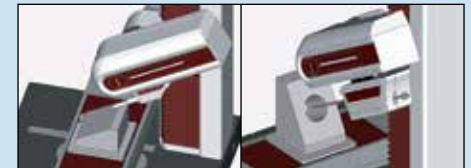
172-143

Drive unit tilting function (Patent pending: Japan)	Large θ Table	Rotary-type detector holder
▲	—	—
—	—	—
—	—	—
—	—	—
—	—	—
●	—	—
●	—	—
—	—	—
—	—	—
—	●	—
—	—	●

●: Essential

▲: Recommended

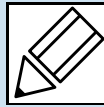
—: Not necessary



Three-axis adjustment table

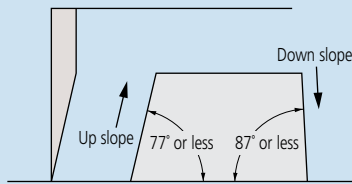
Order No.	178-047
Table top	5.11 x 3.94" (130 x 100mm)
Workpiece weight	33lbs. (15kg) at max.
Workpiece diameter	.04 - 6.3" (1 - 160mm)
Leveling range	$\pm 1.5^\circ$
Swivel range	$\pm 2^\circ$
Y-axis adjustment	$\pm 0.5"$ (± 12.5 mm)
Height	6" (152.5mm)
Mass	19.8lbs. (9kg)
Remarks	V-block (998291) not included

Quick Guide to Precision Measuring Instruments



Contracer (Contour Measuring Instruments)

Traceable Angle

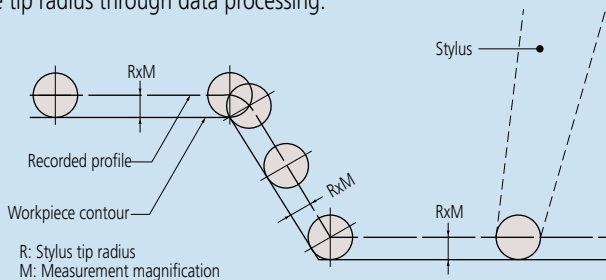


The maximum angle at which a stylus can trace upward or downward along the contour of a workpiece, in the stylus travel direction, is referred to as the traceable angle. A one-sided sharp stylus with a tip angle of 12° (as in the above figure) can trace a maximum 77° of up slope and a maximum 87° of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

For model CV-3200/4500, the same type of stylus (SPH-71: one-sided sharp stylus with a tip angle of 12°) can trace a maximum 77° of up slope and a maximum 83° of down slope.

Compensating for Stylus Tip Radius

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



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

Compensating for Arm Rotation

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

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

Accuracy

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

Overload Safety Cutout

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

For model CV-3200/4500 a safety device functions if the arm comes off the detector mount.

Simple or Complex Arm Guidance

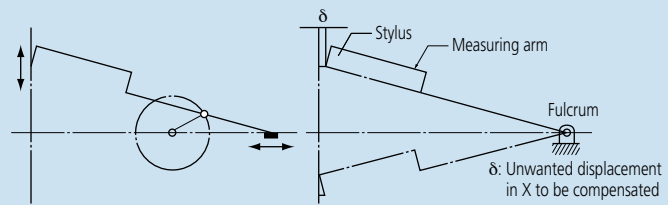
In the case of a simple pivoted arm, the locus that the stylus tip traces during vertical movement (Z direction) is a circular arc that results in an unwanted offset in X, for which compensation has to be made. The larger the arc movement, the larger the unwanted X displacement (δ) that has to be compensated.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

Z-axis Measurement Methods

Though the X axis measurement method commonly adopted is by means of a digital scale, the Z axis measurement divides into analog methods (using a differential transformer, etc.) and digital scale methods.

Analog methods vary in Z-axis resolution depending on the measurement magnification and measuring range. Digital scale methods have fixed resolution.

Generally, a digital scale method provides higher accuracy than an analog method.



■ Contour Analysis Methods

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

1. Data processing section

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

2. Analysis program

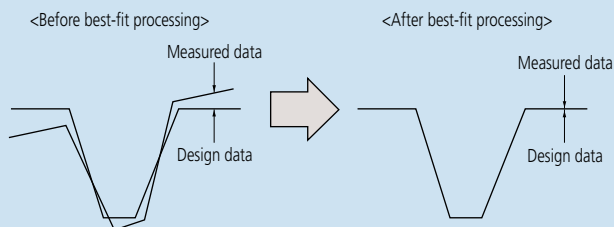
Analysis combining coordinate systems can be easily performed. The graph that goes through stylus radius correction is output to the printer as the recorded profile.

■ Tolerancing with Design Data

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

■ Best-fitting

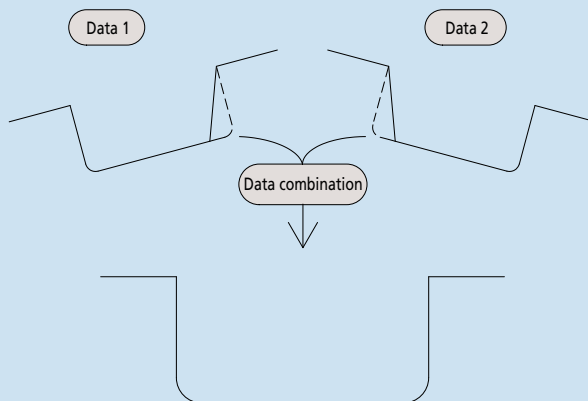
If there is a standard for surface profile data, tolerancing with design data is performed according to the standard. If there is no standard, or if tolerancing only with shape is desired, best-fitting between design data and measurement data can be performed.



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

■ Data Combination

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



■ Measurement Examples



Aspheric lens contour



Inner/outer ring contour of a bearing



Internal gear teeth



Female thread form



Male thread form



Gage contour