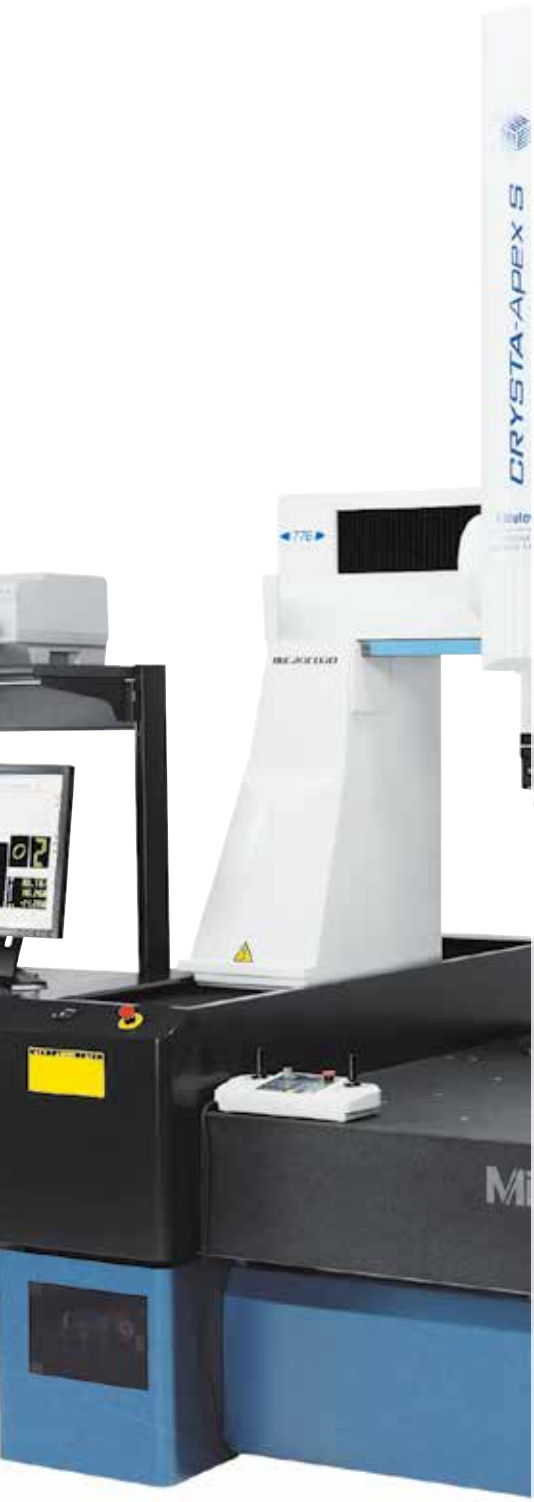
L

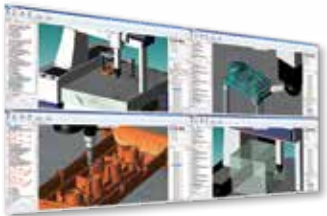
Coordinate Measuring Machines



NEW-STYLE
Vision Measuring Systems

SurfaceMeasure Probes
(Laser scanning probes—non-contact)

CRYSTA-Apex EX 500T w/PH-20 Probe



MiCAT Planner

LEGEX 574

INDEX

Surftest Probe
(surface finish)

MACH Kogame

Mitutoyo

Mitutoyo CMM Accuracy Statements

The accuracy statements specified on the following pages for Mitutoyo CMM's are based on ISO standards. The following is a brief description of these standards.

Performance Assessment Method of Coordinate Measuring Machines

CMM accuracy is specified in accordance to international standards, the ISO 10360 series of standards, and entitled "Acceptance and Reverification Test for CMMs." ISO 10360 consists of multiple parts, with each part describing tests that apply to various configuration and components of CMMs.

Table 1 JIS B 7440 (2003) Series

	Item	JIS Standard No.	Year of issue
1	Terms	ISO 10360-1	2000
2	Dimensional measurement	ISO 10360-2	2009
3	Rotary table-equipped CMM	ISO 10360-3	2000
4	Scanning measurement	ISO 10360-4	2000
5	Probing systems	ISO 10360-5	2010

Maximum Permissible Measuring Error $E_{0,MPE}$ ISO 10360-2:2009

This volumetric test procedure requires that a coordinate measuring machine (CMM) is made to perform a series of five different length measurements in each of seven directions, as shown in Figure 1, to produce a set of 35 measurements. This sequence is then repeated twice more to produce 105 measurements in all. If these test values are equal to or less than the limits specified by the manufacturer, then the performance of the CMM has been determined to meet its specification. This test procedure is a part of Mitutoyo America Corporation's A2LA-accredited calibration of Mitutoyo CMMs.

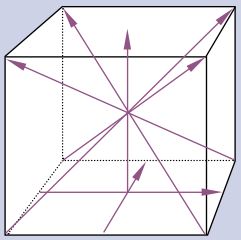


Figure 1 Typical test measurement directions within the CMM measuring volume

Maximum Permissible Measuring Error $E_{150,MPE}$ ISO 10360-2:2009

This test is an extension of the E0 test but uses a probe tip that is offset a default length of 150 mm perpendicular to the ram axis of the CMM (typically the Z-axis). Five different lengths are measured along two different planar diagonals to produce 10 measurements. This sequence is then repeated twice more to produce 30 measurements in all. If these test values are equal to or less than the specified limits, then the performance of the CMM has been determined to meet its specification.
This test is not part of Mitutoyo America's standard A2LA-accredited CMM calibration procedure and is quoted upon request.

Maximum Permissible Limit Repeatability of the Range $R_{0,MPL}$ ISO 10360-2:2009

This test of repeatability is not a separate test but is determined directly from the E0 test values. For each of the 35 sets of three repeated length measurements, the difference between the maximum and minimum of the three test values is calculated. If these 35 calculated test values are equal to or less than the specified limits, then the CMM has been determined to meet its specification.
This test is not part of Mitutoyo America's standard A2LA-accredited CMM calibration procedure and is quoted upon request.

Maximum Permissible Scanning Probing Error MPE_{THP} ISO 10360-4:2000

This is the accuracy standard for a CMM if equipped with a scanning probe. The test procedure under this standard is to perform a scanning measurement of 4 planes on the standard sphere and then, for the least squares sphere center calculated using all the measurement points, calculate the range (dimension 'A' in Figure 2) in which all measurement points exist. Based on the least squares sphere center calculated above, calculate the distance between the calibrated standard sphere radius and the maximum measurement point or minimum measurement point, and take the larger distance (dimension 'B' in Figure 2). If both calculated values are less than the specified limits, this scanning probe test is passed.

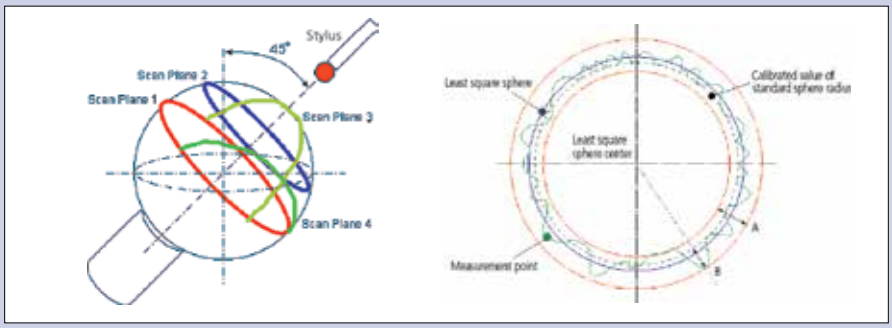


Figure 2 Target measurement planes for the maximum permissible scanning probing error and its evaluation concept

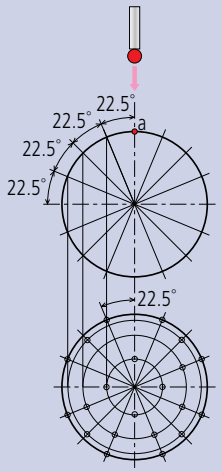


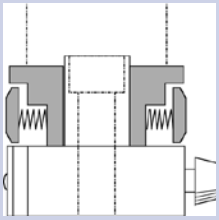
Figure 3 Target points on standard sphere for determining the Maximum Permissible Probing Error

Maximum Permissible Probing Error $P_{FTU,MPE}$ ISO 10360-5:2010

The test procedure under this standard is that a probe is used to measure defined target points on a standard sphere (25 points, as in Figure 3) and the result used to calculate the position of the sphere center by a least squares method. Then the distance R from the sphere center for each of the 25 measurement points is calculated, and the radius difference Rmax - Rmin is computed. If this final calculated value is equal to or less than the specified value, the probe has passed the test.

CRYSTA-Plus M

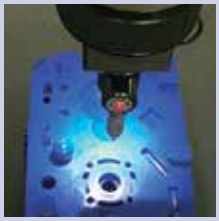
SERIES 196 — Manual Floating CMM



Ergonomically designed guide grip on Z-axis for reliable measurement
(only for Crysta-Plus M776 and M7106)

One-touch air clamp and fine feed for rapid and easy positioning

Crysta-Plus M443



Probe illumination (optional) to illuminate the probe and styli directly and brighten the working field

Manual floating CMMs were developed in quest for high-accuracy, low-cost and easy operation. The Crysta-Plus M is suitable to measure a wide range of applications from a simple dimension to a complex form. The scale systems on Mitutoyo high-precision models use a high-performance linear encoder (manufactured by Mitutoyo) for detecting axis position. In addition, various technologies have been used in the structure, part processing and assembly to provide high-accuracy measurement.

The Crysta-Plus M700 series has a large main unit and is equipped with a mobile clamp so that one-touch clamping on each axis can be performed by hand. Continuous fine feed over the entire measuring range can be performed.

FEATURES

- Smooth operation utilizing high-precision air bearings and lightweight moving members.
- Continuous fine feed over the entire measuring range.
- One-touch air clamp for each axis.

Crysta-Plus M574

MH20i
see page L-20

Crysta-Plus M7106

SPECIFICATIONS

Type: Bridge	Model No.	Crysta-Plus M443	Crysta-Plus M574	Crysta-Plus M7106
Range	X axis	15.74″ (400mm)	19.68″ (500mm)	27.55″ (700mm)
	Y axis	15.74″ (400mm)	27.55″ (700mm)	39.36″ (1000mm)
	Z axis	11.81″ (300mm)	15.74″ (400mm)	23.62″ (600mm)
Resolution		0.000019″ (0.0005mm)		
Work table	Material	Granite		
	Size	24.56″ x 31.69″ (624mm x 805mm)	30.07″ x 46.25″ (764mm x 1175mm)	35.43″ x 68.50″ (900mm x 1740mm)
	Tapped insert	M8 x 1.25mm		
Workpiece	Max. height	18.89″ (480mm)	23.22″ (590mm)	31.49″ (800mm)
	Max. load	396 lbs. (180kg)		1,763 lbs. (800kg)
Mass (incl. stand)		793 lbs. (360kg)	1,424 lbs. (646kg)	3,968 lbs. (1800kg)
Dimensions W x D x H		38.62 x 41.22 x77.44″ (981 x 1047 x 1967mm)	56.45 x 44.17 x 89.25″ (1434 x 1122 x 2267mm)	57.48 x 79.40 x 111.81″ (1460 x 2017 x 2840mm)
Air Supply	Pressure	50.7 PSI (0.35MPa)		58.0 PSI (0.4MPa)
	Consumption	1.76CFM (50L/min)		
	Source	3.53CFM (100L/min)		
ISO-10360-2: 2001				
19-21°C (66.2-69.8°F)	TP20: E	(3.0+4.0L/1000)µm	(3.5+4.0L/1000)µm	(4.5+4.5L/1000)µm
	TP20: R	4µm		5µm

Stylus Configurations for ISO Tests	
TP20:	Ø4mm x L10mm

Environment	19-21°C (66.2-69.8°F)
Rate of change	2.0C° or less per hour 5.0C° or less per day
Gradient	1.0C° or less per meter vertical & horizontal

See page L-2 for explanation of ISO accuracy statements

Mitutoyo

CRYSTA-Apex S 500/700/900/1200

High-performance, low-price CNC Coordinate Measuring Machine that meets global standards

SERIES 191 — Standard CNC CMM

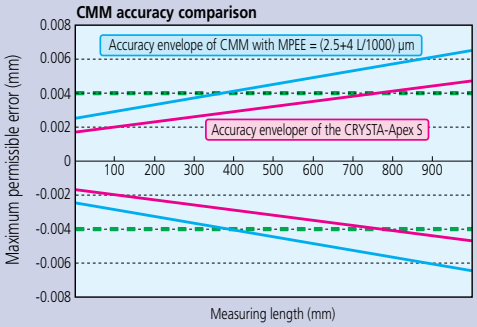
High accuracy in the 1.7µm class

The CRYSTA-Apex S is a high-accuracy CNC coordinate measuring machine that guarantees a maximum permissible error of $*E_{0,MPE}$ = (1.7+3L/1000)µm [500/700/900 Series]. Comparing the CRYSTA-Apex S with CMMs offering $*E_{0,MPE}$ of approximately (2.5+4L/1000)µm where a required tolerance on a dimension is ±0.02 mm, then the measuring machine uncertainty should be no more than one-fifth (ideally one-tenth) of that, i.e. 4µm. This means that with a general purpose CMM, when the measured length exceeds 14.8"(375mm), machine uncertainty exceeds one-fifth of the dimension tolerance in this case. In contrast, as shown in the figure on the right, with the CRYSTA-Apex S the measurement uncertainty remains within one-fifth of the dimension tolerance up to 30.2" (766mm). The higher accuracy specification of the CRYSTA-Apex S, therefore, gives it more than double the effective measuring range in terms of accuracy-guarantee capability in this case.

**ISO 10360-2:2009*

Surftest
(surface finish)
See page L-27

CRYSTA-Apex S 544 **CRYSTA-Apex S 776** **CRYSTA-Apex S 9106**



SPECIFICATIONS

Type: BRIDGE	Model No.	CRYSTA-Apex S 544	CRYSTA-Apex S 574	CRYSTA-Apex S 776	CRYSTA-Apex S 7106	CRYSTA-Apex S 9106	CRYSTA-Apex S 9166	CRYSTA-Apex S 9206
Range	X axis	19.68" (500mm)		27.55" (700mm)		35.43" (900mm)		
	Y axis	15.74" (400mm)	27.55" (700mm)		39.36" (1000mm)		62.99" (1600mm)	78.73" (2000mm)
	Z axis	15.74" (400mm)		23.62" (600mm)				
Resolution		0.000004" (0.0001mm)						
Guide Method		Air bearing on each axis						
Maximum Drive Speed 3D		20.43"/s (519mm/s)						
Maximum Acceleration 3D		0.23G (2,309mm/s²)						
Work table	Material	Granite						
	Size	25.11 x 33.86" (638 x 860mm)	25.11 x 45.67" (638 x 1160mm)	34.64 x 55.90" (880 x 1420mm)	34.64 x 67.71" (880 x 1720mm)	42.51 x 67.71" (1080 x 1720mm)	42.51 x 91.33" (1080 x 2320mm)	42.51 x 107.08" (1080 x 2720mm)
	Tapped insert	M8 x 1.25mm						
Workpiece	Max. height	21.45" (545mm)		31.49" (800mm)				
	Max. load	396 lbs. (180kg)		1,763 lbs. (800kg)	2,204 lbs. (1000kg)	2,645 lbs. (1200kg)	3,306 lbs. (1500kg)	3,968 lbs. (1800kg)
Mass (incl. stand & controller)		1,135 lbs. (515kg)	1,377 lbs. (625kg)	3,692 lbs. (1675kg)	4,301 lbs. (1951kg)	4,918 lbs. (2231kg)	6,322 lbs. (2868kg)	8,624 lbs. (3912kg)
Dimensions W x D x H		42.60x46.88x86.02" (1082x1191x2185mm)	42.60x60.94x86.02" (1082x1548x2185mm)	57.87x66.92x107.48" (1470x1700x2730mm)	57.87x78.73x107.48" (1470x2000x2730mm)	65.74x78.73x107.48" (1670x2000x2730mm)	65.74x107.87x107.48" (1670x2740x2730mm)	65.74x126.77x107.48" (1670x3220x2730mm)
ISO-10360-2:2009 $E_{0,MPE}$								
18-22°C (64.4-71.6°F)	TP200:	(1.9+3L/1000)µm						
	MPP310/SP25:	(1.7+3L/1000)µm						
16-26°C (60.8-78.8°F)	TP200:	(1.9+4L/1000)µm						
	MPP310/SP25:	(1.7+4L/1000)µm						
ISO-10360-2:2009 $E_{150,MPE}$ †								
18-22°C (64.4-71.6°F)	TP200:	(2.4+3L/1000)µm						
	MPP310/SP25:	(1.7+3L/1000)µm						
16-26°C (60.8-78.8°F)	TP200:	(2.4+4L/1000)µm						
	MPP310/SP25:	(1.7+4L/1000)µm						
ISO-10360-2:2009 $R_{0,MPL}$ †								
	TP200:	1.5µm		1.9µm				
	MPP310/SP25:	1.3µm						
ISO-10360-4 MPE_{THP}/MPT_{THP} †								
	SP25:	2.3µm/50sec						
	SP80:	N/A		2.0µm/50sec				
	MPP310:	1.8mm/90sec			1.8mm/80sec			
ISO-10360-5: 2010 $P_{FTU,MPE}$								
	TP200:	1.9µm						
	SP25:	1.7µm						
	MPP310:	1.5µm		1.7µm				

Stylus Configurations for ISO Tests	
TP200:	Ø4mm x L10mm
SP25/SP80:	Ø4mm x L50mm
MPP310Q:	Ø4mm x L18mm

Air Supply	500	700/900
Pressure	58.0 PSI (0.4MPa)	
Consumption	1.76CFM (50L/min)	2.11CFM (60L/min)
Source	3.53CFM (100L/min)	

Environment	18-22°C (64.4-71.6°F)	16-26°C (60.8-78.8°F)
Rate of change	2.0C° or less per hour 2.0C° or less per day	2.0C° or less per hour 5.0C° or less per day
Gradient	1.0C° or less per meter vertical & horizontal	

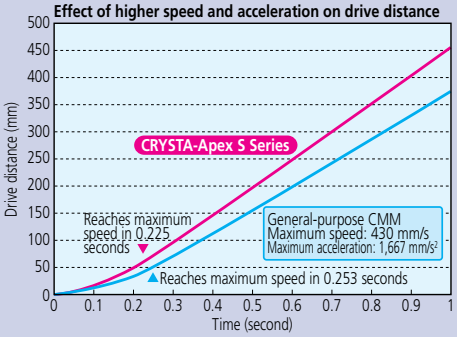
† This test is not part of Mitutoyo America's standard A2LA-accredited CMM calibration procedure and is quoted upon request.

See page L-2 for explanation of ISO accuracy statements

CRYSTA-Apex S 500/700/900/1200

SERIES 191 — Standard CNC CMM

Integrated Y-Axis in Granite Table



Designed for high rigidity

As is the case with Mitutoyo's conventional CMMs, various structures are employed in the CRYSTA-Apex S in order to give the body higher rigidity. The Y-axis guide rail, which is attached to one side of the granite surface plate, shows very little deterioration with use, and thus promises to maintain high accuracy for a long time. The air bearings located on the bottom face, in addition to those at the front, rear, and upper surfaces of the slider unit of the X-axis, minimize vibration even during high-speed, high-acceleration movement, thus ensuring stable linear motion.

Supported Probe Systems			
Type	**Probe**	**AS500**	**AS700/900/1200**
TOUCH TRIGGER PROBES	MH20i	●	●
	TP20	●	●
	TP200	●	●
	TP7	●	●
SCANNING PROBES	SP25	●	●
	MPP	●	●
	SP80	—	●
LASER PROBES	SM606	▲	●
	SM606T	▲	●
	SM610	▲	●
	SM1010	▲	●
SURFACE FINISH	SurfTest	●	●
OPTICAL	QVP	▲	●
	CF20	●	●

● Supported ▲ Not Recommended — Not supported

See page L-20 through L-27 for probe system information

CRYSTA-Apex S 122010

SP25 Probe
(Scanning)
See page L-21

Quick Vision Probe
(Optical probe–non-contact)
See page L-26

SPECIFICATIONS

Type: BRIDGE	Model No.	CRYSTA-Apex S 9108	CRYSTA-Apex S 9168	CRYSTA-Apex S 9208	CRYSTA-Apex S 121210	CRYSTA-Apex S 122010	CRYSTA-Apex S 123010
Range	X axis	35.43" (900mm)			47.24" (1200mm)		
	Y axis	39.36" (1000mm)	62.99" (1600mm)	78.73" (2000mm)	47.24" (1200mm	78.73" (2000mm)	118.1" (3000mm)
	Z axis	31.49" (800mm)			39.36" (1000mm)		
Resolution		0.000004" (0.0001mm)					
Guide Method		Air bearing on each axis					
Maximum Drive Speed 3D		20.43"/s (519mm/s)			27.28"/s (693mm/s)		
Maximum Acceleration 3D		0.17G (1732mm/s²)					
Work table	Material	Granite					
	Size	42.51 x 67.71" (1080 x 1720mm)	42.51 x 91.33" (1080 x 2320mm)	42.51 x 107.08" (1080 x 2720mm)	55.90 x 67.71" (1420 x 2165mm)	55.90 x 116.73" (1420 x 2965mm)	55.90 x 156.10" (1420 x 3965mm)
	Tapped insert	M8 x 1.25mm					
Workpiece	Max. height	39.36" (1000mm)			47.24" (1200mm)		
	Max. load	2,645 lbs. (1200kg)	3,306 lbs. (1500kg)	3,968 lbs. (1800kg)	4,409 lbs. (2000kg)	5,511 lbs. (2500kg)	6,613 lbs. (3000kg)
Mass (incl. stand & controller)		4,985 lbs. (2261kg)	6,389 lbs. (2898kg)	8,691 lbs. (3942kg)	8,928 lbs. (4050kg)	13,558 lbs. (6150kg)	20,084 lbs. (9110kg)
Dimensions W x D x H		65.74x78.73x123.22" (1670x2000x3130mm)	65.74x107.87x123.22" (1670x2740x3130mm)	65.74x126.77x123.22" (1670x3220x3130mm)	86.61x102.16x143.50" (2200x2595x3645mm)	86.61x133.66x143.50" (2200x3395x3645mm)	86.61x173.03x143.50" (2200x4395x3645mm)
ISO-10360-2:2009 $E_{0,MPE}$							
18-22°C (64.4-71.6°F)	TP200:	(1.9+3L/1000)µm			(2.5+3L/1000)µm		
	MPP310/SP25/SP80:	(1.7+3L/1000)µm			(2.3+3L/1000)µm		
16-26°C (60.8-78.8°F)	TP200:	(1.9+4L/1000)µm			(2.5+4L/1000)µm		
	MPP310/SP25/SP80:	(1.7+4L/1000)µm			(2.3+4L/1000)µm		
ISO-10360-2:2009 $E_{150,MPE}$ †							
18-22°C (64.4-71.6°F)	TP200:	(2.4+3L/1000)µm			(3.0+3L/1000)µm		
	MPP310/SP25/SP80:	(1.7+3L/1000)µm			(2.3+3L/1000)µm		
16-26°C | (60.8-78.8°F)	TP200:	(2.4+4L/1000)µm			(3.0+4L/1000)µm		
	MPP310/SP25/SP80:	(1.7+4L/1000)µm			(2.3+4L/1000)µm		
ISO-10360-2:2009 $R_{0,MPL}$ †							
	TP200:	1.9µm			2.0µm		
	MPP310/SP25/SP80:	1.3µm			1.9µm		
ISO-10360-4 MPE_{THP}/MPT_{THP} †							
	SP25:	2.3µm/60sec			2.8µm/50sec		
	SP80:	2.3µm/60sec			2.5µm/50sec		
	MPP310:	1.8µm/80sec			2.3µm/80sec		
ISO-10360-5: 2010 $P_{FTU,MPE}$							
	TP200:	1.9µm			2.2µm		
	MPP310/SP25/SP80:	1.7µm			2.0µm		

Stylus Configurations for ISO Tests	
TP200:	Ø4mm x L10mm
SP25/SP80:	Ø4mm x L50mm
MPP310Q:	Ø4mm x L18mm

Air Supply	900	1200
Pressure	58.0 PSI (0.4MPa)	
Consumption	2.11CFM (60L/min)	3.53CFM (100L/min)
Source	4.23CFM (120L/min)	5.29CFM (150L/min)

Environment	18-22°C (64.4-71.6°F)	16-26°C (60.8-78.8°F)
Rate of change	2.0C° or less per hour 2.0C° or less per day	2.0C° or less per hour 5.0C° or less per day
Gradient	1.0C° or less per meter vertical & horizontal	

† This test is not part of Mitutoyo America's standard A2LA accredited CMM calibration procedure and is quoted upon request.

See page L-2 for explanation of ISO accuracy statements

CRYSTA-Apex EX 500T/700T/900T

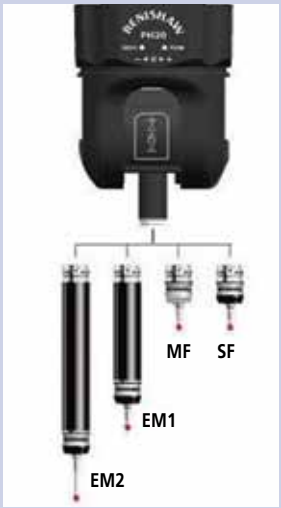
SERIES 191 — PH20 Equipped 5-Axis CNC CMM

The CRYSTA-Apex EX 500T/700T/900T series are CNC CMMs equipped with the PH20 5-axis control touch-trigger probe. The 5-axis operation reduces the time required for probe rotational movements and allows more flexible positioning. This also ensures easy access to complex workpieces and saves time both during programming and measurement.
In addition to 3-axis point measurement similar to conventional coordinate measuring machines, the PH20 probe head also supports head-touch operation for quick point measurement using the two rotational axes of the probe only, with no movement required along the CMM axes.
The PH20 incorporates a TP20 probe and allows use of modules designed for the TP20. Automatic probe changes with a module changer is also supported with the use of the TCR20 change rack (option).

FEATURES

- Incorporates PH20 5-axis touch-trigger probe
- Ultra-high speed 5-axis control touch-trigger probe
- Smooth 5-axis control drastically reduces measurement time (typically 40-65%) for probe rotation
- 5-axis design provides highly efficient measurement method of head touch for point measurement by moving the probe head only in two axes

CRYSTA-Apex EX 544T



Specifications PH20

Rotation angle (Pitch angle)	Vertical (A-axis)	-115° to +115° (0.08sec)
	Horizontal (B-axis)	∞ (0.08sec)
Stylus	Maximum length	50mm

SPECIFICATIONS

Type: BRIDGE	Model No.	CRYSTA-Apex EX 544T	CRYSTA-Apex EX 574T	CRYSTA-Apex EX 776T	CRYSTA-Apex EX 7106T	CRYSTA-Apex EX 9106T	CRYSTA-Apex EX 9166T	CRYSTA-Apex EX 9206T
Range	X axis	19.68" (500mm)		27.55" (700mm)		35.43" (900mm)		
	Y axis	15.74" (400mm)	27.55" (700mm)		39.36" (1000mm)		62.99" (1600mm)	78.73" (2000mm)
	Z axis	15.74" (400mm)		23.62" (600mm)				
Resolution		0.000004" (0.0001mm)						
Guide Method		Air bearing on each axis						
Work table	Material	Granite						
	Size	25.11 x 33.86" (638 x 860mm)	25.11 x 45.67" (638 x 1160mm)	34.64 x 55.90" (880 x 1420mm)	34.64 x 67.71" (880 x 1720mm)	42.51 x 67.71" (1080 x 1720mm)	42.51 x 91.33" (1080 x 2320mm)	42.51 x 107.0" (1080 x 2720mm)
	Tapped insert	M8 x 1.25mm						
Workpiece	Max. height	21.45" (545mm)		31.49" (800mm)				
	Max. load	396 lbs. (180kg)		1,763 lbs. (800kg)	2,204 lbs (1000kg)	2,645 lbs. (1200kg)	3,306 lbs. (1500kg)	3,968 lbs. (1800kg)
Mass (incl. stand & controller)		1,181 lbs. (536kg)	1,424 lbs. (646kg)	3,739 lbs. (1696kg)	4,347 lbs. (1972kg)	4,964 lbs. (2252kg)	6,369 lbs. (2889kg)	8,670 lbs. (3933kg)
Dimensions W x D x H		42.60x46.88x86.02" (1082x1191x2185mm)	42.60x60.94x86.02" (1082x1548x2185mm)	57.87x66.92x107.48" (1470x1700x2730mm)	57.87x78.73x107.48" (1470x2000x2730mm)	65.74x78.73x107.48" (1670x2000x2730mm)	65.74x107.87x107.48" (1670x2740x2730mm)	65.74x126.77x107.48" (1670x3220x2730mm)
ISO-10360-2:2009 $E_{0,MPE}$								
18-22°C (64.4-71.6°F)		(2.2+3L/1000)µm						
16-26°C (60.8-78.8°F)		(2.2+4L/1000)µm						
ISO-10360-2:2009† $R_{0,MPL}$		1.8µm		2.2µm				
ISO-10360-5: 2010 $P_{FTU,MPE}$		2.2µm						

Stylus Configurations for ISO Tests	
TP20:	Ø4mm x L12mm

Air Supply	500	700/900
Pressure	58.0 PSI (0.4MPa)	
Consumption	1.76CFM (50L/min)	2.11CFM (60L/min)
Source	3.53CFM (100L/min)	4.23CFM (120L/min)

Environment	18-22°C (64.4-71.6°F)	16-26°C (60.8-78.8°F)
Rate of change	2.0C° or less per hour 2.0C° or less per day	2.0C° or less per hour 5.0C° or less per day
Gradient	1.0C° or less per meter vertical & horizontal	

† This test is not part of Mitutoyo America's standard A2LA-accredited CMM calibration procedure and is quoted upon request.

See page L-2 for explanation of ISO accuracy statements.

CRYSTA-Apex EX 1200R

SERIES 191 — REVO-Equipped 5-Axis CNC CMM

The CRYSTA-Apex EX 1200R series is advanced CNC CMMs equipped with the REVO 5-axis scanning probe head. The 5-axis operation reduces the time required for probe repositioning movements and allows for more flexible positioning. This also facilitates access to complex workpieces and saves time both during programming and measurement.
The ultra-high speed 5-axis scanning (max. 500mm/s) surpasses conventional 3-axis control, supporting high-speed sampling of up to 4,000 points per second and allowing data acquisition of densely spaced measurement points, even during high-speed scanning.
The internal implementation of laser sensing technology ensures high-accuracy measurement, even with long styli (up to 500 mm as measured from probe rotation center to stylus tip). Two types of scanning probes are supported:

- RSP2 for 5-axis scanning
- RSP3 probe (SP25M type), allowing the use of a cranked stylus

Automatic changeover of these probes with an auto probe changer is possible, enabling fully automated measurement of parts with diverse shapes. Probe calibration of RSP2 requires only about 20 minutes to enable use of the full angular range. Compared to conventional scanning probes, this reduces preparation time.

FEATURES

- Equipped with REVO 5-axis scanning probe head
- Ultra-high speed 5-axis scanning

SPECIFICATIONS

Type: BRIDGE	Model No.	Crysta-Apex EX 121210R	Crysta-Apex EX 122010R	Crysta-Apex EX 123010R
Range	X axis		47.24″ (1200mm)	
	Y axis	47.24″ (1200mm)	78.73″ (2000mm)	118.10″ (3000mm)
	Z axis		39.36″ (1000mm)	
Resolution			0.000004″ (0.0001mm)	
Guide Method			Air bearing on each axis	
Work table	Material		Granite	
	Size	55.11″ x 85.23″ (1400mm x 2165mm)	55.11″ x 116.73″ (1400mm x 2965mm)	55.11″ x 156.10″ (1400mm x 3965mm)
	Tapped insert		M8 x 1.25mm	
Workpiece	Max. height		45.66″ (1160mm)	
	Max. load	4,409 lbs. (2000kg)	5,511 lbs. (2500kg)	6,613 lbs. (3000kg)
Mass (incl. stand & controller)		8,928 lbs. (4050kg)	13,558 lbs. (6150kg)	20,084 lbs. (9110kg)
Dimensions W x D x H		86.61 x 102.16 x 143.50″ (2200 x 2595 x 3645mm)	86.61 x 133.66 x 143.50″ (2200 x 3395 x 3645mm)	86.61 x 173.03 x 143.50″ (2200 x 4395 x 3645mm)
ISO-10360-2:2009 $E_{0,MPE}$				
18-22°C (64.4-71.6°F)			(2.9+4L/1000)µm	
16-26°C (60.8-78.8°F)			(2.9+5L/1000)µm	
ISO-10360-5: 2010 $P_{FTU,MPE}$			3.2µm	

Configuration for ISO Tests	
RSP2+RSH250	Ø6mm x L10mm

Air Supply	
Pressure	72.5 PSI (0.5MPa)
Consumption	5.29CFM (150L/min)
Source	8.12CFM (230L/min)

Environment	18-22°C (64.4-71.6°F)	16-26°C (60.8-78.8°F)
Rate of change	1.0C° or less per hour 2.0C° or less per day	1.0C° or less per hour 5.0C° or less per day
Gradient	1.0C° or less per meter vertical & horizontal	

Specification of REVO Scanning Probe

Rotation angle (Pitch angle)	Vertical (A-axis)	-5° to +120° (0.08 sec)
	Horizontal (B-axis)	∞ (0.08sec)
Stylus	Maximum length	50mm (Distance from probe rotation center to stylus tip)

See page L-2 for explanation of ISO accuracy statements.

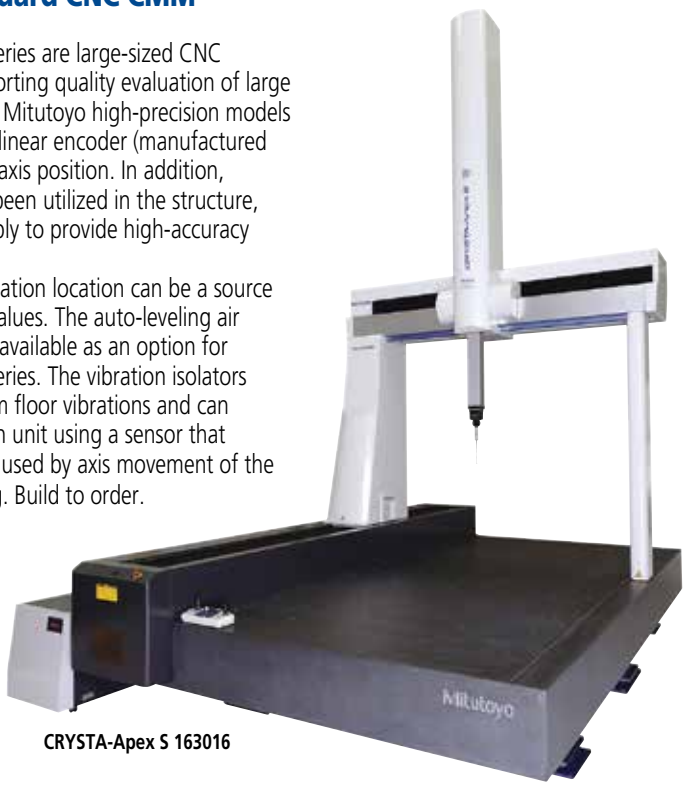
Mitutoyo

CRYSTA-Apex S 1600/2000

SERIES 191 — Standard CNC CMM

Crysta-Apex S1600/2000 series are large-sized CNC CMMs developed for supporting quality evaluation of large parts. The scale systems on Mitutoyo high-precision models utilize a high-performance linear encoder (manufactured by Mitutoyo) for detecting axis position. In addition, various technologies have been utilized in the structure, part processing and assembly to provide high-accuracy measurement.

Floor vibration at the installation location can be a source of variations in measured values. The auto-leveling air spring vibration isolators is available as an option for Crysta-Apex S1600/2000 series. The vibration isolators insulates the main unit from floor vibrations and can quickly level the CMM main unit using a sensor that detects load fluctuations caused by axis movement of the CMM or workpiece loading. Build to order.



CRYSTA-Apex S 163016

SP80 Probe
(Extended reach scanning)
See page L-21

Supported Probe Systems			
Type	**Probe**	**AS1600**	**AS2000**
TOUCH-TRIGGER PROBES	MH20i	●	●
	TP20	●	●
	TP200	●	●
	TP7	●	●
SCANNING PROBES	SP25	●	●
	MPP	●	●
	SP80	●	●
LASER PROBES	SM606	●	●
	SM606T	●	●
	SM610	●	●
	SM1010	●	●
SURFACE FINISH	SurfTest	●	▲
OPTICAL	QVP	●	●
	CF20	●	●

● Supported ▲ Not Recommended

See page L-20 thru L-27 for probe system information.

SPECIFICATIONS

Type: BRIDGE	Model No.	CRYSTA-Apex S 162012 [CRYSTA-Apex S 162016]	CRYSTA-Apex S 163012 [CRYSTA-Apex S 163016]	CRYSTA-Apex S 164012 [CRYSTA-Apex S 164016]	CRYSTA-Apex S 203016	CRYSTA-Apex S 204016
Range	X axis	62.99" (1600mm)			78.73" (2000mm)	
	Y axis	78.73" (2000mm)	118.10" (3000mm)	157.47" (4000mm)	118.10" (3000mm)	157.47" (4000mm)
	Z axis	47.24" (1200mm) [62.99" (1600mm)]			62.99" (1600mm)	
Resolution		0.000004" (0.0001mm)				
Guide Method		Air bearing on each axis				
Maximum Drive Speed 3D		27.28"/s (693mm/s)				
Maximum Acceleration 3D		0.14G (1,390mm/s^2)				
Work table	Material	Granite				
	Size	70.86" x 126.18" (1800mm x 3205mm)	70.86" x 165.55" (1800mm x 4205mm)	70.86" x 204.92" (1800mm x 5205mm)	86.61" x 165.55" (2200mm x 4205mm)	86.61" x 204.92" (2200mm x 5205mm)
	Tapped insert	M8 x 1.25mm				
Workpiece	Max. height	55.11" (1400mm) [70.86" (1800mm)]			70.86" (1800mm)	
	Max. load	6,613 lbs. (3000kg)	7,716 lbs. (3500kg)	9,920 lbs. (4500kg)	8,818 lbs. (4000kg)	11,023 lbs. (5000kg)
Mass (incl. stand & controller)		20,502 lbs. (9300kg) [20,613 lbs. (9350kg)]	23,368 lbs. (10600kg) [23,479 lbs. (10650kg)]	32,628 lbs. (14800kg) [37,738 lbs. (14850kg)]	31,085 lbs. (14100kg)	42,769 lbs. (19400kg)
Dimensions W x D x H		106.29 x 141.73 x 162.99" (2700 x 3600 x 4140mm) [106.29 x 141.73 x 194.48"] [(2700 x 3600 x 4940mm)]	106.29 x 181.10 x 162.99" (2700 x 4600 x 4140mm) [106.29 x 181.10 x 194.48"] [(2700 x 4600 x 4940mm)]	106.29 x 220.47 x 164.96" (2700 x 5600 x 4190mm) [106.29 x 220.47 x 196.45"] [(2700 x 5600 x 4990mm)]	122.04 x 183.07 x 196.45" (3100 x 4650 x 4990mm)	122.04 x 222.44 x 198.42" (3100 x 5650 x 5040mm)
ISO-10360-2:2009 $E_{0,MPE}$						
18-22°C (64.4-71.6°F)	TP200:	(6+4.5L/1000)µm [(7+5.5L/1000)µm]			(9+8L/1000)µm	
	MPP310/SP25:	(3.3+4.5L/1000)µm [(4.5+5.5L/1000)µm]			(4.5+8L/1000)µm	
16-24°C (60.8-75.2°F)	TP200:	(6+5.5L/1000)µm [(7+6.5L/1000)µm]			(9+9L/1000)µm	
	MPP310/SP25:	(3.3+5.5L/1000)µm [(4.5+6.5L/1000)µm]			(4.5+8L/1000)µm	
ISO-10360-4 MPE_{THP}/MPT_{THP} †						
	MPP310/SP25:	5µm/60sec			6µm/60sec	
ISO-10360-5: 2010 $P_{FTU,MPE}$						
	TP200:	6.5µm [7.5 µm]			9.5µm	
	MPP310/SP25:	5µm [6µm]			6µm	

Stylus Configurations for ISO Tests	
TP200:	Ø4mm x L10mm
SP25/SP80:	Ø4mm x L50mm
MPP310Q:	Ø4mm x L18mm

Air Supply	
Pressure	58.0 PSI (0.4MPa)
Consumption	5.29CFM (150L/min)
Source	7.06CFM (200L/min)

Environment	18-22°C (64.4-71.6°F)	16-24°C (60.8-75.2°F)
Rate of change	1.0C° or less per hour 2.0C° or less per day	1.0C° or less per hour 5.0C° or less per day
Gradient	1.0C° or less per meter vertical & horizontal	

† This test is not part of Mitutoyo America's standard A2LA-accredited CMM calibration procedure and is quoted upon request.

See page L-2 for explanation of ISO accuracy statements.

Supported Probe Systems			
Type	**Probe**	**STRATO Apex 500**	**STRATO Apex 700/900**
TOUCH-TRIGGER PROBES	MH20i	●	●
	TP20	●	●
	TP200	●	●
	TP7	●	●
SCANNING PROBES	SP25	●	●
	MPP	●	●
	SP80	▲	●
LASER PROBES	SM606	▲	●
	SM606T	▲	●
	SM610	▲	●
	SM1010	▲	●
SURFACE FINISH	SurfTest	—	●
OPTICAL	QVP	▲	●
	CF20	●	●

● Supported ▲ Not Recommended — Not supported

See page L-20 thru L-27 for probe system information.

Ultra-high precision glass scales

Internal heat generation minimized

STRATO-Apex 500/700/900

SERIES 355 — High-Accuracy CNC CMM

The STRATO-Apex series is high-accuracy CNC CMMs achieving 0.9µm for the first term. The series guarantees high accuracy and also high-moving speed and acceleration achieved with improved rigid air bearings on all axial guideways. The scale systems on Mitutoyo high-precision models utilize a high-performance linear encoder (manufactured by Mitutoyo), for detecting axis position. In addition, various technologies have been utilized in the structure, part processing and assembly to provide high-accuracy measurement.

TP7 Probe
(High-precision touch trigger)
See page L-20

STRATO-Apex 574 **STRATO-Apex 776** **STRATO-Apex 9106**

SPECIFICATIONS

Type: BRIDGE	Model No.	STRATO-Apex 574	STRATO-Apex 776	STRATO-Apex 7106	STRATO-Apex 9106	STRATO-Apex 9166
Range	X axis	19.68" (500mm)	27.55" (700mm)		35.43" (900mm)	
	Y axis	27.55" (700mm)		39.36" (1000mm)		62.99" (1600mm)
	Z axis	15.74" (400mm)	23.62" (600mm)			
Resolution		0.0000019" (0.00005mm)	0.00000078" (0.00002mm)			
Guide Method		Air bearing on each axis				
Maximum Drive Speed 3D		20.43"/s (519mm/s)				
Maximum Acceleration 3D		0.17G (2,309mm/s^2)	0.26G (2,598mm/s^2)			
Work table	Material	Granite				
	Size	26.61 x 55.90" (676 x 1420mm)	33.93 x 55.90" (862 x 1420mm)	33.93 x 67.71" (862 x 1720mm)	41.81 x 67.71" (1062 x 1720mm)	41.81 x 91.33" (1062 x 2320mm)
	Tapped insert	M8 x 1.25mm				
Workpiece	Max. height	22.04" (560mm)	30.31" (770mm)			
	Max. load	396 lbs. (180kg)	1,102 lbs. (500kg)	1,763 lbs. (800kg)	1,763 lbs. (800kg)	2,645 lbs. (1200kg)
Mass (incl. stand & controller)		3,373 lbs. (1530kg)	4,177 lbs. (1895kg)	4,806 lbs. (2180kg)	5,313 lbs. (2410kg)	6,801 lbs. (3085kg)
Dimensions W x D x H		49.99x66.92x94.88" (1270x1700x2410mm)	57.48x75.19x111.41" (1460x1910x2830mm)	57.48x87.00x111.41" (1460x2210x2830mm)	65.35x87.00x111.41" (1660x2210x2830mm)	65.35x110.62x111.41" (1660x2810x2830mm)
ISO-10360-2:2009 $E_{0,MPE}$						
	TP200:	(1.4+2.5L/1000)µm*	(1.4+2.5L/1000)µm**		(1.5+2.5L/1000)µm**	
	SP25:	(0.7+2.5L/1000)µm*	(0.9+2.5L/1000)µm**			
ISO-10360-2:2009 $E_{150,MPE}$						
	TP200:	(1.9+2.5L/1000)µm*	(1.9+2.5L/1000)µm**		(2.0+2.5L/1000)µm**	
	SP25:	(0.7+2.5L/1000)µm*	(0.9+2.5L/1000)µm**			
ISO-10360-2:2009 $R_{0,MPL}$	TP200:	1.2µm*	1.2µm**			
	SP25:	0.7µm*	0.8 µm**			
ISO-10360-4 MPE_{THP}/MPT_{THP}	SP25:	1.3µm/40sec*	1.8µm/45sec**			
ISO-10360-5: 2010 $P_{FTU,MPE}$	TP200:	1.8µm*	1.8µm**			
	SP25:	0.7µm*	0.9 µm**			

* 18-22°C (64.4-71.6°F - Strato Apex 574
** 19-21°C (66.2-69.8°F) - Strato Apex 776/7106/9106/9166

Stylus Configurations for ISO Tests	
TP200:	Ø4mm x L10mm
SP25/SP80:	Ø4mm x L50mm

Air Supply	
Pressure	58.0 PSI (0.4MPa)
Consumption	2.11CFM (60L/min)
Source	4.23CFM (120L/min)

Environment	18-22°C (64.4-71.6°F)	19-21°C (66.2-69.8°F)
Rate of change	1.0C° or less per hour 2.0C° or less per day	
Gradient	1.0C° or less per meter vertical & horizontal	

See page L-2 for explanation of ISO accuracy statements.

Mitutoyo

STRATO-Apex 1600

SERIES 355 — High-Accuracy CNC CMM

The STRATO-Apex 1600 series is a large-sized CNC CMM developed for supporting quality evaluation and assembly of large parts.The scale systems on Mitutoyo high-precision models utilize a high-performance linear encoder (manufactured by Mitutoyo) for detecting axis position. In addition, various technologies have been utilized in the structure, part processing and assembly to provide high-accuracy measurement. Floor vibration at the installation location can be a source of variation in measured values. The auto-leveling air spring vibration isolator is available as an option for STRATO-Apex 1600 series. The vibration isolator insulates the main unit from floor vibrations and can quickly level the CMM main unit using a sensor that detects load fluctuations caused by axis movement of the CMM or workpiece loading. All STRATO-Apex high-precision series CMMs are equipped with temperature compensation and therefore do not require a temperature-controlled room. Accuracy is guaranteed within the range of 16 to 26°C.

STRATO-Apex 1600

Supported Probe Systems		
Type	**Probe**	**STRATO Apex 1600**
TOUCH TRIGGER PROBES	MH20i	●
	TP20	●
	TP200	●
	TP7	●
SCANNING PROBES	SP25	●
	MPP	●
	SP80	●
LASER PROBES	SM606	●
	SM606T	●
	SM610	●
	SM1010	●
SURFACE FINISH	SurfTest	●

● Supported ▲ Not Recommended

See page L-20 thru L-27 for probe system information

SP80 Probe
(Extended reach scanning)
See page L-21

SPECIFICATIONS

Type: BRIDGE	Model	STRATO-Apex 162012	STRATO-Apex 162016	STRATO-Apex 163012	STRATO-Apex 163016
Range	X axis	62.99″ (1600mm)			
	Y axis	78.73″ (2000mm)		118.10″ (3000mm)	
	Z axis	47.24″ (1200mm)	62.99″ (1600mm)	47.24″ (1200mm)	62.99″ (1600mm)
Resolution		0.0000019″ (0.00005mm)			
Guide Method		Air bearing on each axis			
Maximum Drive Speed 3D		23.85″/s (606mm/s)			
Maximum Acceleration 3D		0.13G (1,350mm/s^2)			
Work table	Material	Granite			
	Size	72.83 x 129.13″ (1850mm x 3280mm)		72.83 x 168.50″ (1850mm x 4280mm)	
	Tapped insert	M8 x 1.25mm			
Workpiece	Max. height	53.14″ (1350mm)	368.89″ (1750mm)	53.14″(1350mm)	68.89″ (1750mm)
	Max. load	7,716 lbs. (3500kg)		8,818 lbs. (4000kg)	
Mass (incl. stand & controller)		24,582 lbs. (11150kg)	24,692 lbs. (11200kg)	33,730 lbs. (15300kg)	33,841 lbs. (15350kg)
Dimensions W x D x H		110.43x147.24x170.86″ (2805x3740x4340mm)	110.43x147.24x202.36″ (2805x3740x5140mm)	110.43x186.61x172.83″ (2805x4740x4390mm)	110.43x186.61x204.33″ (2805x4740x5190mm)
ISO-10360-2:2009 $E_{0,MPE}$ 18-22°C (64.4-71.6°F)					
	TP200:	(3.5+4L/1000)µm	(4.0+4L/1000)µm	(3.5+4L/1000)µm	(4.0+4L/1000)µm
	SP25/SP80:	(2.5+4L/1000)µm	(3.0+4L/1000)µm	(2.5+4L/1000)µm	(3.0+4L/1000)µm
ISO-10360-2:2009 $E_{150,MPE}$ † 18-22°C (64.4-71.6°F)					
	TP200:	(3.5+4L/1000)µm	(4.0+4L/1000)µm	(3.5+4L/1000)µm	(4.0+4L/1000)µm
	SP25/SP80:	(2.5+4L/1000)µm	(3.0+4L/1000)µm	(2.5+4L/1000)µm	(3.0+4L/1000)µm
ISO-10360-2:2009 $R_{0,MPL}$ †					
	TP200:	3.5µm	4.0µm	3.5µm	4.0µm
	SP25:	2.5µm			
ISO-10360-4 MPE_{THP}/MPT_{THP} †					
	SP25/SP80:	2.5µm/60sec	3.0µm/60sec	2.5µm/60sec	3.0µm/60sec
ISO-10360-5: 2010 $P_{FTU,MPE}$	TP200:	3.5µm	4.0µm	3.5µm	4.0µm
	SP25/SP80:	2.3µm	2.8µm	2.3µm	2.8µm

Stylus Configurations for ISO Tests	
TP200:	Ø4mm x L10mm
SP25/SP80:	Ø4mm x L50mm

Air Supply	
Pressure	58.0 PSI (0.4MPa)
Consumption	3.53CFM (100L/min)
Source	8.82CFM (250L/min)

Environment	18-22°C (64.4-71.6°F)
Rate of change	1.0C° or less per hour 2.0C° or less per day
Gradient	1.0C° or less per meter vertical & horizontal

† This test is not part of Mitutoyo America's standard A2LA-accredited CMM calibration procedure and is quoted upon request.

See page L-2 for explanation of ISO accuracy statements.

NEW-STYLE
Vision Measuring Systems

FALCIO-Apex 2000/3000

SERIES 355 — High-Accuracy Large CNC CMM

The FALCIO-Apex 2000/3000 series CNC CMMs use Mitutoyo's standard structure for large machines, which are designed for measuring large and heavy workpieces with high accuracy. The measuring accuracy and drive speed are the highest level in the X-axis measuring range of 2000mm and 3000mm for CNC CMMs worldwide. Units are equipped with a system (MOVAC) to automatically restore accuracy deterioration caused by foundation deformation as a standard feature. Safety devices such as Z-axis beam sensor, tape switch and area sensor are available as options. Built to order.

SurfaceMeasure Probes
(Laser scanning probes—non-contact)
See page L-22

FALCIO Apex 305015G

SPECIFICATIONS

Type: SEPARATE GUIDE	Model No.	FALCIO-Apex 203015	FALCIO-Apex 204015	FALCIO-Apex 205015	FALCIO-Apex 305015
Range	X axis	78.73" (2000mm)			118.10" (3000mm)
	Y axis	118.10" (3000mm)	157.47" (4000mm)	196.84" (5000mm)	
	Z axis	59.05" (1500mm)			
Resolution		0.0000039" (0.0001mm)			
Mass (incl. stand & controller)		23,368 lbs. (10600kg)	27,557 lbs. (12500kg)	34,392 lbs. (15600kg)	35,273 lbs. (16000kg)
Dimensions W x D x H		174.40x234.25x184.64" (4430x5950x4690mm)	174.40x273.62x184.64" (4430x6950x4690mm)	174.40x312.99x184.64" (4430x7950x4690mm)	213.77x312.99x184.64" (5430x7950x4690mm)
ISO-10360-2:2009 $E_{0,MPE}$					
18-22°C (64.4-71.6°F)	TP200:	3.5+4L/1000µm			

Supported Probe Systems		
Type	**Probe**	**FALCIO Apex**
TOUCH-TRIGGER PROBES	MH20i	●
	TP20	●
	TP200	●
	TP7	●
SCANNING PROBES	SP25	●
	MPP	▲
	SP80	●
LASER PROBES	SM606	●
	SM606T	●
	SM610	●
	SM1010	●
SURFACE FINISH	SurfTest	●

● Supported ▲ Not Recommended

See page L-20 thru L-27 for probe system information.

Stylus Configurations for ISO Tests	
TP200:	Ø4mm x L10mm

See page L-2 for explanation of ISO accuracy statements.

Main Unit Startup System

This machine incorporates a startup system (relocation detection system), which disables operation when an unexpected vibration is applied or the machine is relocated. Be sure to contact your nearest Mitutoyo prior to relocating this machine after initial installation. Refer to page VIII for details.

TP200 Probe
(Touch trigger)
See page L-20

Mitutoyo

LEGEX 500/700/900

SERIES 356 — Ultra-high Accuracy CNC CMM

Achieving premium performance, the LEGEX series with its fixed bridge structure and precision air bearings resting on rigid guideways ensures superior stability of motion and ultra-high measuring accuracy. Thorough testing, using FEM structure analysis simulation, guarantees geometric motion accuracy has minimal errors from fluctuations in the load and other variables. LEGEX series CNC CMMs are suitable for complex small- to medium-size workpieces, such as gears, bearings, lens, precision dies or other high-precision workpieces requiring dimensional accuracies with small tolerances.

The LEGEX series incorporates an ultra-high accuracy scale unit with crystallized glass scales (thermal expansion coefficient of 0.01×10^{-6}/K), and a high-resolution, high-performance reflection linear encoder providing premium positioning performance. All LEGEX Ultra-accuracy series CMM's are equipped with temperature compensation and therefore do not require a temperature controlled room. Accuracy is guaranteed within the range of 18 to 22°C.

MPP-310Q

Mitutoyo's MPP-310Q probe can be used for point-to-point measuring and continuous scanning applications. If the workpiece requires the maximum accuracy, the MPP-310Q offers zero-point data acquisition for statistical measurement. In this mode the MPP-310Q obtains the measurement data after all the CMM slides have come to a complete standstill. This statistical measurement is intended to eliminate dynamic effects on measurement. *See page L-21 for MPP-310Q system information.*

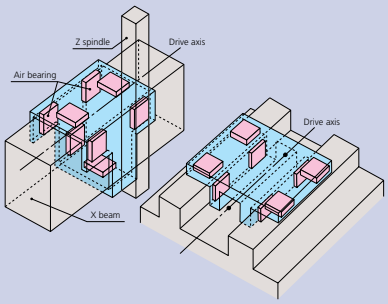
MPP-310Q Specs

- Resolution: 0.01µm
- Measuring Force: 0.20N/mm
- Maximum Stylus Length: 200mm
- Maximum Stylus Weight: 75g

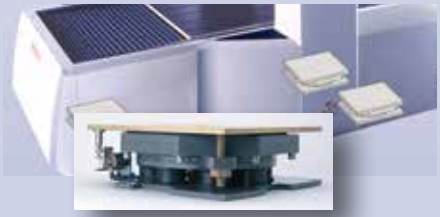
LEGEX 574

LEGEX 776

LEGEX 9106



XY axis independence and center-of-gravity drive system. The fixed-bridge design of the LEGEX allows the axes to operate independently. Movement of the X-axis slide does not change the loading on the Y-axis slide and therefore does not cause deformation. In addition, the center-of-gravity drive system places the drive units near the center of gravity of each slide, allowing high speed and highly accurate measurements by reducing inertia-induced deflections during acceleration and deceleration.



Vibration Control
The LEGEX is hardened against floor-induced vibration by use of air-damped spring isolators with an auto-leveling function, virtually eliminating factory-floor vibrations from the entire machine structure.

Ceramic-coated worktable
Standard feature for corrosion resistance and long life.

SPECIFICATIONS

Type: FIXED BRIDGE	Model No.	LEGEX 574	LEGEX 774	LEGEX 776	LEGEX 9106
Range	X axis	19.68" (500mm)	27.55" (700mm)		35.43" (900mm)
	Y axis	27.55" (700mm)			39.36" (1000mm)
	Z axis	15.74" (400mm)		23.62" (600mm)	
Resolution		0.00000039" (0.01µm)			
Guide Method		Air bearing on each axis			
Maximum Drive Speed 3D		7.8"/s (200mm/s)			
Maximum Acceleration 3D		0.1G (980mm/s²)			
Work table	Material	Cast Iron with Ceramic Coating			
	Size	21.65" x 29.52" (550mm x 750mm)	29.52" x 29.52" (750mm x 750mm)		37.40" x 41.33" (950mm x 1050mm)
	Tapped insert	M8 x 1.25mm			
Workpiece	Max. height	27.55" (700mm)		33.46" (850mm)	
	Max. load	551 lbs. (250kg)	1,102 lbs. (500kg)		1,763 lbs. (800kg)
Mass (incl. stand & controller)		7,716 lbs. (3500kg)	11,023 lbs. (5000kg)	11,243 lbs. (5100kg)	14,330 lbs. (6500kg)
Dimensions W x D x H		62.44 x 95.66 x 103.54" (1470 x 2430 x 2630mm)	65.74 x 95.66 x 103.54" (1670 x 2430 x 2630mm)	65.74 x 94.48 x 115.35" (1670 x 2430 x 2930mm)	73.62 x 119.29 x 120.07" (1870 x 3030 x 3050mm)
ISO-10360-2:2009 $E_{0,MPE}$		19-21°C (66.2-69.8°F)		*18-22°C (64.4-71.6°F)*	
19-21°C (66.2-69.8°F)	MPP310Q:	(0.28+L/1000)µm		*(0.30+L/1000)µm*	
	SP25M:	(0.38+L/1000)µm		*(0.40+L/1000)µm*	
ISO-10360-4 MPE_{THP}/MPT_{THP} †					
	MPP310Q/SP25M:	1.1µm/60sec			
ISO-10360-5: 2010 $P_{FTU,MPE}$	MPP310Q:	0.40µm			
	SP25M:	0.45µm			

Stylus Configurations for ISO Tests	
MPP310Q:	Ø4mm x L18mm
SP25M:	Ø4mm x L50mm

Air Supply	500/700/1200	900
Pressure	58.0 PSI (0.5MPa)	72.5 PSI (0.4MPa)
Consumption	4.23CFM (120L/min)	
Source	5.65CFM (160L/min)	

Environment	19-21°C (66.2-69.8°F) / 18-22°C (64.4-71.6°F)
Rate of change	0.5C° or less per hour 1.0C° or less per day
Gradient	1.0C° or less per meter vertical & horizontal

† This test is not part of Mitutoyo America's standard A2LA-accredited CMM calibration procedure and is quoted upon request.

See page L-2 for explanation of ISO accuracy statements.

MACH-V 9106

SERIES 360 — Inline CNC CMM

The MACH-3A and MACH-V maximize machining operations by performing in-line or near-line high-speed coordinate measuring in conjunction with your CNC machine tools. These high-throughput machines can be incorporated right into the manufacturing line and can provide pre/post machining feedback to your machine tool for machining adjustments.

MACH-V 9106

SPECIFICATIONS

Type: INLINE	Model No.	MACH-V 9106
Range	X axis	35.43" (900mm)
	Y axis	39.36" (1000mm)
	Z axis	23.62" (600mm)
Resolution		0.0000039" (0.0001mm)
Guide Method		Mechanical bearing on each axis
Maximum Drive Speed 3D		34.09"/s (866mm/s)
Maximum Acceleration 3D		0.88g (8660mm/s²)
Work table	Material	Steel
	Size	35.62" x 41.96" (905mm x 1066mm)
	Tapped insert	M8 x 1.25mm
Workpiece	Max. height	31.49" (800mm)
	Max. load	330 lbs. (150kg)
Mass (including controller)		9,105 lbs. (4130kg)
Dimensions W x D x H		58.14 x 115.82 x 114.17" (1477 x 2942 x 2900mm)
ISO-10360-2:2009 $E_{0,MPE}$		
TP7/SP25:	19-21°C (66.2-69.8°F)	(2.5+3.5L/1000)µm
	18-22°C (64.4-71.6°F)	(2.7+3.8L/1000)µm
	15-25°C (59.0-77.0°F)	(2.9+4.3L/1000)µm
	5-35°C (41.0-95.0°F)	(3.6+5.8L/1000)µm
ISO-10360-4 MPE_{THP}/MPT_{THP} †	SP25:	4.0µm/40sec
ISO-10360-5: 2010 $P_{FTU,MPE}$	TP7:	2.2µm
	SP25:	2.2µm

† This test is not part of Mitutoyo America's standard A2LA-accredited CMM calibration procedure and is quoted upon request.

See page L-21.

Stylus Configurations for ISO Tests	
TP7:	Ø4mm x L20mm
SP25:	Ø4mm x L50mm

Environment	5-35°C (71.6-64.4°F)
Rate of change	2.0C° or less per hour 10.0C° or less per day
Gradient	1.0C° or less per meter vertical & horizontal

MACH-3A 653

SERIES 360 — Inline CNC CMM

Inline CNC CMM (horizontal type) incorporating the CMM controller and host computer in the main unit results in a compact spacing-saving footprint for the shop floor. This series is designed for 24-hour operation, resulting in stable operation.

MACH-3A 653

SPECIFICATIONS

Type: INLINE	Model No.	MACH-3A 653
Range	X axis	23.62" (600mm)
	Y axis	19.68" (500mm)
	Z axis	11.02" (280mm)
Resolution		0.0000039" (0.0001mm)
Guide Method		Mechanical bearing on each axis
Maximum Drive Speed 3D		47.71"/s (1,212mm/s)
Maximum Acceleration 3D		1.21G (11,882mm/s²)
Mass		8,818 lbs. (4000kg)
Dimensions W x D x H		73.62 x 50.39 x 75.59" (1870 x 1280 x 1920mm)
ISO-10360-2:2009 $E_{0,MPE}$		
SP25:	19-21°C (66.2-69.8°F)	(2.2+3.5L/1000)µm
	15-25°C (66.2-69.8°F)	(2.5+4.2L/1000)µm
	10-30°C (50.0-86.0°F)	(2.9+5.0L/1000)µm
	5-35°C (66.2-95.0°F)	(3.2+5.7L/1000)µm
TP7:	19-21°C (66.2-69.8°F)	(2.5+3.5L/1000)µm
	15-25°C (66.2-69.8°F)	(2.8+4.2L/1000)µm
	10-30°C (50.0-86.0°F)	(3.2+5.0L/1000)µm
	5-35°C (66.2-95.0°F)	(3.5+5.7L/1000)µm
ISO-10360-4 MPE_{THP}/MPT_{THP} †	SP25:	4.0µm/40sec
ISO-10360-5: 2010 $P_{FTU,MPE}$	SP25:	2.2µm
	TP7:	2.5µm

† This test is not part of Mitutoyo America's standard A2LA-accredited CMM calibration procedure and is quoted upon request.

See page L-2 for explanation of ISO accuracy statements.

TP7 Probe
(High-precision tough-trigger)
See page L-20.

Stylus Configurations for ISO Tests	
TP7:	Ø4mm x L20mm
SP25:	Ø4mm x L50mm

Environment	5-35°C (71.6-64.4°F)
Rate of change	2.0C° per hour 10.0C° per day
Gradient	1.0C° or less per meter vertical & horizontal

Mitutoyo

MACH KO-GA-ME

SERIES 360 — Inline CNC CMM

Mitutoyo MACH Ko-ga-me is a compact, 3D CNC measuring system that can be configured to almost any process. Use for stand-alone applications or integrate into cells. If required, the system can measure workpiece features that exceed the Ko-ga-me's X stroke by mounting the workpiece, or the Ko-ga-me, on an auxiliary X axis. Ideal for inspection of large or small workpieces and offers a wide choice of measuring probes including touch-trigger, optical and scanning types. (Note: Probe choice may be restricted, depending on the application.)

SP25 Scanning Probe
See page L-21.

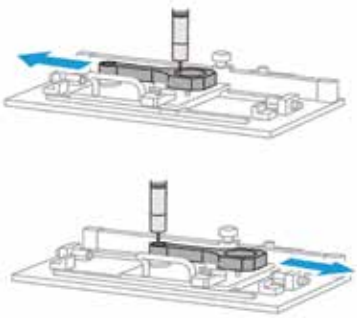
TP200 Touch-Trigger Probe
See page L-20.

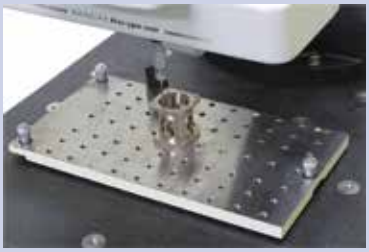
SPECIFICATIONS

Type: INLINE	Model No.	KGM888-B	KGM12128-B
Range	X axis	3.14" (80mm)	4.72" (120mm)
	Y axis	3.14" (80mm)	4.72" (120mm)
	Z axis	3.14" (80mm)	
Resolution		0.00000078" (0.02µm)	
Guide Method		Straight-motion hard bearing	
Maximum Drive Speed 3D		13.38"/s (340mm/s)	
Maximum Acceleration 3D		0.68G (6,750mm/s²)	
Mass: main unit		61.7 lbs. (28kg)	
Dimensions* W x D x H: (height includes Z measuring range)		15.03 x 14.68 x 30.90" (382 x 373 x 785mm)	
Measuring Accuracy (ISO 10360-2:2009)			
TP200/SP25:	19-21°C (66.2-69.8°F)	(2.4+5.7L/1000)µm	
	15-25°C (66.2-69.8°F)	(2.7+6.4L/1000)µm	
	10-30°C (50.0-86.0°F)	(3.1+7.2L/1000)µm	
	10-35°C (50.0-95.0°F)	(3.4+7.9L/1000)µm	
Probing Error (ISO 10360-2:2009)			
	TP200/SP25:	2.0µm	
Scanning probing error (ISO 10360-4:2000)			
	SP25:	2.7µm/(30s)	

Stylus Configurations for Accuracy Tests	
TP200:	Ø3mm x L10mm
SP25:	Ø4mm x L50mm

Environment	10-35°C (50.0-95.0°F)
Rate of Change	2.0C° or less per hour 10.0C° or less per day
Gradient	1.0C° or less per meter vertical & horizontal





See page L-2 for explanation of ISO accuracy statements.

CARBapex / CARBstrato

SERIES 355 — Car Body Measuring System CNC CMM

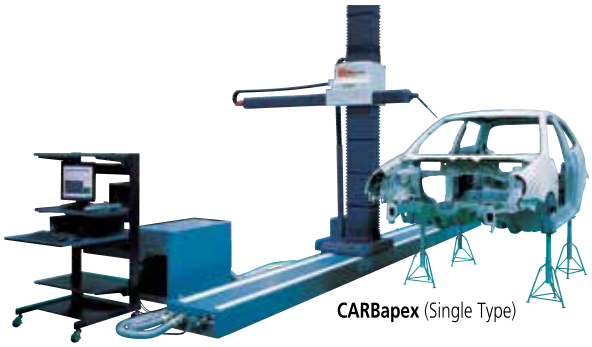
NEW-STYLE
Vision Measuring Systems

SurfaceMeasure Probes
(Laser scanning probes—non-contact)

See page L-22 for probe system information.

The world's largest class
The CARBapex and CABstrato series is a lineup of cost-effective horizontal, large CNC CMMs and offers the world's largest class measurement range, making it possible to measure car bodies.

Single & Dual
Single- and dual-types are available to fit the intended use.
Single type: Measure a workpiece with a single CMM from the CARBstrato series.
Dual type: Measure a workpiece placed between two simultaneously controlled CMMs from the CARBstrato series.

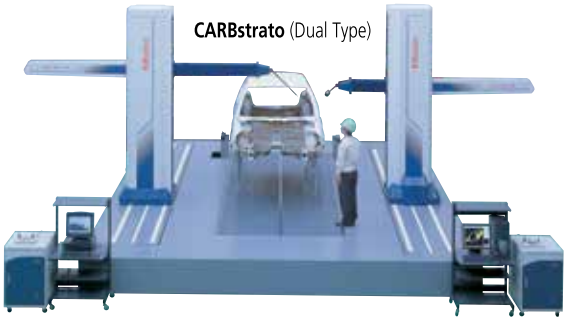


CARBapex (Single Type)

Because the height of the X-axis base of both the single- and the dual-type is set lower, the required depth for the foundation before the installation is relatively shallow.

Remarkable usability
The CARBapex series not only has remarkable usability, but also has the ability to enhance the safety operation by performing the procedures on the shop floor. The Y-axis spindle in the vertical direction is set lower in order to perform measurements at a lower workpiece setting height. In addition, the small cross-section of the Y-axis spindle reduces interference during measurement and expands the measurement area inside a car body.

Safety after installation
Since the height of the X-axis base is set lower, the required depth for the foundation before installation is comparatively shallow. The structure is designed to avoid both long- and short-term problems, such as a aging of the foundation (concrete) or accuracy deterioration resulting in the bimetal phenomenon caused by deformation of the foundation or the X-axis base due to common environmental changes.



CARBstrato (Dual Type)

Options
- Line laser probe for non-contact measurement (SurfaceMeasure).
- Measurement point search function, a necessity for car body measuring, is included in the metrology software.
- A variety of optional safety devices enhance operator safety. Built to order.

Main Unit Startup System

This machine incorporates a startup system (relocation detection system), which disables operation when an unexpected vibration is applied or the machine is relocated. Be sure to contact your nearest Mitutoyo prior to relocating this machine after initial installation.

SPECIFICATIONS

Type: HORIZONTAL ARM	Model No.		CARBapex 601624	CARBstrato 601624
Range	X axis		236.21" (6000mm)	
	Y axis (Single)		62.99" (1600mm)	
	Y axis (Dual)		153.54" (3900mm)	
	Z axis		94.48" (2400mm)	
Resolution			0.0000039" (0.0001mm)	
Mass	Single Arm		4,982 lbs. (2260kg)	13,845 lbs. (6280kg)
	Dual Arm		9,964 lbs. (4520kg)	27,690 lbs. (12560kg)
Dimensions W x D x H	Single Arm		163.18 x 275.58 x 144.33" (4145 x 7000 x 3666mm)	176.10 x 238.34 x 155.62" (4473x 7324 x 3953mm)
	Dual Arm		322.79 x 275.58 x 144.33" (8190 x 7000 x 3666mm)	348.26 x 238.34 x 155.62" (8846x 7324 x 3953mm)
ISO-10360-2:2009 $E_{0,MPE}$ 16-26°C (60.8-78.8°F)	Single Arm	TP20:	(25+28L/1000≤95)µm	(18+20L/1000≤70)µm
		SP25:	(20+28L/1000≤95)µm	(15+20L/1000≤70)µm
	Dual Arm	TP20:	(50+35L/1000≤120)µm	(38+30L/1000≤90)µm
		SP25:	(45+35L/1000≤120)µm	(35+30L/1000≤90)µm
ISO-10360-5: 2010 $P_{FTU,MPE}$	Single Arm	TP20:	20µm	15µm
		SP25:	15µm	13µm
	Dual Arm	TP20:	20µm	15µm
		SP25:	15µm	13µm

Stylus Configurations for ISO Tests	
TP20:	Ø3mm x L10mm
SP25:	Ø4mm x L50mm

See page L-2 for explanation of ISO accuracy statements.

Mitutoyo

MCOSMOS

Software for Manual / CNC Coordinate Measuring Machines

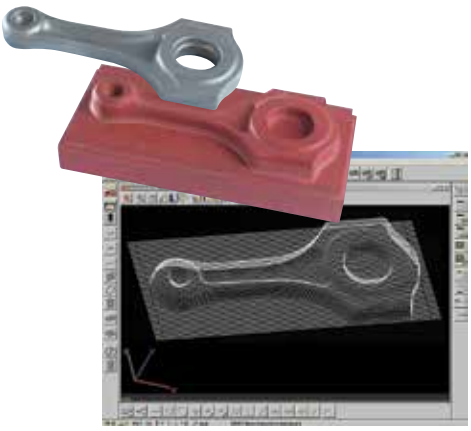
Three levels of module configuration

MCOSMOS has three choices of module configuration. From the basic MCOSMOS-1 to the advanced MCOSMOS-3, choose a configuration for your measurement applications.

MCOSMOS Coordinate Measuring Machine Software				
	CNC			Manual
	MCOSMOS-1	MCOSMOS-2	MCOSMOS-3	MCOSMOS-M
GEOPAK	●	●	●	●
CAT1000P	▲	●	●	—
CAT1000S	▲	●	●	▲
Scanpak	▲	▲	●	▲
Gearpak	▲	▲	●	—
MAFIS*	▲	▲	▲	—

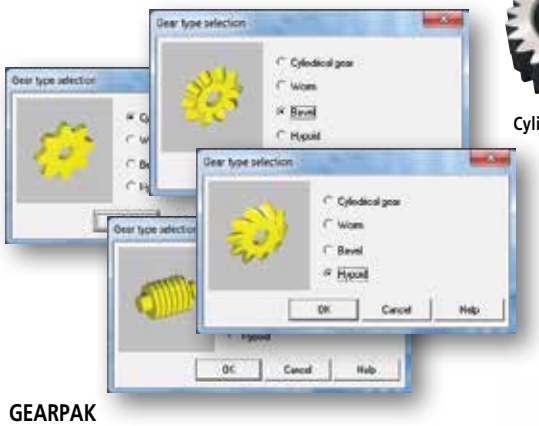
● Standard ▲ Option — Not supported * *Requires Scanpak*

GEOPAK (Basic Geometry Module)
Geopak provides an easy graphical console through the use of tool bars and windows which can be personalized to the operator's preference. Geographically enhanced displays provide step-by-step on-screen wizards that prompt the operator, allowing even inexperienced users to create routines to measure parts. The entry-level MCOSMOS-1 software includes flexible advanced tools demanded by the most experienced operators; e.g. looping, formula calculations or expressions that use variables, libraries of day-to-day subroutines and conditional statements, which can add logic for a variety of applications.



SCANPAK (2D Profile Evaluation Module)
For the scanning and evaluation of workpiece contours (2D), and data transfer to CAD system.

MAFIS (Mitutoyo Airfoil Inspection System)
Evaluation and analysis of airfoil shapes such as turbine blades that require special calculations according to the particular design specifications. The MAFIS system uses cross sectional data of the shape obtained by Scanpak to perform these calculations and outputs the result via the standard geometry program.



GEARPAK
(Gear Measurement and Analysis Module)
Advances in CMM controller techniques make the measurement of gears feasible, and the Gearpak module takes advantage of this to bring sophisticated measurement capabilities within reach.

Cylindrical Gear Spur

Cylindrical Gear Helical

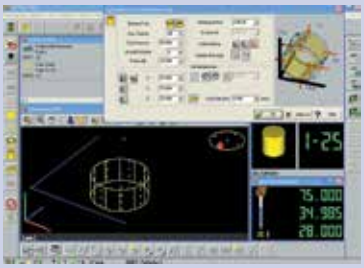
Worm Cylindrical Gear

Hypoid

Straight-Bevel

Spiral-Bevel

MiCAT
Mitutoyo Intelligent Computer Aided Technology
the standard in world metrology software
CMM



Mitutoyo Controlled Open Systems for Modular Operation Support

MCOSMOS by Mitutoyo is a proprietary metrology suite of inter-related modules and dedicated expansion modules for the Microsoft Windows 7 operating system. The world's standard in metrology software, MCOSMOS is supported in 37 locations worldwide and in 12 languages. *(A proud Microsoft Gold Partner.)*

Developed with MiCAT (Mitutoyo Intelligent Computer Aided Technology), your Mitutoyo CMM is streamlined with intuitive user interfaces that provide a familiar look and feel to operate multiple modules. They work together seamlessly for applications throughout the entire production process to put reliable metrology at you fingertips.

MCOSMOS allows integration among a whole series of applications, improving the efficiency of your CMM and the productivity of your quality control functions. Specific expansion modules are available including GEOPAK or for specific applications such as gear measurement, airfoil analysis, reverse engineering and integrating CAD with metrology.

CAT-1000P (Prismatic)
Not available for manual CMMs

CAT1000P significantly facilitates the programming of measurement tasks during the GEOPAK learn mode. All data for measuring parts and tolerance evaluations are taken from the CAD model via pointing device (mouse, trackball, etc.). The same principles apply for programming probe paths (clearance and measurement), while at the same time using the nominal directly from the CAD model for tolerance comparison.

Spatial's 3D InterOp delivers the highest quality data exchange between CAD formats, enabling superior CAD file translation.

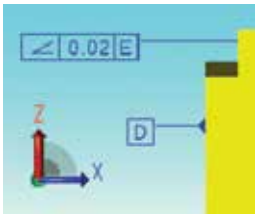
Standard with CAT-1000 is ACIS (*.sat) and STEP AP203, which are both licensed copies from Spatial InterOp.CATIA V5, SolidWorks, NX Siemens (Unigraphics), Parasolids, AutoDesk Inventor, Pro-Engineer and IGES or VDAFS exchange formats are available as an option.

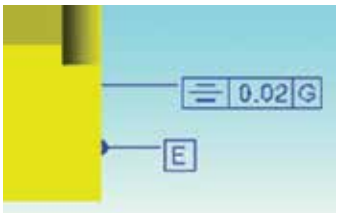
The comprehensive suite of translators provides import/export for all applications, including ACIS, CGM and Parasolid-based applications.

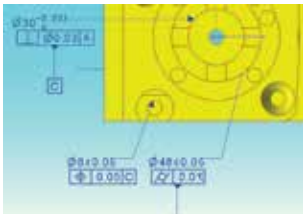
3D InterOp is embedded in many of today's leading design, engineering and manufacturing applications.

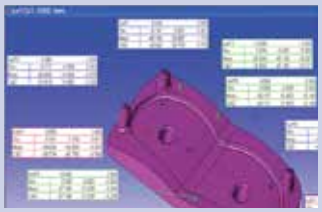
CAT-1000 uses 3D ACIS® Modeler, Spatial's prominent modeling component used in more than 350 customer applications with more than 2 million seats worldwide.

CAT-1000 fully supports and reads PMI (Product Manufacturing Information), which is embedded in the model for datum alignment and GD&T (Geometric Dimensioning and Tolerancing).



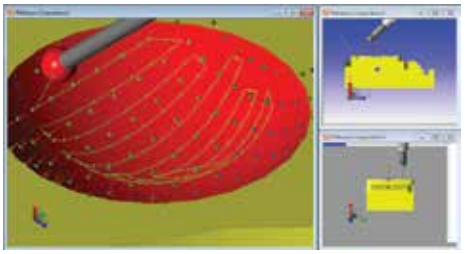






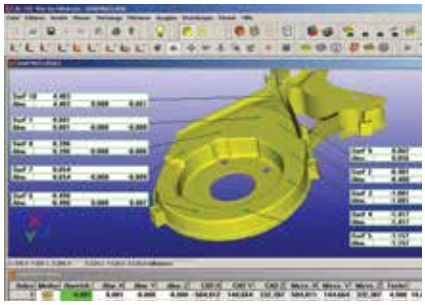
CAT-1000S (Free-form Sculpted)

CAT-1000S is a highly versatile tool that can be used on a manual CMM or a CNC CMM. A coordinate system in GEOPAK is compared to the CAD model. Real-time surface disposition is displayed by showing a color class to determine if there is material to remove or replace.
Surface deviation can be displayed as spherical points or as a gradient surface. Cones also can be used to show the direction of the deviation.
GEOPAK CNC can create grid pattern to verify the surface points. A one-click tool calculates a collision-free probe path to measure a grid of surface points offset from the edge.



If the CAD model has specific points, GEOPAK-CNC can drive the machine to the defined points or vertices.

In addition to the online/offline part program creation, CAD model-based generation of surface measurement points, and comparison of actual/nominal data, with graphical output is available.



MiCAT Planner

Automatic Measurement Program Generation Software

MiCAT Planner is Mitutoyo's latest software development for fast and efficient CMM part programming. Operation of MiCAT Planner is easy and intuitive. Programs are made with a few mouse clicks in jminutes instead of hours or days.

WORKFLOW:

1) Load design model
2) Select target CMM
3) Part placement via virtual alignment
4) Measurement program creation
5) Translate to Geopak MCOSMOS

MiCAT Planner toolbar is workflow based.

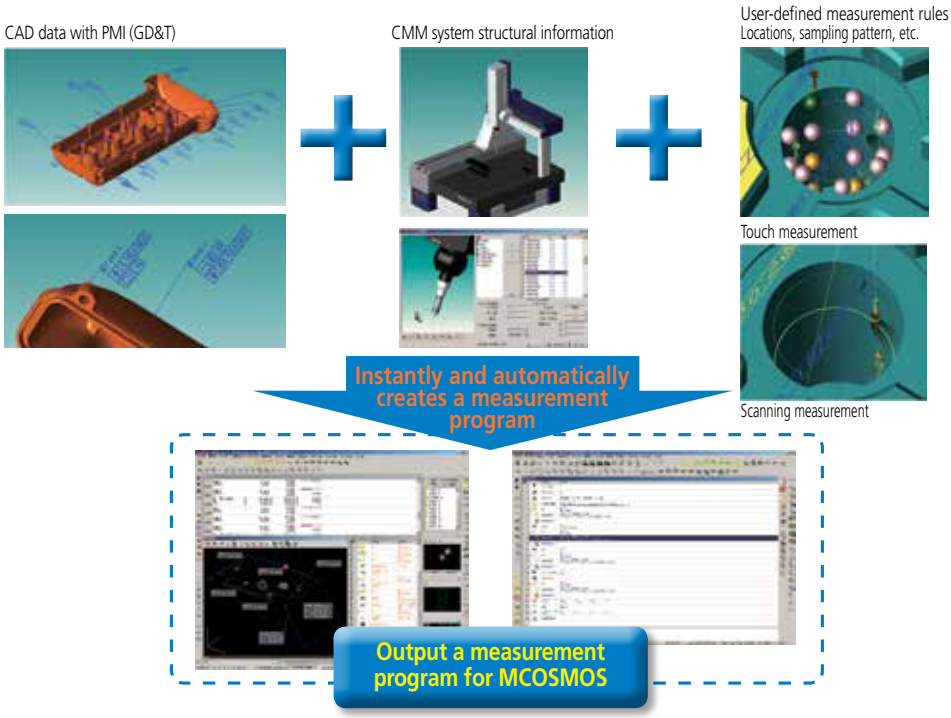
In order to generate a measurement plan, GD&T information attached to the 3D Design Model is needed. Design Model formats marked "w/PMI" will read GD&T information created in the CAD system and stored in the Design Model file. Design Model formats without PMI can be annotated with GD&T in MiCAT Planner.

Design Model Support:

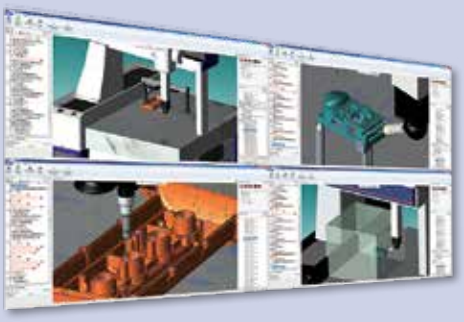
- Siemens NX w/PMI
- CATIA v5 w/PMI
- PRO/E w/PMI
- SOLIDWORKS w/PMI
- ACIS (SAT)

If the Design Model does not contain GD&T information, or the information is incomplete, GD&T information can be added or edited with MiCAT Planner with the following:

- Add new GD&T to an existing feature
- Add GD&T to a new feature
- Edit exiting GD&T information
- Modify display of GD&T in 3D view



MiCAT



Feature/Benefits of MiCAT Planner:

Automatic part program generation
- Up to 90% time savings in CMM part program creation

Collision control
- Minimize potential costly and damaging probe collisions

Program simulation
- Virtual pre-run of measurement program ensures maxim efficiency

Rule editor
- Automatically apply individual or global measurement strategies for all part programs or specific programs

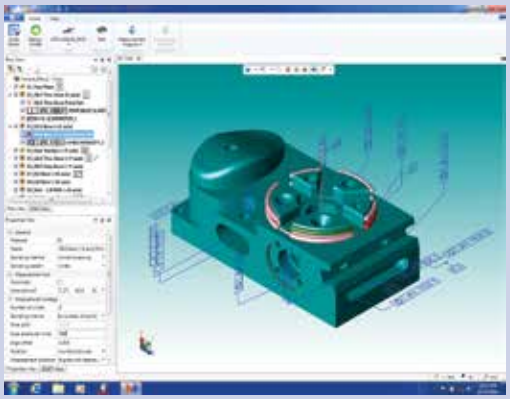
Plan view
- Easy selection of characteristics, features and measurement point sets to include or exclude from the measurement plan

Property pane
- Feature parameter settings for the current selected item can be an exception to a user-defined rule

Direct Help
- Clear, concise explanation for features that can't be measured (missing GD&T, probe angle not defined, etc.)

GD&T Wizard
- The GD&T Wizard enables the use of Design Models that do not include any PMI by allowing the user to add, edit or delete PMI information without modifying the original CAD file. All additions, changes or deletions reside solely within the MiCAT Planner project database. *(See Design Model Support above left for the current list)*

www.mitutoyo.com/MiCAT



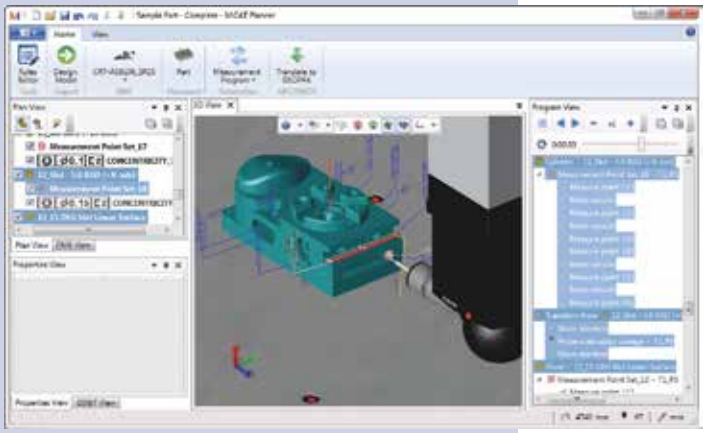
Measurement Plan

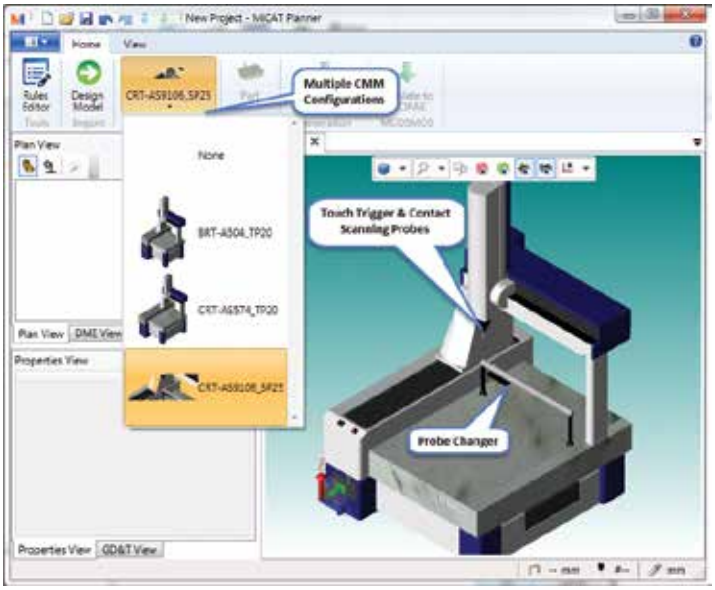
The measurement plan is synchronized with the 3D view and Program View. For example, a feature can be selected in any of the views (Plan View, 3D View, Program View) and is highlighted in the other views. Manual reordering of the feature measurement order is possible by drag and drop of the features in the Plan View. Users can select a feature, characteristic or point set in the Plan View to modify the corresponding properties in the Property View.

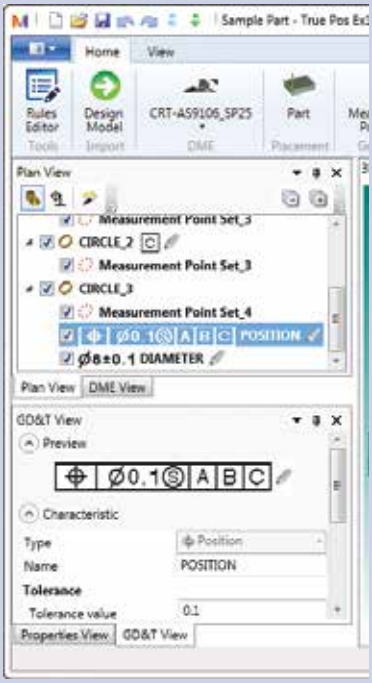
Load and Use MCOSMOS DME Configurations:

(DME: Dimensional Measuring Equipment)

- Load predefined DME configurations from CMM SystemManager
- Default DME is read directly from the MCOSMOS settings
- MiCAT Planner generates a program specifically for the selected DME
- Align DME and Design Model by mating, dragging, center of table or volume, or by direct numerical input
- Import PCS (part coordinate system) information from MCOSMOS

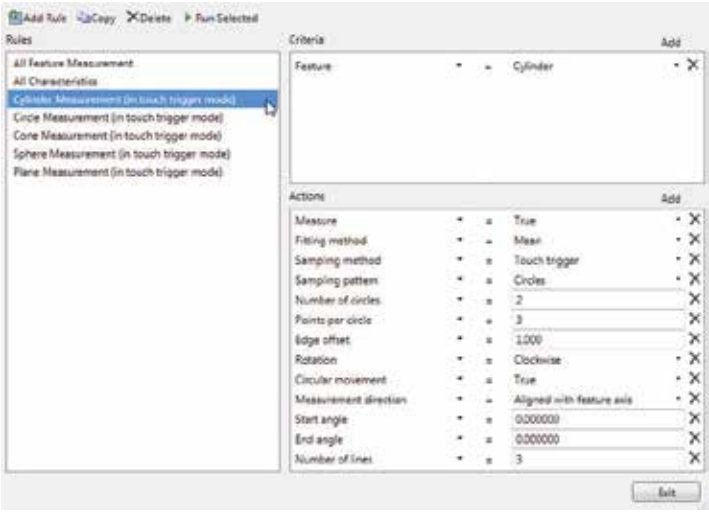






Rules Editor

The Rules Editor allows users to create rules to define measurement approaches, such as number of points per feature, sensor type, fitting method and automatic sensor selection.



Rules are applied during CAD import and can be re-applied after design model import. The Run Selected command automatically updates the measurement plan with the current defined rules and updates changes in the Plan and Program views.

Mitutoyo

CMM Probe & Change Rack Options

Touch-trigger Probe System

MH20i - Manual head **CMM:MANUAL | CNC**

MH20i is a manually adjustable probe head with an integral TP20 kinematic stylus module mount with two-axis indexing. The A-axis rotates through ±180° in the X-Y plane. The B-axis rotates through 90° in the Z plane. A lever locks the head in one of up to 168 repeatable positions, set at 15° increments. Capable of carrying the full range of TP20 modules, which can be changed without re-qualification, providing qualification has taken place in each position with each stylus/module combination.

PH1 - Manual probe head **CMM:MANUAL | CNC**

The PH1 is a general purpose, swivel-type probe head. Its compact design makes it ideally suited to a CMM where manual orientation of an M8 thread-mounted touch-trigger probe is required (TP20, TP200). The PH1 provides two axes of movement. The A-axis allows probe orientation in the vertical plane; the B-axis allows rotational probe orientation. Axis rotation is in relation to the shank mount. Probe re-qualification is required after each re-orientation of the PH1. TP200 not supported on manual CMM..

MIH - Manual indexable probe head **CMM:MANUAL | CNC**

The manually indexable head (MIH) has 720 repeatable positions and features an autojoint probe mount for fast, repeatable probe changing. This probe head is compatible with the TP6A touch probe directly and supports the TP20, andTP200 probe with the use of the autojoint extension bars (e.g. PAA1). An integral LCD enables easy programming with the facility to memorize up to 20 probe positions. Not for use with multi-wire probes.

Probe Mount: M8
Stylus Mount: M2

TP20 - Touch-trigger probe **CMM:MANUAL | CNC**

The TP20 is a compact kinematic touch-trigger probe system featuring a two-piece design, comprising probe body and detachable stylus module(s), connected using a highly repeatable magnetic kinematic coupling. This provides the facility to change stylus configurations either manually or automatically without the need for requalification of the stylus tips. Modules offering a range of trigger forces allow the probe performance to be best matched to the measurement task.

Probe Mount: M8
Stylus Mount: M2

TP200 - Touch-trigger probe **CMM:CNC**

The TP200 features quick-change stylus configurations without the need for requalification, utilizing electronic strain sensing techniques to improve on the form measuring accuracy and operating life that can be achieved when compared with kinematic touch-trigger probes. The TP200 probe is a two-piece design comprising the probe body and a detachable stylus module that holds the stylus assembly.

Probe Mount: Autojoint
Stylus Mount: M4

TP7 - High-accuracy, touch-trigger probe **CMM:CNC**

The TP7M is a high-accuracy touch-trigger probe with a maximum repeatability of $2\sigma \leq 0.25\mu m$. The TP7M can mount a long stylus up to 150mm. In combination with the longest autojoint probe extension of 200mm for direct mounting to the PH10M or PH10MQ, gives the TP7M a maximum access distance of 350mm.

UMAP-CMM - Micro-touch probe **CMM:CNC**

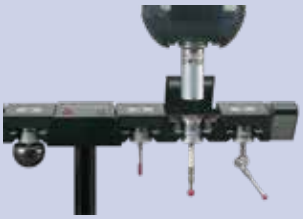
A stylus with an ultra-small diameter of ø0.1mm or ø0.3mm can be used. Measurement of miniscule form and dimensions from practically any direction is possible by mounting on the PH10MQ.

See page L-28 for stylus information.

MCR20 - Module Change Rack (TP20)

The MCR20 is designed to securely hold the stored TP20 probe modules for automatic changing (CNC CMM only) and to protect from airborne contaminants.

SCR200 - Module Change Rack (TP200)



The SCR200 provides automatic, high-speed changing between up to six TP200 stylus modules (CNC CMM only). The SCR200 is powered by the separate probe interface, PI 200, and provides features to facilitate safe stylus changing.

MSR - Manual Storage Rack (TP20/TP200)

The MSR1 manual storage rack holds up to 6 pre-qualified stylus assemblies fitted to TP20 or TP200 probe modules to simplify manual module changing. The MSR1 can be mounted on the CMM table or on a vertical surface.

MAP - Manual Autojoint Probe (TP6A/TP7)

The MAP (manual autojoint probe) stand is a low-cost storage rack capable of holding up to six autojoint mounted probes and extension bars. The MAP stand can be mounted directly on the table of a CMM, cabinet, wall or any vertical surface.

SC6 - Stylus Changer (MPP-310Q)

ACR3 - Autojoint Change Rack (SP25M)

FCR25 - Flexible Change Rack (SP25M)

FCR25-L3 - Flexible Change Rack (SP25M)

FCR25-L6 - Flexible Change Rack (SP25M)

SCP80 - Stylus Change Port (SP80)

CMM Probe & Change Rack Options

Motorized Probe Heads

The range of PH10 PLUS motorized probe heads increases throughput by giving CNC CMMs the added capability of program controlled probe re-orientation. This enables the inspection of features at different angles without the need for frequent, time-consuming stylus cluster changes.

PH10T

Shank-mounted head with two-wired probe capability and an M8 thread supporting TP20, TP200 and TP6 touch-trigger probes.

PH10M

PH10M/10MQ

The PH10M PLUS can carry long extension bars and multi-wire probes such as QVP, SP25M, SurfaceMeasure, Surftest, UMAP-CMM or TP7M. The highly repeatable autojoint allows rapid probe or extension bar changing without the need for re-qualification. The PH10MQ PLUS is a variant of the PH10M PLUS that allows the motorized head to be attached directly to the quill with the B-axis of the head inside the quill itself. This option provides a neater and shorter probe mount, with only the A-axis protruding from the quill.

PH10MQ

Scanning Probe Systems

MPP-310Q Ultra-High Accuracy Scanning

The MPP310Q is a multifunctional measuring head for CNC CMMs. It not only performs continuous contact scanning measurements at V2≤0.3µm, it also allows highly precise point measurements and self-centering measurements. The MPP-310Q incorporates 0.01µm resolution high-precision scales for each axis (XYZ). Air bearings on all axes ensures smooth measuring with minimal measuring force. Software-controlled clamps in each axis eliminate probe deflection while scanning slanted or arched surfaces to reduce measurement errors. The MPP-310Q allows for contact force as low as 0.03 Newtons for sensitive workpieces or when using very small stylus tips. Scanning speed up to 120mm/second can be achieved on known path geometry. Stylus holder changing is supported with the SCR6.

SP25M Compact High-Accuracy Scanning Probe

The SP25 is a compact high-accuracy scanning probe with an outside diameter of ø25 mm. This multi-functional probe is suitable for CNC coordinate measuring machines that perform not only scanning measurement, but also high-accuracy point measurement, as well as data collection from a centering-point measurement. The SP25M measuring head is extremely flexible, in addition to its measuring accuracy at very low contact forces, the SP25M can be used with probe systems ranging in lengths from 20mm (SP25-1) up to 400mm (SP25-4). The SP25M can be used on a fixed probe head (PH6M), or a motorized probe head (PH10M/10MQ). Probe systems, probe module and stylus holder changing is supported with the ACR3 and FCR25 rack changing systems.

SP80 Extended-Length High-Accuracy Scanning

The SP80 scanning measuring head is specially designed for extended length stylus with high-accuracy measurement for lengths up to 500mm (measured in the vertical and horizontal directions). The multifunctional head for CNC CMM' allows not only scanning measurements but also high-precision point measurements and self-centering measurements. Stylus holder changing is supported with the SCP80.

See page L-28 for stylus information.

Mitutoyo

Non-Contact CMM Probe Options

SurfaceMeasure 606/610/1010/606T/201FS

FEATURES

Mitutoyo's line of laser scanning probes automatically adjusts to workpiece surface characteristics to deliver highly efficient measurements. With a conventional laser probe, laser intensity and camera sensitivity must be adjusted according to the environment and workpiece material. In contrast, the SurfaceMeasure line laser probes, which automatically adjust for these factors, enable hassle-free and more reliable laser scanning results.

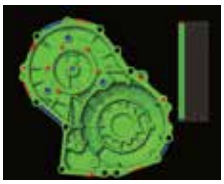
The SurfaceMeasure makes it possible to use coordinate measuring machines as production systems that can be used throughout the entire process, from development and prototyping to production.

Development phase

Optimized design utilizing measurement point cloud data significantly improves the efficiency of the development process, even when no master model or CAD data is available.

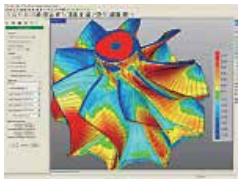
Prototyping phase

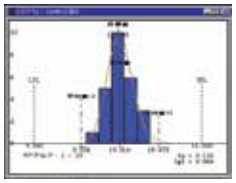
Shortens the entire process from prototyping to mass production because simulations can be used to compare prototypes with CAD data, check for part interference and set clearances, and optimize machine settings.



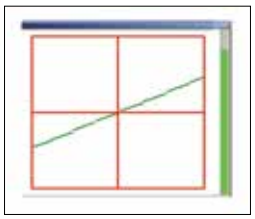
Production phase

Allows the obtained data to be used for correcting dies, for example, by controlling the variability in mass-produced products, and feeding analysis data back to the preceding process step.

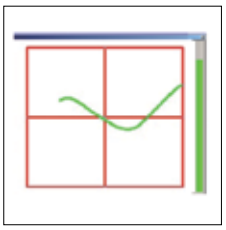




With a conventional laser probe, laser intensity and camera sensitivity must be adjusted according to the environment and the workpiece material. In contrast, the **SurfaceMeasure Series**, which automatically adjusts for these factors, enables simpler and more comfortable laser scanning.

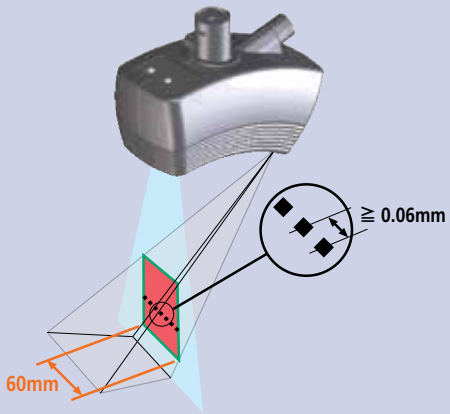


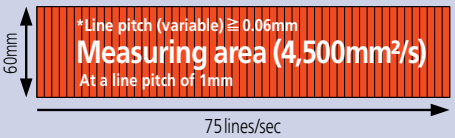
Measuring a color sample plate



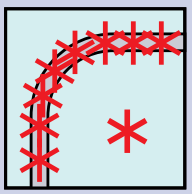
Measuring a glossy object

Because the laser intensity and camera sensitivity are automatically adjusted, stable shape data can be obtained even when the workpiece has multiple colors and varying degrees of reflectance.

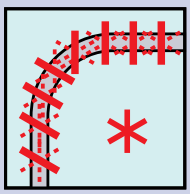




Improvement in measurement efficiency by reducing the frequency of probe attitude change.

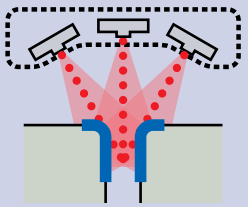


No change of probe attitude



Individual beam selectable

Simultaneous measurement of top and side by concurrently scanning 3-directional laser beams



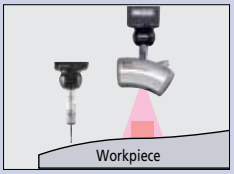
The laser beams converge from 3 directions toward a central point.

The line-laser crossing enables simultaneous scanning by 3 laser beams, thus allowing efficient measurement of complicated shapes.
(Applies to **SurfaceMeasure 606T**)

Non-Contact CMM Probe Options

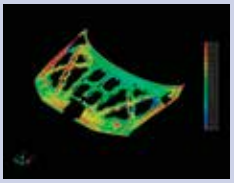
SurfaceMeasure 606/610/1010/606T/201FS

Features of Non-contact CMM



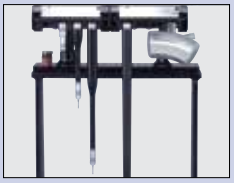
Reliability

- Based on a CMM that supports quality assurance operations.
- Allows the verification of non-contact measurement data with a contact probe.



Hybrid measurement

- Visualizes a shape that was previously invisible by establishing a cutting plane from measured points.
- Allows interchange between contact and non-contact probes according to the required measuring accuracy or workpiece shape.



Fully automatic measurement

- Automatic probe change with a probe changing rack.
- Allows programming a series of jobs from measurement to report creation.

Ultra-high speed data collection

- SurfaceMeasure is a laser probe that collects coordinate values of the surface of the workpiece by moving and irradiating laser light over the workpiece.

* When using SurfaceMeasure 606/610/1010

Advantages of non-contact type

- Non-contact measurement enables measurement of materials that can be easily-deformed by contact measurement, including resin or thin, elastic parts.

Powder-less measurement

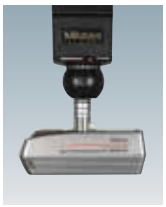
- Automatic configuration of the camera sensitivity and the laser intensity settings according to the environment and materials enable establishing a simple and comfortable laser-scanning environment since measurement is now powder and spray free.

Evaluation cases

- The collected point cloud data can be used by various optional software in a wide range of applications, such as editing, plane creation, comparison using CAD data and more.

606/610/1010

606T



201FS

SPECIFICATIONS

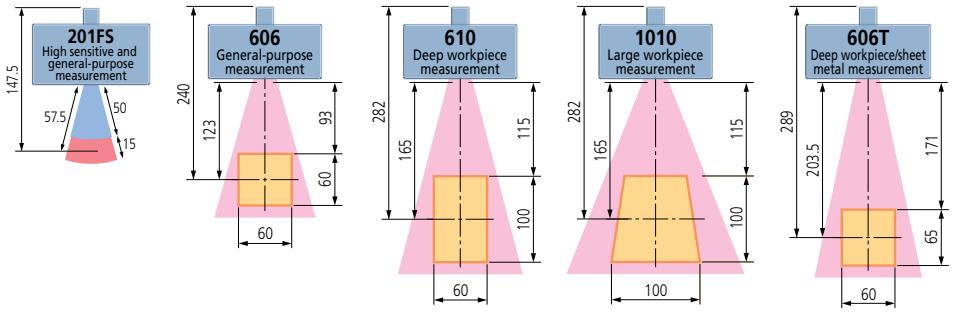
Item/Model		SurfaceMeasure 606	SurfaceMeasure 610	SurfaceMeasure 1010	SurfaceMeasure 606T	SurfaceMeasure 201FS
Laser irradiation method		Line Laser (single)			Line Laser (cross)	Flying spot
Max. scan width		2.36" (60mm)	2.36" (60mm)	3.94" (100mm)	.2"×2.56"(3×65mm)	Max. 23mm
Max. scan depth		2.36" (60mm)	3.94" (100mm)	3.94" (100mm)	2.56" (65mm)	15mm
Working distance		3.54" (93mm)	4.53" (115mm)	4.53" (115mm)	6.85" (174mm)	57.5mm
Scanning error *		12µm	15µm	18µm	17µm	1.8µm
Max. Acquisition rate		75,000 points/sec			3×25,000 points/sec	25,000 points/sec.
Mass		0.95 lbs (430g)	0.88 lbs (400g)	0.88 lbs (400g)	1.06 lbs (480g)	500g
Laser Class	EN/IEC	Class2 [EN/IEC 60825-1(2007)]				
	JIS	Class2 [JIS C 6802 : 2011]				
	Laser type	Red semiconductor				Semiconductor
Line Laser	Wavelength	660nm				670nm
	Output	4mW				1 mW
Point Laser	Wavelength	635nm			—	—
	Output	1mW			—	—

*1: Made-to-order models

*2: According to Mitutoyo's acceptance procedure. (1σ/sphere measurement, probe alone)

*	Accuracy inspection environment	Temperature: 20℃±1℃ / Humidity: 50%±10%
	Target workpiece	Specified master ball for inspection (Diameter 30mm)
	Inspection method	According to Mitutoyo's acceptance procedure. (1σ/sphere measurement, probe alone)

MEASURING RANGE



Mitutoyo

MSURF

Software for SurfaceMeasure Probe for CNC CMMs

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the standard in world metrology software
CMM

Laser Scanning: MSURF-S

A scanning path can be created by defining a scanning start point, a scanning length and a scanning width.

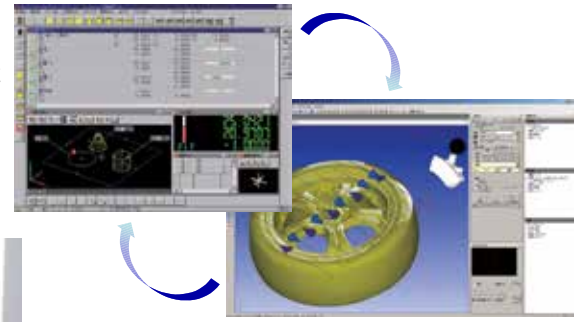
- Specify the 3 points using the joystick while watching the camera view.
- When a point group or master data exists on the screen, 3 points can be defined by selecting the data using the mouse. Automation of measuring paths from start to finish reduces measuring time.
- Operating of a joystick and buttons enables configuration and execution of a scanning path, and registration to or deletion from a macro. The ability to measure without using a PC has significantly improved operational efficiency, particularly for large-sized CMMs.

Scanning paths can be registered as a measurement macro.

- The measurement conditions of a measurement macro can be partly or wholly changed by the override function.
- The sub-macro function is effective for measuring multiple identical workpieces.
- A trial calculation of measurement macro execution time is based on the measurement conditions and the specifications of the CMM.

MSURF-S can be started from MCOSMOS.

- A work coordinate system created with MCOSMOS can be used with MSURF-S. Therefore, fully automatic measurement combined with contact measurement/ non-contact measurement can be performed.



Note: If not using ACR3, probe replacement is performed manually.

MSURF software enables users to perform operations from measurement to evaluation on the same platform when the non-contact line laser probe, SurfaceMeasure, is used. Three types of software are provided according to the task:

MSURF-S: Calculates point cloud data measured by CNC CMM with SurfaceMeasure. Generates scanning paths by defining the scanning start position, length and width.

MSURF-I: Conducts analysis or comparison verification of measured point cloud data in reference to nominal data (supporting CAD data import).

MSURF-G: Primarily creates part programs (measurement procedure programs) using CAD data.

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the standard in world metrology software
cmm

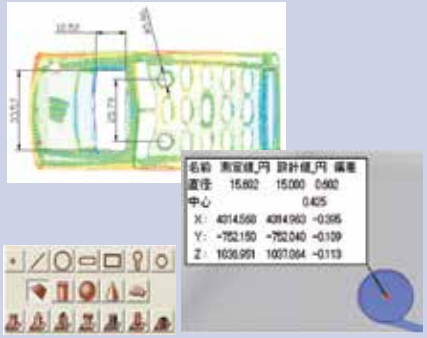
Inspection: MSURF-I

CAD data import

- SAT and STEP format are supported as standard.
- As an option, CATIA V4, CATIA V5, Creo, Unigraphics/NX, IGES, VDAFS, Parasolid, and Solidworks are available.

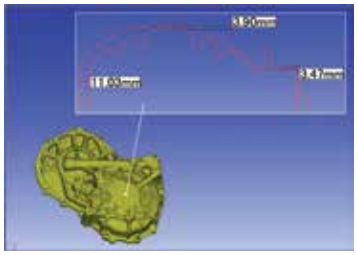
Comparison by features

- MSURF-I can detect various features from point cloud or mesh data and compare with nominal data. It also can calculate distances between features that have point data such as circle elements.
- Detectable features include basic plane, point, straight line, circle, slot, cylinder, cone, sphere, etc., and also weld bolt, weld nut, cylindrical pin, T-shaped stud and more.

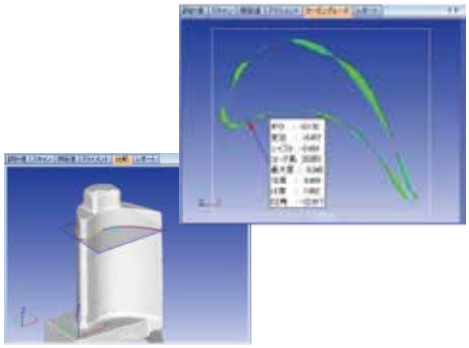


Comparison of cross-sectional shape

- Cut of a point cloud, mesh data or master data allows for comparison of cross-sectional shapes and calculation of angle, distance, radius of curvature and more.
- The turbine blade analysis function enables calculation of LE thickness, TE thickness, maximum thickness, cord length, etc.



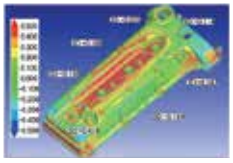
Section evaluation (dimensional calculation)



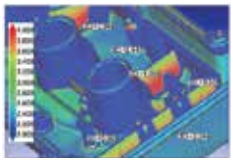
Turbine blade analysis (optional function)

Comparison of plane shape

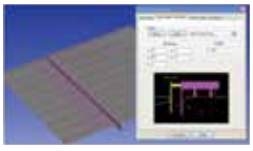
- The plane shape error will be displayed on a color map by comparing a point cloud or mesh data with CAD data.
- Thickness can be displayed on a color map, therefore, it is not necessary to cut a real workpiece.
- Capability of defining the shape of digital calipers enables evaluation of various types of uneven gaps.
- The evaluation of surface curvature can be used for evaluating an angle R within a specified dimensional tolerance.



Error color map



Thickness color map

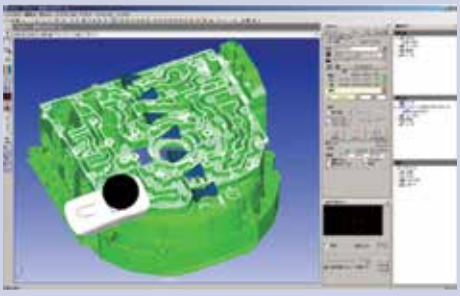


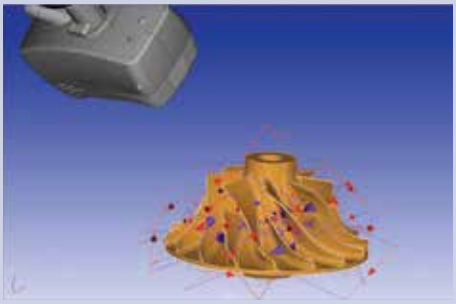
Evaluation of step/clearance

Surface curvature evaluation

Creation of operating procedure macro by automation function

- The automation function allows users to record the operating procedure including execution of a measurement macro.
- A series of operations from measurement to evaluation and report can be automated.





Off-line teaching: MSURF-G

MSURF-G allows users to create measurement macros using model data. Therefore, users can start measurement immediately when a real workpiece is available.
MSURF-G can improve the operating rate of your measuring instrument. Combining it with MSURF-I can reduce the man-hours from measurement to product evaluation.

- CMM time for creating measurement macros can be reduced.
- Measurement macros are created regardless of operator's skill level.
- The workflow from measurement to evaluation can be optimized.

MSURF-PLANNER

MSURF-PLANNER software automatically creates measurement macros (surface form, feature form) for the line laser probe from 3D CAD data.
Optimized data (travel path, number of probe head revolutions, etc.) of a measurement path contributes to improvements in productivity.

*MSURF-PLANNER is optional software for MSURF-S and MSURF-G.

Non-Contact CMM Probe Options

QVP Quick Vision Probe

Provides image measuring capability for coordinate measuring machines.

The QVP probe performs form measurement by image processing micro geometry that cannot be measured by a contact-type probe or flexible bodies that are easily deformed by slight measuring forces. Although the method of microscopic measurement with the centering microscope mounted on the coordinate measuring machine has been used since CMMs came into use in the industry, they have an inherent disadvantage in that the operation of identifying positions is dependent on the operator, possibly resulting in measurement errors. Even with a CNC CMM, manual measurement may still need to be performed, such as with an installed centering microscope. The QVP probe is a vision probe for CMMs and was developed based on Mitutoyo's state-of-the-art technology in order to enable full automation of image measurement with a CNC CMM. This technology was originally developed for Mitutoyo vision measuring machines.

Automatic detection of workpiece edge

The QVP-captured image will have various automatic edge detections performed by the dedicated software, Visionpak, and then various calculation processes (calculation of dimensions and geometrical deviations) will be performed with the general purpose measurement program, Geopak.

Standard provision of white LED illumination

Since the QVP is equipped with the standard co-axial light running through the lens system, as well as white-light LED ring illumination, which is bright and has a long service life, no auxiliary illumination is required. The light volume can be set to between 0 and 100% in 1% increments.

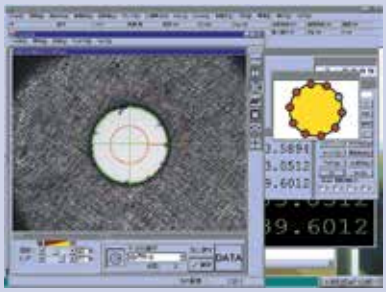
Mounting on the automatic probe changer

The QVP also can be mounted on an automatic probe changer (ACR3), allowing full-automatic measurement including both the contact and non-contact types in combination with the contact-type probes. QVP requires PH10M, PH10MQ or PH6M probe head.

QVP Specifications

QVP Main Unit	CCD Size		1/3 inch (B/W)			
	Optical tube magnification		0.375×			
	Illuminating function	Co-axial	White light LED source (built-in): Power dissipation 5W or less			
		Ring	White light LED source: Power dissipation 10W or less			
	Mass		Automatic-joint type: 315g, shank type: 390g			
	Optical magnification		0.375×	1.125×	1.875×	3.75×
	Observation range (mm)		9.6×12.8	3.2×4.3	1.9×2.6	1×1.3
	Working distance (mm)		61	72.3	61	51
Objective	Magnification		ML1×	ML3×	ML5×	ML10×
			Optional	Standard	Optional	Optional
	Numerical Aperture N.A.		0.03	0.09	0.13	0.21
	Depth of focus (μm)		306	34	16.3	6.2
	Mass		80g	55g	60g	95g
QVP I/F BOX	Supply voltage		AC100 to 240V			
	Frequency		50/60Hz			
	Power capacity		45W			
	Mass		3800g			

Objective ML1X **375-036**
Objective ML5X **375-034**
Objective ML10X **375-035**



VISIONPAK
Dedicated data processing software

VISIONPAK operates using the Microsoft Windows operating system and is a general purpose measurement program for coordinate measuring machines. It displays the image window when it detects a workpiece edge. After detecting an edge, it undertakes various calculations with regular general purpose measurement programs.

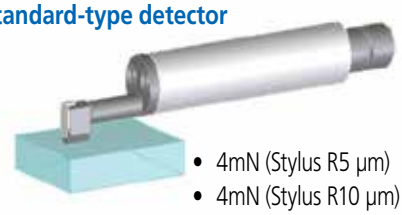
Variety of image processing functions

With the powerful image processing functions (tools), it can detect various forms of edges at high speed. It can measure in the height direction by means of its auto-focus function, and save the captured image as the image data (bitmap format).

Outlier removal function

In ordinary micro-form measurement it is often difficult to remove burrs and dusts from the objective workpiece, resulting in an inevitable measurement error. In contrast, VISIONPAK can recognize, for example, the obstruction as an outlier and bypass it during measurement.

Standard-type detector



- 4mN (Stylus R5 µm)
- 4mN (Stylus R10 µm)

Small hole detector

- 4mN (Stylus R5 µm)

Extra-small hole detector

- 4mN (Stylus R5 µm)

Deep groove detector

- 4mN (Stylus R5 µm)

Gear-tooth surface detector

- 4mN (Stylus R5 µm)

Note: For new purchase of Crysta-AS700 and larger, retrofit of existing Crysta-AS CMM by request.

CMM Surface Roughness Measuring

CMM Surftest Probe

CNC CMMs can be used to measure surface roughness, eliminating workpiece changeover to a second measurement device.

Mitutoyo has developed a range of surface roughness analysis products from handheld portable units to CNC-type Surftest with broader functions and higher accuracy. By utilizing the technologies developed over the years on surface roughness measuring machines, our coordinate measuring machines can execute surface roughness analysis by implementing a Surftest Probe and the dedicated software. The Surftest probe requires PH10M or PH10MQ probe head.

FEATURES

- Can be attached to our CNC CMM. (Retro-fitting is possible depending on the model.)
- The auto joint-probe system allows probe changing automatically between scanning (SP25M) and the CMM Surftest surface analysis probe. The measurement and evaluation of size, shape and roughness, is completely automated with auto joint-probe changing.*
- PH10M(Q) allows surface roughness measurement for features requiring rotation.
- The CMM Surftest Probe is derived from the successful Mitutoyo SJ-210/310 Series of portable surface finish units.

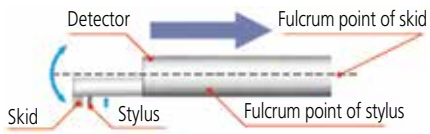
* Requires ACR3 change rack (OPTION)

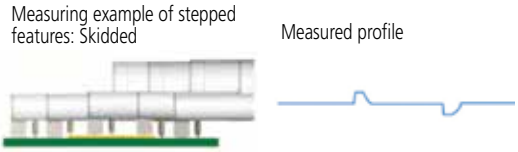
Skid Measurement Specifications

Item		Specifications
Probe (Detector specifications)	Measurement range	AUTO,25,100,360 µm
	Driving range	17.5 mm
	Measurement speed	0.25, 0.5, 0.75 mm/s
	Stylus tip radius	2,5,10*µm *Standard-type detector only
	Measuring force	4mN (Std) , 0.75mN (Opt.)
Evaluation software	Analysis software	SURFPAK-SP
	Control software	MCOSMOS
	Miscellaneous	Multi-wire autojoint probe head required (PH6M, PH10M, PH10MQ)

Skidded Measurement

In skidded measurements, surface features are measured with reference to a skid following close behind the stylus. This cannot measure waviness and stepped features exactly, but the range of movement within which measurement can be made is greater because the skid tracks the workpiece surface contour.





CMM Probing Accessories

Mitutoyo Styli Kits

M2

STARTER - K651376

BASIC 1 - K651377

BASIC 2 - K651354

EXPANSION - K651378

PROFESSIONAL - K651379

M3

STARTER - K651380

BASIC 1 - K651381

Carbon Fiber 1 - K651318

Carbon Fiber 2 - K651319

Carbon Fiber 3 - K651320

Materials used for spherical probes

Ruby

As the hardest of all probe element materials, ruby is the perfect all-round material. Spherical probes made of ruby have been used for most standard applications. The low specific density of ruby enables the mass of the stylus tip to be kept as small as possible. This effectively allows the elimination of false triggers caused by mass inertia when the CMM moves.

Zirconium oxide

Because of the specific surface properties of balls made of zirconium oxide - a ceramic compound – it is ideally suited for aggressive scanning of abrasive surfaces, such as workpieces made of cast iron. Zirconium oxide has virtually the same hardness and wear-resistant properties as ruby.

Silicon nitride

Silicon nitride is extremely hard and wear-resistant with the lowest surface roughness of all ball materials. Specific advantage: Silicon nitride is resistant to absorbing aluminum from workpiece surfaces.

Locating Pins 1 - K551123

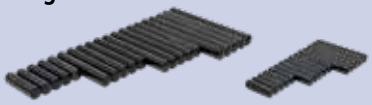
Locating Pins 2 - K551124

Clamping Elements 1 - K551125

Supporting Elements 1 - K551126

Supporting Elements 2 - K551127

Straight Pins - K551128



Receiver Brackets 1 - K551129

Receiver Brackets 2 - K551130

Magnet 1 - K551131

Joints 1 - K551132

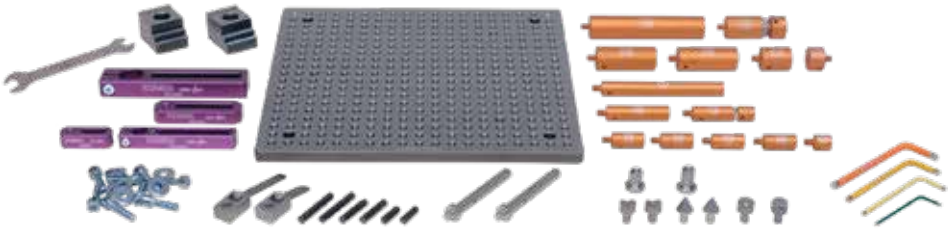
CMM Accessories

Mitutoyo ECO-FIX Kit Fixture Systems

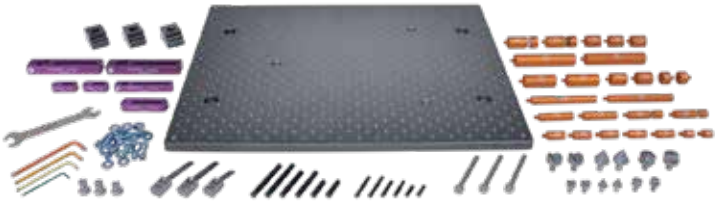
The Mitutoyo Eco-Fix Clamping System for modular CMM and vision product workholding setups work well for different part sizes/types and environments. The design combines operational modularity advances with lower-cost solutions. This can be found both in the reduction or elimination of hard fixturing costs and setup time. This system is comprised of well-marked, color-coded components designed to simplify part measurement requirements. Magnetic or threaded fastening points deliver fast, plug-and-play connectivity. First-time fixturing jobs can be established and reconfigured in a matter of minutes for quick turnaround for future part measurement. Or, as needed, fixtures can be built and stored to meet all common part measurement requirements. Base plates are hard-coated and other components are machined for durability.

The entry-level Mitutoyo Eco-Fix Kit S version is comprised of a 250mm x 250mm base plate footprint and 59 total components in the system. The Eco-Fix Kit L is a larger version and built for more complex part fixturing applications (measuring 500mm x 400mm in base plate footprint and a total of 98 total components in the system).

Eco-Fix Kit - S K551048



Eco-Fix Kit L - K551049

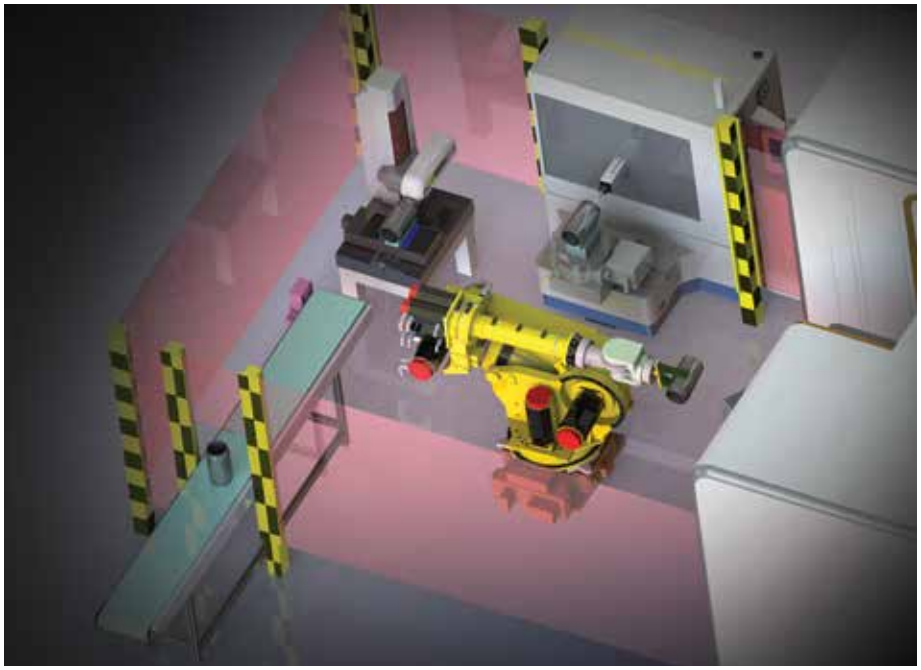


Eco-Fix MAG S - K551089

Eco-Fix MAG L - K551090

Mitutoyo

MITUTOYO CUSTOM SOLUTIONS



Mitutoyo Custom Solutions helps businesses in a wide range of industries achieve higher quality products, parts and machines with custom precision measurement tools and equipment.

Mitutoyo's highly skilled engineers specialize in designing and building custom measurement systems, applications and software to bring value-added solutions to resolve nearly every measurement need for customers with unique applications.

Custom Solutions & Services Include:

- Inline/near line part inspection and gaging
- Factory automation
- Data management
- Fixture design/build
- 3D CAD concepts/renderings
- Turnkey capital projects
- Product implementation
- Custom styli/accessories
- "Green button" technology

If you have any questions or would like more information regarding Mitutoyo Custom Solutions, contact: **solutions@mitutoyo.com**.