

# Coordinate Measuring Machines

## Coordinate Measuring Machines

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#### Coordinate Measuring Machines

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## Coordinate Measuring Machines



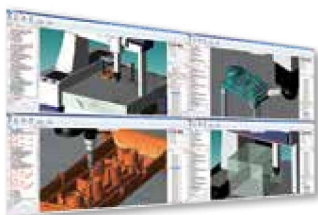
**SurfaceMeasure Probes**  
(Laser scanning probes—non-contact)



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



**LEGEX 574**



**MiCAT Planner**

**SurfTest Probe**  
(surface finish)



**MACH Kogame**



# 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.

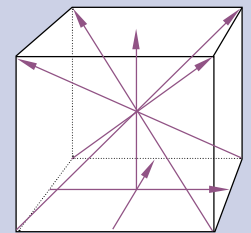


Figure 1 Typical test measurement directions within the CMM measuring volume

## ■ 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.

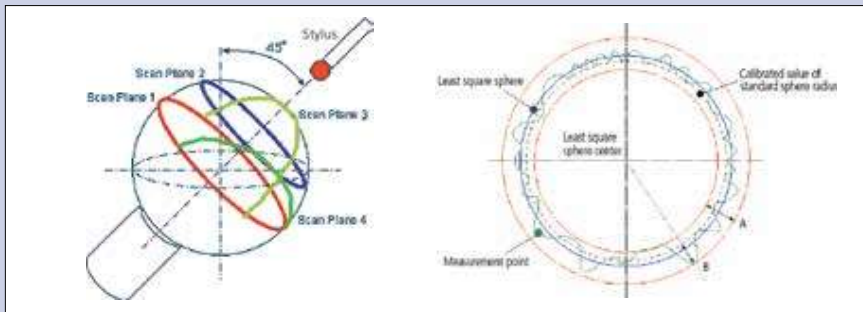


Figure 2 Target measurement planes for the maximum permissible scanning probing error and its evaluation concept

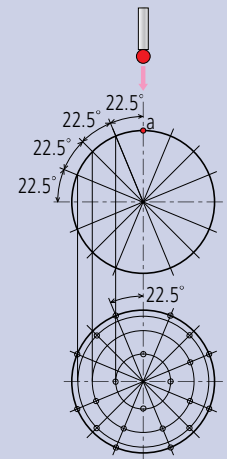


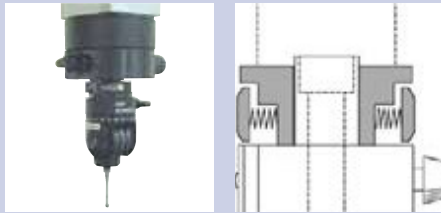
Figure 3 Target points on standard sphere for determining the Maximum Permissible Probing Error

## ■ 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  $R_{max} - R_{min}$  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 x 77.44" (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)			
	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
		R	4µm		5µm

Stylus Configurations for ISO Tests TP20:  Ø4mm x L10mm	Environment	19-21°C (66.2-69.8°F)
	Rate of change	2.0°C or less per hour 5.0°C or less per day
	Gradient	1.0°C or less per meter vertical & horizontal

See page L-2 for explanation of ISO accuracy statements

# CRYSTA-Apex S 500/700/900/1200

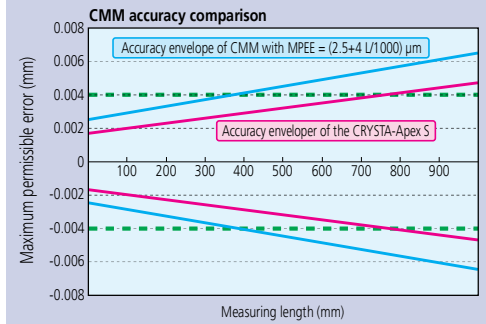
High-performance, low-price CNC Coordinate Measuring Machine that meets global standards

## 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  $*E_{0,MPE} = (1.7+3L/1000)\mu\text{m}$  [500/700/900 Series]. Comparing the CRYSTA-Apex S with CMMs offering  $*E_{0,MPE}$  of approximately  $(2.5+4L/1000)\mu\text{m}$  where a required tolerance on a dimension is  $\pm 0.02\text{ mm}$ , then the measuring machine uncertainty should be no more than one-fifth (ideally one-tenth) of that, i.e.  $4\mu\text{m}$ . 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



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
	X axis	19.68" (500mm)		27.55" (700mm)		35.43" (900mm)		
Range	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/s <sup>2</sup> )						
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 <sub>0,MPE</sub>	18-22°C (64.4-71.6°F)	TP200: MPP310/SP25:		(1.9+3L/1000)µm		(1.7+3L/1000)µm		
	16-26°C (60.8-78.8°F)	TP200: MPP310/SP25:		(1.9+4L/1000)µm		(1.7+4L/1000)µm		
	18-22°C (64.4-71.6°F)	TP200: MPP310/SP25:		(2.4+3L/1000)µm		(1.7+3L/1000)µm		
	16-26°C (60.8-78.8°F)	TP200: MPP310/SP25:		(2.4+4L/1000)µm		(1.7+4L/1000)µm		
ISO-10360-2:2009 E <sub>0,MPL</sub> †		TP200:		1.5µm		1.9µm		
		MPP310/SP25:			1.3µm			
ISO-10360-4 MPE <sub>THP</sub> /MPT <sub>THP</sub> †		SP25:						
		SP80:						
		MPP310:		1.8mm/90sec		2.0µm/50sec		1.8mm/80sec
ISO-10360-5: 2010 P <sub>FTU,MPE</sub>		TP200:						
		SP25:						
		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.

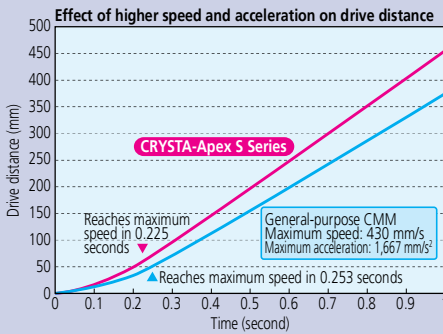
See page L-2 for explanation of ISO accuracy statements

# 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.



CRYSTA-Apex S 122010



SP25 Probe (Scanning)  
See page L-21



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

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

## 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/s <sup>2</sup> )						
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 <sub>D,MPE</sub>	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 <sub>I,ISO,MPE</sub> †	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 <sub>D,MPL</sub> †	TP200:	1.9µm				2.0µm		
	MPP310/SP25/SP80:	1.3µm				1.9µm		
ISO-10360-4 MPE <sub>TRIP</sub> /MPT <sub>TRIP</sub> †	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 <sub>FTU,MPE</sub>	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	2.0°C° or less per hour 2.0°C° or less per day	2.0°C° or less per hour 5.0°C° or less per day
Gradient	1.0°C° 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 <sub>0,MPE</sub>	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 <sub>0,MPL</sub>	1.8µm		2.2µm				
ISO-10360-5: 2010	P <sub>FTU,MPE</sub>	2.2µm						

Stylus Configurations for ISO Tests	Air Supply	500	700/900	Environment	18-22°C (64.4-71.6°F)	16-26°C (60.8-78.8°F)
TP20: Ø4mm x L12mm	Pressure	58.0 PSI (0.4MPa)		Rate of change	2.0C° or less per hour	2.0C° or less per hour
	Consumption	1.76CFM (50L/min)	2.11CFM (60L/min)		2.0C° or less per day	5.0C° or less per day
	Source	3.53CFM (100L/min)	4.23CFM (120L/min)	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:	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 <sub>h</sub> 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 <sub>FTU,MPE</sub>		3.2µm		
Configuration for ISO Tests	Air Supply	Environment	18-22°C (64.4-71.6°F)	16-26°C (60.8-78.8°F)
RSP2+RSH250 Ø6mm x L10mm	Pressure 72.5 PSI (0.5MPa)	Rate of change	1.0C° or less per hour	1.0C° or less per hour
	Consumption 5.29CFM (150L/min)		2.0C° or less per day	5.0C° or less per day
	Source 8.12CFM (230L/min)	Gradient	1.0C° or less per meter vertical & horizontal	

### Specification of REVO Scanning Probe

Rotation angle	Vertical (A-axis)	-5° to +120° (0.08 sec)
(Pitch angle)	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.

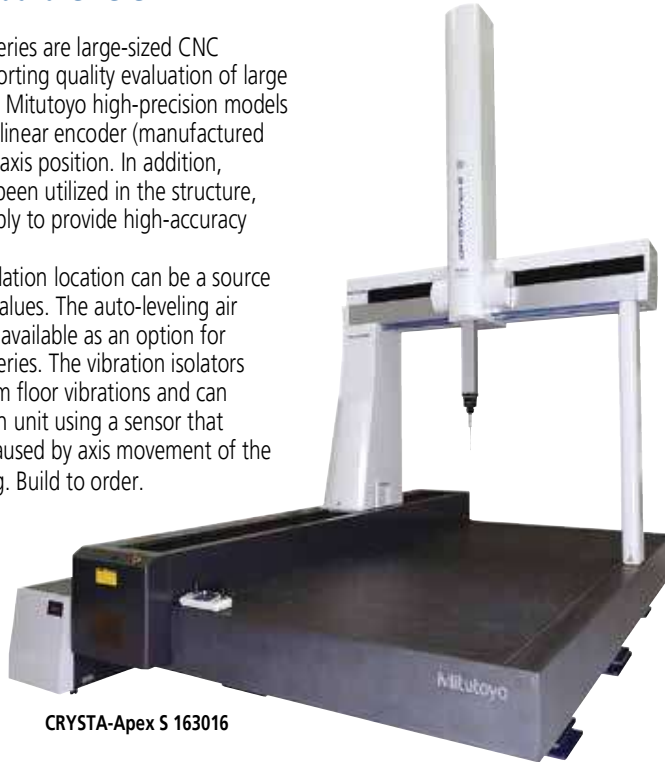
Mitutoyo

# 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 <sup>2</sup> )				
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 <sub>0,MPE</sub>					
	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 <sub>THP</sub> /MPT <sub>THP</sub> †						
	MPP310/SP25:	5µm/60sec			6µm/60sec	
ISO-10360-5: 2010 P <sub>FTU,MPE</sub>						
	TP200:	6.5µm [7.5µm]			9.5µm	
	MPP310/SP25:	5µm [6µm]			6µm	

Stylus Configurations for ISO Tests	Air Supply		Environment	18-22°C (64.4-71.6°F)	16-24°C (60.8-75.2°F)
	TP200: Ø4mm x L10mm	Pressure 58.0 PSI (0.4MPa)		Rate of change	1.0C° or less per hour
	SP25/SP80: Ø4mm x L50mm	Consumption 5.29CFM (150L/min)	2.0C° or less per day		5.0C° or less per day
	MPP310Q: Ø4mm x L18mm	Source 7.06CFM (200L/min)	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 <sup>2</sup> )	0.26G (2,598mm/s <sup>2</sup> )			
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 <sub>0,MPE</sub>	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 <sub>150,MPE</sub>	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 <sub>0,MPL</sub>	TP200:	1.2µm*	1.2µm**			
	SP25:	0.7µm*	0.8µm**			
ISO-10360-4 MPE <sub>L,THP</sub> /MPT <sub>THP</sub>	SP25:	1.3µm/40sec*	1.8µm/45sec**			
ISO-10360-5: 2010 P <sub>FTU,MPE</sub>	TP200:	1.8µm*	1.8µm**			
	SP25:	0.7µm*	0.9µm**			

\* 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	
Environment	18-22°C (64.4-71.6°F)   19-21°C (66.2-69.8°F)
Rate of change	1.0°C° or less per hour 2.0°C° or less per day
Gradient	1.0°C° 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 <sup>2</sup> )			
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 <sub>0,MPE</sub> 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 <sub>150,MPE</sub> † 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 <sub>0,MPL</sub> †	TP200:	3.5μm	4.0μm	3.5μm	4.0μm
	SP25:	2.5μm			
ISO-10360-4 MPE <sub>THF</sub> /MPT <sub>THP</sub> †					
	SP25/SP80:	2.5μm/60sec	3.0μm/60sec	2.5μm/60sec	3.0μm/60sec
ISO-10360-5: 2010 P <sub>FTU,MPE</sub>	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	1.0°C° or less per hour 2.0°C° or less per day
Gradient	1.0°C° 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.



# 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 <sub>0,MPE</sub> 18-22°C (64.4-71.6°F)	TP200:	3.5+4L/1000µm			

Supported Probe Systems		
Type	Probe	FALCIO Apex
TOUCH-TRIGGER PROBES	IMH20i	●
	TP20	●
	TP200	●
	TP7	●
SCANNING PROBES	SP25	●
	IMPP	▲
	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

# 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  $0.01 \times 10^{-6}/K$ ), 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

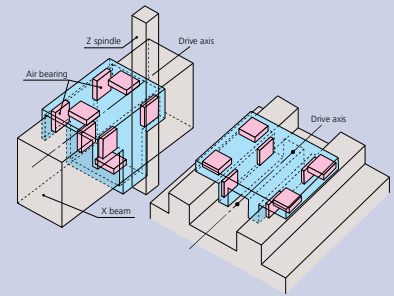
- Resolution: 0.01µm
- Measuring Force: 0.20N/mm
- Maximum Stylus Length: 200mm
- Maximum Stylus Weight: 75g



LEGEX 574

LEGEX 774

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/s <sup>2</sup> )			
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 <sub>0,MPE</sub>		19-21°C (66.2-69.8°F)		18-22°C (64.4-71.6°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 <sub>THP</sub> /MPT <sub>THP</sub> †		MPP310Q/SP25M:			
		1.1µm/60sec			
ISO-10360-5: 2010 P <sub>FTU,MPE</sub>	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	0.5°C° or less per hour 1.0°C° or less per day
Gradient	1.0°C° 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	Model No.	MACH-V 9106
Range	X axis	35.43" (900mm)
	Y axis	39.36" (1000mm)
	Z axis	23.62" (600mm)
Resolution		0.000039" (0.0001mm)
Guide Method		Mechanical bearing on each axis
Maximum Drive Speed 3D		34.09"/s (866mm/s)
Maximum Acceleration 3D		0.88g (8660mm/s <sup>2</sup> )
Work table	Material	Steel
	Size	35.62" x 41.96" (905mm x 1066mm)
Workpiece	Tapped insert	M8 x 1.25mm
	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 <sub>0,MPE</sub>	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 <sub>THP</sub> /MPT <sub>THP</sub> †	SP25:	4.0µm/40sec
	TP7:	2.2µm
ISO-10360-5: 2010 P <sub>FTU,MPE</sub>	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	2.0°C or less per hour 10.0°C or less per day
Gradient	1.0°C 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	Model No.	MACH-3A 653
Range	X axis	23.62" (600mm)
	Y axis	19.68" (500mm)
	Z axis	11.02" (280mm)
Resolution		0.000039" (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/s <sup>2</sup> )
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 <sub>0,MPE</sub>	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
SP25:	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 <sub>THP</sub> /MPT <sub>THP</sub> †	SP25:	4.0µm/40sec
	TP7:	2.2µm
ISO-10360-5: 2010 P <sub>FTU,MPE</sub>	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	2.0°C per hour 10.0°C per day
Gradient	1.0°C or less per meter vertical & horizontal

# MACH KO-GA-ME

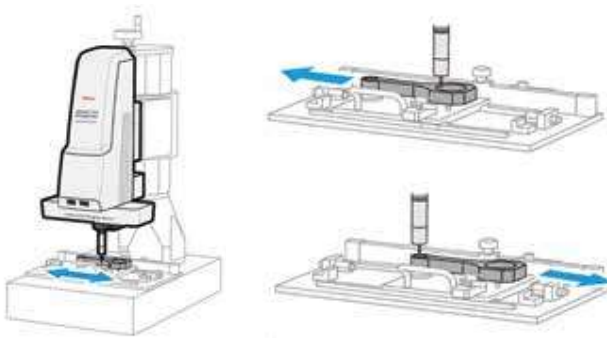
## SERIES 360 — Inline CNC CMM

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.)



### SPECIFICATIONS

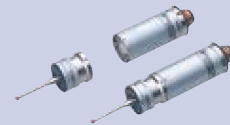
Type: INLINE	Model No.	KGM888-B	KGM12128-B
Range	X axis	3.14" (80mm)	4.72" (120mm)
	Y axis	3.14" (80mm)	4.72" (120mm)
	Z axis	3.14" (80mm)	
Resolution		0.0000078" (0.02µm)	
Guide Method		Straight-motion hard bearing	
Maximum Drive Speed 3D		13.38"/s (340mm/s)	
Maximum Acceleration 3D		0.68G (6,750mm/s <sup>2</sup> )	
Mass: main unit		61.7 lbs. (28kg)	
Dimensions*		15.03 x 14.68 x 30.90"	
W x D x H: (height includes Z measuring range)		(382 x 373 x 785mm)	
Measuring Accuracy (ISO 10360-2:2009)			
	19-21°C (66.2-69.8°F)	(2.4+5.7L/1000)µm	
TP200/SP25:	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	Environment	10-35°C (50.0-95.0°F)	
SP25: Ø4mm x L50mm	Rate of Change	2.0°C or less per hour 10.0°C or less per day	
	Gradient	1.0°C or less per meter vertical & horizontal	



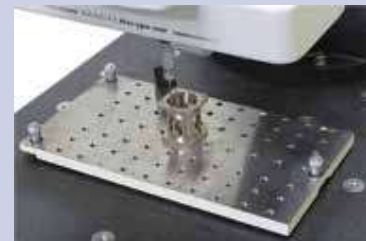
See page L-2 for explanation of ISO accuracy statements.



SP25 Scanning Probe  
See page L-21.



TP200 Touch-Trigger Probe  
See page L-20.





**Surface Measure Probes**  
(Laser scanning probes—non-contact)

See page L-22 for probe system information.



**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.

# CARBapex / CARBstrato

## SERIES 355 — Car Body Measuring System CNC CMM

### The world's largest class

The CARBapex and CARBstrato 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.

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

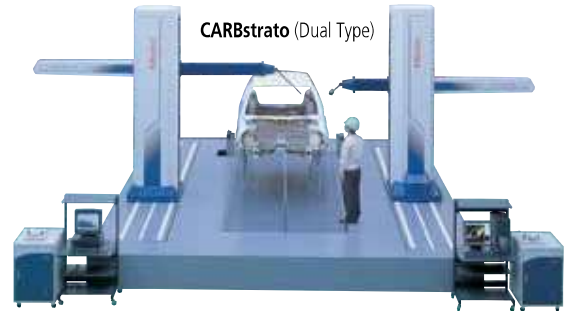
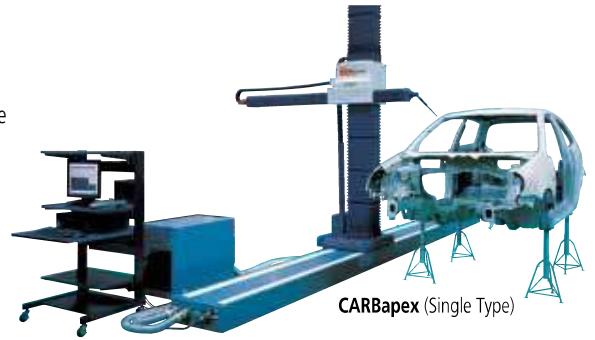
The CARBapex series not only has remarkable usability, but also has the ability to enhance the safety operation by performing the procedures on the shop floor. The Y-axis spindle in the vertical direction is set lower in order to perform measurements at a lower workpiece setting height. In addition, 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 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.

### 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.



## 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		0.000039" (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" (4473 x 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" (8846 x 7324 x 3953mm)	
ISO-10360-2:2009 E <sub>D,MPE</sub> 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 <sub>FTU,MPE</sub>	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.