In-line CNC Coordinate Measuring System
MACH Series

Bulletin No. 2085

Production-line Coordinate Measuring System Addressing Today's Need for Efficiency

Mitutoyo

In-line CNC Coordinate Measuring System
MACH Series

Vertical and Flexible

MACH-V

MACH-V substitutes a flexible measurement system for a series of gauge measurements on a powertrain manufacturing line. The high acceleration, high-speed probe movement results in high-throughput measurement.

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MACH

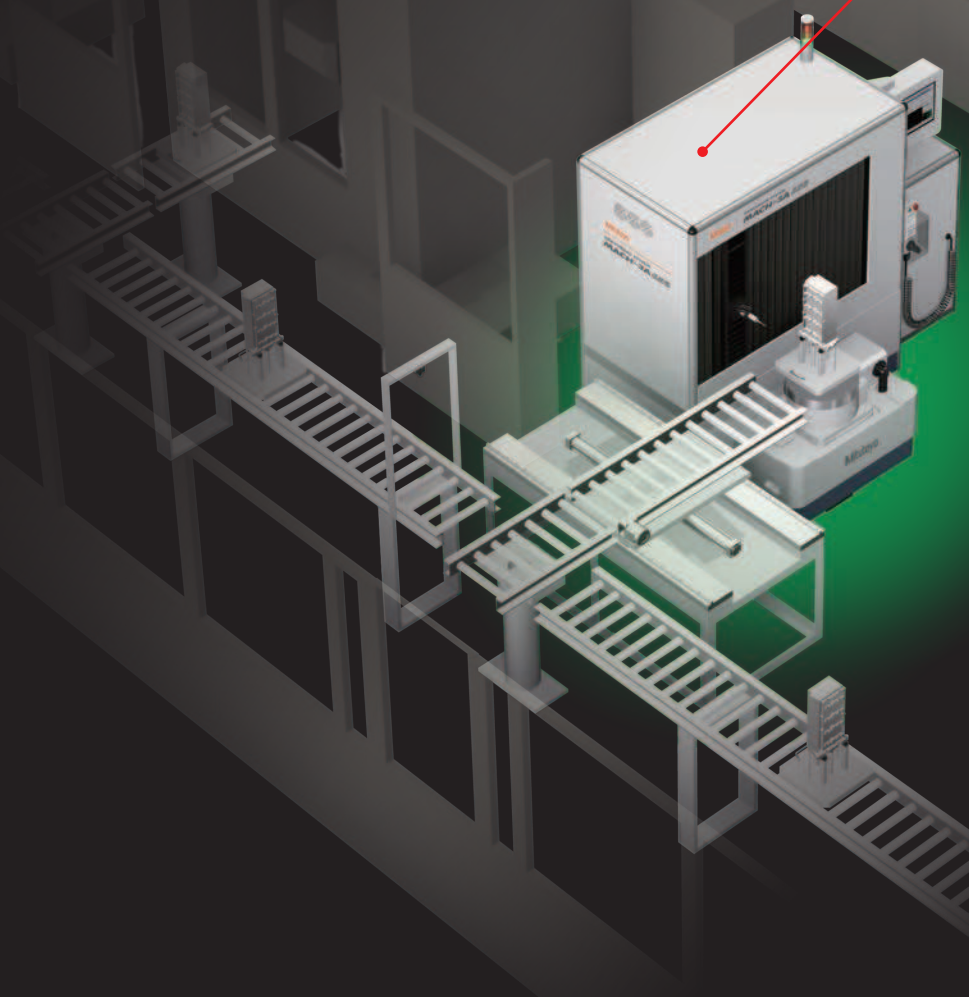
Much-awaited, Fastest In-line Coordinate Measuring Machine, Bursting out of the Inspection Room.

An absolute requirement for a measuring machine to operate around the clock in a factory is the structural design: with due consideration given to superior durability for stable operations, significant reduction in measuring time, accuracy assurance under a wide range of temperature environments, security and ease of maintenance. The MACH series is Mitutoyo's in-line CNC coordinate measuring system that meets these demanding criteria.
This series has established a proven track record particularly in the global automotive market.

Horizontal and High-speed Driven

MACH-3A

This is a horizontal CNC coordinate measuring system that achieves high throughput by increased drive speed, acceleration, and measuring speed.
Space-saving and durability characteristics are compatible with line-side/in-line installation.



MACH-V

An Optimal and Flexible Measuring System in Place of Dedicated Gauge Measurement in a Production Line

High-speed drive up to a maximum of 866mm/s

The world's fastest CNC vertical axis, in-line coordinate measuring machine with world-beating acceleration (8,480mm/s^2), measuring speed (at the moment of contact: 20mm/s) as well as drive speed. This system contributes to the reduction in total cost as an auto-measurement system, either in a line or at line side where a reduction in measurement time is required, and can also serve as a dedicated machine or a substitute system for gauges.

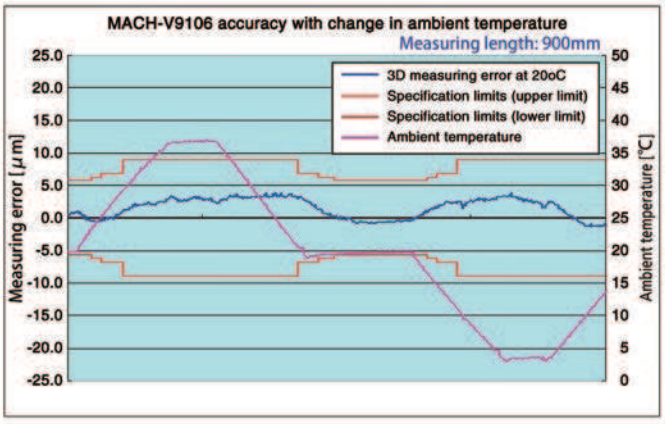
Space-saving design helps installation in a production line

In consideration of installation between processing machines, the width of this machine has been reduced by 15% compared with its predecessor, thus contributing to a reduction in line length. Open access to the measuring area from the front/back and left/right has increased flexibility in the routing arrangements for a workpiece.

Accuracy assurance throughout a wide temperature range (5 to 35°C)

Real-time thermal compensation applied to measurements and origin-setting assure excellent accuracy (referred to 20°C) over a much wider range of ambient temperature than conventional CMMs. The graph below shows the effectiveness of maintaining accuracy over a range of more than 30°C.

Highly effective thermal compensation of the MACH-V9106



Improved dust resistance

This series has improved dust resistance relative to its predecessor by installing all drive system and scale units in the dust-proof enclosure on the machine top. The control unit and PC are installed in the dust-proof rack.

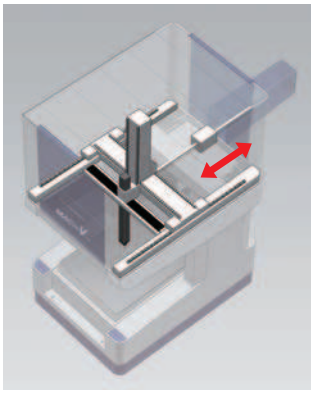
Less maintenance

Construction improvement and air-free operation means less chance of maintenance problems occurring.

Higher speed and accuracy with barycentric drive

When the components of a CMM slide are driven by a force offset from the combined mass center, a rotation-inducing torque is produced that is detrimental to accuracy. To prevent this torque generation, the MACH-V series employs the barycentric drive system, achieving an ideal drive that minimizes slide rotation, especially under high drive acceleration conditions, by applying the drive force directly through the mass center of the slide.

This technique enables high-speed measurement with minimum accuracy deterioration compared with commonly-used CMMs.

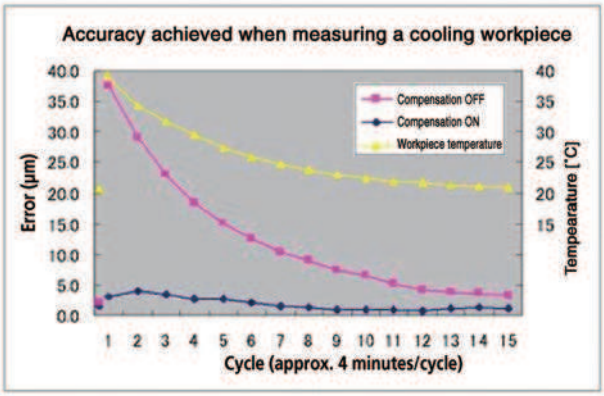


Workpiece thermal compensation - essential for in-line measurement

Generally, during production, the temperature of a workpiece differs from that of the measuring machine due to processing and washing and is always changing.

To support in-line operations, the machine must continue accurate measurement (referred to 20°C) even while the size of a workpiece is changing due to this temperature difference.

The following graph shows the high degree of compensation resulting when a MACH-V series machine (at 20°C) measured a certain workpiece while it cooled from 40°C towards 20°C.



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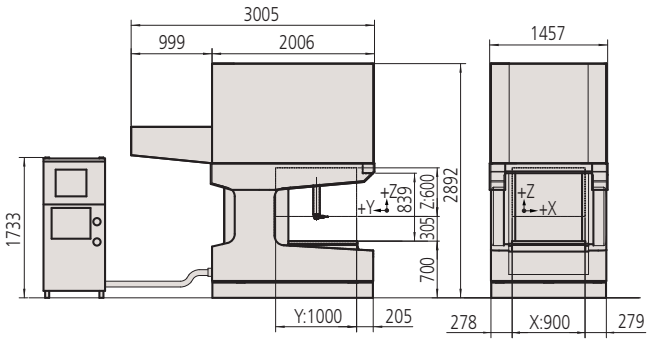
External Dimensions

(Unit: mm)



Specifications

Item		MACH-V9106
Measuring range	X axis	35.43" (900mm)
	Y axis	39.36" (1000mm)
	Z axis	23.62" (600mm)
Resolution		.000004" (0.0001mm)
Guide system		Linear guide on each axis
Operating speeds	CNC Mode	Drive speed: each axis 8 to 500mm/s; all axes 866mm/s
		Measuring speed: 1 to 20mm/s
	Joystick mode	0 to 80mm/s (High Speed)
		0 to 3mm/s (Low Speed)
		0.05mm/s (Fine Speed)
Maximum drive acceleration		Each axis 4,900mm/s^2; all axes 8,480mm/s^2
Scale type		Linear encoder
Workpiece	Maximum height	31.49" (800mm)
	Maximum mass	330lbs. (150kg)
Mass of machine (including the mounting stand and controller)		8,818lbs. (4000kg)

Scanning accuracy ISO 10360-4 Unit (µm)

Applied probe	Maximum permissible error (scanning mode) (MPE_{THP})
SP25M (stylus: ø4x50mm)	5.0µm

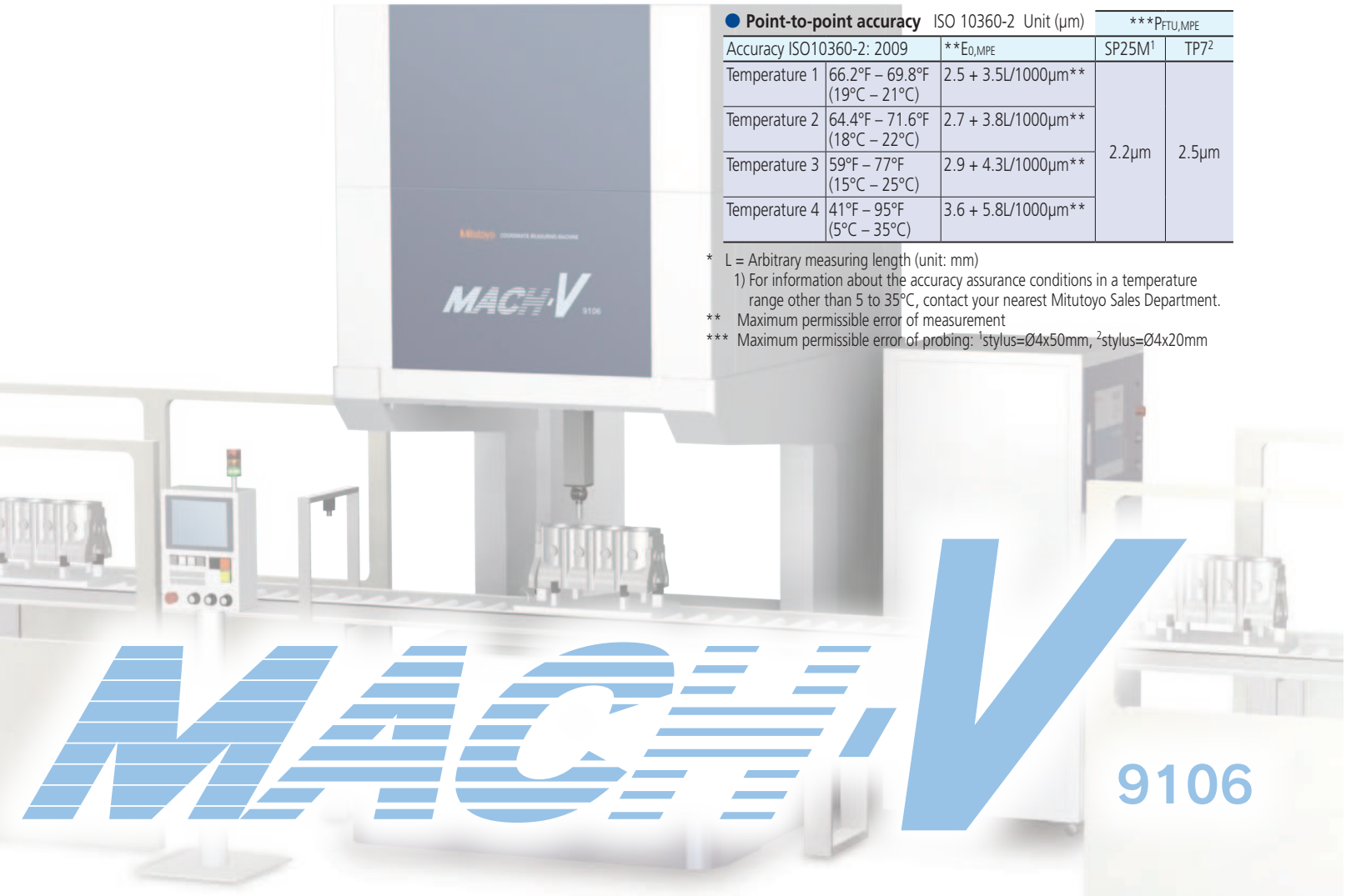
Operating environment

		Temperature
Accuracy assurance conditions	Temperature range	41°F - 95°F (5°C - 35°C)
	Temperature variation	3.6°F (2.0°C) / hour
		18.0°F (10.0°C) or less per 24 hours
	Temperature gradient	Vertical: 1.8°F (1.0°C) or less per meter
		Horizontal: 1.8°F (1.0°C) or less per meter

Point-to-point accuracy ISO 10360-2 Unit (µm)

Accuracy ISO10360-2: 2009		$**E_{0,MPE}$	$***P_{FTU,MPE}$ SP25M[1]	TP7[2]
Temperature 1	66.2°F – 69.8°F (19°C – 21°C)	2.5 + 3.5L/1000µm**	2.2µm	2.5µm
Temperature 2	64.4°F – 71.6°F (18°C – 22°C)	2.7 + 3.8L/1000µm**		
Temperature 3	59°F – 77°F (15°C – 25°C)	2.9 + 4.3L/1000µm**		
Temperature 4	41°F – 95°F (5°C – 35°C)	3.6 + 5.8L/1000µm**		

* L = Arbitrary measuring length (unit: mm)
1) For information about the accuracy assurance conditions in a temperature range other than 5 to 35°C, contact your nearest Mitutoyo Sales Department.
** Maximum permissible error of measurement
*** Maximum permissible error of probing: [1]stylus=Ø4x50mm, [2]stylus=Ø4x20mm



MACH-3A

Much-awaited Horizontal Coordinate Measuring System Appropriate for a Horizontal Machining Line

High-speed drive up to a maximum of 1,212mm/s

The world's fastest CNC horizontal axis, in-line coordinate measuring machine with world-beating acceleration (11,882mm/s^2) and measuring speed (at the moment of contact: 30mm/s) as well as drive speed. This system contributes to the reduction in total cost as an auto auto-measurement system, either in a line or at line side where a reduction in measurement time is required, and can also serve as a dedicated machine or a substitute system for gauges.

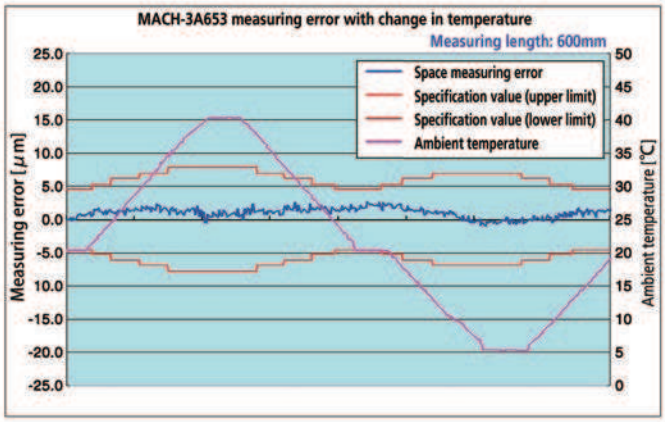
Space-saving design helps installation in a production line

This series comprises horizontal coordinate measuring machines intended for installation between processing machines. The horizontal-axis design allows this system to use the same workpiece handling and routing as the processing machines use.

Accuracy assurance throughout a wide temperature range (5 to 40°C)

Real-time thermal compensation applied to measurements and origin-setting assure excellent accuracy (referred to 20°C) over a much wider range of temperature than conventional CMMs. The graph below shows the effectiveness of the scheme.

Highly effective thermal compensation of the MACH-3A 653



Less maintenance

This system incorporates a control unit and a PC for measurement and has attained superior durability through a design targeted on 24-hour operation.

Improved ease of maintenance

Construction improvement and air-free operation means less chance of maintenance problems occurring.

All-in-one construction

In order to achieve further improved space-saving, dust resistance and adaptation to a wide range of temperatures, the MACH-3A employs an all-in-one construction.

The system integrates the main unit, data processor (PC) and monitor into one location on top of the mounting stand to achieve space-saving and ease of installation.

Additionally, to improve resistance to temperature environment and dust resistance, units other than the monitor are located in a cabinet in which a heat exchanger keeps the ambient temperature constant.

Thermal compensation - essential for in-line measurement

The MACH-3A series is provided with the same thermal compensation functions as the MACH-V series.

For detailed information, refer to page 4.

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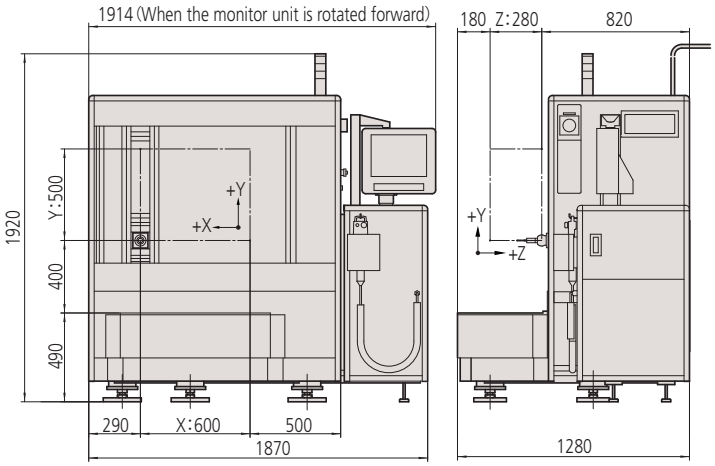
External Dimensions

(Unit: mm)



Specifications

Item \ Model		MACH-3A 653
Measuring range	X axis	23.62" (600mm)
	Y axis	19.68" (500mm)
	Z axis	11.02" (280mm)
Resolution		.000004" (0.0001mm)
Guide system		Linear guide on each axis
Operating speeds	CNC Mode	Drive speed: each axis 8 to 700mm/s; all axes 1212mm/s Measuring speed for TP7M: 1 to 30mm/s Measuring speed for TP20: 1 to 20mm/s
	Joystick mode	0 to 80mm/s (High Speed) 0 to 3mm/s (Low Speed) 0.05mm/s (Fine Speed)
Maximum drive acceleration		Each axis 6,860mm/s^2; all axes 11,882mm/s^2
Scale type		Linear encoder
Workpiece	Maximum height	29.52" (750mm)
	Maximum mass	440lbs. (200kg) excluding optional accessories
Mass of machine (including the mounting stand and controller)		3,306lbs. (1500kg) excluding optional accessories

Scanning accuracy ISO 10360-4 Unit (µm)

Probe used	Maximum permissible error (scanning mode) (MPE_{THP})
SP25M (stylus: ø4x50mm)	4.0µm

Operating environment

		Temperature
Accuracy assurance conditions	Temperature range	41°F - 104°F (5°C - 40°C)
	Temperature variation	3.6°F (2.0°C) / hour 18.0°F (10.0°C) or less per 24 hours
	Temperature gradient	Vertical: 1.8°F (1.0°C) or less per meter Horizontal: 1.8°F (1.0°C) or less per meter

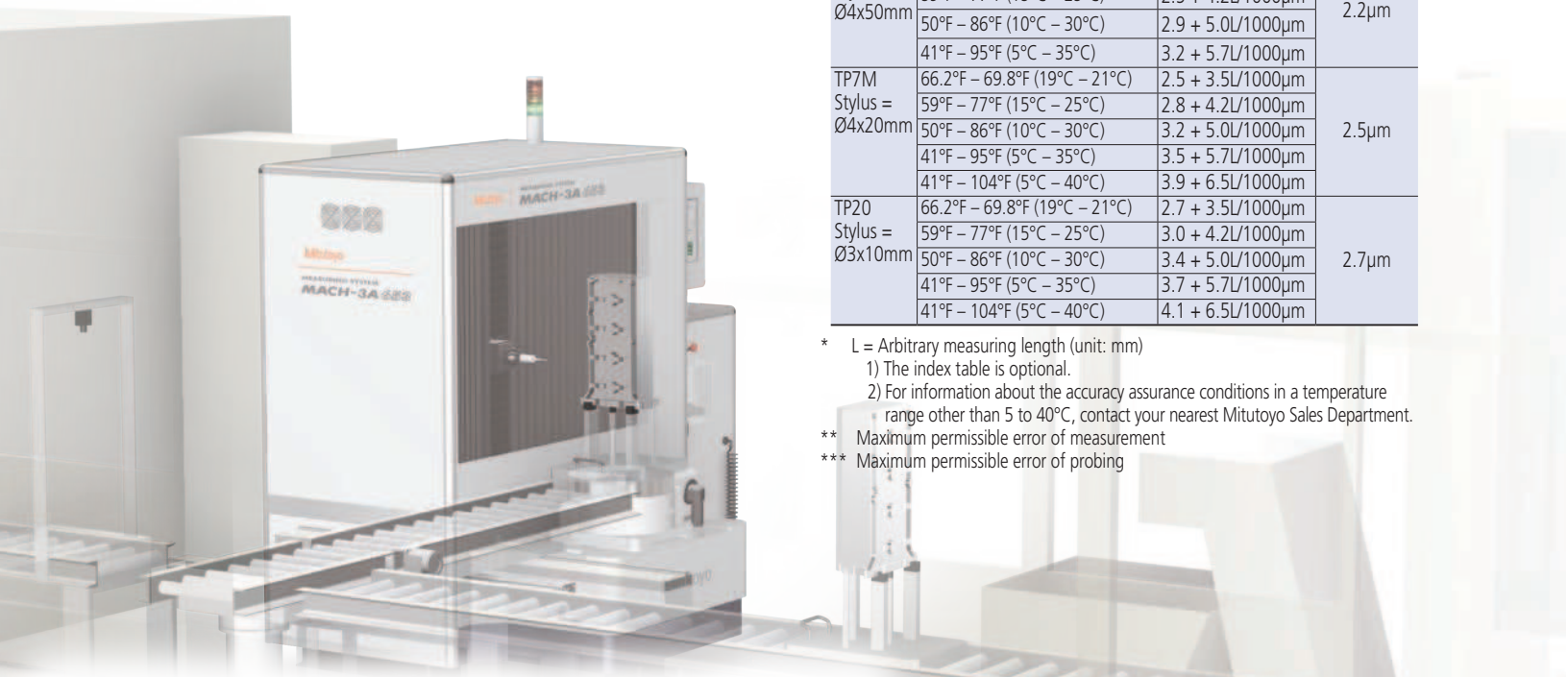
Point-to-point accuracy ISO 10360-2 Unit (µm)

Probe	Temperature Range	**$E_{0,MPE}$	***$P_{FTU,MPE}$
SP25M Stylus = Ø4x50mm	66.2°F – 69.8°F (19°C – 21°C)	2.2 + 3.5L/1000µm	2.2µm
	59°F – 77°F (15°C – 25°C)	2.5 + 4.2L/1000µm	
	50°F – 86°F (10°C – 30°C)	2.9 + 5.0L/1000µm	
	41°F – 95°F (5°C – 35°C)	3.2 + 5.7L/1000µm	
TP7M Stylus = Ø4x20mm	66.2°F – 69.8°F (19°C – 21°C)	2.5 + 3.5L/1000µm	2.5µm
	59°F – 77°F (15°C – 25°C)	2.8 + 4.2L/1000µm	
	50°F – 86°F (10°C – 30°C)	3.2 + 5.0L/1000µm	
	41°F – 95°F (5°C – 35°C)	3.5 + 5.7L/1000µm	
	41°F – 104°F (5°C – 40°C)	3.9 + 6.5L/1000µm	
TP20 Stylus = Ø3x10mm	66.2°F – 69.8°F (19°C – 21°C)	2.7 + 3.5L/1000µm	2.7µm
	59°F – 77°F (15°C – 25°C)	3.0 + 4.2L/1000µm	
	50°F – 86°F (10°C – 30°C)	3.4 + 5.0L/1000µm	
	41°F – 95°F (5°C – 35°C)	3.7 + 5.7L/1000µm	
	41°F – 104°F (5°C – 40°C)	4.1 + 6.5L/1000µm	

* L = Arbitrary measuring length (unit: mm)
1) The index table is optional.
2) For information about the accuracy assurance conditions in a temperature range other than 5 to 40°C, contact your nearest Mitutoyo Sales Department.

** Maximum permissible error of measurement

*** Maximum permissible error of probing



MEASURING SYSTEM
MACH-3A 653

Coordinate Measuring Machines

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