LEGEX 500/700/900/1200

Bulletin No. 2099

Legex - the ultimate ultra-high accuracy coordinate measuring machine in the world. Produced by combining Mitutoyo's long experience in the field of high-precision metrology and machining with state-of-the-art technologies in design, electronics, computing, sensors and materials.

Mitutoyo

Designed for Premium Performance and Exceptionally Low Measuring Uncertainty.

High-speed traverse: 7.87″/s (200mm/s)

Ultimate accuracy: MPE$_E$ = (0.35+L/1000)µm*

*Legex12128: (0.6+1.5L/1000)µm

Wide operating temperature range: 64.4°F to 71.6°F (18°C to 22°C)

Low measuring force: 0.03N*

*Using MPP-300Q

XYZ measuring range:
574: 19.68″x27.55″x17.71″
(500x700x450mm)

XYZ measuring range:
774: 27.55″x27.55″x17.71″
(700x700x450mm)
776: 27.55″x27.55″x23.62″
(700x700x600mm)

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Premium Performance

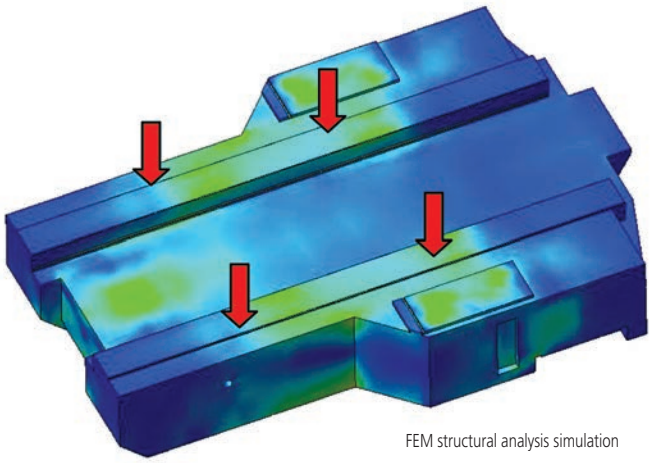
High-speed scanning: 4.72”(120mm/s)*

*Using MPP-300Q or SP80

XYZ measuring range:
12128: 47.24”x47.24”x31.49”
(1200x1200x800mm)

XYZ measuring range:
9106: 35.43”x39.36”x23.62”
(900x1000x600mm)

Technologies Incorporated

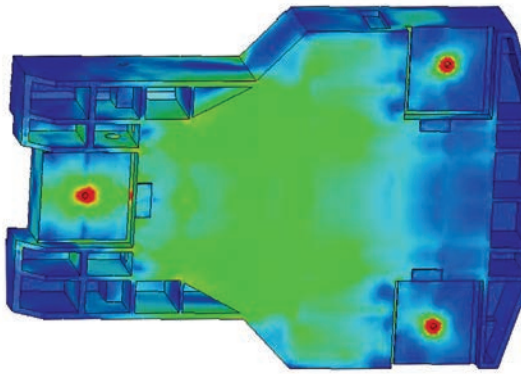


FEM structural analysis simulation

BASE DESIGN

High rigidity

The base of the Legex is made from special spheroidal graphite ductile cast iron to a sealed-structure design that provides high rigidity and vibration attenuating characteristics. Mitutoyo engineers used FEM analysis during the design phase to optimize the final configuration and ensure outstanding geometric accuracy by minimizing deformations caused by normal machine operation.

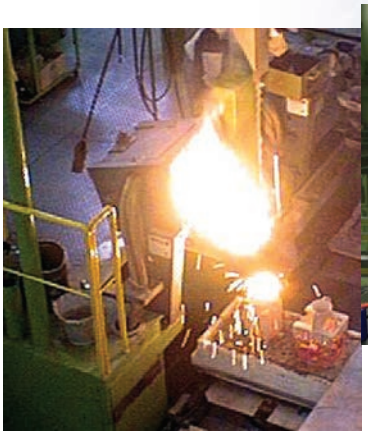


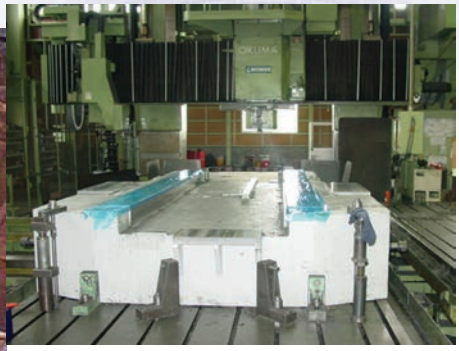
Spheroidal graphite ductile cast iron

Regular cast iron (gray iron) is a ferroalloy that includes carbon, silicon, manganese, phosphorus, and sulfur, in which the carbon is precipitated as flakes in the ferrite or pearlite material, whereas ductile cast iron is made by adding magnesium and other elements which precipitates the carbon in spherical form instead and results in an ideal material for making castings free of cavities and pin holes (defects) of .004" (0.1mm) and larger.

Ductile cast iron has high hardness, close to that of steel, as well as excellent ductility, toughness, and wear-resistance characteristics, making it the material of choice for critical machine components.

EVOLUTIONAL TECHNOLOGIES





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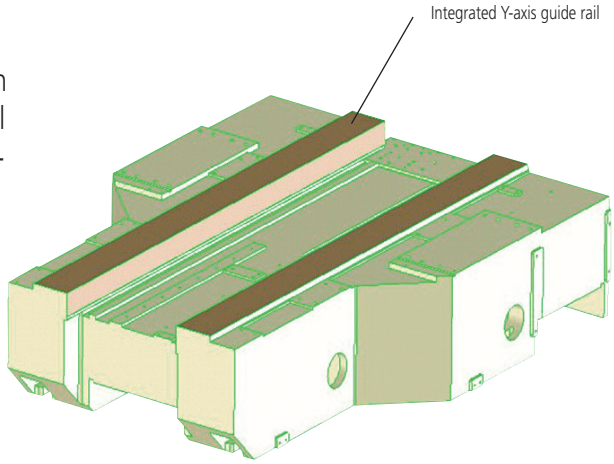
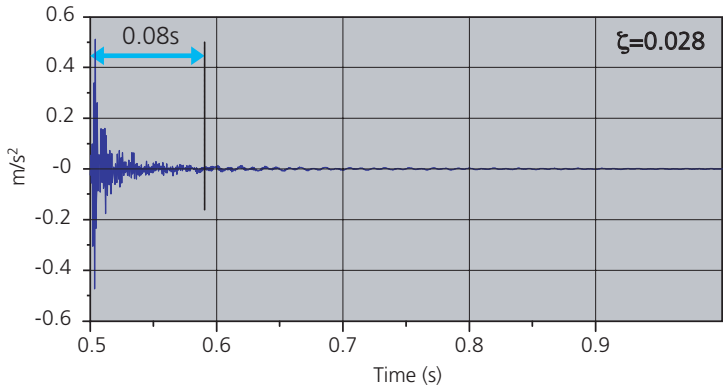
Integrated Y-axis guide rail

The ceramic-plasma coated Y-axis guide rail is cast as an integral part of the base to improve rigidity and thermal stability. This design feature practically eliminates distortion due to changing machine temperatures.



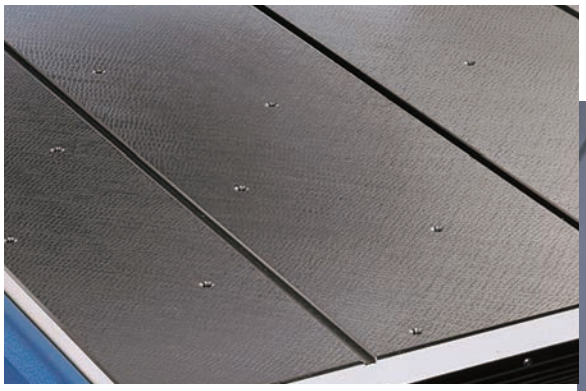


Attenuation characteristics

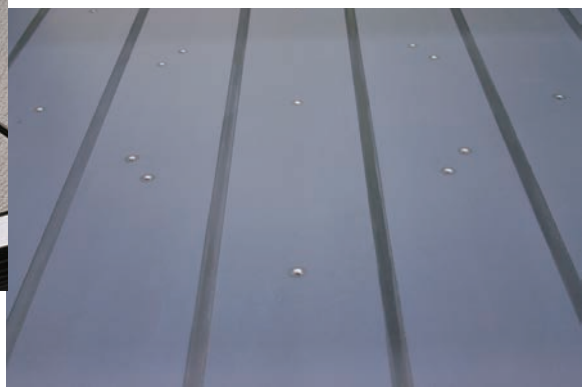
The Legex quickly attenuates traverse-induced vibrations and so reduces any adverse effect on measurements. This characteristic also allows ultra-high scanning accuracy to be realized.

WORKTABLE

The standard worktable is hand-flake finished but an easy maintenance, ceramic-coated worktable is available as an option.



Standard hand-flake finished worktable



Optional ceramic-coated worktable

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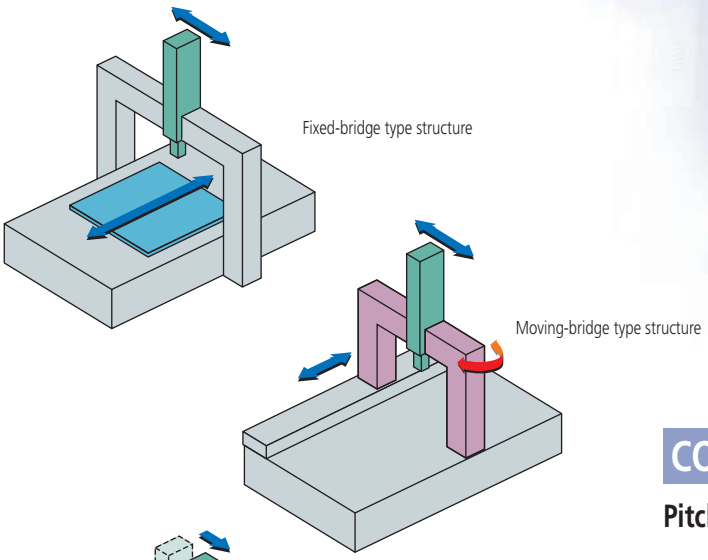
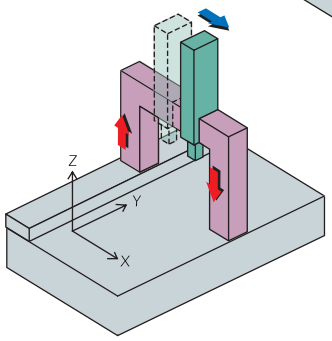




The centre of gravity of a moving bridge type machine is moved according to the X-axis motion. This movement of the bridge CG changes the load distribution and therefore alters the consequential deformations.

CONSTRUCTION

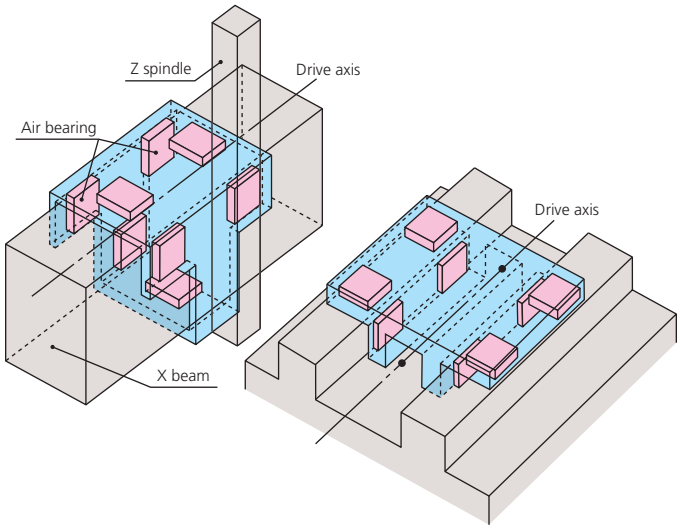
Pitch and yaw errors eliminated

The Legex uses a fixed-bridge type structure. This is the ideal CMM architecture and virtually eliminates pitch and yaw errors. Most other CMMs use a moving-bridge design with a single drive unit under the column, which tends to cause yawing and pitching during slide movements.

DYNAMIC ACCURACY

X- and Y-axis independence and a 'center of gravity' type drive system

The fixed-bridge design of the Legex allows the axes to operate totally independently. Movement of the X-axis slide does not change the loading on the Y-axis slide, and so does not cause deformation. Also, the 'center of gravity' type drive system places the drive units near the center of gravity of each slide. This feature allows very high speed, highly accurate measurements by reducing inertia-induced deflections during acceleration and deceleration.



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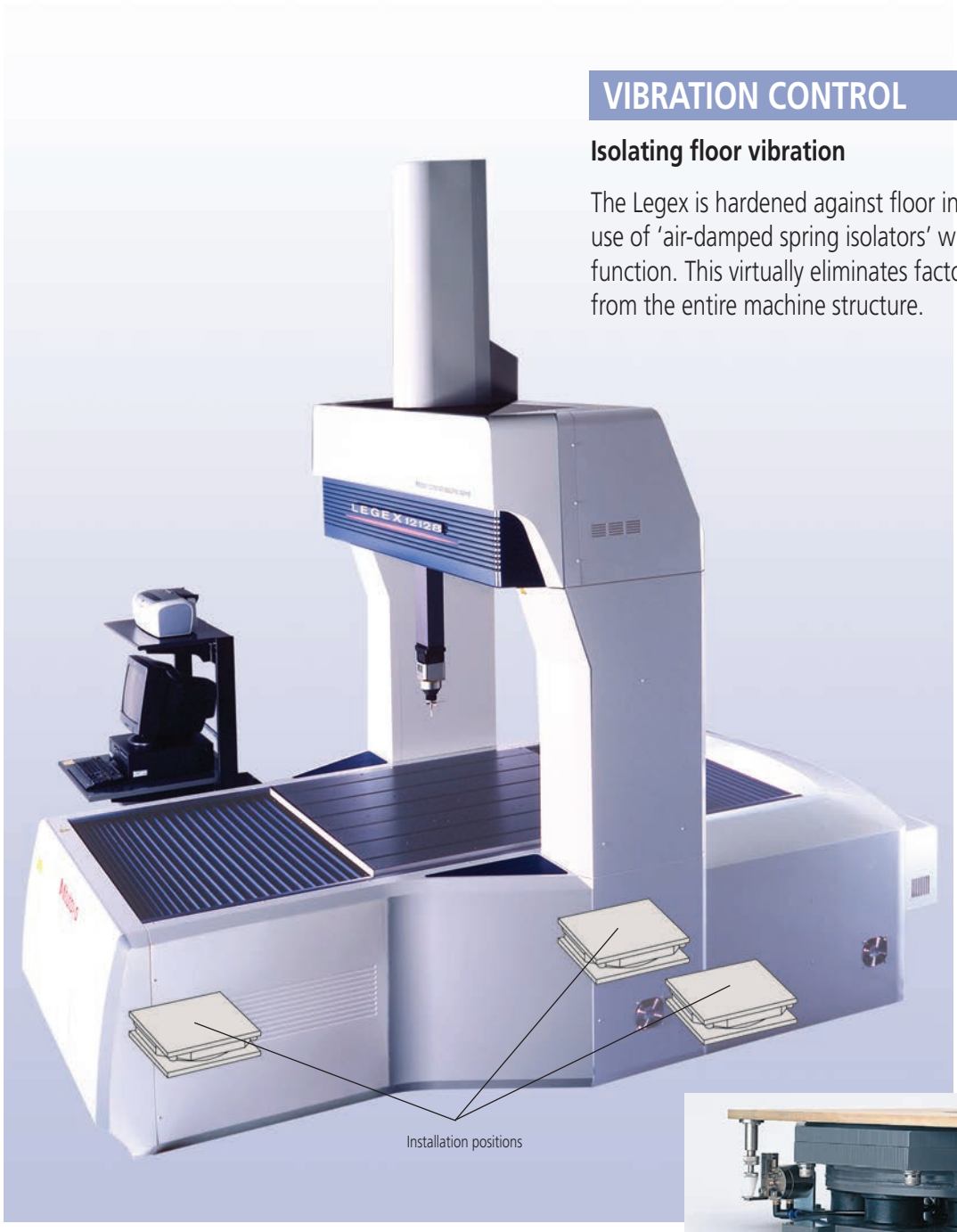
VIBRATION CONTROL

Isolating floor vibration

The Legex is hardened against floor induced vibration by use of 'air-damped spring isolators' with an auto-leveling function. This virtually eliminates factory floor vibrations from the entire machine structure.

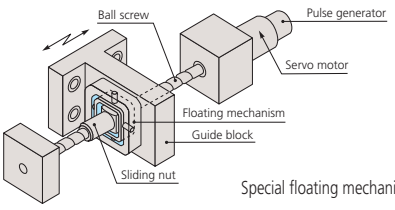


Installation positions

Air-damped spring isolaters

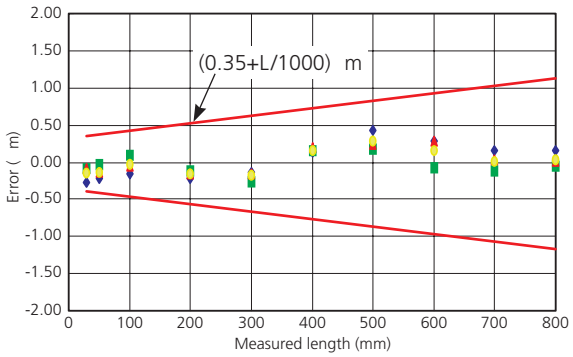
Floating mechanism reduces internal vibration

To reduce the effects of internally generated vibration, the Legex uses a special floating mechanism to couple each ballscrew to its guide block. This isolates the slide from the servo motor as it turns the ballscrew and thus prevents transmission of motor vibrations, especially during acceleration and deceleration.



Special floating mechanism

Inspection results of volumetric accuracy (MPE$_E$) (ex.: Legex 774)



TEMPERATURE COMPENSATION

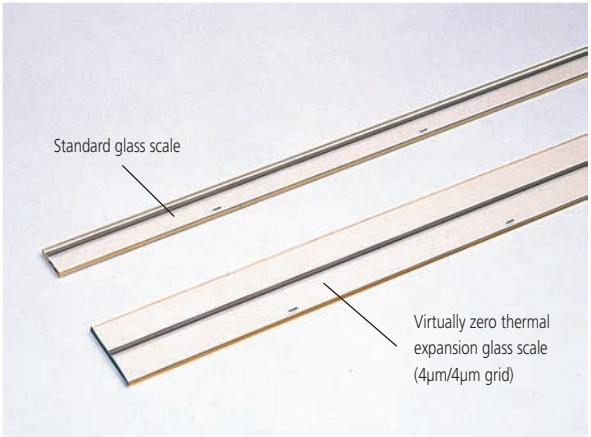
Effective over the 64.4°F to 71.6°F (18°C to 22°C) temperature range

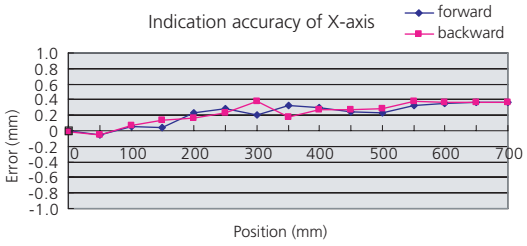
While conventional very high accuracy CMMs require fairly strict temperature controlled environments, the Legex has been designed to improve the thermal stability of each component to minimize deformation. In addition, temperature sensors on each axis and for the workpiece itself detect temperature changes in real time and are used to compensate back to 68°F (20°C).

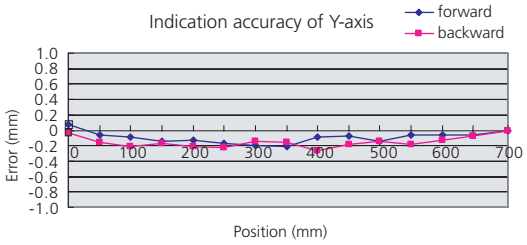
LENGTH STANDARD

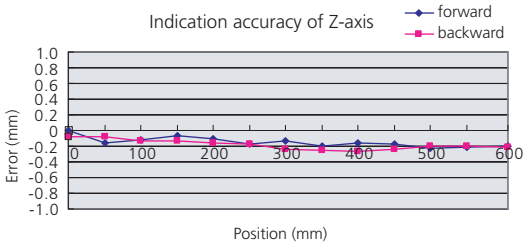
Linear glass scales with virtually zero thermal expansion coefficient

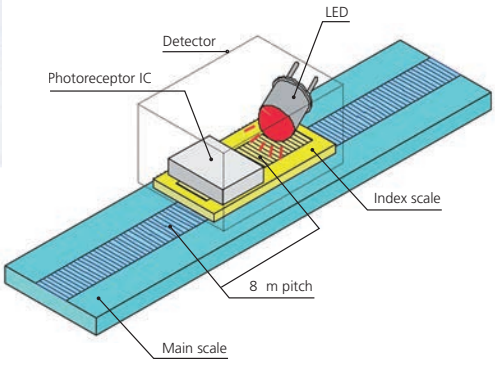
The Legex is equipped with a new crystallized-glass scale with a resolution of 0.01µm and an ultra-low linear expansion coefficient of 0.01 x 10^{-6}/K. This virtually zero thermal expansion coefficient means the Legex can maintain its extreme accuracy in spite of thermal changes. The scales are also mounted in a unique way that reduces the hysteresis error to 1/5 that of previous models. The inspection chart right shows the hysteresis error that results from this new mounting method.











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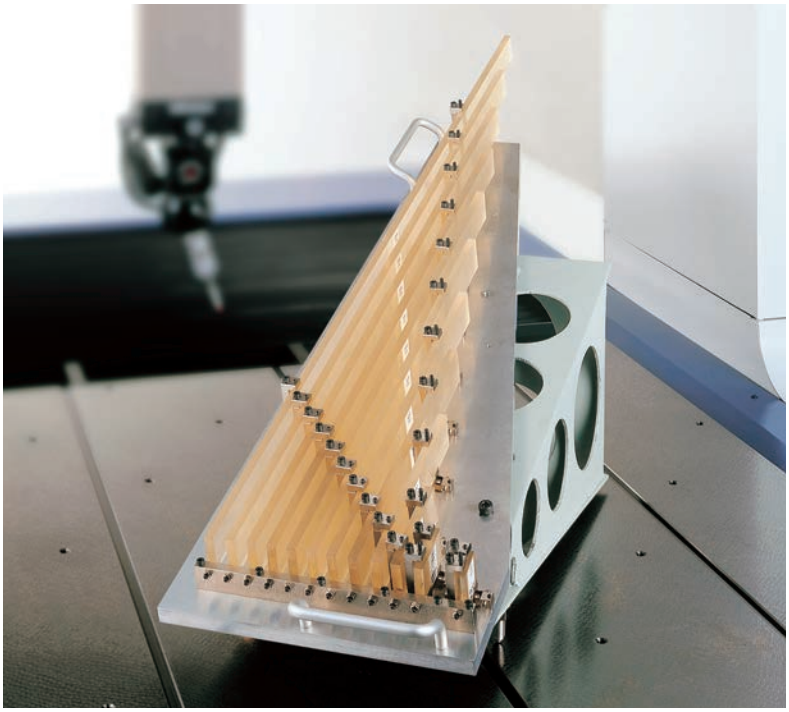


CRYSTALLIZED-GLASS STANDARD

- optional -

Minimizing external thermal influence at calibration

Thermal insensitivity is also critical to the calibration of high-end machines like a Legex. Mitutoyo offers a special calibration standard that uses crystallized-glass gauge blocks with a thermal expansion coefficient of 0.08 x 10^{-6}/K - the same material as used for the linear glass scales. Using this standard prevents calibration error caused by ambient temperature fluctuations. All gauge blocks in the standard are measured by interferometer to 0.0000003" (0.00001mm) resolution in Mitutoyo's Accredited Calibration Laboratory (JCSS No. 0030).

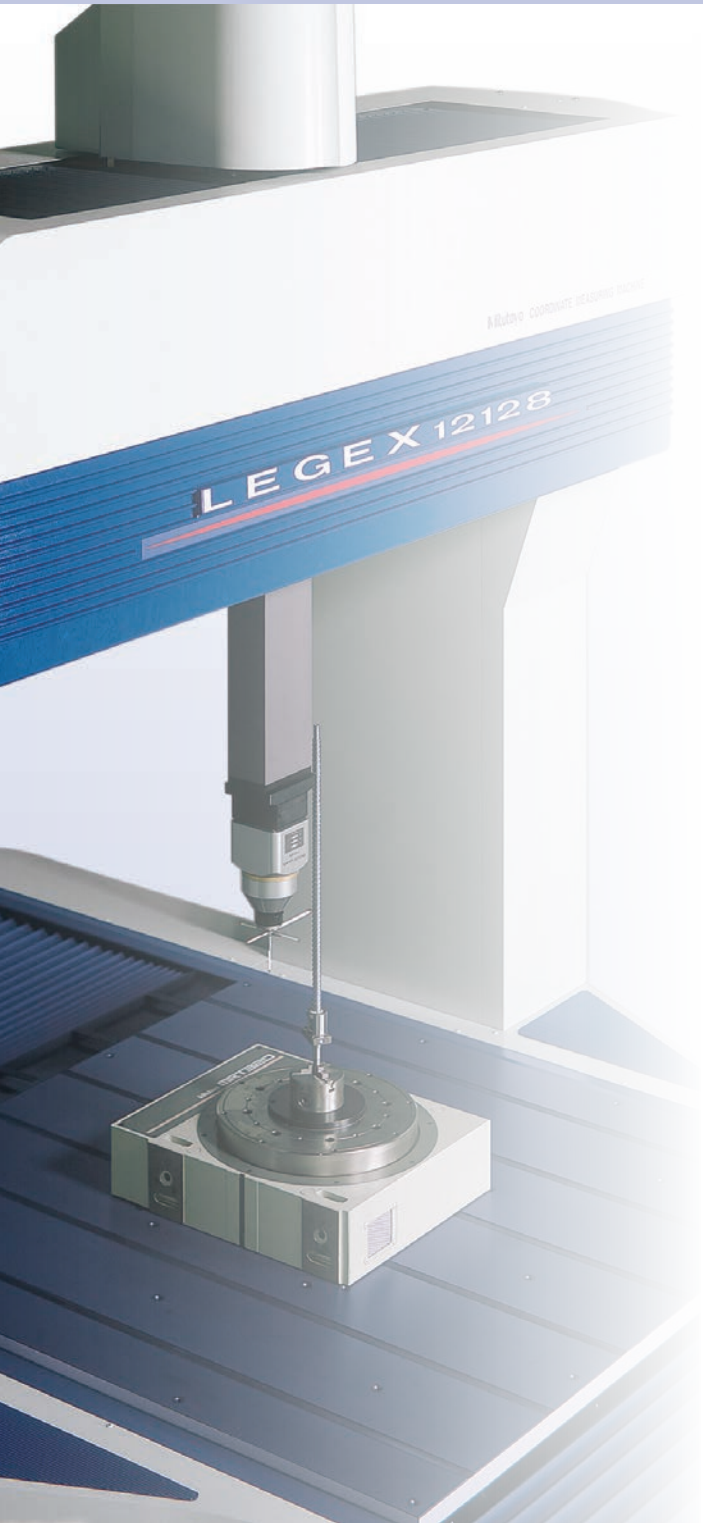
TEMPERATURE STABILIZED

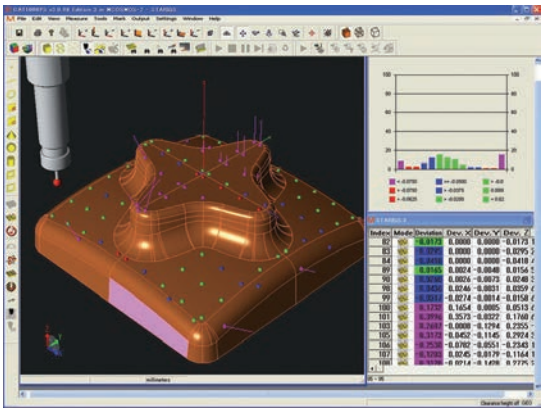
- optional -

Temperature-stabilized air supply

Generally speaking, temperature compensation and thermally insensitive materials can widen the usable range of ambient temperature and gradients. To eliminate a common source of temperature variation, the Legex is also available with a special air-server. In addition to the standard air cleaning and drying functions, this air server can stabilize the temperature of air drawn from the factory air supply to 68°F±0.18°F (20°C±0.1°C). In combination with the machine-enclosure design and thermally insensitive glass scales, temperature-stabilized air supplied to the air bearings can produce the exceptional thermal isolation needed for low measuring uncertainties. This air supply is also used for the MPP-300 probe to provide stabilized scanning.

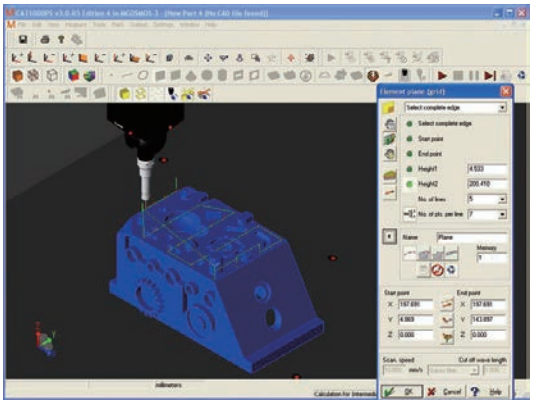
Application Software





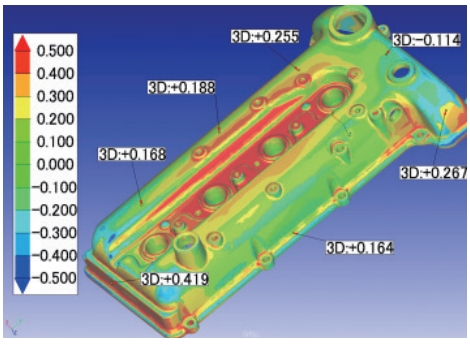
CAT1000S (freeform surface evaluation program)

Checks and compares the workpiece with the CAD data containing freeform surfaces and directly outputs the results in the form of CAD data in various formats. Software to directly convert from/to various types of CAD data is available as an option.



CAT1000P (off-line teaching program)

This module enables the user to use CAD data and on-screen simulation to create parts programs for making automated measurements (off-line teaching). This module allows the user to begin creating a parts program as soon as the design data has been finalized, shortening the entire process.

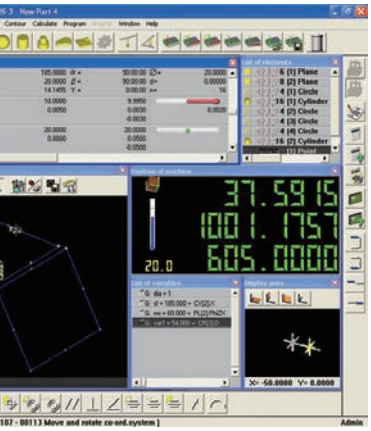


MSURF (non-contact laser measurement and evaluation program)

MSURF-S is used for obtaining measured point cloud data with the SurfaceMeasure (non-contact laser probe), while MSURF-I is used for comparing this data with the master model data, and for making dimensional measurements. Furthermore, MSURF-G for offline teaching allows the user to create a measurement macro even without the actual workpiece, improving the measuring machine's uptime.

Mitutoyo

Software



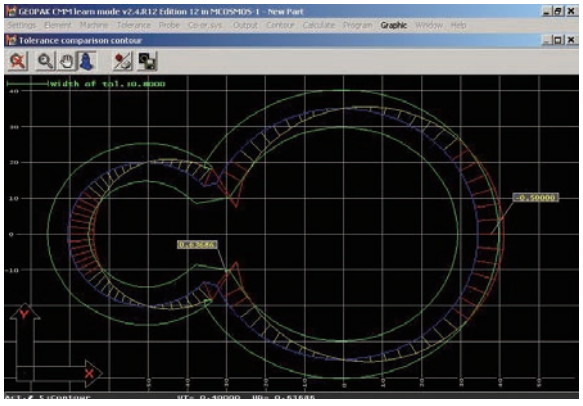
GEOPAK (high-functionality general-purpose measurement program)

This module is the heart of the MCOSMOS software system and is used to measure and analyze geometric elements. All the functions are provided by icons or pull-down menus, so even novices can promptly select desired functions. Its main features include easier viewing of measuring procedures and results such as realtime graphic display of measurement results and a function for direct call-up of elements from results graphics.

SurfaceMeasure606 (non-contact laser probe)

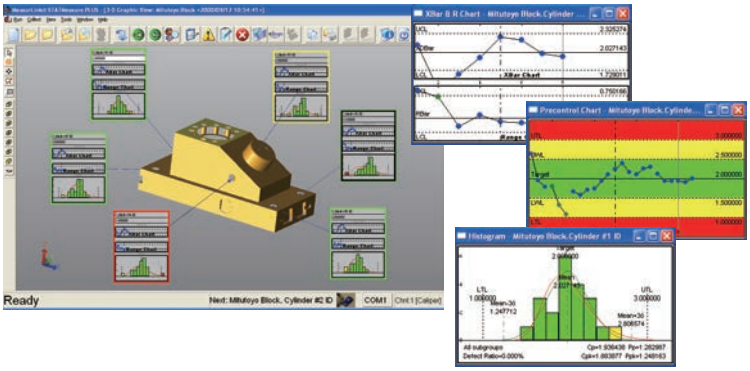
Lightweight, high-performance, non-contact probe developed for CNC coordinate measuring machines. Powder spray-less measurement has been achieved through automatic setting of appropriate laser intensity and camera sensitivity according to environment or material, providing a simpler and more comfortable laser scanning environment.

NEW-STYLE
Coordinate Measuring Machines



SCANPAK (contour measurement program)

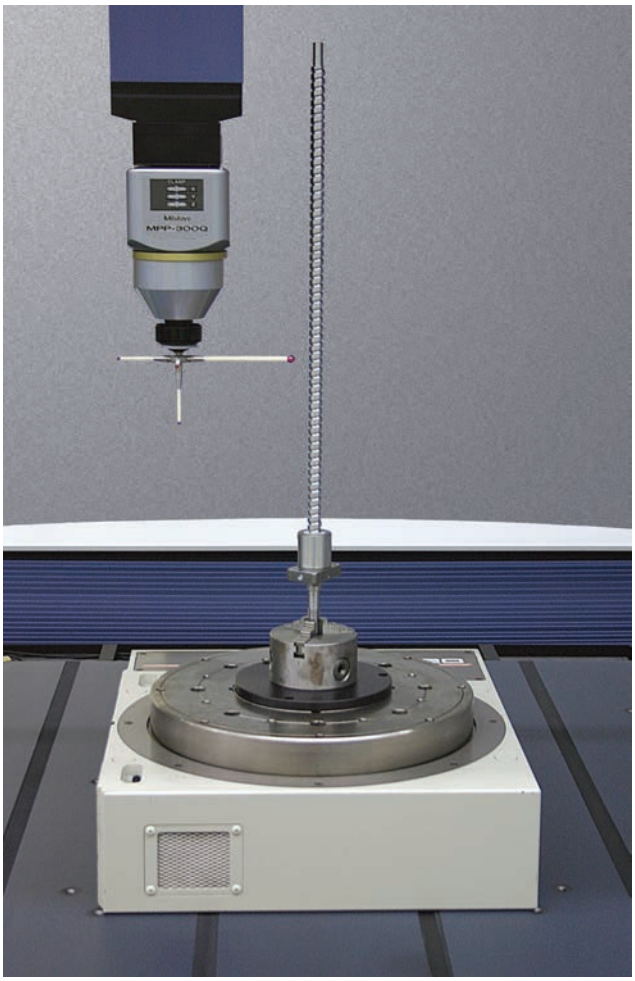
Software for scanning and evaluating workpiece contours (2D). Evaluates contour tolerance between measurement data and design data, and performs various types of element and inter-element calculations based on a desired range of measurement data specified by the user.



MeasurLink STATMeasure Plus (statistical-processing and process-controlling program)

Performs various types of statistical computations using measurement results. In addition, by displaying a control diagram on a real-time basis, this program allows defects that may occur in the future (e.g., wearing or damaging of cutting tools) to be discovered early on. This program can also be linked to a higher-level network environment to build a central control system.

Probes and accessories

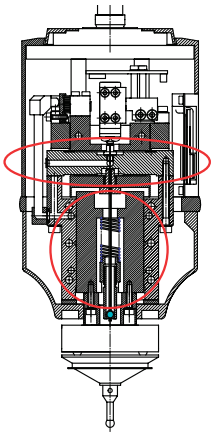


MPP-300Q

Mitutoyo's MPP-300Q probe can be used for point-to-point measuring and continuous scanning applications. If the workpiece requires the maximum accuracy, the MPP-300Q can offer 'zero-point' data acquisition for statistical measurement. In this mode the MPP-300Q 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.

Specifications:

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



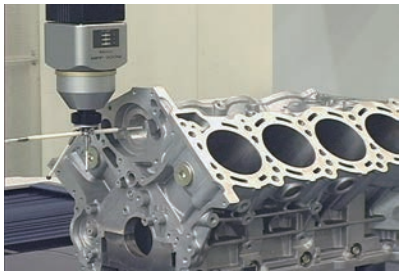
MRT320

The Legex can be used with the MRT320 rotary table as the 4th axis. It is very efficient for gear, cylinder cam and impeller measurements.

Specifications:

- Table diameter: 12.60" (320mm)
- Resolution: 1/10000 degree
- Maximum workpiece load: 220 lbs. (100kg)

High-speed scanning



Point-to-point measurement

Mitutoyo

Probes

MPP-10

For effective screw depth measurement

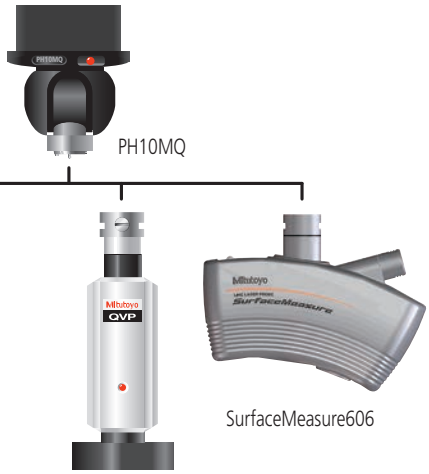
Probes

The Legex supports a wide range of probes to cover all your measurement applications.

Legex 500/700/900/1200

SP80
Ultra-high accuracy
scanning probe

Legex 500/700/900/1200



PH10MQ

TP7M
High accuracy
touch-trigger probe

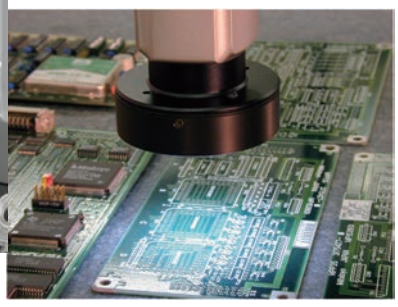
SP25M
High accuracy
scanning probe

QVP
Vision probe

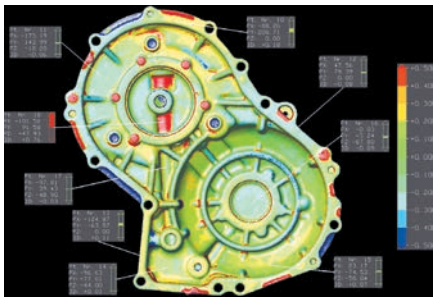
SurfaceMeasure606

NEW-STYLE
Coordinate Measuring Machines

SP80 scanning probe
4.72"/s (120mm/s) scanning speed and
19.69" (500mm) long stylus



QVP Vision probe

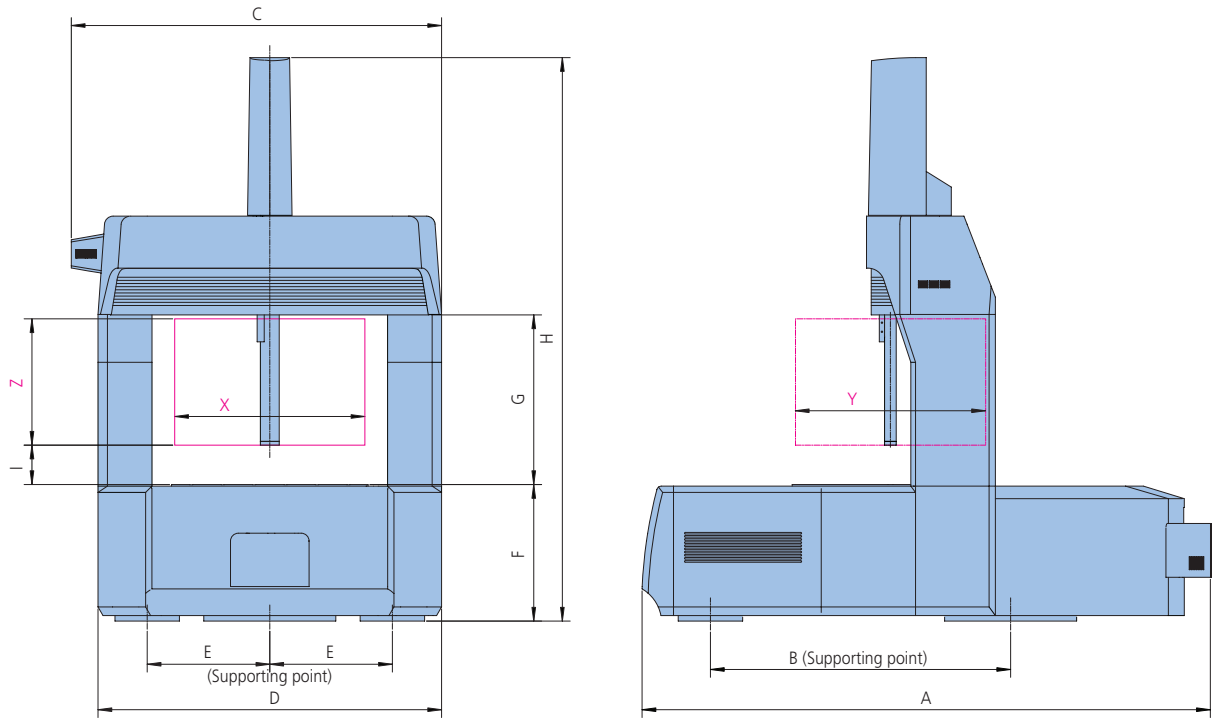


Scanning result of Metris laser probe

Technical Data

Dimensions

Legex 500/700/900/1200

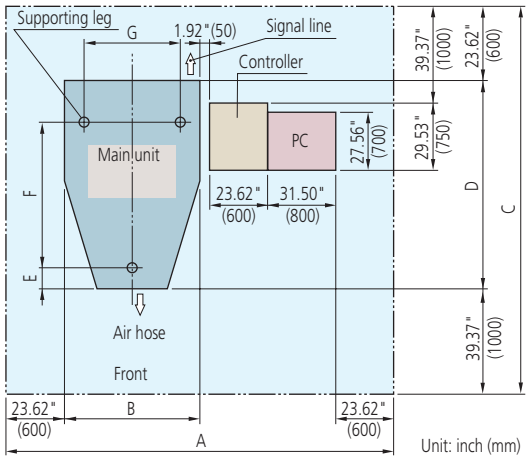


Model	X	Y	Z	A	B	C	D	E	F	G	H	I
Legex 574	19.68″ 500mm	27.55″ 700mm	17.71″ 450mm	99.99″ 2540mm	54.72″ 1390mm	62.44″ 1586mm	56.53″ 1436mm	17.51″ 445mm	25.07″ 637mm	29.36″ 746mm	102.16″ 2595mm	10.07″ 256mm
Legex 774	27.55″ 700mm	27.55″ 700mm	17.71″ 450mm	102.20″ 2596mm	55.51″ 1410mm	73.07″ 1856mm	66.37″ 1686mm	21.65″ 550mm	23.22″ 590mm	29.33″ 745mm	101.77″ 2585mm	9.68″ 246mm
Legex 776	27.55″ 700mm	27.55″ 700mm	23.62″ 600mm	102.20″ 2596mm	55.51″ 1410mm	73.07″ 1856mm	66.37″ 1686mm	21.65″ 550mm	23.22″ 590mm	35.23″ 895mm	113.58″ 2885mm	10.51″ 267mm
Legex 9106	35.43″ 900mm	39.36″ 1000mm	23.62″ 600mm	125.98″ 3200mm	70.66″ 1795mm	80.94″ 2056mm	74.25″ 1886mm	26.08″ 662.5mm	28.42″ 722mm	35.62″ 905mm	119.29″ 3030mm	10.27″ 261mm
Legex 12128	47.24″ 1200mm	47.24″ 1200mm	31.49″ 800mm	142.59″ 3622mm	75.19″ 1910mm	92.75″ 2356mm	86.06″ 2186mm	30.70″ 780mm	34.25″ 870mm	42.55″ 1081mm	141.33 3590mm	10.07″ 256mm

Mitutoyo

Technical Data

Floor layout



Model	A	B	C	D	E	F	G
Legex 574	160.87″ 4086mm	56.54″ 1436mm	154.92″ 3935mm	91.93″ 2335mm	14.49″ 368mm	54.72″ 1390mm	35.04″ 890mm
Legex 774	170.71″ 4336mm	66.38″ 1686mm	155.51″ 3950mm	92.52″ 2350mm	13.39″ 340mm	56.30″ 1430mm	44.09″ 1120mm
Legex 776	170.71″ 4336mm	66.38″ 1686mm	155.51″ 3950mm	92.52″ 2350mm	13.39″ 340mm	56.30″ 1430mm	44.09″ 1120mm
Legex 9106	178.58″ 4336mm	74.25″ 1886mm	179.13″ 4550mm	116.14″ 2950mm	12.80″ 325mm	71.46″ 1815mm	51.97″ 1320mm
Legex 12128	190.39″ 4836mm	86.06″ 2186mm	205.59″ 5222mm	142.60″ 3622mm	17.13″ 435mm	75.20″ 1910mm	61.42″ 1560mm

Specifications

Model		Legex 574	Legex 774	Legex 776	Legex 9106	Legex 12128
Measuring range	X axis	19.68″(500mm)	27.55″(700mm)	27.55″(700mm)	35.43″(900mm)	47.24″(1200mm)
	Y axis	27.55″(700mm)	27.55″(700mm)	27.55″(700mm)	39.36″(1000mm)	47.24″(1200mm)
	Z axis	17.71″(450mm)	17.71″(450mm)	23.62″(600mm)	23.62″(600mm)	31.49″(800mm)
Measurement standard		Ultra-high precision linear encoder				
Resolution		0.00000039″ (0.01μm)				
Accuracy (ISO 10360-2:2009)*	$E_{0,MPE}$	(0.35+L/1000)μm				(0.6+1.5L/1000)μm
	$P_{FTU,MPE}$	0.00001772″ (0.45μm)				0.00002362″ (0.6μm)
Guide method		Air bearings on each axis				
Maximum drive speed		7.87″/s (200mm/s)				
Maximum acceleration		39.37″/s² (1000mm/s²)				
Worktable	Material	Cast iron (ceramic coating: optional)				
	Working area	21.65″x29.52″ (550x750mm)	29.52″x29.52″ (750x750mm)	29.52″x29.52″ (750x750mm)	37.40″x41.33″ (950x1050mm)	49.21″x49.21″ (1250x1250mm)
	Tapped inserts	M8x1.25mm (for worpiece clamping)				
Maximum workpiece height		27.79″(706mm)	27.40″(696mm)	34.13″(867mm)	33.89″(861mm)	41.57″(1056mm)
Maximum worktable loading (Exclusive extreme offset load)		440lbs (200kg)	1,102lbs (500kg)	1,102lbs (500kg)	1,763lbs (800kg)	2,204lbs (1000kg)
Air Requirements	Pressure	58 PSI (0.4MPa)				
	Consumption	4.23CFM (120L/min) under normal conditions				
	Air source	5.65CFM (160L/min)				
Mass		7,716lbs (3500kg)	11,023lbs (5000kg)	11,243lbs (5100kg)	14,330lbs (6500kg)	23,148lbs (10500kg)

*MPP-300Q probe (Legex 500/700/900/1200)
Temperature Range: 64.4°F – 71.6°F (18°C – 22°C), Variation 0.9°F (0.5°C)/hour, 1.8°F (1.0°C)/day, Gradient 1.8°F (1.0°C)/m

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Source of photographs

(1) TOYOTEC Co.,Ltd.	URL http://www.toyotec.com
(2) Chichibu Fuji Co., Ltd.	URL http://www.ccf.co.jp
(3) Ariake Materials CO, LTD.	URL http://www.ariake-materials.co.jp
(4)(5) SHIN-NIHON TECH INC.	URL http://www.sntec.com
(6) YOHWA CO., LTD.	URL http://www.yohwa.co.jp

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