

Calibrating Measuring Instruments Reference Gages and Calibration Instruments

Small Tool Instruments
and Data Management



INDEX


The following provides a brief overview of where reference gages and inspection tools from Mitutoyo may be used to maintain the accuracy of precision measuring tools and instruments.

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① Differential Type Automatic Gauge Block Comparator GBCD-100A

A highly sensitive instrument for calibrating working gauge blocks with lengths between 0.5mm and 100mm by mechanical comparison with reference gauge blocks.



② CERA-Inside Micro-Checker

This fixture provides fast, accurate and convenient zero point setting of inside micrometers. Choose 300mm or 600mm capacity models.




③ Setting Rings

ø1 mm to ø300 mm steel and ø4 mm to ø45 mm ceramic products are available.



④ CERA Caliper Checker

300 mm and 600 mm models are available, ideal for calibration of calipers and height gauges.




⑤ i-Checker, IC2000

Capable of calibrating practically any type of mechanical or electronic indicator or gage with unsurpassed accuracy and convenience.



⑥ Digital Height Master

A best-selling device synonymous with the calibration and setting of height gauges. Available in 310 mm and 310 mm, 460 mm and 610 mm within the digimatic series. Various matching riser blocks are also available to lift the height master position by up to 900mm.



⑦ Black Granite Surface Plates

Precision machined from the highest grade of solid black granite to provide the best combination of easy sliding, even wearing and thermal stability available.



Gauge Blocks
 Calibration Instruments
 Outside Micrometers
 Inside Micrometers
 Height/Borematic
 Bore Gages
 Depth Micrometers
 Calipers
 Height Gages
 Dial Indicators
 Dial Test Indicators
 Electronic Micrometers
 Coordinate Measuring Machines
 Profile Projectors/Measuring Microscopes
 Measuring Table

Reference Gages, Calibration Instruments and Inspection Tools Required for Periodic Inspections

Mitutoyo, as the manufacturer of a comprehensive range of precision measuring tools and instruments, offers the reference gages, calibration instruments and inspection tools necessary for performing the periodic inspections so necessary to ensure your measuring equipment is maintained in best operating condition.

Gauge Blocks

Automatic Comparator with Dual Gage Heads GBCD-100A

- This equipment is used to calibrate gauge blocks with a nominal size from 0.5 mm to 100 mm, by performing incremental measurement against a reference gauge block. Set the gauge block to calibrate with the reference gauge block set to the holder and start calibration. Measurement is automatically performed in the center and at 5 measurement points on the edges.
- The compensation result is not affected by any warping of thinner gauge blocks due to the use of upper and lower gage heads (dual-head system).
- Gauge Block Inspection Software **GBPAK-AJ** can be used to operate inspection equipment, determine grades, and prepare inspection results. It can also output text data in TSV format, for editing using Excel or other spreadsheet software.



Standard Configuration

- Comparator Main Unit
- Controller
- Software GBPAK-AJ
- Gauge Block Holder Set for Rectangular and Square
- Air hose (Urethane Tube, outside diameter $\varnothing 6$ mm, length 5 m)
- Windows PC

Software features

Gauge Block Inspection Software GBPAK-AJ

- Automatic measuring functionality
- Capture measured data and save
- Data processing function:
 - Calculation: Central deviation, Variation, Minimum deviation, and Maximum deviation.
 - Judgment: Grade judgment, and Grade unsatisfaction judgment.
 - Correction: Temperature compensation, and Hertzian-contact-deformation correction
 - Average: Adopt the mean value of the repetition measurements up to 5 times as the measurement value.
- Functions of creating simple tables and printing
- TSV (tab-separated text file) format file output function
 - The measurement data can be saved in a format, by which commercial spread sheet software can read the data.
- Cross-section dimension switching function
- Standard tables files such as JIS, ISO, and DIN, and user-defined standard files can registered.
- Equipped with measuring functionality and data processing function to verify the measurement capability of the gauge block using the calibration master for a gauge block comparator (optional).

Gauge block

Specifications

Measurement target	Rectangular gauge blocks Square gauge blocks	
Gauge block length	0.5 mm - 100 mm	
Resolution	0.01 μm	
Measurement method	1 cycle of automatic comparison measurement with a standard gauge block.	
Detector method	Differential measurement with upper and lower gaging head (dual-head system)	
Upper gaging head	Type	High accuracy electronic micrometer
	Measuring force	1.0 N
Lower gaging head	Contact point	Carbide contact point of curvature radius 20mm
	Type	High accuracy electronic micrometer
	Measuring force	0.6 N
Contact point		Carbide contact point of curvature radius 5mm
	Accuracy (at the 95% confidence level)	$\pm(0.03+0.3L/1000)\mu\text{m}$ L: Gauge block length (mm) (Excluding uncertainty of reference gauge block length and influence of ambient temperature)
Air requirement	0.4 MPa	
Operation temperature range	20 $^{\circ}\text{C} \pm 1$ $^{\circ}\text{C}$ (Under mild temperature change without direct exposure to cold or warm air)	
Operating humidity range	58 ± 15 %RH	
Power supply	AC 100 V - 120 V, 200 - 240 V $\pm 10\%$, 50/60 Hz	
Power consumption (excluding PC)	100 W	



Calibration master for a gauge block comparator Order No. 516-1475-E2

Optional

Order No.	Description	Explanation
516-145-E2	Gauge block set for comparator calibration (Standard type)	A block set for the measurement capacity verification and periodic calibration of inspection devices
613615-03	Ceramic gauge block 5 mm, grade 1 (JIS)	Origin setup gauge block
02ASQ324	Square gauge block holder set	Dedicated holder for measuring square gauge block

Gauge Blocks

Differential Type Manual Gauge Block Comparator

GBCD-250

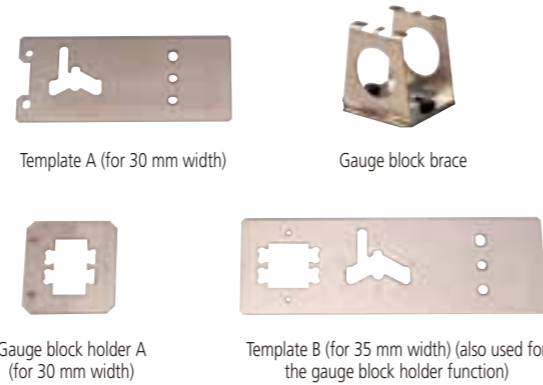
- Patent registered in Japan
- This equipment is used to calibrate gauge blocks with a nominal size from 0.1 mm to 250 mm, by performing incremental measurement against a reference gauge block.
- Calculation uses two vertically arranged detectors (dual head) to ensure that results are not affected by any thin gauge block warping.
- An ultra-wide-range and high-accuracy sensor (linear gauge: measurement range 6 mm, effective display amount 0.01 μm) is used to dramatically reduce the amount of troublesome minute height adjustment work for detectors. It can also calibrate gauge blocks of different nominal dimensions against a single reference gauge block. (Accuracy will vary when measuring combinations of different nominal dimensions. Refer to the specifications section for accuracy.)
- A PC and Gauge Block Inspection Software **GBPAK-ME** can be optionally used to load data, determine grades, and prepare inspection results. It also outputs text data in TSV format, for editing using Excel or other spreadsheet software.



Composition	
GBCD-250 body	
Display for GBCD-250	
Holder set for rectangular gauge block	
• Template A (for 30 mm width)	
• Gauge block holder A (for 30 mm width)	
• Template B (for 35 mm width)	
• Template B (for 35 mm width)	
Instruction manual	
Inspection report	
Calibration certificate (optional)	

Standard Accessories

- Gauge block holder set
This holder set is used to secure rectangular gauge blocks.



SPECIFICATIONS

Measurement target	Rectangular gauge blocks Square gauge blocks*1	
Gauge block length	0.1 - 250 mm	
Detector method	Differential measurement with upper and lower gaging head (dual-head system)	
Resolution (Effective display amount)	0.001 μm (0.01 μm)	
Measurement method	Comparison measurement relative to a reference gauge block.	
Accuracy (at the 95% confidence level)	$\pm(0.03+0.3L/1000)\mu\text{m}^{*2}$ L: Gauge block length (mm) Comparison measurement relative to a reference gauge block having the same nominal length.	
Accuracy (at the 95% confidence level)	$\pm(0.06+0.3L/1000)\mu\text{m}^{*2}$ L: Gauge block length (mm) The difference between the lengths of the reference gauge block and the gauge block to be measured must be within ± 3 mm	
Upper gaging head:	Type	Linear Gauge
	Measuring force	0.4 N
	Contact point	Carbide contact point of curvature radius 20mm
Lower gaging head:	Type	Linear Gauge
	Measuring force	0.2 N
	Contact point	Carbide contact point of curvature radius 5mm
Operation temperature range	20 °C \pm 1 °C Perform in a location where temperature changes are gradual, and away from direct contact with hot or cold air.	
Operating humidity range	30 %RH - 60 %RH	
External dimensions:	455 (W) \times 318 (D) \times 726 (H) mm Includes positioning device	
Measurement body	210 (W) \times 162 (D) \times 118 (H) mm	
Display units		
Mass: Measurement body	Approx. 52kg	
Display units	Approx. 2.4kg	

*1: Square gauge blocks can be measured by using the dedicated holder (optional accessory).

*2: The dimensional inaccuracy of the reference gauge block and the influence of ambient temperature are not taken into account.

Gauge Blocks

Optional Accessories

Gauge Block Inspection Software GBPAK-ME

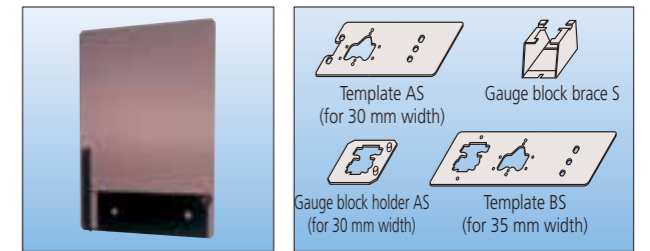
- Environment: Windows XP, Vista, 7, 10
- Measurement data loading and saving
- Data processing function
Calculation: Dimensional difference in center dimension, dimensional difference width, dimensional difference in minimum dimension, dimensional difference in maximum dimension
Determination: Grade determination, grade drop determination
Compensation function: Temperature compensation, deformation compensation
Average operation functionality: Can calculate measured value based on measuring the average value up to 5 times.
- Simple tabulation/printing function
- TSV (tab-separated text file) format file output function
Data can be saved in a format compatible with commercial spreadsheet software, etc.
- Standard table file (JIS, ISO, DIN, can also register user standard)
- Equipped with measuring functionality and data processing function to verify the measurement capability of the gauge block using the calibration master for a gauge block comparator (optional).

Calibration master for gauge block comparator

- Standard type No.516-145-E2
A dedicated block set for use in verifying the measuring ability of gauge block comparators and to perform regular calibration.



- Heat Protection Shielded No.02ASF040
It suppresses the temperature rise of the gauge block during measurement due to the heat generated by the measuring operator.
It is especially useful when measuring long gauge blocks.
- Square gauge block holder set No.02ASD130
A set of gauge block holders for measuring scale gauge blocks. (Gauge block brace included)



Order No.	Description	Explanation
-	Data processing device	Windows PC to be connected to GBCD-250
-	Gauge Block Inspection Software GBPAK-ME	Gauge Block Inspection Software
516-145-E2	Calibration master for gauge block comparator	A block set for the measurement capacity verification and periodic calibration of inspection devices
02ASF040	Heat Protection Shielded	It shields the heat generated by the measurer and suppresses the temperature rise of the gauge block.
02ASD130	Holder set for square gauge block	A gauge block holder set required for measuring square gauge blocks.

Calibration Instruments

Series 516 Micrometer Inspection Gauge Block Set

- Steel and ceramic-type gauge blocks are offered.
- Various combinations are available to meet various needs. Select the ideal product for your usage conditions, environment, and application.
- For more information, refer to Catalog No.E12014 "Gauge Blocks".



103-block set (steel)



103-block set (ceramic)



Long gauge block set

Specifications

Type	Steel		Ceramic		Blocks per set
	Order No.*	Accuracy	Order No.*	Accuracy	
1mm base sets	516-937	Grade K	516-337	Grade K	112
	516-938	Grade 0	516-338	Grade 0	
	516-939	Grade 1	516-339	Grade 1	
	516-940	Grade 2	516-340	Grade 2	
	516-941	Grade K	516-341	Grade K	103
	516-942	Grade 0	516-342	Grade 0	
	516-943	Grade 1	516-343	Grade 1	
	516-944	Grade 2	516-344	Grade 2	
	516-949	Grade K	516-349	Grade K	76
	516-950	Grade 0	516-350	Grade 0	
	516-951	Grade 1	516-351	Grade 1	
	516-952	Grade 2	516-352	Grade 2	
516-953	Grade K	516-353	Grade K	56	
516-954	Grade 0	516-354	Grade 0		
516-955	Grade 1	516-355	Grade 1		
516-956	Grade 2	516-356	Grade 2		
516-957	Grade K	516-357	Grade K	47	
516-958	Grade 0	516-358	Grade 0		
516-959	Grade 1	516-359	Grade 1		
516-960	Grade 2	516-360	Grade 2		
516-994	Grade K	516-394	Grade K	46	
516-995	Grade 0	516-395	Grade 0		
516-996	Grade 1	516-396	Grade 1		
516-997	Grade 2	516-397	Grade 2		
516-128	Grade K	516-178	Grade K	34	
516-129	Grade 0	516-179	Grade 0		
516-130	Grade 1	516-180	Grade 1		
516-131	Grade 2	516-181	Grade 2		
516-965	Grade K	516-365	Grade K	32	
516-966	Grade 0	516-366	Grade 0		
516-967	Grade 1	516-367	Grade 1		
516-968	Grade 2	516-368	Grade 2		
516-973	Grade K	516-373	Grade K	18	
516-974	Grade 0	516-374	Grade 0		
516-975	Grade 1	516-375	Grade 1		
516-976	Grade 2	516-376	Grade 2		
516-981	Grade K	516-381	Grade K	9	
516-982	Grade 0	516-382	Grade 0		
516-983	Grade 1	516-383	Grade 1		
516-984	Grade 2	516-384	Grade 2		
516-985	Grade K	516-385	Grade K	9	
516-986	Grade 0	516-386	Grade 0		
516-987	Grade 1	516-387	Grade 1		
516-988	Grade 2	516-388	Grade 2		
516-701	Grade K	516-731	Grade K	8	
516-702	Grade 0	516-732	Grade 0		
516-703	Grade 1	516-733	Grade 1		
516-704	Grade 2	516-734	Grade 2		
516-990	Grade 0			9	
516-991	Grade 1				
516-992	Grade 2				

* Rectangular gauge block need to set the suffix (last two digits). For more information, refer to Catalog No.E12014 "Gauge Blocks".
Note: Mitutoyo offers some gauge blocks other than the above table, such as Wear Block Sets and Inch Block Sets.

Calibration Instruments

Series 516 Square Gauge Block Sets

- The gauge blocks have a square measurement surface of 24.1x24.1mm and a ø6.7mm through hole at the center to improve ease-of-use and for use in a wide range applications.
- Gauge blocks can be joined using the optional tie rod, screws, and nuts.
- For more information, refer to Catalog No.E12014 "Gauge Blocks".



112-block set



Specifications Block Sets

Type	Order No.	Accuracy	Blocks per set
1mm base sets	516-438	Grade 0	112
	516-439	Grade 1	
	516-440	Grade 2	
	516-442	Grade 0	103
	516-443	Grade 1	
	516-444	Grade 2	
	516-450	Grade 0	76
	516-451	Grade 1	
	516-452	Grade 2	
	516-458	Grade 0	47
	516-459	Grade 1	
	516-460	Grade 2	
516-466	Grade 0	32	
516-467	Grade 1		
516-468	Grade 2		
516-752	Grade 0	8	
516-753	Grade 1		
516-754	Grade 2		

Series 516 Individual Square Gauge Blocks

Rectangular Gauge Blocks (0.1 - 1000mm)
CERA Blocks (0.5 - 500mm)
Square Gauge Blocks (0.5 - 500mm)

- The availability of individual gauge blocks enables damaged or worn blocks to be easily replaced so that a complete set may be economically restored to grade standard.
- For more information, refer to Catalog No.E12014 "Gauge Blocks".
- When placing an order, add the suffix number representing "the JIS class", "the standard", "the grade" and "the calibration certificate requirement" after the part number.



Gauge Blocks
Calibration Instruments
Outside Micrometers
Inside Micrometers
Hole and Boremic
Bore Gages
Depth Micrometers
Calipers
Height Gages
Dial Indicators
Dial Test Indicators
Electronic Micrometers
Coordinate Measuring Machines
Profile Projectors/
Measuring Microscopes
Measuring Table



Calibration Instruments

Series 516

Gauge Blocks with Calibrated Coefficient of Thermal Expansion

- Mitutoyo offers top-quality gauge blocks (steel and ceramic), superior to K class blocks due to their advanced manufacturing technologies.
- Features an accurately calibrated thermal expansion coefficient measured with a proprietary double-faced interferometer (DFI). Each gauge block is calibrated for length on a highly accurate gauge block interferometer (GBI) system.
- Available as rectangular gauge blocks in the range 100 to 500mm.



Specifications

Metric Blocks with CTE			Inch Blocks with CTE		
Order No. (steel)*	Order No. (CERA)*	Length (mm)	Order No. (steel)*	Order No. (CERA)*	Length (inch)
611681	613681	100	611204	613204	4
611802	613802	125	611205	613205	5
611803	613803	150	611206	613206	6
611804	613804	175	611207	613207	7
611682	613682	200	611208	613208	8
611805	613805	250	611222	613222	10
611683	613683	300	611223	613223	12
611684	613684	400	611224	613224	16
611685	613685	500	611225	613225	20

Grade	K class in JIS/ASME/ISO
Uncertainty of thermal expansion coefficient	0.035 × 10 ⁻⁶ /K (k = 2)
Uncertainty of length measurement	30nm (k = 2), for 100mm block

*An inspection certificate and a JCSS calibration certificate are supplied as standard. A calibration report and a calibration certificate for the thermal expansion coefficient are also supplied as standard.
Note: For more information, refer to Catalog No.E12014 "Gauge Blocks".

Series 516

ZERO CERA Blocks

- Zero Cera Block is a next-generation gauge block made from a special lightweight ceramic having extremely low thermal expansion (0±0.02×10⁻⁶/K (20 °C)) and exhibiting almost no secular change, both in dimension and coefficient of thermal expansion.
- Available as rectangular gauge blocks in the range 30 to 1000 mm.



Specifications

Metric Blocks			Length (mm)
JIS/ISO/DIN	Order No.* BS	Order No.* ASME	
617673-016	617673-116	617673-516	30
617675-016	617675-116	617675-516	50
617681-016	617681-116	617681-516	100
617682-016	617682-116	617682-516	200
617683-016	617683-116	617683-516	300
617684-016	617684-116	617684-516	400
617685-016	617685-116	617685-516	500
617840-016	617840-116	617840-516	600
617841-016	617841-116	617841-516	700
617843-016	617843-116	617843-516	800
617844-016	617844-116	617844-516	900
617845-016	617845-116	617845-516	1000
516-771-60	516-771-61	516-771-66	Above set

*An inspection certificate and a JCSS calibration certificate are supplied as standard.
Note: For more information, refer to Catalog No.E12014 "Gauge Blocks".



Calibration Instruments

Series 516

Accessory set for Gauge Blocks

- To expand the variety of rectangular gauge block applications, Mitutoyo offers the Gauge Block Accessories Set. By assembling the items in the set, you can build up various precision measuring setups with gauge blocks easily and quickly.

Specifications

Order No.	Description
516-601	22-piece set for rectangular gauge block
516-602	14-piece set for rectangular gauge block
516-605	For long rectangular gauge block (over 125mm)
516-611	For square gauge block

Note: For more information, refer to Catalog No.E12014 "Gauge Blocks".



Rectangular gauge block accessory set



Square gauge block accessory set



Series 516

Maintenance kit for Gauge Blocks

- An essential set for gauge block use, including the tools needed for burr removal before using the gauge block as well as for close-contact work.
- For more information, refer to Catalog No.E12014 "Gauge Blocks".

Set Order No.516-650E

Contents
Ceraston (100×25×12 mm)
Optical flat (ø45, 12 mm thickness, Flatness 0.2 μm)
Tweezers
Blower brush
Cleaning paper (lens paper, 82×304 mm, 500 pcs.)
Artificial leather mat (B4 size)
Reagent bottle (polyethylene container, 100ml)
Gloves



Series 516

Ceraston

- Alumina-ceramic abrasive stone for removing burrs from hard materials such as ceramics that ordinary stones cannot handle. Can be used both for steel gauge blocks and CERA blocks.

Order No.601644 [150(W)×50(D)×20(H)mm]

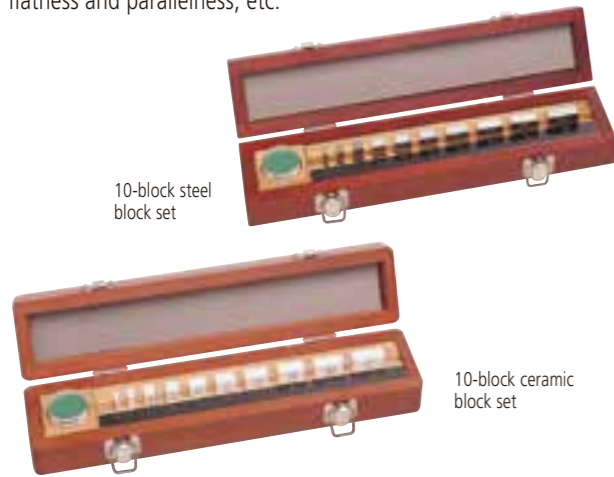
Order No.601644 [100(W)×25(D)×12(H)mm]



Outside Micrometers

Series 516 Gauge Block Set for Micrometer Inspection

- A set of gauge blocks selected for measurement of outside micrometer maximum allowable error, measurement surface flatness and parallelism, etc.



- A dedicated set for micrometer inspection. BM1-10M and BM3-10M are the recommended combination for JIS B 7502-2016 Micrometers "Methods of measuring maximum allowable error." The combined use of BM1-8M and BM3-8M is handy for inspection of the maximum allowable error of large micrometers. BM1-10MK and BM3-10MK are a dedicated set for QuantuMike inspection, in which the spindle moves 2.0 mm per revolution of the thimble.

Specifications

Steel		Ceramic		Blocks per set	Remarks
Order No.	Accuracy	Order No.	Accuracy		
516-103 516-101	Grade 0 Grade 1	516-152 516-153 516-154	Grade 0 Grade 1 Grade 2	10	For outside micrometer 0 - 25mm
516-977-30 516-978 516-979 516-980	Grade K Grade 0 Grade 1 Grade 2	516-378 516-379 516-380	Grade 0 Grade 1 Grade 2	10	
516-106 516-107 516-108	Grade 0 Grade 1 Grade 2	516-156 516-157 516-158	Grade 0 Grade 1 Grade 2	10	Supports JIS B 7502/1994
516-580 516-581 516-582	Grade 0 Grade 1 Grade 2	516-390 516-391 516-392	Grade 0 Grade 1 Grade 2	10	Dedicated for QuantuMike
516-111 516-112 516-113	Grade 0 Grade 1 Grade 2	516-161 516-162 516-163	Grade 0 Grade 1 Grade 2	16	For outside micrometer 0 - 50mm
516-115 516-116 516-117	Grade 0 Grade 1 Grade 2	516-165*1 516-166*1 516-167*1	Grade 0 Grade 1 Grade 2	8	For outside micrometer 0 - 200mm by 25mm pitch

Note: For more information, refer to Catalog No.E12014 "Gauge Blocks".

Series 157 Optical Parallels

- Designed to inspect parallelism and flatness of measuring faces of micrometers.
- Each set consists of 4 sizes to aid in testing parallelism at various angular positions of the micrometer spindle.
- Outside diameter is $\phi 30$ mm



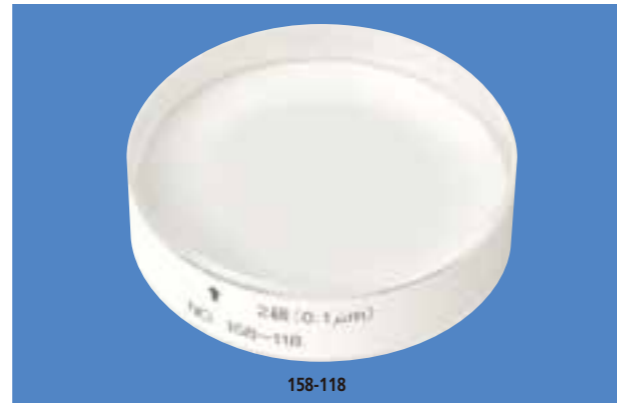
Specifications

Order No.	Application	Thickness (mm)	Flatness (μ m)	Parallelism (μ m)
157-903	Outside micrometer (for 0 - 25mm)	12.00, 12.12 12.25, 12.37	0.1	0.2
157-904	Outside micrometer (for 25 - 50mm)	25.00, 25.12 25.25, 25.37	0.1	0.2

Note: Parallelism for outside micrometer for 50mm or longer model is measured together with the gauge block.

Series 158 Optical Flats

- Used for inspecting the flatness of very flat surface.



Specifications

Order No.	Thickness (mm)	Outside Diameter (mm)	Parallelism (μ m)
158-117	12	$\phi 45$	0.2
158-118			0.1
158-119	15	$\phi 60$	0.2
158-120			0.1

Outside Micrometers

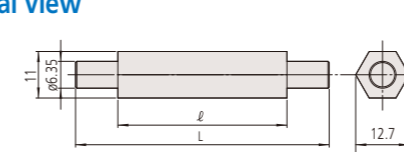
Series 167 Micrometer Standards

- These micrometer standards are used for the zero point setting of outside micrometers (over 50mm).

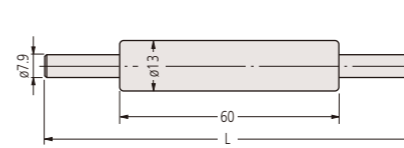


- Accuracy** • Flatness of measuring faces: 0.3μ m • Parallelism between measuring faces: 2.0μ m

External view



Order No.	Length (mm) L	Tolerance (μ m)	ℓ (mm)	Diameter (mm)
167-101	25	± 1.5	18	$\phi 6.35$
167-102	50	± 2.0	40	
167-103	75	± 2.5	40	



Order No.	Length (mm) L	Tolerance (μ m)	Diameter (mm)
167-104	100	± 3	$\phi 7.9$
167-105	125	± 3.5	
167-106	150	± 4	
167-107	175	± 4.5	

Series 167 Micrometer Standards for Screw Thread Micrometers

- Used for accurately setting screw thread micrometers at the start or end of the measuring range.

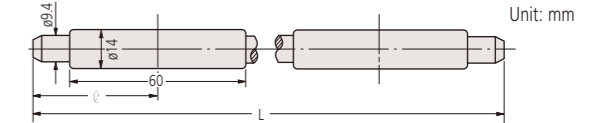


Specifications

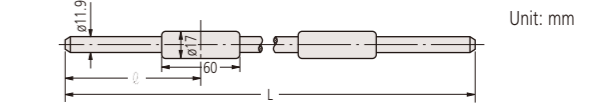
Order No.	Accuracy	Length (mm)
Metric (unified) $\theta=60^\circ$		
167-261	$\pm 4\mu$ m	25
167-262	$\pm 5\mu$ m	50
167-263	$\pm 6\mu$ m	75
167-264	$\pm 7\mu$ m	100
$\theta=55^\circ$		
167-272	$\pm 4\mu$ m	25
167-273	$\pm 5\mu$ m	50
167-274	$\pm 6\mu$ m	75
167-275	$\pm 7\mu$ m	100

Note: Mitutoyo offers other models with the length up to 275mm by 25mm pitch. Inch models are also available.

- Please also refer to our current measuring instruments catalogue to be found on the home page of Mitutoyo. <https://www2.mitutoyo.co.jp/eng/useful/catalog-2021/html5.html#page=1>



Order No.	Length (mm) L	Tolerance (μ m)	ℓ (mm)	Diameter (mm)
167-108	200	± 5.0	47	$\phi 9.4$
167-109	225	± 5.5	47	
167-110	250	± 6.0	52	
167-111	275	± 6.5	57	
167-112	300	± 7	64	
167-113	325	± 7.5	69	
167-114	350	± 8	74	
167-115	375	± 8.5	80	
167-116	400	± 9	85	
167-117	425	± 9.5	90	
167-118	450	± 10	95	
167-119	475	± 10.5	101	



Order No.	Length (mm) L	Tolerance (μ m)	ℓ (mm)	Diameter (mm)
167-120	500	± 11	106	$\phi 11.9$
167-121	525	± 11.5	112	
167-122	550	± 12	117	
167-123	575	± 12.5	122	
167-124	600	± 13	128	
167-125	625	± 13.5	133	
167-126	650	± 14	138	
167-127	675	± 14.5	142	
167-128	700	± 15	147	
167-129	725	± 15.5	153	
167-130	750	± 16	158	
167-131	775	± 16.5	164	
167-132	800	± 17	170	
167-133	825	± 17.5	175	
167-134	850	± 18	180	
167-135	875	± 18.5	185	
167-136	900	± 19	191	
167-137	925	± 19.5	196	
167-138	950	± 20	201	
167-139	975	± 20.5	207	
167-140	1000	± 21	211	

Note: Mitutoyo offers other models with the length up to 2000mm by 25mm pitch. Inch models are also available.

Series 167 Micrometer Standards for V-Anvil Micrometers

- Specially designed for accurately setting of V-anvil micrometers.



Specifications

Order No.	Accuracy	ϕ mm
167-327	$\pm 2\mu$ m	5
167-328	$\pm 2\mu$ m	10
167-329	$\pm 2\mu$ m	25
167-330	$\pm 3\mu$ m	40
167-331	$\pm 3\mu$ m	55
167-332	$\pm 3\mu$ m	70
167-333	$\pm 3\mu$ m	85

Note: Inch models are also available.

Outside Micrometers

Series 156 Micrometer Stands

- A stand for holding micrometers during use.

Specifications

Order No.	Type	Micrometer ranges
156-101-10	Adjustable angle type	15 - 100mm (.6"-4")*
156-105-10	Fixed angle type	25 - 50mm (1"-2")
156-102	Vertical type	100 - 300mm (4"-12")
156-103	Vertical type	325 - 1000mm (13"-40")

*Items that cannot be mounted on these stands (Order No. 406-253-30, 323-253-30, 331-254-30, 342-254-30, 342-264-30, 369-253-30, 422-232-30, 422-233-30, etc.)
Note: Please also refer to our current measuring instruments catalogue to be found on the home page of Mitutoyo.

<https://www2.mitutoyo.co.jp/eng/useful/catalog-2021/html5.html#page=1>



Inside Micrometers

Series 515 CERA Inside Micro-Checker

- The Inside Micro Checker is designed to act as a setting standard for inside micrometers.
- Applicable for SERIES 133, 139 and 145 (over 50 mm). Not applicable for SERIES 137, 141, 337 and 339.

Specifications

Order No.	Zero point setting range	Accuracy
515-585	25 - 300	±(1+L/150)µm
515-586	25 - 600	L: Length to check (mm)

Note 1: Inch models are also available.

Note 2: Please also refer to our current measuring instruments catalogue to be found on the home page of Mitutoyo.

<https://www2.mitutoyo.co.jp/eng/useful/catalog-2021/html5.html#page=1>



Micrometer Oil

- Lubrication and rust-prevention oil.
- Order No.207000* (Volume: 32ml)
- *Not available in certain countries and regions



Holtest/Borematic/Bore Gages

Series 177 Setting Rings

- Used for quick and accurate setting of dial bore gages, Holtest, and inside micrometers.



Specifications Steel Setting Rings

Order No.	Size (mm)	Order No.	Size (mm)
177-220	ø1.0	177-177	ø16.0
177-222	ø1.1	177-133	ø17.0
177-225	ø1.2	177-285	ø18.0
177-227	ø1.3	177-286	ø20.0
177-230	ø1.4	177-139	ø25.0
177-236	ø1.75	177-288	ø30.0
177-239	ø2.0	177-140	ø35.0
177-242	ø2.25	177-290	ø40.0
177-208	ø2.5	177-178	ø45.0
177-246	ø2.75	177-146	ø50.0
177-248	ø3.0	177-292	ø60.0
177-250	ø3.25	177-314	ø62.0
177-252	ø3.5	177-147	ø70.0
177-255	ø3.75	177-316	ø75.0
177-204	ø4.0	177-294	ø80.0
177-257	ø4.5	177-318	ø87.0
177-205	ø5.0	177-148	ø90.0
177-263	ø5.5	177-296	ø100
177-267	ø6.0	177-298	ø125
177-271	ø6.5	177-300	ø150
177-275	ø7.0	177-302	ø175
177-125	ø8.0	177-304	ø200
177-279	ø9.0	177-306	ø225
177-126	ø10.0	177-308	ø250
177-284	ø12.0	177-310	ø275
177-132	ø14.0	177-312	ø300

Note 1: Inch models are also available.

Note 2: Please also refer to our current measuring instruments catalogue to be found on the home page of Mitutoyo.

<https://www2.mitutoyo.co.jp/eng/useful/catalog-2021/html5.html#page=1>

CERA Setting Rings

Order No.	Size (mm)
177-418	ø4.0
177-420	ø6.0
177-423	ø8.0
177-424	ø10.0
177-425	ø12.0
177-427	ø16.0
177-429	ø20.0
177-430	ø25.0
177-431	ø30.0
177-432	ø35.0
177-433	ø40.0
177-434	ø45.0

Accuracy

Size of Setting rings (mm)	Tolerance (µm)	Roundness/Cylindricity (µm)
1 - 45	±10	1.0
Over 45 - 60	±20	
Over 60 - 90		1.5
Over 90 - 100		2.0
Over 100 - 150	2.5	
Over 150 - 225		
Over 225 - 300	3.0	

Note 1: Actual diameter is marked in 0.001 mm increments.

Note 2: Cylindricity is defined as per JIS B 0621

Definitions and designations of geometrical deviations, Section 4.4 "Cylindricity." Cylindricity is measured using three cross-sections between the top and bottom face of a ring, namely, close to the face near each sides and the center.

Series 515 Bore Gage Checker

- The Bore Gage Checker allows easy setting of dial bore gages with ranges of 18mm (.7") through 400mm (16") using gauge blocks.



Specifications

Order No.	Applicable range
515-590	18 - 400mm (.7"-16")

Gauge Blocks

Calibration Instruments

Outside Micrometers

Inside Micrometers

Holtest/Borematic

Bore Gages

Depth Micrometers

Calipers

Height Gages

Dial Indicators

Dial Test Indicators

Electronic Micrometers

Coordinate Measuring Machines

Profile Projectors/Measuring Microscopes

Measuring Table

Depth Micrometers

**Series 515
Depth Micro-Checker**

- The Depth Micro-Checker is designed to check and help set the range-end points of a depth micrometer.



515-570

Specifications

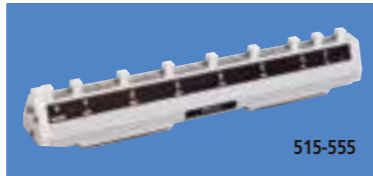
Order No.	Zero point setting range (mm)	Anvil block accuracy
515-570	0 - 150	$\pm(1+L/150)\mu\text{m}$
515-571	0 - 300	L: Length to check (mm)

Note 1: Inch models are also available.
 Note 2: Please also refer to our current measuring instruments catalogue to be found on the home page of Mitutoyo.
<https://www2.mitutoyo.co.jp/eng/useful/catalog-2021/html5.html#page=1>

Calipers and Height Gages

**Series 515
CERA Caliper Checker**

- Enables efficient setting and inspection of calipers and height gages.



515-555

Application for height gage



Specifications

Order No.	Range (mm)	Block pitch accuracy (μm)	Parallelism of blocks (μm)
515-555	20 - 300	± 5	2
515-556-2	20 - 600	$\pm 5, \pm 7$ (range 350 - 600mm)	2, 4 (range 350 - 600mm)

Note 1: Inch models are also available.
 Note 2: Please also refer to our current measuring instruments catalogue to be found on the home page of Mitutoyo.
<https://www2.mitutoyo.co.jp/eng/useful/catalog-2021/html5.html#page=1>

Dial Indicators/Dial Test Indicators/Bore Gages/Lever Head

**Series 170
i-Checker IC2000**

- i-Checker is specially designed to calibrate dial indicators, dial test indicators, and other electronic comparison gage heads.
- Inspection can be performed 2.5 times faster compared to the previous model.
- This instrument achieves the highest accuracy in its class (Mitutoyo survey, February 2016) and therefore guarantees ultra-reliable inspection results.
- Digital indicators equipped with a data output function are checked very efficiently due to spindle positioning at the inspection points and recording of measurement results being under fully automatic control.
- Analog type indicators are inspected in semi-automatic mode with the pointer of the indicator being manually adjusted at each measuring point with automatic transfer of inspection results and movement to the next measuring point.



Specifications

Measuring range	100mm
Resolution	0.01 μm
Accuracy (20°C)	(0.1+0.4L/100) μm L=Measured length (mm)
Feed speed	Max. 10mm/s
Drive method	Motor drive
Measuring unit	Linear encoder
Measurement method	Semi-automatic measurement Fully automatic measurement (only when using an indicator equipped with data output function) *1
Dimensions (Width X Depth X Height)	169x205.5x559.5mm
Mass	20kg
Applied standards	ISO, JIS, JMAS, ANSI, ASME, DIN, VDI/VDE/DGQ*2
Operation temperature range	20 °C \pm 0.5 °C
Power supply	AC100V - 240V \pm 10%, 50/60Hz
Power consumption, maximum (excluding PC)	20W

*1: Automatic measurement requires the indicator's connection cable.
 *2: Compliant with standards including ISO 9493-2010, JIS B 7533-2015 (relevant gauge: TI), DIN 878-2006 (relevant gauge: DG), etc.
 Note 1: Some of indicators require optional stem diameter or attachment for mounting. For details, please contact your local Mitutoyo sales office.
 Note 2: For more information, refer to Catalog No.E12015 "i-Checker".



Calibration of an analog type indicator



Calibration of a digital type indicator



Calibration of a bore gage.



Calibration of a dial test indicator.

Gauge Blocks
Calibration Instruments
Outside Micrometers
Inside Micrometers
Hole and Boremic
Bore Gages
Depth Micrometers
Calipers
Height Gages
Dial Indicators
Dial Test Indicators
Electronic Micrometers
Coordinate Measuring Machines
Profile Projectors/Measuring Microscopes
Measuring Table

Dial Indicators/Dial Test Indicators/Bore Gages/Lever Head

Series 170, 521 Calibration Tester

- 170-102-10**
- UDT-2 is the accuracy tester for 0.01mm resolution/graduation dial indicators, dial test indicators and bore gages.
 - Measuring range is 25mm.
 - For calibration of bore gages, use the optional stand for bore gage inspection (No.12AAK824).*
 - Stem mounting hole: $\varnothing 6, \varnothing 8$ mm (Metric) $\varnothing 1/4", \varnothing 3/8"$ (Inch)
- * Can be used for the inspection of bore gages 511 series standard type and with micrometer head up to 400mm.
- 521-103/521-105**
- The Calibration Tester is specially designed to calibrate short range dial indicators, dial test indicators, and electronic gage heads.
 - Measuring range is 1mm for 521-103 and 5mm for 521-105.

Specifications

Order No.	Graduation	Accuracy (μ m)	Retrace error (μ m)	Range (μ m)
170-102-10	0.001mm	± 1	0.5	0 - 25
521-103	0.0002mm	± 0.2	0.2	0 - 1
521-105	0.0002mm	± 0.8	0.8	0 - 5

Note 1: Inch models are also available.
 Note 2: Please also refer to our current measuring instruments catalogue to be found on the home page of Mitutoyo.
<https://www2.mitutoyo.co.jp/eng/useful/catalog-2021/html5.html#page=1>



Coordinate Measuring Machines (Machine tools/Precision measuring instruments/Semiconductor equipment)

Reference standards for inspecting the travel straightness and axial perpendicularity of moving elements on equipment such as machine tools, CMMs, precision measuring instruments and semiconductor-related equipment. Standards for inspecting positioning accuracy are also available. These standards can also be incorporated in instruments for measuring straightness or perpendicularity.

Series 311 High Precision Square

- The UM is a reference standard for inspecting straightness and perpendicularity, with all 4 faces finished by ultra-precision lapping technology, allowing use as reference planes.
- The product lineup offers a choice of three models as shown in the table.

Specifications

Order No.	Dimension (mm) WxLxT	Reference faces		Side faces		Mass (kg)
		Perpendicularity (μ m)	Straightness (μ m)	Perpendicularity (μ m)	Parallelism (μ m)	
311-111	90x110x25	1	1	5	5	1.5
311-112	160x210x25	1	1	5	5	5.0
311-113*	260x310x30	1	1	5	5	14.0

* 311-113 is supplied with a removal handle.
 Note: Made-to-order



Coordinate Measuring Machines (Machine tools/Precision measuring instruments/Semiconductor equipment)

Series 311 Square Master

- Squareness (perpendicularity) and straightness measurements can be performed accurately and efficiently by just moving a lever. Use the vertical motion handle on the rear of the main unit for operation.



311-215 SL-150 311-225 SL-250 311-245 SL-450

Specifications

Order No.	Accuracy	Vertical travel (mm)	Squareness (μ m)	Straightness (μ m)	Dimension (mm)			Mass (kg)
					Width	Depth	Height	
311-215	SL-150	150	3	2	180	200	420	13.7
311-225	SL-250	250	6	2.5	180	200	520	16.2
311-245	SL-450	450	9	3.5	220	220	720	24

Series 515 Height Master

- Height Master is a bestselling product with a name that has become the industry term for height reference instruments.

Specifications

Order No.	Range (mm)	Resolution (mm)	Remarks
515-322	5 - 310	0.001	Standard
515-374	10 - 310	0.001	Digital
515-376	10 - 460		
515-378	10 - 610		

* Riser Blocks (for increasing the measurable height) are available as optional accessories.

Unit: μ m

Item	Order No.	515-322	515-374	515-376	515-378
Block pitch accuracy	H \leq 310mm	± 1.5			
	310<H \leq 450mm	-	-	-	± 2.5
	310<H \leq 610mm	-	-	-	± 3.5
Parallelism of blocks	H \leq 310mm	1	2		
	310<H \leq 610mm	-	-	-	2.5
Feed error		± 1.0	± 2	± 2.5	

Note 1: Inch models are also available.
 Note 2: Please also refer to our current measuring instruments catalogue to be found on the home page of Mitutoyo.
<https://www2.mitutoyo.co.jp/eng/useful/catalog-2021/html5.html#page=1>

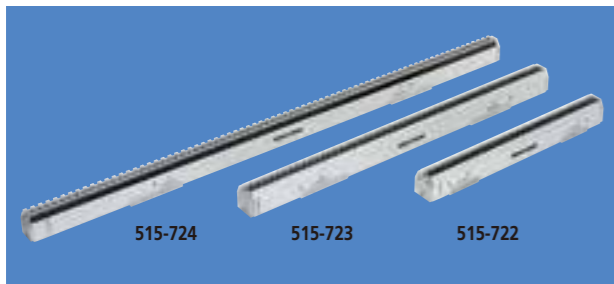


515-374 515-322

Coordinate Measuring Machines (Machine tools/Precision measuring instruments/Semiconductor equipment)

Series 515
Check Master

- Designed to check the accuracy of table movements of machine tools and calibrate CMMs.
- Can be used in either vertical or horizontal orientation.



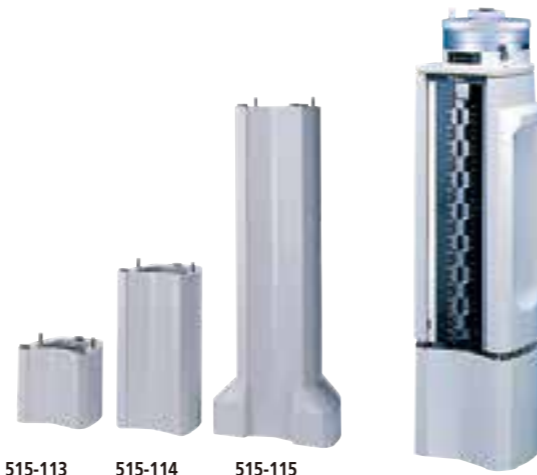
Specifications

Order No.	515-720	515-721	515-722	515-723	515-724
Range	300mm	450mm	600mm	1000mm	1500mm
Block pitch accuracy	H≤310mm	±2.5μm			
	310<H≤610mm	±3.5μm			
	610<H≤1010mm	-	-	-	±5.0μm
Parallelism of blocks	H≤310mm	1.2μm			
	310<H≤610mm	1.5μm			
	610<H≤1010mm	-	-	-	2.0μm
Mass	7kg	10kg	13kg	22kg	30kg

Note: Inch models are also available.

Series 515
Riser Block (HMR)

- These riser blocks are designed to increase the measurable height.
- They can also be used on Square Master models 311-215 and 311-225.



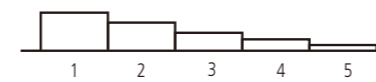
Specifications

Order No.	Accuracy	Height (mm)	Accuracy (μm)	Variation in length (μm)	Mass (kg)
515-113	HMR-150A	150	±0.6	0.6	5.7
515-114	HMR-300A	300	±1.0	0.8	9.8
515-115	HMR-600A	600	±2.0	1	26.8

Profile Projectors/Measuring Microscopes

Series 516
Step Master

- Step Master is a gauge providing 4 small increments in height (steps) constructed from an assembly of 5 highly accurate steel or ceramic blocks.



- Each step is defined as the difference in height between the center of adjacent blocks, measured to a resolution of 0.01μm by using an interferometer with an accuracy tolerance of ±0.20μm.

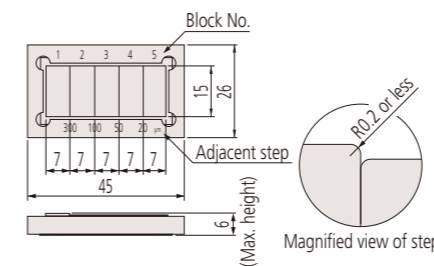
- Steel and ceramic types are available to suit the application.
- Height differences are measured between the centers of adjacent steps.

Specifications

Material	Steel									
Order No.	516-198					516-199				
Material	Ceramic									
Order No.	516-498					516-499				
Block No.	1	2	3	4	5	1	2	3	4	5
Cumulative step (μm)	0	10	15	17	18	0	300	400	450	470
Step value between adjacent blocks (μm)	10	5	2	1		300	100	50	20	

Note: Please also refer to our current measuring instruments catalogue to be found on the home page of Mitutoyo.
<https://www2.mitutoyo.co.jp/eng/useful/catalog-2021/html5.html#page=1>

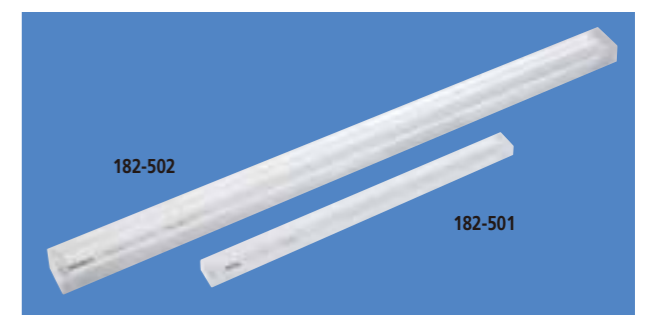
Dimensions



Unit: mm

Series 182
Standard Scales (made-to-order)

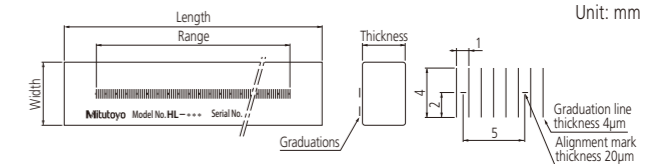
- Glass-made Standard Scales which are considered top-grade length standards.



Specifications

Order No.	182-501-50/182-501-60*	182-502-50/182-502-60*
Range (mm)	250	500
Length (mm)	280	530
Width (mm)	20	30
Thickness (mm)	10	20
Material	Low expansion glass	
Thermal expansion coefficient/K	(0.00±0.02)×10 ⁻⁶	
Graduation line width (μm)	4	
Graduation (mm)	1	
Accuracy (20°C) (μm)	0.5+L/1000 L=Measured length between two lines (mm)	

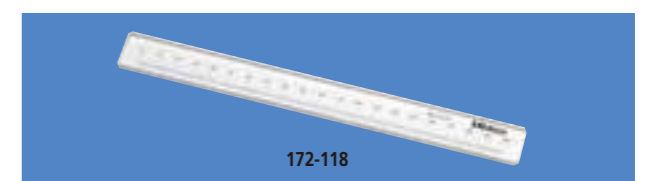
Dimensions



Unit: mm

Series 172
Reading Scales

- A glass scale for checking the magnified image of a standard scale on the projection screen.
- The Reading Scales are specially designed for inspecting the magnified image of a standard scale on the projection screen.



Specifications

Order No.	Length	Graduation	Accuracy
172-118	200mm	0.5mm	(15+15L/1000)μm L=Measured length (mm)
172-161	300mm		
172-329	600mm		

Series 172
Standard Scales

- A glass scale for checking the magnification accuracy in conjunction with a reading scale.



Specifications

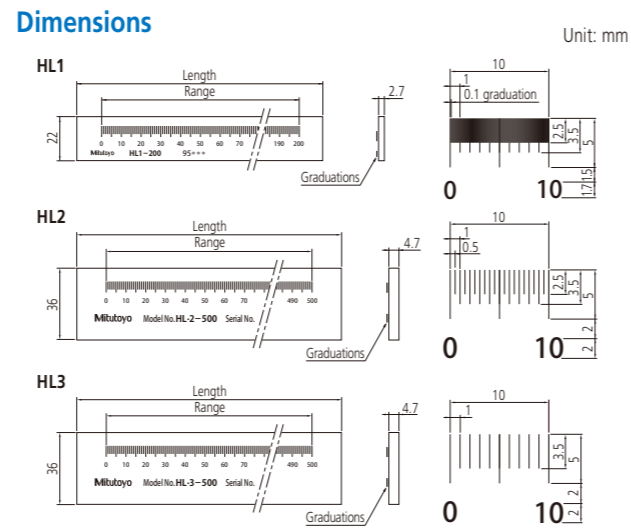
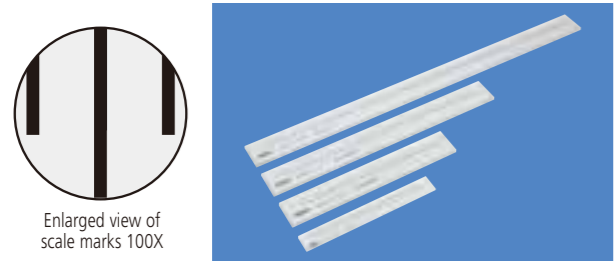
Order No.	Length	Graduation	Accuracy
172-116	50mm	0.1mm	(3+5L/1000)μm L=Measured length (mm)
172-330	80mm		

Gauge Blocks
Calibration Instruments
Outside Micrometers
Inside Micrometers
Hole and Bore Micrometers
Bore Gages
Depth Micrometers
Calipers
Height Gages
Dial Indicators
Dial Test Indicators
Electronic Micrometers
Coordinate Measuring Machines
Profile Projectors/Measuring Microscopes
Measuring Table

Profile Projectors/Measuring Microscopes

Series 182 Working Standard Scales (made-to-order)

- Ideal for checking the table feeding accuracy of measuring equipment and semiconductor production equipment.



Specifications

Order No.	182-511-30	182-512	182-513-30	182-514-30	182-521-30	182-522-30	182-523-30	182-524-30	182-525-30	182-531-30	182-532-30	182-533-30	182-534-30
Range (mm)	50	100	150	200	100	200	300	400	500	250	500	750	1000
Length (mm)	75	125	175	225	130	230	330	430	530	280	530	780	1030
Thermal expansion coefficient/K	8.5×10 ⁻⁶												
Graduation line width (μm)	20			50						100			
Material	Soda-lime glass												
Accuracy (20°C) (μm)	0.5+2L/1000 L=Measured length between two lines (mm)												

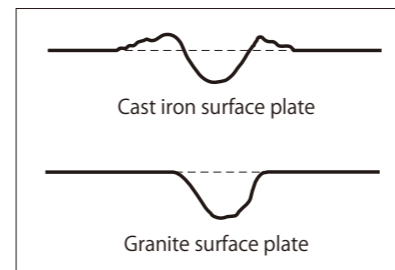
Measuring Table

Series 517 Black Granite Surface Plates

- **Hardly any age-based deterioration**
Black Granite Surface Plate makes use of gabbro, a natural rock with a highly uniform structure that has undergone natural seasoning for several thousands of years, resulting in hardly any age-based deterioration. In comparison, a cast iron surface plate will always be susceptible to age-based deterioration even though heat treatment technologies have undergone remarkable improvements.
- **Excellent abrasion resistance**
With more than twice the hardness of cast iron, the greatest benefit of a Black Granite Surface Plate is its excellent abrasion resistance. (Reference: Shore hardness)

Gabbro	Hs 73 to 93
Granite	Hs 70 to 80
Cast iron	Hs 32 to 40

- **Excellent corrosion resistance**
Excellent corrosion resistance compared with cast iron, with no rusting and little reduction in weight caused even by acid.
- **Resistant to ringing**
Ringing can occur in cast iron surface plates, which can interrupt work. Black Granite Surface Plate is normally resistant to ringing, making work smoother.
- **No burring even if scratched**
 - If the upper surface of a cast iron surface plate is scratched, burring or bulging may occur as the material of the plate is viscous, which will reduce flatness. This will reduce measurement accuracy and could even cause damage to the object being measured or the measuring instrument.
 - Black Granite Surface Plate has a fine-grained hard structure that is less viscous than cast iron, and does not suffer from burring or bulging. This ensures that flatness remains constant and that instruments are not damaged.



- **Non-magnetic**
Black Granite Surface Plate is non-magnetic, and can easily be used even with magnetic instruments.
- **Inexpensive maintenance**
Black Granite Surface Plate does not rust and has a long service life, resulting in much lower maintenance costs compared with a cast iron surface plate.



*2 Optional

1500 x 1000 mm Large Black Granite Surface Plate and standard steel stand *2

750 x 500 mm Black Granite Surface Plate and fall prevention stand *2

Gauge Blocks
Calibration Instruments
Outside Micrometers
Inside Micrometers
Hole and Boremic
Bore Gages
Depth Micrometers
Calipers
Height Gages
Dial Indicators
Dial Test Indicators
Electronic Micrometers
Coordinate Measuring Machines
Profile Projectors/Measuring Microscopes
Measuring Table

Measuring Table

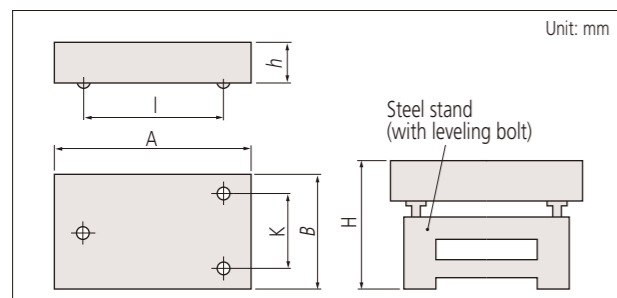
Specifications

Order No.	Grade	Size (mm)			Flatness (μm)	Mass (kg)	Optional stands for black granite surface plates			h (mm)
		WxDxH	d	w			Standard type	with safety frame	with casters (with safety frame)	
517-401	00	300x300x100	240	240	2	27	—	—	—	—
517-301	0				3					
517-101	1				5					
517-411	00	450x300x100	240	390	2	40	—	—	—	—
517-311	0				3					
517-111	1				6					
517-414	00	600x450x100	370	500	2.5	80	517-203	517-203R	517-203CR	755 to 775
517-314	0				4					
517-114	1				8					
517-403	00	600x600x130	500	500	2.5	140	517-204	517-204R	517-204CR	755 to 775
517-303	0				5					
517-103	1				8					
517-405	00	750x500x130	420	630	3	146	517-205	517-205R	517-205CR	755 to 775
517-305	0				5					
517-105	1				9					
517-407	00	1000x750x150	630	700	3	337	517-206	517-206R	517-206CR	755 to 775
517-307	0				6					
517-107	1				12					
517-409	00	1000x1000x150	700	700	3.5	450	517-207	517-207R	517-207CR	735 to 775
517-309	0				7					
517-109	1				13					
517-413	00	1500x1000x200	700	1100	4	900	517-208	517-208R	517-208CR	735 to 775
517-313	0				8					
517-113	1				16					
517-410	00	2000x1000x250	700	1500	4.5	1500	517-209	517-209R	517-209CR	735 to 775
517-310	0				9.5					
517-110	1				19					
517-416	00	2000x1500x300	1100	1500	5	2700	517-210	517-210R	517-210CR	735 to 775
517-316	0				10					
517-116	1				20					
Special-order product	00	2000x2000x350	1500	1500	5.5	4200	06AAY174*1			700 to 706*2
517-317	0				11					
517-117	1				22					
Special-order product	00	3000x1500x400	1100	2000	6.5	5400	06AAY175*1			700 to 706*2
517-318	0				12.5					
517-118	1				25					
Special-order product	00	3000x2000x500	1500	2000	7	9000	06AAY176*1			700 to 706*2
517-319	0				13.5					
517-119	1				27					

*1: It is supported by a dedicated block stand. (There are no options for fall prevention or casters.) Two types of block stands (one for main support and one for auxiliary support) are available, and the usage quantity and height differ depending on the part number.
 *2: Distance from the bottom of the large granite plate block mount to the granite plate top surface.

- In addition to drilling and screw bushing, high-precision, large and special-sized specifications can be custom made. Please contact the local Mitutoyo sales office for details.

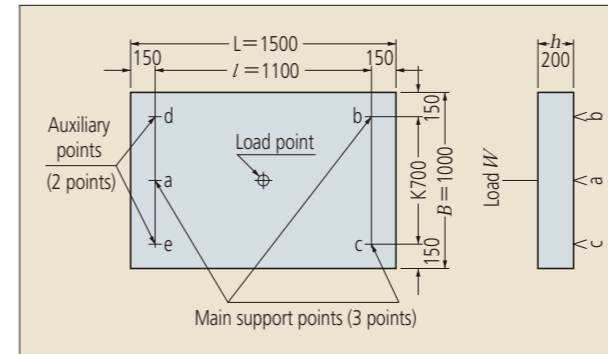
Dimensions



Measuring Table

Main dimensions and specifications of Black Granite Surface Plate 1500 x 1000 x 200 mm

• Dimensions



• Specifications

	Value	Unit	Remarks	
Distance between support points	<i>l</i>	1100	mm	Depends on the size of the Black Granite Surface Plate
Cross section B	<i>B</i>	1000	mm	Depends on the size of the Black Granite Surface Plate
Thickness (cross section h)	<i>h</i>	200	mm	Depends on the size of the Black Granite Surface Plate
Load	<i>W</i>	200	N	JIS value
Young's modulus	<i>E</i>	9.3x10 ⁴	N/mm ²	—
Cross section secondary moment	<i>I</i>	$\frac{1000 \times 200^3}{12}$	mm ⁴	$I = \frac{Bh^3}{12}$
Transverse rupture strength (standard strength)	<i>Pb</i>	26.5	N/mm ²	—
Safety ratio	<i>S</i>	20	—	—
Maximum allowable load	σb	1.325	N/mm ²	$\sigma b = Pb/S$
Section modulus	<i>Z</i>	$\frac{1000 \times 200^2}{6}$	mm ³	$Z = \frac{I}{h/2} = \frac{Bh^2}{6}$
Length	<i>L</i>	1500	mm	Depends on the size of the Black Granite Surface Plate
Temperature difference	ΔT	—	°C	Depends on the installation environment
Linear expansion coefficient	α	5.3x10 ⁻⁶	—	—
Flatness measurement error	<i>V</i>	—	mm	Depends on the installation environment

Precision surface plate grades

- JIS B 7513: 1992 (precision surface plate) stipulates the flatness of the entire surface as follows.

Nominal dimensions of used surface (mm)	Flatness tolerance value of the entire surface (μm)			Excluded width of peripheral section (mm)	Diagonal length (mm)
	Grade 0	Grade 1	Grade 2		
160x 100	3	6	12	2	188
250x 160	3.5	7	14	3	296
400x 250	4	8	16	5	471
630x 400	5	10	20	8	745
1000x 630	6	12	24	13	1180
1600x1000	8	16	33	20	1880
2000x1000	9.5	19	38	20	2236
2500x1600	11.5	23	46	20	2960
250x 250	3.5	7	15	5	354
400x 400	4.5	9	17	8	566
630x 630	5	10	21	13	891
1000x1000	7	14	28	20	1414

- The formula for calculating the flatness of the entire surface is described in "Reference 1. Basics of Flatness Tolerance".

$$t = C_1 l + C_2$$

Here *t*: Flatness tolerance of the entire surface (μm)
l: Nominal length (mm) of the diagonal of the surface plate rounded to the nearest 100 mm
*C*₁, *C*₂: Constant for the grade of the surface plate

Values for *C*₁ and *C*₂

Surface plate grades	<i>C</i> ₁	<i>C</i> ₂
0	0.003	2.5
1	0.006	5
2	0.012	10

- Placing or moving an object on a stone surface plate with dust or dirt adhered may cause the surface to be scratched or worn, which may affect the accuracy. Be sure to wipe any dust or dirt off well before use.

Rigidity of the surface plate

JIS B 7513: 1992 stipulates the rigidity of the precision surface plate as follows. "The rigidity must be such that when a load is applied to the center of the used surface, the deflection of where the load is applied must not exceed 1 μm per 200 N." The deflection is calculated by the following formula, which demonstrates that the Black Granite Surface Plate fully satisfies this standard value. (Ex. For plates measured 1500 x 1000 x 200 mm, the deflection is 0.09 μm)

$$y = \frac{Wl^3}{48EI}$$

Critical strength

As with the main dimensional drawing, the maximum allowable load (*W*_{max}) that can be applied to the center of the surface plate when supported by three support points a, b and c and two auxiliary points d and e can be calculated by the following formula. (Ex. For 1500 x 1000 x 200 mm, the critical strength is 32000 N)

$$W_{max} = \frac{2\sigma b \cdot Bh^2}{3l}$$

Flatness measurement error due to temperature difference

The flatness measurement error that occurs when there is a difference in temperature between the used surface and back surface can easily be determined using the following equation. Note that this is only a reference value as it may differ from the actual result. (Ex.: The flatness measurement error would be 2.2 μm for 1500 x 1000 x 200 mm and a temperature difference of 0.2)

$$V = \alpha(L^2 + B^2)\Delta T/8h$$



Measuring Table

Black Granite Surface Plate has a precise reference plane. Note that the original accuracy may not be maintained if it is improperly installed. It is necessary to pay attention to the following points.

Installation location

- A location with little temperature changes

If large temperature changes occur in the installed environment, there will be a temperature difference between the used surface and back surface, resulting in a flatness measurement error. Avoid installing the Black Granite Surface Plate in a place where temperature changes may occur, such as where there is direct exposure to sunlight or near an air conditioner. Be sure to use it in a stable environment where the temperature difference does not occur as much as possible.

*Recommended environment: Temperature $20 \pm 1^\circ\text{C}$, humidity $58 \pm 2\%$, temperature difference between the front and back surfaces within 0.2°C

- Location without vibration

On the surface plate, measurement is often made using a detector such as a test indicator (lever type dial gauge) or Mu-checker (electric micrometer), so it is necessary to choose a location where there is no vibration so as to prevent the pointer from deviating and becoming difficult to read.

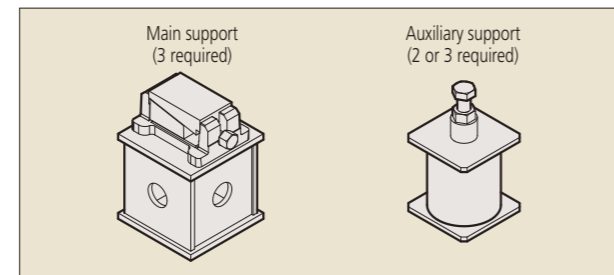
- Location with small particles and dust

Black Granite Surface Plates are widely used not only in precision measurement rooms but also in work sites. Be sure to avoid locations that are affected by small particles, abrasive powder or locations with a large amount of dust.

Support point and installation stand

- For the Black Granite Surface Plate, support legs are attached to three points with the least deflection. For the large Black Granite Surface Plate, it may be necessary to provide multi-point support.
- Stands made of steel, cast iron and other materials are available, such as an integrated type for small to medium Black Granite Surface Plates and a block stand (tripod type) for large Black Granite Surface Plates.

External view of block stand for large Black Granite Surface Plate



Installation height of the used surface

The height of the used surface affects the working efficiency, so it needs to be determined in advance according to the work. Generally, the height of the used surface should be around 750 mm.

Maintaining and Stabilizing Fundamental Technologies in Industry

Traceability of the accuracy of measuring instruments put its basis on calibration standards and instruments that are traceable to nationally or internationally recognized standards. Here is an introduction to our accredited calibration laboratories that guarantee traceability of Mitutoyo's manufacturing, sales and service activities conducted worldwide.



Worldwide Accredited Calibration Laboratories

Mitutoyo has built a network for comprehensive calibration support of precision measuring products in the global market. To provide calibration services on a global scale, Mitutoyo has gained ISO/IEC 17025 certification from the accreditation body in each country, and has issued calibration certificates carrying the mark of each accreditation body. In addition, the calibration certificates issued by each calibration laboratory are mutually recognized in the countries and commercial areas signed in the MRA (Mutual Recognition Arrangement) of ILAC and APAC, or the MLA (Multilateral Arrangement) of EA.

The ISO/IEC 17025 Accreditation List of Mitutoyo Group

Country	Department of Accreditation	Scope	Scope of Calibration Service	Accreditation Body	Accreditation No.	Accredited Date	
Japan	Metrological Standards Calibration Section	Length Temperature	Frequency stabilized laser in the 633nm region Platinum Resistance Thermometer, Thermometer with Indicator	IAJapan, NITE (JCSS)	0067	2017/4/28 2018/8/30	
	Miyazaki Plant	Length	Gauge Block, Step Gauge, etc.	IAJapan, NITE (JCSS)	0030	1994/5/2	
	Utsunomiya Calibration Center	Length	Wavelength of 633nm He-Ne Laser Standard Scale Gauge Block, Step Gauge, Caliper, etc.	IAJapan, NITE (JCSS)	0031	2005/11/1 1998/5/6	
	Kawasaki Calibration Center	Length	Dial Indicator Tester	IAJapan, NITE (JCSS)	0086	2020/2/4	
	Hiroshima Calibration Center	Length Hardness	Caliper, Micrometer, Dial Gauge, etc. Rockwell Hardness Reference Blocks Vickers Hardness Reference Blocks	IAJapan, NITE (JCSS)	0109	2002/4/11 2007/2/21	
	Sales and Service Division	Length Hardness	CMM (On-site Calibration), VMM (On-site Calibration), Surface Roughness Testers (On-site Calibration), Rockwell Hardness Testing Machines (On-site Calibration), Vickers Hardness Testing Machines (On-site Calibration)	IAJapan, NITE (JCSS)	0186	2006/12/27 2019/3/22	
Singapore	Mitutoyo Asia Pacific Pte. Ltd.	Length / Hardness	CMM, VMM, Toolmaker Microscope, Form Measurement, etc.	SAC	LA-1996-0102-C	1996/1/18	
Malaysia	Mitutoyo (Malaysia) Sdn. Bhd.	Length / Hardness	CMM, VMM, Toolmaker Microscope, Form Measurement, etc.	STANDARDS MALAYSIA	SAMM 152	1998/10/15	
Indonesia	PT. Mitutoyo Indonesia	Length / Hardness	CMM, VMM, Toolmaker Microscope, Form Measurement, etc.	KAN	LK-183-IDN	2014/8/20	
Thailand	Mitutoyo (Thailand) Co., Ltd.	Length	CMM, VMM, Toolmaker Microscope, Form Measurement, etc.	TISI	0258	2015/5/29	
Vietnam	Mitutoyo Vietnam Co., Ltd.	Length	CMM, VMM, Toolmaker Microscope, Form Measurement, etc.	BoA	VILAS 741	2014/4/18	
India	Mitutoyo South Asia Pvt. Ltd.	Length / Hardness	Caliper, Micrometer, Dial Gauge, etc.	NABL	CC-2522	2006/2/3	
Taiwan	Mitutoyo Taiwan Co., Ltd.	Length / Hardness	Gauge Block, VMM, Form Measurement, CMM, Hardness Reference Block etc.	TAF	0336	1998/6/15	
Korea	Mitutoyo Korea Corporation	Length	Form Measurement, CMM, VMM, Height gage, Caliper, Dial Indicator, etc.	KOLAS	KC16-321	2016/11/10	
China	Mitutoyo Measuring Instruments (Shanghai) Co., Ltd.	Length	Caliper, Micrometer, Dial Gauge, etc.	CNAS	CNAS L5506	2012/2/28	
U.S.A.	Mitutoyo America Corporation	Length / Hardness	Gauge Block, Caliper, CMM, etc. (On-site Calibration)	A2LA	0750.01	1998/4/07	
Canada	Mitutoyo Canada Inc.	Length / Hardness	Gauge Block, Caliper, Micrometer, etc.	CLAS/SCC	15587	2003/10/07	
Mexico	Mitutoyo Mexicana, S.A. de C.V.	Length	Gauge Block, Micrometer, Dial Gauge, Standard Scale, Caliper, CMM, VMM, Form Measurement, etc.	ema	D-45	2011/9/1	
		Length	Caliper, Micrometer, Dial Gauge, Standard Scale, etc.			D-45-51	2014/12/12
		Hardness	Hardness Testing Machine, etc.			DZA-28	2015/1/21
Germany	Mitutoyo Deutschland GmbH	Length	Laserinterferometers, Gauge Block, Caliper, CMM, VMM, Standard Scale, Step Gauge, Dial Gauge Tester, Roughness Specimen, Surf-test, Micrometer Setting Standards, etc.	DAKKS	D-K-15096-01-00	1995/1/10	
U.K.	Mitutoyo (UK) Ltd.	Length	Gauge Block, Caliper, CMM, VMM, etc.	UKAS	0332	1990/7/30	
Italy	Mitutoyo Italiana S.r.l.	Length	Gauge Block, Reference hemisphere, CMM, Standard Scale, Step Gauge, etc.	ACCREDIA	LAT N. 107	1998/5/1	
Netherlands	Mitutoyo Nederland B.V.	Length / Temperature	Gauge Block, CMM, VMM, Form Measurement, etc.	RvA	K 086	1994/10/14	
Sweden	Mitutoyo Scandinavia AB	Length	Gauge Block, CMM	SWEDAC	1794	2002/3/4	
Switzerland	Mitutoyo Schweiz AG	Length	Gauge Block, CMM, VMM, Height Gage, Caliper, Dial Gauge, etc.	SAS	SCS 0074	1996/12/18	
Poland	Mitutoyo Polska Sp.z o.o.	Length	CMM	PCA	AP 197	2021/8/17	
Czech Republic	Mitutoyo Česko s.r.o.	Length	CMM, Form Measurement	CIA	650/2019	2016/12/8	
Hungary	Mitutoyo Hungária Kft.	Length	Caliper, Micrometer, Dial Gauge, CMM, VMM, Optical Instruments	NAH	NAH-2-0341/2018	2018/11/5	
Brazil	Mitutoyo Sul Americana Ltda.	Length / Hardness	Gauge Block, Caliper, CMM, Rockwell Hardness Testing Machine, etc.	Cgcre	0031	1992/9/15	
Argentina		Length	Micrometer, CMM, etc.	OAA	LC 010	2002/11/7	

- Japan: IAJapan, NITE, JCSS
- Singapore: SAC
- Malaysia: STANDARDS MALAYSIA
- Indonesia: KAN
- Thailand: TISI
- Vietnam: BoA
- India: NABL
- Taiwan: TAF
- Korea: KOLAS
- China: CNAS
- U.S.A.: A2LA
- Canada: CLAS/SCC
- Mexico: ema
- Germany: DAKKS
- U.K.: UKAS
- Italy: ACCREDIA
- The Netherlands: RvA
- Sweden: SWEDAC
- Switzerland: SAS
- Poland: PCA
- Czech Republic: CIA
- Hungary: NAH
- Brazil: Cgcre
- Argentina: OAA
- International Accreditation Japan
- National Institute of Technology and Evaluation
- Japan Calibration Service System
- Singapore Accreditation Council
- STANDARDS MALAYSIA
- Komite Akreditasi Nasional
- Thai Industrial Standards Institute
- BUREAU OF ACCREDITATION
- National Accreditation Board for Testing and Calibration Laboratories
- Taiwan Accreditation Foundation
- Korea Laboratory Accreditation Scheme
- China National Accreditation Service for Conformity Assessment
- American Association for Laboratory Accreditation
- Calibration Laboratory Assessment Service/Standards Council of Canada
- Entidad Mexicana de Acreditación, a.c
- Deutsche Akkreditierungsstelle GmbH
- United Kingdom Accreditation Service
- L'ENTE ITALIANO DI ACCREDITAMENTO
- Raad voor Accreditatie
- Swedish Board for Accreditation and Conformity Assessment
- Swiss Accreditation Service
- Polskie Centrum Akredytacji
- Czech Institute for Accreditation
- Nemzeti Akkreditáló Hatóság
- Coordenação Geral de Acreditação do INMETRO
- Organismo Argentino de Acreditación

Certificate of UKAS accredited Laboratory (Mitutoyo (UK) in England)

Certificate of DAkkS accredited Laboratory (Mitutoyo Deutschland in Germany)

Certificate of JCSS accredited laboratory (Mitutoyo Metrological Standards Calibration Section in Japan)

Certificate of A2LA accredited laboratory (Mitutoyo America in U.S.A.)

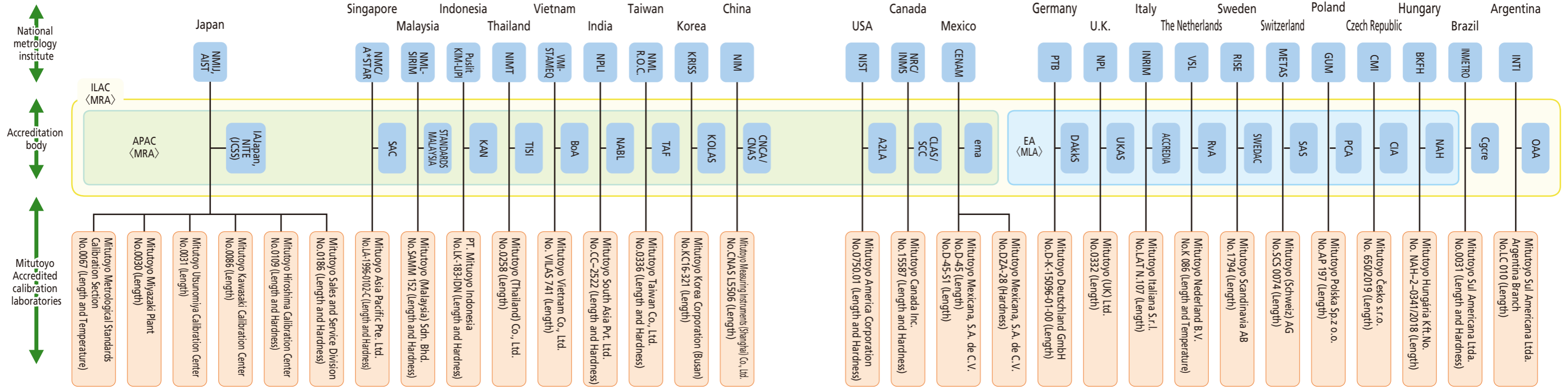
Certificate of RvA accredited laboratory (Mitutoyo Nederland in the Netherlands)

Certificate of CNAS accredited laboratory (Mitutoyo Measuring Instruments (Shanghai) in China)

Certificate of Cgcre accredited laboratory (Mitutoyo Sul Americana in Brazil)

Name of each national metrology institutes and accreditation bodies are based on our survey. As of November, 2021

Traceability System to National Standard



● Japan
 AIST : National Institute of Advanced Industrial Science and Technology
 NMIJ : National Metrology Institute of Japan
 IAJapan : International Accreditation Japan
 NITE : National Institute of Technology and Evaluation
 JCSS : Japan Calibration Service System

● Singapore
 NMC/A*STAR : National Metrology Centre/ Agency for Science, Technology and Research
 SAC : Singapore Accreditation Council

● Malaysia
 NML-SIRIM : National Metrology Laboratory-Standards and Industrial Research Institute of Malaysia
 STANDARDS MALAYSIA : STANDARDS MALAYSIA

● Indonesia
 Puslit KIM-LIPI : Research Center for Calibration, Instrumentation and Metrology- Indonesian Institute of Science
 KAN : Komite Akreditasi Nasional

● Thailand
 NIMT : National Institute of Metrology (Thailand)
 TISI : Thai Industrial Standards Institute

● Vietnam
 VMI-STAMEQ : Vietnam Metrology Institute, Directorate for Standards and Quality
 BoA : BUREAU OF ACCREDITATION

● India
 NPLI : National Physical Laboratory of India
 NABL : National Accreditation Board for Testing and Calibration Laboratories

● Taiwan
 NML R.O.C. : National Measurement Laboratory R.O.C.
 TAF : Taiwan Accreditation Foundation

● Korea
 KRISS : Korea Research Institute of Standards and Science
 KOLAS : Korea Laboratory Accreditation Scheme

● China
 NIM : National Institute of Metrology
 CNCA : Certification and Accreditation Administration of the people's republic of China
 CNAS : China National Accreditation Service for Conformity Assessment

● U.S.A.
 NIST : National Institute of Standards and Technology
 AZLA : American Association for Laboratory Accreditation

● Canada
 NRC/INMS : National Research Council Canada / Institute for National Measurement Standards
 CLAS/SCC : Calibration Laboratory Assessment Service / Standards Council of Canada

● Mexico
 CENAM : Centro Nacional de Metrologia
 ema : Entidad Mexicana de Acreditación, a.c

● Germany
 PTB : Physikalisch-Technische Bundesanstalt
 DAkkS : Deutsche Akkreditierungsstelle GmbH

● U.K.
 NPL : National Physical Laboratory
 UKAS : United Kingdom Accreditation Service

● Italy
 INRIM : Istituto Nazionale di Ricerca Metrologica
 ACCREDIA : L'ENTE ITALIANO DI ACCREDITAMENTO

● The Netherlands
 VSL : Van Swinden Laboratorium
 RvA : Raad voor Accreditatie

● Sweden
 RISE : RISE Research Institutes of Sweden AB
 SWEDAC : Swedish Board for Accreditation and Conformity Assessment

● Switzerland
 METAS : The Federal Institute of Metrology
 SAS : Swiss Accreditation Service

● Poland
 GUM : Główny Urząd Miar - the National Metrology Institute in Poland
 PCA : Polskie Centrum Akredytacji

● Czech Republic
 CMI : Český Metrologický Institut
 CIA : Český Institut pro Akreditaci

● Hungary
 BKFH : Government Office of the Capital City Budapest
 NAH : Nemzeti Akkreditáló Hatóság

● Brazil
 INMETRO : Instituto Nacional de Metrologia Qualidade e Tecnologia
 Cgcre : Coordenação Geral de Acreditação do INMETRO

● Argentina
 INTI : Instituto Nacional de Tecnología Industrial
 OAA : Organismo Argentino de Acreditación

ILAC: International Laboratory Accreditation Cooperation APAC: Asia-Pacific Accreditation Cooperation MLA: Multilateral Agreement
 Name of each national metrology institutes and accreditation bodies are based on our survey.
 The names of registered operations in this document are based on JCSS certifications.

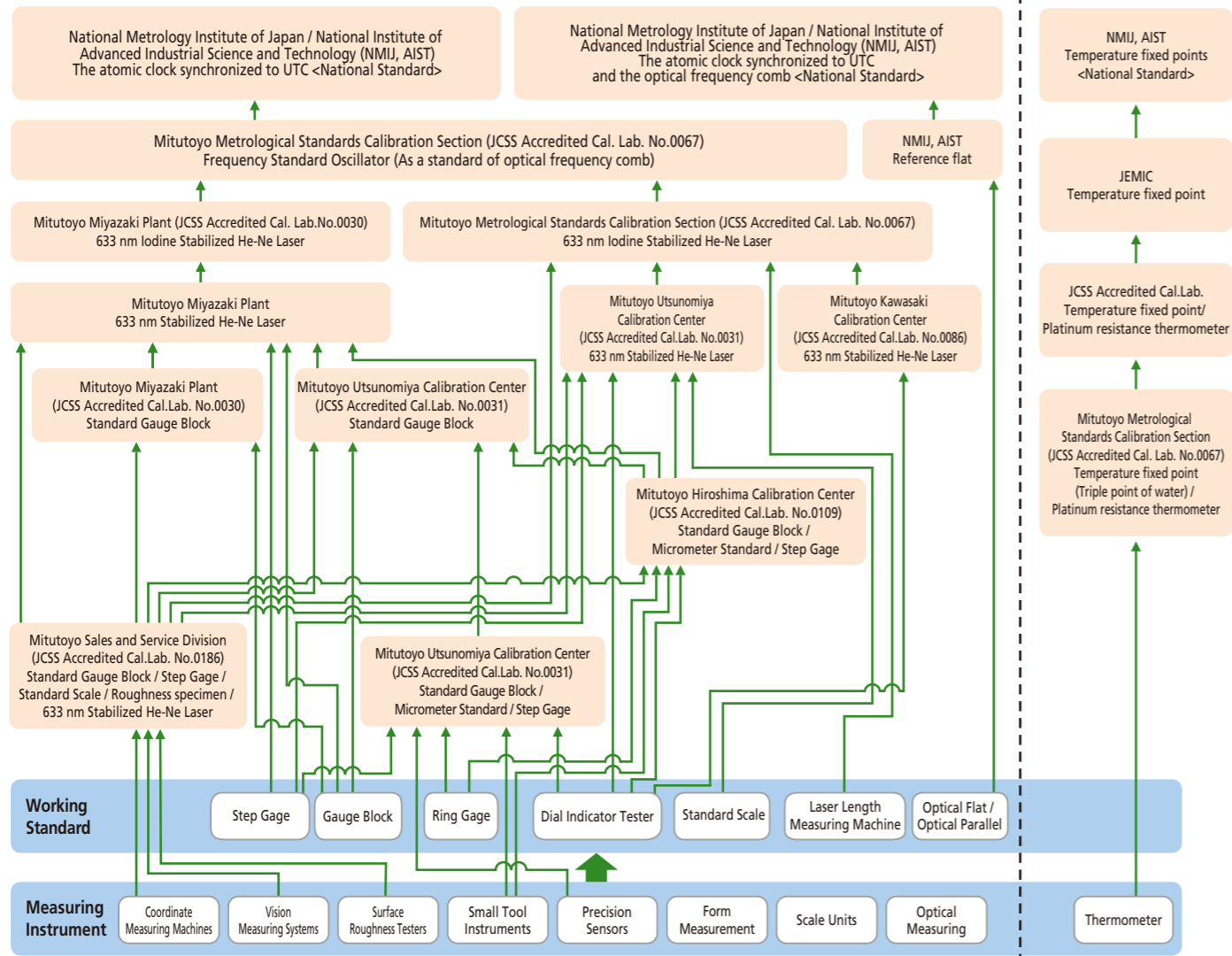
MRA: Mutual Recognition Arrangement EA: European co-operation for Accreditation

Traceability of Mitutoyo Standards

Mitutoyo ensures and maintains traceability of various types of precision measuring instruments by holding standards of length and other physical quantities that are directly traceable to the national standards for use in calibrating the working standards used for the calibration of measuring instrument products supplied to industry. Furthermore, Mitutoyo offers a temperature calibration service which is indispensable for high-accuracy length measurement. In addition, Mitutoyo ensures and maintains traceability of its test equipment such as hardness testing machines and vibrometers.

Traceability of Length Field

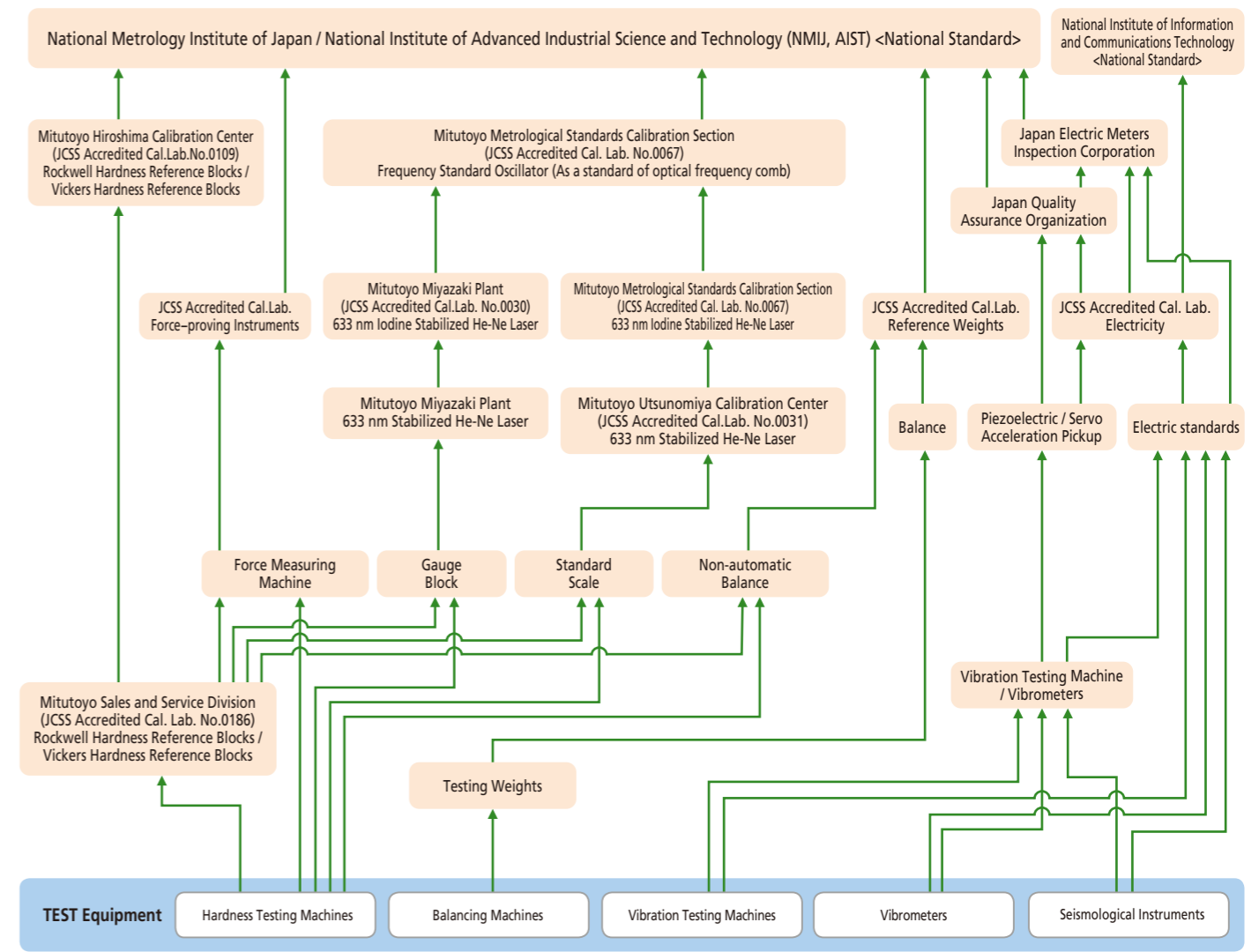
Traceability of Temperature



Note 1: This chart shows a simplified traceability system of a part of Mitutoyo products. Detailed traceability charts are published for each product.
 Note 2: For the latest information, please refer to our website. <https://www.mitutoyo.co.jp>

As of March, 2022

Traceability of Test Equipment



Note 1: This chart shows a simplified traceability system of a part of Mitutoyo products. Detailed traceability charts are published for each product.
 Note 2: For the latest information, please refer to our website. <https://www.mitutoyo.co.jp>

As of March, 2022

Offering high-level services globally based on measurement capabilities of the same level as national standards

Traceability system

Mitutoyo ensures and maintains traceability of various types of precision measuring machines by holding length standards (the optical frequency comb^{*1}), etc., directly traceable to the national standards for use in calibrating the working standards used for the calibration of measuring instrument products supplied to industry. Regarding the calibration service using the optical frequency comb as the standard, this provides performance equivalent to that of Japan's National Length Standard and for which we have obtained accreditation by the Japan Calibration Service System (JCSS)^{*2}. Mitutoyo calibration centers have gained JCSS accreditation from IAJapan^{*3}, the accreditation organization internationally recognized by the MRA^{*4} of ILAC^{*5}, and the measuring technology capabilities of these centers are therefore recognized as equivalent to those of overseas calibration organizations. In addition, our calibration centers are also available as an external laboratory specified by various quality management systems (IATF 16949 standard, etc.) when customers are outsourcing their calibration service.

Since Mitutoyo has achieved the highest level of traceability for our measurement instruments both in Japan and overseas, customers can use our products with absolute confidence.

*1: External view of the optical frequency comb



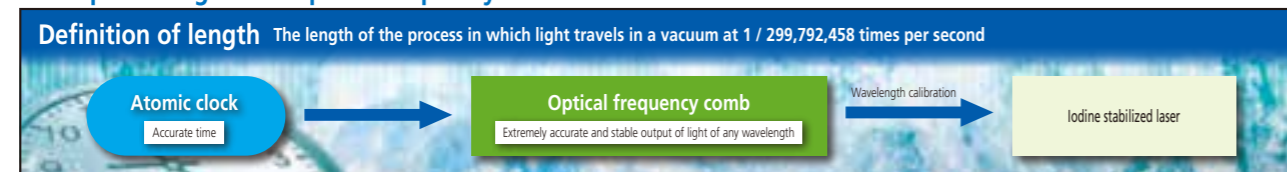
*2: J CSS (Japan Calibration Service System): A system for reviewing the conformity of a calibration service to the international standard ISO/IEC 17025 on the basis of the Measurement Law and registering accredited calibration laboratories

*3: IAJapan (International Accreditation Japan in NITE Accreditation Center): Nominal designation of accreditation organizations such as JCSS situated in the National Institute of Technology and Evaluation (NITE)

*4: MRA (Mutual Recognition Agreement) : An agreement made by mutually evaluating and confirming that accreditation bodies in different economic zones are accrediting calibration laboratories with equivalent capabilities based on the same standards.

*5: ILAC (International Laboratory Accreditation Cooperation): A conference body with the aim of developing international cooperation by promoting the mutual acceptance of accredited test and calibration results

Conceptual diagram of optical frequency comb



There is a video explaining "Traceability" in the "Video Library" on our homepage.

Refer to <https://bcove.video/3juM1jq>



Coordinate Measuring Machines



Vision Measuring Systems



Form Measurement



Optical Measuring



Sensor Systems



Test Equipment



Digital Scale and DRO Systems



Small Tool Instruments and Data Management



Whatever your challenges are, Mitutoyo supports you from start to finish.

Mitutoyo is not only a manufacturer of top quality measuring products but one that also offers qualified support for the lifetime of the equipment, backed up by comprehensive services that ensure your staff can make the very best use of the investment.

Apart from the basics of calibration and repair, Mitutoyo offers product and metrology training, as well as IT support for the sophisticated software used in modern measuring technology. We can also design, build, test and deliver measuring solutions and even, if deemed cost-effective, take your critical measurement challenges in-house on a sub-contract basis.



Find additional product literature and our product catalogue

<https://www.mitutoyo.co.jp/global.html>

Our products are classified as regulated items under Japanese Foreign Exchange and Foreign Trade Law. Please consult us in advance if you wish to export our products to any other country. If the purchased product is exported, even though it is not a regulated item (Catch-All controls item), the customer service available for that product may be affected. If you have any questions, please consult your local Mitutoyo sales office.

Note: Product illustrations are without obligation. Product descriptions, in particular any and all technical specifications, are only binding when explicitly agreed upon.
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Mitutoyo

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<https://www.mitutoyo.co.jp>