

Sheet Metal Micrometer SERIES 119

- Large diameter dial model enables easy and quick measurement of sheet metal thickness.
- Equipped with Ratchet Stop for constant measuring force.
- Adjustable anvil.
- Measuring faces: Carbide



Technical Data

Standard accessories: Spanner (200168), 1 pc

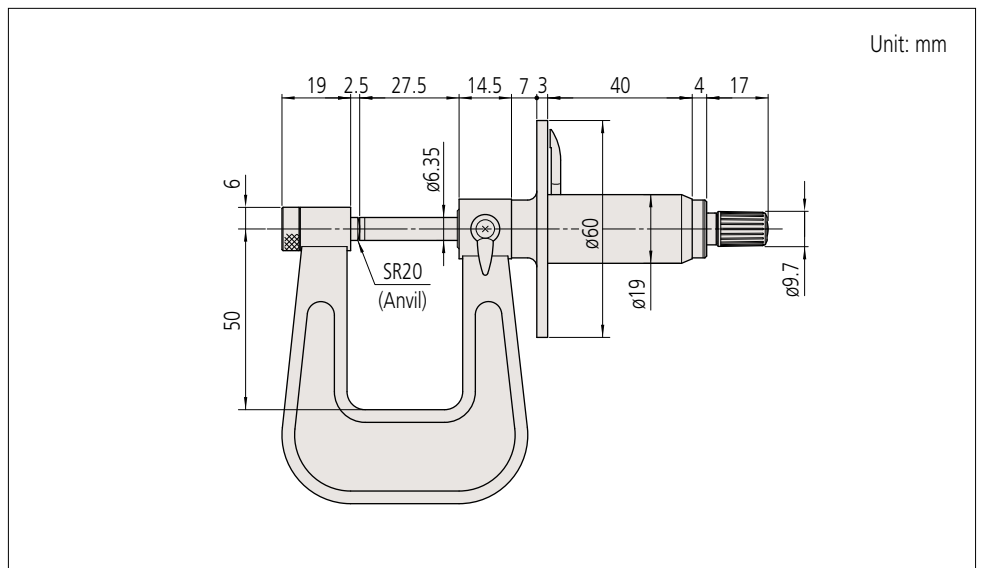


119-202

SPECIFICATIONS

Metric				
Order No.	Range	Graduation	Accuracy	Throat depth
119-202	0 - 25mm	0.01mm	±4μm	50mm

DIMENSIONS



Micrometer

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Tube Micrometers SERIES 395, 115, 295

- Measuring faces: Carbide (**115-101**: only the spindle is carbide tipped.)
- series 395: IP65 digital spherical-flat anvil type micrometer.
- Equipped with Ratchet Stop for constant measuring force.



SPECIFICATIONS

Metric				
Order No.	Range	Resolution	Accuracy*	∅D
Digimatic (LCD)				
395-251-30	0 - 25mm	0.001mm	±2μm	∅15
395-252-30	25 - 50mm			
395-253-30	50 - 75mm			∅19
395-254-30	75 - 100mm			

* Excluding quantizing error

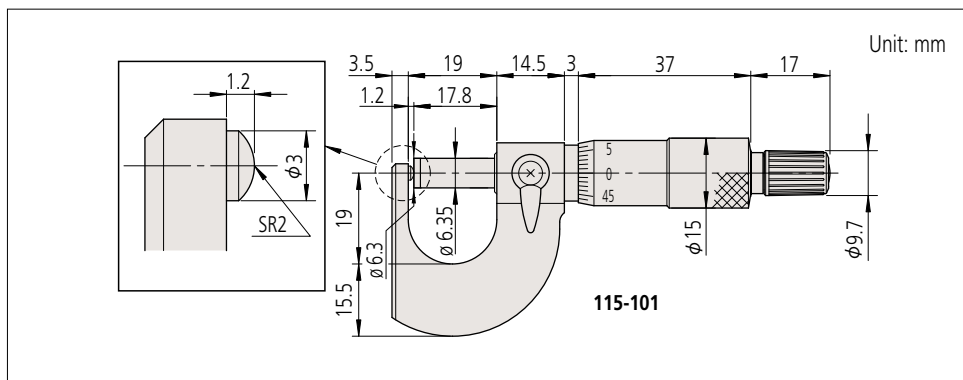
Metric				
Order No.	Range	Graduation	Accuracy	∅D
Analog				
115-101	0 - 15mm	0.01mm	±3μm	∅5.5
115-115	0 - 25mm			∅10
115-116	25 - 50mm			∅11
115-117	50 - 75mm			∅17
115-118	75 - 100mm			∅18
Mechanical counter model				
295-115	0 - 25mm		±3μm	∅10

Inch/Metric				
Order No.	Range	Resolution	Accuracy*	∅D
Digimatic (LCD)				
395-351-30	0 - 1"	.00005" / 0.001mm	±.0001"	∅.59"
395-352-30	1" - 2"			
395-353-30	2" - 3"			∅.75"
395-354-30	3" - 4"			

* Excluding quantizing error

Inch				
Order No.	Range	Graduation	Accuracy	∅D
Analog				
115-153	0 - 1"	.0001"	±.00015"	∅.40"
Mechanical counter model				
295-153	0 - 1"	.0001"	±.00015"	∅.40"

DIMENSIONS



These marks indicate that a product has successfully passed IP65-level testing, which is carried out by the independent German certification organization TÜV Rheinland.



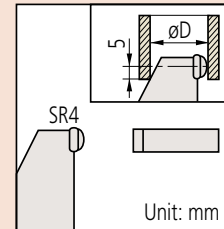
(Refer to page X for details.)

IP Codes (series 395)

- Level 6: Dust-proof.
No ingress of dust allowed.
- Level 5: Protected against water jets.
Water projected in jets against the enclosure from any direction shall have no harmful effects.

Technical Data

Flatness: 0.6μm / .000024" (series 115 & 295)
0.3μm / .000012" (series 395)



Battery for series 395

SR44 (1 pc), **938882**, for initial operational checks (standard accessory)
Battery life: Approx. 2.4 years under normal use (for series 395)
Length standard: Electromagnetic rotary sensor (for series 395)
Standard accessories: Reference bar, 1 pc (except for measuring range 0-15mm/0-25mm (0-1") models)
Spanner (200168), 1 pc (for series 115-101)
Spanner (301336), 1 pc (for models other than series 115-101)

Optional accessories

Connecting cables for **series 395**
1m: **05CZA662**
2m: **05CZA663**
USB Input Tool Direct
USB-ITN-B (2m): **06ADV380B**
Connecting cables for **U-WAVE-T**
02AZD790B 160mm
For foot switch: **02AZE140B**
Refer to page B-68 for details.

Micrometer

The origin of Mitutoyo's trustworthy brand of small tool instruments

Tube Micrometers

SERIES 395, 115, 295 — Spherical and Cylindrical Anvil Type

- Spindle face: Carbide
- series 395: IP65 spherical and cylindrical anvil type digital micrometers
- Equipped with Ratchet Stop for constant measuring force.



395-261-30



SPECIFICATIONS

Metric				
Order No.	Range	Resolution	Accuracy*	Remarks
Digimatic (LCD)				
395-261-30	0 - 25mm	0.001mm	±3µm	Type A
395-262-30				Type B
395-263-30				Type C
395-264-30				Type D

* Excluding quantizing error

Metric				
Order No.	Range	Graduation	Accuracy	Remarks
Analog				
115-302	0 - 25mm	0.01mm	±3µm	Type A
115-308				Type B
115-303				Type A
115-309	25 - 50mm			Type B
115-315	0 - 25mm			Type C
115-316				Type D

Inch/Metric				
Order No.	Range	Resolution	Accuracy*	Remarks
Digimatic (LCD)				
395-362-30	0 - 1"	.00005"/ 0.001mm	±.00015"	Type B
395-363-30				Type C
395-364-30				Type D

* Excluding quantizing error

Inch				
Order No.	Range	Graduation	Accuracy	Remarks
Analog				
115-305	0 - 1"	.001"	±.00015"	Type A
115-313				Type C
115-314		.0001"		Type D



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(Refer to page X for details.)

IP Codes (series 395)

Level 6: Dust-proof.

No ingress of dust allowed.

Level 5: Protected against water jets.

Water projected in jets against the enclosure from any direction shall have no harmful effects.

Type A (pin)



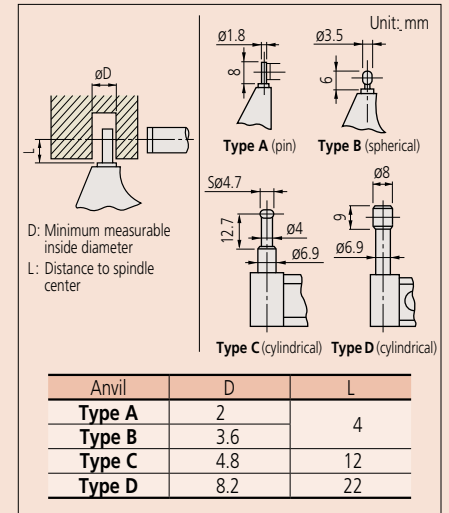
Type B (spherical)



Type C (cylindrical)



Type D (cylindrical)



Battery for series 395

SR44 (1 pc), 938882, for initial operational checks (standard accessory)

Battery life: Approx. 2.4 years under normal use (for series 395)

Length standard: Electromagnetic rotary sensor (for series 395)

Standard accessories: Reference bar, 1 pc (except for measuring range 0-25mm (0-1") models)

Spanner (301336), 1 pc

Optional accessories

Connecting cables for series 395

1m: 05CZA662

2m: 05CZA663

USB Input Tool Direct

USB-ITN-B (2m): 06ADV380B

Connecting cables for U-WAVE-T

02AZD790B 160mm

For foot switch: 02AZE140B

Refer to page B-68 for details.

IP Codes (series 331)

Level 6: Dust-proof.

No ingress of dust allowed.

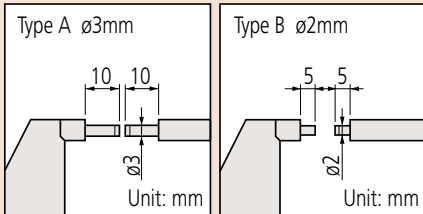
Level 5: Protected against water jets.

Water projected in jets against the enclosure from any direction shall have no harmful effects.

Technical Data

Flatness: $0.3\mu\text{m}/.000012''$

Parallelism: $(2+R/100)\mu\text{m}$, R = max. range (mm)
 $[.00008'' + .00004(R/4)]''$ R = max range (inch)
 fraction rounded down



Battery for series 331

SR44 (1 pc), **938882**, for initial operational checks (standard accessory)

Battery life: Approx. 2.4 years under normal use (for series 331)

Length standard: Electromagnetic rotary sensor (for series 331)

Standard accessories: Reference bar, 1 pc (except for measuring range 0-25mm (0-1") models)
 Spanner (301336), 1 pc

Optional accessories

Connecting cables for series 331

1m: **05CZA662**

2m: **05CZA663**

USB Input Tool Direct

USB-ITN-B (2m): **06ADV380B**

Connecting cables for **U-WAVE-T**

02AZD790B 160mm

For foot switch: **02AZE140B**

Refer to page B-68 for details.

Spline Micrometers SERIES 331, 111, 131

- The anvil and spindle are of small diameter for measuring splined shafts, slots, and keyways.
- IP65 water/dust protection (series 331).
- Measuring faces: Carbide
- Equipped with Ratchet Stop for constant measuring force.



331-251-30



111-115

SPECIFICATIONS

Metric				
Order No.	Range	Resolution	Accuracy*	Remarks
Digimatic (LCD)				
331-251-30	0 - 25mm	0.001mm	±2μm	Type A
331-252-30	25 - 50mm			
331-253-30	50 - 75mm			
331-254-30	75 - 100mm			
331-261-30	0 - 25mm	0.001mm	±2μm	Type B
331-262-30	25 - 50mm			
331-263-30	50 - 75mm			
331-264-30	75 - 100mm			

* Excluding quantizing error

Inch/Metric				
Order No.	Range	Resolution	Accuracy*	Remarks
Digimatic (LCD)				
331-351-30	0 - 1"	.00005"/ 0.001mm	±.0001"	Type A
331-352-30	1" - 2"			
331-353-30	2" - 3"			
331-354-30	3" - 4"			
331-361-30	0 - 1"	.00005"/ 0.001mm	±.0001"	Type B
331-362-30	1" - 2"			
331-363-30	2" - 3"			
331-364-30	3" - 4"			

* Excluding quantizing error

Metric				
Order No.	Range	Graduation	Accuracy	Remarks
Analog				
111-215	0 - 25mm	0.01mm	±3μm	Type B
111-115	0 - 25mm			
111-116	25 - 50mm			
111-117	50 - 75mm			
111-118	75 - 100mm	0.01mm	±4μm	Type A
111-119	100 - 125mm			
111-120	125 - 150mm			
111-121	150 - 175mm			
111-122	175 - 200mm	0.01mm	±5μm	Type A
111-123	200 - 225mm			
111-124	225 - 250mm			
111-125	250 - 275mm			
111-126	270 - 300mm	0.01mm	±6μm	Type A
131-115	0 - 25mm			
Mechanical counter model				
131-115	0 - 25mm		±3μm	Type A

Inch				
Order No.	Range	Graduation	Accuracy	Remarks
Analog				
111-166	0 - 1"	.0001"	±.00015"	Type A

Micrometer

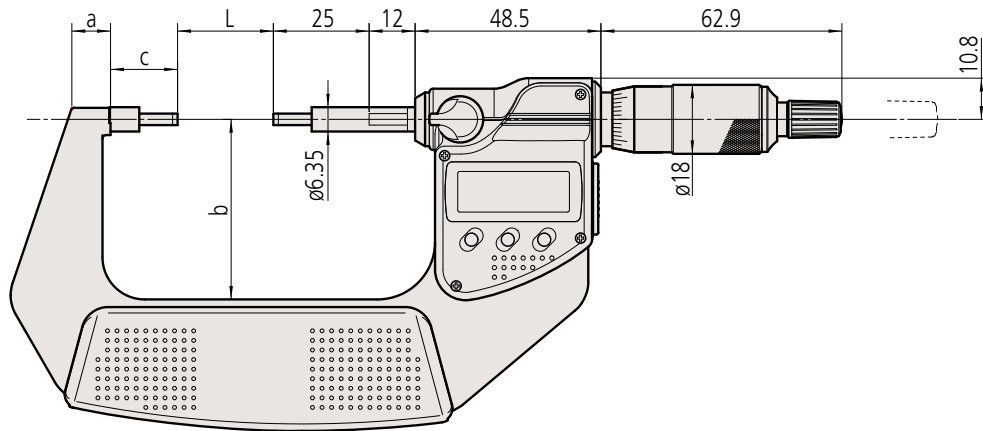
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DIMENSIONS

Digital Models

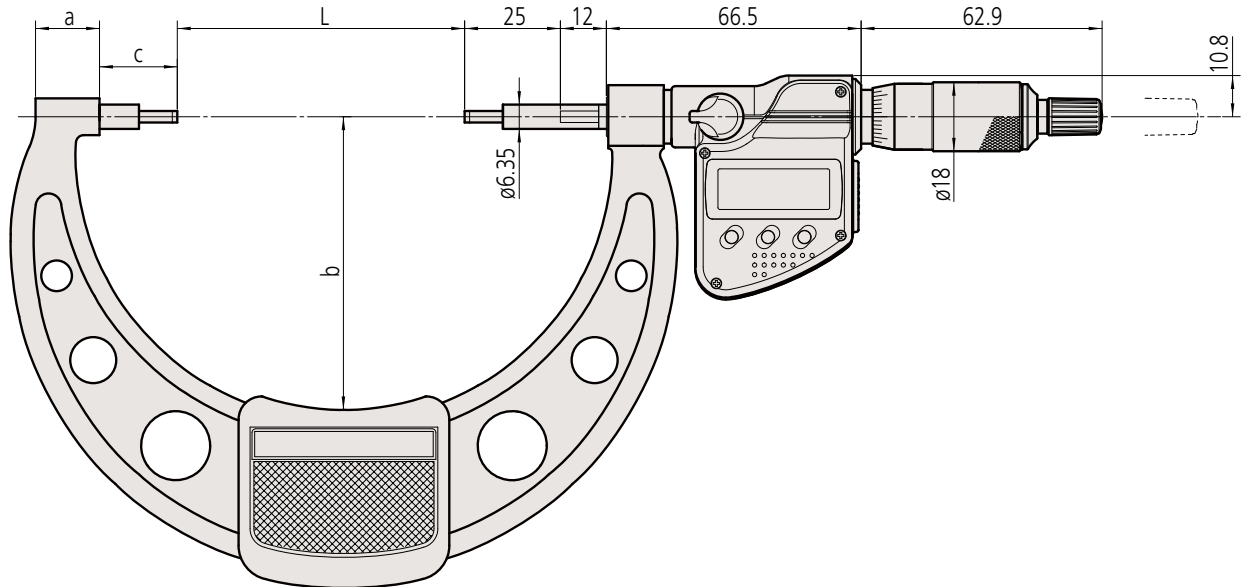
Models up to 75mm measuring range

Unit: mm



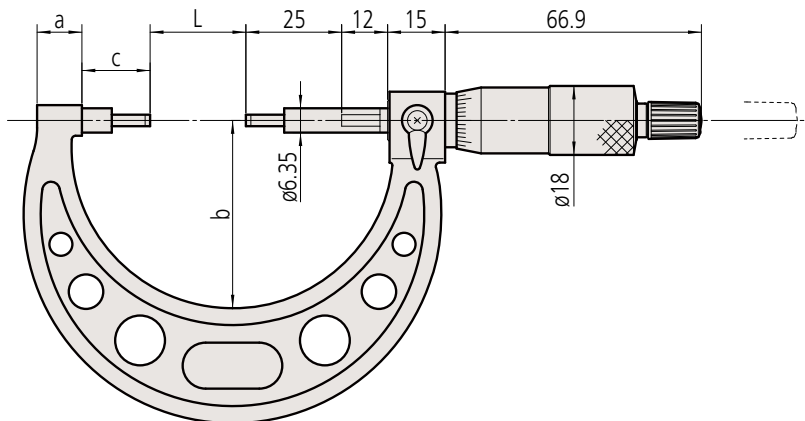
Digital Models

Models over 75mm measuring range



Analog Models

Models up to 300mm measuring range



Order No.	L	a	b	c
331-251-30	0	7.3	32.5	17.5
331-261-30	0			
331-252-30	25	10.1	47	
331-262-30	25	11.5	60	
331-253-30	50			
331-263-30	50	16.7	76	
331-254-30	75			
331-264-30	75	20.3		
111-215	0	10	38	17.5
111-115	0			
111-116	25	12	49	
111-117	50	14	60	
111-118	75	16.7	79	
111-119	100	18.8	94	
111-120	125	19.1	106	21.1
111-121	150	18.2	118	21.3
111-122	175	16.8	130	21.7
111-123	200	18	143	20.5
111-124	225		156	
111-125	250		169	21.5
111-126	275		181	



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(Refer to page X for details.)

IP Codes (series 342)

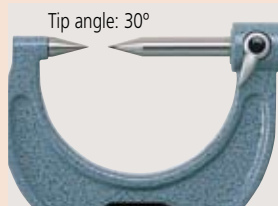
Level 6: Dust-proof.

No ingress of dust allowed.

Level 5: Protected against water jets.

Water projected in jets against the enclosure from any direction shall have no harmful effects.

Technical Data



Battery for series 342

SR44 (1 pc), **938882**, for initial operational checks (standard accessory)

Battery life: Approx. 2.4 years under normal use

(for series 342)

Length standard: Electromagnetic rotary sensor

(for series 342)

Standard accessories: Reference bar, 1 pc

(except for measuring range 0-25mm (0-1") models)

Spanner (301336), 1 pc

Optional accessories

Connecting cables for **series 342**

1m: **05CZA662**

2m: **05CZA663**

USB Input Tool Direct

USB-ITN-B (2m): **06ADV380B**

SPC cables for **U-WAVE** w/ data switch (160mm):

02AZD790B

For foot switch: **02AZE140B**

(Refer to page B-68 for details.)

Point Micrometers SERIES 342, 142, 112

- Pointed spindle and anvil for measuring the web thickness of drills, small grooves, keyways, and other hard-to-reach features.
- The measuring points (carbide tipped) have approximately 0.3mm radius.
- series 342: IP65 Digimatic micrometers
- Equipped with Ratchet Stop for constant measuring force.



SPECIFICATIONS

Metric				
Order No.	Range	Resolution	Accuracy*	Point
Digimatic (LCD) (With carbide tip)				
342-251-30	0 - 25mm	0.001mm	±2µm	15°
342-252-30	25 - 50mm			
342-253-30	50 - 75mm			
342-254-30	75 - 100mm			
342-261-30	0 - 25mm	0.001mm	±2µm	30°
342-262-30	25 - 50mm			
342-263-30	50 - 75mm			
342-264-30	75 - 100mm			

* Excluding quantizing error

Inch/Metric				
Order No.	Range	Resolution	Accuracy*	Point
Digimatic (LCD) (With carbide tip)				
342-351-30	0 - 1"	.00005"/ 0.001mm	±.0001"	15°
342-352-30	1 - 2"			
342-353-30	2 - 3"			
342-354-30	3 - 4"			
342-361-30	0 - 1"	.00005"/ 0.001mm	±.00015"	30°
342-362-30	1 - 2"			
342-363-30	2 - 3"			
342-364-30	3 - 4"			

* Excluding quantizing error

Metric				
Order No.	Range	Graduation	Accuracy	Point
Analog				
112-153	0 - 25mm	0.01mm	±3µm	15°
112-154	25 - 50mm			
112-155	50 - 75mm			
112-156	75 - 100mm			
112-201	0 - 25mm	0.01mm	±3µm	30°
112-202	25 - 50mm			
112-203	50 - 75mm			
112-204	75 - 100mm			
Analog (With carbide tip)				
112-165	0 - 25mm	0.01mm	±3µm	15°
112-166	25 - 50mm			
112-167	50 - 75mm			
112-168	75 - 100mm			
112-213	0 - 25mm	0.01mm	±3µm	30°
112-214	25 - 50mm			
112-215	50 - 75mm			
112-216	75 - 100mm			
Mechanical counter model				
142-153	0 - 25mm		±3µm	15°
142-201				30°

Inch				
Order No.	Range	Graduation	Accuracy	Point
Analog				
112-177	0 - 1"	.001"	±.00015"	15°
112-178	1" - 2"			
112-225	0 - 1"			
112-226	1" - 2"			
Analog (With carbide tip)				
112-189	0" - 1"	.001"	±.00015"	15°
112-190	1" - 2"			
112-191	2" - 3"			
112-237	0 - 1"			
112-238	1" - 2"	.001"	±.00015"	30°
142-177	0 - 1"			
142-225				

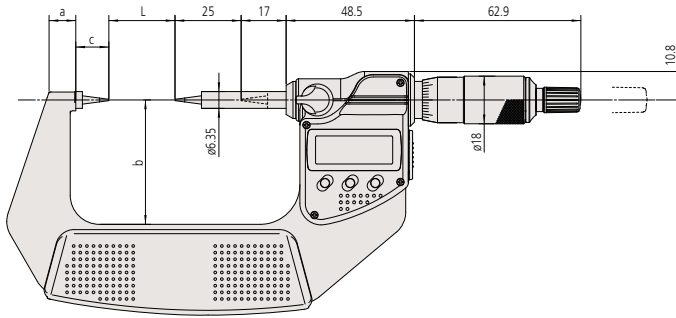
Micrometer

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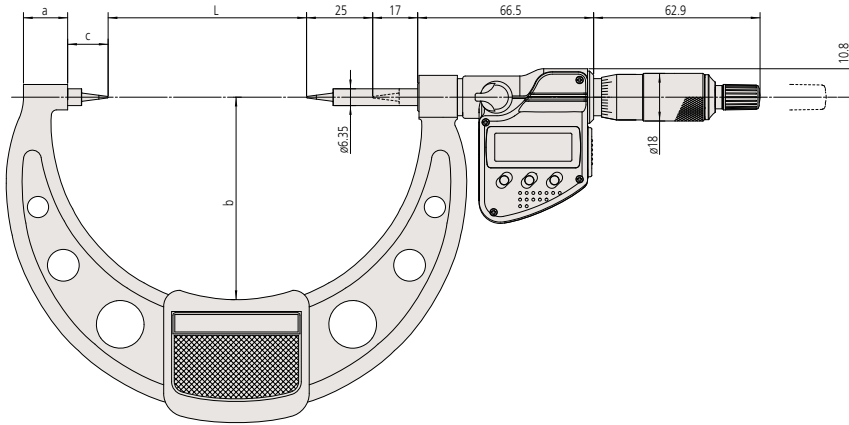
DIMENSIONS

Digital models up to 75mm measuring range

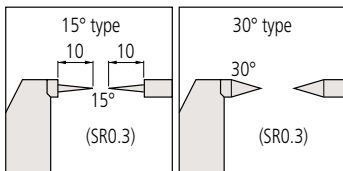
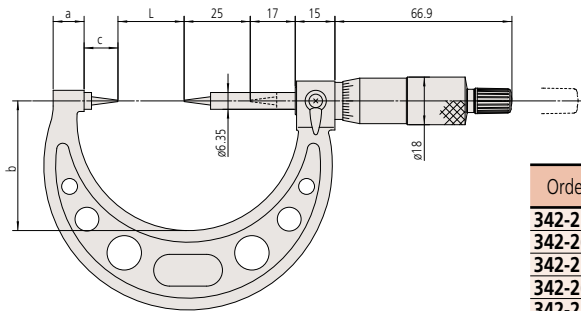
Unit: mm



Digital models over 75mm measuring range



Analog models measuring range



Order No.	L	a	b	c	Frame thickness*1
342-251-30	0	7.3	32.5		(11.2)
342-261-30	0	7.3	32.5		(11.2)
342-252-30	25	10.1	47	12.5	(12.8)
342-262-30	25	10.1	47	12.5	(12.8)
342-253-30	50	11.5	60		(12.8)
342-263-30	50	11.5	60		(12.8)
342-254-30	75	16.7	76	15.3	(20.8)
342-264-30	75	16.7	76	15.3	(20.8)
112-153	0	10	38		(9)
112-154	25	12	49	12.5	(10)
112-155	50	14	60		(11)
112-156	75	16.7	79	15.3	(13)

*1 Digimatic type: thickness over heat shield

Battery for series 314

SR44 (1 pc), **938882**, for initial operational checks (standard accessory)

Battery life: Approx. 2.4 years under normal use (for series 314)

Length standard: Electromagnetic rotary sensor (for series 314)

Standard accessories:

Spanner (301336), 1 pc (for Digimatic type)

(Maximum measuring range up to 55mm/1.6")*1

(Maximum measuring range up to 45mm/1")*2

Spanner (200877), 1 pc

(for maximum measuring range 70mm or over)*1

(for maximum measuring range 65mm or over)*2

*1 For analog type with 3-flute cutting tools.

*2 For analog type with 5-flute cutting tools.

Optional accessories

Connecting cables for **series 314**

1m: **05CZA662**

2m: **05CZA663**

USB Input Tool Direct

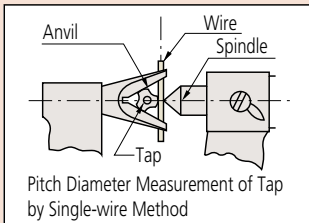
USB-ITN-B (2m): **06ADV380B**

SPC cables for **U-WAVE** w/ data switch (160mm):

02AZD790B

For foot switch: **02AZE140B**

(Refer to page B-68 for details.)



V-Anvil Micrometers SERIES 314, 114 — 3 Flutes and 5 Flutes

- Measures the outside diameter of cutting tools (such as taps, reamers, end mills) which have three or five flutes.
- Measures pitch diameter: refer to "Quick Guide to Precision Measuring Instruments" on page B-73.
- Measuring faces: Carbide
- Equipped with Ratchet Stop for constant measuring force.



314-251-30



114-121



114-102



114-101

Micrometer

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SPECIFICATIONS

Metric For 3-flute cutting tools					
Order No.	Range	Resolution	Accuracy*	Remarks	Anvil
Digimatic (LCD)					
314-251-30	1 - 15mm	0.001mm	±4μm	w/groove	60°
314-252-30	10 - 25mm				
314-253-30	25 - 40mm				
314-261-30	1 - 15mm				
314-262-30	10 - 25mm				

*Excluding quantizing error

Metric For 3-flute cutting tools					
Order No.	Range	Graduation	Accuracy	Remarks	Anvil
Analog Anvil, Spindle (With carbide tip)					
114-204	2.3 - 25mm		±4μm	—	
Analog Spindle (With carbide tip)					
114-101	1 - 15mm	0.01mm	±4μm	w/groove	60°
114-102	10 - 25mm				
114-103	25 - 40mm				
114-104	40 - 55mm				
114-105	55 - 70mm				
114-106	70 - 85mm				
114-161	1 - 15mm				
114-162	10 - 25mm				

Metric For 5-flute cutting tools					
Order No.	Range	Resolution	Accuracy	Remarks	Anvil
Analog Anvil, Spindle (With carbide tip)					
114-137	2.3 - 25mm		±4μm	—	
Analog Spindle (With carbide tip)					
114-121	5 - 25mm	0.01mm	±4μm	w/groove	108°
114-122	25 - 45mm				
114-123	45 - 65mm				
114-124	65 - 85mm				
114-165	5 - 25mm				

Inch/Metric For 3-flute cutting tools					
Order No.	Range	Resolution	Accuracy*	Remarks	Anvil
Digimatic (LCD)					
314-351-30	.05 - .6"	.0005"/ 0.001mm	±.0002"	w/groove	60°
314-352-30	.4" - 1"				
314-353-30	1" - 1.6"				
314-361-30	.05 - .6"				
314-362-30	.4" - 1"				

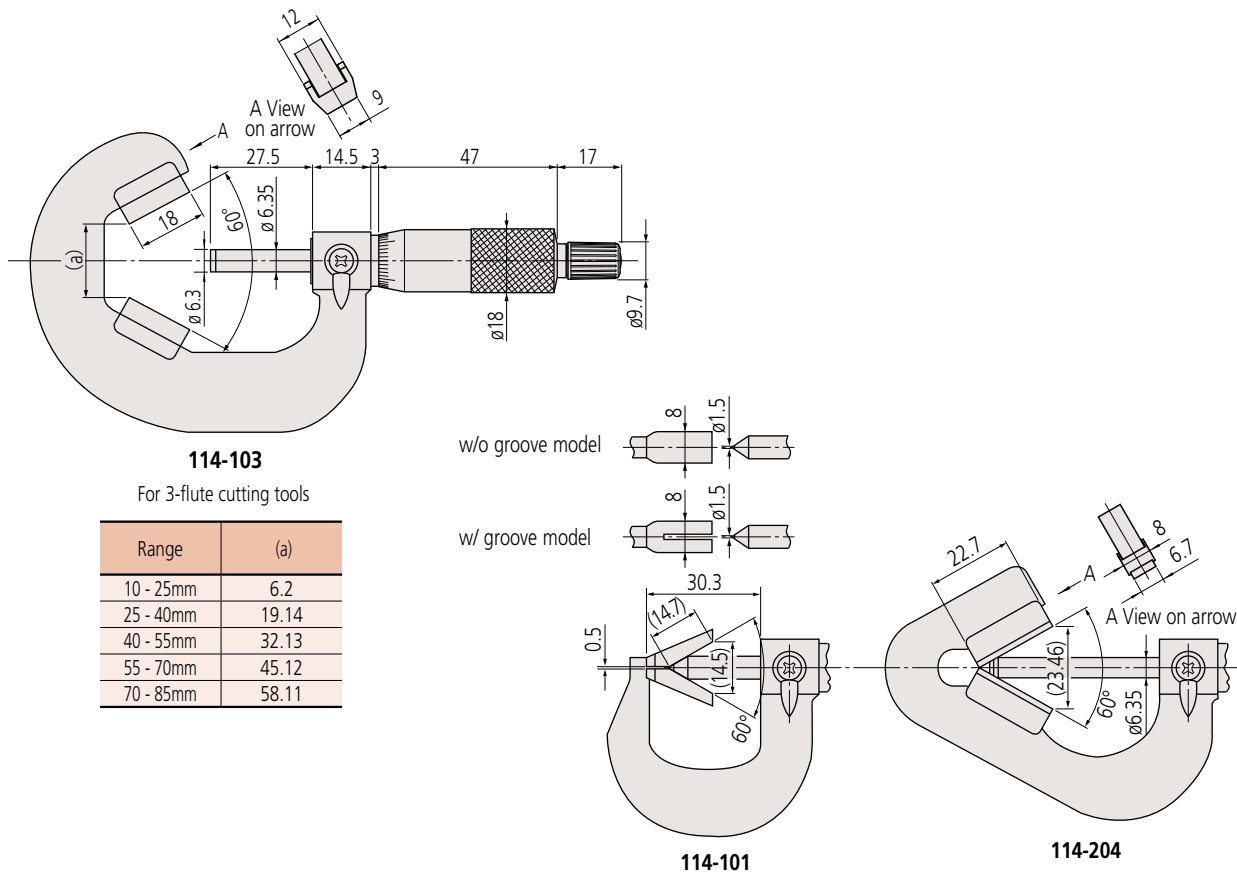
*Excluding quantizing error

Inch For 3-flute cutting tools					
Order No.	Range	Graduation	Accuracy	Remarks	Anvil
Analog Spindle (With carbide tip)					
114-163	.05" - .6"	.001"	±.0002"	—	60°
114-113	1" - 1.6"		±.00025"	—	

Inch For 5-flute cutting tools					
Order No.	Range	Graduation	Accuracy	Remarks	Anvil
Analog Spindle (With carbide tip)					
114-135	.09" - 1"	.0001"	±.0002"	—	108°

DIMENSIONS

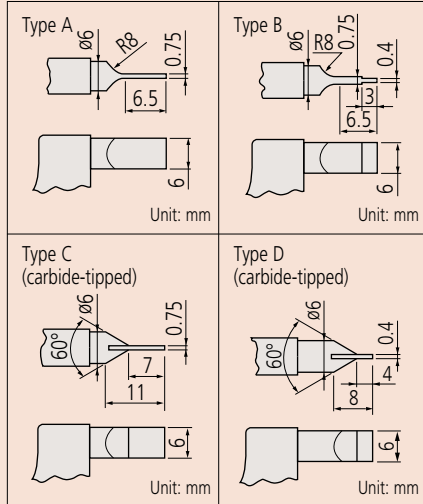
Unit: mm



Technical Data

Parallelism
 3µm for models up to 75mm
 .00015" for models up to 3"
 (3+R/100)µm for models over 75mm
 .0002" for models over 3"
 R = max. range (mm)
 fraction rounded up

Type and Dimensions



Battery for series 422

SR44 (1 pc), 938882, for initial operational checks (standard accessory)

Battery life: Approx. 2.4 years under normal use (for series 422-2XX, 3XX)
 Approx. 1 year under normal use (for series 422-4XX)

Length standard: Electromagnetic rotary sensor (for series 422-2XX, 3XX)
 Electrostatic capacity absolute sensor (for series 422-4XX)

Standard accessories: Reference bar, 1 pc (except for measuring range 0-25mm/0-30mm (0-1"/0-1.2") models)
 Spanner (301336), 1 pc (for series 122-1XX, 422-2XX, 3XX)

Optional accessories

Connecting cables for digital models

1m: **05CZA662**
 2m: **05CZA663**

USB Input Tool Direct

USB-ITN-B (2m): **06ADV380B**

Connecting cables for U-WAVE-T (digital models)

02AZD790B (160mm)

For foot switch: **02AZE140B**

Connecting cables for Quickmike type

1m: **937387**
 2m: **965013**

USB Input Tool Direct

USB-ITN-E (2m): **06ADV380E**

Connecting cables for U-WAVE-T (Quickmike type)

02AZD790E 160mm

For foot switch: **02AZE140E**

Refer to page B-68 for details.

Blade Micrometers SERIES 422, 122 — Non-Rotating Spindle Type

- The anvil and spindle are blade-shaped for measuring the groove diameter of shafts, keyways, and other hard-to-reach features.
- Carbide-tipped measuring faces are also available.
- Non-rotating spindle type.
- Equipped with Ratchet Stop for constant measuring force.



Digimatic (LCD)
422-230-30



122-101



Quickmike Type (LCD)
422-411



ABSOLUTE™

SPECIFICATIONS

Metric				
Order No.	Range	Resolution	Accuracy*	Remark
Digimatic (LCD)				
422-230-30	0 - 25mm	0.001mm	±3µm	Type A
422-231-30	25 - 50mm			
422-232-30	50 - 75mm			
422-233-30	75 - 100mm			
422-260-30	0 - 25mm	±4µm	±3µm	Type B
422-261-30	25 - 50mm			
422-270-30	0 - 25mm	±3µm	±3µm	Type C
422-271-30				Type D

* Excluding quantizing error

Metric Quickmike type				
Order No.	Range	Resolution	Accuracy*	Remark
Digimatic (LCD)				
422-411	0 - 30mm	0.001mm	±3µm	Type A
422-412	25 - 55mm			

* Excluding quantizing error

Metric				
Order No.	Range	Graduation	Accuracy	Remark
Analog				
122-101	0 - 25mm	0.01mm	±3µm	Type A
122-102	25 - 50mm			
122-103	50 - 75mm			
122-104	75 - 100mm			
122-105	100 - 125mm	±4µm	±5µm	Type A
122-106	125 - 150mm			
122-107	150 - 175mm	±6µm	±6µm	Type A
122-108	175 - 200mm			
122-109	200 - 225mm			
122-110	225 - 250mm	±6µm	±6µm	Type A
122-111	250 - 275mm			
122-112	275 - 300mm			
Analog (With carbide tip)				
122-111	0 - 25mm	0.01mm	±3µm	Type B
122-112	25 - 50mm			
122-161	0 - 25mm	0.01mm	±3µm	Type C
122-162	25 - 50mm			
122-141	0 - 25mm	0.01mm	±3µm	Type D
122-142	25 - 50mm			

Notes: 1) A heat shield is provided with Digimatic models and **422-230-30** as standard.

Inch/Metric				
Order No.	Range	Resolution	Accuracy*	Remark
Digimatic (LCD)				
422-330-30	0 - 1"	.0005"/ 0.001mm	±.00015"	Type A
422-331-30	1" - 2"			
422-332-30	2" - 3"			
422-333-30	3" - 4"			
422-360-30	0 - 1"	±.00015"	±.0002"	Type B
422-361-30	1" - 2"			
422-370-30	0 - 1"	±.00015"	±.00015"	Type C
422-371-30				Type D

* Excluding quantizing error

Inch/Metric Quickmike type				
Order No.	Range	Resolution	Accuracy*	Remark
Digimatic (LCD)				
422-421	0 - 1.2"	.00005"/ 0.001mm	±.00015"	Type A

* Excluding quantizing error

Inch				
Order No.	Range	Graduation	Accuracy	Remark
Analog				
122-125	0 - 1"	.0001"	±.00015"	Type A
122-126	1" - 2"			
122-127	2" - 3"			
122-128	3" - 4"			
122-135	0 - 1"	±.00015"	±.00015"	Type B
122-151				Type D

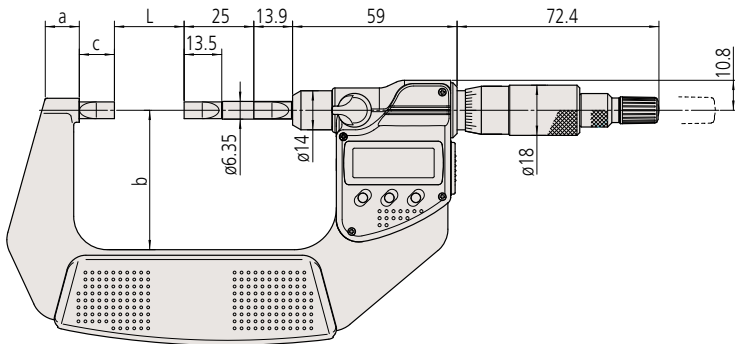
Micrometer

The origin of Mitutoyo's trustworthy brand of small tool instruments

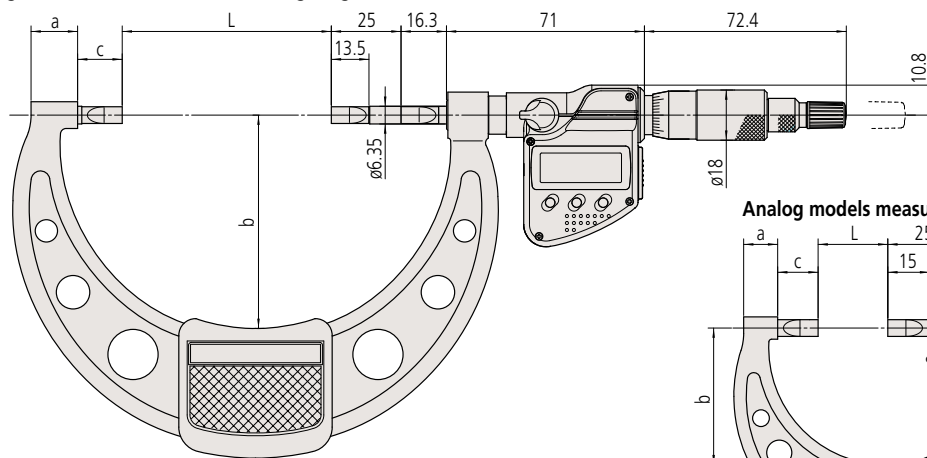
DIMENSIONS

Digital models up to 50mm measuring range

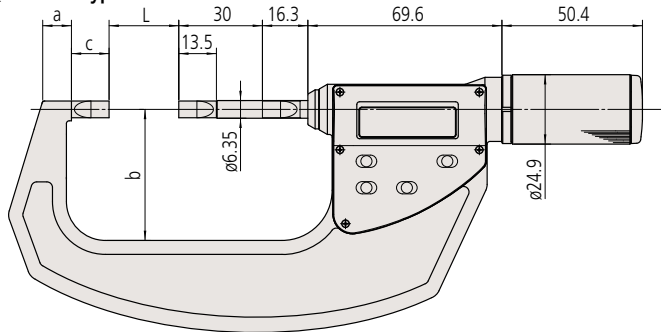
Unit: mm



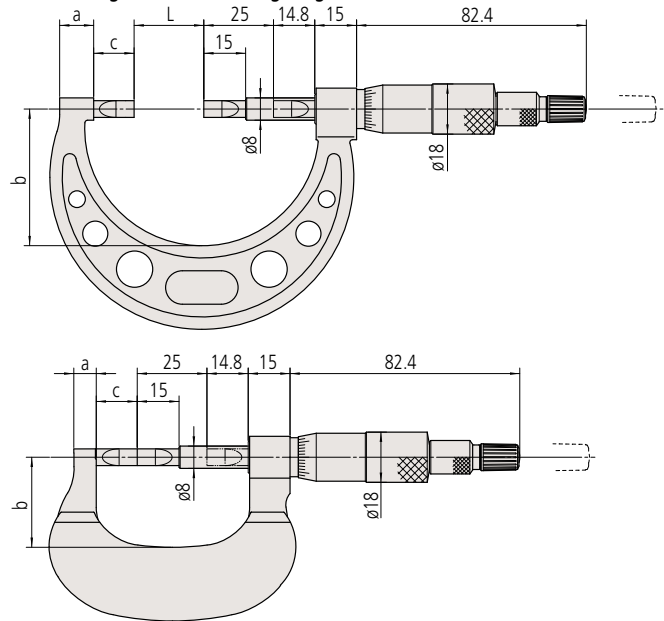
Digital models over 75mm measuring range



Quickmike type



Analog models measuring range



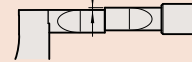
Quickmike

Provides a speedy spindle feed of 10mm per thimble rotation, which enables widely differently sized features to be measured quickly.

Deviation between the Anvil and Spindle in the Vertical Direction

within 0.15mm

Deviation between the anvil and spindle in the vertical direction

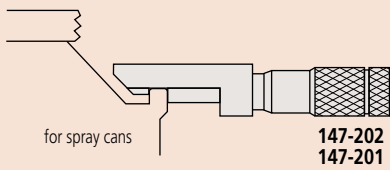
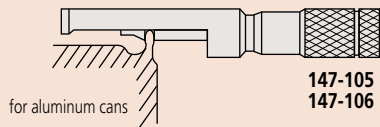
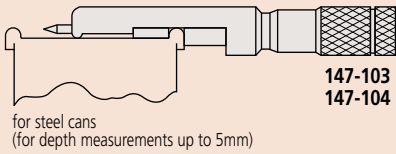


Deviation of 0.15mm or less is guaranteed between the anvil and spindle in the vertical direction.

* When the measuring range is 0 - 25mm

Order No.	L	a	b	C
422-230-30	0	11	31	12.5
422-231-30	25	12.2	50	12.6
422-232-30	50	14.6	57	13
422-233-30	75	16.7	76	16
422-260-30	0	11	31	12.5
422-261-30	25	12.2	50	12.6
422-270-30	0			
422-271-30	0	11	31	12.5
122-101	0	7.8	32	15
122-102	25	12.2	49	
122-103	50	14.6	60	14.5
122-104	75	17	79	17.5
122-105	100	19	94	17.9
122-106	125	20	106	18.3
122-107	150	19	118	18.5
122-108	175	17	130	18.9
122-109	200		143	17.7
122-110	225		156	
122-115	250	18	169	18.7
112-116	275		181	
422-411	0	8.5	36	
422-412	25	10.3	47	13.5

Technical Data



Standard accessories: Spanner (200168), 1 pc
Spanner (202863), 1pc

Can Seam Micrometers SERIES 147

- Measures the width, height, and depth of can seams.

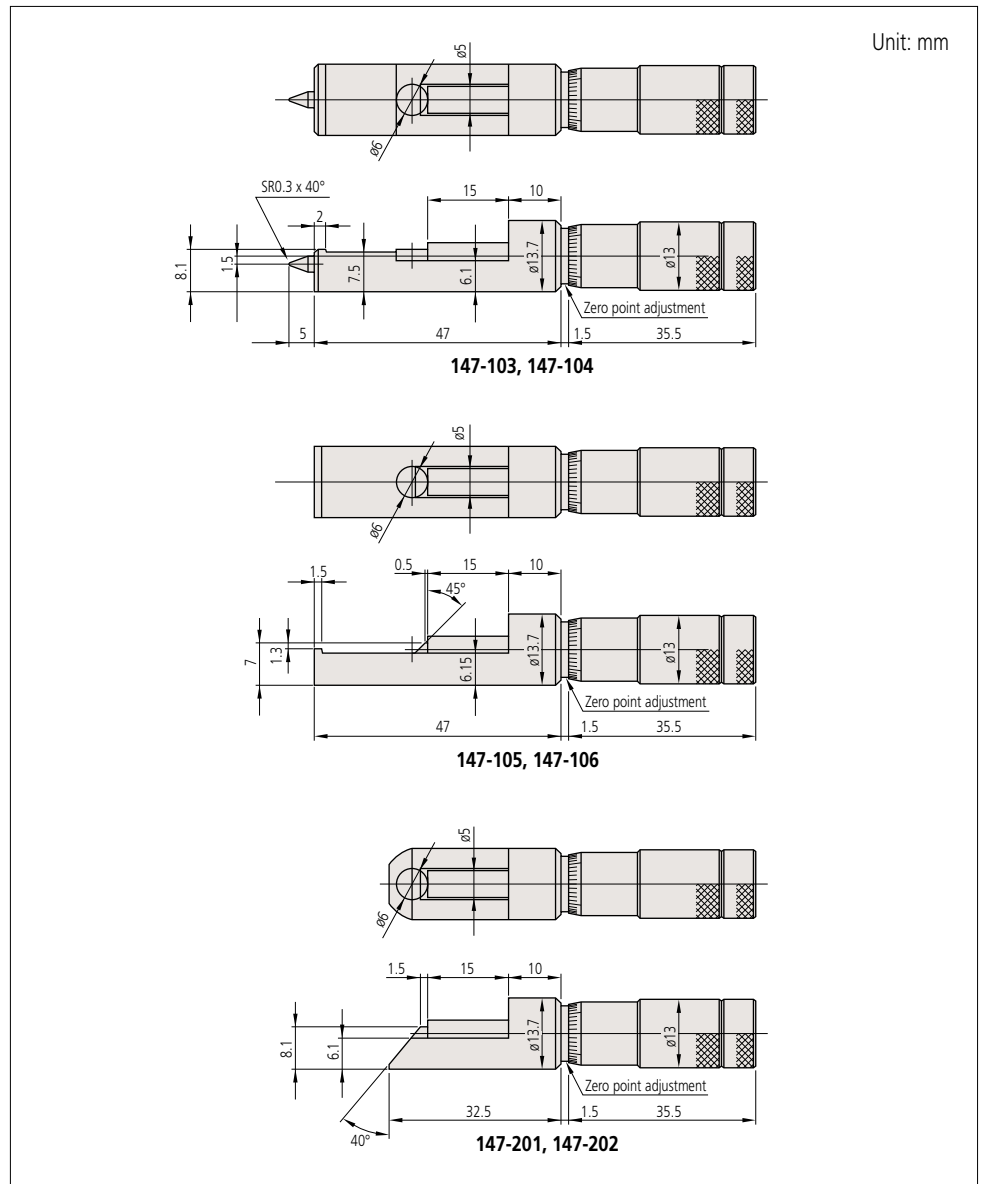


147-103

SPECIFICATIONS

Metric					Inch				
Order No.	Range	Graduation	Accuracy	Remarks	Order No.	Range	Graduation	Accuracy	Remarks
147-103				for steel cans	147-104				for steel cans
147-105	0 - 13mm	0.01mm	±3µm	for aluminum cans	147-106	0 - .5"	.001"	±.00015"	for aluminum cans
147-202				for spray cans	147-201				for spray cans

DIMENSIONS



Micrometer

The origin of Mitutoyo's trustworthy brand of small tool instruments

Hub Micrometers SERIES 147

- Measures hub thickness and shoulders inside a bore.
- Measuring faces: Carbide
- Equipped with Ratchet Stop for constant measuring force.

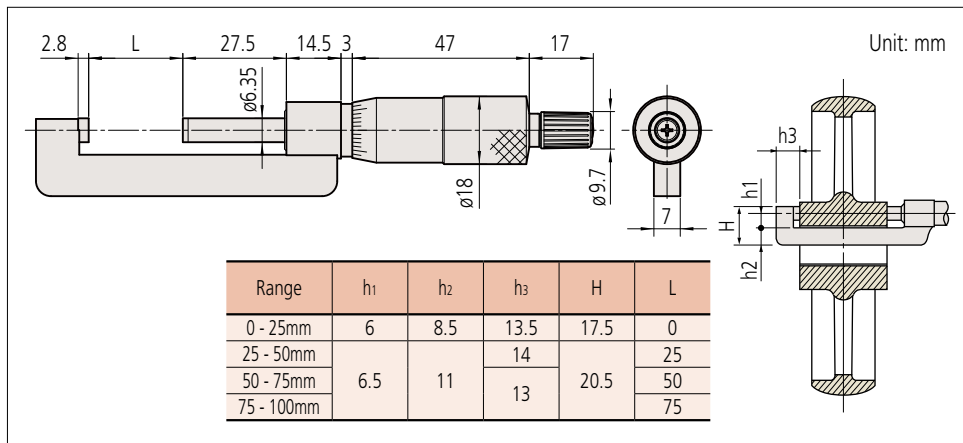


147-301

SPECIFICATIONS

Metric				Inch			
Order No.	Range	Graduation	Accuracy	Order No.	Range	Graduation	Accuracy
147-301	0 - 25mm	0.01mm	±2μm	147-351	0 - 1"	.001"	±.0001"
147-302	25 - 50mm			±3μm	147-352		
147-303	50 - 75mm		±.00015"		147-353		2" - 3"
147-304	75 - 100mm			147-354	3" - 4"		

DIMENSIONS



Wire Micrometers Series 147

- Designed for measuring wire thickness.
- Measurable wire dia.: 10mm or less
- Measuring faces: Carbide
- Equipped with Ratchet Stop for constant measuring force.

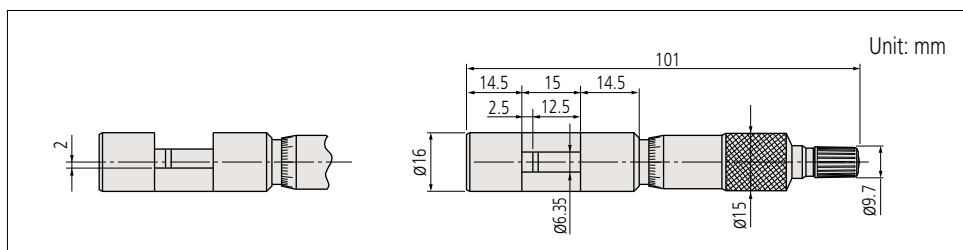


147-401

SPECIFICATIONS

Metric				Inch			
Order No.	Range	Graduation	Accuracy	Order No.	Range	Graduation	Accuracy
147-401	0 - 10mm	0.01mm	±3μm	147-402	0 - .4"	.0001"	±.00015"

DIMENSIONS



Technical data

Flatness: 0.6μm/.000024"
 Parallelism: (2+R/100)μm, R = max. range (mm)
 [.00008" + .00004"(R/4)]" R = max. range (mm)
 *fraction rounded up

Standard accessories: Reference bar, 1 pc
 (except for measuring range 0-25mm (0-1") models)
 Spanner (301336), 1 pc



Technical Data

Flatness: 0.6μm/.000024"
 Parallelism: 1.3μm/.00005"



Standard accessories: Spanner (200168), 1 pc
 Spanner (202863), 1pc



These marks indicate that a product has successfully passed IP65-level testing, which is carried out by the independent German certification organization TÜV Rheinland.



(Refer to page X for details.)

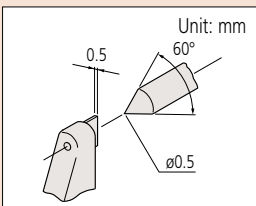
IP Codes (series 342-271-30, 342-371-30)

Level 6: Dust-proof.

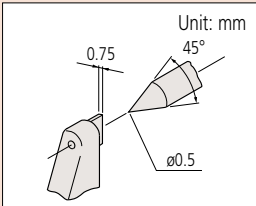
No ingress of dust allowed.

Level 5: Protected against water jets.

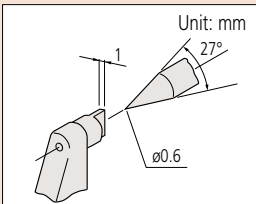
Water projected in jets against the enclosure from any direction shall have no harmful effects.



342-271-30, 342-371-30, 112-401



342-451



142-402, 142-403

Battery for series 342

SR44 (1 pc), 938882, for initial operational checks (standard accessory)

Battery life: Approx. 2.4 years under normal use

(for series 342-271-30/342-371-30)

Approx. 3 years under normal use

(for series 342-451)

Length standard: Electromagnetic rotary sensor

(for series 342-271-30/342-371-30)

Electrostatic capacity absolute sensor

(for series 342-451)

Standard accessories:

Spanner (301336), 1 pc (except for series 342-451)

Optional accessories

Connecting cables (digital model)

1m: 05CZA662

2m: 05CZA663

USB Input Tool Direct

USB-ITN-B (2m): 06ADV380B

Connecting cables for U-WAVE-T (digital model)

02AZD790B (160mm)

For foot switch: 02AZE140B

Connecting cables (Quickmike type)

1m: 937387

2m: 965013

USB Input Tool Direct

USB-ITN-E (2m): 06ADV380E

Connecting cables for U-WAVE-T (Quickmike type)

02AZD790E 160mm

For foot switch: 02AZE140E

Refer to page B-68 for details.

Crimp Height Micrometers Series 342,112,142

- Measures the height of crimp contacts.
- Equipped with Ratchet Stop for constant measuring force.
- IP65 water/dust protection (digital model).
- Model 342-451 is the Quickmike type, which provides a speedy spindle feed of 10mm per thimble rotation, which enables widely differently sized features to be measured quickly.



Digimatic (LCD)
342-271-30



Quickmike type (LCD)
342-451



ABSOLUTE™



112-401

SPECIFICATIONS

Metric			
Order No.	Range	Resolution	Accuracy*
Digimatic (LCD)			
342-271-30	0 - 20mm	0.001mm	±3µm
Quickmike (LCD)			
342-451	0 - 15mm	0.001mm	±3µm

* Excluding quantizing error

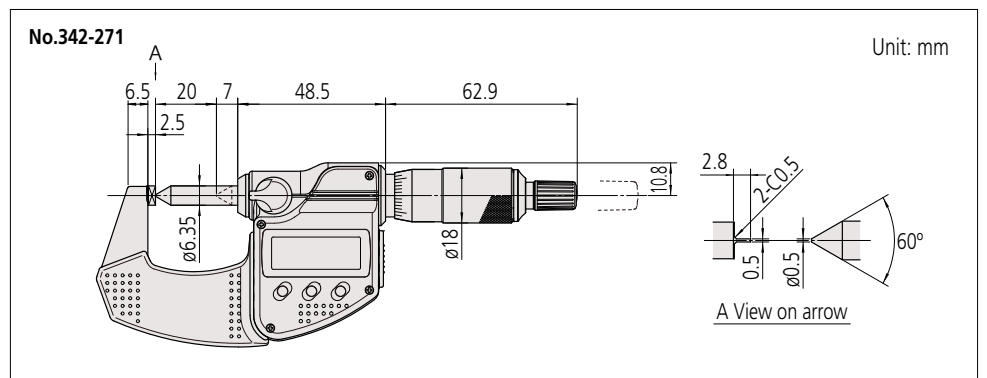
Metric			
Order No.	Range	Graduation	Accuracy
Mechanical counter model			
142-402	0 - 25mm	0.01mm	±3µm
142-403	0 - 25mm	0.001mm	

Metric			
Order No.	Range	Graduation	Accuracy
Analog			
112-401	0 - 25mm	0.01mm	±3µm

Inch/Metric			
Order No.	Range	Resolution	Accuracy*
Digimatic (LCD)			
342-371-30	0 - .8"	.00005"/ 0.001mm	±.00015"

* Excluding quantizing error

DIMENSIONS



Micrometer

The origin of Mitutoyo's trustworthy brand of small tool instruments

"Uni-Mike" Series 317, 117 — Interchangeable Anvil Type

- Measures tubing thickness, shoulder-edge distance, rivet head height, etc., with interchangeable anvils (flat anvil, rod anvil, V-anvil).
- IP65 water/dust protection (series 317).
- Equipped with Ratchet Stop for constant measuring force.



317-251-30



117-101

SPECIFICATIONS

Metric			
Order No.	Range	Resolution	Accuracy*
Digimatic (LCD)			
317-251-30	0 - 25mm	0.001mm	±4μm
317-252-30	25 - 50mm		

* Excluding quantizing error

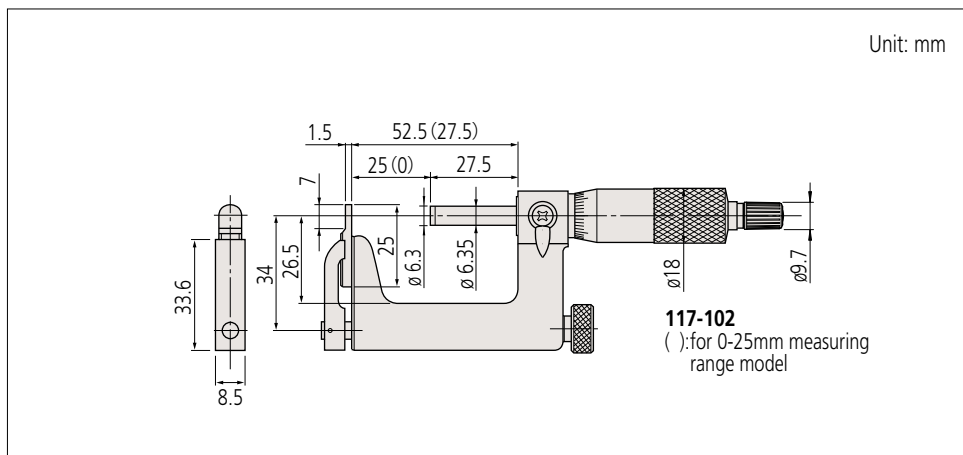
Metric			
Order No.	Range	Graduation	Accuracy
Analog			
117-101	0 - 25mm	0.01mm	±4μm
117-102	25 - 50mm		

Inch/Metric			
Order No.	Range	Resolution	Accuracy*
Digimatic (LCD)			
317-351-30	0 - 1"	.00005"/0.001mm	±.0002"
317-352-30	1" - 2"		

* Excluding quantizing error

Inch			
Order No.	Range	Graduation	Accuracy
Analog			
117-107	0 - 1"	.0001"	±.0002"
117-108	1" - 2"		

DIMENSIONS



These marks indicate that a product has successfully passed IP65-level testing, which is carried out by the independent German certification organization TÜV Rheinland.



(Refer to page X for details.)

IP Codes (series 317)

Level 6: Dust-proof.

No ingress of dust allowed.

Level 5: Protected against water jets.

Water projected in jets against the enclosure from any direction shall have no harmful effects.

Technical data

Flatness: Spindle face 0.6μm

Anvil face 2μm

Parallelism: 3μm



Battery for series 317

SR44 (1 pc, 938882, for initial operational checks (standard accessory)

Battery life: Approx. 2.4 years under normal use (for series 317)

Length standard: Electromagnetic rotary sensor (for series 317)

Standard accessories: Reference bar, 1 pc (except for measuring range 0-25mm (0-1") models)

Spanner (200877), 1pc (for series 117-XXX)

Spanner (301336), 1 pc (for series 317-XXX)

Optional accessories

Connecting cables (series 317)

1m: 05CZA662

2m: 05CZA663

USB Input Tool Direct

USB-ITN-B (2m): 06ADV380B

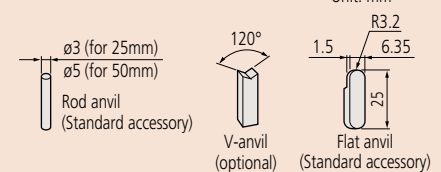
Connecting cables for U-WAVE-T

02AZD790B 160mm

For foot switch: 02AZE140B

Refer to page B-68 for details.

Accessories



Order No.	Item
201216	Flat anvil (standard accessory)
201217	Rod anvil (standard accessory for 117-101/117-107/317-251-30/317-351-30)
201379	Rod anvil (standard accessory for 117-102/117-108/317-252-30/317-352-30)
201218	V-anvil (optional)
950758	Base for 25mm (optional)

Limit Micrometers SERIES 113



Technical Data

Standard accessories: Reference bar, 1 pc
(except for measuring range 0-25mm (0-1") models)
Spanner (200877), 1 pc

- Dual-spindle design enables use as a GO/±NG gage by setting upper and lower limits.
- Measuring faces: Carbide

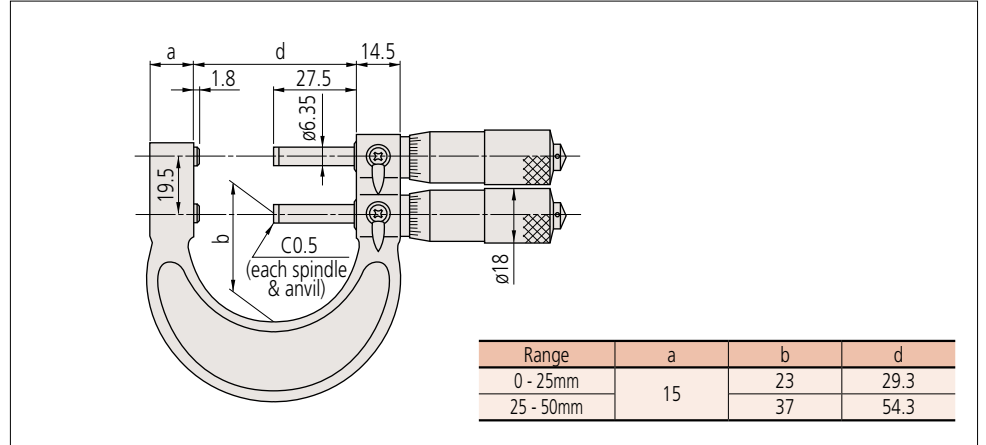


113-102

SPECIFICATIONS

Metric					
Order No.	Range	Graduation	Accuracy	Flatness	Parallelism
113-102	0 - 25mm	0.01mm	±3μm	0.6μm	3μm
113-103	25 - 50mm				

Unit: mm

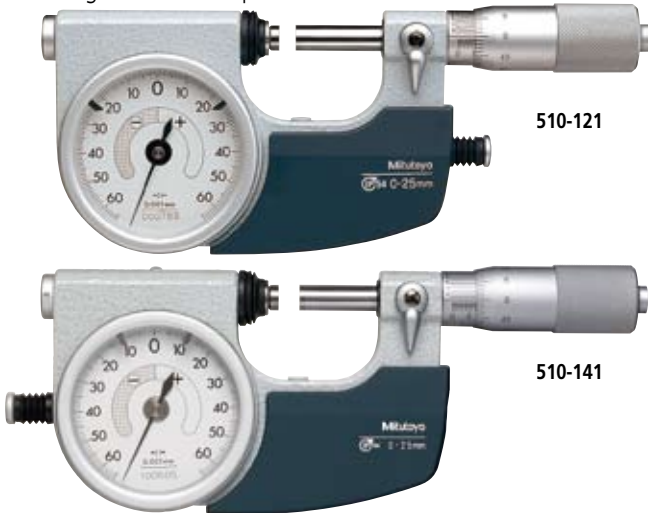


Micrometer

The origin of Mitutoyo's trustworthy brand of small tool instruments

Indicating Micrometers SERIES 510

- Suited to the measurement of low-volume manufactured parts.
- Easy to use when operating one-handed due to retractable anvil.
- In the 25mm measuring range, the model lineup offers a choice of left or right positioning of the anvil-retraction button.
- Greatly improved accuracy: indication error and graduation of 1µm.
- Water-proof to protection level IP54.
- Hard-coated crystal: enhanced oil and scratch resistance.
- Indicator scale is large and easy-to-read.
- The zero position and adjustable limit markers, for GO/±NG testing, are easily set.
- Measuring faces: Carbide

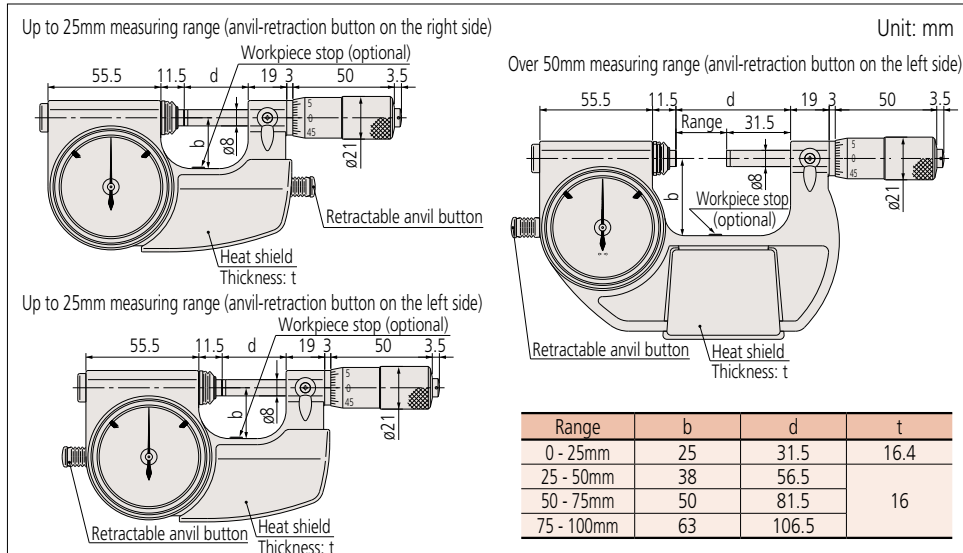


SPECIFICATIONS

Metric							
Order No.	Range	Indicating range	Graduation	Dial graduation	Measuring force	Anvil retraction button	Mass
510-121	0 - 25mm	±0.06mm	0.001mm	0.001mm	5 - 10N	Right side	520g
510-141						530g	
510-122	25 - 50mm					670g	
510-123	50 - 75mm					820g	
510-124	75 - 100mm	970g					

Inch							
Order No.	Range	Indicating range	Graduation	Dial graduation	Measuring force	Anvil retraction button	Mass
510-131	0 - 1"	±.0023"	.0001"	.00005"	5 - 10N	Right side	520g
510-151						530g	
510-132	1" - 2"					670g	
510-133	2" - 3"					820g	
510-134	3" - 4"	970g					

DIMENSIONS



(Refer to page X for details.)

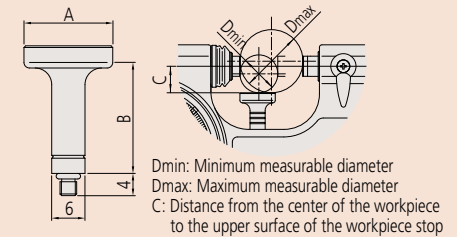
Technical Data

Flatness: 0.3µm/.000012"
 Parallelism: 0.6µm/.000024" for models up to 50mm/ 2"
 1µm/.00004" for models over 50mm/ 2"
 Accuracy: ±2µm
 Spindle feed error: 3µm/.00015"
 Dispersion of indication: 0.4µm/.00002"
 Dial indication accuracy: 1µm/.00005"
 Standard accessories: Reference bar, 1 pc (except for measuring range 0-25mm (0-1") models)
 Spanner (200154), 1 pc

Workpiece stop (optional)

Realizes more stable measurement.
 Three types are available to suit workpieces of different sizes.

Range	Unit: mm	
	A	B
Workpiece stop A 04AZA124	ø16	23
Workpiece stop B 04AZA125	ø14	20.5
Workpiece stop C 04AZA126	ø14	15



Order No	Unit: mm		
	Dmin	Dmax	C
Workpiece stop A	N/A	N/A	N/A
Workpiece stop B	4	16	5.0
Workpiece stop C	15	25	10.5

510-122 and 510-132	Unit: mm		
	Dmin	Dmax	C
Workpiece stop A	25	37	15.5
Workpiece stop B	30	42	18.0
Workpiece stop C	41	50	23.5

510-123 and 510-133	Unit: mm		
	Dmin	Dmax	C
Workpiece stop A	50	61	27.5
Workpiece stop B	54	66	30.0
Workpiece stop C	65	75	35.5

510-124 and 510-134	Unit: mm		
	Dmin	Dmax	C
Workpiece stop A	75	87	40.5
Workpiece stop B	80	92	43.0
Workpiece stop C	91	100	48.2

Technical Data

Indicator
 Indicating range: $\pm 0.06\text{mm}/\pm .0023''$
 Repeatability of indication: $0.4\mu\text{m}/.00002''$
 Dial indication accuracy: $1\mu\text{m}/.00005''$
 Flatness: $0.3\mu\text{m}/.000012''$
 Parallelism: $0.6\mu\text{m}/.000024''$ for models up to 50mm/2" measuring range
 $1\mu\text{m}/.00004''$ for models over 50mm/2" measuring range



**Dial Snap Meters
 SERIES 523**

- Suited to the measurement of mass-produced parts.
- Designed for measurement using a stand: realizes stable measurement.
- Greatly improved accuracy: indication error and graduation of $1\mu\text{m}$.
- Water-proof to protection level IP54.
- Hard-coated crystal: enhanced oil and scratch resistance.
- Indicator scale is large and easy-to-read.
- Easily settable adjustable limit markers for GO/ \pm NG testing.
- Equipped with an elevating workpiece stop as standard.
- Measuring faces: Carbide



523-121

SPECIFICATIONS

Metric				
Order No.	Range	Dial graduation	Measuring force	Mass
523-121	0 - 25mm	0.001mm	5 - 10N	740g
523-122	25 - 50mm			840g
523-123	50 - 75mm			950g
523-124	75 - 100mm			1080g
Inch				
Order No.	Range	Dial graduation	Measuring force	Mass
523-131	0 - 1"	.00005"	5 - 10N	740g
523-132	1" - 2"			840g
523-133	2" - 3"			950g
523-134	3" - 4"			1080g

DIMENSIONS

Unit: mm

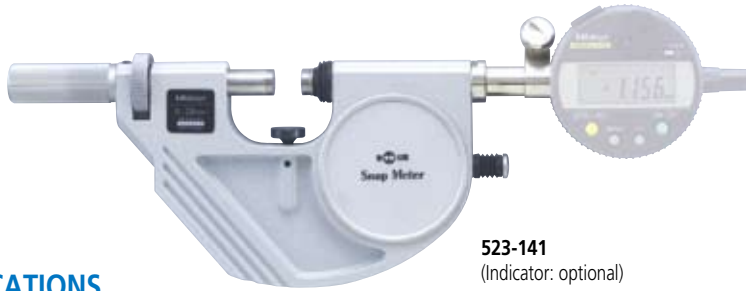
Range	b	d
0 - 25mm	25	31
25 - 50mm	35	56
50 - 75mm	47	81
75 - 100mm	60	106

Micrometer

The origin of Mitutoyo's trustworthy brand of small tool instruments

Snap Meters SERIES 523

- Suited to the measurement of mass-produced parts.
- Various types of indicator can be selected according to the measurement application.
- Measuring faces: Carbide



523-141
(Indicator: optional)

SPECIFICATIONS

Metric

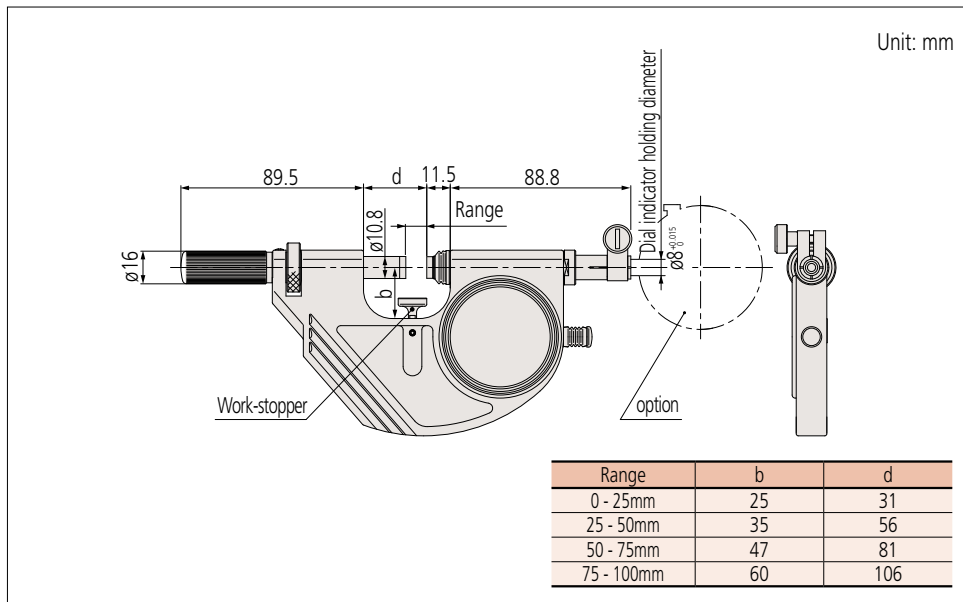
Order No.	Range	Anvil movement	Measuring force*	Mass
523-141	0 - 25mm	2mm	5 - 10N	710g
523-142	25 - 50mm			810g
523-143	50 - 75mm			920g
523-144	75 - 100mm			1050g

Inch

Order No.	Range	Anvil movement	Measuring force*	Mass
523-151	0 - 1"	.078"	5 - 10N	710g
523-152	1" - 2"			810g
523-153	2" - 3"			920g
523-154	3" - 4"			1050g

* Measured at the position where the anvil is retracted by 1mm from the free position without installing the indicator.

DIMENSIONS



Accuracy

Flatness: 0.3 μ m/.000012"
 Parallelism: 0.6 μ m/.000024" for models up to 50mm/2"
 1 μ m/.00004" for models over 50mm/2"
 Repeatability of indication: 0.4 μ m/.00002"

Typical Indicators used with gage

ID-C (0.001mm)/ **543-390B**
 LGF-L (0.001mm)/ **542-181** & Counter **542-015**



ABS Digimatic Indicator



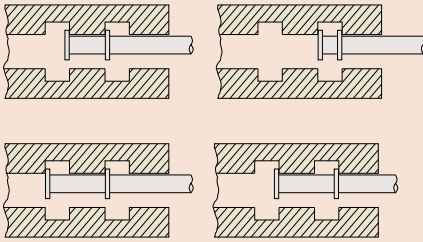
Linear Gage and counter

Technical data

Parallelism: 10µm/.0004"



Standard accessories: Spanner (301336), 1 pc



Groove Micrometers SERIES 146

- Flanged spindle and anvil for measuring width and location of grooves inside bores and tubes.
- Two-directional ratchet stop.
- For ID and OD (except for 0 - 25mm) measurement, a master gage is required for adjusting the reference point.



SPECIFICATIONS

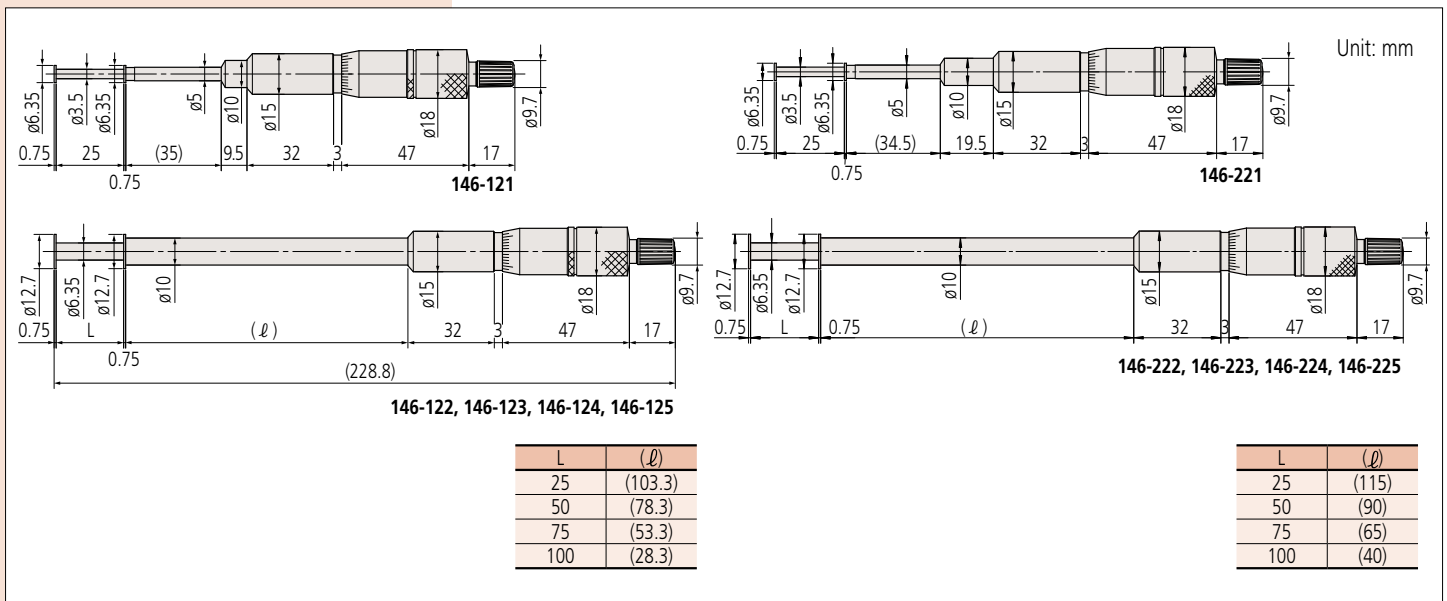
Metric					
Order No.	Range Outside	Range Inside	Graduation	Accuracy	Flange
Rotating spindle					
146-121	0 - 25mm	1.6 - 26.5mm	0.01mm	±10µm	ø6.35mm
146-122					ø12.7mm
146-123	25 - 50mm	26.5 - 51.5mm			
146-124	50 - 75mm	51.5 - 76.5mm			
146-125	75 - 100mm	76.5 - 101.5mm			

Metric					
Order No.	Range Outside	Range Inside	Graduation	Accuracy	Flange
Non-rotating spindle					
146-221	0 - 25mm	1.6 - 26.5mm	0.01mm	±10µm	ø6.35mm
146-222					ø12.7mm
146-223	25 - 50mm	26.5 - 51.5mm			
146-224	50 - 75mm	51.5 - 76.5mm			
146-225	75 - 100mm	76.5 - 101.5mm			

Inch					
Order No.	Range Outside	Range Inside	Graduation	Accuracy	Flange
Rotating spindle					
146-131	0 - 1"	.055" - 1.05"	.001"	±.0004"	ø.25"
146-132					ø.5"
146-133	1" - 2"	1.05" - 2.05"			
146-134	2" - 3"	2.05" - 3.05"			
146-135	3" - 4"	3.05" - 4.05"			

Inch					
Order No.	Range Outside	Range Inside	Graduation	Accuracy	Flange
Non-rotating spindle					
146-231	0 - 1"	.055" - 1.05"	.001"	±.0004"	ø.25"
146-232					ø.5"
146-233	1" - 2"	1.05" - 2.05"			
146-234	2" - 3"	2.05" - 3.05"			
146-235	3" - 4"	3.05" - 4.05"			

DIMENSIONS



Micrometer

The origin of Mitutoyo's trustworthy brand of small tool instruments

Quick-Mini SERIES 700

- Lightweight and palm-sized.
 - Highly suitable for quick dimensional inspection of small, thin and delicate objects.
 - Functions: origin setting and zero-setting.
- Application examples
Measurement of small objects: pearls, jewels, shims for engine tappets and screws.
Measurement of thin objects: printing paper, polyethylene bags, sheet materials, foods including noodles, lenses for glasses, media substrates, foils, thin plates and medical products including filter cloths.
Measurement of fine lines and bars: fishing lines, dental reamers, pasta, drills for PCB and hard wiring.



700-119-20

SPECIFICATIONS

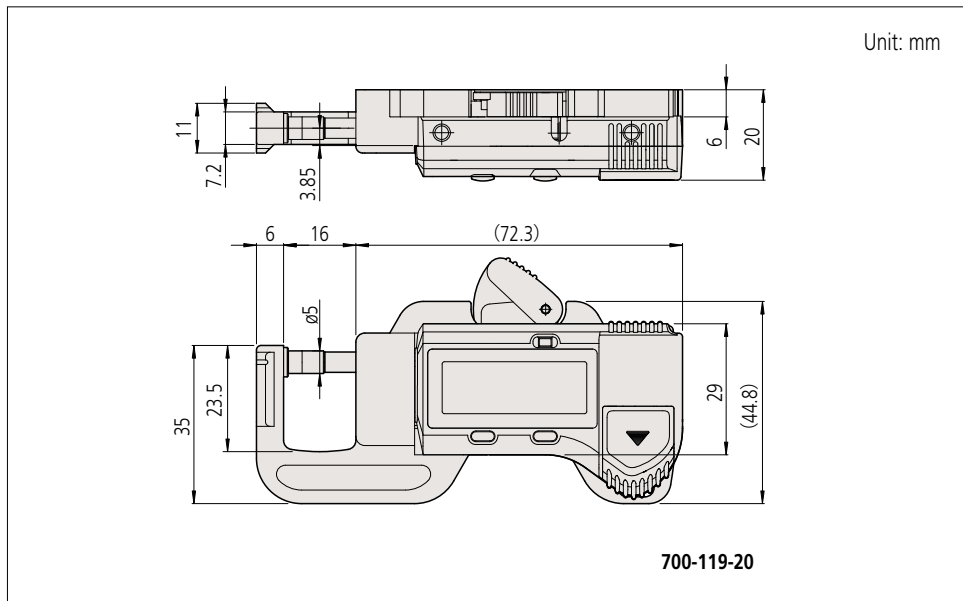
Metric				
Order No.	Range	Resolution	Accuracy*	Mass
700-119-20	0 - 12mm	0.01mm	±0.02	70 g

* Excluding quantizing error

Inch/Metric				
Order No.	Range	Resolution	Accuracy*	Mass
700-118-20	0" - 5" / 0 - 12mm	.0005" / 0.01mm	±.001"	70 g

* Excluding quantizing error

DIMENSIONS



Unit: mm

700-119-20



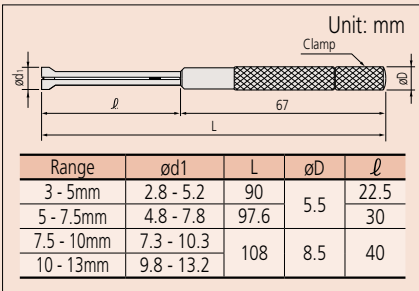
Technical Data

SR44 (1 pc), 938882, for initial operational checks (standard accessory)

Small Hole Gage Set SERIES 154



DIMENSIONS



- Extra long for gaging deep and shallow holes, slots, and similar workpiece features.

- Two sprung leaves are fully expanded inside a feature so that its size can be measured with an outside micrometer after extraction.



154-902

SPECIFICATIONS

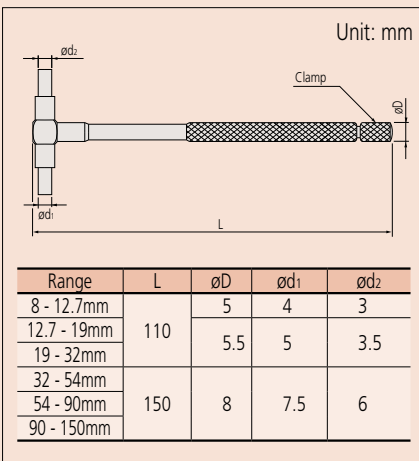
Metric	
Order No.	Range
4-gage Set	
154-902	3 - 13mm
Gages included	
154-101	3 - 5mm
154-102	5 - 7.5mm
154-103	7.5 - 10mm
154-104	10 - 13mm

Inch	
Order No.	Range
4-gage Set	
154-901	.125" - .5"
Gages included	
154-105	.125" - .2"
154-106	.2 - .3"
154-107	.3 - .4"
154-108	.4 - .5"

Telescoping Gage Set SERIES 155



DIMENSIONS



- A spring-loaded plunger expands within a bore (or groove) and is locked in place, allowing measurement of diameter (or width) with an outside micrometer after extraction.



155-905

SPECIFICATIONS

Metric	
Order No.	Range
6-gage Set	
155-905	8 - 150mm
Gages included	
155-127	8 - 12.7mm
155-128	12.7 - 19mm
155-129	19 - 32mm
155-130	32 - 54mm
155-131	54 - 90mm
155-132	90 - 150mm

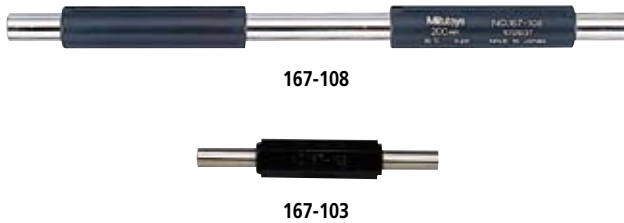
Inch	
Order No.	Range
6-gage Set	
155-903	.313" - 6"
Gages included	
155-121	.313" - .5"
155-122	.5 - .75"
155-123	.75 - 1.25"
155-124	1.25 - 2.125"
155-125	2.125 - 3.5"
155-126	3.5 - 6"

Micrometer

The origin of Mitutoyo's trustworthy brand of small tool instruments

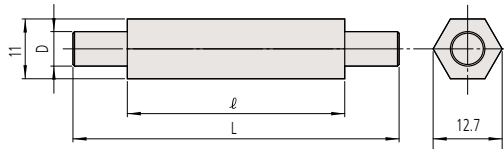
Setting Standards for Outside Micrometers SERIES 167

- Used for adjusting the reference point of the outside micrometer.



SPECIFICATIONS and DIMENSIONS

167-101 – 167-103
167-141 – 167-143

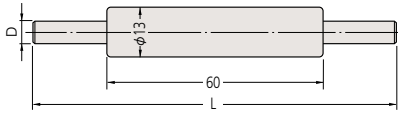


Unit: mm

Metric				
Order No.	Length (L)	Tolerance	ℓ	Diameter (D)
167-101	25mm	±1.5μm	18	6.35mm
167-102	50mm	±2.0μm	40	
167-103	75mm	±2.5μm		

Inch				
Order No.	Length (L)	Tolerance	ℓ	Diameter (D)
167-141	1"	±.00005"	18	.25"
167-142	2"	±.0001"	40	
167-143	3"	±.0001"		

167-104 – 167-107
167-144 – 167-147

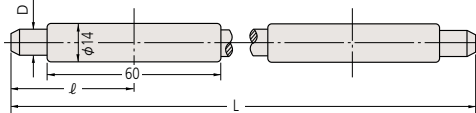


Unit: mm

Metric			
Order No.	Length (L)	Tolerance	Diameter (D)
167-104	100mm	±3μm	7.9mm
167-105	125mm	±3.5μm	
167-106	150mm	±4μm	
167-107	175mm	±4.5μm	

Inch			
Order No.	Length (L)	Tolerance	Diameter (D)
167-144	4"	±.0001"	.31"
167-145	5"	±.00015"	
167-146	6"		
167-147	7"		

167-108 – 167-119
167-148 – 167-159



Unit: mm

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

Inch				
Order No.	Length (L)	Tolerance	ℓ	Diameter (D)
167-148	8"	±.00015"	47	.37"
167-149	9"	±.0002"	47	
167-150	10"	±.0002"	52	
167-151	11"	±.0002"	57	
167-152	12"	±.00025"	64	
167-153	13"	±.00025"	69	
167-154	14"	±.00025"	74	
167-155	15"	±.00025"	80	
167-156	16"	±.00025"	85	
167-157	17"	±.00025"	90	
167-158	18"	±.00025"	95	
167-159	19"	±.0003"	101	

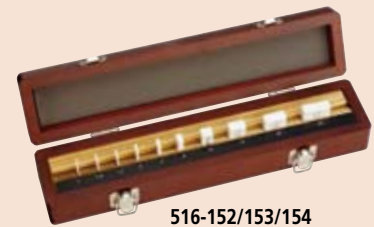
Technical Data

Flatness: 0.3μm
Parallelism: 2μm



Micrometer Inspection Gauge Block

Refer to page E-11 for details.

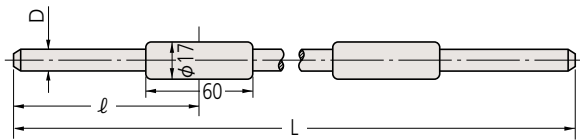


516-152/153/154



Micro Checker (holder only)
516-607

167-120 – 167-404
167-160 – 167-180



Unit: mm

Metric				
Order No.	Length (L)	Tolerance	ℓ	Diameter (D)
167-120	500mm	±11µm	106	11.9mm
167-121	525mm	±11.5µm	112	
167-122	550mm	±12.0µm	117	
167-123	575mm	±12.5µm	122	
167-124	600mm	±13µm	128	
167-125	625mm	±13.5µm	133	
167-126	650mm	±14µm	138	
167-127	675mm	±14.5µm	142	
167-128	700mm	±15µm	147	
167-129	725mm	±15.5µm	153	
167-130	750mm	±16µm	158	
167-131	775mm	±16.5µm	164	
167-132	800mm	±17µm	170	
167-133	825mm	±17.5µm	175	
167-134	850mm	±18µm	180	
167-135	875mm	±18.5µm	185	
167-136	900mm	±19µm	191	
167-137	925mm	±19.5µm	196	
167-138	950mm	±20µm	201	
167-139	975mm	±20.5µm	207	
167-140	1000mm	±21µm	211	
167-365	1025mm	±21.5µm	217	
167-366	1050mm	±22µm	222	
167-367	1075mm	±22.5µm	227	
167-368	1100mm	±23µm	232	
167-369	1125mm	±23.5µm	238	
167-370	1150mm	±24µm	243	
167-371	1175mm	±24.5µm	248	
167-372	1200mm	±25µm	254	
167-373	1225mm	±25.5µm	259	
167-374	1250mm	±26µm	264	
167-375	1275mm	±26.5µm	269	
167-376	1300mm	±27µm	275	
167-377	1325mm	±27.5µm	280	
167-378	1350mm	±28µm	285	
167-379	1375mm	±28.5µm	291	
167-380	1400mm	±29µm	296	
167-381	1425mm	±29.5µm	301	
167-382	1450mm	±30µm	306	
167-383	1475mm	±30.5µm	312	
167-384	1500mm	±31µm	317	
167-385	1525mm	±31.5µm	322	
167-386	1550mm	±32µm	328	
167-387	1575mm	±32.5µm	333	
167-388	1600mm	±33µm	338	
167-389	1625mm	±33.5µm	343	
167-390	1650mm	±34µm	349	
167-391	1675mm	±34.5µm	354	
167-392	1700mm	±35µm	359	
167-393	1725mm	±35.5µm	364	
167-394	1750mm	±36µm	370	
167-395	1775mm	±36.5µm	375	
167-396	1800mm	±37µm	380	
167-397	1825mm	±37.5µm	386	
167-398	1850mm	±38µm	391	
167-399	1875mm	±38.5µm	396	
167-400	1900mm	±39µm	401	
167-401	1925mm	±39.5µm	407	
167-402	1950mm	±40µm	412	
167-403	1975mm	±40.5µm	417	
167-404	2000mm	±41µm	423	

Inch				
Order No.	Length (L)	Tolerance	ℓ	Diameter (D)
167-160	20"	±.0003"	106	.47"
167-161	21"	±.0003"	112	
167-162	22"	±.0003"	117	
167-163	23"	±.0003"	122	
167-164	24"	±.0003"	128	
167-165	25"	±.00035"	133	
167-166	26"	±.00035"	138	
167-167	27"	±.00035"	142	
167-168	28"	±.00035"	147	
167-169	29"	±.00035"	153	
167-170	30"	±.00035"	158	
167-171	31"	±.00035"	164	
167-172	32"	±.00035"	170	
167-173	33"	±.00035"	175	
167-174	34"	±.00035"	180	
167-175	35"	±.00035"	185	
167-176	36"	±.00035"	191	
167-177	37"	±.0004"	196	
167-178	38"	±.0004"	201	
167-179	39"	±.0004"	207	
167-180	40"	±.0004"	211	

Available up to 79"

Micrometer

The origin of Mitutoyo's trustworthy brand of small tool instruments

Setting Standards for Screw Thread Micrometers SERIES 167

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



167-264
(60° screw)



167-262
(60° screw)



Metric		
Order No.	Length	Accuracy
Metric (unified) $\theta = 60^\circ$		
167-261	25mm	$\pm 4\mu\text{m}$
167-262	50mm	$\pm 5\mu\text{m}$
167-263	75mm	$\pm 6\mu\text{m}$
167-264	100mm	$\pm 7\mu\text{m}$
167-265	125mm	$\pm 8\mu\text{m}$
167-266	150mm	$\pm 9\mu\text{m}$
167-267	175mm	$\pm 10\mu\text{m}$
167-268	200mm	$\pm 11\mu\text{m}$
167-269	225mm	$\pm 12\mu\text{m}$
167-270	250mm	$\pm 13\mu\text{m}$
167-271	275mm	$\pm 14\mu\text{m}$
Whitworth $\theta = 55^\circ$		
167-272	25mm	$\pm 4\mu\text{m}$
167-273	50mm	$\pm 5\mu\text{m}$
167-274	75mm	$\pm 6\mu\text{m}$
167-275	100mm	$\pm 7\mu\text{m}$
167-276	125mm	$\pm 8\mu\text{m}$
167-277	150mm	$\pm 9\mu\text{m}$
167-278	175mm	$\pm 10\mu\text{m}$
167-279	200mm	$\pm 11\mu\text{m}$
167-280	225mm	$\pm 12\mu\text{m}$
167-281	250mm	$\pm 13\mu\text{m}$
167-282	275mm	$\pm 14\mu\text{m}$

Inch		
Order No.	Length (L)	Accuracy
Metric (unified) $\theta = 60^\circ$		
167-294	1"	$\pm 0.0015''$
167-295	2"	$\pm 0.002''$
167-296	3"	$\pm 0.0025''$
167-297	4"	$\pm 0.003''$
167-298	5"	$\pm 0.0035''$
167-299	6"	$\pm 0.004''$
Whitworth $\theta = 55^\circ$		
167-283	1"	$\pm 0.0015''$
167-284	2"	$\pm 0.002''$
167-285	3"	$\pm 0.0025''$
167-286	4"	$\pm 0.003''$
167-287	5"	$\pm 0.0035''$
167-288	6"	$\pm 0.004''$

Setting Standards for V-Anvil Micrometers SERIES 167

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



167-329



Metric			
Order No.	Length	Accuracy	Type
167-327	5mm	$\pm 2\mu\text{m}$	Plug
167-328	10mm		
167-329	25mm		
167-330	40mm	$\pm 3\mu\text{m}$	Ring
167-331	55mm		
167-332	70mm		
167-333	85mm		

Inch			
Order No.	Length (L)	Accuracy	Type
167-337	.2"	$\pm 0.001''$	Plug
167-338	.4"		
167-339	1"		
167-340	1.6"	$\pm 0.0015''$	Ring
167-341	2.2"		
167-342	2.8"		
167-343	3.4"		

Optical Parallels SERIES 157

- Designed to inspect parallelism and flatness of measuring faces of micrometers. For details, refer to "Quick Guide to Precision Measuring Instruments".
- Each set consists of 4 sizes to aid in testing parallelism at various angular positions of the micrometer spindle.



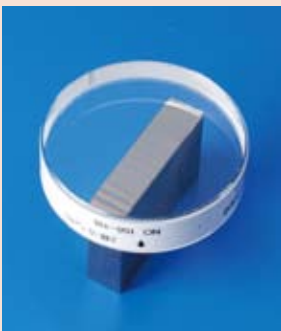
157-903

SPECIFICATIONS

Metric							
Order No.	Range of micrometer to be checked	Sizes of parallels included in set	Diameter	Flatness	Parallelism	Remarks	
157-903	0 - 25mm	12.00, 12.12, 12.25, 12.37mm	ø30	0.1µm	0.2µm	For 25mm	
157-904	25 - 50mm	25.00, 25.12, 25.25, 13.37mm				For 50mm	
Inch							
Order No.	Range of micrometer to be checked	Sizes of parallels included in set	Diameter	Flatness	Parallelism	Remarks	
157-901	0 - 1"	.5000", .5062", .5125", .5187"	ø30	0.1µm	0.2µm	For 25mm	
157-902	1 - 2"	1.0000", 1.0062", 1.0125", 1.0187"				For 50mm	

Optical Flats SERIES 158

- Used for inspecting the flatness of very flat surfaces. For details, refer to "Quick Guide to Precision Measuring Instruments".



158-118

SPECIFICATIONS

Metric				Inch			
Order No.	Thickness	Diameter	Flatness grade	Order No.	Thickness	Diameter	Flatness grade
158-117	12mm	ø45	0.2µm	158-122	.5"	1.8"	.000004"
158-118		ø45	0.1µm	158-124	.6"	2.4"	
158-119	15mm	ø60	0.2µm				
158-120		ø60	0.1µm				

Micrometer

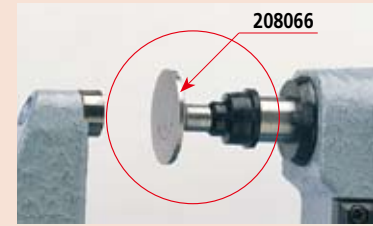
The origin of Mitutoyo's trustworthy brand of small tool instruments

Spindle Attachment Tips

- Simple interchangeable tips attached to standard micrometer spindles enable measurement of contours otherwise unmeasurable (for 6.35 spindles only).
- Measuring range changes when a spindle attachment tip is mounted: the maximum measuring range is 10mm or less (accuracy is not guaranteed).

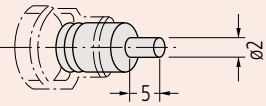
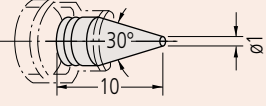
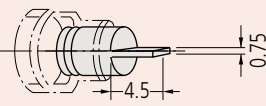
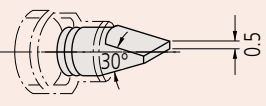
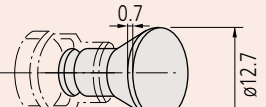
Technical Data

Tip length: 10mm ±5μm



Specifications and Dimensions

Unit: mm

Order No.	Tip type	Dimensions
208062	Spline	
208063	Comparator	
208064	Blade	
208065	Knife-edge	
208066	Disk-plate	

Micrometer Oil

- Special lubricant for micrometers.



207000
(Content: 30ml)

SPECIFICATIONS

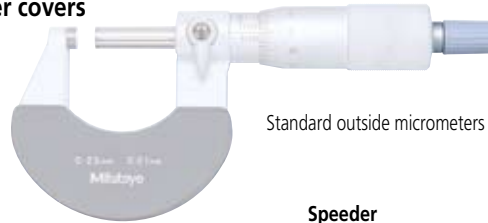
Order No.	Product name	Remarks
207000	Micrometer oil	Grease (30ml)

Color-Coded Ratchet and Speeder Covers

- Ratchet and speeder covers in a choice of seven colors for use in instrument identification control schemes: red, blue, yellow, green, brown, black and gray.

SPECIFICATIONS

Ratchet and speeder covers



Ratchet



Speeder



Analog type: 0 - 300mm

Order No.		Color	Material
Ratchet	Speeder		
04GZA239	04GAA260	Gray	Plastic
985056	301708	Black	
985061	301709	Red	
985081	301713	Blue	
985071	301711	Yellow	
985076	301712	Green	
985066	301710	Brown	
950700	—	Gray	Steel

Analog type: 300 - 1000mm

Order No.		Color	Material
Ratchet	Speeder		
04GZA243	04GAA260	Gray	Plastic
—	301708	Black	
—	301709	Red	
—	301713	Blue	
—	301711	Yellow	
—	301712	Green	
—	301710	Brown	
950701	—	Gray	Steel

Digimatic type 0 - 300mm*

Order No.*		Color	Material
Ratchet	Speeder		
04GZA241	04GAA260	Gray	Plastic
—	301708	Black	
—	301709	Red	
—	301713	Blue	
—	301711	Yellow	
—	301712	Green	
—	301710	Brown	
951588	—	Gray	Steel

*Cannot be used for analog types.

Color-coded speeder covers



Color-coded speeder covers



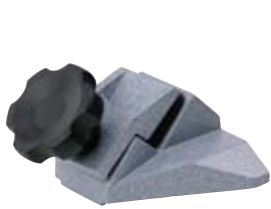
Order No.	Color
04GAA899	Black
04GAA900	Red
04GAA901	Yellow
04GAA902	Green
04GAA903	Blue
04AAB208	Gray

Micrometer

The origin of Mitutoyo's trustworthy brand of small tool instruments

Micrometer Stands SERIES 156

- Designed to allow benchtop use of hand micrometers or other gages which have frames suitable for gripping by the clamp.



156-105-10



156-101-10



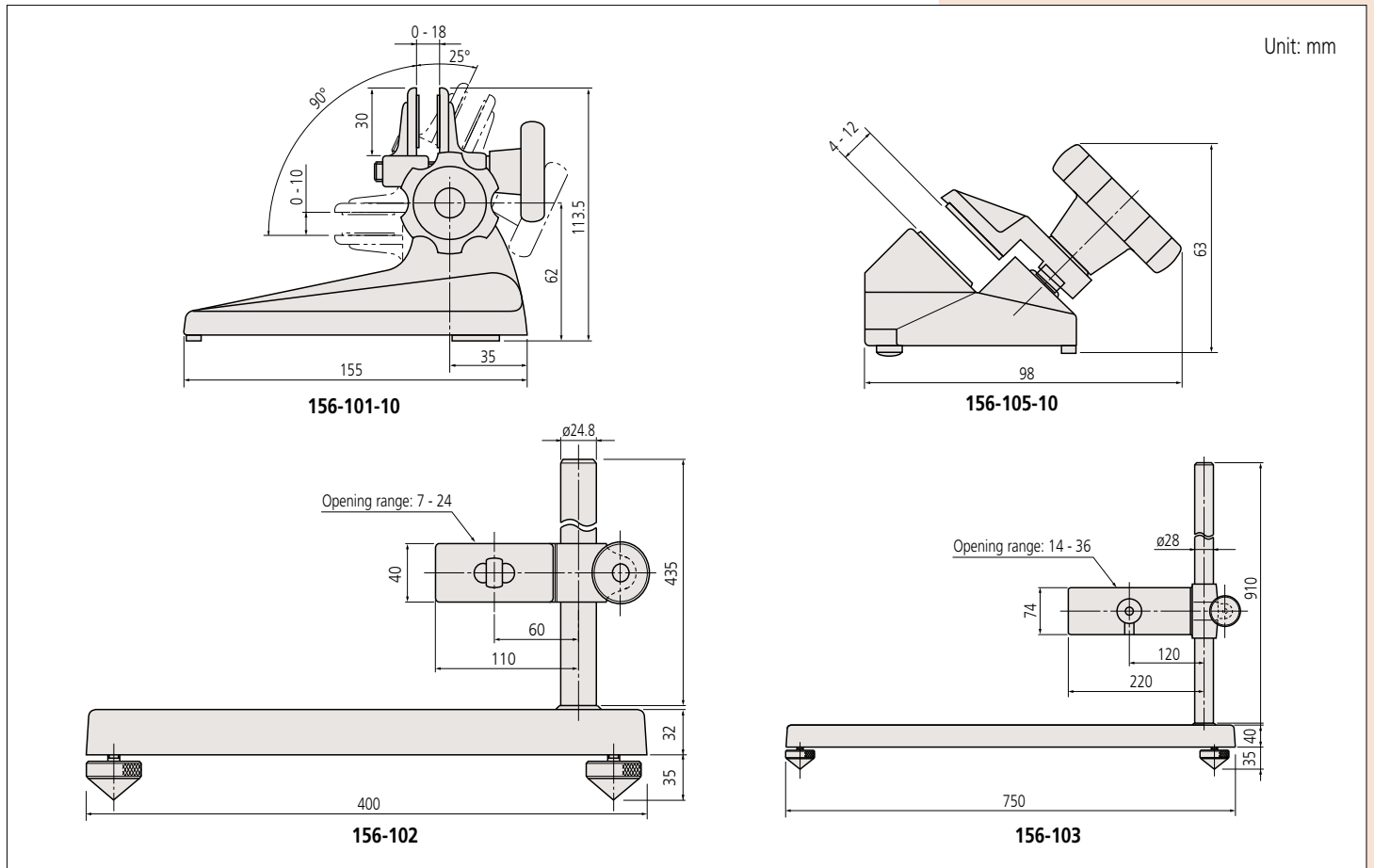
156-102

SPECIFICATIONS

Order No.	Micrometer ranges	Remarks
156-101-10	Up to 100mm (4")*	Adjustable angle type
156-105-10	0-25mm (0-1"), 25-50mm (1"-2")	Fixed angle type
156-102	125-300mm (5"-12")	Vertical type
156-103	300-1000mm (12"-40")	Vertical type

* 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.)

DIMENSIONS



Introduction for Measurement data recording tools for Micrometers and Micrometer Heads (optional)

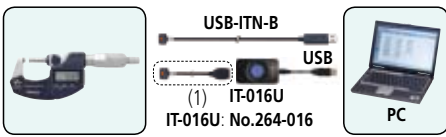
For Digimatic Micrometers other than Quickmike type, and Digimatic Micrometer Heads series 350 (Connector type B)

■ Dedicated connecting cables (optional)

Interface for connecting to PC or PLC, and dedicated printer and its connecting cable.

- **PC connection (wired system) ... USB Input Tool**
(refer to page A-5/A-6)

USB-ITN-B (2m): No.06ADV380B



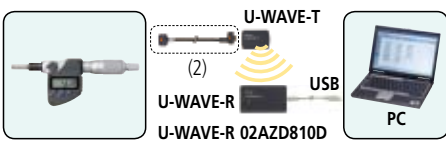
Dedicated cable for models with SPC data output

- (1) 1m: **No.05CZA662**
- 2m: **No.05CZA663**

- **PC connection (wireless system) ... U-WAVE**
(refer to page A-7)

U-WAVE-T (IP67): No.02AZD730D

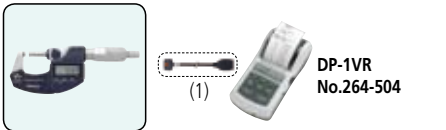
U-WAVE-T (buzzer): No.02AZD880D



Dedicated cable for models with SPC data output

- (2) For standard 160mm: **No.02AZD790B**
- For footswitch: **No.02AZE140B**

- **Dedicated printer connection (only for wired system)**
... **DP-1VR** (refer to page A-13)



Dedicated cable for models with SPC data output

- (1) 1m: **No.05CZA662**
- 2m: **No.05CZA663**

- **Connecting to PC, PLC, etc. by RS-232C communication (only for wired system)**

... **IT-007R** (refer to page A-6), **MUX-10F** (refer to page A-14)



Dedicated cable for models with SPC data output

- (1) 1m: **No.05CZA662**
- 2m: **No.05CZA663**

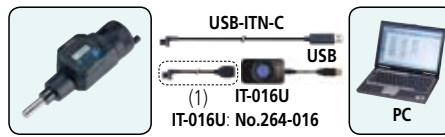
For Digimatic Micrometer Heads series 164 (Connector type C)

■ Dedicated connecting cables (optional)

Interface for connecting to PC or PLC, and dedicated printer and its connecting cable.

- **PC connection (wired system) ... USB Input Tool**
(refer to page A-5/A-6)

USB-ITN-C (2m): No.06ADV380C



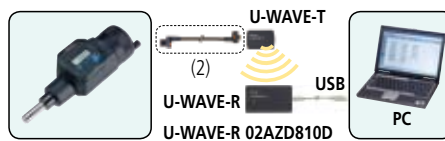
Dedicated cable for models with SPC data output

- (1) 1m: **No.959149**
- 2m: **No.959150**

- **PC connection (wireless system) ... U-WAVE**
(refer to page A-7)

U-WAVE-T (IP67): No.02AZD730D

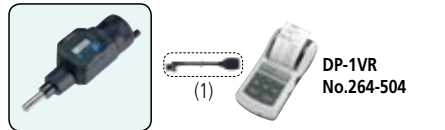
U-WAVE-T (buzzer): No.02AZD880D



Dedicated cable for models with SPC data output

- (2) For standard 160mm: **No.02AZD790C**
- For footswitch: **No.02AZE140C**

- **Dedicated printer connection (only for wired system)**
... **DP-1VR** (refer to page A-13)

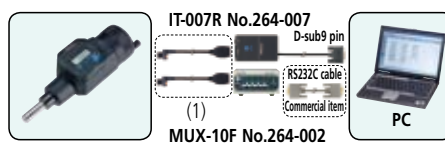


Dedicated cable for models with SPC data output

- (1) 1m: **No.959149**
- 2m: **No.959150**

- **Connecting to PC, PLC, etc. by RS-232C communication (only for wired system)**

... **IT-007R** (refer to page A-6), **MUX-10F** (refer to page A-14)



Dedicated cable for models with SPC data output

- (1) 1m: **No.959149**
- 2m: **No.959150**

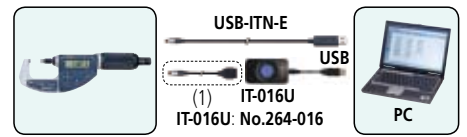
For Quickmike type (Connector type E)

■ Dedicated connecting cables (optional)

Interface for connecting to PC or PLC, and dedicated printer and its connecting cable.

- **PC connection (wired system) ... USB Input Tool**
(refer to page A-5/A-6)

USB-ITN-E (2m): No.06ADV380E



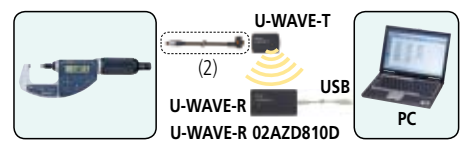
Dedicated cable for models with SPC data output

- (1) 1m: **No.937387**
- 2m: **No.965013**

- **PC connection (wireless system) ... U-WAVE**
(refer to page A-7)

U-WAVE-T (IP67): No.02AZD730D

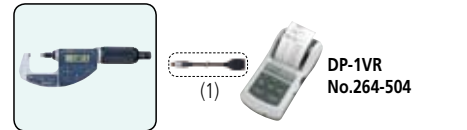
U-WAVE-T (buzzer): No.02AZD880D



Dedicated cable for models with SPC data output

- (2) For standard 160mm: **No.02AZD790E**
- For footswitch: **No.02AZE140E**

- **Dedicated printer connection (only for wired system)**
... **DP-1VR** (refer to page A-13)

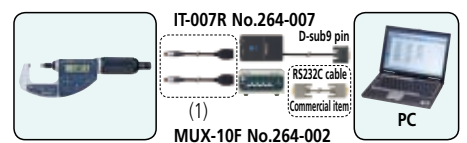


Dedicated cable for models with SPC data output

- (1) 1m: **No.937387**
- 2m: **No.965013**

- **Connecting to PC, PLC, etc. by RS-232C communication (only for wired system)**

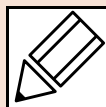
... **IT-007R** (refer to page A-6), **MUX-10F** (refer to page A-14)



Dedicated cable for models with SPC data output

- (1) 1m: **No.937387**
- 2m: **No.965013**

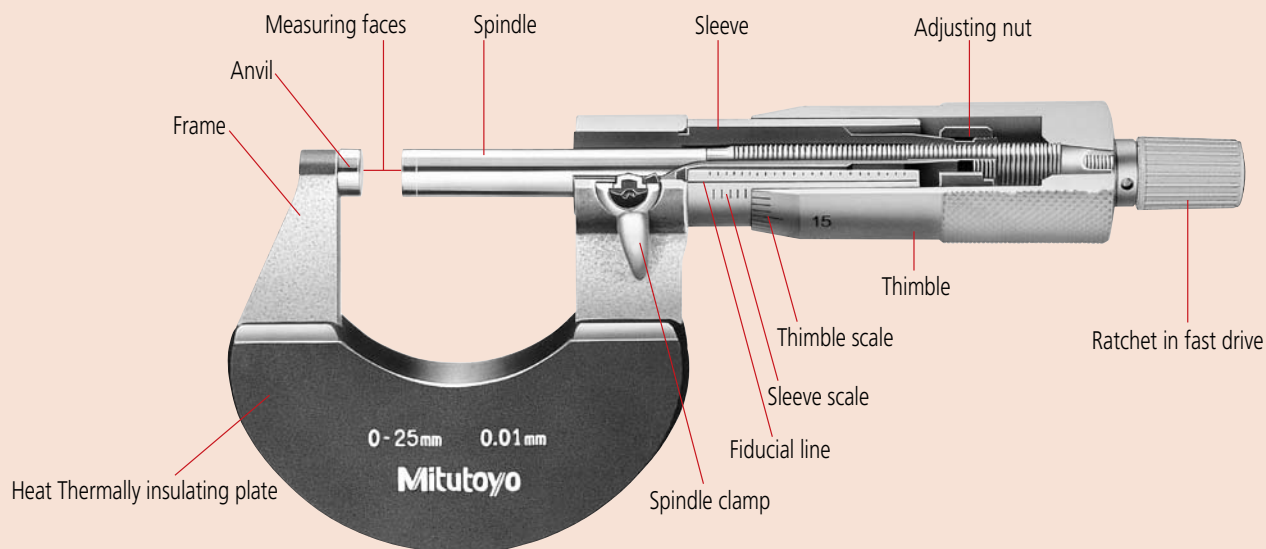
Quick Guide to Precision Measuring Instruments



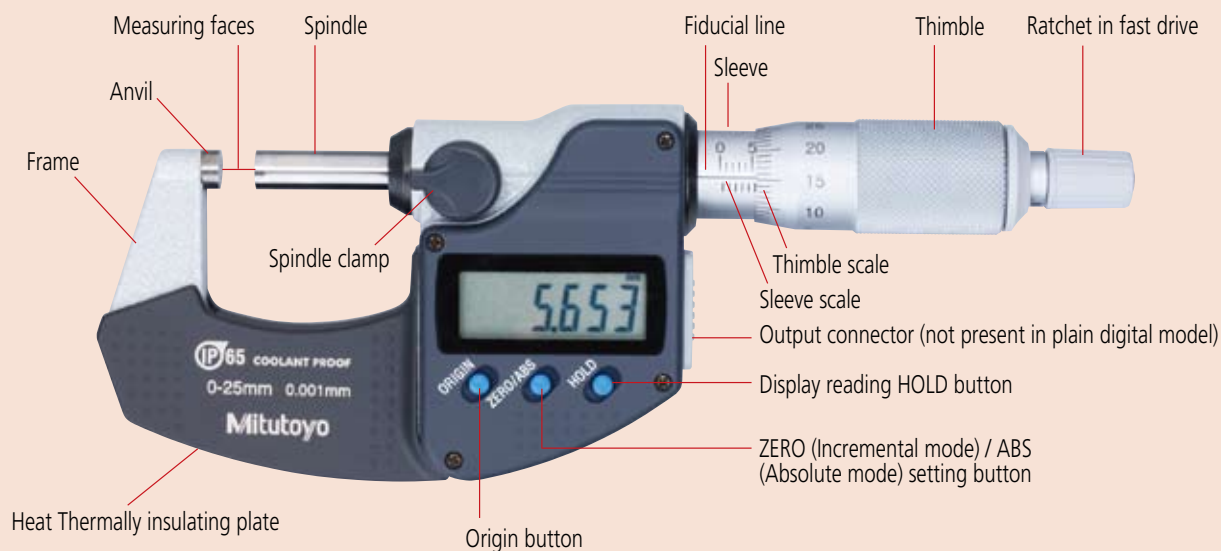
Micrometers

Nomenclature

Standard Analogue Outside Micrometer

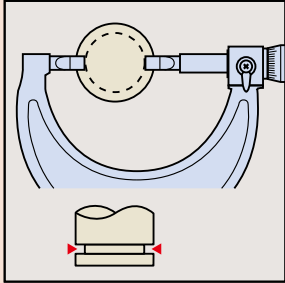


Digimatic Outside Micrometer



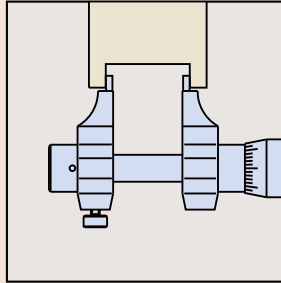
■ Special Purpose Micrometer Applications

Blade micrometer



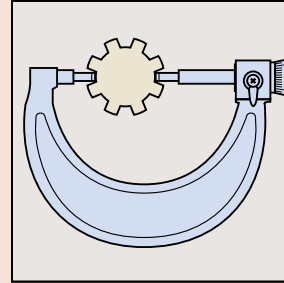
For diameter inside narrow groove measurement

Inside micrometer, caliper type



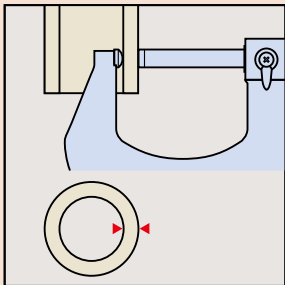
For small internal diameter, and groove width measurement

Spline micrometer



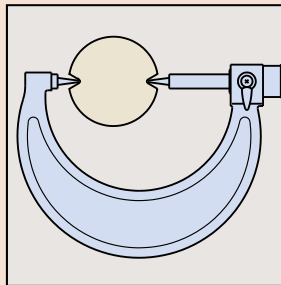
For splined shaft diameter measurement

Tube micrometer



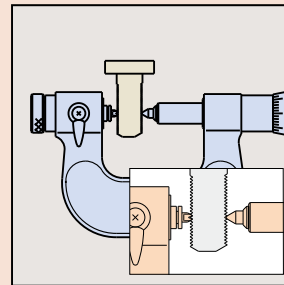
For pipe thickness measurement

Point micrometer



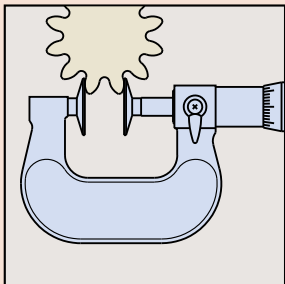
For root diameter measurement

Screw thread micrometer



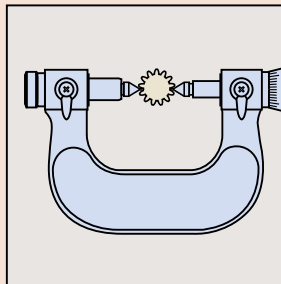
For effective thread diameter measurement

Disc type outside micrometer



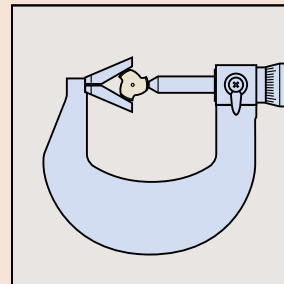
For root tangent measurement on spur gears and helical gears.

Ball tooth thickness micrometer



Measurement of gear over-pin diameter

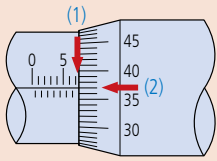
V-anvil micrometer



For measurement of 3- or 5-flute cutting tools

How to Read the Scale

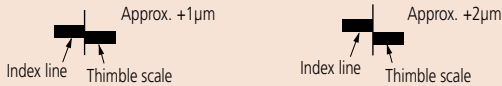
Micrometer with standard scale (graduation: 0.01mm)



- (1) Sleeve scale reading 7. mm
 - (2) Thimble scale reading + 0.37mm
- Micrometer reading 7.37mm

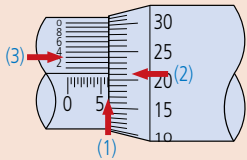
Note) 0.37 mm (2) is read at the position where the sleeve fiducial line is aligned to the thimble graduations.

The thimble scale can be read directly to 0.01mm, as shown above, but may also be estimated to 0.001mm when the lines are nearly coincident because the line thickness is 1/5 of the spacing between them.



Micrometer with vernier scale (graduation: 0.001mm)

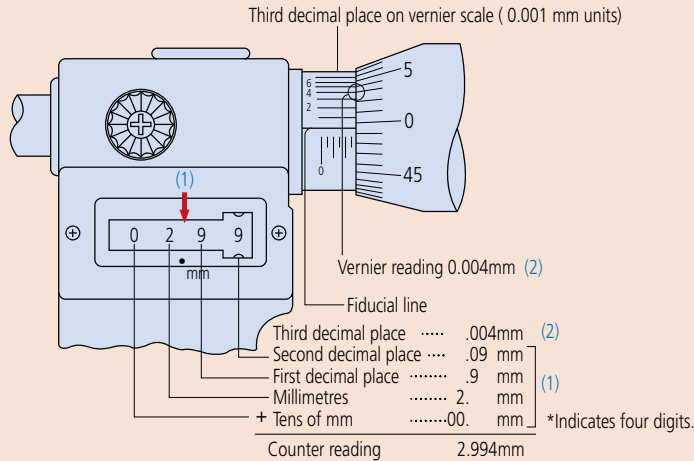
The vernier scale provided above the sleeve index line enables direct readings to be made to within 0.001mm.



- (1) Sleeve scale reading 6. mm
 - (2) Thimble scale reading .21mm
 - (3) Reading from the vernier scale marking and thimble graduation line + .003mm
- Micrometer reading 6.213mm

Note) 0.21 mm (2) is read at the position where the index line is between two graduations (21 and 22 in this case). 0.003 mm (3) is read at the position where one of the vernier graduations aligns with one of the thimble graduations.

Micrometer with mechanical-digit display (digital step: 0.001mm)

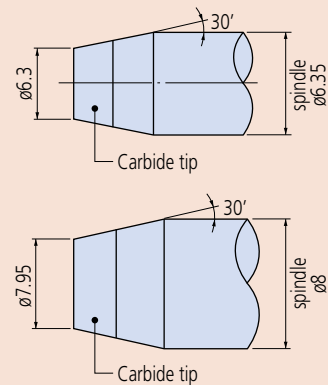


Note) 0.004 mm (2) is read at the position where a vernier graduation line corresponds with one of the thimble graduation lines.

Measuring Force Limiting Device

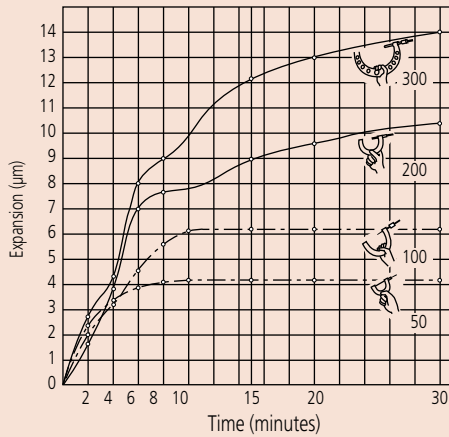
	Audible in operation	One-handed operation	Remarks
Ratchet stop	Yes	Unsuitable	Audible clicking operation causes micro-shocks
Friction thimble (F type)	No	Suitable	Smooth operation without shock or sound
Ratchet thimble (T type)	Yes	Suitable	Audible operation provides confirmation of constant measuring force
Ratchet thimble	Yes	Suitable	Audible operation provides confirmation of constant measuring force

Measuring Face Detail



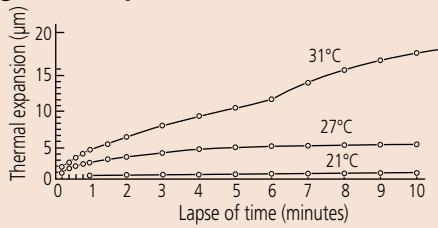
These drawings above are for illustration only and are not to scale

■ Micrometer Expansion due to Holding Frame with the Bare Hand



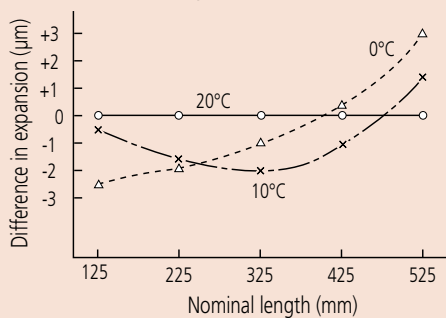
The above graph shows micrometer frame expansion due to heat transfer from hand to frame when the frame is held in the bare hand which, as can be seen, may result in a significant measurement error due to temperature-induced expansion. If the micrometer must be held by hand during measurement then try to minimize contact time. A heat insulator will reduce this effect considerably if fitted, or gloves may be worn. (Note that the above graph shows typical effects, and is not guaranteed).

■ Length Standard Expansion with Change of Temperature (for 200mm bar initially at 20°C)



The above experimental graph shows how a particular micrometer standard expanded with time as people whose hand temperatures were different (as shown) held the end of it at a room temperature of 20°C. This graph shows that it is important not to set a micrometer while directly holding the micrometer standard but to make adjustments only while wearing gloves or lightly supporting the length standard by its heat insulators. When performing a measurement, note also that it takes time until the expanded micrometer standard returns to the original length. (Note that the graph values are not guaranteed values but experimental values.)

■ Difference in Thermal Expansion between Micrometer and Length Standard



In the above experiment, after the micrometer and its standard were left at a room temperature of 20°C for about 24 hours for temperature stabilization, the start point was adjusted using the micrometer standard. Then, the micrometer with its standard were left at the temperatures of 0°C and 10°C for about the same period of time, and the start point was tested for shift. The above graph shows the results for each of the sizes from 125 through 525 mm at each temperature. This graph shows that both the micrometer and its standard must be left at the same location for at least several hours before adjusting the start point. (Note that the graph values are not guaranteed values but experimental values.)

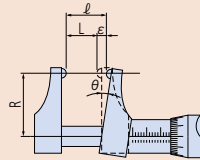
■ Effect of Changing Support Method and Orientation (Unit: µm)

Changing the support method and/or orientation of a micrometer after zero setting affects subsequent measuring results. The tables below highlight the measurement errors to be expected in three other cases after micrometers are zero-set in the 'Supported at the bottom and center' case. These actual results show that it is best to set and measure using the same orientation and support method.

Supporting method	Supported at the bottom and center	Supported only at the center
Attitude		
Maximum measuring length (mm)		
325	0	-5.5
425	0	-2.5
525	0	-5.5
625	0	-11.0
725	0	-9.5
825	0	-18.0
925	0	-22.5
1025	0	-26.0

Supporting method	Supported at the center in a lateral orientation.	Supported by hand downward.
Attitude		
Maximum measuring length (mm)		
325	+1.5	-4.5
425	+2.0	-10.5
525	-4.5	-10.0
625	0	-5.5
725	-9.5	-19.0
825	-5.0	-35.0
925	-14.0	-27.0
1025	-5.0	-40.0

■ Abbe's Principle



Abbe's principle states that "maximum accuracy is obtained when the scale and the measurement axes are common".

This is because any variation in the relative angle (θ) of the moving measuring jaw on an instrument, such as a caliper jaw micrometer, causes displacement that is not measured

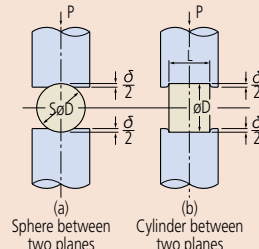
on the instrument's scale and this is an Abbe error ($\epsilon = l - L$ in the diagram). Spindle straightness error, play in the spindle guide or variation of measuring force can all cause (θ) to vary and the error increases with R.

■ Hooke's Law

Hooke's law states that strain in an elastic material is proportional to the stress causing that strain, providing the strain remains within the elastic limit for that material.

■ Hertz's Formulae

Hertz's formulae give the apparent reduction in diameter of spheres and cylinders due to elastic compression when measured between plane surfaces. These formulae are useful for determining the deformation of a workpiece caused by the measuring force in point and line contact situations.



Assuming that the material is steel and units are as follows:
 Modulus of elasticity: $E = 205$ GPa
 Amount of deformation: δ (μm)
 Diameter of sphere or cylinder: D (mm)
 Length of cylinder: L (mm)
 Measuring force: P (N)
 a) Apparent reduction in diameter of sphere
 $\delta 1 = 0.82 \sqrt[3]{P^2/D}$
 b) Apparent reduction in diameter of cylinder
 $\delta 2 = 0.094 \cdot P/L \sqrt{1/D}$

Major measurement errors of the screw micrometer

Error cause	Maximum possible error	Precautions for eliminating errors	Error that might not be eliminated even with precautions
Micrometer feed error	3μm	1. Correct the micrometer before use.	±1μm
Anvil angle error	±5μm assuming the error of a half angle is 15 minutes	1. Measure the angle error and correct the micrometer. 2. Adjust the micrometer using the same thread gage as the workpiece.	±3μm expected measurement error of half angle
Misaligned contact points	+10μm		+3μm
Influence of measuring force	±10μm	1. Use a micrometer with a low measuring force if possible. 2. Always use the ratchet stop. 3. Adjust the micrometer using a thread gage with the same pitch.	+3μm
Angle error of thread gage	±10μm	1. Perform correction calculation (angle). 2. Correct the length error. 3. Adjust the micrometer using the same thread gage as the workpiece.	+3μm
Length error of thread gage	±(3+ $\frac{L}{25}$)μm	1. Perform correction calculation. 2. Adjust the micrometer using the same thread gage as the workpiece.	±1μm
Workpiece thread angle error	JIS 2 grade error of half angle ±229 minutes -91μm +71μm	1. Minimize the angle error as much as possible. 2. Measure the angle error and perform correction calculation. 3. Use the three-wire method for a large angle error.	±8μm assuming the error of half angle is ±23 minutes
Cumulative error	(±117+40)μm		+26μm -12μm

Screw pitch diameter measurement

Three-wire method

The screw pitch diameter can be measured with the three-wire method as shown in the figure.

Calculate the pitch diameter (E) with equations (1) and (2).

Metric thread or unified screw (60°)

$$E = M - 3d + 0.866025P \quad \dots\dots(1)$$

Whitworth thread (55°)

$$E = M - 3.16568d + 0.960491P \quad \dots\dots(2)$$

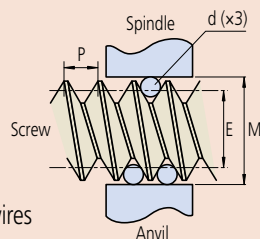
d = Wire diameter

E = Screw pitch diameter

M = Micrometer reading including three wires

P = Screw pitch

(Convert inches to millimeters for unified screws.)



Thread type	Optimal wire size at D
Metric thread or unified screw (60°)	0.577P
Whitworth thread (55°)	0.564P

Major measurement errors of the three-wire method

Error cause	Precautions for eliminating errors	Possible error	Error that might not be eliminated even with precautions
Pitch error (workpiece)	1. Correct the pitch error ($\delta p = \delta E$) 2. Measure several points and adopt their average. 3. Reduce single pitch errors.	±18μm assuming that the pitch error is 0.02 mm.	±3μm
Error of half angle (workpiece)	1. Use the optimal wire diameter. 2. No correction is needed.	±0.3μm	±0.3μm
Due to anvil difference	1. Use the optimal wire diameter. 2. Use the wire which has a diameter close to the average at the one wire side.	±8μm	±1μm
Wire diameter error	1. Use the predetermined measuring force appropriate for the pitch. 2. Use the predetermined width of measurement edge. 3. Use a stable measuring force.	-3μm	-1μm
Cumulative error		In the worst case +20μm -35μm	When measured carefully +3μm -5μm

One-wire method

The pitch diameter of odd-fluted tap can be measured using the V-anvil micrometer with the one-wire method. Obtain the measured value (M₁) and calculate M with equation (3) or (4).

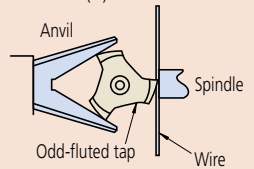
M₁ = Micrometer reading during one-wire measurement

D = Odd-fluted tap diameter

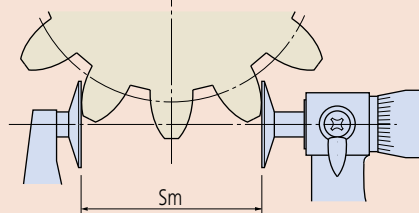
$$\text{Tap with three flutes : } M = 3M_1 - 2D \quad \dots\dots(3)$$

$$\text{Tap with five flutes : } M = 2.2360M_1 - 1.23606D \quad \dots\dots(4)$$

Then, assign the calculated M to equation (1) or (2) to calculate the pitch diameter (E).



Root tangent length



Formula for calculating a root tangent length (Sm):

$$Sm = m \cos \alpha_0 \{ \pi (Zm - 0.5) + Z \operatorname{inv} \alpha_0 \} + 2Xm \sin \alpha_0$$

Formula for calculating the number of teeth within the root tangent length (Zm):

$$Zm' = Z \cdot K(f) + 0.5 \quad (Zm \text{ is the integer closest to } Zm')$$

$$\text{where, } K(f) = \frac{1}{\pi} \{ \sec \alpha_0 \sqrt{(1 + 2f)^2 - \cos^2 \alpha_0} - \operatorname{inv} \alpha_0 - 2f \tan \alpha_0 \}$$

$$\text{and, } f = \frac{X}{Z}$$

m: Module

α₀: Pressure angle

Z: Number of teeth

X: Addendum modification coefficient

Sm: Root tangent length

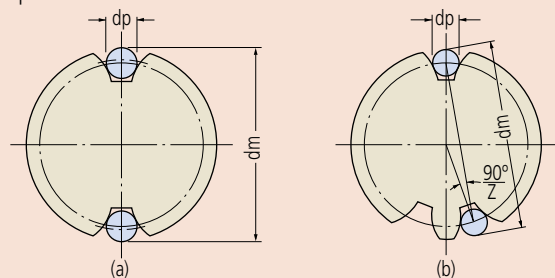
Zm: Number of teeth within the root tangent length

$$\operatorname{inv} 20^\circ \cong 0.014904$$

$$\operatorname{inv} 14.5^\circ \cong 0.0055448$$

Gear measurement

Over-pin method



For a gear with an even number of teeth:

$$dm = dp + \frac{dg}{\cos \theta} = dp + \frac{z \cdot m \cdot \cos \alpha_0}{\cos \theta}$$

For a gear with an odd number of teeth:

$$dm = dp + \frac{dg}{\cos \theta} \cdot \cos \left(\frac{90^\circ}{Z} \right) = dp + \frac{z \cdot m \cdot \cos \alpha_0}{\cos \theta} \cdot \cos \left(\frac{90^\circ}{Z} \right)$$

however,

$$\operatorname{inv} \theta = \frac{dp}{dg} - \frac{X}{Z} = \frac{dp}{z \cdot m \cdot \cos \alpha_0} - \left(\frac{\pi}{2Z} - \operatorname{inv} \alpha_0 \right) + \frac{2 \tan \alpha_0}{Z} \cdot X$$

Obtain θ (invθ) from the involute function table.

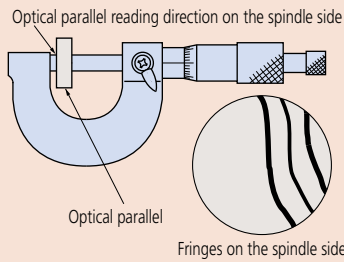
z: Number of teeth

α₀: Pressure angle teeth

m: Module

X: Addendum modification coefficient

■ Testing Parallelism of Micrometer Measuring Faces



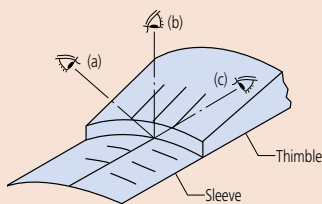
Parallelism can be estimated using an optical parallel held between the faces. Firstly, bring the parallel to the anvil measuring face. Then close the spindle on the parallel using normal measuring force and count the number of red interference fringes seen on the measuring face of the spindle in white light. Each fringe represents a half wavelength difference in height ($0.32\mu\text{m}$ for red fringes).

In the above figure a parallelism of approximately $1\mu\text{m}$ is obtained from $0.32\mu\text{m} \times 3 = 0.96\mu\text{m}$.

■ General notes on using the micrometer

- Carefully check the type, measuring range, accuracy, and other specifications to select the appropriate model for your application.
- Leave the micrometer and workpiece at room temperature long enough for their temperatures to equalize before making a measurement.
- Look directly at the fiducial line when taking a reading against the thimble graduations.

If the graduation lines are viewed from an angle, the correct alignment position of the lines cannot be read due to parallax error.

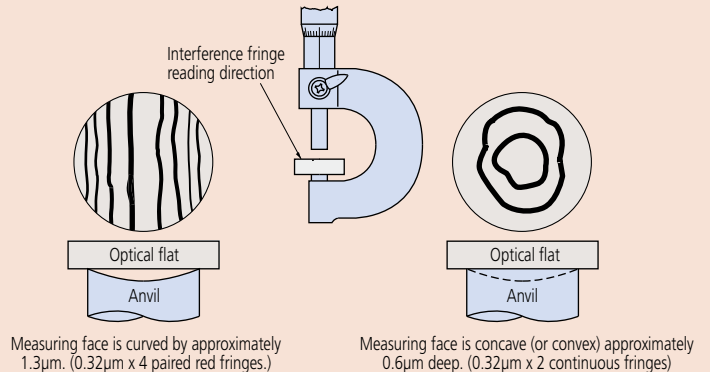


- Wipe off the measuring faces of both the anvil and spindle with lint-free paper set the start (zero) point before measuring.

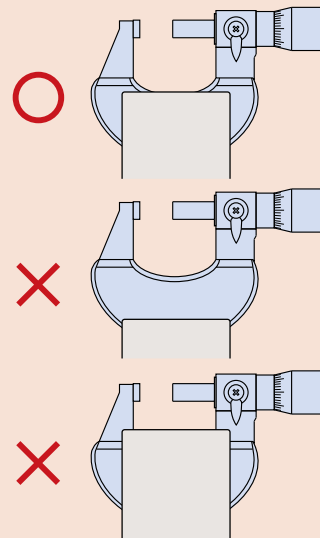


■ Testing Flatness of Micrometer Measuring Faces

Flatness can be estimated using an optical flat (or parallel) held against a face. Count the number of red interference fringes seen on the measuring face in white light. Each fringe represents a half wavelength difference in height ($0.32\mu\text{m}$ for red).



- Wipe away any dust, chips and other debris from the circumference and measuring face of the spindle as part of daily maintenance. In addition, sufficiently wipe off any stains and fingerprints on each part with dry cloth.
- Use the constant-force device correctly so that measurements are performed with the correct measuring force.
- When attaching the micrometer onto a micrometer stand, the stand should clamp the center of the micrometer frame. Do not clamp it too tightly.



- Be careful not to drop or bump the micrometer on anything. Do not rotate the micrometer thimble using excessive force. If you believe a micrometer may have been damaged due to accidental mishandling, ensure that it is inspected for accuracy before further use.
- After a long storage period or when there is no protective oil film visible, lightly apply anti-corrosion oil to the micrometer by wiping with a cloth soaked in it.
- Notes on storage:
 - Avoid storing the micrometer in direct sunlight.
 - Store the micrometer in a ventilated place with low humidity.
 - Store the micrometer in a place with little dust.
 - Store the micrometer in a case or other container, which should not be kept on the floor.
 - When storing the micrometer, always leave a gap of 0.1 to 1 mm between the measuring faces.
 - Do not store the micrometer in a clamped state.