

Bore Gages

For easy and accurate measurement of inside diameters

Bore Gages SERIES 526 — for Extra Small Holes

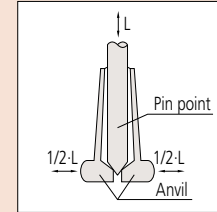
- These gages are designed to measure the diameters of very small holes. The radial displacement of the split-ball anvil is converted to axial displacement of the measuring rod, which is shown on the dial indicator.
- Alternative indicators may be used in place of those recommended*.
 - * Some indicators and protection covers cannot be used with these bore gages. Contact a Mitutoyo sales office if considering the use of dial or digimatic indicators other than the recommended models.
- An optional stand (**215-120-10**) is available for efficient measurement of multiple small holes. Refer to page C-30 for details.



526-170

* The dial indicator and the protection cover are optional.

Measurement principle



Technical Data

Accuracy
Metric models: 4µm
Inch models: .00016"
Repeatability
Metric models: 2µm
Inch models: .00008"

Optional Accessories

– : Dial indicator (See Chapter F)
21DZA000: Dial protection cover
215-120-10: Stand for small holes

Recommended dial indicators (see Chapter F)

Metric models: **2046SB** (0.01mm)
2972TB (0.01mm - One-revolution type)
2109SB-10 (0.001mm)
2900SB-10 (0.001mm - One-revolution type)
Inch models: **2922SB** (.0005")
2977TB (.0005" - One-revolution type)
2923SB-10 (.0001")
2910SB-10 (.0001" - One-revolution type)

Recommended digimatic indicators (see Chapter F)

Metric models: **543-310B** (ID-C112GXB: 0.001mm)
Inch models: **543-312B** (ID-C112GEXB: 0.001mm/.00005")
* Indicators equipped with rubber bellows, such as water-proof types, cannot be used.

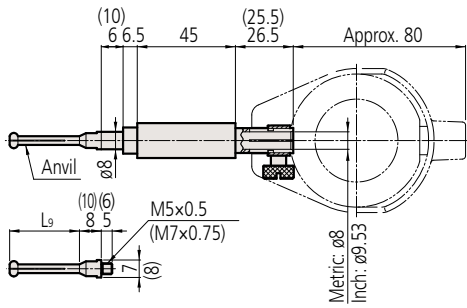
SPECIFICATIONS

Metric								
Order No.	Range	Bore gage	Content of set					Probing depth
			Dial indicator	Dial protection cover	Anvil	Pin point	Setting ring	
526-170	0.95-1.55mm	526-170	Not supplied	Not supplied	5 pcs.	1 pc.	5 pcs.	11.5mm
526-160	1.50-4.00mm	526-160			9 pcs.	2 pcs.	9 pcs.	17.5, 22.5mm
526-150	3.70-7.30mm	526-150			7 pcs.	1 pc.	7 pcs.	32.0mm
526-172	0.95-1.55mm	526-170	2109SB-10 (Graduation 0.001mm)	21DZA000	5 pcs.	1 pc.	5 pcs.	11.5mm
526-162	1.50-4.00mm	526-160			9 pcs.	2 pcs.	9 pcs.	17.5, 22.5mm
526-152	3.70-7.30mm	526-150			7 pcs.	1 pc.	7 pcs.	32.0mm
526-173	0.95-1.55mm	526-170	2046SB (Graduation: 0.01mm)	21DZA000	5 pcs.	1 pc.	5 pcs.	11.5mm
526-163	1.50-4.00mm	526-160			9 pcs.	2 pcs.	9 pcs.	17.5, 22.5mm
526-153	3.70-7.30mm	526-150			7 pcs.	1 pc.	7 pcs.	32.0mm

Inch								
Order No.	Range	Bore gage	Content of set					Probing depth
			Dial indicator	Dial protection cover	Anvil	Pin point	Setting ring	
526-175	.037-.061"	526-175	Not supplied	Not supplied	5 pcs.	1 pc.	5 pcs.	.45"
526-165	.06-.157"	526-165			9 pcs.	2 pcs.	9 pcs.	.68, .88"
526-155	.145-.29"	526-155			7 pcs.	1 pc.	7 pcs.	1.25"
526-176	.037-.061"	526-175	2923SB-10 (Graduation: .0001")	21DZA000	5 pcs.	1 pc.	5 pcs.	.45"
526-166	.06-.157"	526-165			9 pcs.	2 pcs.	9 pcs.	.68, .88"
526-156	.145-.29"	526-155			7 pcs.	1 pc.	7 pcs.	1.25"

DIMENSIONS

Unit: mm

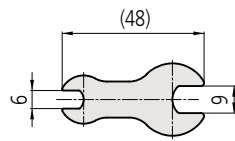


() : 3.7 - 7.3mm / .145 - .29 range model

STANDARD ACCESSORIES

Bore gage (Main body)	Marked No.	Parts No.	Anvil		Pin point	Setting ring mm/inch	Spanner Parts No.
			Measuring range	L ₉			
526-170 526-175	1.0	201414	0.95-1.15mm/.037-.045"	11.5mm/.45"	201435	1.0mm/.04"	210188
	1.1	201415	1.07-1.25mm/.042-.049"			1.1mm/.045"	
	1.2	201416	1.17-1.35mm/.046-.053"			1.2mm/.05"	
	1.3	201417	1.27-1.45mm/.050-.057"			1.3mm/.055"	
	1.4	201418	1.37-1.55mm/.054-.061"			1.4mm/.06"	
526-160 526-165	1.75	201419	1.50-1.90mm/.060-.075"	17.5mm/.68"	201436	1.75mm/.07"	210188
	2.00	201420	1.80-2.20mm/.070-.085"			2.00mm/.08"	
	2.25	201421	2.05-2.45mm/.080-.095"			2.25mm/.09"	
	2.50	201422	2.25-2.75mm/.090-.105"			2.50mm/.10"	
	2.75	201423	2.50-3.00mm/.100-.115"	22.5mm/.88"	201437	2.75mm/.11"	
	3.00	201424	2.75-3.25mm/.110-.125"			3.00mm/.12"	
	3.25	201425	3.00-3.50mm/.120-.135"			3.25mm/.13"	
	3.50	201426	3.25-3.75mm/.130-.145"			3.50mm/.14"	
3.75	201427	3.50-4.00mm/.140-.157"	3.75mm/.15"				
526-150 526-155	4.0	201428	3.70-4.30mm/.145-.170"	32.0mm/1.25"	201438	4.0mm/.16"	210188
	4.5	201429	4.20-4.80mm/.165-.190"			4.5mm/.18"	
	5.0	201430	4.70-5.30mm/.185-.210"			5.0mm/.20"	
	5.5	201431	5.20-5.80mm/.205-.230"			5.5mm/.22"	
	6.0	201432	5.70-6.30mm/.225-.250"			6.0mm/.24"	
	6.5	201433	6.20-6.80mm/.245-.270"			6.5mm/.26"	
7.0	201434	6.70-7.30mm/.265-.290"	7.0mm/.28"				

Spanner
No.210188



Thickness: 1.5

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526-101

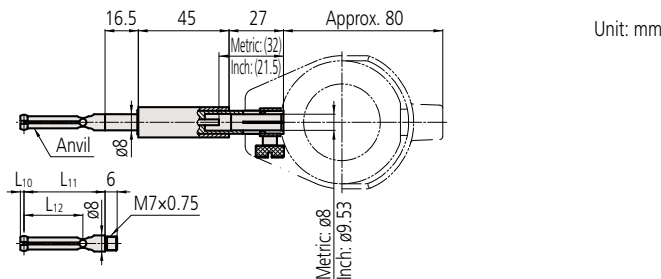
* The dial indicator and the protection cover are optional.

SPECIFICATIONS

Metric		Content of set					Probing depth
Order No.	Range	Bore gage	Dial indicator	Dial protection cover	Anvil		
526-101	7-10mm	526-101	Not supplied	Not supplied	6 pcs.	32mm	
526-102	10-18mm	526-102			8 pcs.	62mm	
526-124	7-10mm	526-101	2109SB-10 (Graduation: 0.001mm)	21DZA000	6 pcs.	32mm	
526-125	10-18mm	526-102			8 pcs.	62mm	
526-126	7-10mm	526-101	2046SB (Graduation: 0.01mm)	21DZA000	6 pcs.	32mm	
526-127	10-18mm	526-102			8 pcs.	62mm	

Inch		Content of set					Probing depth
Order No.	Range	Bore gage	Dial indicator	Dial protection cover	Anvil		
526-103	.3-.4"	526-103	Not supplied	Not supplied	6 pcs.	1.25"	
526-104	.4-.7"	526-104			8 pcs.	2.42"	
526-122	.3-.4"	526-103	2923SB-10 (Graduation: .0001")	21DZA000	6 pcs.	1.25"	
526-123	.4-.7"	526-104			8 pcs.	2.42"	
526-119	.3-.4"	526-103	2922SB (Graduation: .0005")	21DZA000	6 pcs.	1.25"	
526-120	.4-.7"	526-104			8 pcs.	2.42"	

DIMENSIONS

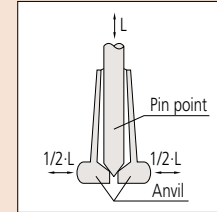


Unit: mm

STANDARD ACCESSORIES

Bore gage (Main body)	Marked No.	Parts No.	Anvil			Spanner Parts No.	
			Measuring range	L10	L11		L12
526-101 526-103	1	102469	7.0 - 7.5mm/.28 - .30"	1.8mm/.07"	40mm/1.57"	29.2mm/1.15"	102148
	2	102470	7.5 - 8.0mm/.30 - .32"				
	3	102471	8.0 - 8.5mm/.32 - .34"				
	4	102472	8.5 - 9.0mm/.34 - .36"				
	5	102473	9.0 - 9.5mm/.36 - .38"				
	6	102474	9.5 - 10.0mm/.38 - .40"				
526-102 526-104	1	102454	10 - 11mm/.40 - .44"	2.7mm/.11"	46mm/1.81"	38mm/1.50"	102148
	2	102455	11 - 12mm/.44 - .48"				
	3	102456	12 - 13mm/.48 - .52"				
	4	102457	13 - 14mm/.52 - .56"				
	5	102458	14 - 15mm/.56 - .60"				
	6	102459	15 - 16mm/.60 - .64"				
	7	102460	16 - 17mm/.64 - .68"				
	8	102461	17 - 18mm/.68 - .72"				

Measurement principle



Technical Data

Accuracy
Metric models: 7-10mm, 4µm / 10-18mm, 6µm
Inch models: .3-.4", .00016" / .4-.7", .00024"
Repeatability
Metric models: 2µm
Inch models: .00008"

Optional accessories

-: Dial indicator (See Chapter F)
21DZA000: Dial protection cover
 -: Setting ring (See page C-47)
215-120-10: Stand for small holes

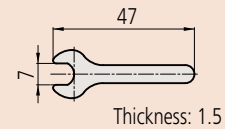
Recommended dial indicators (see Chapter F)

Metric models: 2046SB (0.01mm)
2972TB (0.01mm - One-revolution type)
2109SB-10 (0.001mm)
2900SB-10 (0.001mm - One-revolution type)
Inch models: 2922SB (.0005")
2977TB (.0005" - One-revolution type)
2923SB-10 (.0001")
2910SB-10 (.0001" - One-revolution type)

Recommended digimatic indicators (see Chapter F)

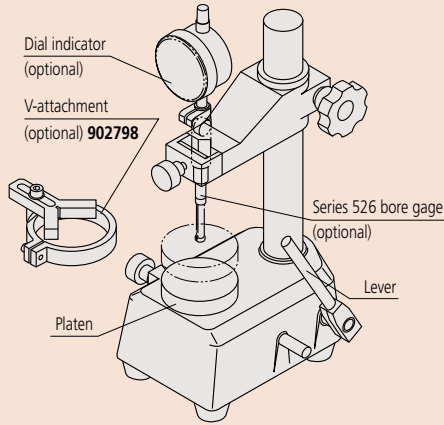
Metric models: 543-310B (ID-C112GXB, 0.001mm)
Inch models: 543-312B (ID-C112GEXB, 0.001mm/.00005")
* Indicators equipped with rubber bellows, such as water-proof types, cannot be used.

Spanner
No.102148



Operating method

Pulling the lever forwards moves the platen upwards and the instrument goes into measurement mode. The V-attachment aids positioning the workpiece on the platen and is useful when measuring a large number of the same size of workpiece.



Bore Gage Stand SERIES 215

- Optimal for efficient measurement of multiple small holes with a bore gage (series 526).
- V-attachment (**902798**) is available for centering a large number of workpieces quickly (option).
- With platen (60mm).

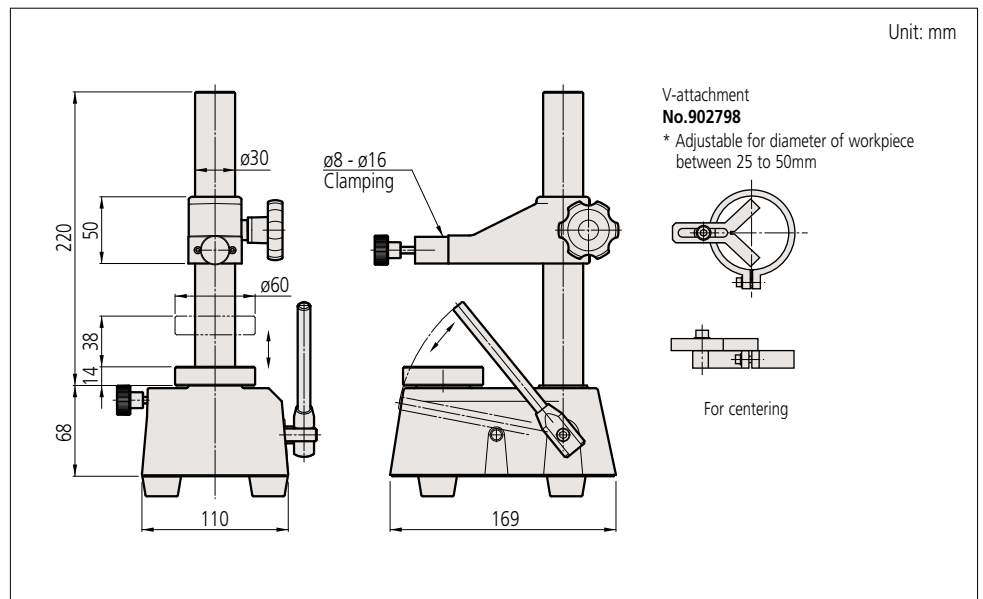


215-120-10

SPECIFICATIONS

Order No.	Measuring table displacement	Measuring table
215-120-10	38 mm	Flat measuring table (ø60mm)

DIMENSIONS



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Bore Gages SERIES 511 — for Small Holes

- Alternative indicators may be used in place of those recommended*.
- Setting Rings are available to aid in accurately setting a gage before making a measurement. (For details, refer to page C-47)

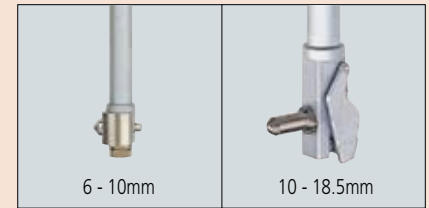
* Some indicators and protection covers cannot be used with these bore gages. Contact a Mitutoyo sales office if considering the use of dial or digimatic indicators other than the recommended models.



511-201

The dial indicator and protection cover are optional.

Close-up view of anvils and contact points



Technical Data

Accuracy: Metric models: 5µm
Inch models: .0002"
Repeatability: Metric models: 2µm
Inch models: .00008"
Adjacent error: Metric models: 2µm
Inch models: .00008"

Optional Accessories

- : Dial indicator (See Chapter F)
21DZA000: Dial protection cover

Recommended digimatic indicators (see Chapter F)

Metric models: **2046SB** (0.01mm)
2972TB (0.01mm - One-revolution type)
2109SB-10 (0.001mm)
2900SB-10 (0.001mm - One-revolution type)
Inch models: **2922SB** (.0005")
2977TB (.0005" - One-revolution type)
2923SB-10 (.0001")
2910SB-10 (.0001" - One-revolution type)

Recommended digimatic indicators (see Chapter F)

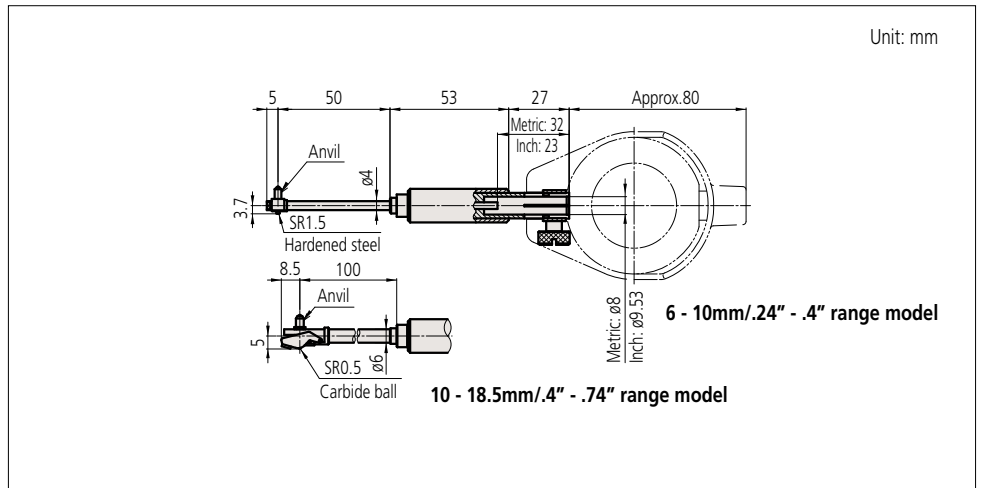
Metric models: **543-310B** (ID-C112GXB: 0.001mm)
Inch models: **543-312B** (ID-C112GEXB: 0.001mm/.00005")
* Indicators equipped with rubber bellows, such as water-proof types, cannot be used.

SPECIFICATIONS

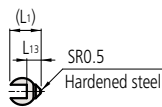
Metric										
Order No.	Range	Stroke of contact point	Measuring force	Guide force	Content of set					Probing depth
					Bore gage	Dial indicator	Dial protection cover	Anvil	Interchangeable Washer	
511-209	6-10mm	0.5mm	2N or less	—	511-209	Not supplied	Not supplied	9 pcs.	Not supplied	50mm
511-201	10-18.5mm	0.6mm		6N or less	511-201				1 pc.	100mm
511-210	6-10mm	0.5mm	2N or less	—	511-209	2109SB-10 (Graduation: 0.001mm)	21DZA000	9 pcs.	Not supplied	50mm
511-203	10-18.5mm	0.6mm		6N or less	511-201				1 pc.	100mm
511-211	6-10mm	0.5mm	2N or less	—	511-209	2046SB (Graduation: 0.01mm)	21DZA000	9 pcs.	Not supplied	50mm
511-204	10-18.5mm	0.6mm		6N or less	511-201				1 pcs.	100mm

Inch										
Order No.	Range	Stroke of contact point	Measuring force	Guide force	Content of set					Probing depth
					Bore gage	Dial indicator	Dial protection cover	Anvil	Interchangeable Washer	
511-214	.24-.4"	.020"	2N or less	—	511-214	Not supplied	Not supplied	9 pcs.	Not supplied	2"
511-205	.4-.74"	.024"		6N or less	511-205				1 pc.	4"
511-212	.24-.4"	.020"	2N or less	—	511-214	2923SB-10 (Graduation: .0001")	21DZA000	9 pcs.	Not supplied	2"
511-206	.4-.74"	.024"		6N or less	511-205				1 pc.	4"
511-213	.24-.4"	.020"	2N or less	—	511-214	2922SB (Graduation: .0005")	21DZA000	9 pcs.	Not supplied	2"
511-207	.4-.74"	.024"		6N or less	511-205				1 pc.	4"

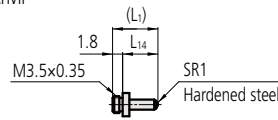
DIMENSIONS



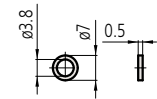
511-209/511-214
Anvil



511-201/511-205
Anvil



Interchangeable washer
(Supplied only with **511-201/511-205**)



No.204355

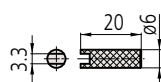
STANDARD ACCESSORIES

Bore gage (Main body)	Anvil					Interchangeable Washer	Spanner
	Marked No.	Parts No.	Indication of measuring size	L ₁	L ₁₃	Parts No.	Parts No.
511-209 511-214	1	952168	6.0mm/.24"	4.7mm/.19"	1.2mm/.05"	Not supplied	206709
	2	952169	6.5mm/.26"	5.3mm/.21"	1.7mm/.07"		
	3	952170	7.0mm/.28"	5.8mm/.23"	2.2mm/.09"		
	4	952414	7.5mm/.30"	6.3mm/.25"	2.7mm/.11"		
	5	952415	8.0mm/.32"	6.8mm/.27"	3.2mm/.13"		
	6	952416	8.5mm/.34"	7.3mm/.29"	3.7mm/.15"		
	7	952417	9.0mm/.36"	7.8mm/.31"	4.2mm/.17"		
	8	952418	9.5mm/.38"	8.3mm/.33"	4.7mm/.19"		
	9	952419	10.0mm/.40"	8.8mm/.35"	5.2mm/.21"		

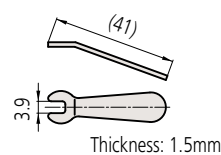
Bore gage (Main body)	Anvil					Interchangeable Washer	Spanner
	Marked No.	Parts No.	Indication of measuring size	L ₁	L ₁₄	Parts No.	Parts No.
511-201* 511-205	1	204356	10mm/.40"	3.8mm/.15"	2mm/.08"	204355	204354
	2	204357	11mm/.44"	4.8mm/.19"	3mm/.12"		
	3	204358	12mm/.48"	5.8mm/.23"	4mm/.16"		
	4	204359	13mm/.52"	6.8mm/.27"	5mm/.20"		
	5	204360	14mm/.56"	7.8mm/.31"	6mm/.24"		
	6	204361	15mm/.60"	8.8mm/.35"	7mm/.28"		
	7	204362	16mm/.64"	9.8mm/.39"	8mm/.32"		
	8	204363	17mm/.68"	10.8mm/.43"	9mm/.36"		
	9	204364	18mm/.72"	11.8mm/.46"	10mm/.40"		

* Equipped with an anvil fixing plate.

Spanner
No.206709



No.204354

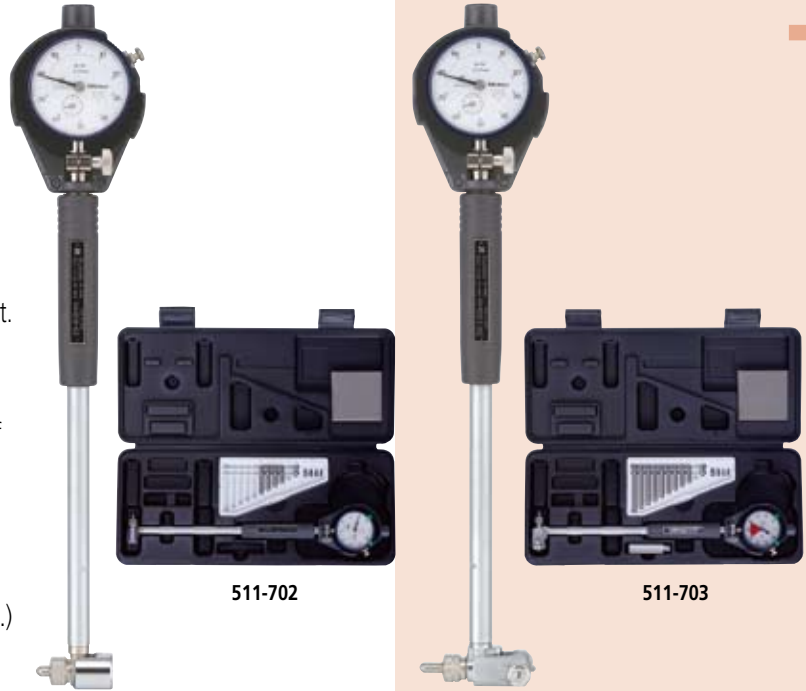


Bore Gages

For easy and accurate measurement of inside diameters

Bore Gages SERIES 511

- Longer plunger stroke with no affect on accuracy.
- Carbide is used for the contact point ensuring high durability and wear resistance.
- This model reduces the influence of heat from the operator's hand by 50% by increasing the grip size and making the grip hollow-structured, thereby retaining high-accuracy measurement.
- Alternative indicators may be used in place of those recommended*.
- * Some indicators and protection covers cannot be used with these bore gages. Contact a Mitutoyo sales office if considering the use of dial or digimatic indicators other than the recommended models.
- Optional extension rods can be attached for measuring deep holes. (For details, refer to page C-45.)
- A Bore Gage Checker and a range of Setting Rings are available to aid in accurately setting a gage before making a measurement. (For details, refer to pages C-46 and C-47.)



511-702

511-703

Dial indicators and protection covers are optional.

SPECIFICATIONS

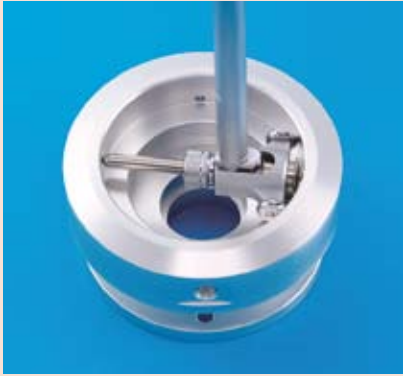
Metric		Stroke of contact point	Measuring force	Guide force	Content of set							Probing depth
Order No.	Range				Bore gage	Dial indicator	Dial protection cover	Anvil	Interchangeable Washer	Sub-Anvil	Spanner	
511-701	18-35mm	1.2mm	4N or less	6N or less	511-701	Not supplied	Not supplied	9 pcs.	2 pcs.	Not supplied	1 pc.	100mm
511-702	35-60mm				511-702			6 pcs.				
511-703	50-150mm	1.6mm	5N or less	10N or less	511-703	Not supplied	Not supplied	11 pcs.	4 pcs.	1 pc.	Not supplied	150mm
511-704	100-160mm				511-704			13 pcs.				
511-705	160-250mm				511-705			6 pcs.				
511-706	250-400mm				511-706			5 pcs.				
511-721	18-35mm	1.2mm	4N or less	6N or less	511-701	2109SB-10 (Graduation: 0.001mm)	21DZA000	9 pcs.	2 pcs.	Not supplied	1 pc.	100mm
511-722	35-60mm				511-702			6 pcs.				
511-723	50-150mm	1.6mm	5N or less	10N or less	511-703	2109SB-10 (Graduation: 0.001mm)	21DZA000	11 pcs.	4 pcs.	1 pc.	Not supplied	150mm
511-724	100-160mm				511-704			13 pcs.				
511-725	160-250mm				511-705			6 pcs.				
511-726	250-400mm				511-706			5 pcs.				
511-711	18-35mm	1.2mm	4N or less	6N or less	511-701	2046SB (Graduation: 0.01mm)	21DZA000	9 pcs.	2 pcs.	Not supplied	1 pc.	100mm
511-712	35-60mm				511-702			6 pcs.				
511-713	50-150mm	1.6mm	5N or less	10N or less	511-703	2046SB (Graduation: 0.01mm)	21DZA000	11 pcs.	4 pcs.	1 pc.	Not supplied	150mm
511-714	100-160mm				511-704			13 pcs.				
511-715	160-250mm				511-705			6 pcs.				
511-716	250-400mm				511-706			5 pcs.				
511-921	18-150mm	—	—	—	511-701	2046SB	21DZA000	9 pcs.	—	—	—	—
511-922					511-702			6 pcs.				
511-925-10					511-703			543-310B				

Inch		Stroke of contact point	Measuring force	Guide force	Content of set							Probing depth
Order No.	Range				Bore gage	Dial indicator	Dial protection cover	Anvil	Interchangeable Washer	Sub-Anvil	Spanner	
511-731	.7-1.4"	.047"	4N or less	6N or less	511-731	Not supplied	Not supplied	9 pcs.	2 pcs.	Not supplied	1 pc.	4"
511-732	1.4-2.5"				511-732			6 pcs.				
511-733	2.0-6.0"	.063"	5N or less	10N or less	511-733	Not supplied	Not supplied	11 pcs.	4 pcs.	1 pc.	Not supplied	6"
511-734	4.0-6.5"				511-734			13 pcs.				
511-735	6.5-10.0"				511-735			6 pcs.				
511-736	10.0-16.0"				511-736			5 pcs.				
511-751	.7-1.4"	.047"	4N or less	6N or less	511-731	2923SB-10 (Graduation: .0001")	21DZA000	9 pcs.	2 pcs.	Not supplied	1 pc.	4"
511-752	1.4-2.5"				511-732			6 pcs.				
511-753	2.0-6.0"	.063"	5N or less	10N or less	511-733	2923SB-10 (Graduation: .0001")	21DZA000	11 pcs.	4 pcs.	1 pc.	Not supplied	6"
511-754	4.0-6.5"				511-734			13 pcs.				
511-755	6.5-10.0"				511-735			6 pcs.				
511-756	10.0-16.0"				511-736			5 pcs.				
511-741	.7-1.4"	.047"	4N or less	6N or less	511-731	2922SB (Graduation: .0005")	21DZA000	9 pcs.	2 pcs.	Not supplied	1 pc.	4"
511-742	1.4-2.5"				511-732			6 pcs.				
511-743	2.0-6.0"	.063"	5N or less	10N or less	511-733	2922SB (Graduation: .0005")	21DZA000	11 pcs.	4 pcs.	1 pc.	Not supplied	6"
511-744	4.0-6.5"				511-734			13 pcs.				
511-745	6.5-10.0"				511-735			6 pcs.				
511-746	10.0-16.0"				511-736			5 pcs.				
511-931	.7-6.0"	—	—	—	511-731	2922SB	21DZA000	9 pcs.	—	—	—	—
511-932					511-732			6 pcs.				
511-935-10					511-733			543-312B				

Notes: 1) A 50mm sub-anvil is supplied with 511-703, and a 75mm sub-anvil is supplied with 511-706.

2) A 2" sub-anvil is supplied with 511-733, and a 3" sub-anvil is supplied with 511-736.

3) It is not permissible to use a sub-anvil other than as supplied as a standard accessory, or widen a measuring range by using multiple sub-anvils. (The measurement accuracy in such cases is not guaranteed.)



New grip improves accuracy during prolonged use

Technical Data

Accuracy: Metric models 2µm
Inch models .00008"
Repeatability: Metric models 0.5µm
Inch models .00002"
Adjacent error: Metric models 1µm
Inch models .00004"

Optional Accessories

-: Dial indicator (See Chapter F)
21DZA000: Dial protection cover

Recommended dial indicators (see Chapter F)

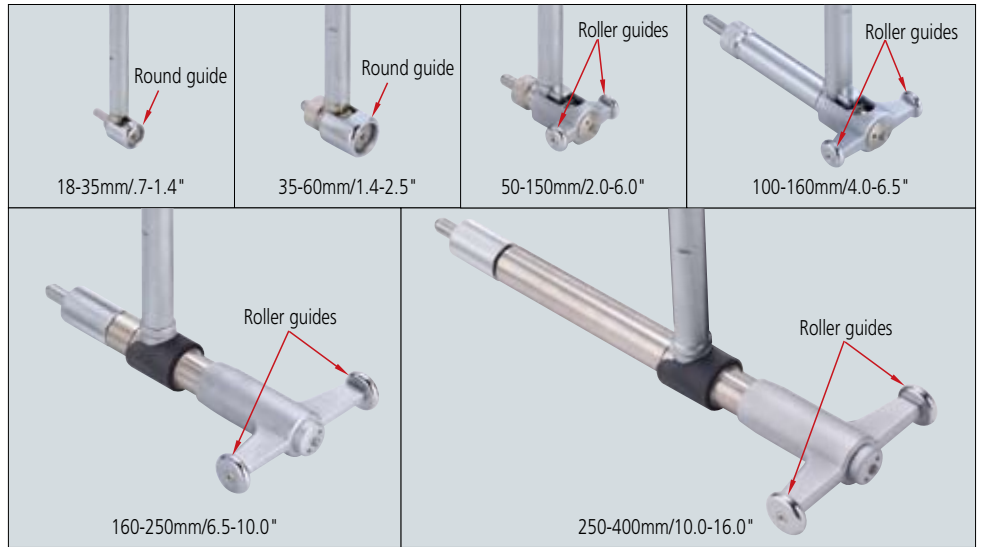
Metric models: **2046SB** (0.01mm)
2972TB (0.01mm - One revolution type)
2109SB-10 (0.001mm)
2900SB-10 (0.001mm - One-revolution type)
Inch models: **2922SB** (.0005")
2977TB (.0005" - One-revolution type)
2923SB-10 (.0001")
2910SB-10 (.0001" - One-revolution type)

Recommended digimatic indicators (see Chapter F)

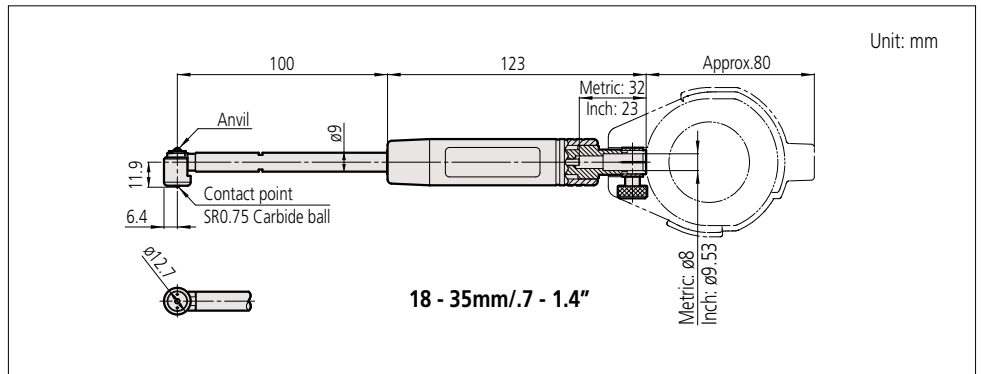
Metric models: **543-310B** (ID-C112GXB: 0.001mm)
Inch models: **543-312B** (ID-C112GEXB: 0.001mm/.00005")

* Indicators equipped with rubber bellows, such as water-proof types, cannot be used.

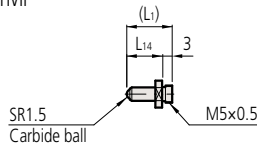
Contact Points



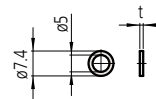
DIMENSIONS



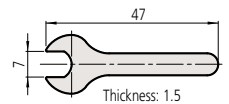
Anvil



Interchangeable washer



Spanner 102148



STANDARD ACCESSORIES

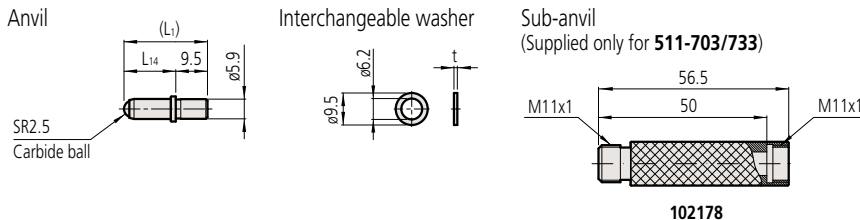
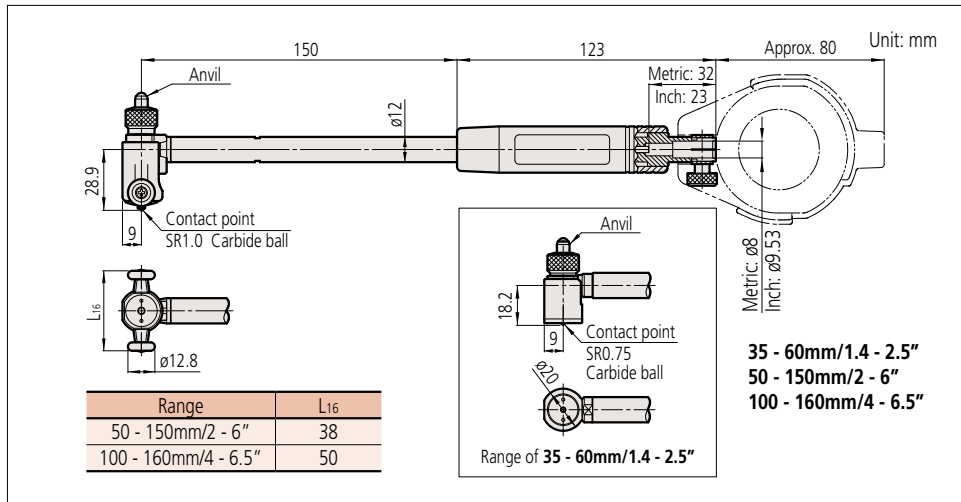
Bore gage (Main body)	Anvil					Interchangeable washer		Spanner
	Marked No.	Parts No.	Indication of measuring size	L1	L14	Parts No.	t	Parts No.
511-701 511-731	1	21DZA213A	18mm/.71"	5.5mm/2.17"	2.5mm/.10"	205623 205624	0.5mm/.02" 1.0mm/.04"	102148
	2	21DZA213B	20mm/.79"	7.5mm/2.95"	4.5mm/.18"			
	3	21DZA213C	22mm/.87"	9.5mm/3.74"	6.5mm/.26"			
	4	21DZA213D	24mm/.94"	11.5mm/4.53"	8.5mm/.33"			
	5	21DZA213E	26mm/1.02"	13.5mm/5.31"	10.5mm/.41"			
	6	21DZA213F	28mm/1.10"	15.5mm/6.10"	12.5mm/.49"			
	7	21DZA213G	30mm/1.18"	17.5mm/6.89"	14.5mm/.57"			
	8	21DZA213H	32mm/1.26"	19.5mm/7.68"	16.5mm/.65"			
	9	21DZA213J	34mm/1.34"	21.5mm/8.46"	18.5mm/.73"			

Bore Gages

For easy and accurate measurement of inside diameters

Bore Gages SERIES 511

DIMENSIONS

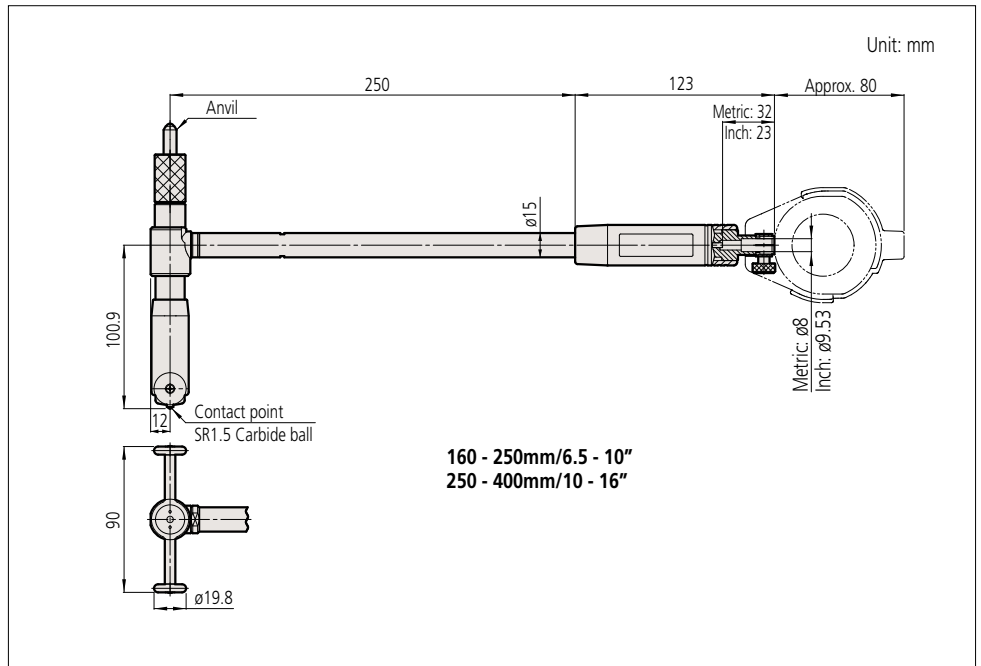


Notes: It is not permissible to use a sub-anvil other than as supplied as a standard accessory, or widen a measuring range by using multiple sub-anvils. (The measurement accuracy in such cases is not guaranteed.)

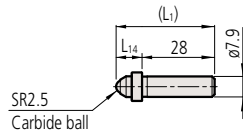
STANDARD ACCESSORIES

Bore gage (Main body)	Anvil					Interchangeable washer		Sub-Anvil		
	Marked No.	Parts No.	Indication of measuring size	L1	L14	Parts No.	t	Parts No.		
511-702 511-732	1	21DZA232A	35mm/1.38"	15mm/.59"	5.5mm/.22"	205457 205458 205459 205460	0.5mm/.02" 1.0mm/.04" 2.0mm/.08" 3.0mm/.12"			
	2	21DZA232B	40mm/1.57"	20mm/.79"	10.5mm/.41"					
	3	21DZA232C	45mm/1.77"	25mm/.98"	15.5mm/.61"					
	4	21DZA232D	50mm/1.97"	30mm/1.18"	20.5mm/.81"					
	5	21DZA232E	55mm/2.17"	35mm/1.38"	25.5mm/1.00"					
	6	21DZA232F	60mm/2.36"	40mm/1.57"	30.5mm/1.20"					
511-703 511-733 () Used 50mm/2" Sub-Anvil	1	21DZA232A	50mm (100mm)/1.97" (3.94")	15mm/.59"	5.5mm/.22"			205457 205458 205459 205460	0.5mm/.02" 1.0mm/.04" 2.0mm/.08" 3.0mm/.12"	102178 (50mm/2")
	2	21DZA232B	55mm (105mm)/2.17" (4.13")	20mm/.79"	10.5mm/.41"					
	3	21DZA232C	60mm (110mm)/2.36" (4.33")	25mm/.98"	15.5mm/.61"					
	4	21DZA232D	65mm (115mm)/2.55" (4.53")	30mm/1.18"	20.5mm/.81"					
	5	21DZA232E	70mm (120mm)/2.74" (4.72")	35mm/1.38"	25.5mm/1.00"					
	6	21DZA232F	75mm (125mm)/2.93" (4.92")	40mm/1.57"	30.5mm/1.20"					
	7	21DZA232G	80mm (130mm)/3.12" (5.12")	45mm/1.77"	35.5mm/1.40"					
	8	21DZA232H	85mm (135mm)/3.31" (5.31")	50mm/1.97"	40.5mm/1.59"					
	9	21DZA232J	90mm (140mm)/3.50" (5.51")	55mm/2.17"	45.5mm/1.79"					
	10	21DZA232L	95mm (145mm)/3.69" (5.71")	60mm/2.36"	50.5mm/1.99"					
	11	21DZA232M	100mm (150mm)/3.88" (5.91")	65mm/2.56"	55.5mm/2.19"					
511-704 511-734	1	21DZA232A	100mm/3.94"	15mm/.59"	5.5mm/.22"	205457 205458 205459 205460	0.5mm/.02" 1.0mm/.04" 2.0mm/.08" 3.0mm/.12"			
	2	21DZA232B	105mm/4.13"	20mm/.79"	10.5mm/.41"					
	3	21DZA232C	110mm/4.33"	25mm/.98"	15.5mm/.61"					
	4	21DZA232D	115mm/4.53"	30mm/1.18"	20.5mm/.81"					
	5	21DZA232E	120mm/4.72"	35mm/1.38"	25.5mm/1.00"					
	6	21DZA232F	125mm/4.92"	40mm/1.57"	30.5mm/1.20"					
	7	21DZA232G	130mm/5.12"	45mm/1.77"	35.5mm/1.40"					
	8	21DZA232H	135mm/5.31"	50mm/1.97"	40.5mm/1.59"					
	9	21DZA232J	140mm/5.51"	55mm/2.17"	45.5mm/1.79"					
	10	21DZA232L	145mm/5.71"	60mm/2.36"	50.5mm/1.99"					
	11	21DZA232M	150mm/5.91"	65mm/2.56"	55.5mm/2.19"					
	12	21DZA232N	155mm/6.10"	70mm/2.76"	60.5mm/2.38"					
	13	21DZA232P	160mm/6.30"	75mm/2.95"	65.5mm/2.58"					

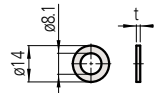
DIMENSIONS



Anvil

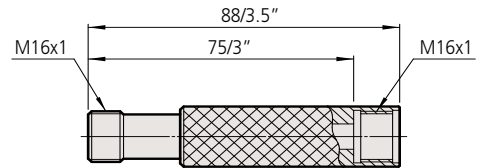


Interchangeable washer



Sub-anvil

(Supplied only for 511-706 (202974) and 511-736 (202975))



No. 202974 (511-706)
No. 202975 (511-736)

Notes: It is not permissible to use a sub-anvil other than as supplied as a standard accessory, or widen a measuring range by using multiple sub-anvils. (The measurement accuracy in such cases is not guaranteed.)

STANDARD ACCESSORIES

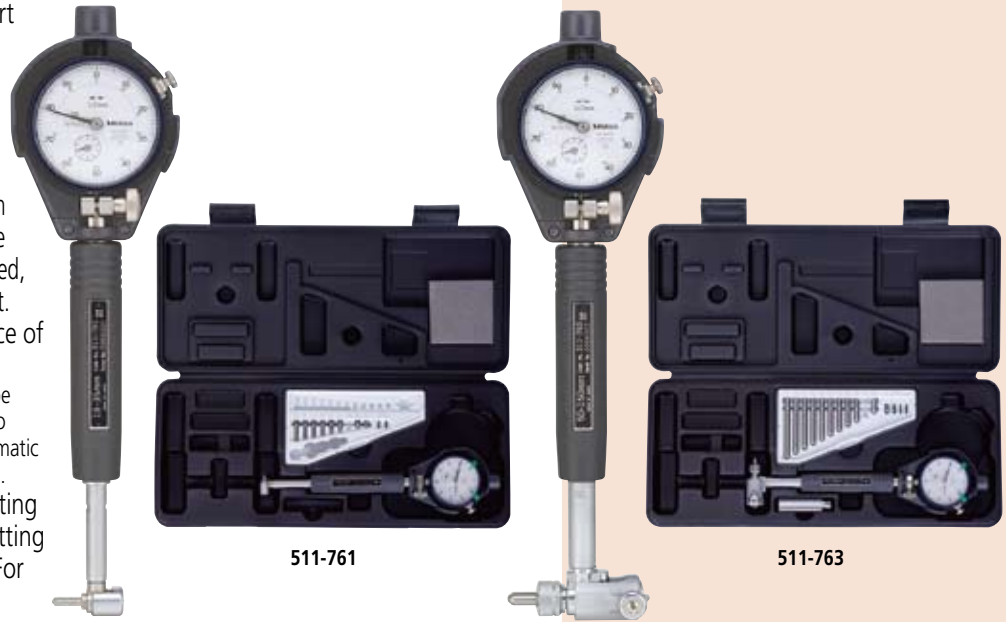
Bore gage (Main body)	Anvil					Interchangeable washer		Sub-Anvil
	Marked No.	Parts No.	Indication of measuring size	L1	L14	Parts No.	t	Parts No.
511-705 511-735	1	21DZA241A	160mm/6.30"	38mm/1.50"	10mm/.39"	205467 205461 205462 205463 205464 205465 205466	0.5mm/.02" 1.0mm/.04" 2.0mm/.08" 3.0mm/.12" 4.0mm/.16" 5.0mm/.20" 6.0mm/.24"	Metric: 202974 (75mm) Inch: 202975 (3.0")
	2	21DZA241B	175mm/6.89"	53mm/2.09"	25mm/.98"			
	3	21DZA241C	190mm/7.48"	68mm/2.68"	40mm/1.57"			
	4	21DZA241D	205mm/8.07"	83mm/3.27"	55mm/2.17"			
	5	21DZA241E	220mm/8.66"	98mm/3.86"	70mm/2.76"			
	6	21DZA241F	235mm/9.25"	113mm/4.45"	85mm/3.35"			
511-706 511-736 () Used 75mm/3" Sub-Anvil	1	21DZA241A	250mm (325mm)/9.84" (12.80")	38mm/1.50"	10mm/.39"	205467 205461 205462 205463 205464 205465 205466	0.5mm/.02" 1.0mm/.04" 2.0mm/.08" 3.0mm/.12" 4.0mm/.16" 5.0mm/.20" 6.0mm/.24"	Metric: 202974 (75mm) Inch: 202975 (3.0")
	2	21DZA241B	265mm (340mm)/10.43" (13.39")	53mm/2.09"	25mm/.98"			
	3	21DZA241C	280mm (355mm)/11.02" (13.98")	68mm/2.68"	40mm/1.57"			
	4	21DZA241D	295mm (370mm)/11.61" (14.57")	83mm/3.27"	55mm/2.17"			
	5	21DZA241E	310mm (385mm)/12.20" (15.16")	98mm/3.86"	70mm/2.76"			

Bore Gages

For easy and accurate measurement of inside diameters

Bore Gages SERIES 511 — Short Leg Type

- Compact and lightweight due to the short length below the grip.
- Longer plunger stroke with no effect on accuracy.
- Carbide contact point ensuring high durability and wear resistance.
- This model reduces the influence of heat from the operator's hand by 50% by increasing the grip size and making the grip hollow-structured, thereby retaining high-accuracy measurement.
- Alternative indicators may be used in place of those recommended*.
- * Some indicators and protection covers cannot be used with these bore gages. Contact a Mitutoyo sales office if considering the use of dial or digimatic indicators other than the recommended models.
- A Bore Gage Checker and a range of Setting Rings are available to aid in accurately setting a gage before making a measurement. (For details, refer to pages C-46 and C-47.)



Dial indicators and protection covers are optional.

SPECIFICATIONS

Metric												
Order No.	Range	Stroke of contact point	Measuring force	Guide force	Content of set							Probing depth
					Bore gage	Dial indicator	Dial protection cover	Anvil	Interchangeable Washer	Sub-Anvil	Spanner	
511-761	18-35mm	1.2mm	4N or less	6N or less	511-761	Not supplied	Not supplied	9 pcs.	2 pcs.	Not supplied	1 pc.	50mm
511-762	35-60mm				511-762			6 pcs.			1 pc.	
511-763	50-150mm	511-763	11 pcs.	4 pcs.	Not supplied							
511-764	100-160mm	511-764	13 pcs.					1 pc.	Not supplied			
511-771	18-35mm	1.2mm	4N or less	6N or less	511-761	2109SB-10 (Graduation: 0.001mm)	21DZA000			9 pcs.	2 pcs.	Not supplied
511-772	35-60mm				511-762			6 pcs.	4 pcs.	Not supplied		
511-773	50-150mm	511-763	11 pcs.	1 pc.	Not supplied							
511-774	100-160mm	511-764	13 pcs.					1 pc.	Not supplied			
511-766	18-35mm	1.2mm	4N or less	6N or less	511-761	2046SB (Graduation: 0.01mm)	21DZA000			9 pcs.	2 pcs.	Not supplied
511-767	35-60mm				511-762			6 pcs.	4 pcs.	Not supplied		
511-768	50-150mm	511-763	11 pcs.	1 pc.	Not supplied							
511-769	100-160mm	511-764	13 pcs.					1 pc.	Not supplied			

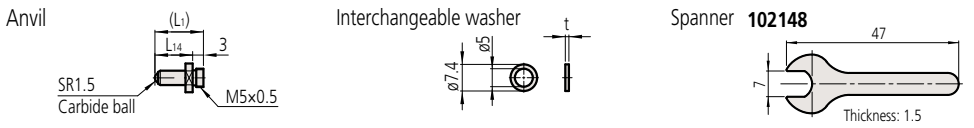
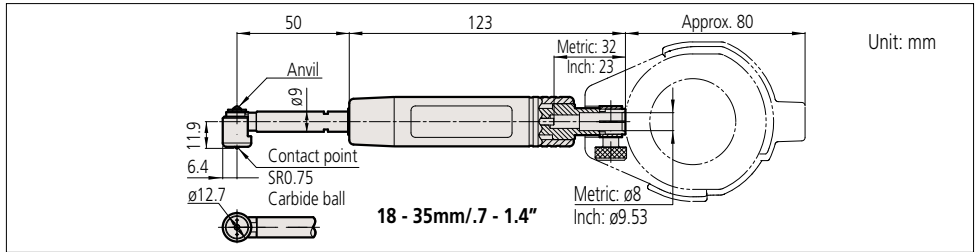
Inch												
Order No.	Range	Stroke of contact point	Measuring force	Guide force	Content of set							Probing depth
					Bore gage	Dial indicator	Dial protection cover	Anvil	Interchangeable Washer	Sub-Anvil	Spanner	
511-781	.7-1.4"	.047"	4N or less	6N or less	511-781	Not supplied	Not supplied	9 pcs.	2 pcs.	Not supplied	1 pc.	2"
511-782	1.4-2.5"				511-782			6 pcs.			4 pcs.	
511-783	2.0-6.0"	511-783	11 pcs.	1 pc.	Not supplied							
511-784	4.0-6.5"	511-784	13 pcs.					1 pc.	Not supplied			
511-791	.7-1.4"	.047"	4N or less	6N or less	511-781	2923SB-10 (Graduation: .0001")	21DZA000			9 pcs.	2 pcs.	Not supplied
511-792	1.4-2.5"				511-782			6 pcs.	4 pcs.	Not supplied		
511-793	2.0-6.0"	511-783	11 pcs.	1 pc.	Not supplied							
511-794	4.0-6.5"	511-784	13 pcs.					1 pc.	Not supplied			
511-786	.7-1.4"	.047"	4N or less	6N or less	511-781	2922SB (Graduation: .0005")	21DZA000			9 pcs.	2 pcs.	Not supplied
511-787	1.4-2.5"				511-782			6 pcs.	4 pcs.	Not supplied		
511-788	2.0-6.0"	511-783	11 pcs.	1 pc.	Not supplied							
511-789	4.0-6.5"	511-784	13 pcs.					1 pc.	Not supplied			

Notes: 1) A 50mm sub-anvil is supplied with 511-763.

2) A 2" sub-anvil is supplied with 511-783.

3) It is not permissible to use a sub-anvil other than as supplied as a standard accessory, or widen a measuring range by using multiple sub-anvils. (The measurement accuracy in such cases is not guaranteed.)

DIMENSIONS



Technical Data

Accuracy: Metric models 2µm
Inch models .0008"
Repeatability: Metric models 0.5µm
Inch models .0002"
Adjacent error: Metric models 1µm
Inch models .00004"

Optional Accessories

-: Dial indicator (See Chapter F)
21DZA000: Dial protection cover

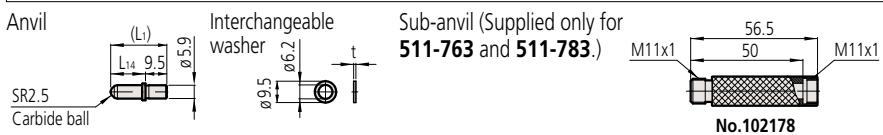
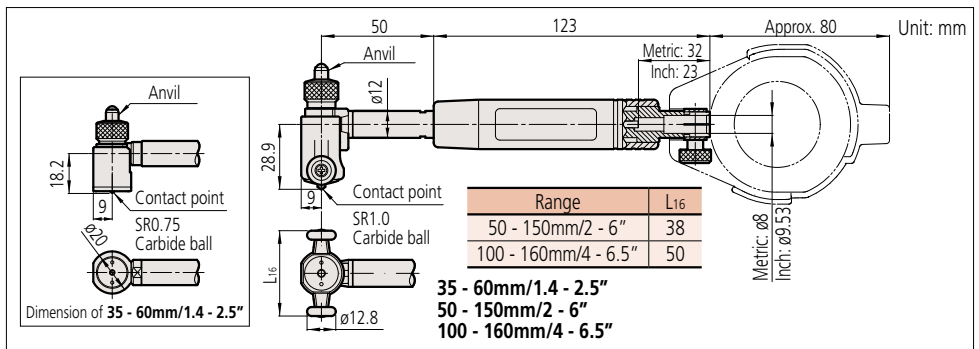
Recommended dial indicators (see Chapter F)

Metric models: **2046SB** (0.01mm)
2972TB (0.01mm - One-revolution type)
2109SB-10 (0.001mm)
2900SB-10 (0.001mm - One-revolution type)
Inch models: **2922SB** (.0005")
2977TB (.0005" - One-revolution type)
2923SB-10 (.0001")
2910SB-10 (.0001" - One-revolution type)

STANDARD ACCESSORIES

Bore gage (Main body)	Anvil					Interchangeable washer		Spanner Parts No.
	Marked No.	Parts No.	Indication of measuring size	L ₁	L ₁₄	Parts No.	t	
511-761 511-781	1	21DZA213A	18mm/.71"	5.5mm/.22"	2.5mm/.10"	205623 205624	0.5mm/.02" 1.0mm/.04"	102148
	2	21DZA213B	20mm/.79"	7.5mm/.30"	4.5mm/.18"			
	3	21DZA213C	22mm/.87"	9.5mm/.37"	6.5mm/.26"			
	4	21DZA213D	24mm/.94"	11.5mm/.45"	8.5mm/.33"			
	5	21DZA213E	26mm/1.02"	13.5mm/.53"	10.5mm/.41"			
	6	21DZA213F	28mm/1.10"	15.5mm/.61"	12.5mm/.49"			
	7	21DZA213G	30mm/1.18"	17.5mm/.69"	14.5mm/.57"			
	8	21DZA213H	32mm/1.26"	19.5mm/.77"	16.5mm/.65"			
	9	21DZA213J	34mm/1.34"	21.5mm/.85"	18.5mm/.73"			

DIMENSIONS

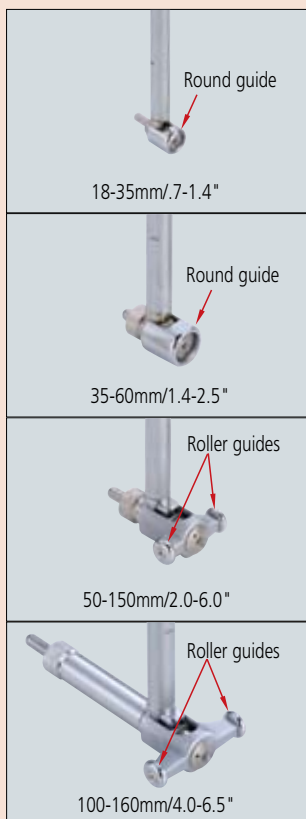


Notes: It is not permissible to use a sub-anvil other than as supplied as a standard accessory, or widen a measuring range by using multiple sub-anvils. (The measurement accuracy in such cases is not guaranteed.)

STANDARD ACCESSORIES

Bore gage (Main body)	Anvil					Interchangeable washer		Sub-Anvil Parts No.
	Marked No.	Parts No.	Indication of measuring size	L ₁	L ₁₄	Parts No.	t	
511-762 511-782	1	21DZA232A	35mm/1.38"	15mm/.59"	5.5mm/.22"	205457 205458 205459 205460	0.5mm/.02" 1.0mm/.04" 2.0mm/.08" 3.0mm/.12"	102178 (50mm/2")
	2	21DZA232B	40mm/1.57"	20mm/.79"	10.5mm/.41"			
	3	21DZA232C	45mm/1.77"	25mm/.98"	15.5mm/.61"			
	4	21DZA232D	50mm/1.97"	30mm/1.18"	20.5mm/.81"			
	5	21DZA232E	55mm/2.17"	35mm/1.38"	25.5mm/1.00"			
	6	21DZA232F	60mm/2.36"	40mm/1.57"	30.5mm/1.20"			
511-763 511-783 () Used 50mm/2" Sub-Anvil	1	21DZA232A	50mm (100mm)/1.97" (3.94")	15mm/.59"	5.5mm/.22"	205457 205458 205459 205460	0.5mm/.02" 1.0mm/.04" 2.0mm/.08" 3.0mm/.12"	102178 (50mm/2")
	2	21DZA232B	55mm (105mm)/2.17" (4.13")	20mm/.79"	10.5mm/.41"			
	3	21DZA232C	60mm (110mm)/2.36" (4.33")	25mm/.98"	15.5mm/.61"			
	4	21DZA232D	65mm (115mm)/2.55" (4.53")	30mm/1.18"	20.5mm/.81"			
	5	21DZA232E	70mm (120mm)/2.74" (4.72")	35mm/1.38"	25.5mm/1.00"			
	6	21DZA232F	75mm (125mm)/2.93" (4.92")	40mm/1.57"	30.5mm/1.20"			
	7	21DZA232G	80mm (130mm)/3.12" (5.12")	45mm/1.77"	35.5mm/1.40"			
	8	21DZA232H	85mm (135mm)/3.31" (5.31")	50mm/1.97"	40.5mm/1.59"			
	9	21DZA232J	90mm (140mm)/3.50" (5.51")	55mm/2.17"	45.5mm/1.79"			
	10	21DZA232L	95mm (145mm)/3.69" (5.71")	60mm/2.36"	50.5mm/1.99"			
	11	21DZA232M	100mm (150mm)/3.88" (5.91")	65mm/2.56"	55.5mm/2.19"			
511-764 511-784	1	21DZA232A	100mm/3.94"	15mm/.59"	5.5mm/.22"	205457 205458 205459 205460	0.5mm/.02" 1.0mm/.04" 2.0mm/.08" 3.0mm/.12"	102178 (50mm/2")
	2	21DZA232B	105mm/4.13"	20mm/.79"	10.5mm/.41"			
	3	21DZA232C	110mm/4.33"	25mm/.98"	15.5mm/.61"			
	4	21DZA232D	115mm/4.53"	30mm/1.18"	20.5mm/.81"			
	5	21DZA232E	120mm/4.72"	35mm/1.38"	25.5mm/1.00"			
	6	21DZA232F	125mm/4.92"	40mm/1.57"	30.5mm/1.20"			
	7	21DZA232G	130mm/5.12"	45mm/1.77"	35.5mm/1.40"			
	8	21DZA232H	135mm/5.31"	50mm/1.97"	40.5mm/1.59"			
	9	21DZA232J	140mm/5.51"	55mm/2.17"	45.5mm/1.79"			
	10	21DZA232L	145mm/5.71"	60mm/2.36"	50.5mm/1.99"			
	11	21DZA232M	150mm/5.91"	65mm/2.56"	55.5mm/2.19"			
	12	21DZA232N	155mm/6.10"	70mm/2.76"	60.5mm/2.38"			
	13	21DZA232P	160mm/6.30"	75mm/2.95"	65.5mm/2.58"			

Contact Points



Bore Gages

For easy and accurate measurement of inside diameters

Bore Gages

SERIES 511 — with Micrometer Head

- Micrometer head is attached to the anvil for accurate dimensional setting.
- Longer plunger stroke with no affect on accuracy.
- Carbide is used for the contact point ensuring high durability and wear resistance.
- This model reduces the influence of heat from the operator's hand by 50% by increasing the grip size and making the grip hollow-structured, thereby retaining high-accuracy measurement.
- Wide measuring range with sub-anvils.
- Alternative indicators may be used in place of those recommended*.

* Some indicators and protection covers cannot be used with these bore gages. Contact a Mitutoyo sales office if considering the use of dial or digimatic indicators other than the recommended models.

- Optional extension rods can be attached for measuring deep holes. (For details, refer to page C-45.)
- A Bore Gage Checker and a range of Setting Rings are available to aid in accurately setting a gage before making a measurement. (For details, refer to pages C-46 and C-47.) details, refer to pages C-46 and C-47.)



511-803

511-804



511-804



511-806

Dial indicators and protection covers are optional.

SPECIFICATIONS

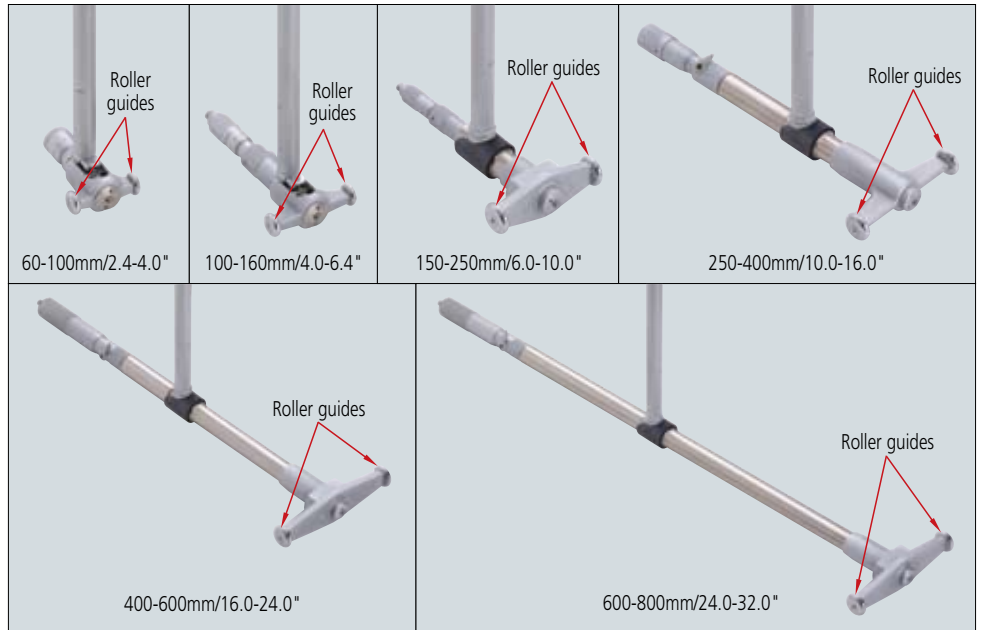
Metric													
Order No.	Range	Stroke of contact point	Measuring force	Guide force	Content of set						Probing depth		
					Bore gage	Dial indicator	Dial protection cover	Micrometer head	Sub-Anvil	Spanner			
511-803	60-100mm	1.6mm	5N or less	10N or less	511-803	Not supplied	Not supplied	1 pc.	2 pcs.	3 pcs.	150mm		
511-804	100-160mm				511-804				3 pcs.				
511-805	150-250mm				511-805				4 pcs.				
511-806	250-400mm		6N or less	15N or less	511-806				3 pcs.			2 pcs.	250mm
511-807	400-600mm				511-807				2 pcs.				
511-808	600-800mm				511-808				2 pcs.				
511-823	60-100mm	1.6mm	5N or less	10N or less	511-803	2109SB-10 (Graduation: 0.001mm)	21DZA000	1 pc.	2 pcs.	3 pcs.	150mm		
511-824	100-160mm				511-804				3 pcs.				
511-825	150-250mm				511-805				4 pcs.				
511-826	250-400mm		6N or less	15N or less	511-806				3 pcs.			2 pcs.	250mm
511-827	400-600mm				511-807				2 pcs.				
511-828	600-800mm				511-808				2 pcs.				
511-813	60-100mm	1.6mm	5N or less	10N or less	511-803	2046SB (Graduation: 0.01mm)	21DZA000	1 pc.	2 pcs.	3 pcs.	150mm		
511-814	100-160mm				511-804				3 pcs.				
511-815	150-250mm				511-805				4 pcs.				
511-816	250-400mm		6N or less	15N or less	511-806				3 pcs.			2 pcs.	250mm
511-817	400-600mm				511-807				2 pcs.				
511-818	600-800mm				511-808				2 pcs.				

Inch													
Order No.	Range	Stroke of contact point	Measuring force	Guide force	Content of set						Probing depth		
					Bore gage	Dial indicator	Dial protection cover	Micro meter head	Sub-Anvil	Spanner			
511-833	2.4-4.0"	.063"	5N or less	10N or less	511-833	Not supplied	Not supplied	1 pc.	2 pcs.	3 pcs.	6"		
511-834	4.0-6.4"				511-834				3 pcs.				
511-835	6.0-10.0"				511-835				4 pcs.				
511-836	10.0-16.0"		6N or less	15N or less	511-836				3 pcs.			2 pcs.	10"
511-837	16.0-24.0"				511-837				2 pcs.				
511-838	24.0-32.0"				511-838				2 pcs.				
511-853	2.4-4.0"	.063"	5N or less	10N or less	511-833	2923SB-10 (Graduation: .0001")	21DZA000	1 pc.	2 pcs.	3 pcs.	4"		
511-854	4.0-6.4"				511-834				3 pcs.				
511-855	6.0-10.0"				511-835				4 pcs.				
511-856	10.0-16.0"		6N or less	15N or less	511-836				3 pcs.			2 pcs.	6"
511-857	16.0-24.0"				511-837				2 pcs.				
511-858	24.0-32.0"				511-838				2 pcs.				
511-843	2.4-4.0"	.063"	5N or less	10N or less	511-833	2922SB (Graduation: .0005")	21DZA000	1 pc.	2 pcs.	3 pcs.	4"		
511-844	4.0-6.4"				511-834				3 pcs.				
511-845	6.0-10.0"				511-835				4 pcs.				
511-846	10.0-16.0"		6N or less	15N or less	511-836				3 pcs.			2 pcs.	6"
511-847	16.0-24.0"				511-837				2 pcs.				
511-848	24.0-32.0"				511-838				2 pcs.				

Notes: 1) Storage boxes for 511-807/808/837/838 models are made of wood. The boxes of other models are made of plastic.

2) It is not permissible to expand measuring range using sub-anvils other than as supplied as standard accessories. (The measurement accuracy in such cases is not guaranteed.)

Contact Points



Technical Data

Accuracy: Metric models 2µm
Inch models .00008"
Repeatability: Metric models 0.5µm
Inch models .00002"
Adjacent error: Metric models 1µm
Inch models .00004"

Optional Accessories

-: Dial indicator (See Chapter F)
21DZA000: Dial protection cover

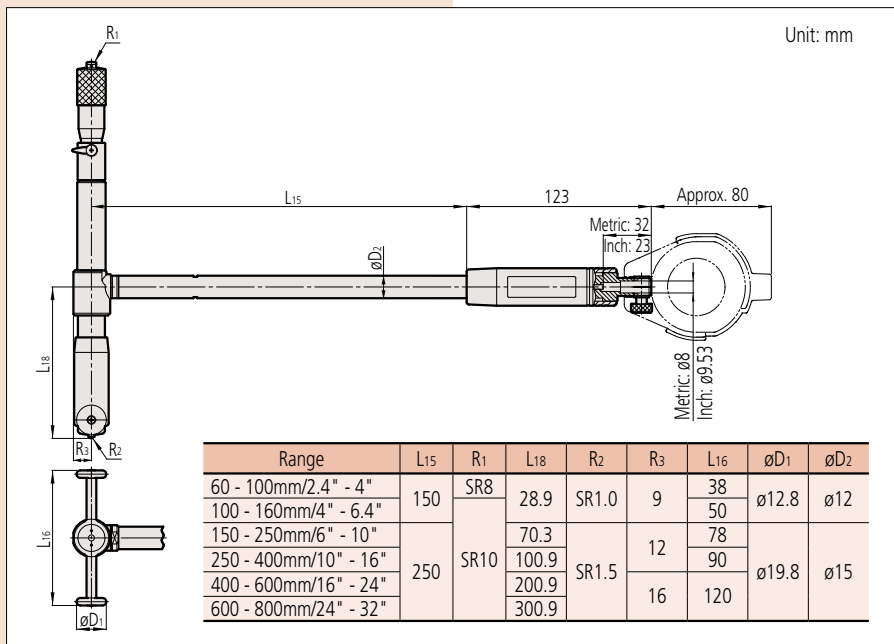
Recommended dial indicators (see Chapter F)

Metric models: **2046SB** (0.01mm)
2972TB (0.01mm - One-revolution type)
2109SB-10 (0.001mm)
2900SB-10 (0.001mm - One-revolution type)
Inch models: **2922SB** (.0005")
2977TB (.0005" - One-revolution type)
2923SB-10 (.0001")
2910SB-10 (.0001" - One-revolution type)

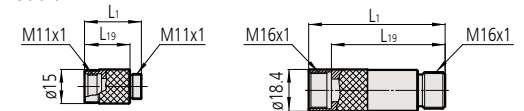
Recommended digimatic indicators (see Chapter F)

Metric models: **543-310B** (ID-C112GXB: 0.001mm)
Inch models: **543-312B** (ID-C112GEXB: 0.001mm/.00005")
* Indicators equipped with rubber bellows, such as water-proof types, cannot be used.

DIMENSIONS



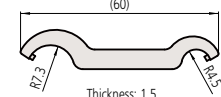
Sub-anvil



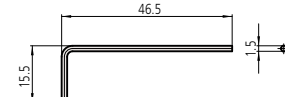
Notes: It is not permissible to use a sub-anvil other than as supplied as a standard accessory, or widen a measuring range by using multiple sub-anvils. (The measurement accuracy in such cases is not guaranteed.)

Spanner

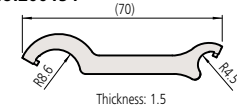
No.301336



No.202863



No.200154



STANDARD ACCESSORIES

Metric		Micrometer head		Sub-Anvil				Spanner
Bore gage (Main body)	Parts No.	Stroke	Screw size	Marked No.	Parts No.	L1	L19	Parts No.
511-803	21DZA267	10mm	M11x1	10mm	208892	15mm	10mm	301336 (2 pcs.)
				20mm	208894	25mm	20mm	202863 (1 pcs.)
511-804	21DZA268	13mm	M11x1	10mm	208892	15mm	10mm	301336 (2 pcs.)
				20mm	208894 (2 pcs.)	25mm	20mm	
511-805	21DZA268	13mm	M11x1	10mm	208892	15mm	10mm	301336 (2 pcs.)
				20mm	208894 (2 pcs.)	25mm	20mm	
				50mm	21DAA492	55mm	50mm	
511-806	953118	25mm	M16x1	25mm	208926	35mm	25mm	200154 (2 pcs.)
				50mm	208928 (2 pcs.)	60mm	50mm	
511-807	953120	50mm	M16x1	50mm	208928	60mm	50mm	200154 (2 pcs.)
				100mm	208932	110mm	100mm	
511-808	953120	50mm	M16x1	50mm	208928	60mm	50mm	200154 (2 pcs.)
				100mm	208932	110mm	100mm	

Inch		Micrometer head		Sub-Anvil				Spanner
Bore gage (Main body)	Parts No.	Stroke	Screw size	Marked No.	Parts No.	L1	L19	Parts No.
511-833	21DZA272	.4"	M11x1	.4"	208893	.6"	.4"	301336 (2 pcs.)
				.8"	208895	1.0"	.8"	202863 (1 pcs.)
511-834	21DZA273	.5"	M11x1	.4"	208893	.6"	.4"	301336 (2 pcs.)
				.8"	208895 (2 pcs.)	1.0"	.8"	
511-835	21DZA273	.5"	M11x1	.4"	208893	.6"	.4"	301336 (2 pcs.)
				.8"	208895 (2 pcs.)	1.0"	.8"	
				2"	21DAA493	2.2"	2"	
511-836	21DZA275	1.0"	M16x1	1"	208927	1.4"	1"	200154 (2 pcs.)
				2"	208929 (2 pcs.)	2.4"	2"	
511-837	902313	2.0"	M16x1	2"	208929	2.4"	2"	200154 (2 pcs.)
				4"	208933	4.4"	4"	
511-838	902313	2.0"	M16x1	2"	208929	2.4"	2"	200154 (2 pcs.)
				4"	208933	4.4"	4"	

Bore Gages

For easy and accurate measurement of inside diameters

Bore Gages SERIES 511 — for Blind Holes

- Capable of ID (inside diameter) measurement close to the bottom of a hole.
- Carbide contact point ensuring high durability and wear resistance.
- Grip is large and hollow to reduce effect of body heat on high-accuracy measurements.
- Alternative indicators may be used in place of those recommended*.

* Some indicators and protection covers cannot be used with these bore gages. Contact a Mitutoyo sales office if considering the use of dial or digimatic indicators other than the recommended models.

- Optional extension rods can be attached for measuring deep holes. (For details, refer to page C-45.)
- A Bore Gage Checker and a range of Setting Rings are available to aid in accurately setting a gage before making a measurement. (For details, refer to pages C-46 and C-47.)



511-415

511-416

511-417

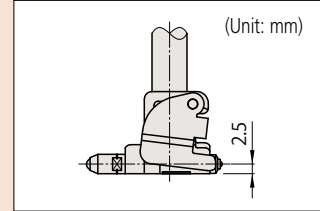


511-416



511-417

The dial indicator and protection cover are optional.



Technical Data

Accuracy: Metric models 4µm
Inch models .00016"
Repeatability: Metric models 1µm
Inch models .00004"
Adjacent error: Metric models 1µm
Inch models .00004"

Optional Accessories

–: Dial indicator (See Chapter F)
21DZA000: Dial protection cover

Recommended dial indicators (see Chapter F)

Metric models: 2046SB (0.01mm)
2972TB (0.01mm - One-revolution type)
2109SB-10 (0.001mm)
2900SB-10 (0.001mm - One-revolution type)
Inch models: 2922SB (.0005")
2977TB (.0005" - One-revolution type)
2923SB-10 (.0001")
2910SB-10 (.0001" - One-revolution type)

Recommended digimatic indicators (see Chapter F)

Metric models: 543-310B (0.001mm)
Inch models: 543-312B (0.001mm/.00005")

* Indicators equipped with rubber bellows, such as water-proof types, cannot be used.

SPECIFICATIONS

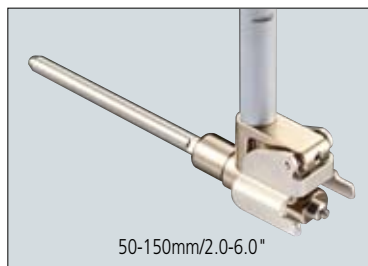
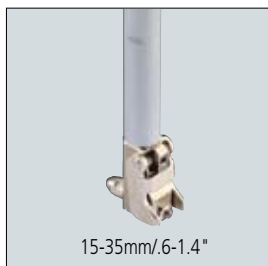
Metric										
Order No.	Range	Stroke of contact point	Measuring force	Guide force	Content of set					Probing depth
					Bore gage	Dial indicator	Dial protection cover	Anvil	Washer	
511-415	15-35mm	1.2mm	4N or less	6N or less	511-415	Not supplied	Not supplied	11 pcs.	1 pc.	150mm
511-416	35-60mm				511-416					
511-417	50-150mm				511-417					
511-425	15-35mm	1.2mm	4N or less	6N or less	511-415	2046SB (Graduation: 0.01mm)	21DZA000	6 pcs.	4 pcs.	150mm
511-426	35-60mm				511-416					
511-427	50-150mm				511-417					
511-435	15-35mm	1.2mm	4N or less	6N or less	511-415	2109SB-10 (Graduation: 0.001mm)	21DZA000	11 pcs.	1 pc.	150mm
511-436	35-60mm				511-416					
511-437	50-150mm				511-417					

Inch										
Order No.	Range	Stroke of contact point	Measuring force	Guide force	Content of set					Probing depth
					Bore gage	Dial indicator	Dial protection cover	Anvil	Washer	
511-418	.6-1.4"	.047"	4N or less	6N or less	511-418	Not supplied	Not supplied	11 pcs.	1 pc.	6"
511-419	1.4-2.4"				511-419					
511-420	2.0-6.0"				511-420					
511-428	.6-1.4"	.047"	4N or less	6N or less	511-418	2922SB (Graduation: .0005")	21DZA000	11 pcs.	1 pc.	6"
511-429	1.4-2.4"				511-419					
511-430	2.0-6.0"				511-420					
511-438	.6-1.4"	.047"	4N or less	6N or less	511-418	2923SB-10 (Graduation: .0001")	21DZA000	11 pcs.	1 pc.	6"
511-439	1.4-2.4"				511-419					
511-440	2.0-6.0"				511-420					

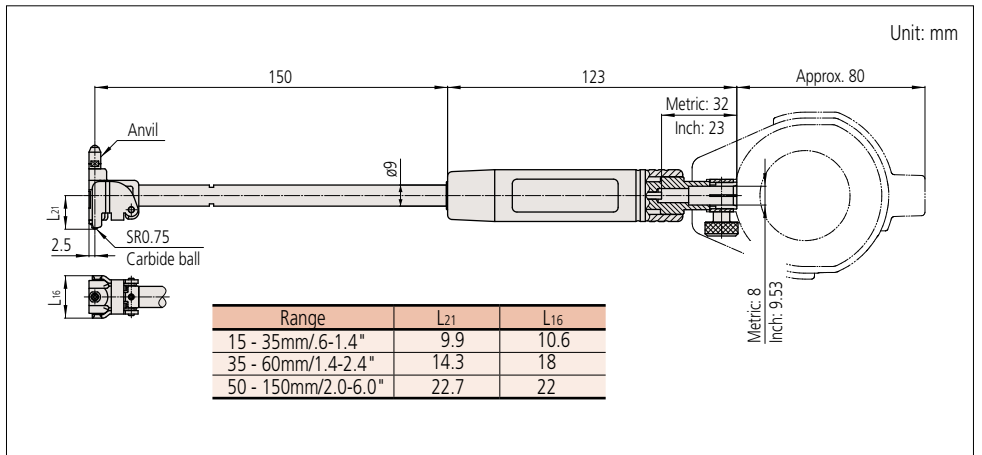
Notes: 1) A 10mm (.4") sub-anvil is supplied with 511-415/425/435/418/428/438 and a 50mm (2") sub-anvil is supplied with 511-417/427/437/420/430/440.

2) It is not permissible to use a sub-anvil other than as supplied as a standard accessory, or widen a measuring range by using multiple sub-anvils. (The measurement accuracy in such cases is not guaranteed.)

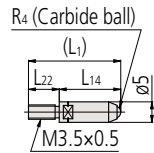
Contact Points



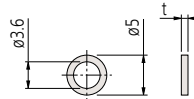
DIMENSIONS



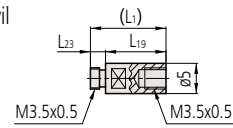
Anvil



Interchangeable washer

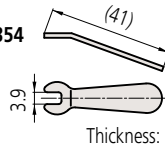


Sub-anvil

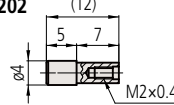


Notes: It is not permissible to use a sub-anvil other than as supplied as a standard accessory, or widen a measuring range by using multiple sub-anvils. (The measurement accuracy in such cases is not guaranteed.)

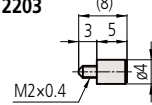
Spanner
No.204354



Washer holder
No.212202



Locking screw
No.212203



STANDARD ACCESSORIES

Bore gage (Main body)	Anvil							Interchangeable washer		Sub-Anvil		
	Marked No.	Order No.	Indication of measuring size	L ₁	L ₂₂	R ₄	L ₁₄	Order No.	t	Order No.	L ₂₃	L ₁₉
511-415 511-418 () Used 10mm/.4" Sub-Anvil	1	21DZA376A	15mm(25mm)/.59"(.98")	4.5mm/.18"	2.5 mm/.1"	SR1 mm/SR.04"	2mm/.08"	212127	0.5mm/.02"	21DAA563	2.5mm/.1"	10mm/.4"
	2	21DZA376B	16mm(26mm)/.63"(1.02")	5.5mm/.22"			3mm/.12"					
	3	21DZA376C	17mm(27mm)/.67"(1.06")	6.5mm/.26"			4mm/.16"					
	4	21DZA376D	18mm(28mm)/.71"(1.10")	7.5mm/.30"			5mm/.20"					
	5	21DZA376E	19mm(29mm)/.75"(1.14")	8.5mm/.33"			6mm/.24"					
	6	21DZA376F	20mm(30mm)/.79"(1.18")	9.5mm/.37"		7mm/.28"	SR1.5 mm/SR.06"					
	7	21DZA376G	21mm(31mm)/.83"(1.22")	10.5mm/.41"		8mm/.31"						
	8	21DZA376H	22mm(32mm)/.87"(1.26")	11.5mm/.45"		9mm/.35"						
	9	21DZA376J	23mm(33mm)/.91"(1.30")	12.5mm/.49"		10mm/.39"						
	10	21DZA376L	24mm(34mm)/.94"(1.34")	13.5mm/.53"		11mm/.43"						
	11	21DZA376M	25mm(35mm)/.98"(1.38")	14.5mm/.57"		12mm/.47"						
511-416 511-419	1	21DZA404A	35mm/1.38"	17.5mm/.69"	7.5 mm/.3"	SR1.5 mm/SR.06"	10mm/.39"	212127	0.5mm/.02"			
	2	21DZA404B	40mm/1.57"	22.5mm/.89"			15mm/.59"					
	3	21DZA404C	45mm/1.77"	27.5mm/1.08"			20mm/.79"					
	4	21DZA404D	50mm/1.97"	32.5mm/1.28"			25mm/.98"					
	5	21DZA404E	55mm/2.17"	37.5mm/1.48"			30mm/1.18"					
	6	21DZA404F	60mm/2.36"	42.5mm/1.67"			35mm/1.38"					
511-417 511-420 () Used 50mm/2" Sub-Anvil	1	21DZA404A	50mm(100mm)/1.97"(3.94")	17.5mm/.69"	7.5 mm/.3"	SR1.5 mm/SR.06"	10mm/.39"	212127	0.5mm/.02"	21DAA596	7.5mm/.3"	50mm/2"
	2	21DZA404B	55mm(105mm)/2.17"(4.13")	22.5mm/.89"			15mm/.59"					
	3	21DZA404C	60mm(110mm)/2.36"(4.33")	27.5mm/1.08"			20mm/.79"					
	4	21DZA404D	65mm(115mm)/2.56"(4.53")	32.5mm/1.28"			25mm/.98"					
	5	21DZA404E	70mm(120mm)/2.76"(4.72")	37.5mm/1.48"			30mm/1.18"					
	6	21DZA404F	75mm(125mm)/2.95"(4.92")	42.5mm/1.67"			35mm/1.38"					
	7	21DZA404G	80mm(130mm)/3.15"(5.12")	47.5mm/1.87"			40mm/1.57"					
	8	21DZA404H	85mm(135mm)/3.35"(5.31")	52.5mm/2.07"			45mm/1.77"					
	9	21DZA404J	90mm(140mm)/3.54"(5.51")	57.5mm/2.26"			50mm/1.97"					
	10	21DZA404L	95mm(145mm)/3.74"(5.71")	62.5mm/2.46"			55mm/2.17"					
	11	21DZA404M	100mm(150mm)/3.94"(5.91")	67.5mm/2.66"			60mm/2.36"					

Bore Gages

For easy and accurate measurement of inside diameters

Bore Gages

SERIES 511 — ABSOLUTE Digimatic Bore Gages

- These ABSOLUTE Digimatic bore gages are exclusively designed for inside diameter measurement.
- Up to four extension rods (250mm or 500mm) can be used for measuring at the bottom of a hole 2m deep.
- ABS (ABSOLUTE) type bore gages are not subject to overspeed error.
- The display and grip can be rotated up to 320 degrees and the display can be inclined up to 90 degrees, so that it is easily readable from any direction.
- The minimum value holding function provides easy measurement of hole diameter.
- Setting the Bore Gage to a master value using a gauge block set allows quick and accurate setting.
- A Bore Gage Checker and a range of Setting Rings are available to aid in accurately setting a gage before making a measurement. (For details, refer to pages C-46 and C-47.)



SPECIFICATIONS

Metric									
Order No.	Range	Stroke of contact point	Measuring force	Guide force	Resolution	Content of set			Probing depth
						Anvil	Interchangeable washer	Battery (SR44)	
511-501	45-100mm	1.2mm	5N or less	10N or less	0.001mm	12 pcs.	4 pcs.	2 pcs.	150mm
511-502	100-160mm					13 pcs.	4 pcs.	2 pcs.	

Inch									
Order No.	Range	Stroke of contact point	Measuring force	Guide force	Resolution	Content of set			Probing depth
						Anvil	Interchangeable washer	Battery (SR44)	
511-521	1.8-4.0"	.047"	5N or less	6N or less	.00005"/ 0.001mm	12 pcs.	4 pcs.	2 pcs.	6"
511-522	4.0-6.5"					13 pcs.	4 pcs.	2 pcs.	

- Notes: 1) Normal use is assumed to be 8 hours per day.
 2) The correct peak value may not be displayed if the anvil's speed exceeds 50 µm/s.
 3) IP53 indicates resistance to dust and dripping water, but only applies when the connector cap is in place.



ABSOLUTE™ (Refer to page X for details.)

Technical Data

- Accuracy: Metric models 3µm
 Inch models .00012"
 Excluding quantizing error
- Repeatability: Metric models 2µm
 Inch models .00008"
- Adjacent error: Metric models 2µm
 Inch models .00008"
- Battery: SR44 (2 pc), **938882**, for initial operational checks (standard accessory)
- Battery life: Approx. 2000 hours under normal use.
- Display: LCD character height 8.5mm
- Scale type: ABSOLUTE electrostatic linear encoder
- Max. response speed: Unlimited

Function

- Preset function
- Master value registration (3 values at maximum)
- Tolerance judgment
- Upper/lower limit registration (3 values at maximum)
- Minimum value holding
- Data output
- Display rotation (320°)
- Display inclination (90°, 7 steps)
- Low battery alarm display
- Error display

Optional Accessories

21DZA089: Extension rod 250 mm (10")

21DZA081: Extension rod 500 mm (20")

Up to four extension rods can be jointed, and the maximum length 2m is allowed.

Refer to page A-21 for details

Connecting cables for Input Tool/ Digimatic Mini-Processor, etc.

1m: **905338**

2m: **905409**

USB Input Tool Direct (2m): 06ADV380F

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

For standard (160mm): **02AZD790F**

For foot switch: **02AZE140F**

Setting ring (See page C-47.)

• Digimatic Mini-Processor DP-1VR: **264-504**

Example of connection

When connecting four pieces of 500mm extension rods

Gauge blocks and block sets for setting the origin or master value (optional)

Usage example



Rectangular gauge blocks

* Available only for 511-501/521

516-118-10

516-118-60 with calibration certificate

Description	Order No.	Qty	
Nominal length (mm)	1	611611-021	1
	2	611612-021	1
	3	611613-021	1
	5	611615-021	1
	10	611671-021	1
	20	611672-021	1
	30	611673-021	1
40	611674-021	1	
Flat jaw	630030	1 pair (2 pcs)	
Holder 160 mm	619004	1	
Certificate of inspection		1	

* Equivalent to JIS B 7506 Grade 0

Square gauge blocks

* Available only for 511-501/521

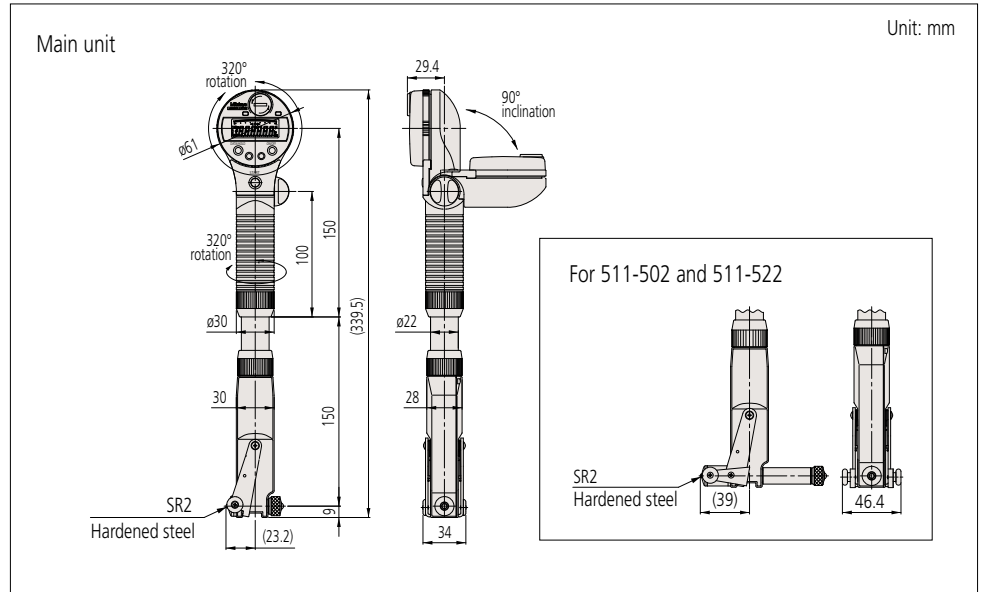
516-119-10

516-119-60 with calibration certificate

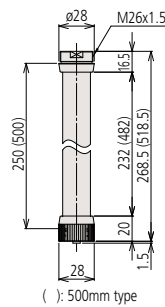
Description	Order No.	Qty	
Nominal length (mm)	1	614611-021	1
	2	614612-021	1
	3	614613-021	1
	5	614615-021	1
	10	614671-021	1
	20	614672-021	1
	30	614673-021	1
40	614674-021	1	
Flat jaw	619072	1 pair (2 pcs)	
Tie rod 3"	619062	1	
Tie rod 2 1/4"	619063	1	
Tie rod 1 1/2"	619064	1	
Flat head screw 1 1/4"	619057	2	
Flat head screw 5/8"	619058	2	
Certificate of inspection		1	

* Equivalent to JIS B 7506 Grade 0

DIMENSIONS

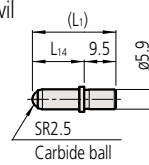


Extension rod

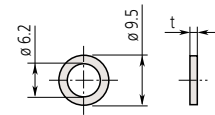


(): 500mm type

Anvil



Interchangeable washer



STANDARD ACCESSORIES

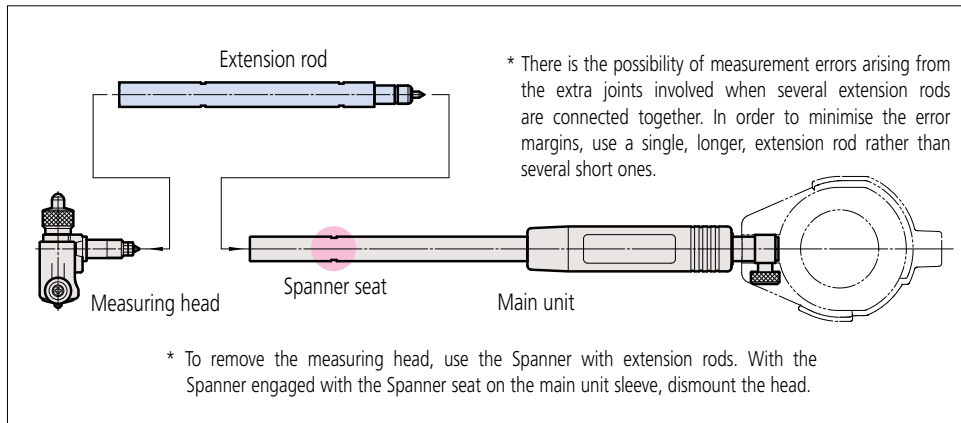
Bore gage (Main body)	Marked No.	Anvil				Interchangeable washer	
		Parts No.	Indication of measuring size	L1	L14	Parts No.	t
511-501 511-521	1	21DZA232A	45mm/1.8"	15mm/.59"	5.5mm/.22"	205457 205458 205459 205460	0.5mm/.02" 1.0mm/.04" 2.0mm/.08" 3.0mm/.12"
	2	21DZA232B	50mm/2.0"	20mm/.79"	10.5mm/.42"		
	3	21DZA232C	55mm/2.2"	25mm/.98"	15.5mm/.61"		
	4	21DZA232D	60mm/2.4"	30mm/1.18"	20.5mm/.81"		
	5	21DZA232E	65mm/2.6"	35mm/1.38"	25.5mm/1.00"		
	6	21DZA232F	70mm/2.8"	40mm/1.57"	30.5mm/1.20"		
	7	21DZA232G	75mm/3.0"	45mm/1.77"	35.5mm/1.40"		
	8	21DZA232H	80mm/3.2"	50mm/1.97"	40.5mm/1.59"		
	9	21DZA232J	85mm/3.4"	55mm/2.17"	45.5mm/1.79"		
	10	21DZA232L	90mm/3.6"	60mm/2.36"	50.5mm/1.99"		
	11	21DZA232M	95mm/3.8"	65mm/2.56"	55.5mm/2.19"		
	12	21DZA232N	100mm/4.0"	70mm/2.76"	60.5mm/2.38"		
511-502 511-522	1	21DZA232A	100mm/4.0"	15mm/.59"	5.5mm/.22"	205457 205458 205459 205460	0.5mm/.02" 1.0mm/.04" 2.0mm/.08" 3.0mm/.12"
	2	21DZA232B	105mm/4.2"	20mm/.79"	10.5mm/.42"		
	3	21DZA232C	110mm/4.4"	25mm/.98"	15.5mm/.61"		
	4	21DZA232D	115mm/4.6"	30mm/1.18"	20.5mm/.81"		
	5	21DZA232E	120mm/4.8"	35mm/1.38"	25.5mm/1.00"		
	6	21DZA232F	125mm/5.0"	40mm/1.57"	30.5mm/1.20"		
	7	21DZA232G	130mm/5.2"	45mm/1.77"	35.5mm/1.40"		
	8	21DZA232H	135mm/5.4"	50mm/1.97"	40.5mm/1.59"		
	9	21DZA232J	140mm/5.6"	55mm/2.17"	45.5mm/1.79"		
	10	21DZA232L	145mm/5.8"	60mm/2.36"	50.5mm/1.99"		
	11	21DZA232M	150mm/6.0"	65mm/2.56"	55.5mm/2.19"		
	12	21DZA232N	155mm/6.2"	70mm/2.76"	60.5mm/2.38"		
	13	21DZA232P	160mm/6.4"	75mm/2.95"	65.5mm/2.58"		

Bore Gages

For easy and accurate measurement of inside diameters

Extension rod SERIES 511 — Accessories for Bore Gages

- Extension rods (optional) are available to assist in deep-hole measurement.
- If two or more extension rods are connected together, measurement errors may occur due to flexure of the rod assembly. Therefore it is best to use no more than a single extension rod.
- The extension rod length is available up to 1000mm.
- Can not be connected to the products with special sizes or special specifications.
- When using a 500mm (or longer) extension rod, use the bore gage in an upright position.
- The accuracy and security of the assembly should be confirmed after connecting a rod.



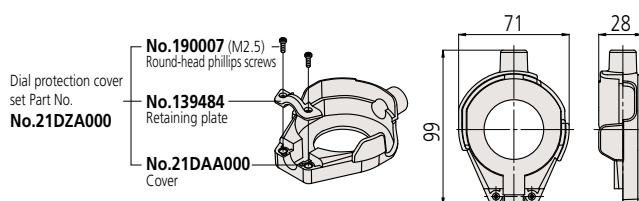
SPECIFICATIONS

Applicable model Order No.	Extension rod length					Extension rod diameter	Spanner part No.
	125m	250m	500m	750m	1000m		
511-701/511-731 511-415/511-418 511-416/511-419 511-417/511-420	953549	953550	953551	—	—	ø9mm	102148
511-702/511-732 511-703/511-733 511-704/511-734	953552	953553	953554	953555	953556	ø12mm	212556
511-803/511-833 511-804/511-834 511-705/511-735 511-706/511-736 511-805/511-835 511-806/511-836 511-807/511-837 511-808/511-838	953557	952361	953558	953559	953560	ø15mm	212556

*Spanner is supplied as standard.

Protection cover

- Both the flat backplate of a dial indicator and backplate with a lug can be attached to a protection cover.



Usage example



Technical Data

Flatness of parallel jaw
0.5 μ m (Parallelism 1 μ m)

Standard accessories

Parallel jaw 2 pcs. **630030**
Attachment A **940088**
Attachment B **940089**
Attachment C **940090**

Bore Gage Checker SERIES 515

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



515-590

Standard configuration: Stand
Attachment A, B, C 1pc. for each
Parallel jaw (2 pcs.)

SPECIFICATIONS

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

Bore Gages

For easy and accurate measurement of inside diameters

Setting Rings

SERIES 177 — Accessories for Inside Micrometers, Holtest and Dial Bore Gages

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

Steel Setting Rings



177-146



177-300

CERA Setting Rings

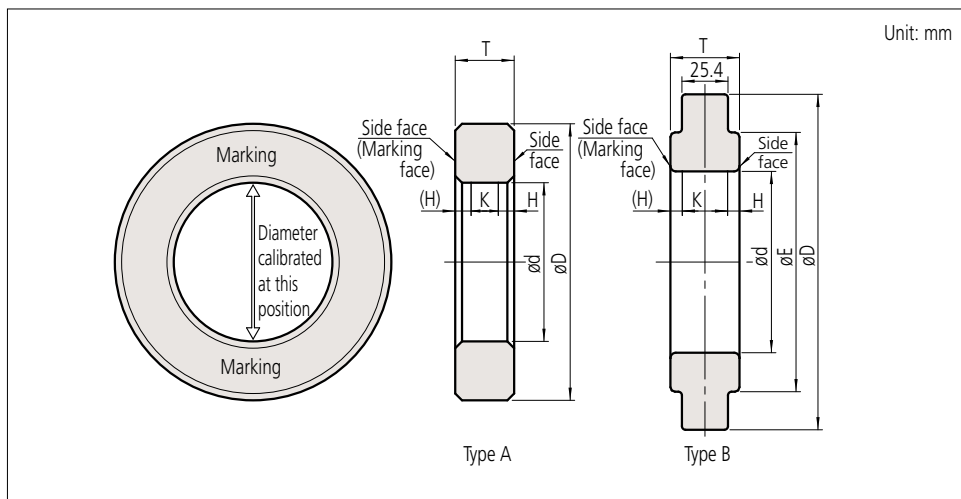


177-429



177-432

DIMENSIONS



Suffix

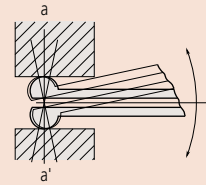
- 177-***-12:** With Inspection Certificate (provides a record of the calibrated diameter)
- 177-***-62:** With Inspection Certificate (provides a record of the calibrated diameter) and Calibration Certificate
- 177-***-82:** With Inspection Certificate (provides a record of the calibrated diameter), Calibration Certificate, and Traceability System Chart

Notes:

- The Inspection Certificate is not a substitute for a calibration certificate as it is undated.
- A more detailed inspection certificate describing roundness and cylindricity is available on request.

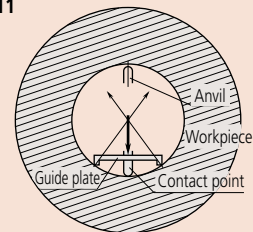
How to read the indicated value

Series 526



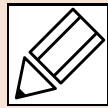
The 526 series has a gage head with high curvature. Alignment with the diameter (a - a') is achieved by rotating the gage head in the direction indicated by the arrow, and the reading is the maximum value read from the dial indicator.

Series 511



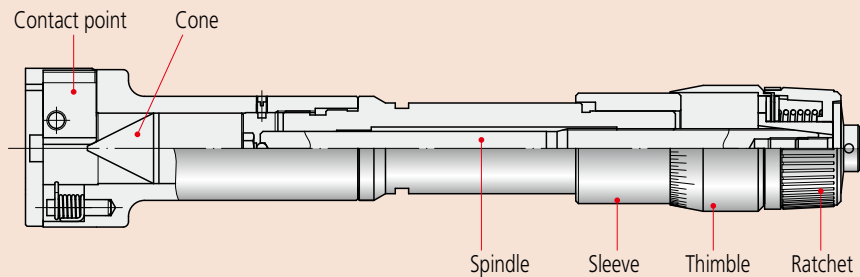
The 511 series provides a guide plate to align the setting ring diameter with the measurement axis of the bore gage.

Quick Guide to Precision Measuring Instruments



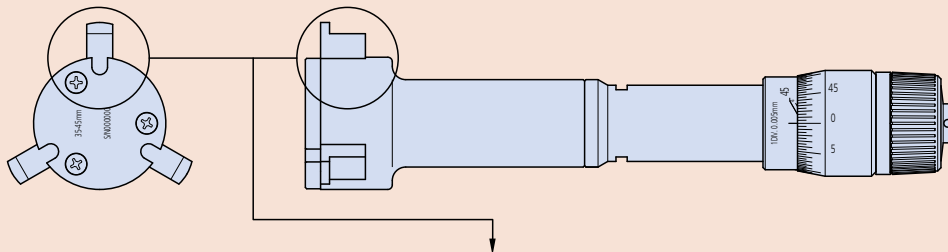
Internal Micrometers

Nomenclature



Custom-ordered Products (Holtest / Borematic)

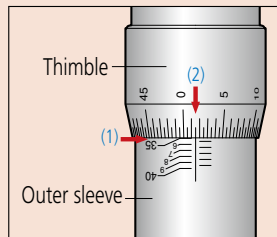
Mitutoyo can custom-build an internal micrometer best suited to your special application. Please feel free to contact Mitutoyo about the possibilities - even if only one custom-manufactured piece is required. Please note that, depending on circumstances, such a micrometer will usually need to be used with a master setting ring for accuracy assurance. (A custom-ordered micrometer can be made compatible with a master ring supplied by the customer. Please consult Mitutoyo.)



Type of feature	Workpiece profile (example)	Contact point tip profile (example)	Remarks
Square groove		<p>Tip radius R that can measure the minimum diameter (different for each size)</p> <p>W=1 or more</p>	<ul style="list-style-type: none"> ● Allows measurement of the diameter of variously shaped inside grooves and splines. ● Minimum measurable groove diameter is approximately 16mm (differs depending on the workpiece profile.) ● Dimension l should be as follows: For $W =$ less than 2mm: $l =$ less than 2mm For $W =$ 2mm or more: $l =$ 2mm as the standard value which can be modified according to circumstances. ● The number of splines or serrations is limited to a multiple of 3. ● Details of the workpiece profile should be provided at the time of placing a custom-order. ● If your application needs a measuring range different from that of the standard internal micrometer an additional initial cost for the master ring will be required.
Round groove		<p>Tip radius R that can measure the minimum diameter (different for each size)</p> <p>W=1 or more Radius=0.5 or more</p>	
Spline		<p>W=0.5 or more</p> <p>Tip radius R that can measure the minimum diameter (different for each size)</p>	
Serration		<p>45° or more</p> <p>R=0.3 or more</p>	
Threaded hole			

How to Read the Scale

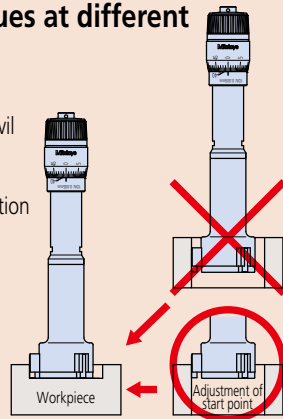
Graduation	0.005mm
(1) Outer sleeve	35 mm
(2) Thimble	0.015 mm
Reading	35.015 mm



Changes in measured values at different measuring points

When Holtest is used, the measured value differs between measurement across the anvil and the measurement only at the tip of the anvil due to the product mechanism. Adjust the start point under the same condition before measurement.

When you use the tip of the anvil for measurement, adjust the start point for using the tip of the anvil.



Measurement error due to temperature variation of Tubular Inside Micrometers

Heat transfer from the operator to the micrometer should be minimized to avoid any significant measuring error due to temperature difference between the workpiece and micrometer. If the micrometer is held directly by hand when measuring, use gloves or hold the heat-insulator (if fitted).

Misalignment Errors

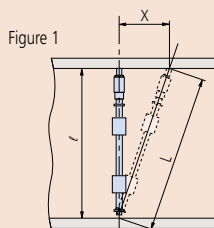


Figure 1
 ℓ : Inside diameter to be measured
 L : Length measured with axial offset X
 X : Offset in axial direction
 $\Delta \ell$: Error in measurement
 $\Delta \ell$: $L - \ell = \sqrt{\ell^2 + X^2} - \ell$

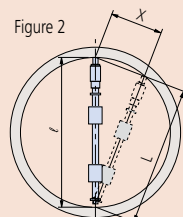
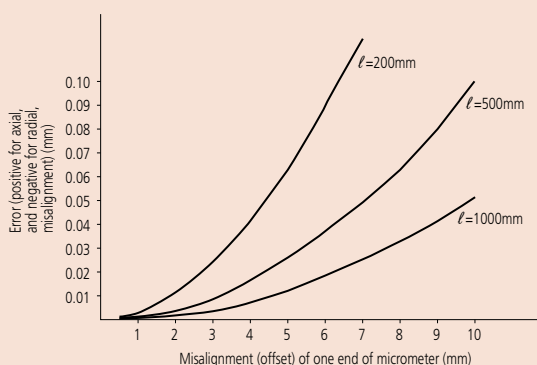


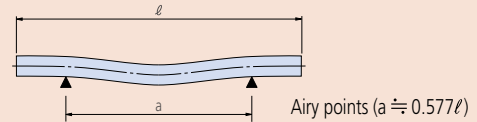
Figure 2
 ℓ : Inside diameter to be measured
 L : Length measured with radial offset X
 X : Offset in radial direction
 $\Delta \ell$: Error in measurement
 $\Delta \ell$: $L - \ell = \sqrt{\ell^2 - X^2} - \ell$

If the Tubular Inside Micrometer is misaligned in the axial or radial direction by an offset distance X when a measurement is taken, as in Figures 1 and 2, then that measurement will be in error as shown in the graph below (constructed from the formulae given above). The error is positive for axial misalignment and negative for radial misalignment.

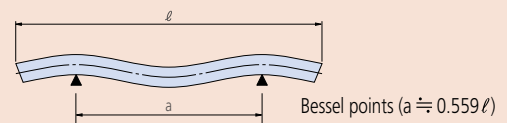


Airy and Bessel Points

When a length standard bar or internal micrometer lies horizontally, supported as simply as possible at two points, it bends under its own weight into a shape that depends on the spacing of those points. There are two distances between the points that control this deformation in useful ways, as shown below.



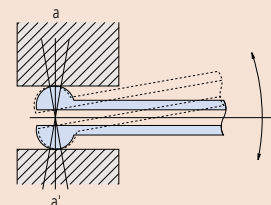
The ends of a bar (or micrometer) can be made exactly horizontal by spacing the two supports symmetrically as shown above. These points are known as the 'Airy Points' and are commonly used to ensure that the ends of a length bar are parallel to one another, so that the length is well defined.



The change in length of a bar (or micrometer) due to bending can be minimized by spacing the two supports symmetrically as shown above. These points are known as the 'Bessel Points' and may be useful when using a long inside micrometer.

Bore Gages

- Mitutoyo bore gages for small holes feature contact elements with a large curvature so they can be easily positioned for measuring the true diameter (in the direction $a-a'$) of a hole. The true diameter is the minimum value seen on the dial gage while rocking the bore gage as indicated by the arrow.



- The spring-loaded guide plate on a Mitutoyo two-point bore gage automatically ensures radial alignment so that only an axial rocking movement is needed to find the minimum reading (true diameter).

