

# Rolling Bearings

Rolling Elements-Balls and Rollers



## STEEL BALLS AND ROLLERS

### STEEL BALLS FOR BALL BEARINGS

Nominal Diameter 0.3 – 114.3mm ..... B344

### CYLINDRICAL ROLLERS FOR ROLLER BEARINGS

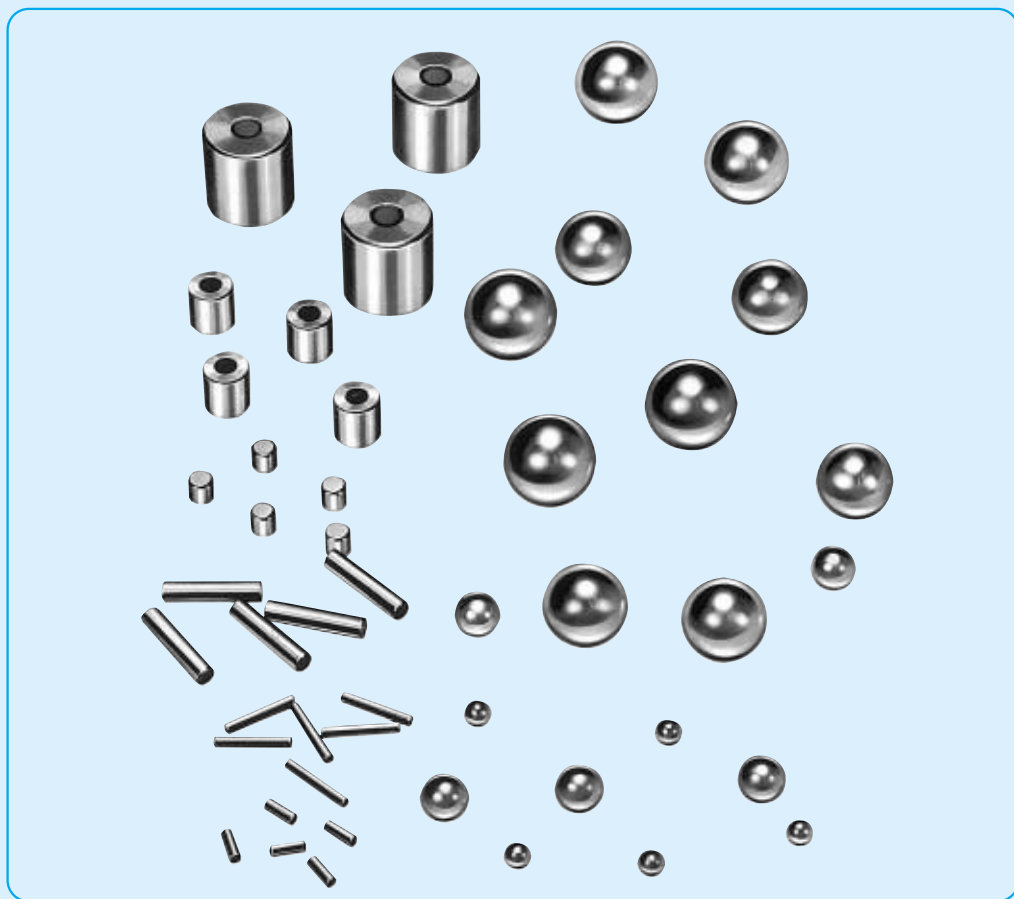
Nominal Diameter 3 – 80mm ..... B346

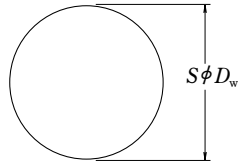
### LONG CYLINDRICAL ROLLERS FOR ROLLER BEARINGS

Nominal Diameter 5.5 – 15mm ..... B348

### NEEDLE ROLLERS FOR ROLLER BEARINGS

Nominal Diameter 1 – 5mm ..... B350





Nominal Size, Basic Diameters, and Mass

Nominal Size		Basic Diameter Dw (mm)	Mass (kg) per 10000 pcs approx	Nominal Size		Basic Diameter Dw (mm)	Mass (kg) per 1000 pcs approx	Nominal Size		Basic Diameter Dw (mm)	Mass (kg) per 10 pcs approx
Metric	Inch			Metric	Inch			Metric	Inch		
0.3mm		0.30000	0.0011	10 mm	3/8	9.52500	3.523	30mm	30.00000	1.101	
0.4mm		0.40000	0.0026			10.00000	4.076	1 3/16	30.16250	1.119	
0.5mm		0.50000	0.0051	10 mm	13/32	10.31875	4.479	1 1/4	31.75000	1.305	
0.6mm	0.025	0.60000	0.0088	11 mm		11.00000	5.425	32mm	32.00000	1.336	
		0.63500	0.0104		7/16	11.11250	5.594	1 5/16	33.33750	1.510	
0.7mm		0.70000	0.0140	11.5mm		11.50000	6.199	34mm	34.00000	1.602	
	1/32	0.79375	0.0204		15/32	11.90625	6.880	1 3/8	34.92500	1.736	
0.8mm		0.80000	0.0209	12 mm		12.00000	7.044	35mm	35.00000	1.748	
1 mm		1.00000	0.0408	12 mm	1/2	12.00000	8.350	36mm	36.00000	1.902	
	3/64	1.19062	0.0688	13 mm		13.00000	8.955	1 7/16	36.51250	1.984	
1.2mm		1.20000	0.0704	14 mm	17/32	13.49375	10.02	38mm	38.00000	2.237	
1.5mm		1.50000	0.1376	14 mm		14.00000	11.19	1 1/2	38.10000	2.254	
	1/16	1.58750	0.1631	15 mm	9/16	14.28750	11.89	1 9/16	39.68750	2.548	
2 mm	5/64	1.98438	0.3185	15 mm		15.00000	13.76	40mm	40.00000	2.609	
		2.00000	0.3261		19/32	15.08125	13.98	1 5/8	41.27500	2.866	
2.5mm	3/32	2.38125	0.5504	16 mm	5/8	15.87500	16.31	1 11/16	42.86250	3.210	
		2.50000	0.6369	16 mm		16.00000	16.70	1 3/4	44.45000	3.580	
3 mm	7/64	2.77812	0.8740	17 mm	21/32	16.66875	18.88	45mm	45.00000	3.714	
		3.00000	1.101	17 mm		17.00000	20.03	1 13/16	46.03750	3.977	
3.5mm	1/8	3.17500	1.305	18 mm	11/16	17.46250	21.71	1 7/8	47.62500	4.403	
		3.50000	1.748	18 mm		18.00000	23.77	1 15/16	49.21250	4.858	
	9/64	3.57188	1.858	19 mm	23/32	18.25625	24.80	50mm	50.00000	5.095	
4 mm	5/32	3.96875	2.548	19 mm		19.00000	27.96	2	50.80000	5.344	
		4.00000	2.609	20 mm	3/4	19.05000	28.18	2 1/8	53.97500	6.410	
4.5mm		4.50000	3.714	20 mm	25/32	19.84375	31.85	55mm	55.00000	6.782	
5 mm	3/16	4.76250	4.403	20 mm		20.00000	32.61	2 1/4	57.15000	7.609	
		5.00000	5.095	21 mm	13/16	20.63750	35.83	60mm	60.00000	8.805	
5.5mm		5.50000	6.782	21 mm		21.00000	37.75	2 3/8	60.32500	8.948	
	7/32	5.55625	7.016	22 mm	27/32	21.43125	40.12	2 1/2	63.50000	10.44	
	15/64	5.95312	8.600	22 mm		22.00000	43.40	65mm	65.00000	11.19	
6 mm		6.00000	8.805	23 mm	7/8	22.22500	44.75	2 5/8	66.67500	12.08	
	1/4	6.35000	10.44	23 mm		23.00000	49.60	2 3/4	69.85000	13.89	
6.5mm		6.50000	11.19	23 mm	29/32	23.01875	49.72	2 7/8	73.02500	15.87	
	17/64	6.74688	12.52	24 mm	15/16	23.81250	55.04	3	76.20000	18.04	
7 mm		7.00000	13.98	24 mm		24.00000	56.35	3 1/4	82.55000	22.93	
	9/32	7.14375	14.86	24 mm	31/32	24.60625	60.73	3 1/2	88.90000	28.64	
7.5mm		7.50000	17.20	25 mm		25.00000	63.69	3 3/4	95.25000	35.23	
	5/16	7.93750	20.38	25 mm	1	25.40000	66.80	4	101.60000	42.75	
8 mm		8.00000	20.87	26 mm		26.00000	71.64	4 1/4	107.95000	51.28	
8.5mm		8.50000	25.03	28 mm	1 1/16	26.98750	80.12	4 1/2	114.30000	60.87	
	11/32	8.73125	27.13			28.00000	89.48				
9 mm		9.00000	29.72		1 1/8	28.57500	95.11				

Application, Nominal Size, Tolerances, Roughness, and Gauges

Units : μm

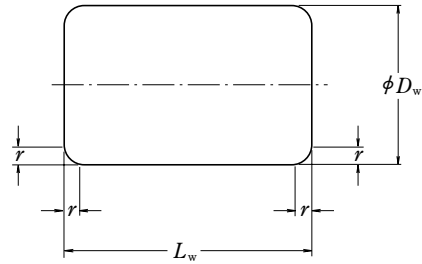
Class	Nominal Size		Tolerances			Gauges		
			Variation in Dia. max	Sphericity max	Roughness Ra max	Diameter Difference per Lot max	Gauge Interval	Gauge
	Metric (mm)	Inch						
3	0.3 to 12	0.025~ 1/2	0.08	0.08	0.012	0.13	0.5	- 5, , - 0.5, 0, + 0.5, , + 5
5	0.3 to 12	0.025~ 1/2	0.13	0.13	0.02	0.25	1	- 5, , - 1, 0, + 1, , + 5
10	0.3 to 25	0.025~1	0.25	0.25	0.025	0.5	1	- 9, , - 1, 0, + 1, , + 9
16	0.3 to 25	0.025~1	0.4	0.4	0.032	0.8	2	-10, , - 2, 0, + 2, , +10
20	0.3 to 38	0.025~1 1/2	0.5	0.5	0.04	1	2	-10, , - 2, 0, + 2, , +10
28	0.3 to 38	0.025~1 1/2	0.7	0.7	0.05	1.4	2	-12, , - 2, 0, + 2, , +12
40	0.3 to 50	0.025~2	1	1	0.08	2	4	-16, , - 4, 0, + 4, , +16
60	0.3 to 65	0.025~3	1.5	1.5	0.095	3	5	-25, , - 5, 0, + 5, , +25
100	0.3 to 65	0.025~4 1/2	2.5	2.5	0.125	5	10	-40, , -10, 0, +10, , +40
200	0.3 to 65	0.025~4 1/2	5	5	0.2	10	15	-60, , -15, 0, +15, , +60

Hardness

Nominal Size		Hardness	
Metric (mm)	Inch	HV	HRC
0.3 to 3	0.025 to 7/64	772 to 900	(63 to 67) <sup>(1)</sup>
3.5 to 30	1/8 to 1 1/8	—	62 to 67
32 to 65	1 3/16 to 4 1/2	—	61 to 67

Note <sup>(1)</sup> Values in ( ) are converted values for reference.

Tolerances for Cylindrical Roller Chamfers



Units : mm

min	max
0.1	0.3
0.2	0.5
0.3	0.8
0.5	1.2
0.6	1.5
0.7	1.7
1	2.2 <sup>(1)</sup>
1.5	3.5
2	4

Note <sup>(1)</sup> If  $D_w$  exceeds 40mm,  $r$  (max) is 2.7mm.

Units : mm

Nominal Size	$D_w$	$L_w$	$r$ min	Mass (kg) per 100 pcs approx
3 × 3	3	3	0.1	0.016
3 × 5	3	5	0.1	0.027
3.5 × 5	3.5	5	0.2	0.037
4 × 4	4	4	0.2	0.039
4 × 6	4	6	0.2	0.058
4 × 8	4	8	0.2	0.078
4.5 × 4.5	4.5	4.5	0.2	0.055
4.5 × 6	4.5	6	0.2	0.073
5 × 5	5	5	0.2	0.075
5 × 8	5	8	0.2	0.121
5 × 10	5	10	0.2	0.152
5.5 × 5.5	5.5	5.5	0.2	0.10
5.5 × 8	5.5	8	0.2	0.146
6 × 6	6	6	0.2	0.13
6 × 8	6	8	0.2	0.178
6 × 12	6	12	0.2	0.261
6.5 × 6.5	6.5	6.5	0.3	0.166
6.5 × 9	6.5	9	0.3	0.23
7 × 7	7	7	0.3	0.206
7 × 10	7	10	0.3	0.296
7 × 14	7	14	0.3	0.415
7.5 × 7.5	7.5	7.5	0.3	0.254
7.5 × 11	7.5	11	0.3	0.375
8 × 8	8	8	0.3	0.31
8 × 12	8	12	0.3	0.465
9 × 9	9	9	0.3	0.44
9 × 14	9	14	0.3	0.68
10 × 10	10	10	0.3	0.60
10 × 14	10	14	0.3	0.85
11 × 11	11	11	0.3	0.81
11 × 15	11	15	0.3	1.1
12 × 12	12	12	0.3	1.04
12 × 18	12	18	0.3	1.57
13 × 13	13	13	0.3	1.33
13 × 20	13	20	0.3	2.04
14 × 14	14	14	0.3	1.66
14 × 20	14	20	0.3	2.38

Units : mm

Nominal Size	$D_w$	$L_w$	$r$ min	Mass (kg) per 100 pcs approx
15 × 15	15	15	0.5	2.04
15 × 22	15	22	0.5	3.0
16 × 16	16	16	0.5	2.48
16 × 24	16	24	0.5	3.75
17 × 17	17	17	0.5	2.97
17 × 24	17	24	0.5	4.2
18 × 18	18	18	0.5	3.55
18 × 26	18	26	0.5	5.1
19 × 19	19	19	0.6	4.16
19 × 28	19	28	0.6	6.1
20 × 20	20	20	0.6	4.85
20 × 30	20	30	0.6	7.3
21 × 21	21	21	0.6	5.6
21 × 30	21	30	0.6	8.0
22 × 22	22	22	0.6	6.4
22 × 34	22	34	0.6	10
23 × 23	23	23	0.6	7.4
23 × 34	23	34	0.6	11.2
24 × 24	24	24	0.6	8.4
24 × 36	24	36	0.6	12.6
25 × 25	25	25	0.7	9.5
25 × 36	25	36	0.7	13.7
26 × 26	26	26	0.7	10.7
26 × 40	26	40	0.7	16.4
28 × 28	28	28	0.7	13.3
28 × 44	28	44	0.7	21
30 × 30	30	30	0.7	16.3
30 × 48	30	48	0.7	26.2
32 × 32	32	32	1	19.9
32 × 52	32	52	1	32.5
34 × 34	34	34	1	23.9
34 × 55	34	55	1	38.5
36 × 36	36	36	1	28.3
36 × 58	36	58	1	45.5
38 × 38	38	38	1	33.5
38 × 62	38	62	1	55
40 × 40	40	40	1	39
40 × 65	40	65	1	63

Units : mm

Nominal Size	$D_w$	$L_w$	$r$ min	Mass (kg) per 100 pcs approx
42 × 42	42	42	1	45
45 × 45	45	45	1	55.5
48 × 48	48	48	1	67
50 × 50	50	50	1	76
52 × 52	52	52	1.5	85
54 × 54	54	54	1.5	95.5
56 × 56	56	56	1.5	107
60 × 60	60	60	1.5	131
64 × 64	64	64	1.5	159
68 × 68	68	68	1.5	191
75 × 75	75	75	2	256
80 × 80	80	80	2	310

Accuracy of Cylindrical Rollers

Units : μm

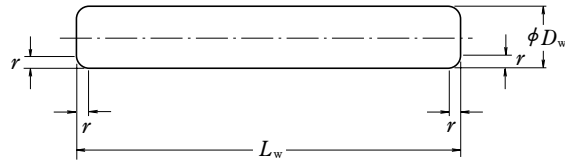
Class	$D_w$ (mm)		Out-of-Roundness <sup>(1)</sup> $\Delta R$ max	Single Plane Mean Roller Diameter Variation <sup>(2)</sup> $VD_{Wmp}$ max	Roller Gauge Lot Diameter Variation <sup>(1)</sup> $VD_{WL}$ max	Length Deviation <sup>(3)</sup> $\Delta L_{Ws}$		Roller Gauge Lot Length Variation $VL_{WL}$ max	End Face Runout $S_w$ max
	over	incl				high	low <sup>(4)</sup>		
1	3	18	0.5	0.8	1	+10	- [ (IT9) - 10]	5	3
1A	3	30	0.7	1	1.5	+10	- [ (IT9) - 10]	7	5
2	3	50	1	1.5	2	+10	- [ (IT9) - 10]	10	6
2A	10	80	1.3	2	2.5	+10	- [ (IT9) - 10]	13	8
3	18	80	1.5	3	3	+10	- [ (IT9) - 10]	15	10
5	30	80	2.5	4	5	+10	- [ (IT9) - 10]	25	15

Notes <sup>(1)</sup> Applicable to roller center (length direction).

<sup>(2)</sup> Applicable to cylindrical outside surface.

<sup>(3)</sup> To find the IT9 standard tolerance according to the  $L_w$  size classification, refer to the IT9 column of the Appendix Table 11 on Page C22.

<sup>(4)</sup> The value for low of length deviation is subtracted 10μm from the value of the standard tolerance for each roller length.



**Remarks** The figure shows an example of a flat-end long cylindrical roller.

**Tolerances for Long Cylindrical Roller Chamfers**

Units : mm

min	max
0.2	0.5
0.3	0.8
0.5	1.2

Units : mm

Nominal Size	$D_w$	$L_w$	$r^{(1)}$ min	Mass (kg) per 100 pcs approx
<b>5.5×18</b>	5.5	18	0.2	0.333
<b>5.5×22.4</b>	5.5	22.4	0.2	0.414
<b>5.5×28</b>	5.5	28	0.2	0.518
<b>6 ×20</b>	6	20	0.2	0.44
<b>6 ×25</b>	6	25	0.2	0.55
<b>6 ×31.5</b>	6	31.5	0.2	0.693
<b>6 ×40</b>	6	40	0.2	0.88
<b>6 ×50</b>	6	50	0.2	1.1
<b>6.5×20</b>	6.5	20	0.3	0.516
<b>6.5×25</b>	6.5	25	0.3	0.645
<b>6.5×31.5</b>	6.5	31.5	0.3	0.813
<b>7 ×22.4</b>	7	22.4	0.3	0.671
<b>7 ×28</b>	7	28	0.3	0.838
<b>7 ×35.5</b>	7	35.5	0.3	1.06
<b>7 ×45</b>	7	45	0.3	1.35
<b>7 ×56</b>	7	56	0.3	1.68
<b>7.5×31.5</b>	7.5	31.5	0.3	1.08
<b>7.5×40</b>	7.5	40	0.3	1.38

Units : mm

Nominal Size	$D_w$	$L_w$	$r^{(1)}$ min	Mass (kg) per 100 pcs approx
<b>8 ×25</b>	8	25	0.3	0.978
<b>8 ×31.5</b>	8	31.5	0.3	1.23
<b>8 ×40</b>	8	40	0.3	1.56
<b>8 ×50</b>	8	50	0.3	1.96
<b>8 ×63</b>	8	63	0.3	2.46
<b>9 ×28</b>	9	28	0.3	1.39
<b>9 ×35.5</b>	9	35.5	0.3	1.76
<b>9 ×45</b>	9	45	0.3	2.23
<b>9 ×56</b>	9	56	0.3	2.77
<b>10×31.5</b>	10	31.5	0.3	1.93
<b>10×40</b>	10	40	0.3	2.44
<b>10×50</b>	10	50	0.3	3.06
<b>10×63</b>	10	63	0.3	3.85
<b>12×40</b>	12	40	0.3	3.52
<b>12×50</b>	12	50	0.3	4.4
<b>12×63</b>	12	63	0.3	5.54
<b>15×45</b>	15	45	0.5	6.16
<b>15×56</b>	15	56	0.5	7.68
<b>15×71</b>	15	71	0.5	9.74
<b>15×90</b>	15	90	0.5	12.4

**Note** <sup>(1)</sup> Only for flat-end rollers.

**Accuracy of Long Cylindrical Rollers**

Units :  $\mu\text{m}$

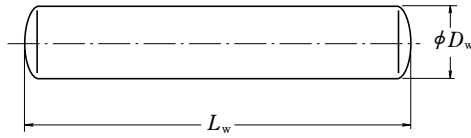
Class	Out-of-Roundness <sup>(1)</sup> $\Delta R$ max	Single Plane Mean Roller Diameter Variation <sup>(2)</sup> $VD_{Wmp}$ max	Roller Gauge Lot Diameter Variation <sup>(1)</sup> $VD_{WL}$ max	Length Deviation <sup>(2)</sup> $\Delta L_{Ws}$
3	1.5	3	3	h12
5	2	5	5	h12

**Notes** <sup>(1)</sup> Applicable to roller center (length direction).  
<sup>(2)</sup> Classified by  $L_w$ . Refer to Tolerance for Length Deviation.  
<sup>(3)</sup> Applicable to cylindrical outside surface.

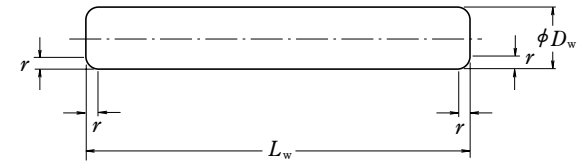
**Tolerance for Length Deviation**

Units : mm

Length		h12		h13	
		high	low	high	low
3	6	—	—	0	-0.18
6	10	—	—	0	-0.22
10	18	—	—	0	-0.27



Spherical-end Type



Flat-end Type

Units : mm

Nominal Size	$D_w$	$L_w$	$r^{(1)}$ min	Mass (kg) per 1000 pcs approx
1 × 5.8	1	5.8	0.1	0.035
1 × 6.8	1	6.8	0.1	0.042
1 × 7.8	1	7.8	0.1	0.048
1 × 9.8	1	9.8	0.1	0.060
1.5 × 5.8	1.5	5.8	0.1	0.080
1.5 × 6.8	1.5	6.8	0.1	0.093
1.5 × 7.8	1.5	7.8	0.1	0.105
1.5 × 9.8	1.5	9.8	0.1	0.135
1.5 × 11.8	1.5	11.8	0.1	0.160
1.5 × 13.8	1.5	13.8	0.1	0.190
2 × 6.8	2	6.8	0.1	0.165
2 × 7.8	2	7.8	0.1	0.190
2 × 9.8	2	9.8	0.1	0.240
2 × 11.8	2	11.8	0.1	0.290
2 × 13.8	2	13.8	0.1	0.335
2 × 15.8	2	15.8	0.1	0.385
2 × 17.8	2	17.8	0.1	0.435
2 × 19.8	2	19.8	0.1	0.485
2.5 × 7.8	2.5	7.8	0.1	0.300
2.5 × 9.8	2.5	9.8	0.1	0.375
2.5 × 11.8	2.5	11.8	0.1	0.450
2.5 × 13.8	2.5	13.8	0.1	0.525
2.5 × 15.8	2.5	15.8	0.1	0.605
2.5 × 17.8	2.5	17.8	0.1	0.680
2.5 × 19.8	2.5	19.8	0.1	0.755
2.5 × 21.8	2.5	21.8	0.1	0.835
2.5 × 23.8	2.5	23.8	0.1	0.910
3 × 9.8	3	9.8	0.1	0.540
3 × 11.8	3	11.8	0.1	0.650
3 × 13.8	3	13.8	0.1	0.760
3 × 15.8	3	15.8	0.1	0.870
3 × 17.8	3	17.8	0.1	0.980
3 × 19.8	3	19.8	0.1	1.10
3 × 21.8	3	21.8	0.1	1.20
3 × 23.8	3	23.8	0.1	1.30
3 × 25.8	3	25.8	0.1	1.40
3 × 27.8	3	27.8	0.1	1.55
3 × 29.8	3	29.8	0.1	1.65
3.5 × 11.8	3.5	11.8	0.1	0.885
3.5 × 13.8	3.5	13.8	0.1	1.05
3.5 × 15.8	3.5	15.8	0.1	1.20
3.5 × 17.8	3.5	17.8	0.1	1.35

Units : mm

Nominal Size	$D_w$	$L_w$	$r^{(1)}$ min	Mass (kg) per 1000 pcs approx
3.5 × 19.8	3.5	19.8	0.1	1.50
3.5 × 21.8	3.5	21.8	0.1	1.65
3.5 × 23.8	3.5	23.8	0.1	1.80
3.5 × 25.8	3.5	25.8	0.1	1.95
3.5 × 27.8	3.5	27.8	0.1	2.10
3.5 × 29.8	3.5	29.8	0.1	2.25
3.5 × 31.8	3.5	31.8	0.1	2.40
3.5 × 34.8	3.5	34.8	0.1	2.60
4 × 13.8	4	13.8	0.1	1.35
4 × 15.8	4	15.8	0.1	1.55
4 × 17.8	4	17.8	0.1	1.75
4 × 19.8	4	19.8	0.1	1.95
4 × 21.8	4	21.8	0.1	2.15
4 × 23.8	4	23.8	0.1	2.35
4 × 25.8	4	25.8	0.1	2.55
4 × 27.8	4	27.8	0.1	2.70
4 × 29.8	4	29.8	0.1	2.90
4 × 31.8	4	31.8	0.1	3.10
4 × 34.8	4	34.8	0.1	3.40
4 × 37.8	4	37.8	0.1	3.70
4 × 39.8	4	39.8	0.1	3.90
4.5 × 17.8	4.5	17.8	0.1	2.20
4.5 × 19.8	4.5	19.8	0.1	2.45
4.5 × 21.8	4.5	21.8	0.1	2.70
4.5 × 23.8	4.5	23.8	0.1	2.95
4.5 × 25.8	4.5	25.8	0.1	3.20
4.5 × 29.8	4.5	29.8	0.1	3.70
4.5 × 31.8	4.5	31.8	0.1	3.95
4.5 × 34.8	4.5	34.8	0.1	4.30
4.5 × 37.8	4.5	37.8	0.1	4.70
4.5 × 39.8	4.5	39.8	0.1	4.90
5 × 19.8	5	19.8	0.1	3.00
5 × 21.8	5	21.8	0.1	3.35
5 × 23.8	5	23.8	0.1	3.65
5 × 25.8	5	25.8	0.1	3.95
5 × 27.8	5	27.8	0.1	4.25
5 × 29.8	5	29.8	0.1	4.55
5 × 31.8	5	31.8	0.1	4.85
5 × 34.8	5	34.8	0.1	5.30
5 × 37.8	5	37.8	0.1	5.75
5 × 39.8	5	39.8	0.1	6.10
5 × 49.8	5	49.8	0.1	7.60

Tolerances for Needle Roller Chamfers

Units : mm

$D_w$		$r$ min	$r$ max
over	incl		
—	1	0.1	0.4
1	3	0.1	0.6
3	5	0.1	0.9

Remarks Only for flat-end needle rollers.

Accuracy of Needle Rollers

Units :  $\mu$ m

Class	Single Plane Mean Roller Diameter Variation <sup>(1)</sup> $VD_{WP}$ max	Out-of-Roundness <sup>(1)</sup> $\Delta R$ max	Roller Gauge Lot Diameter Variation <sup>(1)</sup> $VD_{WL}$ max	Length Deviation <sup>(2)</sup> $\Delta L_{Ws}$
2	1	1	2	h13
3	1.5	1.5	3	h13
5	2	2.5	5	h13

Notes <sup>(1)</sup> Applicable to roller center (length direction).

<sup>(2)</sup> Classified by  $L_w$ . Refer to Tolerance for Length Deviation in Page B349.

Remarks The actual diameter at any place along the entire length should not exceed the following figures compared to the actual maximum diameter at the roller center (length direction).

Class2: 0.5 $\mu$ m

Class3: 0.8 $\mu$ m

Class5: 1.0 $\mu$ m

Note <sup>(1)</sup> Only for flat-end rollers.

Remarks 1. The figure shows a spherical-end type and a flat-end type.

2. The radius R of the spherical-end type is bounded by the following range:

Minimum:  $D_w/2$

Maximum:  $L_w/2$