Supplementary table 1 (1) Boundary dimensions of radial bearings (except tapered roller bearings) – diameter series 7, 8, 9, 0 –

Unit : mm

Deep groove ball brg.								68										69									160	60						
Angular contact ball brg.																												70					
Self-aligning ball brg.																																	
Cylindrical roller brg.																	N 19	N 29		NNU 49							NU 10		NN 30				
Needle roller brg.										NA 48										NA 49	NA 59	NA 69											
Spherical roller brg.									238										239										230	240				

Bore dia. No.	Bore dia.	Diameter series 7					Diameter series 8									Diameter series 9										Diameter series 0									
		Outside dia.	Dimension series				Outside dia.	Dimension series								Outside dia.	Dimension series									Outside dia.	Dimension series								
			17	27	37	17~37		08	18	28	38	48	58	68	08	18~68		09	19	29	39	49	59	69	09	19~39	49~69		00	10	20	30	40	50	60	00	10~60
			Width			r min.		Width B							r min.			Width B							r min.				Width B							r min.	
	d	D			B		D									D										D									
–	0.6	2	0.8	–	–	0.05	2.5	–	1	–	1.4				0.05	–	–	–	–	–					–	–	–	–	–	–	–	–	–	–	–	–
1	1	2.5	1	–	–	0.05	3	–	1	–	1.5				0.05	4	–	1.6	–	2.3					0.1	–	–	–	–	–	–	–	–	–	–	–
–	1.5	3	1	–	1.8	0.05	4	–	1.2	–	2				0.05	5	–	2	–	2.6					0.15	–	6	–	2.5	–	3					0.15
2	2	4	1.2	–	2	0.05	5	–	1.5	–	2.3				0.08	6	–	2.3	–	3					0.15	–	7	–	2.8	–	3.5					0.15
–	2.5	5	1.5	–	2.3	0.08	6	–	1.8	–	2.6				0.08	7	–	2.5	–	3.5					0.15	–	8	–	2.8	–	4					0.15
3	3	6	2	2.5	3	0.08	7	–	2	–	3				0.1	8	–	3	–	4					0.15	–	9	–	3	–	5					0.15
4	4	7	2	2.5	3	0.08	9	–	2.5	3.5	4				0.1	11	–	4	–	5	–	–	–	–	0.15	–	12	–	4	–	6					0.2
5	5	8	2	2.5	3	0.08	11	–	3	4	5				0.15	13	–	4	–	6	10	–	–	–	0.2	0.15	14	–	5	–	7					0.2
6	6	10	2.5	3	3.5	0.1	13	–	3.5	5	6				0.15	15	–	5	–	7	10	–	–	–	0.2	0.15	17	–	6	–	9					0.3
7	7	11	2.5	3	3.5	0.1	14	–	3.5	5	6	–	–	–	0.15	17	–	5	–	7	10	–	–	–	0.3	0.15	19	–	6	8	10	–	–	–	–	0.3
8	8	12	2.5	–	3.5	0.1	16	–	4	5	6	8	–	–	0.2	19	–	6	–	9	11	–	–	–	0.3	0.2	22	–	7	9	11	14	19	25	–	0.3
9	9	14	3	–	4.5	0.1	17	–	4	5	6	8	–	–	0.2	20	–	6	–	9	11	–	–	–	0.3	0.3	24	–	7	10	12	15	20	27	–	0.3
00	10	15	3	–	4.5	0.1	19	–	5	6	7	9	–	–	0.3	22	–	6	8	10	13	16	22	–	0.3	0.3	26	–	8	10	12	16	21	29	–	0.3
01	12	18	4	–	5	0.2	21	–	5	6	7	9	–	–	0.3	24	–	6	8	10	13	16	22	–	0.3	0.3	28	7	8	10	12	16	21	29	0.3	0.3
02	15	21	4	–	5	0.2	24	–	5	6	7	9	–	–	0.3	28	–	7	8.5	10	13	18	23	–	0.3	0.3	32	8	9	11	13	17	23	30	0.3	0.3
03	17	23	4	–	5	0.2	26	–	5	6	7	9	–	–	0.3	30	–	7	8.5	10	13	18	23	–	0.3	0.3	35	8	10	12	14	18	24	32	0.3	0.3
04	20	27	4	–	5	0.2	32	4	7	8	10	12	16	22	0.3	0.3	37	7	9	11	13	17	23	30	0.3	0.3	0.3	42	8	12	14	16	22	30	40	0.3	0.6
/22	22	–	–	–	–	–	34	4	7	–	10	–	16	22	0.3	0.3	39	7	9	11	13	17	23	30	0.3	0.3	0.3	44	8	12	14	16	22	30	40	0.3	0.6
05	25	32	4	–	5	0.2	37	4	7	8	10	12	16	22	0.3	0.3	42	7	9	11	13	17	23	30	0.3	0.3	0.3	47	8	12	14	16	22	30	40	0.3	0.6
/28	28	–	–	–	–	–	40	4	7	–	10	–	16	22	0.3	0.3	45	7	9	11	13	17	23	30	0.3	0.3	0.3	52	8	12	15	18	24	32	43	0.3	0.6
06	30	37	4	–	5	0.2	42	4	7	8	10	12	16	22	0.3	0.3	47	7	9	11	13	17	23	30	0.3	0.3	0.3	55	9	13	16	19	25	34	45	0.3	1
/32	32	–	–	–	–	–	44	4	7	–	10	–	16	22	0.3	0.3	52	7	10	13	15	20	27	36	0.3	0.6	0.6	58	9	13	16	20	26	35	47	0.3	1
07	35	–	–	–	–	–	47	4	7	8	10	12	16	22	0.3	0.3	55	7	10	13	15	20	27	36	0.3	0.6	0.6	62	9	14	17	20	27	36	48	0.3	1
08	40	–	–	–	–	–	52	4	7	8	10	12	16	22	0.3	0.3	62	8	12	14	16	22	30	40	0.3	0.6	0.6	68	9	15	18	21	28	38	50	0.3	1
09	45						58	4	7	8	10	13	18	23	0.3	0.3	68	8	12	14	16	22	30	40	0.3	0.6	0.6	75	10	16	19	23	30	40	54	0.6	1
10	50						65	5	7	10	12	15	20	27	0.3	0.3	72	8	12	14	16	22	30	40	0.3	0.6	0.6	80	10	16	19	23	30	40	54	0.6	1
11	55						72	7	9	11	13	17	23	30	0.3	0.3	80	9	13	16	19	25	34	45	0.3	1	1	90	11	18	22	26	35	46	63	0.6	1.1
12	60						78	7	10	12	14	18	24	32	0.3	0.3	85	9	13	16	19	25	34	45	0.3	1	1	95	11	18	22	26	35	46	63	0.6	1.1
13	65						85	7	10	13	15	20	27	36	0.3	0.6	90	9	13	16	19	25	34	45	0.3	1	1	100	11	18	22	26	35	46	63	0.6	1.1
14	70						90	8	10	13	15	20	27	36	0.3	0.6	100	10	16	19	23	30	40	54	0.6	1	1	110	13	20	24	30	40	54	71	0.6	1.1
15	75						95	8	10	13	15	20	27	36	0.3	0.6	105	10	16	19	23	30	40	54	0.6	1	1	115	13	20	24	30	40	54	71	0.6	1.1
16	80						100	8	10	13	15	20	27	36	0.3	0.6	110	10	16	19	23	30	40	54	0.6	1	1	125	14	22	27	34	45	60	80	0.6	1.1
17	85						110	9	13	16	19	25	34	45	0.3	1	120	11	18	22	26	35	46	63	0.6	1.1	1.1	130	14	22	27	34	45	60	80	0.6	1.1
18	90						115	9	13	16	19	25	34	45	0.3	1	125	11	18	22	26	35	46	63	0.6	1.1	1.1	140	16	24	30	37	50	67	90	1	1.5
19	95						120	9	13	16	19	25	34	45	0.3	1	130	11	18	22	26	35	46	63	0.6	1.1	1.1	145	16	24	30	37	50	67	90	1	1.5
20	100						125	9	13	16	19	25	34	45	0.3	1	140	13	20	24	30	40	54	71	0.6	1.1	1.1	150	16	24	30	37	50	67	90	1	1.5
21	105						130	9	13	16	19	25	34	45	0.3	1	145	13	20	24	30	40	54	71	0.6	1.1	1.1	160	18	26	33	41	56	75	100	1	2
22	110						140	10	16	19	23	30	40	54	0.6	1	150	13	20	24	30	40	54	71	0.6	1.1	1.1	170	19	28	36	45	60	80	109	1	2
24	120						150	10	16	19	23	30	40	54	0.6	1	165	14	22	27	34	45	60	80	0.6	1.1	1.1	180	19	28	36	46	60	80	109	1	2
26	130						165	11	18	22	26	35	46	63	0.6	1.1	180	16	24	30	37	50	67	90	1	1.5	1.5	200	22	33	42	52	69	95	125	1.1	2
28	140						175	11	18	22	26	35	46	63	0.6	1.1	190	16	24	30	37	50	67	90	1	1.5	1.5	210	22	33	42	53	69	95	125	1.1	2
30	150						190	13	20	24	30	40	54	71	0.6	1.1	210	19	28	36	45	60	80	109	1	2	2	225	24	35	45	56	75	100	136	1.1	2.1
32	160						200	13	20	24	30	40	54	71	0.6	1.1	220	19	28	36	45	60	80	109	1	2	2	240	25	38	48	60	80	109	145	1.5	2.1
34	170						215	14	22	27	34	45	60	80	0.6	1.1	230	19	28	36	45	60	80	109	1	2	2	260	28	42	54	67	90	122	160	1.5	2.1
36	180						225	14	22	27	34	45	60	80	0.6	1.1	250	22	33	42	52	69	95	125	1.1	2	2	280	31	46	60	74	100	136	180	2	2.1
38	190						240	16	24	30	37	50	67	90	1	1.5	260	22	33	42	52	69	95	125	1.1	2	2	290	31	46	60	75	100	136	180	2	2.1
40	200						250	16	24	30	37	50	67	90	1	1.5	280	25	38	48	60	80	109	145	1.5	2.1	2.1	310	34	51	66	82	109	150	200	2	2.1
44	220						270	16	24	30	37	50	67	90	1	1.5	300	25	38	48	60	80	109	145	1.5	2.1	2.1	340	37	56	72	90	118	160	218	2.1	3
48	240						300	19	28	36	45	60	80	109	1	2	320	25	38	48	60	80	109	145	1.5	2.1	2.1	360	37	56	72	92	118	160	218	2.1	3
52	260						320	19	28	36	45	60	80	109	1	2	360	31	46	60	75	100	136	180	2	2.1	2.1	400	44	65	82	104	140	190	250	3	4
56	280						350	22	33	42	52	69	95	125	1.1	2	380	31	46	60	75	100	136	180	2	2.1	2.1	420	44	65	82	106	140	190	250	3	4
60	300						380	25	38	48	60	80	109	145	1.5	2.1	420	37	56	72	90	118	160	218	2.1	3	3	460	50	74	95	118	160	218	290	4	4
64	320						400	25	38	48	60	80	109	145	1.5	2.1	440	37	56	72	90	118	160	218	2.1	3	3	480	50	74	95	121	160	218	290	4	4
68	340						420	25	38	48	60	80	109	145	1.5	2.1	460	37	56	72	90	118	160	218	2.1	3	3	520	57	82	106	133	180	243	325	4	5
72	360						440	25	38	48	60	80	109	145	1.5	2.1	480	37	56	72	90	118	160	218	2.1	3	3	540	57	82	106	134	180	243	325	4	5
76	380						480	31	46	60	75	100	136	180	2	2.1	520	44	65	82	106	140	190	250	3	4	4	560	57	82	106	135	180	243	325	4	5
80	400						500	31	46	60	75	100	136	180	2	2.1	540	44	65	82	106	140	190	250	3	4	4	600	63	90	118	148	200	272	355	5	5
84	420						520	31	46	60	75	100	136	180	2	2.1	560	44	65	82	106	140	190	250	3	4	4	620	63	90	118	150	200	272	355	5	5
88	440						540	31	46	60	75	100	136	180	2	2.1	600	50	74	95	118	160	218	290	4	4	4	650	67	94	122	157	212	280	375	5	6
92	460						580	37	56	72	90	118	160	218	2.1	3	620	50	74	95	118	160	218	290	4	4	4	680	71	100	128	163	218	300	400	5	6
96	480						600	37	56	72	90	118	160	218	2.1	3	650	54	78	100	128	170	230	308	4	5	5	700	71	100	128	165	218	300	400	5	6
/500	500						620	37	56	72	90	118	160	218	2.1	3	670	54	78	100	128	170	230	308	4	5	5	720	71	100	128	167	218	300	400	5	6
/530	530						650	37	56	72	90	118	160	218	2.1	3	710	57	82	106	136	180	243	325	4	5	5	780	80	112	145	185	250	335	450	6	6
/560	560						680	37	56	72	90	118	160	218	2.1	3	750	60	85	112	140	190	258	345	5	5	5	820	82	115	150	195	258	355	462	6	6
/600	600						730	42	60	78	98	128	175	236	3	3	800	63	90	118	150	200	272	355	5	5	5	870	85	118	155	200	272	365	488	6	6
/630	630						780	48	69	88	112	150	200	272	3	4	850	71	100	128	165	218	300	400	5	6	6	920	92	128	170	212	290	388	515	6	7.5
/670	670						820	48	69	88	112	150	200	272	3	4	900	73	103	136	170	230	308	412	5	6	6	980	100	136	180	230	308	425	560	6	7.5
/710	710						870	50	74	95	118	160	218	290	4	4	950	78	106	140	180	243	325	438	5	6	6	1030	103	140	185	236	315	438	580	6	7.5
/750	750						920	54	78	100	128	170	230	308	4	5	1000	80	112	145	185	250	335	450	6	6	6	1090	109	150	195	250	335	462	615	7.5	7.5
/800	800						980	57	82	106	136	180	243	325	4	5	1060	82	115	150	195	258	355	462	6	6	6	1150	112	155	200	258	345	475	630	7.5	7.5
/850	850						1030	57	82	106	136	180	243	325	4	5	1120	85	118	155	200	272	365	488	6	6	6	1220	118	165	212	272	365	500	670	7.5	7.5
/900	900						1090	60	85	112	140	190	258	345	5	5	1180	88	122	165	206	280	375	500	6	6	6	1280	122	170	218	280	375	515	690	7.5	7.5
/950	950						1150	63	90	118	150	200	272	355	5	5	1250	95	132	175	224	300	400	545	6	7.5	7.5	1360	132	180	236	300	412	560	730	7.5	7.5
/1000	1000						1220	71	100	128	165	218	300	400	5	6	1320	103	140	185	236	315	438	580	6	7.5	7.5	1420	136	185	243	308	412	560	750	7.5	7.5
/1060	1060						1280	71	100	128	165	218	300	400	5	6	1400	109	150	195	250	335	462	615	7.5	7.5	7.5	1500	140	195	250	325	438	600	800	9.5	9.5
/1120	1120						1360	78	106	140	180	243	325	438	5	6	1460	109	150	195	250	335	462	615	7.5	7.5	7.5	1580	145	200	265	345	462	615	825	9.5	9.5
/1180	1180						1420	78	106	140	180	243	325	438	5	6	1540	115	160	206	272	355	488	650	7.5	7.5	7.5	1660	155	212	272	355	475	650	875	9.5	9.5
/1250	1250						1500	80	112	145	185	250	335	450	6	6	1630	122	170	218	280	375	515	690	7.5	7.5	7.5	1750	–	218	290	375	500	–	–	–	9.5
/1320	1320						1600	88	122	165	206	280	375	500	6	6	1720	128	175	230	300	400	545	710	7.5	7.5	7.5	1850	–	230	300	400	530	–	–	–	12
/1400	1400						1700	95	132	175	224	300	400	545	6	7.5	1820	–	185	243	315	425	–	–	–	9.5	9.5	1950	–	243	315	412	545	–	–	–	12
/1500	1500						1820	–	140	185	243	315	–	–	–	7.5	1950	–	195	258	335	450	–	–	–	9.5	9.5	2120	–	272	355	462	615	–	–	–	12
/1600	1600						1950	–	155	200	265	345	–	–	–	7.5	2060	–	200	265	345	462	–	–	–	9.5	9.5	2240	–	280	365	475	630	–	–	–	12
/1700	1700						2060	–	160	206	272	355	–	–	–	7.5	2180	–	212	280	355	475	–	–	–	9.5	9.5	2360	–	290	375	500	650	–	–	–	15
/1800	1800						2180	–	165	218	290	375	–	–	–	9.5	2300	–	218	290	375	500	–	–	–	12	12	2500	–	308	400	530	690	–	–	–	15
/1900	1900						2300	–	175	230	300	400	–	–	–	9.5	2430	–	230	308	400	530	–	–	–	12	12	–	–	–	–	–	–	–	–	–	–
/2000	2000						2430	–	190	250	325	425	–	–	–	9.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

[Remark] The chamfer dimensions (r) in this table are not always applicable to the following corners. (a) Snap ring groove side corner of outer ring with snap ring groove. (b) No-rib side bearing ring corner of thin section cylindrical roller bearing. (c) Front bearing ring corner of angular contact ball bearing. (d) Inner ring corner of tapered bore bearing.

E1

E2

Koyo

Supplementary table 1 (2) Boundary dimensions of radial bearings (except tapered roller bearings) – diameter series 1, 2, 3, 4 –

Unit : mm

Deep groove ball bearing										62		42								63		43					64		
Angular contact ball bearing										72			32 52							73			33 53				74		
Self-aligning ball bearing										12		22								13		23							
Cylindrical roller bearing				NN 31						NU 2		NU 22	NU 32							NU 3		NU 23	NU 33				NU 4		
Needle roller bearing																													
Spherical roller bearing				231	241							222	232							213		223							

Bore dia. No.	Bore dia.	Diameter series 1								Diameter series 2								Diameter series 3								Diameter series 4			
		Outside dia.	Dimension series							Outside dia.	Dimension series							Outside dia.	Dimension series							Outside dia.	Dimension series		
			01	11	21	31	41	01	11-41		82	02	12	22	32	42	82	02-42		83	03	13	23	33	83	03-33		04	24	04. 24
	d	D	Width B					r min.		D	Width B						r min.		D	Width B				r min.			D	Width B		r min.
–	0.6																													
1	1																													
–	1.5																													
2	2									–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–				
–	2.5									–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–				
3	3									10	2.5	4	–	–	5	–	0.1	0.15	13	–	5	–	–	7	–	0.2				
4	4									13	3	5	–	–	7	–	0.15	0.2	16	–	5	–	–	9	–	0.3				
5	5									16	3.5	5	–	–	8	–	0.15	0.3	19	–	6	–	–	10	–	0.3				
6	6									19	4	6	–	–	10	–	0.2	0.3	22	–	7	–	11	13	–	0.3				
7	7									22	5	7	–	–	11	–	0.3	0.3	26	–	9	–	13	15	–	0.3	–	–	–	–
8	8									24	5	8	–	–	12	–	0.3	0.3	28	–	9	–	13	15	–	0.3	30	10	14	0.6
9	9									26	6	8	–	–	13	–	0.3	0.3	30	–	10	–	14	16	–	0.6	32	11	15	0.6
00	10									30	7	9	–	14	14.3	–	0.3	0.6	35	9	11	–	17	19	0.3	0.6	37	12	16	0.6
01	12									32	7	10	–	14	15.9	–	0.3	0.6	37	9	12	–	17	19	0.3	1	42	13	19	1
02	15									35	8	11	–	14	15.9	20	0.3	0.6	42	9	13	–	17	19	0.3	1	52	15	24	1.1
03	17									40	8	12	–	16	17.5	22	0.3	0.6	47	10	14	–	19	22.2	0.6	1	62	17	29	1.1
04	20									47	9	14	–	18	20.6	27	0.3	1	52	10	15	–	21	22.2	0.6	1.1	72	19	33	1.1
/22	22									50	9	14	–	18	20.6	27	0.3	1	56	11	16	–	21	25	0.6	1.1	–	–	–	–
05	25									52	10	15	–	18	20.6	27	0.3	1	62	12	17	–	24	25.4	0.6	1.1	80	21	36	1.5
/28	28									58	10	16	–	19	23	30	0.6	1	68	13	18	–	24	30	0.6	1.1	–	–	–	–
06	30									62	10	16	–	20	23.8	32	0.6	1	72	13	19	–	27	30.2	0.6	1.1	90	23	40	1.5
/32	32									65	11	17	–	21	25	33	0.6	1	75	14	20	–	28	32	0.6	1.1	–	–	–	–
07	35									72	12	17	–	23	27	37	0.6	1.1	80	14	21	–	31	34.9	0.6	1.5	100	25	43	1.5
08	40									80	13	18	–	23	30.2	40	0.6	1.1	90	16	23	–	33	36.5	1	1.5	110	27	46	2
09	45									85	13	19	–	23	30.2	40	0.6	1.1	100	17	25	–	36	39.7	1	1.5	120	29	50	2
10	50									90	13	20	–	23	30.2	40	0.6	1.1	110	19	27	–	40	44.4	1	2	130	31	53	2.1
11	55									100	14	21	–	25	33.3	45	0.6	1.5	120	21	29	–	43	49.2	1.1	2	140	33	57	2.1
12	60									110	16	22	–	28	36.5	50	1	1.5	130	22	31	–	46	54	1.1	2.1	150	35	60	2.1
13	65									120	18	23	–	31	38.1	56	1	1.5	140	24	33	–	48	58.7	1.1	2.1	160	37	64	2.1
14	70									125	18	24	–	31	39.7	56	1	1.5	150	25	35	–	51	63.5	1.5	2.1	180	42	74	3
15	75									130	18	25	–	31	41.3	56	1	1.5	160	27	37	–	55	68.3	1.5	2.1	190	45	77	3
16	80									140	19	26	–	33	44.4	60	1	2	170	28	39	–	58	68.3	1.5	2.1	200	48	80	3
17	85									150	21	28	–	36	49.2	65	1.1	2	180	30	41	–	60	73	2	3	210	52	86	4
18	90	150	–	–	–	–	60	–	2	160	22	30	–	40	52.4	69	1.1	2	190	30	43	–	64	73	2	3	225	54	90	4
19	95	160	–	–	–	–	65	–	2	170	24	32	–	43	55.6	75	1.1	2.1	200	33	45	–	67	77.8	2	3	240	55	95	4
20	100	165	21	30	39	52	65	1.1	2	180	25	34	–	46	60.3	80	1.5	2.1	215	36	47	51	73	82.6	2.1	3	250	58	98	4
21	105	175	22	33	42	56	69	1.1	2	190	27	36	–	50	65.1	85	1.5	2.1	225	37	49	53	77	87.3	2.1	3	260	60	100	4
22	110	180	22	33	42	56	69	1.1	2	200	28	38	–	53	69.8	90	1.5	2.1	240	42	50	57	80	92.1	3	3	280	65	108	4
24	120	200	25	38	48	62	80	1.5	2	215	–	40	42	58	76	95	–	2.1	260	44	55	62	86	106	3	3	310	72	118	5
26	130	210	25	38	48	64	80	1.5	2	230	–	40	46	64	80	100	–	3	280	48	58	66	93	112	3	4	340	78	128	5
28	140	225	27	40	50	68	85	1.5	2.1	250	–	42	50	68	88	109	–	3	300	50	62	70	102	118	4	4	360	82	132	5
30	150	250	31	46	60	80	100	2	2.1	270	–	45	54	73	96	118	–	3	320	–	65	75	108	128	–	4	380	85	138	5
32	160	270	34	51	66	86	109	2	2.1	290	–	48	58	80	104	128	–	3	340	–	68	79	114	136	–	4	400	88	142	5
34	170	280	34	51	66	88	109	2	2.1	310	–	52	62	86	110	140	–	4	360	–	72	84	120	140	–	4	420	92	145	5
36	180	300	37	56	72	96	118	2.1	3	320	–	52	62	86	112	140	–	4	380	–	75	88	126	150	–	4	440	95	150	6
38	190	320	42	60	78	104	128	3	3	340	–	55	65	92	120	150	–	4	400	–	78	92	132	155	–	5	460	98	155	6
40	200	340	44	65	82	112	140	3	3	360	–	58	70	98	128	160	–	4	420	–	80	97	138	165	–	5	480	102	160	6
44	220	370	48	69	88	120	150	3	4	400	–	65	78	108	144	180	–	4	460	–	88	106	145	180	–	5	540	115	180	6
48	240	400	50	74	95	128	160	4	4	440	–	72	85	120	160	200	–	4	500	–	95	114	155	195	–	5	580	122	190	6
52	260	440	57	82	106	144	180	4	4	480	–	80	90	130	174	218	–	5	540	–	102	123	165	206	–	6	620	132	206	7.5
56	280	460	57	82	106	146	180	4	5	500	–	80	90	130	176	218	–	5	580	–	108	132	175	224	–	6	670	140	224	7.5
60	300	500	63	90	118	160	200	5	5	540	–	85	98	140	192	243	–	5	620	–	109	140	185	236	–	7.5	710	150	236	7.5
64	320	540	71	100	128	176	218	5	5	580	–	92	105	150	208	258	–	5	670	–	112	155	200	258	–	7.5	750	155	250	9.5
68	340	580	78	106	140	190	243	5	5	620	–	92	118	165	224	280	–	6	710	–	118	165	212	272	–	7.5	800	165	265	9.5
72	360	600	78	106	140	192	243	5	5	650	–	95	122	170	232	290	–	6	750	–	125	170	224	290	–	7.5	850	180	280	9.5
76	380	620	78	106	140	194	243	5	5	680	–	95	132	175	240	300	–	6	780	–	128	175	230	300	–	7.5	900	190	300	9.5
80	400	650	80	112	145	200	250	6	6	720	–	103	140	185	256	315	–	6	820	–	136	185	243	308	–	7.5	950	200	315	12
84	420	700	88	122	165	224	280	6	6	760	–	109	150	195	272	335	–	7.5	850	–	136	190	250	315	–	9.5	980	206	325	12
88	440	720	88	122	165	226	280	6	6	790	–	112	155	200	280	345	–	7.5	900	–	145	200	265	345	–	9.5	1030	212	335	12
92	460	760	95	132	175	240	300	6	7.5	830	–	118	165	212	296	365	–	7.5	950	–	155	212	280	365	–	9.5	1060	218	345	12
96	480	790	100	136	180	248	308	6	7.5	870	–	125	170	224	310	388	–	7.5	980	–	160	218	290	375	–	9.5	1120	230	365	15
/500	500	830	106	145	190	264	325	7.5	7.5	920	–	136	185	243	336	412	–	7.5	1030	–	170	230	300	388	–	12	1150	236	375	15
/530	530	870	109	150	195	272	335	7.5	7.5	980	–	145	200	258	355	450	–	9.5	1090	–	180	243	325	412	–	12	1220	250	400	15
/560	560	920	115	160	206	280	355	7.5	7.5	1030	–	150	206	272	365	475	–	9.5	1150	–	190	258	335	438	–	12	1280	258	412	15
/600	600	980	122	170	218	300	375	7.5	7.5	1090	–	155	212	280	388	488	–	9.5	1220	–	200	272	355	462	–	15	1360	272	438	15
/630	630	1030	128	175	230	315	400	7.5	7.5	1150	–	165	230	300	412	515	–	12	1280	–	206	280	375	488	–	15	1420	280	450	15
/670	670	1090	136	185	243	336	412	7.5	7.5	1220	–	175	243	315	438	545	–	12	1360	–	218	300	400	515	–	15	1500	290	475	15
/710	710	1150	140	195	250	345	438	9.5	9.5	1280	–	180	250	325	450	560	–	12	1420	–	224	308	412	530	–	15	–	–	–	–
/750	750	1220	150	206	272	365	475	9.5	9.5	1360	–	195	265	345	475	615	–	15	1500	–	236	325	438	560	–	15	–	–	–	–
/800	800	1280	155	212	272	375	475	9.5	9.5	1420	–	200	272	355	488	615	–	15	1600	–	258	355	462	600	–	15				
/850	850	1360	165	224	290	400	500	12	12	1500	–	206	280	375	515	650	–	15	1700	–	272	375	488	630	–	19				
/900	900	1420	165	230	300	412	515	12	12	1580	–	218	300	388	515	670	–	15	1780	–	280	388	500	650	–	19				
/950	950	1500	175	243	315	438	545	12	12	1660	–	230	315	412	530	710	–	15	1850	–	290	400	515	670	–	19				
/1000	1000	1580	185	258	335	462	580	12	12	1750	–	243	330	425	560	750	–	15	1950	–	300	412	545	710	–	19				
/1060	1060	1660	190	265	345	475	600	12	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–				
/1120	1120	1750	–	280	365	475	630	–	15																					
/1180	1180	1850	–	290	388	500	670	–	15																					
/1250	1250	1950	–	308	400	530	710	–	15																					
/1320	1320	2060	–	325	425	560	750	–	15																					
/1400	1400	2180	–	345	450	580	775	–	19																					
/1500	1500	2300	–	355	462	600	800	–	19																					

[Remark] The chamfer dimensions (r) in this table are not always applicable to the following corners.
(a) Snap ring groove side corner of outer ring with snap ring groove. (b) No-rib side bearing ring corner of thin section cylindrical roller bearing.
(c) Front bearing ring corner of angular contact ball bearing. (d) Inner ring corner of tapered bore bearing.

Supplementary table 2 Boundary dimensions of tapered roller bearings

Unit : mm

Tapered roller bearing		329						320				330					331						302				322			332				303 , 303D					313			323					Tapered roller bearing	
Bore dia. No.	Bore dia.	Diameter series 9						Diameter series 0									Diameter series 1						Diameter series 2											Diameter series 3													Bore dia.	Bore dia. No.
		Outside dia.	Dimension series 29			Chamfer		Outside dia.	Dimension series 20			Dimension series 30			Chamfer		Outside dia.	Dimension series 31			Chamfer		Outside dia.	Dimension series 02			Dimension series 22			Dimension series 32			Chamfer		Outside dia.	Dimension series 03					Dimension series 13			Dimension series 23			Chamfer			
						Inner ring	Outer ring								Inner ring	Outer ring					Inner ring	Outer ring									Inner ring	Outer ring										Inner ring	Outer ring				
	d	D	T	B	C	r min.		D	T	B	C	T	B	C	r min.		D	T	B	C	r min.		D	T	B	C	T	B	C	T	B	C	r min.		D	T	B	C_{303}	C_{303D}	T	B	C	T	B	C	r min.		d	
00	10																						–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–				–	–	–	–	–	10	00
01	12																						–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–				–	–	–	–	–	12	01
02	15																						(35)	11.75	11	10)	–	–	–	–	–	–	–	–	42	14.25	13	11	–				–	–	–	1	1	15	02
03	17	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–						40	13.25	12	11	17.25	16	14	–	–	–	1	1	47	15.25	14	12	–				20.25	19	16	1	1	17	03
04	20	37	12	12	9	0.3	0.3	42	15	15	12	–	–	–	0.6	0.6							47	15.25	14	12	19.25	18	15	–	–	–	1	1	52	16.25	15	13	–				22.25	21	18	1.5	1.5	20	04
/22	22	40	12	12	9	0.3	0.3	44	15	15	11.5	–	–	–	0.6	0.6							50	–	–	–	–	–	–				–	–	56	–	–	–	–				–	–	–	–	–	22	/22
05	25	42	12	12	9	0.3	0.3	47	15	15	11.5	17	17	14	0.6	0.6							52	16.25	15	13	19.25	18	16 [2]	22	22	18	1	1	62	18.25	17	15	13				25.25	24	20	1.5	1.5	25	05
/28	28	45	12	12	9	0.3	0.3	52	16	16	12	–	–	–	1	1							58	–	–	–	(20.25 | 19 | 16) [1]	24	24	19	1	1	68	–	–	–	–				–	–	–	–	–	28	/28
06	30	47	12	12	9	0.3	0.3	55	17	17	13	20	20	16	1	1							62	17.25	16	14	21.25	20	17	25	25	19.5	1	1	72	20.75	19	16	14				28.75	27	23	1.5	1.5	30	06
/32	32	52	14	15	10	0.6	0.6	58	17	17	13	–	–	–	1	1	–	–	–	–	–	–	65	18.25	17	15	(22 | 21.5 | 17) [1]	26	26	20.5	1	1	75	–	–	–	–				29.75	28	23	1.5	1.5	32	/32
07	35	55	14	14	11.5	0.6	0.6	62	18	18	14	21	21	17	1	1	–	–	–	–	–	–	72	18.25	17	15	24.25	23	19	28	28	22	1.5	1.5	80	22.75	21	18	15				32.75	31	25	2	1.5	35	07
08	40	62	15	15	12	0.6	0.6	68	19	19	14.5	22	22	18	1	1	75	26	26	20.5	1.5	1.5	80	19.75	18	16	24.75	23	19	32	32	25	1.5	1.5	90	25.25	23	20	17				35.25	33	27	2	1.5	40	08
09	45	68	15	15	12	0.6	0.6	75	20	20	15.5	24	24	19	1	1	80	26	26	20.5	1.5	1.5	85	20.75	19	16	24.75	23	19	32	32	25	1.5	1.5	100	27.25	25	22	18				38.25	36	30	2	1.5	45	09
10	50	72	15	15	12	0.6	0.6	80	20	20	15.5	24	24	19	1	1	85	26	26	20	1.5	1.5	90	21.75	20	17	24.75	23	19 [3]	32	32	24.5	1.5	1.5	110	29.25	27	23	19				42.25	40	33	2.5	2	50	10
11	55	80	17	17	14	1	1	90	23	23	17.5	27	27	21	1.5	1.5	95	30	30	23	1.5	1.5	100	22.75	21	18	26.75	25	21	35	35	27	2	1.5	120	31.5	29	25	21				45.5	43	35	2.5	2	55	11
12	60	85	17	17	14	1	1	95	23	23	17.5	27	27	21	1.5	1.5	100	30	30	23	1.5	1.5	110	23.75	22	19	29.75	28	24	38	38	29	2	1.5	130	33.5	31	26	22				48.5	46	37	3	2.5	60	12
13	65	90	17	17	14	1	1	100	23	23	17.5	27	27	21	1.5	1.5	110	34	34	26.5	1.5	1.5	120	24.75	23	20	32.75	31	27	41	41	32	2	1.5	140	36	33	28	23				51	48	39	3	2.5	65	13
14	70	100	20	20	16	1	1	110	25	25	19	31	31	25.5	1.5	1.5	120	37	37	29	2	1.5	125	26.25	24	21	33.25	31	27	41	41	32	2	1.5	150	38	35	30	25				54	51	42	3	2.5	70	14
15	75	105	20	20	16	1	1	115	25	25	19	31	31	25.5	1.5	1.5	125	37	37	29	2	1.5	130	27.25	25	22	33.25	31	27	41	41	31	2	1.5	160	40	37	31	26				58	55	45	3	2.5	75	15
16	80	110	20	20	16	1	1	125	29	29	22	36	36	29.5	1.5	1.5	130	37	37	29	2	1.5	140	28.25	26	22	35.25	33	28	46	46	35	2.5	2	170	42.5	39	33	27				61.5	58	48	3	2.5	80	16
17	85	120	23	23	18	1.5	1.5	130	29	29	22	36	36	29.5	1.5	1.5	140	41	41	32	2.5	2	150	30.5	28	24	38.5	36	30	49	49	37	2.5	2	180	44.5	41	34	28				63.5	60	49	4	3	85	17
18	90	125	23	23	18	1.5	1.5	140	32	32	24	39	39	32.5	2	1.5	150	45	45	35	2.5	2	160	32.5	30	26	42.5	40	34	55	55	42	2.5	2	190	46.5	43	36	30	–	–	–	67.5	64	53	4	3	90	18
19	95	130	23	23	18	1.5	1.5	145	32	32	24	39	39	32.5	2	1.5	160	49	49	38	2.5	2	170	34.5	32	27	45.5	43	37	58	58	44	3	2.5	200	49.5	45	38	32	–	–	–	71.5	67	55	4	3	95	19
20	100	140	25	25	20	1.5	1.5	150	32	32	24	39	39	32.5	2	1.5	165	52	52	40	2.5	2	180	37	34	29	49	46	39	63	63	48	3	2.5	215	51.5	47	39	–	56.5	51	35	77.5	73	60	4	3	100	20
21	105	145	25	25	20	1.5	1.5	160	35	35	26	43	43	34	2.5	2	175	56	56	44	2.5	2	190	39	36	30	53	50	43	68	68	52	3	2.5	225	53.5	49	41	–	58	53	36	81.5	77	63	4	3	105	21
22	110	150	25	25	20	1.5	1.5	170	38	38	29	47	47	37	2.5	2	180	56	56	43	2.5	2	200	41	38	32	56	53	46	–	–	–	3	2.5	240	54.5	50	42	–	63	57	38	84.5	80	65	4	3	110	22
24	120	165	29	29	23	1.5	1.5	180	38	38	29	48	48	38	2.5	2	200	62	62	48	2.5	2	215	43.5	40	34	61.5	58	50	–	–	–	3	2.5	260	59.5	55	46	–	68	62	42	90.5	86	69	4	3	120	24
26	130	180	32	32	25	2	1.5	200	45	45	34	55	55	43	2.5	2	–	–	–	–	–	–	230	43.75	40	34	67.75	64	54	–	–	–	4	3	280	63.75	58	49	–	72	66	44	–	–	–	5	4	130	26
28	140	190	32	32	25	2	1.5	210	45	45	34	56	56	44	2.5	2	–	–	–	–	–	–	250	45.75	42	36	71.75	68	58	–	–	–	4	3	300	67.75	62	53	–	77	70	47	–	–	–	5	4	140	28
30	150	210	38	38	30	2.5	2	225	48	48	36	59	59	46	3	2.5	–	–	–	–	–	–	270	49	45	38	77	73	60	–	–	–	4	3	320	72	65	55		82	75	50	–	–	–	5	4	150	30
32	160	220	38	38	30	2.5	2	240	51	51	38	–	–	–	3	2.5							290	52	48	40	84	80	67	–	–	–	4	3	340	75	68	58	–	–	–	–	–	–	–	5	4	160	32
34	170	230	38	38	30	2.5	2	260	57	57	43	–	–	–	3	2.5							310	57	52	43	91	86	71	–	–	–	5	4	360	80	72	62	–	–	–	–	–	–	–	5	4	170	34
36	180	250	45	45	34	2.5	2	280	64	64	48	–	–	–	3	2.5							320	57	52	43	91	86	71	–	–	–	5	4	–	–	–	–	–	–	–	–	–	–	–	–	–	180	36
38	190	260	45	45	34	2.5	2	290	64	64	48				3	2.5							340	60	55	46	97	92	75	–	–	–	5	4														190	38
40	200	280	51	51	39	3	2.5	310	70	70	53				3	2.5							360	64	58	48	104	98	82	–	–	–	5	4														200	40
44	220	300	51	51	39	3	2.5	340	76	76	57				4	3							–	–	–	–	–	–	–	–	–	–	–	–														220	44
48	240	320	51	51	39	3	2.5	360	76	76	57				4	3																																240	48
52	260	360	63.5	63.5	48	3	2.5	400	87	87	65				5	4																																260	52
56	280	380	63.5	63.5	48	3	2.5	420	87	87	65				5	4																																280	56
60	300	420	76	76	57	4	3	460	100	100	74				5	4																																300	60
64	320	440	76	76	57	4	3	480	100	100	74				5	4																																320	64
68	340	460	76	76	57	4	3	–	–	–	–				–	–																																340	68
72	360	480	76	76	57	4	3	–	–	–	–				–	–																																360	72

[Remark] In the new JIS, new dimension series (classified by contact angle) is also specified in accordance with ISO standards.

[Notes] 1) Bearing group with large contact angle
2) Outer ring width C of bearings with large contact angle is 15 mm.
3) Outer ring width C of bearings with large contact angle is 18 mm.

Supplementary table 3 Boundary dimensions of single direction thrust bearings (with flat back faces) – diameter series 0, 1, 2, 3, 4, 5 –

Unit : mm

Thrust ball brg.									511						512						513						514					
Spherical thrust roller bearings														292						293						294						

Bore dia. No.	Bore dia.	Diameter series 0					Diameter series 1							Diameter series 2							Diameter series 3							Diameter series 4							Diameter series 5			
		Outside dia.	Dimension series			Chamfer	Outside dia.	Dimension series					Chamfer	Outside dia.	Dimension series					Chamfer	Outside dia.	Dimension series				Chamfer	Outside dia.	Dimension series				Chamfer	Outside dia.	*		Chamfer
			70	90	10			71	91	11	11				72	92	12	12				73	93	13	13				74	94	14	14				95		
			Height		T	r min.		Height		T	d_1 max.	D_1 min.	r min.		Height		T	d_1 max.	D_1 min.	r min.		Height		T	d_1 max.	D_1 min.	r min.		Height		T	d_1 max.	D_1 min.	r min.				r min.
	d	D					D							D							D							D							D	T	
4	4	12	4	–	6	0.3	–	–	–	–	–	–	–	16	6	–	8	16	4	0.3	20	7	–	11	20	4	0.6										
6	6	16	5	–	7	0.3	–	–	–	–	–	–	–	20	6	–	9	20	6	0.3	24	8	–	12	24	6	0.6							* Dimension series			
8	8	18	5	–	7	0.3	–	–	–	–	–	–	–	22	6	–	9	22	8	0.3	26	8	–	12	26	8	0.6										
00	10	20	5	–	7	0.3	24	6	–	9	24	11	0.3	26	7	–	11	26	12	0.6	30	9	–	14	30	10	0.6										
01	12	22	5	–	7	0.3	26	6	–	9	26	13	0.3	28	7	–	11	28	14	0.6	32	9	–	14	32	12	0.6										
02	15	26	5	–	7	0.3	28	6	–	9	28	16	0.3	32	8	–	12	32	17	0.6	37	10	–	15	37	15	0.6										
03	17	28	5	–	7	0.3	30	6	–	9	30	18	0.3	35	8	–	12	35	19	0.6	40	10	–	16	40	19	0.6	–	–	–	–	–	–	–	52	21	1
04	20	32	6	–	8	0.3	35	7	–	10	35	21	0.3	40	9	–	14	40	22	0.6	47	12	–	18	47	22	1	–	–	–	–	–	–	–	60	24	1
05	25	37	6	–	8	0.3	42	8	–	11	42	26	0.6	47	10	–	15	47	27	0.6	52	12	–	18	52	27	1	60	16	21	24	60	27	1	73	29	1.1
06	30	42	6	–	8	0.3	47	8	–	11	47	32	0.6	52	10	–	16	52	32	0.6	60	14	–	21	60	32	1	70	18	24	28	70	32	1	85	34	1.1
07	35	47	6	–	8	0.3	52	8	–	12	52	37	0.6	62	12	–	18	62	37	1	68	15	–	24	68	37	1	80	20	27	32	80	37	1.1	100	39	1.1
08	40	52	6	–	9	0.3	60	9	–	13	60	42	0.6	68	13	–	19	68	42	1	78	17	22	26	78	42	1	90	23	30	36	90	42	1.1	110	42	1.5
09	45	60	7	–	10	0.3	65	9	–	14	65	47	0.6	73	13	–	20	73	47	1	85	18	24	28	85	47	1	100	25	34	39	100	47	1.1	120	45	2
10	50	65	7	–	10	0.3	70	9	–	14	70	52	0.6	78	13	–	22	78	52	1	95	20	27	31	95	52	1.1	110	27	36	43	110	52	1.5	135	51	2
11	55	70	7	–	10	0.3	78	10	–	16	78	57	0.6	90	16	21	25	90	57	1	105	23	30	35	105	57	1.1	120	29	39	48	120	57	1.5	150	58	2.1
12	60	75	7	–	10	0.3	85	11	–	17	85	62	1	95	16	21	26	95	62	1	110	23	30	35	110	62	1.1	130	32	42	51	130	62	1.5	160	60	2.1
13	65	80	7	–	10	0.3	90	11	–	18	90	67	1	100	16	21	27	100	67	1	115	23	30	36	115	67	1.1	140	34	45	56	140	68	2	170	63	2.1
14	70	85	7	–	10	0.3	95	11	–	18	95	72	1	105	16	21	27	105	72	1	125	25	34	40	125	72	1.1	150	36	48	60	150	73	2	180	67	3
15	75	90	7	–	10	0.3	100	11	–	19	100	77	1	110	16	21	27	110	77	1	135	27	36	44	135	77	1.5	160	38	51	65	160	78	2	190	69	3
16	80	95	7	–	10	0.3	105	11	–	19	105	82	1	115	16	21	28	115	82	1	140	27	36	44	140	82	1.5	170	41	54	68	170	83	2.1	200	73	3
17	85	100	7	–	10	0.3	110	11	–	19	110	87	1	125	18	24	31	125	88	1	150	29	39	49	150	88	1.5	180	42	58	72	177	88	2.1	215	78	4
18	90	105	7	–	10	0.3	120	14	–	22	120	92	1	135	20	27	35	135	93	1.1	155	29	39	50	155	93	1.5	190	45	60	77	187	93	2.1	225	82	4
20	100	120	9	–	14	0.6	135	16	21	25	135	102	1	150	23	30	38	150	103	1.1	170	32	42	55	170	103	1.5	210	50	67	85	205	103	3	250	90	4
22	110	130	9	–	14	0.6	145	16	21	25	145	112	1	160	23	30	38	160	113	1.1	190	36	48	63	187	113	2	230	54	73	95	225	113	3	270	95	5
24	120	140	9	–	14	0.6	155	16	21	25	155	122	1	170	23	30	39	170	123	1.1	210	41	54	70	205	123	2.1	250	58	78	102	245	123	4	300	109	5
26	130	150	9	–	14	0.6	170	18	24	30	170	132	1	190	27	36	45	187	133	1.5	225	42	58	75	220	134	2.1	270	63	85	110	265	134	4	320	115	5
28	140	160	9	–	14	0.6	180	18	24	31	178	142	1	200	27	36	46	197	143	1.5	240	45	60	80	235	144	2.1	280	63	85	112	275	144	4	340	122	5
30	150	170	9	–	14	0.6	190	18	24	31	188	152	1	215	29	39	50	212	153	1.5	250	45	60	80	245	154	2.1	300	67	90	120	295	154	4	360	125	6
32	160	180	9	–	14	0.6	200	18	24	31	198	162	1	225	29	39	51	222	163	1.5	270	50	67	87	265	164	3	320	73	95	130	315	164	5	380	132	6
34	170	190	9	–	14	0.6	215	20	27	34	213	172	1.1	240	32	42	55	237	173	1.5	280	50	67	87	275	174	3	340	78	103	135	335	174	5	400	140	6
36	180	200	9	–	14	0.6	225	20	27	34	222	183	1.1	250	32	42	56	247	183	1.5	300	54	73	95	295	184	3	360	82	109	140	355	184	5	420	145	6
38	190	215	11	–	17	1	240	23	30	37	237	193	1.1	270	36	48	62	267	194	2	320	58	78	105	315	195	4	380	85	115	150	375	195	5	440	150	6
40	200	225	11	–	17	1	250	23	30	37	247	203	1.1	280	36	48	62	277	204	2	340	63	85	110	335	205	4	400	90	122	155	395	205	5	460	155	7.5
44	220	250	14	–	22	1	270	23	30	37	267	223	1.1	300	36	48	63	297	224	2	360	63	85	112	355	225	4	420	90	122	160	415	225	6	500	170	7.5
48	240	270	14	–	22	1	300	27	36	45	297	243	1.5	340	45	60	78	335	244	2.1	380	63	85	112	375	245	4	440	90	122	160	435	245	6	540	180	7.5
52	260	290	14	–	22	1	320	27	36	45	317	263	1.5	360	45	60	79	355	264	2.1	420	73	95	130	415	265	5	480	100	132	175	475	265	6	580	190	9.5
56	280	310	14	–	22	1	350	32	42	53	347	283	1.5	380	45	60	80	375	284	2.1	440	73	95	130	435	285	5	520	109	145	190	515	285	6	620	206	9.5
60	300	340	18	24	30	1	380	36	48	62	376	304	2	420	54	73	95	415	304	3	480	82	109	140	475	305	5	540	109	145	190	535	305	6	670	224	9.5
64	320	360	18	24	30	1	400	36	48	63	396	324	2	440	54	73	95	435	325	3	500	82	109	140	495	325	5	580	118	155	205	575	325	7.5	710	236	9.5
68	340	380	18	24	30	1	420	36	48	64	416	344	2	460	54	73	96	455	345	3	540	90	122	160	535	345	5	620	125	170	220	615	345	7.5	750	243	12
72	360	400	18	24	30	1	440	36	48	65	436	364	2	500	63	85	110	495	365	4	560	90	122	160	555	365	5	640	125	170	220	635	365	7.5	780	250	12
76	380	420	18	24	30	1	460	36	48	65	456	384	2	520	63	85	112	515	385	4	600	100	132	175	595	385	6	670	132	175	224	665	385	7.5	820	265	12
80	400	440	18	24	30	1	480	36	48	65	476	404	2	540	63	85	112	535	405	4	620	100	132	175	615	405	6	710	140	185	243	705	405	7.5	850	272	12
84	420	460	18	24	30	1	500	36	48	65	495	424	2	580	73	95	130	575	425	5	650	103	140	180	645	425	6	730	140	185	243	725	425	7.5	900	290	15
88	440	480	18	24	30	1	540	45	60	80	535	444	2.1	600	73	95	130	595	445	5	680	109	145	190	675	445	6	780	155	206	265	775	445	9.5	950	308	15
92	460	500	18	24	30	1	560	45	60	80	555	464	2.1	620	73	95	130	615	465	5	710	112	150	195	705	465	6	800	155	206	265	795	465	9.5	980	315	15
96	480	520	18	24	30	1	580	45	60	80	575	484	2.1	650	78	103	135	645	485	5	730	112	150	195	725	485	6	850	165	224	290	845	485	9.5	1000	315	15
/500	500	540	18	24	30	1	600	45	60	80	595	504	2.1	670	78	103	135	665	505	5	750	112	150	195	745	505	6	870	165	224	290	865	505	9.5	1060	335	15
/530	530	580	23	30	38	1.1	640	50	67	85	635	534	3	710	82	109	140	705	535	5	800	122	160	212	795	535	7.5	920	175	236	308	915	535	9.5	1090	335	15
/560	560	610	23	30	38	1.1	670	50	67	85	665	564	3	750	85	115	150	745	565	5	850	132	175	224	845	565	7.5	980	190	250	335	975	565	12	1150	355	15
/600	600	650	23	30	38	1.1	710	50	67	85	705	604	3	800	90	122	160	795	605	5	900	136	180	236	895	605	7.5	1030	195	258	335	1025	605	12	1220	375	15
/630	630	680	23	30	38	1.1	750	54	73	95	745	634	3	850	100	132	175	845	635	6	950	145	190	250	945	635	9.5	1090	206	280	365	1085	635	12	1280	388	15
/670	670	730	27	36	45	1.5	800	58	78	105	795	674	4	900	103	140	180	895	675	6	1000	150	200	258	995	675	9.5	1150	218	290	375	1145	675	15	1320	388	15
/710	710	780	32	42	53	1.5	850	63	85	112	845	714	4	950	109	145	190	945	715	6	1060	160	212	272	1055	715	9.5	1220	230	308	400	1215	715	15	1400	412	15
/750	750	820	32	42	53	1.5	900	67	90	120	895	755	4	1000	112	150	195	995	755	6	1120	165	224	290	1115	755	9.5	1280	236	315	412	1275	755	15			
/800	800	870	32	42	53	1.5	950	67	90	120	945	805	4	1060	118	155	205	1055	805	7.5	1180	170	230	300	1175	805	9.5	1360	250	335	438	1355	805	15			
/850	850	920	32	42	53	1.5	1000	67	90	120	995	855	4	1120	122	160	212	1115	855	7.5	1250	180	243	315	1245	855	12	1440	–	354	–	–	–	15			
/900	900	980	36	48	63	2	1060	73	95	130	1055	905	5	1180	125	170	220	1175	905	7.5	1320	190	250	335	1315	905	12	1520	–	372	–	–	–	15			
/950	950	1030	36	48	63	2	1120	78	103	135	1115	955	5	1250	136	180	236	1245	955	7.5	1400	200	272	355	1395	955	12	1600	–	390	–	–	–	15			
/1000	1000	1090	41	54	70	2.1	1180	82	109	140	1175	1005	5	1320	145	190	250	1315	1005	9.5	1460	–	276	–	–	–	12	1670	–	402	–	–	–	15			
/1060	1060	1150	41	54	70	2.1	1250	85	115	150	1245	1065	5	1400	155	206	265	1395	1065	9.5								1770	–	426	–	–	–	15			
/1120	1120	1220	45	60	80	2.1	1320	90	122	160	1315	1125	5	1460	–	206	–	–	–	9.5								1860	–	444	–	–	–	15			
/1180	1180	1280	45	60	80	2.1	1400	100	132	175	1395	1185	6	1520	–	206	–	–	–	9.5								1950	–	462	–	–	–	19			
/1250	1250	1360	50	67	85	3	1460	–	–	175	1455	1255	6	1610	–	216	–	–	–	9.5																	
/1320	1320	1440	–	–	95	3	1540	–	–	175	1535	1325	6	1700	–	228	–	–	–	9.5																	
/1400	1400	1520	–	–	95	3	1630	–	–	180	1620	1410	6																								
/1500	1500	1630	–	–	105	4	1750	–	–	195	1740	1510	6																								
/1600	1600	1730	–	–	105	4	1850	–	–	195	1840	1610	6																								
/1700	1700	1840	–	–	112	4	1970	–	–	212	1960	1710	7.5																								
/1800	1800	1950	–	–	120	4	2080	–	–	220	2070	1810	7.5																								
/1900	1900	2060	–	–	130	5	2180	–	–	220	2170	1910	7.5																								
/2000	2000	2160	–	–	130	5	2300	–	–	236	2290	2010	7.5																								
/2120	2120	2300	–	–	140	5	2430	–	–	243	2420	2130	7.5																								
/2240	2240	2430	–	–	150	5	2570	–	–	258	2560	2250	9.5																								
/2360	2360	2550	–	–	150	5	2700	–	–	265	2690	2370	9.5																								
/2500	2500	2700	–	–	160	5	2850	–	–	272	2840	2510	9.5																								

Supplementary table 4 Boundary dimensios of double direction thrust ball bearings (with flat back faces)

Unit : mm

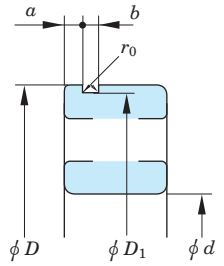
Bore dia. No.	522									523										524									Bore dia. No.
	Diameter series 2									Diameter series 3										Diameter series 4									
	Dimension series 22									Dimension series 23										Dimension series 24									
	Bore dia. d_2	Out-side dia. D	Height T_1	Central race height B	d_3 max.	D_1 min.	r min.	r_1 min.	(Refer.) d 1)	Bore dia. d_2	Out-side dia. D	Height T_1	Central race height B	d_3 max.	D_1 min.	r min.	r_1 min.	(Refer.) d 1)		Bore dia. d_2	Out-side dia. D	Height T_1	Central race height B	d_3 max.	D_1 min.	r min.	r_1 min.	(Refer.) d 1)	
02	**10**	32	22	5	32	17	0.6	0.3	15	**10**	–	–	–	–	–	–	–	–		–	–	–	–	–	–	–	–	–	**02**
04	**15**	40	26	6	40	22	0.6	0.3	20	**15**	–	–	–	–	–	–	–	–		–	–	–	–	–	–	–	–	–	**04**
05	**20**	47	28	7	47	27	0.6	0.3	25	**20**	52	34	8	52	27	1	0.3	25		**15**	60	45	11	60	27	1	0.6	25	**05**
06	**25**	52	29	7	52	32	0.6	0.3	30	**25**	60	38	9	60	32	1	0.3	30		**20**	70	52	12	70	32	1	0.6	30	**06**
07	**30**	62	34	8	62	37	1	0.3	35	**30**	68	44	10	68	37	1	0.3	35		**25**	80	59	14	80	37	1.1	0.6	35	**07**
08	**30**	68	36	9	68	42	1	0.6	40	**30**	78	49	12	78	42	1	0.6	40		**30**	90	65	15	90	42	1.1	0.6	40	**08**
09	**35**	73	37	9	73	47	1	0.6	45	**35**	85	52	12	85	47	1	0.6	45		**35**	100	72	17	100	47	1.1	0.6	45	**09**
10	**40**	78	39	9	78	52	1	0.6	50	**40**	95	58	14	95	52	1.1	0.6	50		**40**	110	78	18	110	52	1.5	0.6	50	**10**
11	**45**	90	45	10	90	57	1	0.6	55	**45**	105	64	15	105	57	1.1	0.6	55		**45**	120	87	20	120	57	1.5	0.6	55	**11**
12	**50**	95	46	10	95	62	1	0.6	60	**50**	110	64	15	110	62	1.1	0.6	60		**50**	130	93	21	130	62	1.5	0.6	60	**12**
13	**55**	100	47	10	100	67	1	0.6	65	**55**	115	65	15	115	67	1.1	0.6	65		**50**	140	101	23	140	68	2	1	65	**13**
14	**55**	105	47	10	105	72	1	1	70	**55**	125	72	16	125	72	1.1	1	70		**55**	150	107	24	150	73	2	1	70	**14**
15	**60**	110	47	10	110	77	1	1	75	**60**	135	79	18	135	77	1.5	1	75		**60**	160	115	26	160	78	2	1	75	**15**
16	**65**	115	48	10	115	82	1	1	80	**65**	140	79	18	140	82	1.5	1	80		**65**	170	120	27	170	83	2.1	1	80	**16**
17	**70**	125	55	12	125	88	1	1	85	**70**	150	87	19	150	88	1.5	1	85		**65**	180	128	29	179.5	88	2.1	1.1	85	**17**
18	**75**	135	62	14	135	93	1.1	1	90	**75**	155	88	19	155	93	1.5	1	90		**70**	190	135	30	189.5	93	2.1	1.1	90	**18**
20	**85**	150	67	15	150	103	1.1	1	100	**85**	170	97	21	170	103	1.5	1	100		**80**	210	150	33	209.5	103	3	1.1	100	**20**
22	**95**	160	67	15	160	113	1.1	1	110	**95**	190	110	24	189.5	113	2	1	110		**90**	230	166	37	229	113	3	1.1	110	**22**
24	**100**	170	68	15	170	123	1.1	1.1	120	**100**	210	123	27	209.5	123	2.1	1.1	120		**95**	250	177	40	249	123	4	1.5	120	**24**
26	**110**	190	80	18	189.5	133	1.5	1.1	130	**110**	225	130	30	224	134	2.1	1.1	130		**100**	270	192	42	269	134	4	2	130	**26**
28	**120**	200	81	18	199.5	143	1.5	1.1	140	**120**	240	140	31	239	144	2.1	1.1	140		**110**	280	196	44	279	144	4	2	140	**28**
30	**130**	215	89	20	214.5	153	1.5	1.1	150	**130**	250	140	31	249	154	2.1	1.1	150		**120**	300	209	46	299	154	4	2	150	**30**
32	**140**	225	90	20	224.5	163	1.5	1.1	160	**140**	270	153	33	269	164	3	1.1	160		**130**	320	226	50	319	164	5	2	160	**32**
34	**150**	240	97	21	239.5	173	1.5	1.1	170	**150**	280	153	33	279	174	3	1.1	170		**135**	340	236	50	339	174	5	2.1	170	**34**
36	**150**	250	98	21	249	183	1.5	2	180	**150**	300	165	37	299	184	3	2	180		**140**	360	245	52	359	184	5	3	180	**36**
38	**160**	270	109	24	269	194	2	2	190	**160**	320	183	40	319	195	4	2	190		–	–	–	–	–	–	–	–	–	**38**
40	**170**	280	109	24	279	204	2	2	200	**170**	340	192	42	339	205	4	2	200		–	–	–	–	–	–	–	–	–	**40**
44	**190**	300	110	24	299	224	2	2	220	–	–	–	–	–	–	–	–	–		–	–	–	–	–	–	–	–	–	**44**

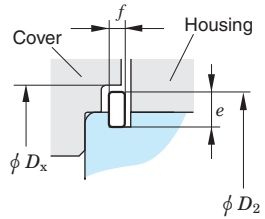
[Note] 1) Nominal bore diameter of single direction bearings of the same diameter series and with the same nominal outside diameter.

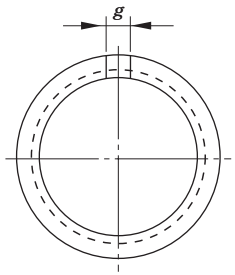
Supplementary table 5 (1) Dimension of snap ring grooves and locationg snap rings – diameter series 18, 19 –

Unit : mm

Applicable bearing			Snap ring groove									Locating snap ring						Housing
Bore dia. d		Outside dia. D	Snap ring groove dia. D_1		Position of snap ring groove a				Snap ring groove width b		Fillet radius of snap ring groove r_0	No.	Section height e		Thickness f		Mounted state		Shoulder bore dia. D_x
Dimension series					Dimension series 18		Dimension series 19										Distance between cut ends g	Locating snap ring O.D. D_2	
18	19		max.	min.	max.	min.	max.	min.	max.	min.	max.		max.	min.	max.	min.	max.	max.	max.
–	10	22	20.8	20.5	–	–	1.05	0.9	1.05	0.8	0.2	NR 1022	2.0	1.85	0.7	0.6	2	24.8	25.5
–	12	24	22.8	22.5	–	–	1.05	0.9	1.05	0.8	0.2	NR 1024	2.0	1.85	0.7	0.6	2	26.8	27.5
–	15	28	26.7	26.4	–	–	1.3	1.15	1.2	0.95	0.25	NR 1028	2.05	1.9	0.85	0.75	3	30.8	31.5
–	17	30	28.7	28.4	–	–	1.3	1.15	1.2	0.95	0.25	NR 1030	2.05	1.9	0.85	0.75	3	32.8	33.5
20	–	32	30.7	30.4	1.3	1.15	–	–	1.2	0.95	0.25	NR 1032	2.05	1.9	0.85	0.75	3	34.8	35.5
22	–	34	32.7	32.4	1.3	1.15	–	–	1.2	0.95	0.25	NR 1034	2.05	1.9	0.85	0.75	3	36.8	37.5
25	20	37	35.7	35.4	1.3	1.15	1.7	1.55	1.2	0.95	0.25	NR 1037	2.05	1.9	0.85	0.75	3	39.8	40.5
–	22	39	37.7	37.4	–	–	1.7	1.55	1.2	0.95	0.25	NR 1039	2.05	1.9	0.85	0.75	3	41.8	42.5
28	–	40	38.7	38.4	1.3	1.15	–	–	1.2	0.95	0.25	NR 1040	2.05	1.9	0.85	0.75	3	42.8	43.5
30	25	42	40.7	40.4	1.3	1.15	1.7	1.55	1.2	0.95	0.25	NR 1042	2.05	1.9	0.85	0.75	3	44.8	45.5
32	–	44	42.7	42.4	1.3	1.15	–	–	1.2	0.95	0.25	NR 1044	2.05	1.9	0.85	0.75	4	46.8	47.5
–	28	45	43.7	43.4	–	–	1.7	1.55	1.2	0.95	0.25	NR 1045	2.05	1.9	0.85	0.75	4	47.8	48.5
35	30	47	45.7	45.4	1.3	1.15	1.7	1.55	1.2	0.95	0.25	NR 1047	2.05	1.9	0.85	0.75	4	49.8	50.5
40	32	52	50.7	50.4	1.3	1.15	1.7	1.55	1.2	0.95	0.25	NR 1052	2.05	1.9	0.85	0.75	4	54.8	55.5
–	35	55	53.7	53.4	–	–	1.7	1.55	1.2	0.95	0.25	NR 1055	2.05	1.9	0.85	0.75	4	57.8	58.5
45	–	58	56.7	56.4	1.3	1.15	–	–	1.2	0.95	0.25	NR 1058	2.05	1.9	0.85	0.75	4	60.8	61.5
–	40	62	60.7	60.3	–	–	1.7	1.55	1.2	0.95	0.25	NR 1062	2.05	1.9	0.85	0.75	4	64.8	65.5
50	–	65	63.7	63.3	1.3	1.15	–	–	1.2	0.95	0.25	NR 1065	2.05	1.9	0.85	0.75	4	67.8	68.5
–	45	68	66.7	66.3	–	–	1.7	1.55	1.2	0.95	0.25	NR 1068	2.05	1.9	0.85	0.75	5	70.8	72
55	50	72	70.7	70.3	1.7	1.55	1.7	1.55	1.2	0.95	0.25	NR 1072	2.05	1.9	0.85	0.75	5	74.8	76
60	–	78	76.2	75.8	1.7	1.55	–	–	1.6	1.3	0.4	NR 1078	3.25	3.1	1.12	1.02	5	82.7	84
–	55	80	77.9	77.5	–	–	2.1	1.9	1.6	1.3	0.4	NR 1080	3.25	3.1	1.12	1.02	5	84.4	86
65	60	85	82.9	82.5	1.7	1.55	2.1	1.9	1.6	1.3	0.4	NR 1085	3.25	3.1	1.12	1.02	5	89.4	91
70	65	90	87.9	87.5	1.7	1.55	2.1	1.9	1.6	1.3	0.4	NR 1090	3.25	3.1	1.12	1.02	5	94.4	96
75	–	95	92.9	92.5	1.7	1.55	–	–	1.6	1.3	0.4	NR 1095	3.25	3.1	1.12	1.02	5	99.4	101
80	70	100	97.9	97.5	1.7	1.55	2.5	2.3	1.6	1.3	0.4	NR 1100	3.25	3.1	1.12	1.02	5	104.4	106
–	75	105	102.6	102.1	–	–	2.5	2.3	1.6	1.3	0.4	NR 1105	4.04	3.89	1.12	1.02	5	110.7	112
85	80	110	107.6	107.1	2.1	1.9	2.5	2.3	1.6	1.3	0.4	NR 1110	4.04	3.89	1.12	1.02	5	115.7	117
90	–	115	112.6	112.1	2.1	1.9	–	–	1.6	1.3	0.4	NR 1115	4.04	3.89	1.12	1.02	5	120.7	122
95	85	120	117.6	117.1	2.1	1.9	3.3	3.1	1.6	1.3	0.4	NR 1120	4.04	3.89	1.12	1.02	7	125.7	127
100	90	125	122.6	122.1	2.1	1.9	3.3	3.1	1.6	1.3	0.4	NR 1125	4.04	3.89	1.12	1.02	7	130.7	132
105	95	130	127.6	127.1	2.1	1.9	3.3	3.1	1.6	1.3	0.4	NR 1130	4.04	3.89	1.12	1.02	7	135.7	137
110	100	140	137.6	137.1	2.5	2.3	3.3	3.1	2.2	1.9	0.6	NR 1140	4.04	3.89	1.7	1.6	7	145.7	147
–	105	145	142.6	142.1	–	–	3.3	3.1	2.2	1.9	0.6	NR 1145	4.04	3.89	1.7	1.6	7	150.7	152
120	110	150	147.6	147.1	2.5	2.3	3.3	3.1	2.2	1.9	0.6	NR 1150	4.04	3.89	1.7	1.6	7	155.7	157
130	120	165	161.8	161.3	3.3	3.1	3.7	3.5	2.2	1.9	0.6	NR 1165	4.85	4.7	1.7	1.6	7	171.5	173
140	–	175	171.8	171.3	3.3	3.1	–	–	2.2	1.9	0.6	NR 1175	4.85	4.7	1.7	1.6	10	181.5	183
–	130	180	176.8	176.3	–	–	3.7	3.5	2.2	1.9	0.6	NR 1180	4.85	4.7	1.7	1.6	10	186.5	188
150	140	190	186.8	186.3	3.3	3.1	3.7	3.5	2.2	1.9	0.6	NR 1190	4.85	4.7	1.7	1.6	10	196.5	198
160	–	200	196.8	196.3	3.3	3.1	–	–	2.2	1.9	0.6	NR 1200	4.85	4.7	1.7	1.6	10	206.5	208





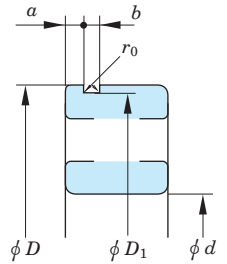


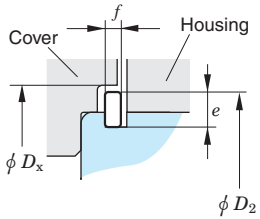
[Remark] Minimum chamfer dimension tolerances on snap ring groove-side outer ring are as follows :
Bearings belonging to dimension series 18 : 0.3 mm for those with nominal outside diameter not more than 78 mm ; 0.5 mm for those with nominal diameter over 78 mm.
Bearings belonging to dimension series 19 : 0.3 mm for those with nominal outside diameter not more than 47 mm ; 0.5 mm for those with nominal diameter over 47 mm.

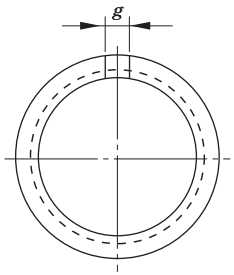
Supplementary table 5 (2) Dimension of snap ring grooves and locationg snap rings – diameter series 0, 2, 3, 4 –

Unit : mm

Applicable bearing					Snap ring groove								Locating snap ring						Housing
Bore dia. d				Outside dia. D	Snap ring groove dia. D_1		Position of snap ring groove a				Snap ring groove width b		Fillet radius of snap ring groove r_0	No.	Section height e		Thickness f		Mounted state		Shoulder bore dia. D_x
							Diameter series												Distance between cut ends g	Locating snap ring O.D. D_2	
							0		2, 3, 4												
Diameter series																					
0	2	3	4		max.	min.	max.	min.	max.	min.	max.	min.	max.		max.	min.	max.	min.	max.	max.	max.
–	10	9	8	30	28.17	27.91	–	–	2.06	1.9	1.65	1.35	0.4	NR 30	3.25	3.1	1.12	1.02	3	34.7	35.5
15	12	–	9	32	30.15	29.9	2.06	1.9	2.06	1.9	1.65	1.35	0.4	NR 32	3.25	3.1	1.12	1.02	3	36.7	37.5
17	15	10	–	35	33.17	32.92	2.06	1.9	2.06	1.9	1.65	1.35	0.4	NR 35	3.25	3.1	1.12	1.02	3	39.7	40.5
–	–	12	10	37	34.77	34.52	–	–	2.06	1.9	1.65	1.35	0.4	NR 37	3.25	3.1	1.12	1.02	3	41.3	42
–	17	–	–	40	38.1	37.85	–	–	2.06	1.9	1.65	1.35	0.4	NR 40	3.25	3.1	1.12	1.02	3	44.6	45.5
20	–	15	12	42	39.75	39.5	2.06	1.9	2.06	1.9	1.65	1.35	0.4	NR 42	3.25	3.1	1.12	1.02	3	46.3	47
22	–	–	–	44	41.75	41.5	2.06	1.9	–	–	1.65	1.35	0.4	NR 44	3.25	3.1	1.12	1.02	3	48.3	49
25	20	17	–	47	44.6	44.35	2.06	1.9	2.46	2.31	1.65	1.35	0.4	NR 47	4.04	3.89	1.12	1.02	4	52.7	53.5
–	22	–	–	50	47.6	47.35	–	–	2.46	2.31	1.65	1.35	0.4	NR 50	4.04	3.89	1.12	1.02	4	55.7	56.5
28	25	20	15	52	49.73	49.48	2.06	1.9	2.46	2.31	1.65	1.35	0.4	NR 52	4.04	3.89	1.12	1.02	4	57.9	58.5
30	–	–	–	55	52.6	52.35	2.08	1.88	–	–	1.65	1.35	0.4	NR 55	4.04	3.89	1.12	1.02	4	60.7	61.5
–	–	22	–	56	53.6	53.35	–	–	2.46	2.31	1.65	1.35	0.4	NR 56	4.04	3.89	1.12	1.02	4	61.7	62.5
32	28	–	–	58	55.6	55.35	2.08	1.88	2.46	2.31	1.65	1.35	0.4	NR 58	4.04	3.89	1.12	1.02	4	63.7	64.5
35	30	25	17	62	59.61	59.11	2.08	1.88	3.28	3.07	2.2	1.9	0.6	NR 62	4.04	3.89	1.7	1.6	4	67.7	68.5
–	32	–	–	65	62.6	62.1	–	–	3.28	3.07	2.2	1.9	0.6	NR 65	4.04	3.89	1.7	1.6	4	70.7	71.5
40	–	28	–	68	64.82	64.31	2.49	2.29	3.28	3.07	2.2	1.9	0.6	NR 68	4.85	4.7	1.7	1.6	5	74.6	76
–	35	30	20	72	68.81	68.3	–	–	3.28	3.07	2.2	1.9	0.6	NR 72	4.85	4.7	1.7	1.6	5	78.6	80
45	–	32	–	75	71.83	71.32	2.49	2.29	3.28	3.07	2.2	1.9	0.6	NR 75	4.85	4.7	1.7	1.6	5	81.6	83
50	40	35	25	80	76.81	76.3	2.49	2.29	3.28	3.07	2.2	1.9	0.6	NR 80	4.85	4.7	1.7	1.6	5	86.6	88
–	45	–	–	85	81.81	81.31	–	–	3.28	3.07	2.2	1.9	0.6	NR 85	4.85	4.7	1.7	1.6	5	91.6	93
55	50	40	30	90	86.79	86.28	2.87	2.67	3.28	3.07	3	2.7	0.6	NR 90	4.85	4.7	2.46	2.36	5	96.5	98
60	–	–	–	95	91.82	91.31	2.87	2.67	–	–	3	2.7	0.6	NR 95	4.85	4.7	2.46	2.36	5	101.6	103
65	55	45	35	100	96.8	96.29	2.87	2.67	3.28	3.07	3	2.7	0.6	NR100	4.85	4.7	2.46	2.36	5	106.5	108
70	60	50	40	110	106.81	106.3	2.87	2.67	3.28	3.07	3	2.7	0.6	NR110	4.85	4.7	2.46	2.36	5	116.6	118
75	–	–	–	115	111.81	111.3	2.87	2.67	–	–	3	2.7	0.6	NR115	4.85	4.7	2.46	2.36	5	121.6	123
–	65	55	45	120	115.21	114.71	–	–	4.06	3.86	3.4	3.1	0.6	NR120	7.21	7.06	2.82	2.72	7	129.7	131.5
80	70	–	–	125	120.22	119.71	2.87	2.67	4.06	3.86	3.4	3.1	0.6	NR125	7.21	7.06	2.82	2.72	7	134.7	136.5
85	75	60	50	130	125.22	124.71	2.87	2.67	4.06	3.86	3.4	3.1	0.6	NR130	7.21	7.06	2.82	2.72	7	139.7	141.5
90	80	65	55	140	135.23	134.72	3.71	3.45	4.9	4.65	3.4	3.1	0.6	NR140	7.21	7.06	2.82	2.72	7	149.7	152
95	–	–	–	145	140.23	139.73	3.71	3.45	–	–	3.4	3.1	0.6	NR145	7.21	7.06	2.82	2.72	7	154.7	157
100	85	70	60	150	145.24	144.73	3.71	3.45	4.9	4.65	3.4	3.1	0.6	NR150	7.21	7.06	2.82	2.72	7	159.7	162
105	90	75	65	160	155.22	154.71	3.71	3.45	4.9	4.65	3.4	3.1	0.6	NR160	7.21	7.06	2.82	2.72	7	169.7	172
110	95	80	–	170	163.65	163.14	3.71	3.45	5.69	5.44	3.8	3.5	0.6	NR170	9.6	9.45	3.1	3	10	182.9	185
120	100	85	70	180	173.66	173.15	3.71	3.45	5.69	5.44	3.8	3.5	0.6	NR180	9.6	9.45	3.1	3	10	192.9	195
–	105	90	75	190	183.64	183.13	–	–	5.69	5.44	3.8	3.5	0.6	NR190	9.6	9.45	3.1	3	10	202.9	205
130	110	95	80	200	193.65	193.14	5.69	5.44	5.69	5.44	3.8	3.5	0.6	NR200	9.6	9.45	3.1	3	10	212.9	215







[Remark] 1. Snap ring groove dimension does not apply to bearings of dimension series 00, 82 and 83.
2. The minimum permissible chamfer dimension for snap ring groove-side outer ring is 0.5 mm, except 0.3 mm for bearings belonging to diameter series 0 with nominal outside diameter not more than 35 mm.

Supplementary table 6 Shaft tolerances (deviation from nominal dimensions)

Unit : μm

Nominal shaft dia. (mm) over	up to	Deviation classes of shaft dia. d 6	e 6	f 6	g 5	g 6	h 5	h 6	h 7	h 8	h 9	h 10	js 5	js 6	js 7	j 5	j 6	k 5	k 6	k 7	m 5	m 6	m 7	n 5	n 6	p 6	r 6	r 7	Nominal shaft dia. (mm) over	up to	Δ_{dmp} [1] of bearing (class 0)
3	6	− 30 − 38	− 20 − 28	− 10 − 18	− 4 − 9	− 4 −12	− 0 − 5	− 0 − 8	0 −12	0 − 18	0 − 30	0 − 48	± 2.5	± 4	± 6	+ 3 − 2	+ 6 − 2	+ 6 + 1	+ 9 + 1	+13 + 1	+ 9 + 4	+12 + 4	+ 16 + 4	+13 + 8	+ 16 + 8	+ 20 + 12	+ 23 + 15	+ 27 + 15	3	6	0 − 8
6	10	− 40 − 49	− 25 − 34	− 13 − 22	− 5 −11	− 5 −14	− 0 − 6	− 0 − 9	0 −15	0 − 22	0 − 36	0 − 58	± 3	± 4.5	± 7.5	+ 4 − 2	+ 7 − 2	+ 7 + 1	+10 + 1	+16 + 1	+12 + 6	+15 + 6	+ 21 + 6	+16 +10	+ 19 + 10	+ 24 + 15	+ 28 + 19	+ 34 + 19	6	10	0 − 8
10	18	− 50 − 61	− 32 − 43	− 16 − 27	− 6 −14	− 6 −17	− 0 − 8	0 −11	0 −18	0 − 27	0 − 43	0 − 70	± 4	± 5.5	± 9	+ 5 − 3	+ 8 − 3	+ 9 + 1	+12 + 1	+19 + 1	+15 + 7	+18 + 7	+ 25 + 7	+20 +12	+ 23 + 12	+ 29 + 18	+ 34 + 23	+ 41 + 23	10	18	0 − 8
18	30	− 65 − 78	− 40 − 53	− 20 − 33	− 7 −16	− 7 −20	− 0 − 9	0 −13	0 −21	0 − 33	0 − 52	0 − 84	± 4.5	± 6.5	±10.5	+ 5 − 4	+ 9 − 4	+11 + 2	+15 + 2	+23 + 2	+17 + 8	+21 + 8	+ 29 + 8	+24 +15	+ 28 + 15	+ 35 + 22	+ 41 + 28	+ 49 + 28	18	30	0 − 10
30	50	− 80 − 96	− 50 − 66	− 25 − 41	− 9 −20	− 9 −25	0 −11	0 −16	0 −25	0 − 39	0 − 62	0 −100	± 5.5	± 8	±12.5	+ 6 − 5	+11 − 5	+13 + 2	+18 + 2	+27 + 2	+20 + 9	+25 + 9	+ 34 + 9	+28 +17	+ 33 + 17	+ 42 + 26	+ 50 + 34	+ 59 + 34	30	50	0 − 12
50	80	−100 −119	− 60 − 79	− 30 − 49	−10 −23	−10 −29	0 −13	0 −19	0 −30	0 − 46	0 − 74	0 −120	± 6.5	± 9.5	±15	+ 6 − 7	+12 − 7	+15 + 2	+21 + 2	+32 + 2	+24 +11	+30 +11	+ 41 + 11	+33 +20	+ 39 + 20	+ 51 + 32	+ 60 + 41	+ 71 + 41	50	65	0 − 15
																											+ 62 + 43	+ 73 + 43	65	80	
80	120	−120 −142	− 72 − 94	− 36 − 58	−12 −27	−12 −34	0 −15	0 −22	0 −35	0 − 54	0 − 87	0 −140	± 7.5	±11	±17.5	+ 6 − 9	+13 − 9	+18 + 3	+25 + 3	+38 + 3	+28 +13	+35 +13	+ 48 + 13	+38 +23	+ 45 + 23	+ 59 + 37	+ 73 + 51	+ 86 + 51	80	100	0 − 20
																											+ 76 + 54	+ 89 + 54	100	120	
120	180	−145 −170	− 85 −110	− 43 − 68	−14 −32	−14 −39	0 −18	0 −25	0 −40	0 − 63	0 −100	0 −160	± 9	±12.5	±20	+ 7 −11	+14 −11	+21 + 3	+28 + 3	+43 + 3	+33 +15	+40 +15	+ 55 + 15	+45 +27	+ 52 + 27	+ 68 + 43	+ 88 + 63	+103 + 63	120	140	0 − 25
																											+ 90 + 65	+105 + 65	140	160	
																											+ 93 + 68	+108 + 68	160	180	
180	250	−170 −199	−100 −129	− 50 − 79	−15 −35	−15 −44	0 −20	0 −29	0 −46	0 − 72	0 −115	0 −185	±10	±14.5	±23	+ 7 −13	+16 −13	+24 + 4	+33 + 4	+50 + 4	+37 +17	+46 +17	+ 63 + 17	+51 +31	+ 60 + 31	+ 79 + 50	+106 + 77	+123 + 77	180	200	0 − 30
																											+109 + 80	+126 + 80	200	225	
																											+113 + 84	+130 + 84	225	250	
250	315	−190 −222	−110 −142	− 56 − 88	−17 −40	−17 −49	0 −23	0 −32	0 −52	0 − 81	0 −130	0 −210	±11.5	±16	±26	+ 7 −16	±16	+27 + 4	+36 + 4	+56 + 4	+43 +20	+52 +20	+ 72 + 20	+57 +34	+ 66 + 34	+ 88 + 56	+126 + 94	+146 + 94	250	280	0 − 35
																											+130 + 98	+150 + 98	280	315	
315	400	−210 −246	−125 −161	− 62 − 98	−18 −43	−18 −54	0 −25	0 −36	0 −57	0 − 89	0 −140	0 −230	±12.5	±18	±28.5	+ 7 −18	±18	+29 + 4	+40 + 4	+61 + 4	+46 +21	+57 +21	+ 78 + 21	+62 +37	+ 73 + 37	+ 98 + 62	+144 +108	+165 +108	315	355	0 − 40
																											+150 +114	+171 +114	355	400	
400	500	−230 −270	−135 −175	− 68 −108	−20 −47	−20 −60	0 −27	0 −40	0 −63	0 − 97	0 −155	0 −250	±13.5	±20	±31.5	+ 7 −20	±20	+32 + 5	+45 + 5	+68 + 5	+50 +23	+63 +23	+ 86 + 23	+67 +40	+ 80 + 40	+108 + 68	+166 +126	+189 +126	400	450	0 − 45
																											+172 +132	+195 +132	450	500	
500	630	−260 −304	−145 −189	− 76 −120	−22 −54	−22 −66	0 −32	0 −44	0 −70	0 −110	0 −175	0 −280	±16	±22	±35	–	–	+32 0	+44 0	+70 0	+58 +26	+70 +26	+ 96 + 26	+76 +44	+ 88 + 44	+122 + 78	+194 +150	+220 +150	500	560	0 − 50
																											+199 +155	+225 +155	560	630	
630	800	−290 −340	−160 −210	− 80 −130	−24 −60	−24 −74	0 −36	0 −50	0 −80	0 −125	0 −200	0 −320	±18	±25	±40	–	–	+36 0	+50 0	+80 0	+66 +30	+80 +30	+110 + 30	+86 +50	+100 + 50	+138 + 88	+225 +175	+255 +175	630	710	0 − 75
																											+235 +185	+265 +185	710	800	
800	1000	−320 −376	−170 −226	− 86 −142	−26 −66	−26 −82	0 −40	0 −56	0 −90	0 −140	0 −230	0 −360	±20	±28	±45	–	–	+40 0	+56 0	+90 0	+74 +34	+90 +34	+124 + 34	+96 +56	+112 + 56	+156 +100	+266 +210	+300 +210	800	900	0 −100
																											+276 +220	+310 +220	900	1000	

[Note] 1) Δ_{dmp} : single plane mean bore diameter deviation

Supplementary table 7 Housing bore tolerances (deviation from nominal dimensions)

Unit : μm

Nominal Bore dia. (mm) over	up to	Deviation classes of housing bore E 6	F 6	F 7	G 6	G 7	H 6	H 7	H 8	H 9	H 10	JS 5	JS 6	JS 7	J 6	J 7	K 5	K 6	K 7	M 5	M 6	M 7	N 5	N 6	N 7	P 6	P 7	R 7	Nominal Bore dia. (mm) over	up to	(Refer.) Δ_{Dmp}[1] of bearing (class 0)
10	18	+ 43 + 32	+ 27 + 16	+ 34 + 16	+17 + 6	+ 24 + 6	+11 0	+ 18 0	+ 27 0	+ 43 0	+ 70 0	± 4	± 5.5	± 9	+ 6 − 5	+10 − 8	+ 2 − 6	+ 2 − 9	+ 6 − 12	− 4 −12	− 4 − 15	0 − 18	− 9 − 17	− 9 − 20	− 5 − 23	− 15 − 26	− 11 − 29	− 16 − 34	10	18	0 − 8
18	30	+ 53 + 40	+ 33 + 20	+ 41 + 20	+20 + 7	+ 28 + 7	+13 0	+ 21 0	+ 33 0	+ 52 0	+ 84 0	± 4.5	± 6.5	±10.5	+ 8 − 5	+12 − 9	+ 1 − 8	+ 2 −11	+ 6 − 15	− 5 −14	− 4 − 17	0 − 21	− 12 − 21	− 11 − 24	− 7 − 28	− 18 − 31	− 14 − 35	− 20 − 41	18	30	0 − 9
30	50	+ 66 + 50	+ 41 + 25	+ 50 + 25	+25 + 9	+ 34 + 9	+16 0	+ 25 0	+ 39 0	+ 62 0	+100 0	± 5.5	± 8	±12.5	+10 − 6	+14 −11	+ 2 − 9	+ 3 −13	+ 7 − 18	− 5 −16	− 4 − 20	0 − 25	− 13 − 24	− 12 − 28	− 8 − 33	− 21 − 37	− 17 − 42	− 25 − 50	30	50	0 − 11
50	80	+ 79 + 60	+ 49 + 30	+ 60 + 30	+29 +10	+ 40 + 10	+19 0	+ 30 0	+ 46 0	+ 74 0	+120 0	± 6.5	± 9.5	±15	+13 − 6	+18 −12	+ 3 −10	+ 4 −15	+ 9 − 21	− 6 −19	− 5 − 24	0 − 30	− 15 − 28	− 14 − 33	− 9 − 39	− 26 − 45	− 21 − 51	− 30 − 60	50	65	0 − 13
																												− 32 − 62	65	80	
80	120	+ 94 + 72	+ 58 + 36	+ 71 + 36	+34 +12	+ 47 + 12	+22 0	+ 35 0	+ 54 0	+ 87 0	+140 0	± 7.5	±11	±17.5	+16 − 6	+22 −13	+ 2 −13	+ 4 −18	+ 10 − 25	− 8 −23	− 6 − 28	0 − 35	− 18 − 33	− 16 − 38	− 10 − 45	− 30 − 52	− 24 − 59	− 38 − 73	80	100	0 − 15
																												− 41 − 76	100	120	
120	180	+110 + 85	+ 68 + 43	+ 83 + 43	+39 +14	+ 54 + 14	+25 0	+ 40 0	+ 63 0	+100 0	+160 0	± 9	±12.5	±20	+18 − 7	+26 −14	+ 3 −15	+ 4 −21	+ 12 − 28	− 9 −27	− 8 − 33	0 − 40	− 21 − 39	− 20 − 45	− 12 − 52	− 36 − 61	− 28 − 68	− 48 − 88	120	140	(up to 150) 0 − 18 (over to 150) 0 − 25
																												− 50 − 90	140	160	
																												− 53 − 93	160	180	
180	250	+129 +100	+ 79 + 50	+ 96 + 50	+44 +15	+ 61 + 15	+29 0	+ 46 0	+ 72 0	+115 0	+185 0	±10	±14.5	±23	+22 − 7	+30 −16	+ 2 −18	+ 5 −24	+ 13 − 33	−11 −31	− 8 − 37	0 − 46	− 25 − 45	− 22 − 51	− 14 − 60	− 41 − 70	− 33 − 79	− 60 −106	180	200	0 − 30
																												− 63 −109	200	225	
																												− 67 −113	225	250	
250	315	+142 +110	+ 88 + 56	+108 + 56	+49 +17	+ 69 + 17	+32 0	+ 52 0	+ 81 0	+130 0	+210 0	±11.5	±16	±26	+25 − 7	+36 −16	+ 3 −20	+ 5 −27	+ 16 − 36	−13 −36	− 9 − 41	0 − 52	− 27 − 50	− 25 − 57	− 14 − 66	− 47 − 79	− 36 − 88	− 74 −126	250	280	0 − 35
																												− 78 −130	280	315	
315	400	+161 +125	+ 98 + 62	+119 + 62	+54 +18	+ 75 + 18	+36 0	+ 57 0	+ 89 0	+140 0	+230 0	±12.5	±18	±28.5	+29 − 7	+39 −18	+ 3 −22	+ 7 −29	+ 17 − 40	−14 −39	− 10 − 46	0 − 57	− 30 − 55	− 26 − 62	− 16 − 73	− 51 − 87	− 41 − 98	− 87 −144	315	355	0 − 40
																												− 93 −150	355	400	
400	500	+175 +135	+108 + 68	+131 + 68	+60 +20	+ 83 + 20	+40 0	+ 63 0	+ 97 0	+155 0	+250 0	±13.5	±20	±31.5	+33 − 7	+43 −20	+ 2 −25	+ 8 −32	+ 18 − 45	−16 −43	− 10 − 50	0 − 63	− 33 − 60	− 27 − 67	− 17 − 80	− 55 − 95	− 45 −108	−103 −166	400	450	0 − 45
																												−109 −172	450	500	
500	630	+189 +145	+120 + 76	+146 + 76	+66 +22	+ 92 + 22	+44 0	+ 70 0	+110 0	+175 0	+280 0	±16	±22	±35	–	–	0 −32	0 −44	0 − 70	−26 −58	− 26 − 70	− 26 − 96	− 44 − 76	− 44 − 88	− 44 −114	− 78 −122	− 78 −148	−150 −220	500	560	0 − 50
																												−155 −225	560	630	
630	800	+210 +160	+130 + 80	+160 + 80	+74 +24	+104 + 24	+50 0	+ 80 0	+125 0	+200 0	+320 0	±18	±25	±40	–	–	0 −36	0 −50	0 − 80	−30 −66	− 30 − 80	− 30 −110	− 50 − 86	− 50 −100	− 50 −130	− 88 −138	− 88 −168	−175 −255	630	710	0 − 75
																												−185 −265	710	800	
800	1000	+226 +170	+142 + 86	+176 + 86	+82 +26	+116 + 26	+56 0	+ 90 0	+140 0	+230 0	+360 0	±20	±28	±45	–	–	0 −40	0 −56	0 − 90	−34 −74	− 34 − 90	− 34 −124	− 56 − 96	− 56 −112	− 56 −146	−100 −156	−100 −190	−210 −300	800	900	0 −100
																												−220 −310	900	1000	
1000	1250	+261 +195	+164 + 98	+203 + 98	+94 +28	+133 + 28	+66 0	+105 0	+165 0	+260 0	+420 0	±23.5	±33	±52.5	–	–	0 −47	0 −66	0 −105	−40 −87	− 40 −106	− 40 −145	− 66 −113	− 66 −132	− 66 −171	−120 −186	−120 −225	−250 −355	1000	1120	0 −125
																												−260 −365	1120	1250	

[Note] 1) Δ_{Dmp} : single plane mean outside diameter deviation

Supplementary table 8 Numerical values for standard tolerance grades IT (ISO 286-1 : 1988)

Basic size (mm)		Standard tolerance grades (IT)																	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14[1]	15[1]	16[1]	17[1]	18[1]
over	up to	Tolerances (μm)											Tolerances (mm)						
–	3	0.8	1.2	2	3	4	6	10	14	25	40	60	0.10	0.14	0.26	0.40	0.60	1.00	1.40
3	6	1	1.5	2.5	4	5	8	12	18	30	48	75	0.12	0.18	0.30	0.48	0.75	1.20	1.80
6	10	1	1.5	2.5	4	6	9	15	22	36	58	90	0.15	0.22	0.36	0.58	0.90	1.50	2.20
10	18	1.2	2	3	5	8	11	18	27	43	70	110	0.18	0.27	0.43	0.70	1.10	1.80	2.70
18	30	1.5	2.5	4	6	9	13	21	33	52	84	130	0.21	0.33	0.52	0.84	1.30	2.10	3.30
30	50	1.5	2.5	4	7	11	16	25	39	62	100	160	0.25	0.39	0.62	1.00	1.60	2.50	3.90
50	80	2	3	5	8	13	19	30	46	74	120	190	0.30	0.46	0.74	1.20	1.90	3.00	4.60
80	120	2.5	4	6	10	15	22	35	54	87	140	220	0.35	0.54	0.87	1.40	2.20	3.50	5.40
120	180	3.5	5	8	12	18	25	40	63	100	160	250	0.40	0.63	1.00	1.60	2.50	4.00	6.30
180	250	4.5	7	10	14	20	29	46	72	115	185	290	0.46	0.72	1.15	1.85	2.90	4.60	7.20
250	315	6	8	12	16	23	32	52	81	130	210	320	0.52	0.81	1.30	2.10	3.20	5.20	8.10
315	400	7	9	13	18	25	36	57	89	140	230	360	0.57	0.89	1.40	2.30	3.60	5.70	8.90
400	500	8	10	15	20	27	40	63	97	155	250	400	0.63	0.97	1.55	2.50	4.00	6.30	9.70
500	630	–	–	–	–	–	44	70	110	175	280	440	0.70	1.10	1.75	2.80	4.40	7.00	11.00
630	800	–	–	–	–	–	50	80	125	200	320	500	0.80	1.25	2.00	3.20	5.00	8.00	12.50
800	1000	–	–	–	–	–	56	90	140	230	360	560	0.90	1.40	2.30	3.60	5.60	9.00	14.00
1000	1250	–	–	–	–	–	66	105	165	260	420	660	1.05	1.65	2.60	4.20	6.60	10.50	16.50
1250	1600	–	–	–	–	–	78	125	195	310	500	780	1.25	1.95	3.10	5.00	7.80	12.50	19.50
1600	2000	–	–	–	–	–	92	150	230	370	600	920	1.50	2.30	3.70	6.00	9.20	15.00	23.00
2000	2500	–	–	–	–	–	110	175	280	440	700	1100	1.75	2.80	4.40	7.00	11.00	17.50	28.00
2500	3150	–	–	–	–	–	135	210	330	540	860	1350	2.10	3.30	5.40	8.60	13.50	21.00	33.00

[Note] 1) Standard tolerance grades IT 14 to IT 18 (incl.) shall not be used for basic sizes less than or equal to 1 mm.

Supplementary table 9 Greek alphabet list

Name	Roman type	Italic type		Name	Roman type	Italic type	
	Capital	Capital	Lowercase		Capital	Capital	Lowercase
alpha	A	*A*	α	nu	N	*N*	ν
beta	B	*B*	β	xi	Ξ	*Ξ*	ξ
gamma	Γ	*Γ*	γ	omicron	O	*O*	*o*
delta	Δ	*Δ*	δ	pi	Π	*Π*	π
epsilon	E	*E*	ε	rho	P	*P*	ρ
zeta	Z	*Z*	ζ	sigma	Σ	*Σ*	σ
eta	H	*H*	η	tau	T	*T*	τ
theta	Θ	*Θ*	θ	upsilon	Y	*Y*	υ
iota	I	*I*	ι	phi	Φ	*Φ*	ϕ
kappa	K	*K*	κ	chi	X	*X*	χ
lambda	Λ	*Λ*	λ	psi	Ψ	*Ψ*	ψ
mu	M	*M*	μ	omega	Ω	*Ω*	ω

Supplementary table 10 Prefixes used with SI units

Factor	Prefix		Factor	Prefix	
	Name	Symbol		Name	Symbol
10^{18}	exa	E	10^{-1}	deci	d
10^{15}	peta	P	10^{-2}	centi	c
10^{12}	tera	T	10^{-3}	milli	m
10^{9}	giga	G	10^{-6}	micro	μ
10^{6}	mega	M	10^{-9}	nano	n
10^{3}	kilo	k	10^{-12}	pico	p
10^{2}	hecto	h	10^{-15}	femto	f
10	deka	da	10^{-18}	atto	a

Supplementary table 11 (1) SI units and conversion factors

Mass	SI units	Other units [1]	Conversion into SI units	Conversion from SI units
Angle	rad [radian(s)]	° [degree(s)] * ′ [minute(s)] * ″ [second(s)] *	1° = π /180 rad 1′ = π /10 800 rad 1″ = π /648 000 rad	1 rad = 57.295 78°
Length	m [meter(s)]	Å [Angstrom unit] μ [micron(s)] in [inch(es)] ft [foot(feet)] yd [yard(s)] mile [mile(s)]	1Å = 10^{-10}m = 0.1nm = 100pm 1μ = 1 μm 1in = 25.4 mm 1ft = 12 in = 0.304 8 m 1yd = 3 ft = 0.914 4 m 1mile = 5 280 ft = 1 609.344 m	1m = 10^{10}Å 1m = 39.37 in 1m = 3.280 8 ft 1m = 1.093 6 yd 1km = 0.621 4 mile
Area	m^2	a [are(s)] ha [hectare(s)] acre [acre(s)]	1a = 100 m^2 1ha = 10^4 m^2 1acre = 4 840 yd^2 = 4 046.86 m^2	 1km^2 = 247.1 acre
Volume	m^3	ℓ , L [liter(s)] * cc [cubic centimeters] gal(US) [gallon(s)] floz(US) [fluid ounce(s)] barrel(US) [barrels(US)]	1 ℓ = 1 dm^3 = 10^{-3} m^3 1cc = 1 cm^3 = 10^{-6} m^3 1gal(US)= 231 in^3 = 3.785 41dm^3 1floz(US)= 29.573 5 cm^3 1barrel(US)= 158.987 dm^3	1m^3 = 10^3 ℓ 1m^3 = 10^6 cc 1m^3 = 264.17 gal 1m^3 = 33 814 floz 1m^3 = 6.289 8 barrel
Time	s [second(s)]	min [minute(s)] * h [hour(s)] * d [day(s)] *		
Angular velocity	rad / s			
Velocity	m / s	kn [knot(s)] m / h *	1kn = 1 852 m / h	1km / h = 0.539 96 kn
Acceleration	m / s^2	G	1G = 9.806 65 m/s^2	1m/s^2 = 0.101 97 G
Frequency	Hz [hertz]	c / s [cycle(s)/second]	1c / s = 1s^{-1} = 1 Hz	
Rotational frequency	s^{-1}	rpm [revolutions per minute] min^{-1} * r / min	1rpm = 1 / 60 s^{-1}	1s^{-1} = 60 rpm
Mass	kg [kilogram(s)]	t [ton(s)] * lb [pound(s)] gr [grain(s)] oz [ounce(s)] ton (UK) [ton(s)(UK)] ton (US) [ton(s)(US)] car [carat(s)]	1t = 10^3 kg 1lb = 0.453 592 37 kg 1gr = 64.798 91 mg 1oz = 1/16 lb = 28.349 5 g 1ton(UK) = 1 016.05 kg 1ton(US) = 907.185 kg 1car = 200 mg	 1kg = 2.204 6 lb 1g = 15.432 4 gr 1kg = 35.274 0 oz 1t = 0.984 2 ton(UK) 1t = 1.102 3 ton(US) 1g = 5 car

[Note] * : Unit can be used as an SI unit.
No asterisk : Unit cannot be used.

Supplementary table 11 (2) SI units and conversion factors

Mass	SI units	Other units [1]	Conversion into SI units	Conversion from SI units
Density	kg / m^3			
Linear density	kg / m			
Momentum	kg·m / s			
Moment of momentum, angular momentum	kg·m^2 / s			
Moment of inertia	kg·m^2			
Force	N [newton(s)]	dyn [dyne(s)] kgf [kilogram-force] gf [gram-force] tf [ton-force] lbf [pound-force]	1dyn = 10^{-5} N 1kgf = 9.806 65 N 1gf = 9.806 65×10^{-3} N 1tf = 9.806 65×10^3 N 1lbf = 4.448 22 N	1N = 10^5 dyn 1N = 0.101 97 kgf 1N = 0.224 809 lbf
Moment of force	N·m [Newton meter(s)]	gf·cm kgf·cm kgf·m tf·m lbf·ft	1gf·cm = 9.806 65×10^{-5} N·m 1kgf·cm = 9.806 65×10^{-2} N·m 1kgf·m = 9.806 65 N·m 1tf·m = 9.806 65×10^3 N·m 1lbf·ft = 1.355 82 N·m	 1N·m = 0.101 97 kgf·m 1N·m = 0.737 56 lbf·ft
Pressure, Normal stress	Pa [Pascal(s)] or N / m^2 {1 Pa = 1 N / m^2}	gf / cm^2 kgf / mm^2 kgf / m^2 lbf / in^2 bar [bar(s)] at [engineering air pressure] mH_2O, mAq [meter water column] atm [atmosphere] mHg [meter merury column] Torr [torr]	1gf/cm^2 = 9.806 65×10 Pa 1kgf/mm^2 = 9.806 65×10^6 Pa 1kgf/m^2 = 9.806 65 Pa 1lbf/in^2 = 6 894.76 Pa 1bar = 10^5 Pa 1at = 1kgf/cm^2 = 9.806 65×10^4 Pa 1mH_2O = 9.806 65×10^3 Pa 1atm = 101 325 Pa 1mHg = $\frac{101\,325}{0.76}$ Pa 1Torr = 1 mmHg = 133.322 Pa	 1MPa = 0.101 97 kgf / mm^2 1Pa = 0.101 97 kgf / m^2 1Pa = 0.145×10^{-3} lbf / in^2 1Pa = 10^{-2} mbar 1Pa = 7.500 6×10^{-3} Torr
Viscosity	Pa·s [pascal second]	P [poise] kgf·s / m^2	10^{-2} P = 1 cP = 1 mPa·s 1kgf·s / m^2 = 9.806 65 Pa·s	1Pa·s = 0.101 97 kgf·s / m^2
Kinematic viscosity	m^2 / s	St [stokes]	10^{-2} St = 1 cSt = 1 mm^2 / s	
Surface tension	N / m			

Supplementary table 11 (3) SI units and conversion factors

Mass	SI units	Other units [1]	Conversion into SI units	Conversion from SI units
Work, energy	J [joule(s)] {1 J=1 N·m}	eV [electron volt(s)] *	1eV = (1.602 189 2± 0.000 004 6)×10^{-19} J	
		erg [erg(s)]	1 erg = 10^{-7} J	1 J = 10^{7} erg
		kgf·m	1 kgf·m = 9.806 65 J	1 J = 0.101 97 kgf·m
		lbf·ft	1 lbf·ft = 1.355 82 J	1 J = 0.737 56 lbf·ft
Power	W [watt(s)]	erg / s [ergs per second]	1 erg / s = 10^{-7} W	
		kgf·m / s	1 kgf·m / s = 9.806 65 W	1 W = 0.101 97 kgf·m / s
		PS [French horse-power]	1 PS = 75 kgf·m / s = 735.5 W	1 W = 0.001 36 PS
		HP [horse-power (British)]	1 HP = 550 lbf·ft / s = 745.7 W	1 W = 0.001 34 HP
		lbf·ft / s	1 lbf·ft / s = 1.355 82 W	
Thermo-dynamic temperature	K [kelvin(s)]			
Celsius temperature	℃ [Celsius(s)] {t℃ = (t+273.15)K}	℉ [degree(s) Fahrenheit]	t ℉ = $\frac{5}{9}$ (t–32)℃	t ℃ = ($\frac{9}{5}$t+32)℉
Linear expansion coefficient	K^{-1}	$℃^{-1}$ [per degree]		
Heat	J [joule(s)] {1 J=1 N·m}	erg [erg(s)]	1 erg = 10^{-7} J	1 J = 10^{7} erg
		kgf·m		
		cal_{IT} [I. T. calories]	1 cal_{IT} = 4.186 8 J	1 J = 0.238 85 cal_{IT}
			1 $Mcal_{IT}$ = 1.163 kW·h	1 kW·h = 0.86 × 10^{6} cal_{IT}
Thermal conductivity	W/(m·K)	W/(m·℃)	1 W/(m·℃) = 1 W/(m·K)	
		cal/(s·m·℃)	1 cal/(s·m·℃) = 4.186 05 W/(m·K)	
Coefficient of heat transfer	W/(m^2·K)	W/(m^2·℃)	1 W/(m^2·℃) = 1 W/(m^2·K)	
		cal/(s·m^2·℃)	1 cal/(s·m^2·℃) = 4.186 05 W/(m^2·K)	
Heat capacity	J/K	J/℃	1 J/℃ = 1 J/K	
Massic heat capacity	J/(kg·K)	J/(kg·℃)		

[Note] * : Unit can be used as an SI unit.
No asterisk : Unit cannot be used.

Supplementary table 11 (4) SI units and conversion factors

Mass	SI units	Other units [1]	Conversion into SI units	Conversion from SI units
Electric current	A [ampere(s)]			
Electric charge, quantity of electricity	C [coulomb(s)] {1 C = 1 A·s}	A·h *	1 A·h = 3.6 kC	
Tension, electric potential	V [volt(s)] {1 V = 1 W/A}			
Capacitance	F [farad(s)] {1 F = 1 C/V}			
Magnetic field strength	A/m	Oe [oersted(s)]	1 Oe = $\frac{10^3}{4\pi}$ A/m	1 A/m = 4 π × 10^{-3} Oe
Magnetic flux density	T [tesla(s)] {1T=1N/(A·m) =1Wb/m^2 =1V·s/m^2}	Gs [gauss(es)]	1 Gs = 10^{-4} T	1 T = 10^{4} Gs
		γ [gamma(s)]	1 γ = 10^{-9} T	1 T = 10^{9} γ
Magnetic flux	Wb [weber(s)] {1 Wb = 1 V·s}	Mx [maxwell(s)]	1 Mx = 10^{-8} Wb	1 Wb = 10^{8} Mx
Self inductance	H [henry(-ries)] {1 H = 1 Wb/A}			
Resistance (to direct current)	Ω [ohm(s)] {1 Ω = 1 V/A}			
Conductance (to direct current)	S [siemens] {1 S = 1 A/V}			
Active power	W {1 W=1 J/s =1 A·V}			

Supplementary table 12 Inch/millimeter conversion

Inch		Inches										
		0	1	2	3	4	5	6	7	8	9	10
		mm										
0	0	**0**	**25.4000**	**50.8000**	**76.2000**	**101.6000**	**127.0000**	**152.4000**	**177.8000**	**203.2000**	**228.6000**	**254.0000**
1/64	0.015625	0.3969	25.7969	51.1969	76.5969	101.9969	127.3969	152.7969	178.1969	203.5969	228.9969	254.3969
1/32	0.03125	0.7938	26.1938	51.5938	76.9938	102.3938	127.7938	153.1938	178.5938	203.9938	229.3938	254.7938
3/64	0.046875	1.1906	26.5906	51.9906	77.3906	102.7906	128.1906	153.5906	178.9906	204.3906	229.7906	255.1906
1/16	0.0625	1.5875	26.9875	52.3875	77.7875	103.1875	128.5875	153.9875	179.3875	204.7875	230.1875	255.5875
5/64	0.078125	1.9844	27.3844	52.7844	78.1844	103.5844	128.9844	154.3844	179.7844	205.1844	230.5844	255.9844
3/32	0.09375	2.3812	27.7812	53.1812	78.5812	103.9812	129.3812	154.7812	180.1812	205.5812	230.9812	256.3812
7/64	0.109375	2.7781	28.1781	53.5781	78.9781	104.3781	129.7781	155.1781	180.5781	205.9781	231.3781	256.7781
1/8	0.125	**3.1750**	**28.5750**	**53.9750**	**79.3750**	**104.7750**	**130.1750**	**155.5750**	**180.9750**	**206.3750**	**231.7750**	**257.1750**
9/64	0.140625	3.5719	28.9719	54.3719	79.7719	105.1719	130.5719	155.9719	181.3719	206.7719	232.1719	257.5719
5/32	0.15625	3.9688	29.3688	54.7688	80.1688	105.5688	130.9688	156.3688	181.7688	207.1688	232.5688	257.9688
11/64	0.171875	4.3656	29.7656	55.1656	80.5656	105.9656	131.3656	156.7656	182.1656	207.5656	232.9656	258.3656
3/16	0.1875	4.7625	30.1625	55.5625	80.9625	106.3625	131.7625	157.1625	182.5625	207.9625	233.3625	258.7625
13/64	0.203125	5.1594	30.5594	55.9594	81.3594	106.7594	132.1594	157.5594	182.9594	208.3594	233.7594	259.1594
7/32	0.21875	5.5562	30.9562	56.3562	81.7562	107.1562	132.5562	157.9562	183.3562	208.7562	234.1562	259.5562
15/64	0.234375	5.9531	31.3531	56.7531	82.1531	107.5531	132.9531	158.3531	183.7531	209.1531	234.5531	259.9531
1/4	0.25	**6.3500**	**31.7500**	**57.1500**	**82.5500**	**107.9500**	**133.3500**	**158.7500**	**184.1500**	**209.5500**	**234.9500**	**260.3500**
17/64	0.265625	6.7469	32.1469	57.5469	82.9469	108.3469	133.7469	159.1469	184.5469	209.9469	235.3469	260.7469
9/32	0.28125	7.1438	32.5438	57.9438	83.3438	108.7438	134.1438	159.5438	184.9438	210.3438	235.7438	261.1438
19/64	0.296875	7.5406	32.9406	58.3406	83.7406	109.1406	134.5406	159.9406	185.3406	210.7406	236.1406	261.5406
5/16	0.3125	7.9375	33.3375	58.7375	84.1375	109.5375	134.9375	160.3375	185.7375	211.1375	236.5375	261.9375
21/64	0.328125	8.3344	33.7344	59.1344	84.5344	109.9344	135.3344	160.7344	186.1344	211.5344	236.9344	262.3344
11/32	0.34375	8.7312	34.1312	59.5312	84.9312	110.3312	135.7312	161.1312	186.5312	211.9312	237.3312	262.7312
23/64	0.359375	9.1281	34.5281	59.9281	85.3281	110.7281	136.1281	161.5281	186.9281	212.3281	237.7281	263.1281
3/8	0.375	**9.5250**	**34.9250**	**60.3250**	**85.7250**	**111.1250**	**136.5250**	**161.9250**	**187.3250**	**212.7250**	**238.1250**	**263.5250**
25/64	0.390625	9.9219	35.3219	60.7219	86.1219	111.5219	136.9219	162.3219	187.7219	213.1219	238.5219	263.9219
13/32	0.40625	10.3188	35.7188	61.1188	86.5188	111.9188	137.3188	162.7188	188.1188	213.5188	238.9188	264.3188
27/64	0.421875	10.7156	36.1156	61.5156	86.9156	112.3156	137.7156	163.1156	188.5156	213.9156	239.3156	264.7156
7/16	0.4375	11.1125	36.5125	61.9125	87.3125	112.7125	138.1125	163.5125	188.9125	214.3125	239.7125	265.1125
29/64	0.453125	11.5094	36.9094	62.3094	87.7094	113.1094	138.5094	163.9094	189.3094	214.7094	240.1094	265.5094
15/32	0.46875	11.9062	37.3062	62.7062	88.1062	113.5062	138.9062	164.3062	189.7062	215.1062	240.5062	265.9062
31/64	0.484375	12.3031	37.7031	63.1031	88.5031	113.9031	139.3031	164.7031	190.1031	215.5031	240.9031	266.3031
1/2	0.5	**12.7000**	**38.1000**	**63.5000**	**88.9000**	**114.3000**	**139.7000**	**165.1000**	**190.5000**	**215.9000**	**241.3000**	**266.7000**
33/64	0.515625	13.0969	38.4969	63.8969	89.2969	114.6969	140.0969	165.4969	190.8969	216.2969	241.6969	267.0969
17/32	0.53125	13.4938	38.8938	64.2938	89.6938	115.0938	140.4938	165.8938	191.2938	216.6938	242.0938	267.4938
35/64	0.546875	13.8906	39.2906	64.6906	90.0906	115.4906	140.8906	166.2906	191.6906	217.0906	242.4906	267.8906
9/16	0.5625	14.2875	39.6875	65.0875	90.4875	115.8875	141.2875	166.6875	192.0875	217.4875	242.8875	268.2875
37/64	0.578125	14.6844	40.0844	65.4844	90.8844	116.2844	141.6844	167.0844	192.4844	217.8844	243.2844	268.6844
19/32	0.59375	15.0812	40.4812	65.8812	91.2812	116.6812	142.0812	167.4812	192.8812	218.2812	243.6812	269.0812
39/64	0.609375	15.4781	40.8781	66.2781	91.6781	117.0781	142.4781	167.8781	193.2781	218.6781	244.0781	269.4781
5/8	0.625	**15.8750**	**41.2750**	**66.6750**	**92.0750**	**117.4750**	**142.8750**	**168.2750**	**193.6750**	**219.0750**	**244.4750**	**269.8750**
41/64	0.640625	16.2719	41.6719	67.0719	92.4719	117.8719	143.2719	168.6719	194.0719	219.4719	244.8719	270.2719
21/32	0.65625	16.6688	42.0688	67.4688	92.8688	118.2688	143.6688	169.0688	194.4688	219.8688	245.2688	270.6688
43/64	0.671875	17.0656	42.4656	67.8656	93.2656	118.6656	144.0656	169.4656	194.8656	220.2656	245.6656	271.0656
11/16	0.6875	17.4625	42.8625	68.2625	93.6625	119.0625	144.4625	169.8625	195.2625	220.6625	246.0625	271.4625
45/64	0.703125	17.8594	43.2594	68.6594	94.0594	119.4594	144.8594	170.2594	195.6594	221.0594	246.4594	271.8594
23/32	0.71875	18.2562	43.6562	69.0562	94.4562	119.8562	145.2562	170.6562	196.0562	221.4562	246.8562	272.2562
47/64	0.734375	18.6531	44.0531	69.4531	94.8531	120.2531	145.6531	171.0531	196.4531	221.8531	247.2531	272.6531
3/4	0.75	**19.0500**	**44.4500**	**69.8500**	**95.2500**	**120.6500**	**146.0500**	**171.4500**	**196.8500**	**222.2500**	**247.6500**	**273.0500**
49/64	0.765625	19.4469	44.8469	70.2469	95.6469	121.0469	146.4469	171.8469	197.2469	222.6469	248.0469	273.4469
25/32	0.78125	19.8438	45.2438	70.6438	96.0438	121.4438	146.8438	172.2438	197.6438	223.0438	248.4438	273.8438
51/64	0.796875	20.2406	45.6406	71.0406	96.4406	121.8406	147.2406	172.6406	198.0406	223.4406	248.8406	274.2406
13/16	0.8125	20.6375	46.0375	71.4375	96.8375	122.2375	147.6375	173.0375	198.4375	223.8375	249.2375	274.6375
53/64	0.828125	21.0344	46.4344	71.8344	97.2344	122.6344	148.0344	173.4344	198.8344	224.2344	249.6344	275.0344
27/32	0.84375	21.4312	46.8312	72.2312	97.6312	123.0312	148.4312	173.8312	199.2312	224.6312	250.0312	275.4312
55/64	0.859375	21.8281	47.2281	72.6281	98.0281	123.4281	148.8281	174.2281	199.6281	225.0281	250.4281	275.8281
7/8	0.875	**22.2250**	**47.6250**	**73.0250**	**98.4250**	**123.8250**	**149.2250**	**174.6250**	**200.0250**	**225.4250**	**250.8250**	**276.2250**
57/64	0.890625	22.6219	48.0219	73.4219	98.8219	124.2219	149.6219	175.0219	200.4219	225.8219	251.2219	276.6219
29/32	0.90625	23.0188	48.4188	73.8188	99.2188	124.6188	150.0188	175.4188	200.8188	226.2188	251.6188	277.0188
59/64	0.921875	23.4156	48.8156	74.2156	99.6156	125.0156	150.4156	175.8156	201.2156	226.6156	252.0156	277.4156
15/16	0.9375	23.8125	49.2125	74.6125	100.0125	125.4125	150.8125	176.2125	201.6125	227.0125	252.4125	277.8125
61/64	0.953125	24.2094	49.6094	75.0094	100.4094	125.8094	151.2094	176.6094	202.0094	227.4094	252.8094	278.2094
31/32	0.96875	24.6062	50.0062	75.4062	100.8062	126.2062	151.6062	177.0062	202.4062	227.8062	253.2062	278.6062
63/64	0.984375	25.0031	50.4031	75.8031	101.2031	126.6031	152.0031	177.4031	202.8031	228.2031	253.6031	279.0031

Supplementary table 13 Steel hardness conversion

Rockwell	Vicker's	Brinell		Rockwell		Shore
C-scale 1 471.0 N		Standard ball	Tungsten carbide ball	A-scale 588.4 N	B-scale 980.7 N	
68	940			85.6		97
67	900			85.0		95
66	865			84.5		92
65	832		739	83.9		91
64	800		722	83.4		88
63	772		705	82.8		87
62	746		688	82.3		85
61	720		670	81.8		83
60	697		654	81.2		81
59	674		634	80.7		80
58	653		615	80.1		78
57	633		595	79.6		76
56	613		577	79.0		75
55	595	–	560	78.5		74
54	577	–	543	78.0		72
53	560	–	525	77.4		71
52	544	500	512	76.8		69
51	528	487	496	76.3		68
50	513	475	481	75.9		67
49	498	464	469	75.2		66
48	484	451	455	74.7		64
47	471	442	443	74.1		63
46	458	432	432	73.6		62
45	446	421		73.1		60
44	434	409		72.5		58
43	423	400		72.0		57
42	412	390		71.5		56
41	402	381		70.9		55
40	392	371		70.4	–	54
39	382	362		69.9	–	52
38	372	353		69.4	–	51
37	363	344		68.9	–	50
36	354	336		68.4	(109.0)	49
35	345	327		67.9	(108.5)	48
34	336	319		67.4	(108.0)	47
33	327	311		66.8	(107.5)	46
32	318	301		66.3	(107.0)	44
31	310	294		65.8	(106.0)	43
30	302	286		65.3	(105.5)	42
29	294	279		64.7	(104.5)	41
28	286	271		64.3	(104.0)	41
27	279	264		63.8	(103.0)	40
26	272	258		63.3	(102.5)	38
25	266	253		62.8	(101.5)	38
24	260	247		62.4	(101.0)	37
23	254	243		62.0	100.0	36
22	248	237		61.5	99.0	35
21	243	231		61.0	98.5	35
20	238	226		60.5	97.8	34
(18)	230	219		–	96.7	33
(16)	222	212		–	95.5	32
(14)	213	203		–	93.9	31
(12)	204	194		–	92.3	29
(10)	196	187			90.7	28
(8)	188	179			89.5	27
(6)	180	171			87.1	26
(4)	173	165			85.5	25
(2)	166	158			83.5	24
(0)	160	152			81.7	24

Supplementary table 14 Surface roughness comparison

Arithmetical mean deviation of the profile R_a	Maximum height of the profile R_{max}	Ten-point height of irregularities R_z	Roughness grade numbers N
0.013 a	0.05 S	0.05 Z	–
0.025 a	0.1 S	0.1 Z	N 1
0.05 a	0.2 S	0.2 Z	N 2
0.10 a	0.4 S	0.4 Z	N 3
0.20 a	0.8 S	0.8 Z	N 4
0.40 a	1.6 S	1.6 Z	N 5
0.80 a	3.2 S	3.2 Z	N 6
1.6 a	6.3 S	6.3 Z	N 7
3.2 a	12.5 S	12.5 Z	N 8
6.3 a	25 S	25 Z	N 9
12.5 a	50 S	50 Z	N 10
25 a	100 S	100 Z	N 11
50 a	200 S	200 Z	N 12
100 a	400 S	400 Z	–

[Note] Above table is applicable only when processed surface peaks are of equal height.
Above table is roughly applicable to processed surface for general use.
Numbers are combined only for convenience in deciding surface roughness.

Supplementary table 15 Viscosity conversion

Kinematic viscosity mm^2/s	Saybolt SUS (second)		Redwood R (second)		Engler E (degree)
	100°F	210°F	50°C	100°C	
2	32.6	32.8	30.8	31.2	1.14
3	36.0	36.3	33.3	33.7	1.22
4	39.1	39.4	35.9	36.5	1.31
5	42.3	42.6	38.5	39.1	1.40
6	45.5	45.8	41.1	41.7	1.48
7	48.7	49.0	43.7	44.3	1.56
8	52.0	52.4	46.3	47.0	1.65
9	55.4	55.8	49.1	50.0	1.75
10	58.8	59.2	52.1	52.9	1.84
11	62.3	62.7	55.1	56.0	1.93
12	65.9	66.4	58.2	59.1	2.02
13	69.6	70.1	61.4	62.3	2.12
14	73.4	73.9	64.7	65.6	2.22
15	77.2	77.7	68.0	69.1	2.32
16	81.1	81.7	71.5	72.6	2.43
17	85.1	85.7	75.0	76.1	2.54
18	89.2	89.8	78.6	79.7	2.64
19	93.3	94.0	82.1	83.6	2.76
20	97.5	98.2	85.8	87.4	2.87
21	102	102	89.5	91.3	2.98
22	106	107	93.3	95.1	3.10
23	110	111	97.1	98.9	3.22
24	115	115	101	103	3.34
25	119	120	105	107	3.46
26	123	124	109	111	3.58
27	128	129	112	115	3.70
28	132	133	116	119	3.82
29	137	138	120	123	3.95
30	141	142	124	127	4.07
31	145	146	128	131	4.20
32	150	150	132	135	4.32
33	154	155	136	139	4.45
34	159	160	140	143	4.57

Kinematic viscosity mm^2/s	Saybolt SUS (second)		Redwood R (second)		Engler E (degree)
	100°F	210°F	50°C	100°C	
35	163	164	144	147	4.70
36	168	170	148	151	4.83
37	172	173	153	155	4.96
38	177	178	156	159	5.08
39	181	183	160	164	5.21
40	186	187	164	168	5.34
41	190	192	168	172	5.47
42	195	196	172	176	5.59
43	199	201	176	180	5.72
44	204	205	180	185	5.85
45	208	210	184	189	5.98
46	213	215	188	193	6.11
47	218	219	193	197	6.24
48	222	224	197	202	6.37
49	227	228	201	206	6.50
50	231	233	205	210	6.63
55	254	256	225	231	7.24
60	277	279	245	252	7.90
65	300	302	266	273	8.55
70	323	326	286	294	9.21
75	346	349	306	315	9.89
80	371	373	326	336	10.5
85	394	397	347	357	11.2
90	417	420	367	378	11.8
95	440	443	387	399	12.5
100	464	467	408	420	13.2
120	556	560	490	504	15.8
140	649	653	571	588	18.4
160	742	747	653	672	21.1
180	834	840	734	757	23.7
200	927	933	816	841	26.3
250	1159	1167	1020	1051	32.9
300	1391	1400	1224	1241	39.5

[Remark] $1mm^2/s = 1$ cSt (centi stokes)

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