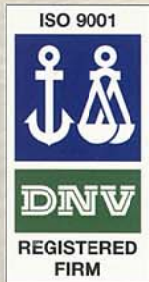


IJK

PRODUCTS GUIDE

BALL BEARINGS



INOUE JIKUKE KOGYO CO., LTD.

We, IJK (Inoue Jikuuke Kogyo), have been one of the leading manufacturers of small sized ball bearings since 1938. Our high quality bearings for precision motors meet the various needs of both domestic and overseas well-known electric appliances manufacturers.

In order to respond to the rapid development of many appliances and the specific demands for types, dimensions and efficiency of bearings, we have been endeavouring to innovate our manufacturing equipment and technology.

Now we have revised our catalog. We believe IJK ball bearings will result in the highest satisfaction to the users. In addition to the standard types shown in this new catalog, we can offer you special types or sizes to fit your need. So, what ever your needs, please ask us to help you plan better.

IJK ball bearing company is always ready to serve you.

INOUE JIKUUE KOGYO



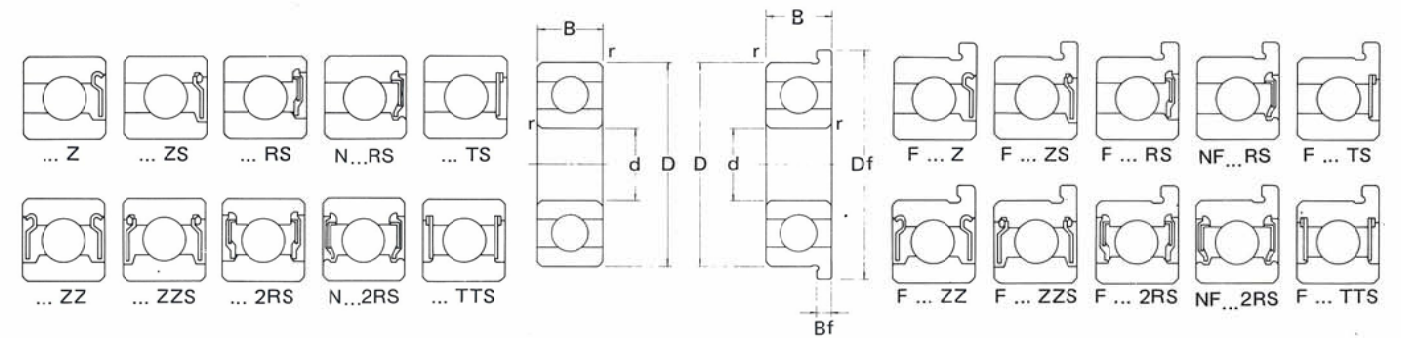
IJK BALL BEARINGS

For the content of this catalog, we take every possible care for accuracy, but please excuse us in case of clerical error or omissions. Regarding the extra or special specifications of the bearings, the usual manner is for applications to be sent to us and after approval, we produce it.

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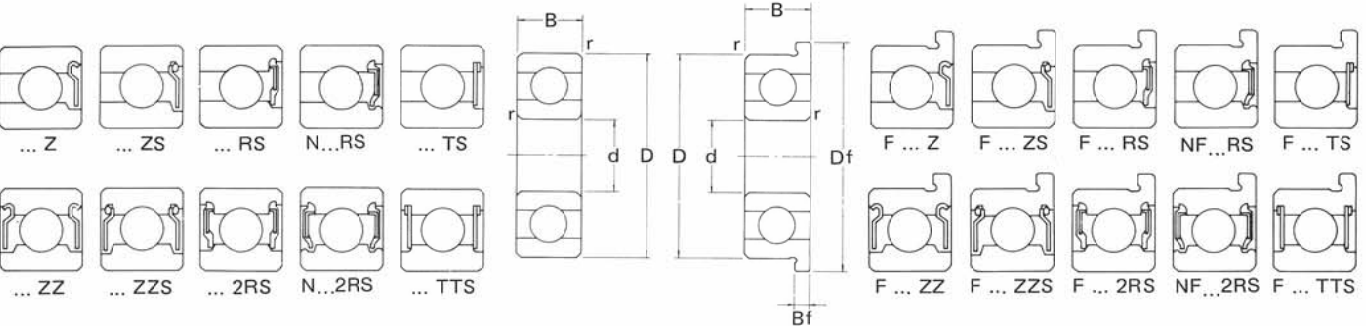
DEEP GROOVE BALL BEARINGS METRIC SERIES 68



BASIC BEARING NUMBER	Dimensions $\frac{\text{mm}}{\text{inches}}$									
	BORE	O.D.	WIDTH	CHAMFER	FLANGE		BALLS		LOAD RATINGS	
	d	D	B	f min.	Df	Bf	NO.	SIZE	DYNAMIC C (kgf/lbf)	STATIC Co. (kgf/lbf)
686 *	6.000 .2362	13.000 .5118	3.500 .1378	0.15 .006	15.00 .591	1.00 .039	8	2.000 .0787	110 243	45 99
686	6.000 .2362	13.000 .5118	5.000 .1969	0.15 .006	15.00 .591	1.10 .043	8	2.000 .0787	110 243	45 99
687 *	7.000 .2756	14.000 .5512	3.500 .1378	0.15 .006	16.00 .630	1.00 .039	9	2.000 .0787	120 265	52 115
687	7.000 .2756	14.000 .5512	5.000 .1969	0.15 .006	16.00 .630	1.10 .043	9	2.000 .0787	120 265	52 115
688 *	8.000 .3150	16.000 .6299	4.000 .1575	0.20 .008	18.00 .709	1.00 .039	10	2.000 .0787	128 282	60 132
688	8.000 .3150	16.000 .6299	5.000 .1969	0.20 .008	18.00 .709	1.10 .043	10	2.000 .0787	128 282	60 132
689 *	9.000 .3543	17.000 .6693	4.000 .1575	0.20 .008	19.00 .748	1.00 .039	11	2.000 .0787	136 300	68 150
689	9.000 .3543	17.000 .6693	5.000 .1969	0.20 .008	19.00 .748	1.10 .043	11	2.000 .0787	136 300	68 150
6800	10.000 .3937	19.000 .7480	5.000 .1969	0.30 .012	22.00 .866	1.50 .059	10	2.381 3-32	175 386	86 190
6801	12.000 .4724	21.000 .8268	5.000 .1969	0.30 .012			12	2.381 3-32	195 430	106 234
6802	15.000 .5906	24.000 .9449	5.000 .1969	0.30 .012	26.80 1.055	1.50 .059	14	2.778 7-64	212 467	128 282
6803	17.000 .6693	26.000 1.0236	5.000 .1969	0.30 .012			13	2.778 7-64	212 467	128 282
6804	20.000 .7874	32.000 1.2598	7.000 .2756	0.30 .012			13	3.500 .1378	410 904	252 556

* Open type only.

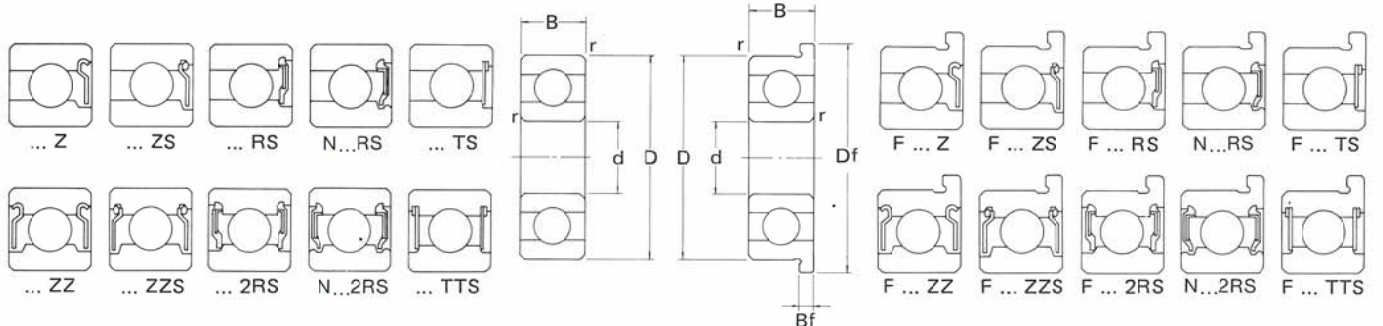
**DEEP GROOVE BALL BEARINGS
METRIC SERIES 69**



BASIC BEARING NUMBER	Dimensions <small>mm</small> <small>inches</small>									
	BORE d	O.D. D	WIDTH B	CHAMFER f min.	FLANGE		BALLS		LOAD RATINGS	
					Df	Bf	NO.	SIZE	DYNAMIC C (kgf/lbf)	STATIC Co (kgf/lbf)
695	5.000 .1969	13.000 .5118	4.000 .1575	0.20 .008	15.00 .590	1.00 .039	8	2.000 .0787	110 243	44 97
696	6.000 .2362	15.000 .5906	5.000 .1969	0.20 .008	17.00 .669	1.20 .047	8	2.381 3-32	177 390	68 150
697 *	7.000 .2756	17.000 .6693	6.000 .2362	0.30 .012	19.00 .748	1.20 .047	9	2.381 3-32	164 362	73 161
698	8.000 .3150	19.000 .7480	6.000 .2362	0.30 .012	22.00 .866	1.50 .059	7	3.175 1-8	228 503	93 205
699	9.000 .3543	20.000 .7874	6.000 .2362	0.30 .012	23.00 .906	1.50 .059	10	2.381 3-32	175 386	86 190
6900	10.000 .3937	22.000 .8661	6.000 .2362	0.30 .012			9	3.175 1-8	275 606	129 284
6901	12.000 .4724	24.000 .9449	6.000 .2362	0.30 .012			10	3.175 1-8	295 650	149 328
6902	15.000 .5906	28.000 1.1024	7.000 .2756	0.30 .012			10	3.969 5-32	440 970	230 507
6903	17.000 .6693	30.000 1.1811	7.000 .2756	0.30 .012			11	3.969 5-32	470 1036	260 573
6904	20.000 .7874	37.000 1.4567	9.000 .3543	0.30 .012			11	4.762 3-16	650 1433	375 827

* Open type only.

**DEEP GROOVE BALL BEARINGS
METRIC SERIES 60**

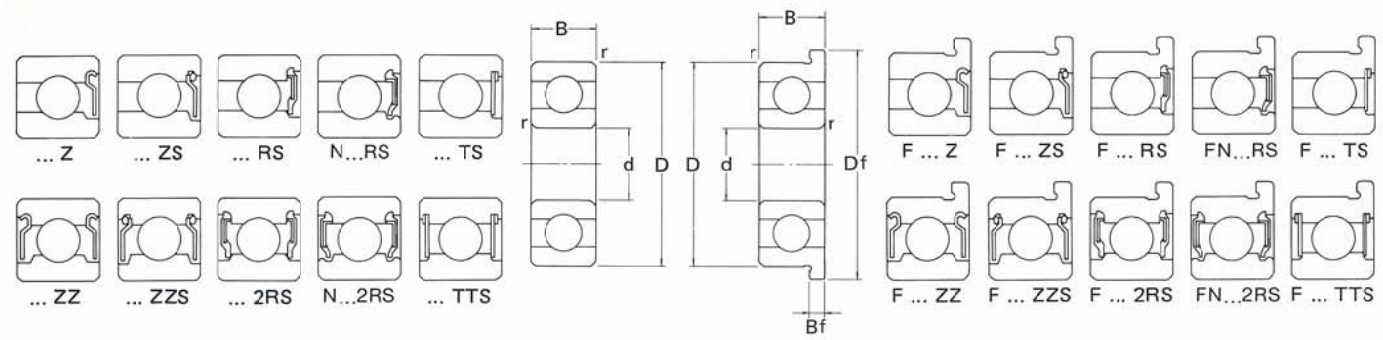


BASIC BEARING NUMBER	Dimensions <small>mm</small> <small>inches</small>									
	BORE d	O.D. D	WIDTH B	CHAMFER f min.	FLANGE		BALLS		LOAD RATINGS	
					Df	Bf	NO.	SIZE	DYNAMIC C (kgf/lbf)	STATIC Co (kgf/lbf)
604	4.000 .1575	12.000 .4724	4.000 .1575	0.20 .008	13.50 .531	1.00 .039	7	2.000 .0787	98 216	35 77
605	5.000 .1969	14.000 .5512	5.000 .1969	0.20 .008	16.00 .630	1.00 .039	7	2.381 3-32	135 298	52 115
606	6.000 .2362	17.000 .6693	6.000 .2362	0.30 .012	19.00 .748	1.20 .047	6	3.500 .1378	231 509	85 187
607	7.000 .2756	19.000 .7480	6.000 .2362	0.30 .012	22.00 .866	1.50 .059	7	3.500 .1378	238 525	90 198
608	8.000 .3150	22.000 .8661	7.000 .2756	0.30 .012	25.00 .984	1.50 .059	7	3.969 5-32	335 739	140 309
609	9.000 .3543	24.000 .9449	8.000 .2756	0.30 .012			7	3.969 5-32	335 739	140 309
6000	10.000 .3937	26.000 1.0236	8.000 .3150	0.30 .012			7	4.762 3-16	465 1025	201 443
6001	12.000 .4724	28.000 1.1024	8.000 .3150	0.30 .012			8	4.762 3-16	520 1146	241 531

* Open type only.



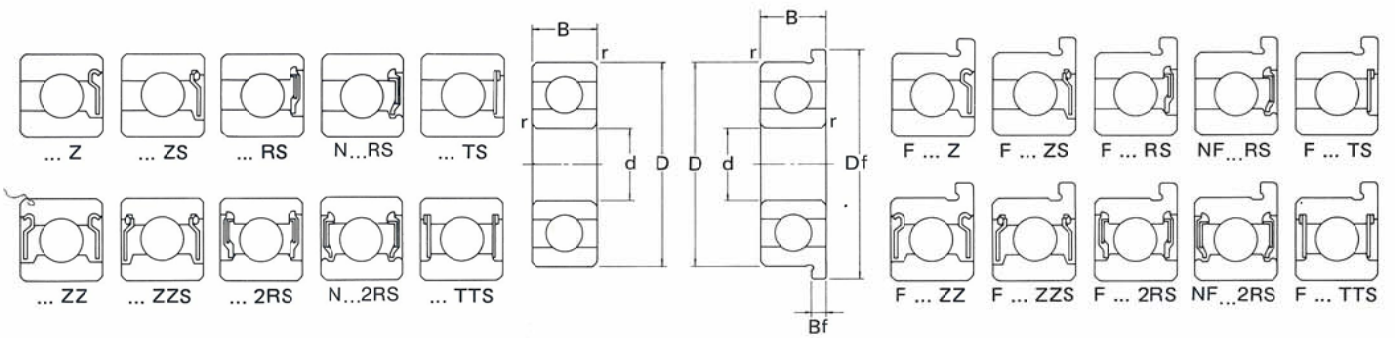
**DEEP GROOVE BALL BEARINGS
METRIC SERIES 62**



Dimensions $\frac{\text{mm}}{\text{inches}}$

BASIC BEARING NUMBER	BORE d	O.D. D	WIDTH B	CHAMFER r min.	FLANGE		BALLS NO.	BALLS SIZE	LOAD RATINGS	
					Df	Bf			DYNAMIC C (kgf/lbf)	STATIC Co (kgf/lbf)
624	4.000	13.000	5.000	0.20	15.00	1.00	7	2.381	133	49
	.1575	.5118	.1969	.008	.590	.039		7-32	293	108
625	5.000	16.000	5.000	0.30	18.00	1.00	8	2.500	177	67
	.1969	.6299	.1969	.012	.709	.039		.0984	390	148
626	6.000	19.000	6.000	0.30	22.00	1.50	7	3.500	238	90
	.2362	.7480	.2362	.012	.866	.059		.1378	525	198
627	7.000	22.000	7.000	0.30	25.00	1.50	7	3.969	335	140
	.2756	.8661	.2756	.012	.984	.059		5-32	789	309
628	8.000	24.000	8.000	0.30			7	3.969	340	146
	.3150	.9449	.3150	.012				5-32	750	322
629	9.000	26.000	8.000	0.60			7	4.762	465	201
	.3543	1.0236	.3150	.024				3-16	1025	443
6200	10.000	30.000	9.000	0.60			8	4.762	520	244
	.3937	1.1811	.3543	.024				3-16	1146	538

**DEEP GROOVE BALL BEARINGS
METRIC SERIES 63**

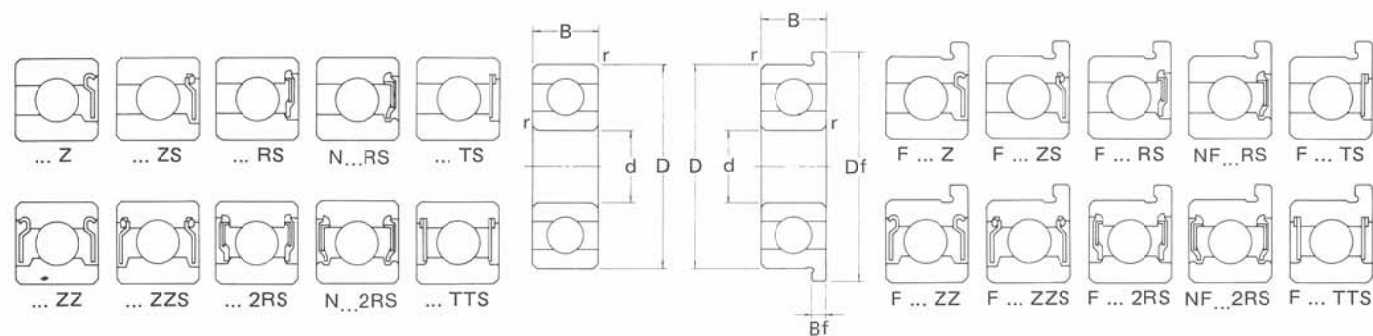


Dimensions $\frac{\text{mm}}{\text{inches}}$

BASIC BEARING NUMBER	BORE d	O.D. D	WIDTH B	CHAMFER r min.	FLANGE		BALLS NO.	BALLS SIZE	LOAD RATINGS	
					Df	Bi			DYNAMIC C (kgf/lbf)	STATIC Co (kgf/lbf)
634	4.000	16.000	5.000	0.30	18.00	1.00	8	2.500	177	68
	.1575	.6299	.1969	.012	.709	.039		.0984	390	150
635	5.000	19.000	6.000	0.30	22.00	1.50	7	3.500	266	107
	.1969	.7480	.2362	.012	.866	.059		.1378	586	236
636	6.000	22.000	7.000	0.30						
	.2362	.8661	.2756	.012						
637	7.000	26.000	9.000	0.30						
	.2756	1.0236	.3543	.012						
638	8.000	28.000	9.000	0.30			7	4.762	465	201
	.3150	1.1024	.3543	.012				3-16	1025	443
639	9.000	30.000	10.000	0.60			8	4.762	520	230
	.3543	1.1811	.3937	.024				3-16	1146	5070
6300	10.000	35.000	11.000	0.60			6	7.144	825	350
	.3937	1.3780	.4331	.024				9-32	1819	772
6301	12.000	37.000	12.000	1.00			6	7.938	990	425
	.4724	1.4567	.4724	.040				5-16	2183	937
6302	15.000	42.000	13.000	1.00			7	7.938	1162	555
	.5906	1.6535	.5118	.040				5-16	2563	1223



DEEP GROOVE BALL BEARINGS INCH SERIES

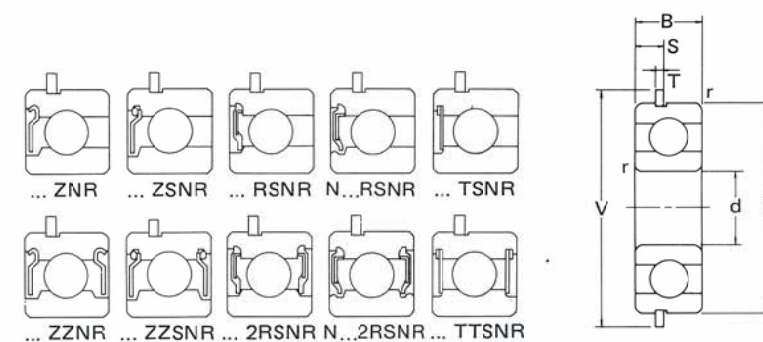


BASIC BEARING NUMBER	Dimensions $\frac{\text{mm}}{\text{inches}}$									
	BORE d	O.D. D	WIDTH B	CHAMFER r min.	FLANGE		BALLS		LOAD RATINGS	
					Df	Bf	NO.	SIZE	DYNAMIC C (kgf/lbf)	STATIC Co (kgf/lbf)
R3 *	4.762	12.700	3.967	0.30	14.35	1.07	7	2.381	133	49
	.1875	.5000	.1562	.012	.565	.042	7	3-32	293	108
R3	4.762	12.700	4.978	0.30	14.35	1.07	7	2.381	133	49
	.1875	.5000	.1960	.012	.565	.042	7	3-32	293	108
R188 *	6.350	12.700	3.175	0.15	13.89	0.58	10	1.588	110	45
	.2500	.5000	.1250	.006	.547	.023	10	1-16	243	99
R188	6.350	12.700	4.762	0.15	13.89	1.14	10	1.588	110	45
	.2500	.5000	.1875	.006	.547	.045	10	1-16	243	99
R4	6.350	15.875	4.978	0.30	17.53	1.07	8	2.500	164	68
	.2500	.6250	.1960	.012	.690	.042	8	.0984	362	150
R4A *	6.350	19.050	5.558	0.40			7	3.500	274	107
	.2500	.7500	.2188	.016			7	.1378	604	236
R4A	6.350	19.050	7.142	0.40	17.53	1.07	7	3.500	274	107
	.2500	.7500	.2812	.016	.690	.042	7	.1378	604	236
R5A	7.938	22.225	7.142	0.40			7	3.969	340	138
	.3125	.8750	.2812	.016			7	5-32	750	304
R6 *	9.525	22.225	5.558	0.40	24.61	1.57	7	3.969	340	138
	.3750	.8750	.2188	.016	.969	.062	7	5-32	750	304
R6	9.525	22.225	7.142	0.40	24.61	1.57	7	3.969	340	138
	.3750	.8750	.2812	.016	.969	.062	7	5-32	750	304
R8 *	12.700	28.575	6.350	0.40			8	4.762	520	229
	.5000	1.1250	.2500	.016			8	3-16	1146	505
R8	12.700	28.575	7.938	0.40	31.11	1.57	8	4.762	520	229
	.5000	1.1250	.3125	.016	1.225	.062	8	3-16	1146	505
R10 *	15.875	34.925	7.142	0.80			10	4.762	611	331
	.6250	1.375	.2812	.031			10	3-16	1347	729
R10	15.875	34.925	8.733	0.80			10	4.762	611	331
	.6250	1.375	.3438	.031			10	3-16	1347	729
R12 *	19.05	41.275	7.938	0.80			9	6.350	955	510
	.75	1.625	.3125	.031			9	1-4	2105	1124
R12	19.05	41.275	11.112	0.80			9	6.350	955	510
	.75	1.625	.4375	.031			9	1-4	2105	1124

* Open type only.

BALL 7 BEARINGS

DEEP GROOVE BALL BEARINGS INCH SERIES, WITH SNAP RING

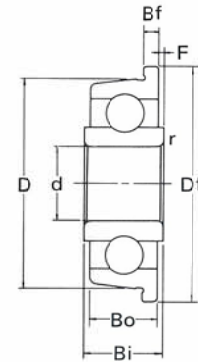
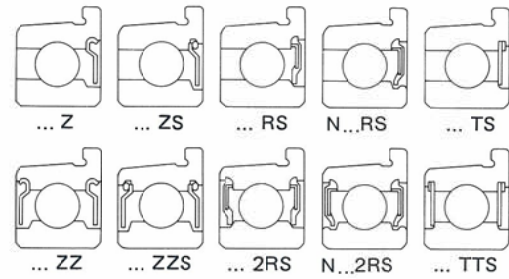


BASIC BEARING NUMBER	Dimensions $\frac{\text{mm}}{\text{inches}}$										
	BORE BORE d	O.D. D	WIDTH B	CHAMFER r min.	SNAP RING			BALLS		LOAD RATINGS	
					V	T	S	NO.	SIZE	DYNAMIC C (kgf/lbf)	STATIC Co (kgf/lbf)
R4	6.350	15.875	4.978	0.30	18.64	0.65	1.78	8	2.500	164	68
	.2500	.6250	.1960	.012	.730	.026	.070	8	.0984	362	150
R4A	6.350	19.050	7.142	0.40	21.64	0.66	2.28	7	3.500	274	107
	.2500	.7500	.2812	.016	.852	.026	.090	7	.1378	604	236
R6	9.525	22.225	7.142	0.40	25.40	0.80	2.28	7	3.969	340	138
	.3750	.8750	.2812	.016	1.000	.031	.090	7	5-32	750	304
R8	12.700	28.575	7.938	0.40	31.93	0.70	2.28	8	4.762	520	229
	.5000	1.1250	.3125	.016	1.257	.028	.090	8	3-16	1146	505

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BALL 8 BEARINGS

DEEP GROOVE BALL BEARINGS
O.D. TAPER FLANGED EXTR-SMALL
INCH SERIES
OPEN TYPE
CLOSURES TYPE

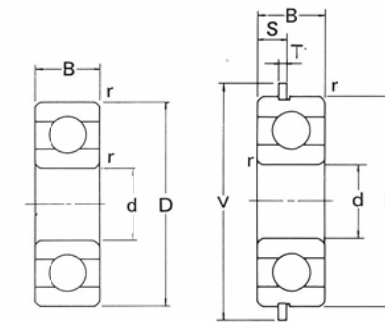
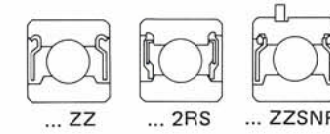


Dimensions $\frac{mm}{inches}$

BEARING NUMBER	BORE d	O.D. D	O.D. TAPER PER FOOT	WIDTH		INNER RING PROJECT F	CAMFER $r \times 45^\circ$	FLANGE		BALLS		LOAD RATINGS	
				Bo	Bi			O.D. Df	WIDTH Bf	NO.	SIZE	DYNAMIC C (kgf/lbf)	STATIC Co (kgf/lbf)
	+0.008 -0	+0 -0.010		+0 -0.10	± 0.025	+0.25 -0	+0.25 -0	+0.127 -0	± 0.050	(mm TOLERANCE)			
	+0.003 -0.000	+0.000 -0.004		+0.000 -0.004	$\pm .001$	+0.010 -0.000	+0.010 -0.000	+0.005 -0.002	$\pm .002$	(in TOLERANCE)			
F2 *	4.762 .1875	11.130 .4382	2.032 .080	4.14 .163	4.78 .188	0.41 .016	0.25 .010	12.700 .5000	1.07 .042	15 1-16	1.588 1-16	108 238	47 104
F3	4.762 .1875	14.305 .5632	2.032 .080	4.95 .195	5.51 .217	0.38 .015	0.25 .010	15.875 .6250	1.07 .042	7 3-32	2.381 3-32	135 298	50 243
F4	6.350 .2500	15.893 .6257	1.727 .068	5.740 .226	6.62 .249	0.38 .015	0.25 .010	17.462 .6875	1.07 .042	8 .0984	2.500 .0984	163 359	63 139
F5	7.938 .3125	17.480 .6882	1.727 .068	5.740 .226	6.32 .249	0.38 .015	0.25 .010	19.050 .7500	1.07 .042	7 1-8	3.175 1-8	226 498	88 198
F2ZZ	3.175 .1250	9.543 .3757	1.905 .075	4.14 .163	4.78 .188	0.38 .015	0.25 .010	11.125 .438	0.94 .037	7 1-16	1.588 1-16	65 143	22 49
F3ZZ	4.762 .1875	14.305 .5632	1.727 .068	5.740 .226	6.35 .250	0.38 .015	0.25 .010	15.875 .625	1.07 .042	7 3-32	2.381 3-32	135 298	50 110
F4ZZ	6.350 .2500	15.893 .6257	1.727 .068	5.740 .226	6.35 .250	0.38 .015	0.25 .010	17.450 .687	1.07 .042	8 .0984	2.500 .0984	163 359	63 139
F5ZZ	7.938 .3125	17.480 .6882	1.727 .068	5.740 .226	6.35 .250	0.38 .015	0.25 .010	19.050 .750	1.07 .042	7 1-8	3.175 1-8	226 498	88 194

* Full complement - no cage.

DEEP GROOVE BALL BEARINGS
INCH SERIES, 1600

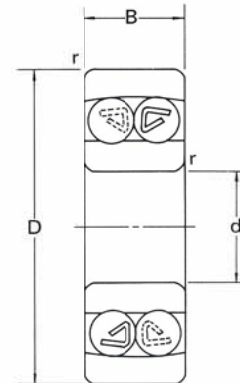


Dimensions $\frac{mm}{inches}$

BEARING NUMBER	O.D. D	BORE d	WIDTH B	CHAMFER $r_{min.}$	SNAP RING			BALLS		LOAD RATINGS	
					V	T	S	NO.	SIZE	DYNAMIC C (kgf/lbf)	STATIC Co (kgf/lbf)
1601ZZ	17.462 .6875	4.762 .1875	6.350 .2500	0.40 .016				6 1-8	3.175 1-8	201 443	76 168
1601DC	17.462 .6875	4.762 .1875	7.938 .3125	0.40 .016				6 1-8	3.175 1-8	201 443	76 168
1602ZZ	17.462 .6875	6.350 2500	6.350 .2500	0.40 .016				6 1-8	3.175 1-8	201 443	76 168
1602DC	17.462 .6875	6.350 2500	7.938 .3125	0.40 .016				6 1-8	3.175 1-8	201 443	76 168
1603ZZ	22.225 .8750	7.938 .3125	7.142 .2812	0.50 .020				7 5-32	3.969 5-32	340 750	138 304
1603ZZNR	22.225 .8750	7.938 .3125	7.142 .2812	0.50 .020	25.40 1.000	0.50 .020	1.68 .066	7 5-32	3.969 5-32	340 750	138 304
1603DC	22.225 .8750	7.938 .3125	8.731 .3438	0.50 .020				7 5-32	3.969 5-32	340 750	138 304
1604ZZ	22.225 .8750	9.525 .3750	7.142 .2812	0.50 .020				7 5-32	3.969 5-32	340 750	138 304
1604DC	22.225 .8750	9.525 .3750	8.731 .3438	0.50 .020				7 5-32	3.969 5-32	340 750	138 304
1605ZZ	23.017 .9062	7.938 .3125	7.938 .3125	0.50 .020				7 5-32	3.969 5-32	340 750	138 304
1605-2RS	23.017 .9062	7.938 .3125	7.938 .3125	0.50 .020				7 5-32	3.969 5-32	340 750	138 304
1606ZZ	23.017 .9062	9.525 .3750	7.938 .3125	0.50 .020				7 5-32	3.969 5-32	340 750	138 304
1606-2RS	23.017 .9062	9.525 .3750	7.938 .3125	0.50 .020				7 5-32	3.969 5-32	340 750	138 304
1607ZZ	23.017 .9062	11.112 .4375	7.938 .3125	0.50 .020				9 1-16	3.500 1-16	328 723	138 304
1607-2RS	23.017 .9062	11.112 .4375	7.938 .3125	0.50 .020				9 1-16	3.500 1-16	328 723	138 304
1614ZZ	28.575 1.1250	9.525 .3750	9.525 .3750	0.60 .024				8 3-16	4.762 3-16	520 1146	241 531
1614-2RS	28.575 1.1250	9.525 .3750	9.525 .3750	0.60 .024				8 3-16	4.762 3-16	520 1146	241 531
1615ZZ	28.575 1.1250	11.112 .4375	9.525 .3750	0.60 .024				8 3-16	4.762 3-16	520 1146	241 531
1615-2RS	28.575 1.1250	11.112 .4375	9.525 .3750	0.60 .024				8 3-16	4.762 3-16	520 1146	241 531
1616ZZ	28.575 1.1250	12.700 .5000	9.525 .3750	0.60 .024				8 3-16	4.762 3-16	520 1146	241 531
1616-2RS	28.575 1.1250	12.700 .5000	9.525 .3750	0.60 .024				8 3-16	4.762 3-16	520 1146	241 531



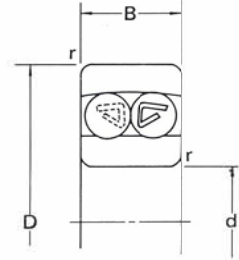
SELF-ALIGNING BALL EBEARINGS
100 SERIES
12000 SERIES
RL SERIES



Dimensions $\frac{mm}{inches}$

BEARING NUMBER	BORE d	O.D. D	WIDTH B	CHAMFER r min.	BALLS		LOAD RATINGS	
					NO.	SIZE	DYNAMIC C (kgf/lbf)	STATIC Co (kgf/lbf)
135	5.000	19.000	6.000	0.30	16	3.175	258	49
	.1969	.7480	.2362	.012			1-8	569
12306	6.000	15.000	5.000	0.30	20	2.381	136	27
	.2362	.5906	.1968	.012			3-32	300
126	6.000	19.000	6.000	0.30	16	3.175	258	49
	.2362	.7480	.2362	.012			1-8	569
127	7.000	22.000	7.000	0.30	22	3.175	280	61
	.2756	.8661	.2756	.012			1-8	617
12308	8.000	18.000	5.000	0.30	24	2.500	193	51
	.3150	.7087	.1969	.012			.0984	425
108	8.000	22.000	7.000	0.30	22	3.175	280	61
	.3150	.8661	.2756	.012			1-8	617
129	9.000	26.000	8.000	0.60	20	3.969	425	91
	.3543	1.0236	.3150	.024			5-32	937
12310	10.000	23.000	7.000	0.30	22	3.175	280	61
	.3937	.9055	.2756	.012			1-8	617
RL4	12.700	33.338	11.112	0.60	20	4.762	590	154
	.5000	1.3125	.4375	.024			3-16	1300
RL5	15.875	39.688	11.112	0.60	24	5.556	827	252
	.6250	1.5625	.4375	.024			7-32	1823

SELF-ALIGNING BALL BEARINGS
12 SERIES
13 SERIES
22 SERIES



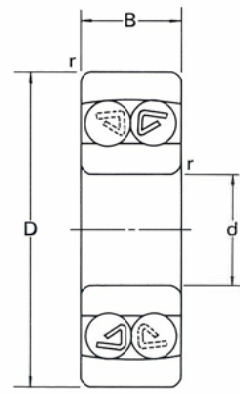
Dimensions $\frac{mm}{inches}$

BEARING NUMBER	BORE d	O.D. D	WIDTH B	CHAMFER r min.	BALLS		LOAD RATINGS	
					NO.	SIZE	DYNAMIC C (kgf/lbf)	STATIC Co (kgf/lbf)
1200	10.000	30.000	9.000	0.60	18	4.762	570	121
	.3937	1.1811	.3543	.024			3-16	1257
1201	12.000	32.000	10.000	0.60	20	4.762	580	130
	.4724	1.2598	.3937	.024			3-16	1279
1202	15.000	35.000	11.000	0.60	20	5.556	775	179
	.5906	1.3780	.4331	.024			7-32	1709
1203	17.000	40.000	12.000	0.60	24	5.556	815	205
	.6693	1.5748	.4724	.024			7-32	1797
1204	20.000	47.000	14.000	1.00	24	6.350	1020	266
	.7874	1.8504	.5512	.040			1-4	2249
1205	25.000	52.000	15.000	1.00	24	7.144	1250	335
	.9843	2.0472	.5906	.040			9-32	2755
1300	10.000	35.000	11.000	0.60	18	5.556	750	165
	.3937	1.3780	.4331	.024			7-32	1653
1301	12.000	37.000	12.000	1.00	18	6.350	985	221
	.4724	1.4567	.4724	.040			1.4	2171
1302	15.000	42.000	13.000	1.00	20	6.350	990	234
	.5906	1.6535	.5118	.040			1.4	2183
1303	17.000	47.000	14.000	1.00	22	7.144	1300	325
	.6693	1.8504	.5512	.040			9-32	2866
1304	20.000	52.000	15.000	1.10	24	7.144	1280	340
	.7874	2.0472	.5906	.430			9-32	2822
2200 *	10.000	30.000	14.000	0.60	18	5.556	760	162
	.3937	1.1811	.5512	.024			7-32	1676
2201 *	12.000	32.000	14.000	0.60	20	5.556	790	177
	.4724	1.2593	.5512	.024			7-32	1742
2202 *	15.000	35.000	14.000	0.60	22	5.556	795	188
	.5906	1.3780	.5512	.024			7-32	1753
2203 *	17.000	40.000	16.000	0.60	22	6.350	1010	247
	.6693	1.5748	.6299	.024			1-4	2227
2204 *	20.000	47.000	18.000	1.10	24	7.144	1310	340
	.7874	1.8504	.7087	.043			9-32	2888
2205 *	25.000	52.000	18.000	1.00	26	7.144	1270	350
	.9843	2.0472	.7087	.040			9-32	2800
2206 *	30.000	62.000	20.000	1.00	28	7.938	1560	460
	1.1811	2.4409	.7874	.039			5-16	3439

* Rubber Seals type available
 * M cage only



**SELF-ALIGNING BALL BEARINGS
23 SERIES**

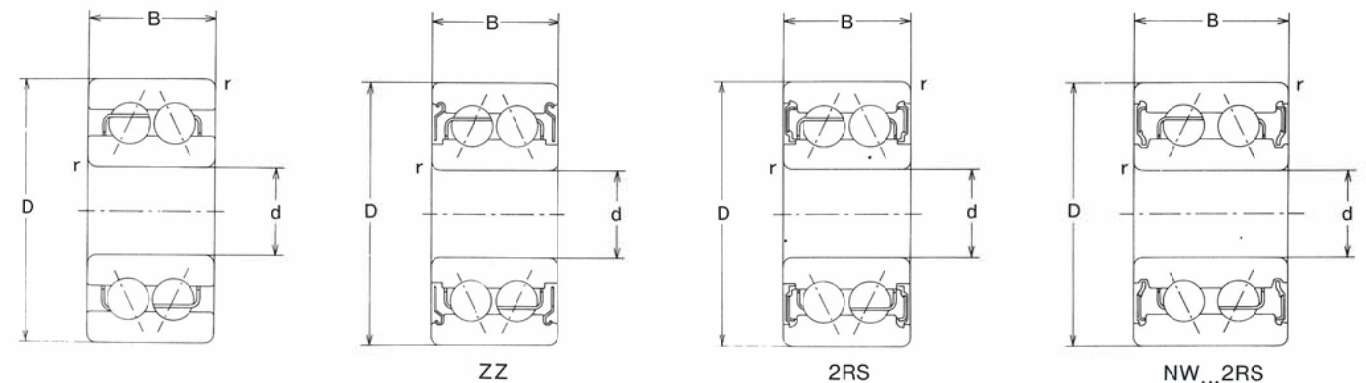


Dimensions mm inches

BEARING NUMBER	BORE d	O.D. D	WIDTH B	CHAMFER r min.	BALLS		LOAD RATINGS	
					NO.	SIZE	DYNAMIC C (kgf/lbf)	STATIC Co (kgf/lbf)
2300 *	10.000	35.000	17.000	0.60	18	6.350	953	205
	.3937	1.3780	.6693	.024		1-4	2101	452
2301 *	12.000	37.000	17.000	1.10	18	7.144	1240	278
	.4724	1.4567	.6693	.043		9-32	2734	613
2302 *	15.000	42.000	17.000	1.10	20	7.144	1250	296
	.5906	1.6535	.6693	.043		9-32	2756	653
2303 *	17.000	47.000	19.000	1.10	20	7.938	1500	365
	.6693	1.8504	.7480	.043		5-16	3307	805
2304 *	20.000	52.000	21.000	1.10	22	8.731	1880	480
	.7874	2.0472	.8268	.043		11-32	4145	1058
2305 *	25.000	62.000	24.000	1.50	22	10.319	2520	675
	.9843	2.4409	.9449	.043		13-32	5578	1488

* Rubber Seals type available
* M cage only

**DOUBLE ROW ANGULAR CONTACT BALL BEARINGS
52 SERIES
53 SERIES**



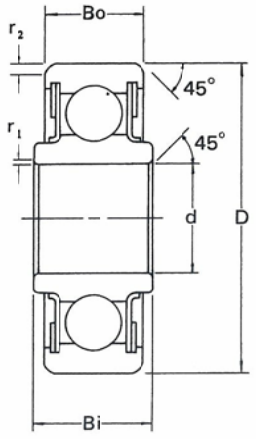
Dimensions mm inches

BEARING NUMBER	BORE d	O.D. D	WIDTH B	CHAMFER r min.	BALLS		LOAD RATINGS	
					NO.	SIZE	DYNAMIC C (kgf/lbf)	STATIC Co (kgf/lbf)
5200	10.000	30.000	14.30	0.60	14	4.762	730	400
	.3937	1.1811	.5630	.024		3-16	1609	882
NW5200-2RS	10.000	30.000	17.462	0.60	14	4.762	730	400
	.3937	1.1811	.6875	.024		3-16	1609	882
5201 *	12.000	32.000	15.90	0.60	14	5.953	1070	590
	.4724	1.2598	.6260	.024		15-64	2359	1301
5201T1X *	12.000	32.000	15.90	0.60	18	4.762	865	480
	.4724	1.2598	.6260	.024		3-16	1907	1058
5202 *	15.000	35.000	15.90	0.60	16	5.953	1190	715
	.5906	1.3780	.6260	.024		15-64	2624	1576
5202T1X *	15.000	35.000	15.90	0.60	18	4.762	865	480
	.5906	1.3780	.6260	.024		3-16	1907	1058
5203	17.000	40.000	17.462	0.60	18	5.556	1170	765
	.6693	1.5748	.6875	.024		7-32	2579	1687
W5203-2RS	17.000	40.000	20.638	0.60	18	5.556	1170	765
	.6693	1.5748	.8125	.024		7-32	2579	1687
5204 *	20.000	47.000	20.60	1.0	16	7.938	2000	1270
	.7874	1.8504	.8110	.040		5-16	1416	2800
5204ZZ	20.000	47.000	20.60	1.0	18	6.747	1620	1090
	.7874	1.8504	.8110	.040		17-64	3571	2403
5205 *	25.000	52.000	20.60	1.0	18	7.938	2170	1500
	.9843	2.0472	.8110	.040		5-16	4791	3307
5205T12ZZ	25.000	52.000	20.60	1.0	20	6.747	1730	1260
	.9843	2.0472	.8110	.040		17-64	3814	2778
5206 *	30.000	62.000	23.80	1.0	18	9.525	3000	2150
	1.1811	2.4409	.9370	.040		3-8	6615	4740
5206ZZ	30.000	62.000	23.80	1.0	18	8.731	2570	1850
	1.1811	2.4409	.9370	.040		11-32	5667	4079
5300T12 *	10.000	35.000	19.05	0.60	14	5.953	1060	560
	.3937	1.3780	.7500	.024		15-64	2337	1235
5301	12.000	37.000	19.05	1.0	14	6.350	1210	640
	.4724	1.4567	.7500	.040		1-4	2668	1411
5302	15.000	42.000	19.05	1.0	16	6.350	1370	755
	.5906	1.6535	.7500	.040		1-4	3020	1664
5303	17.000	47.000	22.225	1.0	16	7.144	1600	955
	.6693	1.8504	.8750	.040		9-32	3527	2105
5304 *	20.000	52.000	22.20	1.5	14	9.525	2510	1530
	.7874	2.0472	.8740	.059		3-8	5534	3373
5304ZZ	20.000	52.000	22.20	1.5	16	7.938	2010	1300
	.7874	2.0472	.8740	.059		5-16	4432	2866
5305 *	25.000	62.000	25.40	1.5	14	11.112	3350	2110
	.9843	2.4409	1.000	.059		7-16	7387	4653
5305ZZ	25.000	62.000	25.40	1.5	18	8.731	2570	1850
	.9843	2.4409	1.000	.059		11-32	5667	4079

* Open type only. ZZ.2RS types related to 52xx series available
* Plastic cage. (Basic reference 5000, 5001, 508 series available)



**CONTROL BEARINGS
KP-A SERIES
SINGLE ROW
RADIAL TYPE**



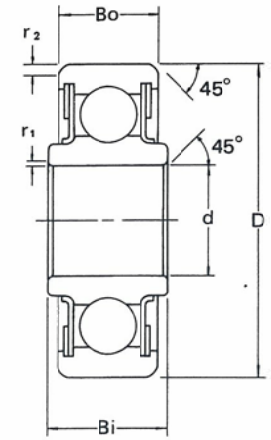
Equipped with teflon seals.

X : Non-Plated

Dimensions $\frac{\text{mm}}{\text{inches}}$

BEARING NUMBER	BORE		O.D.		WIDTH		MINIMUM CHAMFER		BALLS		LIMITED LOAD RATINGS	
	d	D	Bi	Bo	r1	r2	NO.	SIZE	RADIAL	THRUST	(kgf)	(kgf)
	+0.000	+0.000	+0.00	+0.00	+0.38	+0.38					(kgf)	(kgf)
	-0.013	-0.013	-0.13	-0.13	-0.00	-0.00					(lbf)	(lbf)
	+0.000	+0.000	+0.00	+0.00	+0.15	+0.15						
	-0.005	-0.005	-0.05	-0.05	-0.00	-0.00						
KP3ALX	4.826	12.700	6.02	4.98	0.13	0.30	11	2.381	440	195		
	.1900	.5000	.237	.196	.005	.012		3-32	970	430		
KP 3AX	4.826	15.875	7.54	5.94	0.13	0.41	10	3.175	708	318		
	.1900	.6250	.297	.234	.005	.016		1-8	1560	700		
KP 4AX	6.350	19.050	7.14	5.56	0.13	0.41	12	3.175	853	408		
	.2500	.7500	.281	.219	.005	.016		1-8	1880	900		
KP 5AX	7.938	20.638	7.54	5.94	0.38	0.41	14	3.175	993	454		
	.3125	.8125	.297	.234	.015	.016		1-8	2190	1000		
KP 6AX	9.525	22.225	7.95	6.35	0.38	0.41	16	3.175	1134	499		
	.3750	.8750	.313	.250	.015	.016		1-8	2500	1100		
KP 8AX	12.700	28.575	9.52	7.95	0.38	0.41	16	3.969	1774	771		
	.5000	1.1250	.375	.313	.015	.016		5-32	3910	1700		
KP10AX	15.875	34.925	10.31	8.74	0.38	0.81	14	5.556	3039	1361		
	.6250	1.3750	.406	.344	.015	.032		7-32	6700	3000		

**CONTROL BEARINGS
KP SERIES
SINGLE ROW
RADIAL TYPE**



Equipped with teflon seals.

X : Non-Plated

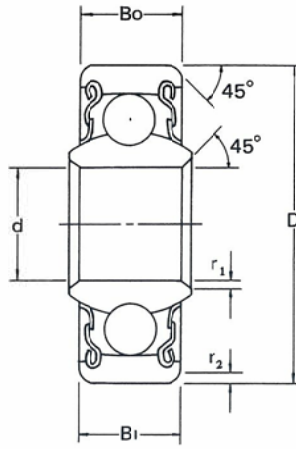
Dimensions $\frac{\text{mm}}{\text{inches}}$

BEARING NUMBER	BORE		O.D.		WIDTH		MINIMUM CHAMFER		BALLS		LIMITED LOAD RATINGS	
	d	D	Bi	Bo	r1	r2	NO.	SIZE	RADIAL	THRUST	(kgf)	(kgf)
	+0.000	+0.000	+0.00	+0.00	+0.38	+0.38					(kgf)	(kgf)
	-0.013	-0.013	-0.13	-0.13	-0.00	-0.00					(lbf)	(lbf)
	+0.000	+0.000	+0.00	+0.00	+0.15	+0.15						
	-0.005	-0.005	-0.05	-0.05	-0.00	-0.00						
KP3LX	4.826	15.875	6.22	5.16	0.13	0.25	10	3.175	708	318		
	.1900	.6250	.245	.203	.005	.010		1-8	1560	700		
KP 3X	4.826	19.746	7.54	6.86	0.13	0.56	12	3.175	853	408		
	.1900	.7774	.297	.270	.005	.022		1-8	1880	900		
KP 4X	6.350	22.896	7.14	6.51	0.13	0.81	11	3.969	1216	544		
	.2500	.9014	.284	.335	.005	.032		5-32	2680	1200		
KP 5X	7.938	31.750	7.54	6.92	0.38	0.81	9	6.350	2549	1134		
	.3125	1.2500	.297	.375	.015	.032		1-4	5620	2500		
KP 6X	9.525	36.516	7.95	7.32	0.38	0.81	10	7.144	3588	1588		
	.3750	1.4375	.313	.469	.015	.032		9-32	7910	3500		
KP 8X	12.700	42.862	9.52	8.89	0.38	1.12	10	9.525	5352	2359		
	.5000	1.6875	.375	.500	.015	.044		3-8	11800	5200		
KP10X	15.875	49.212	10.31	9.68	0.38	1.12	10	9.525	6396	2812		
	.6250	1.9375	.406	.500	.015	.044		3-8	14100	6200		



**CONTROL BEARINGS
KSP, KSP-A SERIES
SINGLE ROW
SELF-ALIGNING TYPE**

Equipped with teflon seals.



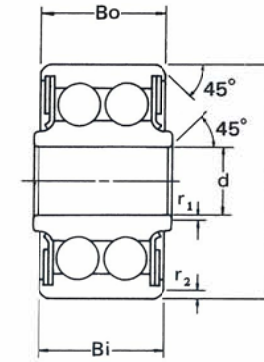
X : Non-Plated

Dimensions $\frac{\text{mm}}{\text{inches}}$

BEARING NUMBER	BORE		WIDTH		MINIMUM CHAMFER		BALLS		LIMITED LOAD RATINGS	
	d	D	Bi	Bo	r ₁	r ₂	NO.	SIZE	RADIAL	THRUST
	+0.000 -0.013 +0.000 -0.0005	+0.000 -0.013 +0.000 -0.0005	+0.00 -0.13 +0.00 -0.005	+0.00 -0.13 +0.00 -0.005	+0.38 -0.00 +0.15 -0.000	+0.38 -0.00 +0.15 -0.000			(kgf) (lbf)	(kgf) (lbf)
KSP3LX	4.826 .1900	15.875 .6250	6.22 .245	5.16 .203	0.13 .005	0.41 .016	13	2.381 3-32	249 550	45 100
KSP4AX	6.350 .2500	19.050 .7500	7.14 .281	5.56 .219	0.13 .005	0.41 .016	12	3.175 1-8	408 900	91 200
KSP5AX	7.938 .3125	20.638 .8125	7.54 .297	5.94 .234	0.38 .015	0.41 .016	14	3.175 1-8	454 1000	91 200
KSP6AX	9.525 .3750	22.225 .8750	7.95 .313	6.35 .250	0.41 .016	0.41 .016	15	3.175 1-8	508 1120	91 200
KSP 3X	4.826 .1900	19.746 .7774	7.54 .297	6.86 .270	0.13 .005	0.56 .022	12	3.175 1-8	408 900	91 200
KSP 4X	6.350 .2500	22.896 .9014	12.29 .484	8.51 .335	0.13 .005	0.81 .032	13	3.572 9-64	640 1410	136 300
KSP 5X	7.938 .3125	31.750 1.2500	14.17 .558	9.52 .375	0.38 .015	0.81 .032	13	4.762 3-16	993 2190	186 300
KSP 6X	9.525 .3750	36.512 1.4375	15.75 .620	11.91 .469	0.38 .015	0.81 .032	13	5.556 7-32	1352 2980	181 400
KSP 8X	12.700 .5000	42.862 1.6875	15.75 .620	12.70 .500	0.38 .015	1.12 .044	16	5.556 7-32	1665 3670	227 500
KSP10X	15.875 .6250	49.212 1.9375	20.65 .813	15.88 .625	0.38 .015	1.12 .044	14	7.144 9-32	2413 5320	272 600

**CONTROL BEARINGS
DPP SERIES
DOUBLE ROW
RADIAL TYPE**

Equipped with teflon seals.



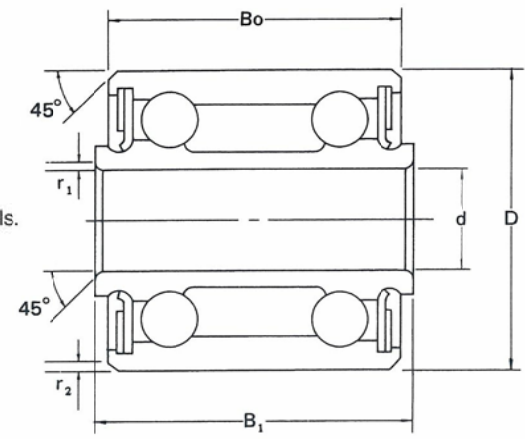
X : Non-Plated

Dimensions $\frac{\text{mm}}{\text{inches}}$

BEARING NUMBER	BORE		WIDTH		MINIMUM CHAMFER		BALLS		LIMITED LOAD RATINGS	
	d	D	Bi	Bo	r ₁	r ₂	NO.	SIZE	RADIAL	THRUST
	+0.000 -0.013 +0.000 -0.0005	+0.000 -0.013 +0.000 -0.0005	+0.00 -0.13 +0.00 -0.005	+0.00 -0.13 +0.00 -0.005	+0.38 -0.00 +0.15 -0.000	+0.38 -0.00 +0.15 -0.000			(kgf) (lbf)	(kgf) (lbf)
DPP 3X	4.826 .1900	19.746 .7774	12.57 .495	12.01 .473	0.13 .005	0.46 .018	20	3.969 5-32	1338 2950	771 1700
DPP 4X	6.350 .2500	22.896 .9014	15.75 .620	12.47 .491	0.13 .005	0.81 .032	22	3.969 5-32	2436 5370	816 1800
DPP 5X	7.938 .3125	31.750 1.2500	18.92 .745	17.45 .687	0.38 .015	0.81 .032	22	5.953 15-64	499 11000	1814 4000
DPP 6X	9.525 .3750	36.512 1.4375	22.10 .870	20.17 .794	0.38 .015	0.81 .032	20	7.144 9-32	7149 15760	2404 5300
DPP 8X	12.700 .5000	42.862 1.6875	23.67 .932	21.74 .856	0.38 .015	1.12 .044	20	8.731 11-32	10705 23600	3538 7800
DPP10X	15.875 .6250	49.212 1.9375	25.27 .995	23.37 .920	0.38 .015	1.12 .044	24	8.731 11-32	12882 28400	4264 9400

IJK

**CONTROL BEARINGS
DW SERIES
DOUBLE ROW
EXTRA WIDE TYPE**



Equipped with teflon seals.

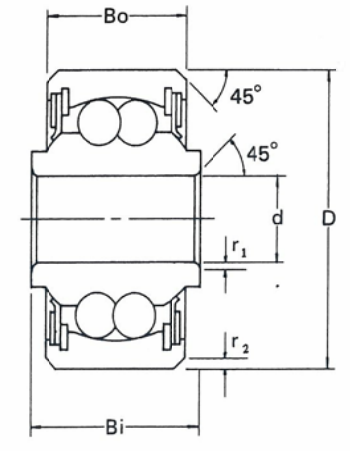
X : Non-Plated

Dimensions $\frac{\text{mm}}{\text{inches}}$

BEARING NUMBER	BORE		WIDTH		MINIMUM CHAMFER		BALLS		LIMITED LOAD RATINGS	
	d	D	Bi	Bo	r ₁	r ₂	NO.	SIZE	RADIAL	THRUST
									(kgf)	(kgf)
	+0.000 -0.013 +0.000 -0.0005	+0.000 -0.013 +0.000 -0.0005	+0.00 -0.13 +0.00 -0.005	+0.00 -0.13 +0.00 -0.005	+0.38 -0.00 +0.15 -0.000	+0.38 -0.00 +0.15 -0.000			(lbf)	(lbf)
DW4K2X*	6.350 .2500	15.875 .6250	14.27 .562	12.70 .500	0.13 .005	0.41 .016	16	2.381 3-32	635 1400	227 500
DW4KX *	6.350 .2500	19.050 .7500	22.22 .875	19.05 .750	0.13 .005	0.41 .016	14	3.572 9-64	1256 2770	408 900
DW4X	6.350 .2500	19.050 .7500	22.22 .875	19.05 .750	0.13 .005	0.41 .016	24	3.175 1-8	1701 3750	562 1240
DW5X	7.938 .3125	22.225 .8750	23.83 .938	20.65 .813	0.13 .005	0.41 .016	26	3.572 9-64	2332 5140	726 1600
DW6X	9.525 .3750	26.988 1.0625	30.18 1.188	27.00 1.063	0.13 .005	0.41 .016	24	4.762 3-16	3828 8440	1179 2600

* Retainer type

**CONTROL BEARINGS
DSP SERIES
DOUBLE ROW
SELF-ALIGNING TYPE**



Equipped with teflon seals.

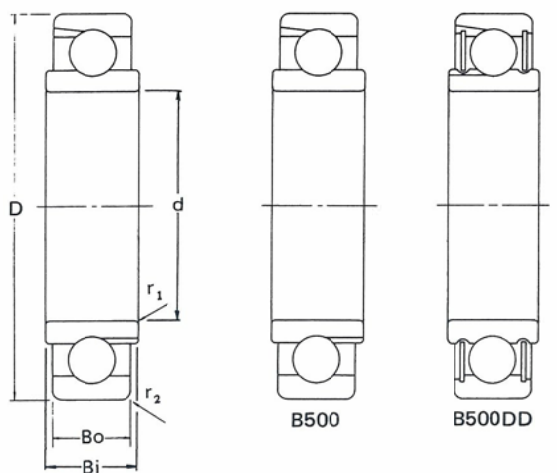
X : Non-Plated

Dimensions $\frac{\text{mm}}{\text{inches}}$

BEARING NUMBER	BORE		WIDTH		MINIMUM CHAMFER		BALLS		LIMITED LOAD RATINGS	
	d	D	Bi	Bo	r ₁	r ₂	NO.	SIZE	RADIAL	THRUST
									(kgf)	(kgf)
	+0.000 -0.013 +0.000 -0.0005	+0.000 -0.013 +0.000 -0.0005	+0.00 -0.13 +0.00 -0.005	+0.00 -0.13 +0.00 -0.005	+0.38 -0.00 +0.15 -0.000	+0.38 -0.00 +0.15 -0.000			(lbf)	(lbf)
DSP 3X	4.826 .1900	19.746 .7774	12.70 .500	9.96 .392	0.13 .005	0.56 .022	24	3.175 1-8	644 1420	91 200
DSP 4X	6.350 .2500	22.896 .9014	17.45 .687	11.79 .464	0.13 .005	0.81 .032	30	3.175 1-8	807 1780	136 300
DSP 5X	7.938 .3125	31.750 1.2500	20.62 .812	16.66 .656	0.38 .015	0.81 .032	28	4.762 3-16	1696 3740	272 600
DSP 6X	9.525 .3750	36.512 1.4375	23.80 .937	19.05 .750	0.38 .015	0.81 .032	28	5.556 7-32	2313 5100	363 800
DSP 8X	12.700 .5000	42.862 1.6875	25.40 1.000	20.62 .812	0.38 .015	1.12 .044	30	6.350 1-4	3230 7120	454 1000
DSP10X	15.875 .6250	49.212 1.9375	28.58 1.125	23.80 .937	0.38 .015	1.12 .044	30	7.144 9-32	4082 9000	590 1300



**CONTROL BEARINGS
B500, B500DD SERIES
SINGLE ROW
TORQUE TUBE TYPE**



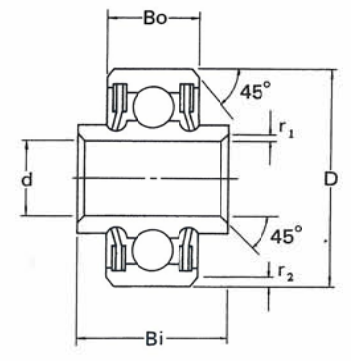
DD: Equipped with teflon coated glass fabric seals.

X : Non-Plated

Dimensions $\frac{\text{mm}}{\text{inches}}$

BEARING NUMBER	BORE		O.D.		WIDTH		MINIMUM CHAMFER		BALLS		LIMITED LOAD RATINGS	
	d	D	Bi	Bo	r ₁	r ₂	NO.	SIZE	RADIAL R (kgf) (lbf)	THRUST T (kgf) (lbf)		
TYPE	+0.018	+0.000	+0.00	+0.00								
OPEN SEAL	-0.018	-0.025	-0.13	-0.13								
	+0.007	+0.000	+0.00	+0.00								
	-0.007	-0.010	-0.05	-0.05								
B538,B538DDX	15.875 .6250	26.988 1.0625	7.14 .281	6.35 .250	0.38 .015	0.38 .015	21	3.175 1-8	1487 3280	680 1500		
B539,B539DDX	19.050 .7500	30.162 1.1875	7.14 .281	6.35 .250	0.38 .015	0.38 .015	24	3.175 1-8	1701 3750	771 1700		
B540,B540DDX	22.225 .8750	33.338 1.3125	7.14 .281	6.35 .250	0.38 .015	0.38 .015	27	3.175 1-8	1914 4220	862 1900		
B541,B541DDX	26.988 1.0625	38.100 1.5000	7.14 .281	6.35 .250	0.38 .015	0.38 .015	32	3.175 1-8	2268 5000	998 2200		
B542,B542DDX	33.338 1.3125	44.450 1.7500	7.14 .281	6.35 .250	0.38 .015	0.38 .015	38	3.175 1-8	2699 5950	1225 2700		
B543,B543DDX	39.688 1.5625	50.800 2.0000	7.14 .281	6.35 .250	0.38 .015	0.38 .015	44	3.175 1-8	3121 6880	1452 3200		

**CONTROL BEARINGS
P SERIES
SINGLE ROW
RADIAL TYPE**



Equipped with teflon seals.

X : Non-Plated

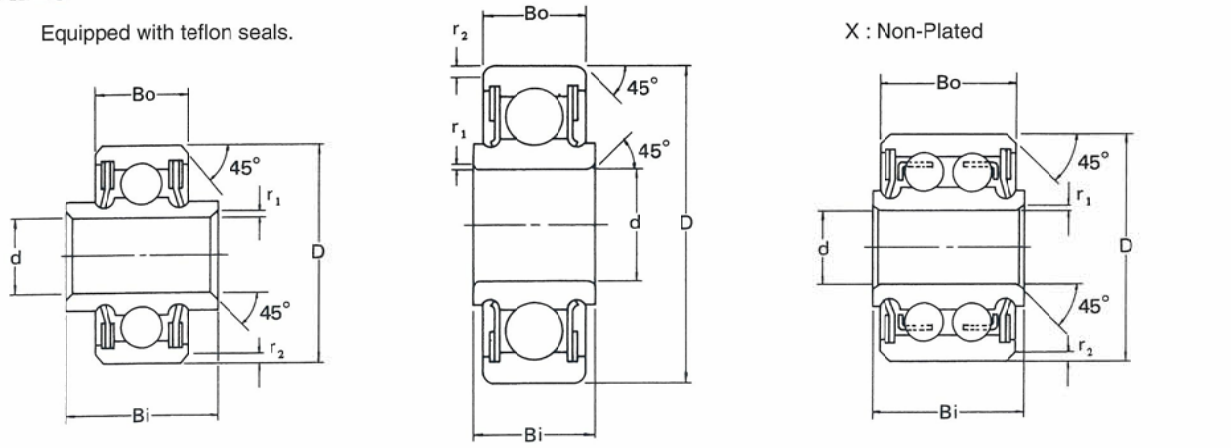
Dimensions $\frac{\text{mm}}{\text{inches}}$

BEARING NUMBER	BORE		O.D.		WIDTH		MINIMUM CHAMFER		BALLS		LIMITED LOAD RATINGS	
	d	D	Bi	Bo	r ₁	r ₂	NO.	SIZE	RADIAL (kgf) (lbf)	THRUST (kgf) (lbf)		
TYPE	+0.000	+0.000	+0.00	+0.00	+0.38	+0.38						
	-0.013	-0.013	-0.13	-0.13	-0.00	-0.00						
	+0.000	+0.000	+0.00	+0.00	+0.15	+0.15						
	-0.005	-0.005	-0.05	-0.05	-0.00	-0.00						
KP3KX	4.826 .1900	19.746 .7774	7.54 .297	6.86 .270	0.13 .005	0.61 .024	7	3.175 1-8	494 1090	272 600		
KP3AKX	4.826 .1900	15.875 .6250	7.54 .297	5.94 .234	0.13 .005	0.41 .016	8	2.381 3-32	320 705	175 385		
KP3AK-2X	4.826 .1900	15.875 .6250	15.88 .625	5.94 .234	0.13 .005	0.41 .016	8	2.381 3-32	320 705	175 385		
W4AKX	6.350 .2500	19.050 .7500	11.13 .438	7.92 .312	0.13 .005	0.41 .016	7	3.175 1-8	494 1090	272 600		
KP4KX	6.350 .2500	22.896 .9014	12.29 .484	8.51 .335	0.13 .005	0.86 .034	7	3.969 5-32	776 1710	363 800		



**CONTROL BEARINGS
P SERIES**

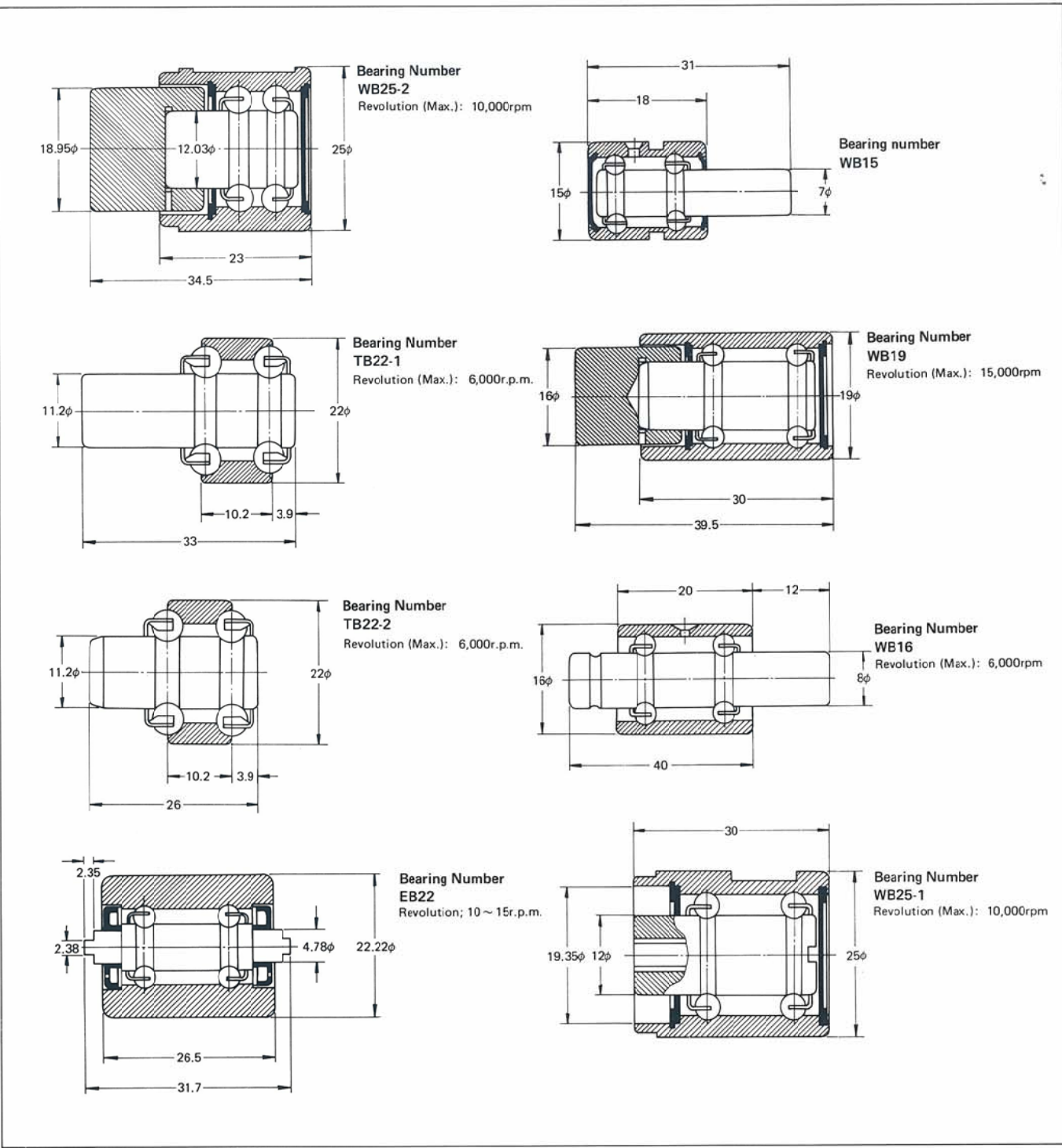
Equipped with teflon seals.



BEARING NUMBER	BORE		O.D.		WIDTH		MINIMUM CHAMFER		BALLS		LIMITED LOAD RATINGS	
	d	D	Bi	Bo	r1	r2	NO.	SIZE	RADIAL	THRUST		
	Dimensions mm inches											
	+0.000	+0.000	+0.00	+0.00	+0.38	+0.38					(kgf)	(kgf)
	-0.013	-0.013	-0.13	-0.13	-0.00	-0.00					(lbf)	(lbf)
	+0.000	+0.000	+0.00	+0.00	+0.15	+0.15						
	-0.005	-0.005	-0.05	-0.05	-0.00	-0.00						
P 4KX	6.350	22.225	11.13	9.52	0.13	0.56	7	3.969	776	363		
	.2500	.8750	.438	.375	.005	.022		5-32	1710	800		
P 5KX	7.938	22.225	15.88	9.52	0.13	0.56	7	3.969	776	363		
	.3125	.8750	.625	.375	.005	.022		5-32	1710	800		
PD5KX	7.938	23.812	15.88	14.30	0.13	0.56	14	3.969	1551	467		
	.3125	.9375	.625	.563	.005	.022		5-32	3420	1030		
P 8X *	12.700	42.862	19.05	14.30	0.13	0.81	10	8.731	5352	2359		
	.5000	1.6875	.750	.563	.005	.032		11-32	11800	5200		
P10KX	15.875	30.162	11.13	9.52	0.13	0.56	10	3.969	1107	499		
	.6250	1.1875	.438	.375	.005	.022		5-32	2440	1100		

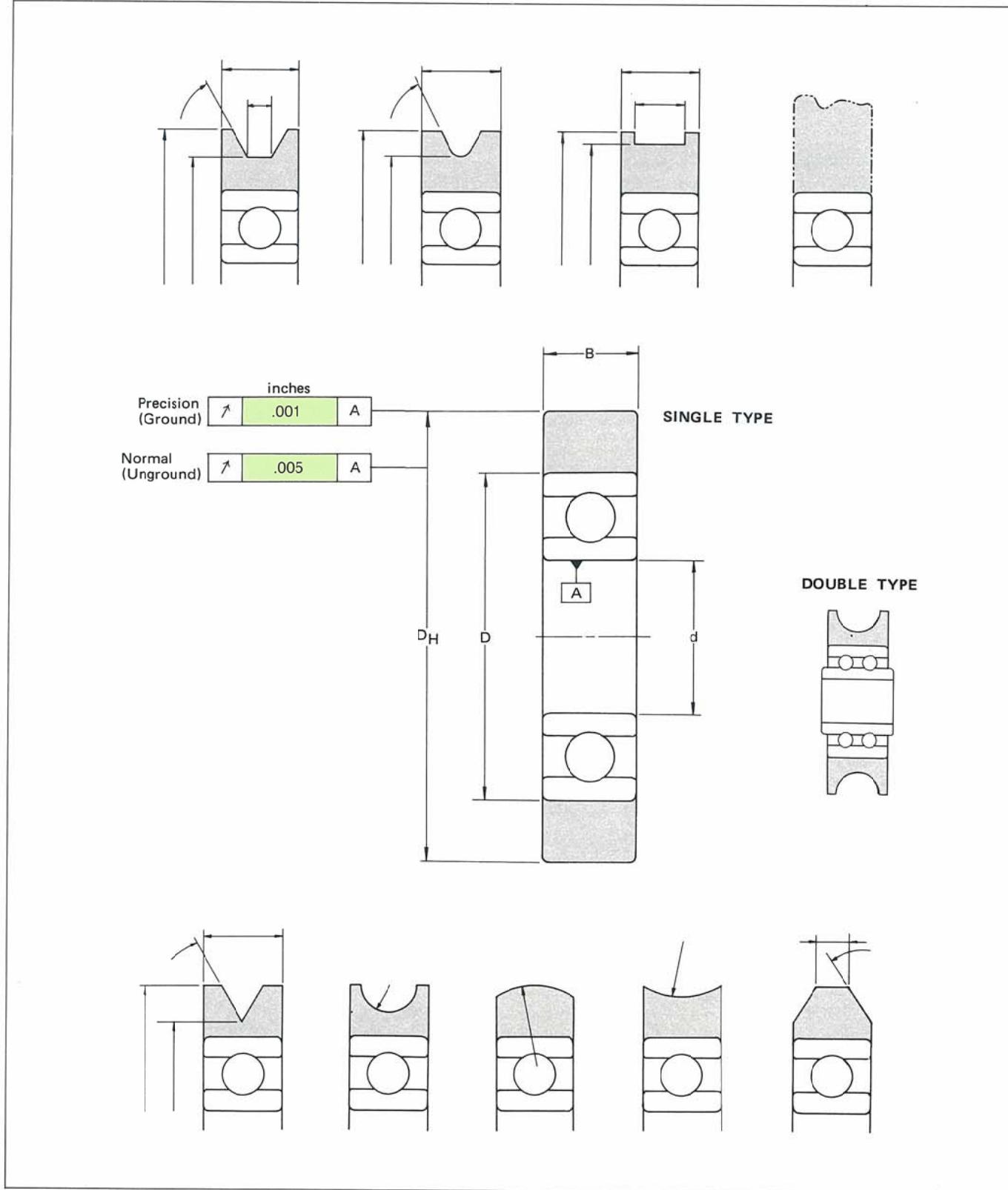
* Full complement-no cage.

**SPECIAL BEARINGS
DOUBLE ROW BALL BEARINGS
FOR SPINNING MACHINE**



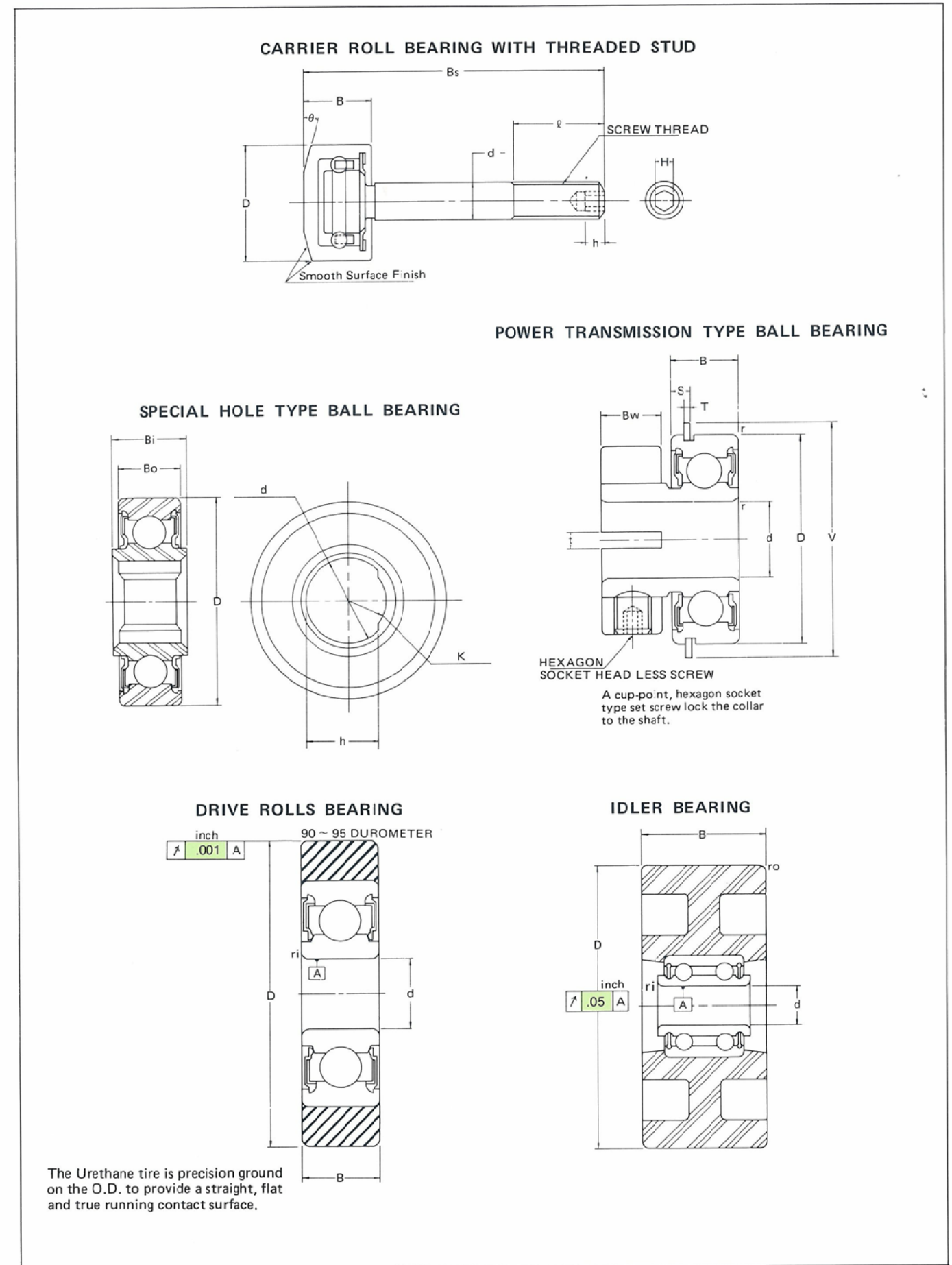
SPECIAL BEARINGS
HOUSING TYPE BALL BEARINGS

MATERIAL: HARD ANODIZED ALUMINUM, ACETAL RESIN SAE 52100 CHROME STEEL,
 AISI 440C STAINLESS STEEL
 INSERT BEARING: SINGLE ROW BALL BEARING, DOUBLE ROW BEARING



BALL 29 BEARINGS

SPECIAL BEARINGS



BALL 30 BEARINGS

IJK

MATERIAL

As regard the material of bearings, JIS G4805 High Carbon Chromium Bearing Steel Class 2 (SUJ2) is in general use, but where corrosion resistance is required, JIS G4303 Stainless Steel Bar Class 440 (SUS 440C) which belongs to martensite type stainless steel used.

Table 1 Composition of bearing material

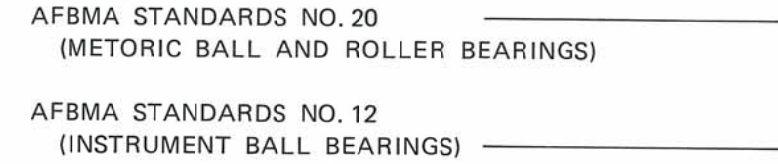
Kind of steel	Symbol	Chemical composition							Similar steel
		C	Si	Mn	P	S	Cr	Mo	
High Carbon Chromium Bearing Steel Class 2	SUJ 2	0.95 ~ 1.10	0.15 ~ 0.35	Max. 0.50	Max. 0.025	Max. 0.025	1.30 ~ 1.60	—	AISI 52100
Stainless Steel Bar Class 440	SUS 440C	0.95 ~ 1.20	Max. 1.00	Max. 1.00	Max. 0.040	Max. 0.030	16.00 ~ 18.00	Max. 0.75	AISI 440C

TOLERANCE

The bearings, which are important mechanical elements are used for every machinery, have internationally standardized: ISA, ISO.

The countries of the world have the standards of the bearings: JIS (JAPAN), ANSI/AFBMA (U.S.A.), DIN (Germany), BS (England)

IJK have applied AFBMA STANDARDS.



Selection of Tolerance

Tolerance class of bearings is designated according to application.

Table 2 Selection of tolerance class

Place of application	Tolerance class
Electric motor, generator, servomechanism, cam mechanism, pinch roller, servomotor, low sensitivity synchro, etc.	ABEC 1, ABEC 3,
Gyro gimbals & rotor, high sensitivity synchro, servomotor, resolver, potentiometer, high frequency spindle, etc.	ABEC 5P, ABEC 7P,

INTERNAL CLEARANCE

The internal clearance of bearing has a considerable affect upon the life, generation of heat, and noise of the bearing; Accordingly, it is important to select clearance most suitable for the working conditions.

To determine the clearance of bearings, the following should be taken into account.

Decrease of the clearance by fitting.

Decrease of the clearance by the difference of temperature of the inner and outer rings.

The most suitable operating clearance.

IJK Tolerance Limits are shown in the following table. (Table 3 ~ Table 8) (AFBMA Tolerance Limits See Table 9)

Table 3 Radial Internal Clearance in Single Row Deep Groove Ball Bearings under No Load

Values in 0.001 mm

Nominal Bore Diameter <i>d</i> mm	Radial Internal Clearance								
	C2		Normal		C3		C4		
Over	Incl	Low	High	Low	High	Low	High	Low	High
(10mm only*)	—	7	2	13	8	23	14	29	—
10	18	—	9	3	18	11	25	18	33
18	24	—	10	5	20	13	28	20	36
24	30	—	11	5	20	13	28	23	41
30	40	—	11	6	20	15	33	28	46
40	50	—	11	6	23	18	36	30	51
50	65	—	15	8	28	23	43	38	61

Values in 0.0001 inch

Nominal Bore Diameter <i>d</i> inch	Radial Internal Clearance								
	C2		Normal		C3		C4		
Over	Incl	Low	High	Low	High	Low	High	Low	High
(0.3937 inch only*)	—	2.8	0.8	5.1	3.1	9.1	5.5	11.4	—
0.3937	0.7087	—	3.5	1.2	7.1	4.3	9.8	7.1	13.0
0.7087	0.9449	—	3.9	2.0	7.9	5.1	11.0	7.9	14.2
0.9449	2.1811	—	4.3	2.0	7.9	5.1	11.0	9.1	16.1
1.1811	1.5748	—	4.3	2.4	7.9	5.9	13.0	11.0	18.1
1.5748	1.9685	—	4.3	2.4	9.1	7.1	14.2	11.8	20.1
1.9685	2.5591	—	5.9	3.1	11.0	9.1	16.9	15.0	24.0



Table 4 Radial Internal Clearance in Extra Small and Miniature Ball Bearings under No Load

Values in 0.001 mm

Clearance Symbols	MC1		MC2		MC3		MC4		MC5		MC6	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Radial Internal Clearance	0	5	3	8	5	10	8	13	13	20	20	28
Nominal Bore Diameter $d < 10\text{mm}(0.3937\text{ inch})$												
Values in 0.0001 inch												
Clearance Symbols	MC1		MC2		MC3		MC4		MC5		MC6	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Radial Internal Clearance	0	2.0	1.2	3.1	2.0	3.9	3.1	5.1	5.1	7.9	7.9	11.0

Table 5 Radial Internal Clearances in Magneto Bearings under No Load

Nominal Bore Diameter d				Radial Internal Clearance			
mm		inch		Values in 0.001 mm		Values in 0.0001 inch	
Over	Incl	Over	Incl	Low	High	Low	High
2.5	30	0.0984	1.1811	30	60	11.8	23.6

Table 6 Radial Internal Clearances of Deep Groove Ball Bearings for Electric Motors

Nominal Bore Diameter d				Radial Internal Clearance CM			
mm		inch		Values in 0.001 mm		Values in 0.0001 inch	
Over	Incl	Over	Incl	Low	High	Low	High
($d=$) 10		($d=$) 0.3937		4	11	1.6	4.3
10	18	0.3937	0.7087	4	11	1.6	4.3
18	30	0.7087	1.1811	5	12	2.0	4.7
30	50	1.1811	1.9685	9	17	3.5	6.7

Table 7 Radial Internal Clearances in Self-Aligning Ball Bearings with Cylindrical Bore under No Load

Values in 0.001 mm

Nominal Bore Diameter d mm		Radial Internal Clearance							
		C2		Normal		C3		C4	
Over	Inch	Low	High	Low	High	Low	High	Low	High
2.5	6	1	5	5	10	10	15	15	21
6	10	2	6	6	12	12	19	19	27
10	14	2	6	6	13	13	21	21	30
14	18	3	8	8	15	15	23	23	32
18	24	4	10	10	17	17	25	25	34
24	30	5	11	11	19	19	29	29	40
30	40	6	13	13	23	23	34	34	46
40	50	6	14	14	25	25	37	37	50
50	65	7	16	16	30	30	45	45	65

Values in 0.001 inch

Nominal Bore Diameter d inch		Radial Internal Clearance							
		C2		Normal		C3		C4	
Over	Incl	Low	High	Low	High	Low	High	Low	High
0.0984	0.2362	0.4	2.0	2.0	3.9	3.9	5.9	5.9	8.3
0.2362	0.3937	0.8	2.4	2.4	4.7	4.7	7.5	7.5	10.6
0.3937	0.5512	0.8	2.4	2.4	5.1	5.1	8.3	8.3	11.8
0.5512	0.7087	1.2	3.1	3.1	5.9	5.9	9.1	9.1	12.6
0.7087	0.9449	1.6	3.9	3.9	6.7	6.7	9.8	9.8	13.4
0.9449	1.1811	2.0	4.3	4.3	7.5	7.5	11.4	11.4	15.7
1.1811	1.5748	2.4	5.1	5.1	9.1	9.1	13.4	13.4	18.1
1.5748	1.9685	2.4	5.5	5.5	9.8	9.8	14.6	14.6	19.7
1.9685	2.5591	2.8	6.3	6.3	11.8	11.8	17.7	17.7	25.6
2.5591	3.1496	3.1	7.1	7.1	13.8	13.8	21.3	21.3	29.9
3.1496	3.9370	3.5	8.7	8.7	16.5	16.5	25.2	25.2	35.0
3.9370	4.7244	3.9	9.8	9.8	19.7	19.7	29.5	29.5	41.3



Table 8 Axial Internal Clearances in Double Row Angular Contact Ball Bearings under No Load

Values in 0.001 mm

Nominal Bore Diameter d mm		Axial Internal Clearance					
		C2		Normal		C3	
Over	Incl	Low	High	Low	High	Low	High
—	10	0	6	4	11	11	18
10	18	0	6	4	14	14	24
18	24	0	8	6	16	16	27
24	30	0	8	6	17	17	28
30	40	0	9	7	18	18	29
40	50	0	10	9	20	20	32

Values in 0.0001 inch

Nominal Bore Diameter d inch		Axial Internal Clearance					
		C2		Normal		C3	
Over	Incl	Low	High	Low	High	Low	High
—	0.3937	0	2.4	1.6	4.3	4.3	7.1
0.3937	0.7087	0	2.4	1.6	5.5	5.5	9.4
0.7087	0.9449	0	3.1	2.4	6.3	6.3	10.6
0.9449	1.1811	0	3.1	2.4	6.7	6.7	11.0
1.1811	1.5748	0	3.5	2.8	7.1	7.1	11.4
1.5748	1.9685	0	3.9	3.5	7.9	7.9	12.6

Table 9 Radial Internal Clearances, Single Row, Radial Contact, Ball Bearings.

(AFBMA STANDARD NO. 20 – 1977)

Tolerance Limits for Radial Internal Clearance of Single Row, Radial Contact Ball Bearings under no load

(Applicable to Bearings of ABEC 1, ABEC 5, ABEC 7 and ABEC 9 Tolerance Classes)

TOLERANCE LIMITS IN 0.0001 INCH

BASIC BORE DIAMETER d mm		SYMBOL 2 ⁽¹⁾				SYMBOL 0 ⁽¹⁾ (Normal)				SYMBOL 3 ⁽¹⁾				SYMBOL 4 ⁽¹⁾			
		Acceptance Limits				Acceptance Limits				Acceptance Limits				Acceptance Limits			
		Mfg. Limits		Mfg. Limits		Mfg. Limits		Mfg. Limits		Mfg. Limits		Mfg. Limits		Mfg. Limits		Mfg. Limits	
Over	Incl.	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
2.5	10	-	-	2.5	3.0	1	1.5	4.5	5	3	4	8	9	-	-	-	-
10	18	-	-	3.0	3.5	1	2	6	7	4	5	9	10	7	8	12	13
18	24	-	-	3.5	4.0	2	3	7	8	5	6	10	11	8	9	13	14
24	30	-	-	4	4.5	2	3	7	8	5	6	10	11	9	10	15	16
30	40	-	-	4	4.5	2	3	7	8	5	6	10	11	9	10	15	16
40	50	-	-	4	4.5	2	3	8	9	7	8	13	14	12	13	19	20
50	65	-	1	5	6	3	4	10	11	9	10	16	17	15	16	23	24
65	80	-	1	5	6	4	5	11	12	10	11	19	20	18	19	27	28
80	100	-	1	6	7	5	6	13	14	12	13	22	23	21	22	32	33
100	120	-	1	7	8	6	7	15	16	14	15	25	26	24	25	37	38
120	140	-	1	8	9	7	8	18	19	16	18	30	32	28	30	43	45
140	160	-	1	8	9	7	8	20	21	18	20	34	36	32	34	49	51
160	180	-	1	9	10	8	9	23	24	21	23	38	40	36	38	55	58
180	200	-	1	11	12	10	11	27	28	25	27	44	46	42	44	62	64

(1) These symbols relate to the Identification Code.

LUBRICANT CODE TABLE

The standard lubrication for IJK BALL BEARINGS is NS7; however, many other types of lubricants may be supplied. A number of other standard and acceptable lubricants are shown in the following table.

COMMON OILS AND GREASES

NAME	MANUFACTURE	U.S.A. MIL SPEC.	IJK CODE	OPERATING TEMPERATURE RANGE (°F)	THICKNER TYPE	LUBRICANT BASE
Aero Shell Fluid 3	Shell	MIL-L-7870A	AF3	-70 ~ +240	-	Petroleum
Aero Shell Fluid 12	Shell	MIL-L-6085A	AF2	-65 ~ +250	-	Diester
Anderol L-401D	Teneco	MIL-L-6085A	A4D	-75 ~ +260	-	Diester
Aero Shell Grease 6	Shell	MIL-G-7711A	AG2	-40 ~ +250	Non-soap	Mineral
Aero Shell Grease 5	Shell	MIL-G-3545C	AG3	-40 ~ +350	Non-soap	Mineral
Aero Shell Grease 14	Shell	MIL-G-255374	AG4	-65 ~ +250	Ca	Mineral
Aero Shell Grease 15A	Shell	MIL-G-25013D	AG5	-100 ~ +500	Non-soap	Silicon
Aero Shell Grease 16	Shell	MIL-G-25760A	AG6		Non-soap	Diester
Aero Shell Grease 22	Shell	MIL-G-81322A	A22		Non-soap	Diester
Alvania No. 1	Shell		AV1	-15 ~ +250	Li	Mineral
Alvania No. 2	Shell		AV2	-15 ~ +250	Li	Mineral
Alvania No. 3	Shell		AV3	-15 ~ +280	Li	Mineral
Alvania RA	Shell		AVR	-40 ~ +280	Li	Mineral
Aero Shell Grease 17	Shell	MIL-G-21164C	AG8	-100 ~ +300	Microgel	Diester
Alvania EP Grease 2	Shell	MIL-G-21164C	AP2	0 ~ +230	Li	Mineral
Andok B	Esso	MIL-G-18709A	AKB	-40 ~ +250	Na	Mineral
Andok C	Esso		AKC	0 ~ +250	Na	Mineral
Andok 260	Esso	MIL-G-3545B	AK2	0 ~ +300	Na	Mineral
Anderol L-793A	Teneco	MIL-G-3278A	AL7	-75 ~ +300	Na	Diester
Texaco Regal AFB2	Texaco		AB2		Li	Mineral
Beacon 325	Esso	MIL-G-3278A	B32	-65 ~ +250	Li	Diester
Tore Silicon SH331	Tore	MIL-S-27875	D31	-100 ~ +350	-	-
Dow Corning DC44	Dow	MIL-G-15719A	D4F	-40 ~ +400	Li	Silicon
Dow Corning DC55	Dow	MIL-G-4343A	D5M	-65 ~ +325	Li	Silicon
Tore silicon SH44M	Tore		D4M	-40 ~ +400	Li	Silicon
Krytox 240 AB	Dupont	MIL-G-38220	KAB	-40 ~ +400	Fluorotelomer	Fluorinated
Krytox 240 AC	Dupont	MIL-G-27617A	KAC		Fluorotelomer	Fluorinated
Krytox 240 AD	Dupont	MIL-G-27617A	KAD		Fluorotelomer	Fluorinated
Krytox 283 AC	Dupont	MIL-G-27617A	K3C		Fluorotelomer	Fluorinated
Krytox 280 AC	Dupont	MIL-G-27617A	K0C		Fluorotelomer	Fluorinated
Mobil 28	Mobil	MIL-G-81322A	MG2	-65 ~ +350	Non-soap	Synthetic
NS High Lube	Kyodo Ushi		NS7	-40 ~ +260	Li	Diester
Martemp PS No. 1	Mobil		PS1		Li	Diester
Martemp PS No. 2	Mobil		PS2	-40 ~ +230	Li	Diester
Martemp PS No. 3	Mobil		PS3		Li	Diester
Martemp PS 2A	Mobil		PSA		Li	Diester
Univis P-38	Esso	MIL-L-6085A	P38		-	-
Caltex RPM BRB-2	Caltex	MIL-G-3545B	RB2		Non-soap	Mineral
Caltex Aviation 33	Caltex	MIL-G-3545B	RP3		Non-soap	Mineral
Caltex RPM SRI 2	Caltex		SRI		Non-soap	Mineral
Molykote EP	Dow		MEP		Li	Mineral



TORQUE

Standard Torque Unit — The standard units of torque shall be the milligram-force millimeter. Convenient multiples thereof may also be used (1gram-force centimeter = 10,000 milligram force millimeter). Ref. AFBMA STANDARD NO. 12 — 1969 TABLE 9. (STARTING TORQUE VALUES FOR INSTRUMENT BALL BEARINGS)

VIBRATION (NOISE GRADE CODE)

One basis for quality ball bearings is the degree of quietness with which they operate. Higher grade bearings receive an ANDEROMETER Test or IJK-developed "VMC" to check noise level and nature of sound. The operator observes vibration noise level readings visually on dial level meter or oscilloscope.

Grade N = Commercial grade.
EM = Indicates very low noise-leveled bearings for electric motor quality.
EMR = Best quality

SPECIAL REQUIREMENTS

- CHAMFERS
- FACE CONDITIONS
- SURFACE CONDITIONS
- PLATING
- WIDTH
- MATERIAL
- HEAT STABILIZATION

Please consult with your IJK sales engineer or contact the factory in Japan for information on many special sizes not listed in the catalog.

NUMBERING SYSTEM

DEEP GROOVE BALL BEARINGS

Typical Call-Out	S	F	R4	E	J	ZZ	EM	5	K25	B32-L	Q15
	Material	Flange	Basic Number	Special Feature	Retainer Type	Closures	Vibration Spec.	Tolerance	Radial Clearance	Lubrication	Torque Spec.
Code Positions	1	2	3	4	5	6	7	8	9	10	11

EXAMPLES: SFR4EZZEM5K25B32Q15

1	S = AISI 440C Stainless Steel OMITTED = SAE 52100 Chrome Steel										
2	F = Flanged										
3	Basic Number										
4	E = Extended Inner Ring NW = Narrower Than Standard Width W = Wider Than Standard Width										
5	J = Two Piece Ribbon, Crimped (Omitted) TD = Delrin Crown TG = Teflon Slugs TN = Nylon Crown TP = Phenol Crown										
6	Z1 = Shield on Flanged Side, RS = 1 Rubber Seal Molded Steel. Z2 = Shield Opposite Flange, 2RS = 2 Rubber Seal Molded Steel. Z = 1 Shield, ZZ = 2 Shield, T = 1 Teflon Seal Grass-Reinforced ZS = 1 Shield, Removable TT = 2 Teflon Seal Grass-Reinforced ZZS = 2 Shield, Removable										
7	N = Commercial Grade EM = High Grade (General Motor Grade) EMR = Higher Grade Than EM (Precision Motor Grade)										
8	1 = ABEC 1, 3 = ABEC 3, 5 = ABEC 5, 7 = ABEC 7										
9	K Followed by Last Digit of Each Limit. EXAMPLE .0002 to .0005 = K25 (inches) .0002 to .0008 = K28 IJK Standard, → Table 3 ~ Table 8 See clearance Symbols AFBMA Standard → Table 9										
10	AF2 = ASF12 (MIL-L-6085A) — Amount of Grease (%) AK2 = ANDOK 260 (MIL-G-3545B) — L = Light B32 = BEACON 325 (MIL-G-3278A) — M = Medium NS7 = NS High Lube — F = Full PS2 = Maltemp PS No. 2										
11	Q Followed by a Number Indicates Peak Starting Torque Limit in Hundred of mg.mm. for Example "Q15" Indicates a Bearing with Less Than 1500 mg. mm. Peak Starting Torque.										

TOLERANCES

ABEC standards for dimensional tolerances and terminology have been established by the Anti Friction Bearing Manufacturers Association. These are shown in the tables below. Tolerances are in .0001".

INNER RING	BORE DIAMETER				Bore Tolerance +0		Radial Runout		Width Tolerance +0	
	mm		inch		ABEC 3	ABEC 1	ABEC 3	ABEC 1	ABEC 3	ABEC 1
	Over	Incl	Over	Incl						
	0	10	0	0.3937	-2	-3	2	3	-50	-50
	10	18	0.3937	0.7087	-2	-3	3	4	-50	-50
	18	30	0.7087	1.1811	-2	-4	3	5	-50	-50

INNER RING	BORE DIAMETER				Bore Tolerance +0		Radial Runout (Max.)		Width Variation (Max.)		Width Tolerances +0		Bore 2 point Out-of-Round (Max.)		Bore Taper (Max.)					
	mm		inch		ABEC 7P	ABEC 5P	ABEC 7P	ABEC 5P	ABEC 7P	ABEC 5P	ABEC 7P	ABEC 5P	ABEC 7P	ABEC 5P	ABEC 7P	ABEC 5P				
	Over	Incl	Over	Incl																
	0	10	0	0.3937	-2	-2	1.0	1.5	1	2	1.0	3	1.0	3	-10	-10	1	1	1	1
	10	18	0.3937	0.7087	-2	-2	1.0	1.5	1	2	1.0	3	1.0	3	-10	-10	1	1	1	1
	18	30	0.7087	1.1811	-2	-2	1.5	1.5	1	2	1.5	3	1.5	3	-10	-10	1	1	1	1

OUTER RING	OUTSIDE DIAMETER				O.D. Tolerance +0		Radial Runout (Max.)		Width Variation (Max.)		Outside Cylindrical Surface Runout with Reference Side (Max.)		Groove Runout with Reference Side (Max.)		With Toleranced +0		Flange Width Tolerance Limits +0		Flange Diameter Tolerance Limits +0		O.D. 2 Point Out-of-Round (Max.)		Outside Diameter Taper (Max.)	
	mm		inch		ABEC 7P	ABEC 5P	ABEC 7P	ABEC 5P	ABEC 7P	ABEC 5P	ABEC 7P	ABEC 5P	ABEC 7P	ABEC 5P	ABEC 7P	ABEC 5P	ABEC 7P	ABEC 5P	ABEC 7P	ABEC 5P	ABEC 7P	ABEC 5P	ABEC 7P	ABEC 5P
	Over	Incl	Over	Incl																				
	18	30	0.7087	1.1811	-2	-2	1.5	2	1	2	1.5	3	2	3	-10	-10	-20	-20	-10	-10	1	1	1	1
	0	18	0	0.7087	-2	-2	1.5	2	1	2	1.5	3	2	3	-10	-10	-20	-20	-10	-10	1	1	1	1
	30	50	1.1811	1.9685	-2	-2	1.2	2	1	2	1.5	3	2	3	-10	-10	-20	-20	-10	-10	1	1	1	1

INNER RING	BORE DIAMETER d				BORE TOLERANCE LIMITS(S)								Radial Runout	Width Variation	Bore Runout with Reference Side	Raceway Runout with Reference Side
	mm		inch		dm		Torque Tube Type		Extra Thin Section							
	Over	Incl	Over	Incl	Low	High	d ₁	d ₂	d _{min}	d _{max}	d _{min}	d _{max}				
	13	18	.5118	.7087	-2	+0	-3	+1	-3	+1	2	2	3	3		
	18	30	.7087	1.1811	-2	+0	-3	+1	-4	+2	2	2	3	3		
	30	45	1.1811	1.7717	-3	+0	-4	+1	-6	+3	3	2	3	3		

OUTER RING	OUTSIDE DIAMETER D				OUTSIDE DIAMETER TOLERANCE LIMITS (2)										Radial Runout	Width Variation	Outside Cylindrical Surface Runout with Reference Side	Raceway Runout with Reference Side
	mm		inch		Dm		Open Type Bearings				Shielded or Sealed Bearings							
	Over	Incl	Over	Incl	High	Low	D _{max}	D _{min}	D _{max}	D _{min}	D _{max}	D _{min}	D _{max}	D _{min}				
	18	28	.7087	1.1024	+0	-2	+1	-3	+1	-3	+1	-4	+2	-4	2	2	3	3
	28	50	1.1024	1.9685	+0	-4	+1	-5	+3	-7	+2	-6	+4	-3	3	2	3	3
	50	80	1.9685	3.1496	+0	-4	+1	-5	+4	-8	+2	-6	+5	-9	3	2	3	4

INNER RING	BORE DIAMETER d				BORE TOLERANCE LIMITS(1)								Radial Runout	Width Variation	Bore Runout with Reference Side	Raceway Runout with Reference Side
	mm		inch		dm		Torque Tube Type		Extra Thin Section							
	Over	Incl	Over	Incl	Low	High	d _{min}	d _{max}	d _{min}	d _{max}	d _{min}	d _{max}				
	13	18	.5118	.7087	-2	+0	-2	+0	-2	+0	1	1	1	1		
	18	30	.7087	1.1811	-2	+0	-2.5	+0.5	-3	+1	1.5	1	1.5	1.5		
	30	45	1.1811	1.7717	-2	+0	-3	+1	-4	+2	1.5	1	1.5	1.5		

OUTER RING	OUTSIDE DIAMETER D				OUTSIDE DIAMETER TOLERANCE LIMITS(2)										Radial Runout	Width Variation	Outside Cylindrical Surface Runout with Reference Side	Raceway Runout with Reference Side
	mm		inch		Dm		Open Type Bearings				Shielded or Sealed Bearings							
	Over	Incl	Over	Incl	High	Low	D _{max}	D _{min}	D _{max}	D _{min}	D _{max}	D _{min}	D _{max}	D _{min}				
	18	28	.7087	1.1024	+0	-2	+0	-2	+0	-2	+1	-3	+1	-3	1.5	1	1.5	2
	28	50	1.1024	1.9685	+0	-2	+1	-3	+2	-4	+2	-4	+3	-5	2	1	1.5	2
	50	80	1.9685	3.1496	+0	-3	+1	-4	+3	-6	+2	-5	+4	-7	2	1.5	1.5	3

ABEC 5T ABEC 7T TOLERANCE LIMITS	Bore Inner Ring Bore				Bearings Other Than Duplex				Duplex Bearings			
	mm		inch		Width of Individual Inner or Outer Ring				Total Width of a pair of Inner or Outer Rings			
					HIGH		LOW		HIGH		LOW	
	Over	Incl	Over	Incl	ABEC 5T	ABEC 7T	ABEC 5T	ABEC 7T	ABEC 5T	ABEC 7T	ABEC 5T	ABEC 7T
	0	30	0	1.1811	+0	+0	-10	-10	+0	+0	-150	-150
	30	80	1.1811	3.1496	+0	+0	-50	-10	+0	+0	-200	-150

(1) $\frac{d_{max} + d_{min}}{2}$ must be with dm. (2) $\frac{D_{max} + D_{min}}{2}$ must be with in dm.



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