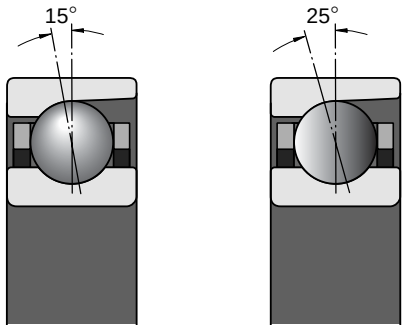
To meet the various demands with regard to running accuracy, speed capability, stiffness as well as load carrying capacity placed on precision bearing arrangements in an optimum manner, two different types of single row angular contact ball bearings are available from MRC:

- precision angular contact ball bearings
- hybrid precision angular contact ball bearings (with ceramic balls)

MRC precision angular contact ball bearings are non-separable and are essentially single row angular contact ball bearings. In all such bearings the load is transmitted from one raceway to another at an angle to the bearing axis. These bearings can therefore carry axial loads acting in one direction in addition to radial loads. Axial forces produced in the bearing when subjected to a radial load must be counteracted by an opposing force applied externally. The bearings are therefore adjusted against a second bearing.

The internal design of MRC precision angular contact ball bearings differs appreciably from that of standard single row bearings and reflects the latest state of the art where machine tool bearings are concerned. Only one flange on one ring has reduced height; the contact angles are small, and lightweight one-piece cages with a large number of balls are incorporated.

To meet the requirements of modern machine tool applications as fully as possible, MRC precision angular contact ball bearings are made in several series and designs. They are supplied in matched bearing sets. Bearing sets are used when the load carrying capacity of a single bearing is inadequate, or if axial loads acting in both directions have to be accommodated.



Precision Angular Contact Ball Bearings

MRC precision angular contact bearings are designed with either a 15° or 25° contact angle in order to meet specific machine tool spindle application requirements.

The 15° contact angle bearings are available in the 1900RDS, 100KRDS, 200RDS and 300RDS series, and have ample radial and axial load capacity for most applications, and have the ability to operate at very high speeds.

The 25° contact angle bearings are available in the 71900DS, 7100KRDS, and 7200DS series, can carry very high axial loads and provide ample axial stiffness.

All of the precision angular contact bearings shown in this catalog incorporate a light preload (GA). Many of the sizes listed are available from stock. Other sizes and preloads can be furnished upon request.

Matched Bearing Sets

All MRC precision angular contact ball bearings can be supplied as required in complete sets of two, three, four, and five matched bearings.

The bearings of a set are matched in production so that when they are mounted immediately adjacent to each other in the prescribed order, a given preload will be obtained or the load will be evenly distributed. The bore and outside diameters of the bearings of a set differ from each other by half the permissible diameter tolerance.

To facilitate correct mounting, the bearings of a matched set have a “V” marking on their outside cylindrical surface. The prescribed order must be adhered to if the set is to perform properly. The “V” marking also indicates how the set should be mounted in relation to the axial load. The point of the “V” indicates the direction in which the axial load should act on the center ring. Where axial load acts in both directions, the “V” indicates the direction of the greater axial load.

The bearings of a set are supplied in a unit package but are individually packed within the package.

Universal Bearings for Paired Mounting

These “universal” bearings are a special version of the precision bearings and are intended for paired mounting. They are adjusted during manufacture so that they may be mounted immediately adjacent to each other in a back-to-back, face-to-face or tandem arrangement as desired. When arranged back-to-back or face-to-face, the bearings will have a light preload.

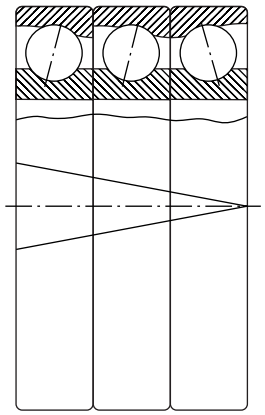
Bearings of universal design are identified by the designation suffix DS.

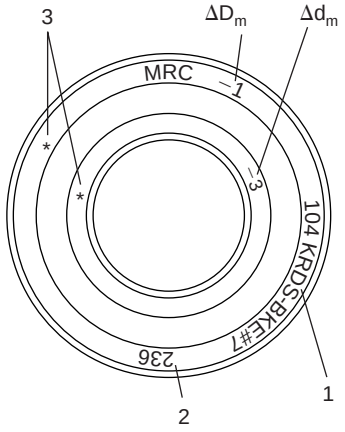
When ordering these bearings it should be remembered that the number of bearing pairs required should be stated, not the number of single bearings.

Tolerances

MRC precision angular contact bearings are manufactured to tolerances that meet the dimensional and running accuracy required in machine tool spindle applications. The tolerances are found in the table on page 24.

Each bearing of a matched set is marked, as illustrated in the adjacent figure, with the complete designation of the bearing set (1) and with the same consecutive number (2) on the face of the outer ring. The position of the greatest out-of-round is also marked on the inner and outer ring faces with an asterisk (3), i.e. the marking shows the greatest wall thickness between the base of the raceway groove and the bore or outside diameter surface. In addition, this position is also indicated by the "V" marking on the outer ring, which is always applied at this position. The actual values of the mean deviations from the nominal bore and outside diameters, Δd_m and ΔD_m respectively, are given on the rings and on the package (expressed in μm).





Mounting Bearing Sets

When mounting bearing sets it should be remembered that the positions of greatest out-of-round on the inner rings should be lined up as well as those on the outer rings. As already mentioned, the order indicated by the "V" marking, and the direction should be adhered to.

Bearing arrangements with particularly high running accuracy can be obtained if the bearings are mounted so that the position of greatest out-of-round of the inner ring is opposite to the position of greatest out-of-round of the shaft. In arrangements where the bearing outer rings rotate, the greatest out-of-round of the outer ring should be diametrically opposed to that of the housing bore.

If spacer sleeves are to be mounted between the bearings of a matched set, sufficient accuracy will be obtained if the sleeves between the inner and outer rings have the same width and flat, parallel faces. This can be achieved by machining the sleeves together, e.g. on a lapping machine. It should be remembered that the order of the bearings indicated by the "V" should be maintained even when spacer sleeves are used.

Speed Ratings

The speed ratings quoted in the bearing tables are guideline values and are valid provided that the bearings are lightly loaded ($P \leqq 0.06\ C$), are lightly preloaded by means of springs, and that good heat dissipation exists.

The values under oil lubrication are maximum values and should be reduced for certain other methods of oil lubrication. The values under grease lubrication are maximum values which can be attained using a good quality grease of soft consistency.

If single bearings have to be adjusted against each other to a greater degree to increase spindle stiffness, or if matched sets of two, three, four or five bearings are to be used, the limiting speed values given in the tables must be reduced. Reduction factors to obtain guideline values for the appropriate conditions are given in the table on page 19. The limiting speeds quoted in the bearing tables should be multiplied by these factors as appropriate.

If the limiting speeds, from the table below, for matched bearing sets are inadequate, a simple design change—the inclusion of intermediate rings between the bearings—will allow appreciable increases to be made. For sets of three bearings, for example, it should then be possible to run at the limiting speeds for paired bearings. Springs to preload the bearings may be beneficial. This type of preload is generally used for high speed operation in order to obtain an even preload over the whole operating range of the machine.

Reduction Factors for Limiting Speeds

	Reduction Factor		
	Preload		
Bearing Arrangement	Light	Medium	Heavy
Set of two bearings arranged in tandem	0.90	0.80	0.65
Sets of two bearings arranged back-to-back	0.80	0.70	0.55
Sets of three bearings	0.70	0.55	0.35
Sets of four bearings	0.65	0.45	0.25
Sets of five bearings	0.60	0.40	0.20

Cages

All MRC precision angular contact ball bearings are fitted with an outer ring centered cage of fabric reinforced phenolic resin. The cages are of a particularly light-weight design in order to keep centrifugal force at a minimum, and are designed to allow free passage of lubricant to the ball/raceway contacts.

Suffix Designations

MRC precision angular contact ball bearings are identified by the basic size number followed by the suffixes DS, BKE and #7, as shown in the bearing tables.

DS a duplex single bearing having a light preload as standard.

BKE an outer ring centered fabric reinforced phenolic resin cage also known as bake, or bakelite.

#7 ABEC 7 tolerance grade.

Hybrid Precision Angular Contact Ball Bearings

MRC hybrid precision angular contact ball bearings are identical in design to precision bearings, but incorporate silicon nitride ceramic balls. Silicon nitride is a material that improves wear characteristics, is chemically inert in harsh conditions, and has electrical insulating properties. Compared to traditional all-steel bearings, the service life of hybrid bearings can be increased by as much as ten times.

The silicon nitride ceramic material demonstrates a good combination of stiffness, hardness, wear resistance and density. The ceramic balls have 60% lower density than steel balls so that the centrifugal forces in the bearing are much reduced. The lighter balls also cause less alteration of the contact angle and increase the dynamic accuracy of the bearing.

A 70% smaller thermal expansion than for steel balls considerably reduces the influence of temperature changes on the bearing preload. It is therefore possible for hybrid bearings to operate at speeds which are some 20% higher than for all-steel bearings without any risk of uncontrolled preload increases occurring.

The modulus of elasticity of the ceramic material is some 50% greater than for steel. Thus hybrid bearings are stiffer, by up to 20% at elevated speeds. Power losses are reduced by approximately 10% compared with all-steel bearings. Most of the precision angular contact bearings available from MRC, can be furnished with silicon nitride balls, made-to-order.

Preload

For single bearings, preload is obtained first after mounting and depends on adjustment against a second bearing which can accommodate axial loads acting in the opposite direction to those acting on the first bearing.

Matched sets of two bearings arranged back-to-back or face-to-face are supplied with a light preload (G_A) as standard. Other preloads can be furnished on request.The degree of actual preload depends on the bearing series, the contact angle and the bearing size. These preloads are quoted in the tables on page 22 and are nominal values for bearings arranged back-to-back or face-to-face before mounting.

Matched sets of three, four or five bearings in tandem/back-to-back or tandem/face-to-face arrangements have greater preload than bearing pairs. The actual values can be obtained by multiplying the values given in the preload tables by the following factors:

1.35 triplex set
1.60 quad. set, 3DT + 1DB or DF
2.00 quad. set, One pair DT opposed by one pair DT
1.75 set of 5, 4DT + 1DB or DF
2.45 set of 5, 3DT + 1Pair DB or DF

Preload of Mounted Bearings

The values of preload given in the tables on page 22 apply to bearing sets before mounting. When mounted, the bearing sets will always have a higher preload. This increase is mainly determined by the fits and the stiffness of the bearing seatings on the shaft and in the housing.

If the bearings are mounted with normal interference fits (shaft seating to tolerance js4 and housing seating to JS5) and the shaft is of steel and the housing of steel or cast iron, with a sufficiently thick wall, the preload of the mounted bearing sets can be calculated with reasonable accuracy from the equation

$$G_m = f\, f_1\, f_2\, G_A$$

where

G_m = preload of the mounted bearing sets, N
G_A = preload of bearing sets before mounting, corresponding to tables, page 22
f = bearing factor, see diagram opposite
f_1 = correction factor depending on contact angle, see table opposite
f_2 = correction factor depending on preload class, see table opposite

Example

Determine the mounted preload of the 7120KRDS - BKE#7 pair with a light preload (G_A) and mounted with a js4 shaft fit and a JS5 housing fit.

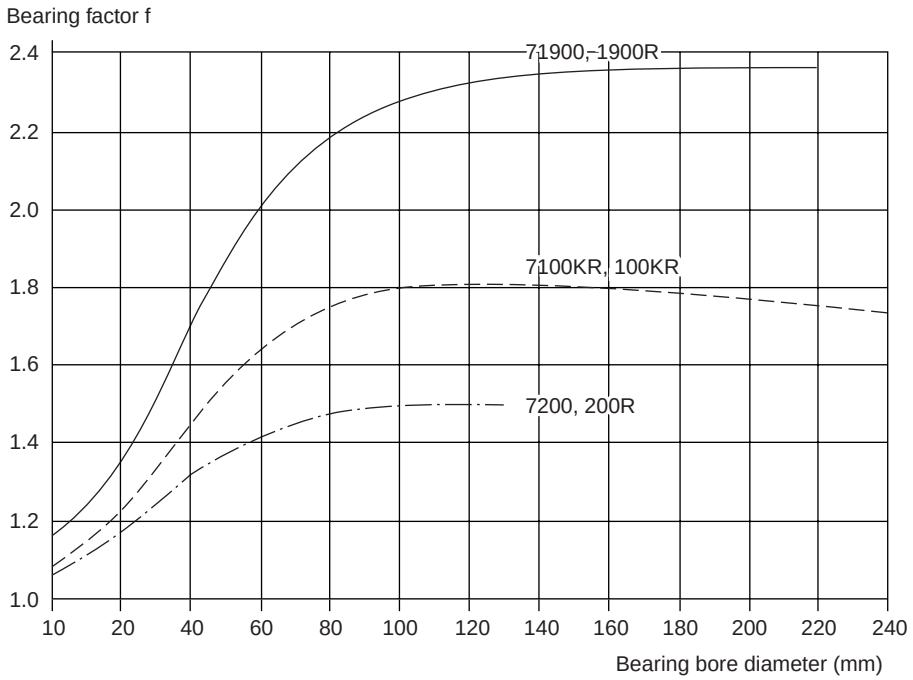
From the table on page 22, the value of G_A is 500 N. From the graph on the opposite page 21, $f = 1.8$, and from the table, $f_1 = 1.0$ and $f_2 = 0.92$. Then,

$$G_m = f\, f_1\, f_2\, G_A$$

$$G_m = 1.8 \times 1.0 \times 0.92 \times 500 = 828 \text{ N}$$

$$= 186 \text{ lbf}$$

Correction factors f_1 and f_2		
Light Preload (G_A)		
	Factors	
Bearing Series	f_1	f_2
71900DS-BKE#7	0.92	1
1900RDS-BKE#7	1	1
7100KRDS-BKE#7	0.92	1
100KRDS-BKE#7	1	1
7200DS-BKE#7	0.95	1
200RDS-BKE#7	1	1



Light Axial Preload (G_A) in Matched Sets of Angular Contact Bearings

Bore Dia mm	Size	Bearing													
		1900R		100KR		200R		300R		71900		7100KR		7200	
		N	lbf	N	lbf	N	lbf	N	lbf	N	lbf	N	lbf	N	lbf
10	00	10	2	15	3	20	5	40	10	15	3	25	6	35	8
12	01	10	2	15	3	20	5	60	15	15	3	25	6	35	8
15	02	15	3	20	5	30	7	90	20	25	6	30	7	45	10
17	03	15	3	25	6	35	8	110	25	25	6	40	10	60	13
20	04	25	6	35	6	45	10	155	35	35	8	50	11	70	16
25	05	25	6	35	8	50	11	180	40	40	10	60	13	80	18
30	06	25	6	50	11	90	20	245	55	40	10	90	20	150	34
35	07	35	8	60	13	120	27	310	70	60	13	90	20	190	43
40	08	45	10	60	13	150	34	380	85	70	16	100	22	240	54
45	09	50	11	110	25	160	36	445	100	80	18	170	38	260	58
50	10	50	11	110	25	170	38	620	140	80	18	180	40	260	58
55	11	70	16	150	34	210	47	710	160	120	27	230	52	330	74
60	12	70	16	150	34	250	56	820	185	120	27	240	54	400	90
65	13	80	18	160	36	290	65			120	27	240	54	450	101
70	14	130	29	200	45	300	67			200	45	300	67	480	108
75	15	130	29	200	45	310	70			210	47	310	70	500	112
80	16	140	31	240	54	370	83			220	49	390	88	580	130
85	17	170	38	250	56	370	83			270	61	400	90	600	135
90	18	180	40	300	67	480	108			280	63	460	103	750	169
95	19	190	43	310	70	520	117			290	65	480	108	850	191
100	20	230	52	310	70	590	133			360	81	500	112	950	214
105	21	230	52	360	81	650	146			360	81	560	126	1000	225
110	22	230	52	420	94	670	151			370	83	650	146	1050	236
120	24	290	65	430	97	750	169			450	101	690	155	1200	270
130	26	350	79	560	126					540	121	900	202		
140	28	360	81	570	128					560	126	900	202		
150	30	470	106	650	146					740	166	1000	225		
160	32	490	110	730	164					800	180	1150	259		
170	34	500	112	800	180					800	180	1250	281		
180	36	630	142	900	202					1000	225	1450	326		
190	38	640	144	950	214					1000	225	1450	326		
200	40	800	180	1100	247					1250	281	1750	393		
220	44	850	191	1250	281					1300	292	2000	450		

Mounting Fits

The recommended shaft and housing bore diameters for precision angular contact bearings for machine tool spindle applications are shown in the table below, for a rotating shaft and stationary housing. The shaft tolerance is valid for both solid and hollow steel shafts.

Shaft Limits

Shaft Diameter Nominal (mm)		js4 Tolerance			
		Millimeter		Inch	
Over	Incl.	High	Low	High	Low
6	10	+.002	−.002	+.00008	−.00008
10	18	+.0025	−.0025	+.0001	−.0001
18	30	+.003	−.003	+.0001	−.0001
30	50	+.0035	−.0035	+.00015	−.00015
50	80	+.004	−.004	+.00015	−.00015
80	120	+.005	−.005	+.0002	−.0002
120	180	+.006	−.006	+.00025	−.00025
180	250	+.007	−.007	+.0003	−.0003

Housing Bore Limits

Housing Bore Diameter Nominal (mm)		Locating Bearing JS5 Tolerance				Floating Bearing H5 Tolerance			
		Millimeter		Inch		Millimeter		Inch	
Over	Incl.	High	Low	High	Low	High	Low	High	Low
18	30	+.0045	−.0045	+.0002	−.0002	+.009	0	+.00035	0
30	50	+.0055	−.0055	+.0002	−.0002	+.011	0	+.00045	0
50	80	+.0065	−.0065	+.00025	−.00025	+.013	0	+.0005	0
80	120	+.0075	−.0075	+.0003	−.0003	+.015	0	+.0006	0
120	180	+.009	−.009	+.00035	−.00035	+.018	0	+.0007	0
180	250	+.010	−.010	+.0004	−.0004	+.020	0	+.0008	0
250	315	+.0115	−.0115	+.00045	−.00045	+.023	0	+.0009	0
315	400	+.0125	−.0125	+.0005	−.0005	+.025	0	+.0010	0

Tolerances in Inches (Shaded) and Millimeters

Inner Ring

Bore Diameter	Over	2.5	10	18	30	50	80	120	150	180
	Incl.	10	18	30	50	80	120	150	180	250
Bore Diameter	+.0000	−.00015	−.00015	−.0002	−.00025	−.0003	−.0003	−.0004	−.0004	−.00045
		−.004	−.004	−.005	−.006	−.007	−.008	−.010	−.010	−.012
Bore Out-of-Round (Max)		.00005	.00005	.00005	.00005	.00008	.0001	.00025	.00025	.0003
		.0013	.0013	.0013	.0013	.002	.0025	.006	.006	.007
Radial Runout (Max)		.00005	.00005	.0001	.0001	.0001	.0001	.00015	.00025	.0003
		.0013	.0013	.0025	.0025	.0025	.0025	.004	.006	.007
Width Variation (Max)		.00005	.00005	.00005	.00005	.00005	.0001	.00015	.00015	.0002
		.0013	.0013	.0013	.0013	.0013	.0025	.004	.004	.005
Side Runout With Bore (Max)		.00005	.00005	.00005	.00005	.00005	.0001	.00015	. 0002	.00025
		.0013	.0013	.0013	.0013	.0013	.0025	.004	.005	.006
Raceway Runout With Side (Max)		.00005	.00005	.0001	.0001	.0001	.0001	.00015	.00025	.0003
		.0013	.0013	.0025	.0025	.0025	.0025	.004	.006	.007
Ring Width Single Bearing	+.0000	−.0016	−.0031	−.0047	−.0047	−.0059	−.0079	−.0098	−.0098	−.0118
		−.040	−.080	−.120	−.120	−.150	−.200	−.250	−.250	−.300
Ring Width Duplex Bearing	+.0000	−.0098	−.0098	−.0098	−.0098	−.0098	−.0098	−.0150	−.0150	−.0197
		−.250	−.250	−.250	−.250	−.250	−.250	−.380	−.380	−.500

Outer Ring

Outside Diameter	Over	18	30	50	80	120	150	180	250	315
	Incl	30	50	80	120	150	180	250	315	400
Outside Diameter	+.0000	−.0002	−.00025	−.0003	−.0003	−.00035	−.0004	−.00045	−.0005	−.0006
		−.005	−.006	−.007	−.008	−.009	−.010	−.011	−.013	−.015
Outside Diameter Out-of-Round (Max)		.00008	.00008	.00008	.0001	.0001	.00025	.00025	.0003	.0003
		.002	.002	.002	.0025	.0025	.006	.006	.008	.009
Radial Runout (Max)		.0001	.0001	.00015	.0002	.0002	.00025	.0003	.00035	.0004
		.0025	.0025	.0038	.005	.005	.006	.008	.009	.010
Width Variation (Max)		Identical to Inner Ring of Same Bearing								
O.D. Runout With Side (Max)		.00005	.00005	.00005	.0001	.0001	.00015	.0002	.00025	.0003
		.0013	.0013	.0013	.0025	.0025	.004	.005	.006	.008
Raceway Runout With Side (Max)		.0001	.0001	.00015	.0002	.0002	.00025	.0003	.0003	.0004
		.0025	.0025	.0038	.005	.005	.006	.008	.008	.010
Ring Width Single Bearing		Identical to Inner Ring of Same Bearing								
Ring Width Duplex Bearing										

Equivalent Bearing Loads

In machine tool spindle applications, angular contact bearings are often subjected to combined radial and axial loads. In these cases it is necessary to calculate an equivalent load which will have the same influence on bearing life as the actual loads. The method used is shown below, and in tables at right.

Equivalent Dynamic Radial Load

$P = X F_R + Y F_A$

P = Equivalent dynamic radial load
F_R = Radial load
F_A = Thrust load
X = Radial load factor
Y = Thrust load factor

For single row angular contact bearings arranged singly or paired in tandem,

$P = F_R$ when $F_A/F_R \leqq e$

$P = X F_R + Y F_A$ when $F_A/F_R > e$

For bearings paired back-to-back or face-to-face,

$P = F_R + Y_1 F_A$ when $F_A/F_R \leqq e$

$P = X F_R + Y_2 F_A$ when $F_A/F_R > e$

Equivalent Static Radial Load

For single row angular contact bearings arranged singly or paired in tandem,

$P_0 = 0.5 F_R + Y_0 F_A$ P_0 = equivalent static radial load

P_0 is always $\geqq F_R$ Y_0 = thrust load factor

For bearings paired back-to-back or face-to-face,

$P_0 = F_R + Y_0 F_A$

Load Ratings for Bearing Sets

For bearing sets of two or more bearings, multiply the single bearing dynamic rating C in the bearing tables by the following factors:

1.62 for two bearings
2.16 for three bearings
2.64 for four bearings
3.08 for five bearings

For static ratings, multiply the single bearing rating C_o by the number of bearings in the set.

Calculation Factors for Single Bearings and Bearings Paired in Tandem

F_A/C_o	e	X	Y	Y_o
Contact Angle 15°				
≤0.015	0.38	0.44	1.47	0.46
0.029	0.40	0.44	1.40	0.46
0.058	0.43	0.44	1.30	0.46
0.087	0.46	0.44	1.23	0.46
0.12	0.47	0.44	1.19	0.46
0.17	0.50	0.44	1.12	0.46
0.29	0.55	0.44	1.02	0.46
≥0.44	0.56	0.44	1.00	0.46
Contact Angle 25°				
—	0.68	0.41	0.87	0.38

Calculation Factors for Bearings Paired Back-to-Back or Face-to-Face

$2F_a/C_o$	e	X	Y_1	Y_2	Y_o
Contact Angle 15°					
≤0.015	0.38	0.72	1.65	2.39	0.92
0.029	0.40	0.72	1.57	2.28	0.92
0.058	0.43	0.72	1.46	2.11	0.92
0.087	0.46	0.72	1.38	2.00	0.92
0.12	0.47	0.72	1.34	1.93	0.92
0.17	0.50	0.72	1.26	1.82	0.92
0.29	0.55	0.72	1.14	1.66	0.92
≥0.44	0.56	0.72	1.12	1.63	0.92
Contact Angle 25°					
—	0.68	0.67	0.92	1.41	0.76

Life Rating

$$L10 = \left(\frac{C}{P}\right)^3 \text{ (millions of revolutions)}$$

or

$$L10h = \frac{10^6}{60n}\left(\frac{C}{P}\right)^3 \text{ (Hours)}$$

For DB or DF Mounting:

C = Duplex pair dynamic radial load rating (from duplex bearing tables) or
C = Single-row dynamic radial load rating times $(i)^{0.7}$, where i = 2 (See Load Ratings for Bearing Sets)

For tandem mounting:

C = Single-row dynamic radial load rating times $(i)^{0.7}$, where i = number of bearings in set (See Load Ratings for Bearing Sets)
P = Dynamic equivalent radial load
n = Speed in RPM

Dynamic and Static Equivalent Radial Load Calculation Examples

Bearing Size 109KRDS

Single Bearing Dynamic

$F_R = 1890$

$F_A = 1250$

$F_A/C_0 = 1250/5040 = .25$

$e = .53$

$F_A/F_R = .66$

since $F_A/F_R > e$, $P = X\,F_R + Y\,F_A$

$X = .44$, $Y = 1.05$

$P = .44 \times 1890 + 1.05 \times 1250 = 2144$

Single Bearing Static

$F_R = 1500$

$F_A = 1000$

$P_0 = 0.5\,F_R + Y_0\,F_A$

$Y_0 = 0.46$

$P = 0.5 \times 1500 + 0.46 \times 1000 = 1210$

since P_0 is always $\geq F_R$,

$P_0 = 1500$

Paired Bearings Static (DB OR DF)

$F_R = 1500$

$F_A = 2000$

$P_0 = F_R + Y_0\,F_A$

$Y_0 = 0.92$

$P_0 = 1500 + 0.92 \times 2000 = 3340$

Paired Bearings Dynamic (DB OR DF)

Case 1

$F_R = 1890$

$F_A = 1250$

$2F_A/C_0 = 2500/5040 = .50$

$F_A/F_R = .66$

$e = .56$

Since $F_A/F_R > e$, $P = XF_R + Y_2\,F_A$

$X = .72$, $Y_2 = 1.63$

$P = .72 \times 1890 + 1.63 \times 1250 = 3398$

Case 2

$F_R = 1890$

$F_A = 500$

$2F_A/C_0 = \dfrac{1000}{5040} = .20$

$F_A/F_R = .26$

$e = .53$

Since $F_A/F_R \leqq e$, $P = F_R + Y_1\,F_A$

$Y_1 = 1.23$

$P = 1890 + 1.23 \times 500 = 2505$

Case 3

$F_R = 0$

$F_A = 1250$

$2F_A/C_0 = .50$

$F_A/F_R = \infty$

$e = .56$

since $F_A/F_R > e$, $P = X\,F_R + Y_2\,F_A$

$Y_2 = 1.63$

$P = 1.63 \times 1250 = 2038$

Dynamic and Static Equivalent Radial Load Calculation Examples

Bearing Size 7210DS

Single Bearing Dynamic

Case 1

$F_R = 2000$

$F_A = 1000$

$F_A/F_R = 0.50$

$e = 0.68$

since $F_A/F_R \leqq e$,

$P = F_R = 2000$

Case 2

$F_R = 1000$

$F_A = 2000$

$F_A/F_R = 2.0$

$e = 0.68$

since $F_A/F_R > e$, $P = X\,F_R + Y\,F_A$

$X = 0.41$, $Y = 0.87$

$P = 0.41 \times 1000 + 0.87 \times 2000 = 2150$

Paired Bearings Dynamic (DB OR DF)

Case 1

$F_R = 2000$

$F_A = 1000$

$F_A/F_R = 0.50$

$e = 0.68$

since $F_A/F_R \leqq e$, $P = F_R + Y_1\,F_A$

$Y_1 = 0.92$

$P = 2000 + 0.92 \times 1000 = 2920$

Case 2

$F_R = 1000$

$F_A = 2000$

$F_A/F_R = 2.0$

$e = 0.68$

since $F_A/F_R > e$, $P = X\,F_R + Y_2\,F_A$

$X = 0.67$, $Y_2 = 1.41$

$P = 0.67 \times 1000 + 1.41 \times 2000 = 3490$

Single Bearing Static

$F_R = 1500$

$F_A = 1000$

$P_0 = 0.5\,F_R + Y_0\,F_A$

$Y_0 = 0.38$

$P_0 = 0.5 \times 1500 + 0.38 \times 1000 = 1130$

since P_0 is always $\geq F_R$,

$P_0 = 1500$

Paired Bearings Static

$F_R = 1000$

$F_A = 1500$

$P_0 = F_R + Y_0\,F_A$

$Y_0 = 0.76$

$P_0 = 1000 + 0.76 \times 1500 = 2140$

Effect of Preload on Total Axial Force (F_A)

For bearing pairs under radial load and mounted with interference fits,

$F_A = G_m$

For bearing pairs under radial load and preloaded by springs,

$F_A = G_A$

For bearing pairs under axial load and preloaded by springs,

$F_A = G_A + K_a$

For bearing pairs under axial load and mounted with interference fits,

$F_A = G_m + 0.67\ K_a$ when $K_a \leqq 3\ G_m$

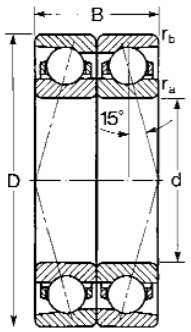
$F_A = K_a$ when $K_a > 3\ G_m$

where

F_A = axial component of bearing load
G_A = preload of bearing pair from table on page 22
G_m = preload in mounted pair, see page 20
K_a = external axial force acting on single bearing

MRC

Precision 15° Angular Contact
1900 RDS-BKE#7 Series, Duplex



Load ratings are for single bearings. For sets of two or more see page 25 for the multiplying factor.

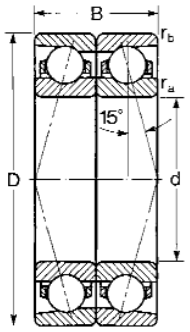
Speed ratings are for single bearings. For the speed reduction factor for sets of two or more, or tandem arrangements, see page 19.

Caution: Single bearings are not to be used where only radial loads are present. For two-direction thrust loads, use duplex bearings.

MRC Bearing Number	Bore d		Outside Diameter D		Width B		Fillet Radius[1] r_a		Fillet Radius[1] r_b		Basic Radial Load Rating Dynamic C[2]		Basic Radial Load Rating Static C_o		Speed Rating Grease RPM	Speed Rating Oil RPM
	mm	in	mm	in	mm	in	mm	in	mm	in	N	lbf	N	lbf		
1900RDS-BKE#7	10	.3737	22	.8661	12	.4724	.30	.012	.10	.004	2510	565	1100	247	70000	110000
1901RDS-BKE#7	12	.4724	24	.9449	12	.4724	.30	.012	.10	.004	2650	595	1250	281	63000	95000
1902RDS-BKE#7	15	.5906	28	1.1024	14	.5512	.30	.012	.10	.004	3970	892	1900	427	56000	85000
1903RDS-BKE#7	17	.6693	30	1.1811	14	.5512	.30	.012	.10	.004	4160	935	2080	468	50000	75000
1904RDS-BKE#7	20	.7874	37	1.4567	18	.7087	.30	.012	.15	.006	6050	1360	3200	719	43000	63000
1905RDS-BKE#7	25	.9843	42	1.6535	18	.7087	.30	.012	.15	.006	6760	1520	4000	899	36000	53000
1906RDS-BKE#7	30	1.1811	47	1.8504	18	.7087	.30	.012	.15	.006	7150	1610	4550	1020	30000	45000
1907RDS-BKE#7	35	1.3780	55	2.1654	20	.7874	.60	.024	.15	.006	9750	2190	6550	1470	26000	40000
1908RDS-BKE#7	40	1.5748	62	2.4409	24	.9449	.60	.024	.15	.006	12400	2790	8500	1910	20000	34000
1909RDS-BKE#7	45	1.7717	68	2.6772	24	.9449	.60	.024	.15	.006	13000	2920	9500	2140	19000	32000
1910RDS-BKE#7	50	1.9685	72	2.8346	24	.9449	.60	.024	.15	.006	13500	3030	10400	2340	17000	28000
1911RDS-BKE#7	55	2.1654	80	3.1496	26	1.0236	1.0	.040	.30	.012	19500	4380	14600	3280	16000	26000
1912RDS-BKE#7	60	2.3622	85	3.3465	26	1.0236	1.0	.040	.30	.012	19900	4470	15300	3440	15000	24000
1913RDS-BKE#7	65	2.5591	90	3.5433	26	1.0236	1.0	.040	.30	.012	20800	4680	17000	3820	14000	22000
1914RDS-BKE#7	70	2.7559	100	3.9370	32	1.2598	1.0	.040	.30	.012	34500	7760	34000	7640	13000	20000
1915RDS-BKE#7	75	2.9528	105	4.1339	32	1.2598	1.0	.040	.30	.012	35800	8050	37500	8430	12000	19000
1916RDS-BKE#7	80	3.1496	110	4.3307	32	1.2598	1.0	.040	.30	.012	36400	8180	39000	8770	11000	18000
1917RDS-BKE#7	85	3.3465	120	4.7244	36	1.4173	1.1	.043	.60	.024	46200	10400	48000	10800	10000	17000
1918RDS-BKE#7	90	3.5433	125	4.9213	36	1.4173	1.1	.043	.60	.024	47500	10700	51000	11500	9500	16000
1919RDS-BKE#7	95	3.7402	130	5.1181	36	1.4173	1.1	.043	.60	.024	49400	11100	55000	12400	9000	15000
1920RDS-BKE#7	100	3.9370	140	5.5118	40	1.5748	1.1	.043	.60	.024	60500	13600	65500	14700	8500	14000
1921RDS-BKE#7	105	4.1339	145	5.7087	40	1.5748	1.1	.043	.60	.024	61800	13900	69500	15600	8500	14000
1922RDS-BKE#7	110	4.3307	150	5.9055	40	1.5748	1.1	.043	.60	.024	62400	14000	72000	16200	8000	13000
1924RDS-BKE#7	120	4.7244	165	6.4961	44	1.7323	1.1	.043	.60	.024	78000	17500	91500	20600	7500	12000
1926RDS-BKE#7	130	5.1181	180	7.0866	48	1.8898	1.5	.060	.60	.024	92300	20700	108000	24300	7000	11000
1928RDS-BKE#7	140	5.5118	190	7.4803	48	1.8898	1.5	.060	.60	.024	95600	21500	116000	26100	6700	10000
1930RDS-BKE#7	150	5.9055	210	8.2677	56	2.2047	2.0	.080	1.0	.040	125000	28100	146000	32800	6300	9500

[1] Fillet radius indicates maximum fillet radius on shaft or in housing which bearing corner will clear.
[2] Rating for one million revolutions or 500 hours at 33⅓ RPM.

Precision 15° Angular Contact 100KRDS-BKE#7 Series, Duplex



Load ratings are for single bearings. For sets of two or more see page 25 for the multiplying factor.

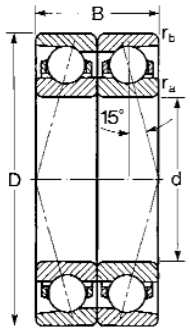
Speed ratings are for single bearings. For the speed reduction factor for sets of two or more, or tandem arrangements, see page 19.

Caution: Single bearings are not to be used where only radial loads are present. For two-direction thrust loads, use duplex bearings.

MRC Bearing Number	Bore d		Outside Diameter D		Width B		Fillet Radius[1] r_a		Fillet Radius[1] r_b		Basic Radial Load Rating Dynamic C[2]		Basic Radial Load Rating Static C_o		Speed Rating Grease RPM	Speed Rating Oil RPM
	mm	in	mm	in	mm	in	mm	in	mm	in	N	lbf	N	lbf		
100KRDS-BKE#7	10	0.3937	26	1.0236	16	0.63	.30	0.012	.10	0.004	4100	922	1660	373	67000	100000
101KRDS-BKE#7	12	0.4724	28	1.1024	16	0.63	.30	0.012	.10	0.004	4490	1010	1900	427	60000	90000
102KRDS-BKE#7	15	0.5906	32	1.2598	18	0.7086	.30	0.012	.10	0.004	5200	1170	2450	551	50000	75000
103KRDS-BKE#7	17	0.6693	35	1.378	20	0.7874	.30	0.012	.10	0.004	6760	1520	3250	731	48000	70000
104KRDS-BKE#7	20	0.7874	42	1.6535	24	0.9448	.60	0.024	.30	0.012	8710	1960	4300	967	38000	56000
105KRDS-BKE#7	25	0.9843	47	1.8504	24	0.9448	.60	0.024	.30	0.012	9560	2150	5200	1170	34000	50000
106KRDS-BKE#7	30	1.1811	55	2.1654	26	1.0236	1.0	0.04	.30	0.012	14300	3210	8000	1800	28000	43000
107KRDS-BKE#7	35	1.378	62	2.4409	28	1.1024	1.0	0.04	.30	0.012	15600	3510	9500	2140	22000	36000
108KRDS-BKE#7	40	1.5748	68	2.6772	30	1.1812	1.0	0.04	.30	0.012	16800	3780	11000	2470	19000	32000
109KRDS-BKE#7	45	1.7717	75	2.9528	32	1.2598	1.0	0.04	.30	0.012	28600	6430	22400	5040	18000	30000
110KRDS-BKE#7	50	1.9685	80	3.1496	32	1.2598	1.0	0.04	.30	0.012	29600	6650	24000	5400	17000	28000
111KRDS-BKE#7	55	2.1654	90	3.5433	36	1.4174	1.1	0.043	.60	0.024	39700	8920	32500	7310	15000	24000
112KRDS-BKE#7	60	2.3622	95	3.7402	36	1.4174	1.1	0.043	.60	0.024	40300	9060	34500	7760	14000	22000
113KRDS-BKE#7	65	2.5591	100	3.937	36	1.4174	1.1	0.043	.60	0.024	41600	9350	37500	8430	14000	22000
114KRDS-BKE#7	70	2.7559	110	4.3307	40	1.5748	1.1	0.043	.60	0.024	52000	11700	45000	10100	12000	19000
115KRDS-BKE#7	75	2.9528	115	4.5276	40	1.5748	1.1	0.043	.60	0.024	52700	11800	49000	11000	11000	18000
116KRDS-BKE#7	80	3.1496	125	4.9213	44	1.7322	1.1	0.043	.60	0.024	65000	14600	61000	13700	10000	17000
117KRDS-BKE#7	85	3.3465	130	5.1181	44	1.7322	1.1	0.043	.60	0.024	67600	15200	65500	14700	9500	16000
118KRDS-BKE#7	90	3.5433	140	5.5118	48	1.8898	1.5	0.06	.60	0.024	79300	17800	76500	17200	9000	15000
119KRDS-BKE#7	95	3.7402	145	5.7087	48	1.8898	1.5	0.06	.60	0.024	81900	18400	80000	18000	8500	14000
120KRDS-BKE#7	100	3.937	150	5.9055	48	1.8898	1.5	0.06	.60	0.024	83200	18700	85000	19100	8500	14000
121KRDS-BKE#7	105	4.1339	160	6.2992	52	2.0472	2.0	0.08	1.0	0.04	95600	21500	96500	21700	8000	13000
122KRDS-BKE#7	110	4.3307	170	6.6929	56	2.2048	2.0	0.08	1.0	0.04	111000	25000	108000	24300	7500	12000
124KRDS-BKE#7	120	4.7244	180	7.0866	56	2.2048	2.0	0.08	1.0	0.04	114000	25600	122000	27400	7000	11000
126KRDS-BKE#7	130	5.1181	200	7.874	66	2.5984	2.0	0.08	1.0	0.04	148000	33300	156000	35100	6700	10000
128KRDS-BKE#7	140	5.5118	210	8.2677	66	2.5984	2.0	0.08	1.0	0.04	153000	34400	166000	37300	6700	10000
130KRDS-BKE#7	150	5.9055	225	8.8583	70	2.756	2.1	0.083	1.0	0.04	172000	38700	190000	42700	6000	9000
132KRDS-BKE#7	160	6.2992	240	9.4488	76	2.9922	2.1	0.083	1.0	0.04	195000	43800	216000	48600	5600	8500
134KRDS-BKE#7	170	6.6929	260	10.2362	84	3.307	2.1	0.083	1.1	0.043	212000	47700	245000	55100	5300	8000
136KRDS-BKE#7	180	7.0866	280	11.0236	92	3.622	2.1	0.083	1.1	0.043	242000	54400	290000	65200	5000	7500
138KRDS-BKE#7	190	7.4803	290	11.4173	92	3.622	2.1	0.083	1.1	0.043	247000	55500	300000	67400	4800	7000
140KRDS-BKE#7	200	7.874	310	12.2047	102	4.0158	2.1	0.083	1.1	0.043	296000	66500	390000	87700	4500	6700
144KRDS-BKE#7	220	8.6614	340	13.3858	112	4.4094	3.0	0.12	1.1	0.043	338000	76000	455000	102000	4000	6000

[1] Fillet radius indicates maximum fillet radius on shaft or in housing which bearing corner will clear.
[2] Rating for one million revolutions or 500 hours at 33⅓ RPM.

Precision 15° Angular Contact
200 RDS-BKE#7 Series, Duplex



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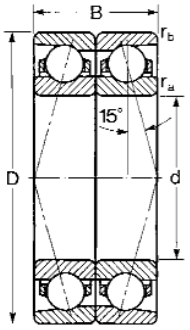
Caution: Single bearings are not to be used where only radial loads are present. For two-direction thrust loads, use duplex bearings.

MRC Bearing Number	Bore d		Outside Diameter D		Width B		Fillet Radius[1] r_a		Fillet Radius[1] r_b		Basic Radial Load Rating Dynamic $C^{2)}$		Basic Radial Load Rating Static C_o		Speed Rating Grease RPM	Speed Rating Oil RPM
	mm	in	mm	in	mm	in	mm	in	mm	in	N	lbf	N	lbf		
200RDS-BKE#7	10	0.3937	30	1.1811	18	0.7086	.60	0.024	.30	0.012	5400	1210	2200	495	60000	90000
201RDS-BKE#7	12	0.4724	32	1.2598	20	0.7874	.60	0.024	.30	0.012	5850	1320	2550	573	53000	80000
202RDS-BKE#7	15	0.5906	35	1.378	22	0.8662	.60	0.024	.30	0.012	7410	1670	3350	753	48000	70000
203RDS-BKE#7	17	0.6693	40	1.5748	24	0.9448	.60	0.024	.30	0.012	9230	2070	4150	933	43000	63000
204RDS-BKE#7	20	0.7874	47	1.8504	28	1.1024	1.0	0.04	.30	0.012	11900	2680	5850	1320	36000	53000
205RDS-BKE#7	25	0.9843	52	2.0472	30	1.1812	1.0	0.04	.30	0.012	13500	3030	7200	1620	30000	45000
206RDS-BKE#7	30	1.1811	62	2.4409	32	1.2598	1.0	0.04	.30	0.012	24200	5440	16000	3600	24000	38000
207RDS-BKE#7	35	1.378	72	2.8346	34	1.3386	1.1	0.043	.30	0.012	31900	7170	21600	4860	20000	34000
208RDS-BKE#7	40	1.5748	80	3.1496	36	1.4174	1.1	0.043	.60	0.024	41000	9220	28000	6290	18000	30000
209RDS-BKE#7	45	1.7717	85	3.3465	38	1.496	1.1	0.043	.60	0.024	42300	9510	31000	6970	17000	28000
210RDS-BKE#7	50	1.9685	90	3.5433	40	1.5748	1.1	0.043	.60	0.024	44900	10100	34000	7640	16000	26000
211RDS-BKE#7	55	2.1654	100	3.937	42	1.6536	1.5	0.06	.60	0.024	55300	12400	43000	9670	14000	22000
212RDS-BKE#7	60	2.3622	110	4.3307	44	1.7322	1.5	0.06	.60	0.024	67600	15200	53000	11900	13000	20000
213RDS-BKE#7	65	2.5591	120	4.7244	46	1.811	1.5	0.06	.60	0.024	76100	17100	60000	13500	12000	19000
214RDS-BKE#7	70	2.7559	125	4.9213	48	1.8898	1.5	0.06	.60	0.024	79300	17800	64000	14400	11000	18000
215RDS-BKE#7	75	2.9528	130	5.1181	50	1.9686	1.5	0.06	0.6	0.024	83200	18700	69500	15600	10000	17000
216RDS-BKE#7	80	3.1496	140	5.5118	52	2.0472	2.0	0.08	1.0	0.040	97500	21900	81500	18300	9500	16000
217RDS-BKE#7	85	3.3465	150	5.9055	56	2.2048	2.0	0.08	1.0	0.040	99500	22400	88000	19800	9000	15000
218RDS-BKE#7	90	3.5433	160	6.2992	60	2.3622	2.0	0.08	1.0	0.040	127000	28500	112000	25200	2500	14000
219RDS-BKE#7	95	3.7402	170	6.6929	64	2.5196	2.1	0.083	1.1	0.043	138000	31000	120000	27000	8000	13000
220RDS-BKE#7	100	3.937	180	7.0866	68	2.6772	2.1	0.083	1.1	0.043	156000	35100	137000	30800	7500	12000
221RDS-BKE#7	105	4.1339	190	7.4803	72	2.8346	2.1	0.083	1.1	0.043	172000	38700	153000	34400	7500	12000
222RDS-BKE#7	110	4.3307	200	7.874	76	2.9922	2.1	0.083	1.1	0.043	178000	40000	166000	37300	7000	11000
224RDS-BKE#7	120	4.7244	215	8.4646	80	3.1496	2.1	0.083	1.1	0.043	199000	44700	193000	43400	6700	10000

[1)] Fillet radius indicates maximum fillet radius on shaft or in housing which bearing corner will clear.
[2)] Rating for one million revolutions or 500 hours at 33⅓ RPM.



Load ratings are for single bearings. For sets of two or more see page 25 for the multiplying factor.

Speed ratings are for single bearings. For the speed reduction factor for sets of two or more, or tandem arrangements, see page 19.

Caution: Single bearings are not to be used where only radial loads are present. For two-direction thrust loads, use duplex bearings.

MRC Bearing Number	Bore d		Outside Diameter D		Width B		Fillet Radius[1] r_a		Fillet Radius[1] r_b		Basic Radial Load Rating Dynamic C[2]		Basic Radial Load Rating Static C_o		Speed Rating Grease RPM	Speed Rating Oil RPM
	mm	in	mm	in	mm	in	mm	in	mm	in	N	lbf	N	lbf		
300RDS-BKE#7	10	0.3937	35	1.357	22	0.8662	.60	0.024	.60	0.024	10500	2360	4550	1020	46000	73000
301RDS-BKE#7	12	0.4724	37	1.4567	24	0.9454	1.0	0.04	1.0	0.04	10600	2380	4900	1100	44000	67000
302RDS-BKE#7	15	0.5906	42	1.6535	26	1.0236	1.0	0.04	1.0	0.04	12100	2720	6550	1470	39000	56000
303RDS-BKE#7	17	0.6693	47	1.8504	28	1.1024	1.0	0.04	1.0	0.04	14800	3330	8150	1830	37000	53000
304RDS-BKE#7	20	0.7874	52	2.0472	30	1.1812	1.1	0.043	1.1	0.043	20300	4560	11400	2560	30000	45000
305RDS-BKE#7	25	0.9843	62	2.4409	34	1.3386	1.1	0.043	1.1	0.043	23400	5260	15300	3440	25000	39000
306RDS-BKE#7	30	1.1811	72	2.8346	38	1.496	1.1	0.043	1.1	0.043	31200	7010	20000	4500	21000	31000
307RDS-BKE#7	35	1.378	80	3.1496	42	1.6536	1.5	0.06	1.5	0.06	39700	8920	26000	5850	20000	28000
308RDS-BKE#7	40	1.5748	90	3.5433	46	1.811	1.5	0.06	1.5	0.06	48800	11000	33500	7530	17000	25000
309RDS-BKE#7	45	1.7717	100	3.937	50	1.9686	1.5	0.06	1.5	0.06	58500	13200	40500	9100	15000	22000
310RDS-BKE#7	50	1.9685	110	4.3307	54	2.126	2.0	0.08	2.0	0.08	76100	17100	52000	11700	14000	21000
311RDS-BKE#7	55	2.1654	120	4.7244	58	2.2834	2.0	0.08	2.0	0.08	88400	19900	61000	13700	13000	19000
312RDS-BKE#7	60	2.3622	130	5.1181	62	2.441	2.1	0.083	2.1	0.083	101000	22700	71000	16000	12000	17000

[1] Fillet radius indicates maximum fillet radius on shaft or in housing which bearing corner will clear.
[2] Rating for one million revolutions or 500 hours at 33⅓ RPM.