The PumPac 8000 Series is used in centrifugal pumps, large vertical electric motors, compressors, centrifuges, and other applications subject to thrust loads operating at relatively high speeds. The bearings are mounted so that the 40 degree bearing takes the primary thrust, or axial, load.

Traditionally, matched sets of 40 degree angular contact bearings are used to obtain maximum theoretical fatigue life, but in most instances only a fraction of the calculated life is actually achieved. At the heart of these premature failures are phenomena known as "ball sliding" and "ball shuttling" in the unloaded or inactive bearing. Angular contact bearings used in high speed (e.g. 3600 RPM) pumps and other applications require a minimum axial load for proper operation. Without axial load, gyroscopic forces in the unloaded bearing can cause the balls to rotate perpendicular to their true rolling axis and momentarily lose contact with the raceway. As a result, a microscopic wear or lapping process occurs giving the appearance of a burnished or polished raceway. The oil film thickness separating the ball and raceway is reduced producing friction and heat with lower oil viscosity, accelerating wear. This thermally unstable condition dramatically reduces bearing service life.

The main benefit of the PumPac is that the 15 degree bearing is designed with considerably less internal clearance than the 40 degree bearing making it less susceptible to the gyroscopic forces which result in ball sliding or shuttling. This bearing also provides additional radial stiffness helping to maintain integrity of the shaft and mechanical seals. The 40 degree, loaded bearing provides sufficient axial rigidity under the imposed thrust load.

The PumPac is furnished with a one piece, inner ring land guided, machined bronze cage and is manufactured to meet ABEC-3 grade tolerances. Dimensional stability is assured by heat treating for operation up to 375˚F (190˚C).

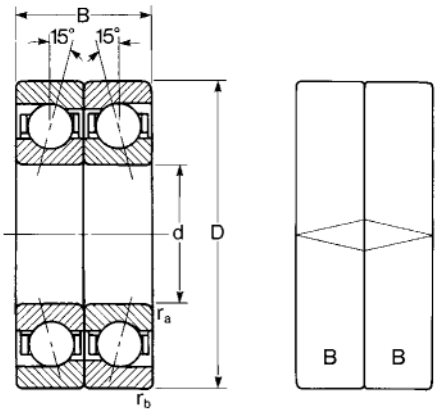
For identification purposes the 40 degree bearing is marked with the letter "A" and the 15 degree bearing with the letter "B". A "V" is etched on the outer ring surface of the set so that the apex falls on the "B" bearing. The set should be mounted so that the "V" points in the same direction as the primary shaft thrust load which places this load on bearing "A". Any reversing load is carried on bearing "B".

The PumPac is also available in the 8000BB PumPac Diamond series, which consists of a matched set of 15 degree (B) bearings in a back-to-back arrangement. The marking on the outer ring surface forms a diamond. This series is desirable in high speed, lightly loaded applications in which axial loads are balanced, resulting in reduced operating temperatures and increased life.

For applications involving very heavy primary thrust loads the PumPac may be furnished as a triplex set identified as the 8000AAB Series. It consists of two 40 degree bearings in tandem matched back-to-back (DB) with one 15 degree bearing. The outer ring surface of the set is marked with a "V" pointing in the direction of primary thrust.

For applications having a rotating shaft and stationary housing, an ISO k5 shaft fit and an ISO H6 housing fit is recommended as shown in the table on page 180.

NOTE: The basic radial load rating, C, is calculated according to the actual bearing geometry and not according to ISO/ABMA Standards.



The PumPac 8000-BB series consists of two 15˚ (B) bearings.

ABEC 3 Tolerances

MRC Bearing Number	Bore d		Outside Diameter D		Width B		Fillet Radius[1] r_a		Fillet Radius[1] r_b		Basic Radial Load Rating[2] Dynamic C[4]		Basic Radial Load Rating[2] Static C_0		Speed Rating[3] Grease	Speed Rating[3] Oil
	mm	in	mm	in	mm	in	mm	in	mm	in	N	lbf	N	lbf	RPM	RPM
8218BB	90	**3.5433**	160	**6.2992**	60	**2.3622**	2.0	**.08**	1.0	**.04**	203 000	**45 600**	216 000	**48 600**	3 800	5 400
8219BB	95	**3.7402**	170	**6.6929**	64	**2.5197**	2.0	**.08**	1.0	**.04**	216 000	**48 600**	236 000	**53 100**	3 600	5 100
8220BB	100	**3.9370**	180	**7.0866**	68	**2.6772**	2.0	**.08**	1.0	**.04**	238 000	**53 500**	270 000	**60 700**	3 400	4 800
8222BB	110	**4.3307**	200	**7.8740**	70	**2.9921**	2.0	**.08**	1.0	**.04**	296 000	**66 500**	340 000	**76 400**	3 000	4 400
8224BB	120	**4.7244**	215	**8.4646**	80	**3.1496**	2.0	**.08**	1.0	**.04**	319 000	**71 800**	390 000	**87 700**	2 800	4 100
8238BB	190	**7.4803**	340	**13.3858**	110	**4.3307**	3.0	**.12**	1.0	**.04**	605 000	**136 000**	1 000 000	**225 000**	1 800	2 600
8308BB	40	**1.5748**	90	**3.5433**	46	**1.8110**	1.5	**.06**	1.0	**.04**	79 300	**17 800**	67 000	**15 100**	7 500	11 000
8309BB	45	**1.7717**	100	**3.9370**	50	**1.9685**	1.5	**.06**	1.0	**.04**	95 600	**21 500**	81 500	**18 300**	6 800	9 600
8310BB	50	**1.9685**	110	**4.3307**	54	**2.1260**	2.0	**.08**	1.0	**.04**	124 000	**27 900**	104 000	**23 400**	6 300	9 000
8311BB	55	**2.1654**	120	**4.7244**	58	**2.2845**	2.0	**.08**	1.0	**.04**	143 000	**32 100**	122 000	**27 400**	5 600	8 100
8312BB	60	**2.3622**	130	**5.1181**	62	**2.4409**	2.0	**.08**	1.0	**.04**	165 000	**37 100**	143 000	**32 100**	5 000	7 200
8313BB	65	**2.5591**	140	**5.5118**	66	**2.5984**	2.0	**.08**	1.0	**.04**	174 000	**39 100**	160 000	**36 000**	4 800	6 800
8314BB	70	**2.7559**	150	**5.9055**	70	**2.7559**	2.0	**.08**	1.0	**.04**	199 000	**44 700**	190 000	**42 700**	4 500	6 300
8315BB	75	**2.9528**	160	**6.2992**	74	**2.9134**	2.0	**.08**	1.0	**.04**	238 000	**53 500**	228 000	**51 300**	4 300	6 000
8316BB	80	**3.1496**	170	**6.6929**	78	**3.0709**	2.0	**.08**	1.0	**.04**	255 000	**57 300**	260 000	**58 500**	3 800	5 400
8317BB	85	**3.3465**	180	**7.0866**	82	**3.2283**	2.5	**.10**	1.0	**.04**	281 000	**63 200**	260 000	**58 500**	3 600	5 100
8318BB	90	**3.5433**	190	**7.4803**	86	**3.3858**	2.5	**.10**	1.0	**.04**	302 000	**67 900**	325 000	**73 100**	3 400	4 800
8319BB	95	**3.7402**	200	**7.8740**	90	**3.5433**	2.5	**.10**	1.0	**.04**	325 000	**73 100**	360 000	**80 900**	3 300	4 500
8320BB	100	**3.9370**	215	**8.4646**	94	**3.7008**	2.5	**.10**	1.0	**.04**	345 000	**77 600**	400 000	**89 900**	3 000	4 400
8322BB	110	**4.3307**	240	**9.4488**	100	**3.9370**	2.5	**.10**	1.0	**.04**	416 000	**93 500**	510 000	**115 000**	2 600	3 900
8326BB	130	**5.1181**	280	**11.0236**	116	**4.5669**	3.0	**.12**	1.0	**.04**	475 000	**107 000**	695 000	**156 000**	2 300	3 300
8330BB	150	**5.9055**	320	**12.5984**	130	**5.1181**	3.0	**.12**	1.0	**.04**	624 000	**140 000**	950 000	**214 000**	2 000	2 900
8336BB	180	**7.0866**	380	**14.9606**	150	**5.9055**	3.0	**.12**	1.0	**.04**	780 000	**175 000**	1 270 000	**286 000**	1 600	2 400

[1] Fillet radius indicates maximum fillet radius on shaft or in housing which bearing corner will clear.
[2] For thrust rating multiply C by 0.51 and Co by 1.00.
[3] Values have been determined through historical application and practice. For a more complete explanation, see page 276.
[4] Rating for one million revolutions or 500 hours at 33⅓ RPM.

The following method considers only thrust load in either direction with negligible radial load. For combined radial and thrust loads consult MRC Technical Services for analysis.

Dynamic equivalent radial load

Primary thrust on bearing A (40˚)

$P = 0.57\ F_A$

Reversing thrust on bearing B (15˚)

$P = YF_A$

P = Dynamic equivalent radial load
F_A = Thrust load
Y = Thrust load factor
Z = Number of balls
D = Ball diameter

$\frac{F_A}{ZD^2}$		Y
N/mm	Lb/in.	
0.172	25	1.47
0.345	50	1.40
0.689	100	1.30
1.03	150	1.23
1.38	200	1.19
2.07	300	1.12
3.45	500	1.02
5.17	750	1.00
6.89	1 000	1.00

Size	ZD^2		Size	ZD^2		Size	ZD^2	
	mm	inch		mm	inch		mm	inch
8218B	7410	11.5	8310B	3990	6.19	8318B	11800	18.3
8219B	7900	12.3	8311B	4690	7.26	8319B	13100	20.3
8220B	9070	14.1	8312B	5430	8.42	8320B	14400	22.4
8222B	11700	18.1	8313B	5930	9.19	8322B	18900	29.3
8224B	13100	20.3	8314B	6800	10.5	8326B	25700	39.8
8238B	31200	48.4	8315B	8390	13.0	8330B	31500	48.8
8308B	2450	3.80	8316B	9470	14.7	8336B	45700	70.9
8309B	3020	4.69	8317B	10600	16.5			

Values of Y for loads not shown are obtained from chart at right.

Notes: For 8000BB series see page 80.
For combined radial and thrust loads please contact MRC bearing services.

Life rating

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

or

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

C = Basic dynamic load rating
P = Dynamic equivalent radial load
n = speed in RPM

Static equivalent radial load

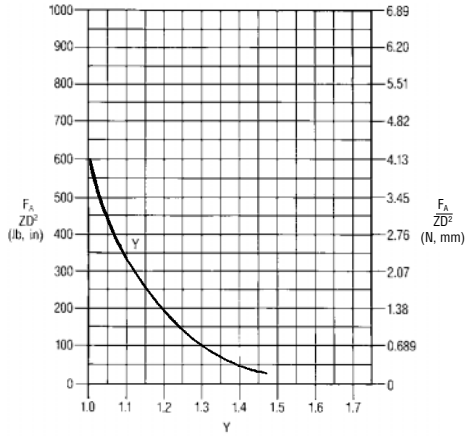
Bearing A (40˚)

$P_0 = 0.26\ F_A$

Bearing B (15˚)

$P_0 = 0.5\ F_A$

P_0 = Static equivalent radial load
F_A = Thrust load



MRC

Dynamic equivalent radial load and life calculation examples

PumPac 8000 Series
Bearing size: 8310
Speed: 3500 RPM
Basic dynamic radial load rating (C):
Bearing A = 19600 lbf
Bearing B = 17100 lbf

Bearing A
Primary thrust load (F_A) = 3000
Equivalent load (P) = 0.57 F_A
P = 0.57 × 3000 = 1710

$$\text{Life (L10)} = \left(\frac{C}{P}\right)^3 = \left(\frac{19600}{1710}\right)^3 = 1506 \times 10^6 \text{ Rev.}$$

or

$$\text{Life (L10h)} = \frac{10^6}{60n}\left(\frac{C}{P}\right)^3 = \frac{10^6}{60 \times 3500}\left(\frac{19600}{1710}\right)^3 = 7170 \text{ Hrs}$$

Bearing B
Reversing thrust load (F_A) = 1000
F_A/ZD^2 = 1000/6.19 = 162
Equivalent load (P) = Y F_A
Y = 1.22
P = 1.22 × 1000 = 1220

$$\text{Life (L10)} = \left(\frac{C}{P}\right)^3 = \left(\frac{17100}{1220}\right)^3 = 2753 \times 10^6 \text{ Rev.}$$

or

$$\text{Life (L10h)} = \frac{10^6}{60n}\left(\frac{C}{P}\right)^3 = \frac{10^6}{60 \times 3500}\left(\frac{17100}{1220}\right)^3 = 13113 \text{ Hrs}$$

PumPac Diamond 8000 BB Series
Bearing size: 8317BB
Speed: 3000 RPM
Basic dynamic radial load rating (C):

$$\text{(Single Bearing)} = \frac{C}{(2)^{0.7}} = \frac{63200}{1.625} = 38890 \text{ lbf}$$

Primary Thrust Bearing
Primary thrust load (F_A) = 2500
F_A/ZD^2 = 2500/16.5 = 152
Equivalent load (P) = Y F_A
Y = 1.23
P = 1.23 × 2500 = 3075

$$\text{Life (L10)} = \left(\frac{C}{P}\right)^3 = \left(\frac{38890}{3075}\right)^3 = 2023 \times 10^6 \text{ Rev.}$$

or

$$\text{Life (L10h)} = \frac{10^6}{60n}\left(\frac{C}{P}\right)^3 = \frac{10^6}{60 \times 3000}\left(\frac{38890}{3075}\right)^3 = 11238 \text{ Hrs}$$

Reversing Thrust Bearing
Reversing thrust load (F_A) = 1000
F_A/ZD^2 = 1000/16.5 = 61
Equivalent load (P) = Y F_A
Y = 1.38
P = 1.238 × 1000 = 1380

$$\text{Life (L10)} = \left(\frac{C}{P}\right)^3 = \left(\frac{38890}{1380}\right)^3 = 22381 \times 10^6 \text{ Rev.}$$

or

$$\text{Life (L10h)} = \frac{10^6}{60n}\left(\frac{C}{P}\right)^3 = \frac{10^6}{60 \times 3000}\left(\frac{38890}{1380}\right)^3 = 124{,}340 \text{ Hrs}$$

PumPac 8000 AAB Series
Bearing size: 8314 AAB
Speed: 3500 RPM
Basic dynamic radial load rating (C):
Bearings AA = 54400 lbf
Bearing B = 27200 lbf

Bearings AA
Primary thrust load (F_A) = 5000
Equivalent load (P) = 0.57 F_A
P = 0.57 × 5000 = 2850

$$\text{Life (L10)} = \left(\frac{C}{P}\right)^3 = \left(\frac{54400}{2850}\right)^3 = 6954 \times 10^6 \text{ Rev.}$$

or

$$\text{Life (L10h)} = \frac{10^6}{60n}\left(\frac{C}{P}\right)^3 = \frac{10^6}{60 \times 3500}\left(\frac{54400}{2850}\right)^3 = 33116 \text{ Hrs}$$

Bearing B
Reversing thrust load (F_A) = 1500
F_A/ZD^2 = 1500/10.5 = 143
Equivalent load (P) = Y F_A
Y = 1.24
P = 1.24 × 1500 = 1860

$$\text{Life (L10)} = \left(\frac{C}{P}\right)^3 = \left(\frac{27200}{1860}\right)^3 = 3127 \times 10^6 \text{ Rev.}$$

or

$$\text{Life (L10h)} = \frac{10^6}{60n}\left(\frac{C}{P}\right)^3 = \frac{10^6}{60 \times 3500}\left(\frac{27200}{1860}\right)^3 = 14900 \text{ Hrs}$$