INTRODUCTION

The first RBC bearings designed expressly for airframe controls were manufactured in 1929. As pioneers in this field, these early control bearings paved the way for later generations of RBC products which are recognized as design and performance standards by the global aircraft industry.

Over the years RBC has steadily expanded its aircraft line to meet the increasingly exacting demands imposed by newer, larger aircraft and airborne vehicles. This line now offers the widest range of types and sizes available to the aircraft industry. Many of these products have been specifically designed to meet the demands for elevated temperatures, low torque, closer tolerances, compactness, and greatest load capacity to bearing weight ratios.

Although most bearings listed on the following pages are designed primarily for the airframe industry, many have been used successfully in other fields in which the motion is mainly oscillatory. These bearings are manufactured with the high standards of precision and quality synonymous with RBC's reputation throughout the industry.

GENERAL INFORMATION

RBC airframe (or aircraft) control bearings and RBC ball bearing rod ends are manufactured in compliance to U.S. Government and Aerospace Industry Standards and Specifications.

Airframe control bearings and ball bearing rod ends are of lightweight design, corrosion protected, grease-lubricated, and typically sealed. Although designed and manufactured under demanding quality control requirements for airborne systems, these bearings have been successfully used in other fields of application, where motions are mainly oscillatory and/or with limited rotation.

PRECISION

RBC supplies airframe control bearings both in "Standard" and "Precision" series. The prefix "M" in a bearing number indicates that it is of a precision series. RBC supplies ball bearing rod ends as a Precision series.

MATERIAL

Rings and balls are made of hardened bearing alloy, AISI 52100. All exposed surfaces except bearing bore are cadmium or zinc nickel plated for corrosion protection, unless otherwise noted.

For improved corrosion protection, RBC also supplies bearings made of hardened stainless steel alloy, AISI 440C. This alloy may, in addition, be passivated, cadmium plated, or zinc nickel plated for enhanced corrosion protection.

On ball bearing rod ends the outer rod body is made of a selectively hardened AISI 8620 or RBC AeroCres® fracture-tough material. AeroCres fracture-tough airframe products use a specialized carburized stainless steel. RBC has developed and optimized the heat treatment process resulting in a homogeneous microstructure — delivering both corrosion protection and core fracture toughness.

PERFORMANCE

Please refer to the individual Engineering Section for specific useful information on bearing performance characteristics as for load rating, installation and application.

Tabulated performance data provided in this catalog are guidelines only. Rotational load ratings listed are calculated assuming intermittent slow rotation. When selecting bearings, the loads, motion modes of oscillation or rotation, and speeds must be taken into account.

We strongly recommend that you consult RBC before finalizing your selection, especially when considering a full complement airframe control or rod end bearing for continuous rotational application.

RBC airframe control and rod end bearings offer the following key design features

- Inch and metric sizes with final as-plated dimensions.
- Corrosion Resistance available with stainless steel and/or cadmium plated alloy steels on all exposed surfaces except bore and seals. RBC also offers other corrosion resistant plated materials, which include zinc nickel plated alloy steels and RBC AeroCres® fracture-tough airframe products.
- High load capacities in a compact, lightweight design.
- Inert polytetrafluoroethelene (PTFE) —Teflon®— seals standard on most sizes.
- Extended inner rings eliminate the need for spacers.
- Bearings with suffix FS428 are prepacked with lubricant conforming to specification MIL-PRF-23827 and BMS3-33 and are equipped with PTFE seals.

- Bearings with suffix FS464 are prepacked 80% to 100% with lubricant conforming to specification MIL-PRF-81322 and are equipped with PTFE seals.
- Most self-aligning designs permit up to 10° misalignment in either direction.
- RBC airframe control ball bearings conform to SAE-AS7949 (formerly MIL-B-7949) and all major OEM specifications.
- RBC ball bearing rod ends conform to SAE-AS6039 (formerly MIL-B-6039) and OEM specifications.
- NSA ball bearing rod ends.

U.S. GOVERNMENT SPECIFICATIONS

It should be noted that all bearings listed in this section, whether covered by military specification or not, are manufactured to the same high standards of quality and reliability. RBC's objective is to engineer and fabricate control bearings which will meet and exceed the customer's needs, however exacting they may be. By utilizing the latest technology in bearing design and manufacture, RBC surpasses standards set by military specifications. Keeping abreast of advances in the field is RBC's assurance that RBC bearings will be available to fill the most demanding performance requirements as flight vehicles of the future become reality.

SAE-AS7949 SPECIFICATIONS

The airframe control bearings listed on the following pages are manufactured in accordance with the U.S. Government standards as set forth under the appropriate military specifications. The government specification covering the largest number of bearings is SAE-AS7949. Standards applicable under this specification and the bearing series to which they apply are shown in Table 1 below.

SAE-AS6039 SPECIFICATIONS

The rod end bearings listed on the following pages are manufactured in accordance with the U.S. Government standards as set forth under the appropriate military specifications. The government specification covering the largest number of bearings is SAE-AS6039. Standards applicable under this specification and the bearing series to which they apply are shown below:

MS21150 . . . . .REP-S . . . . .Solid Shank Rod End

MS21151 . . . . .REP-M . . . . .Male Rod End

MS21152 . . . . .REP-H . . . . . . .Hollow Shank Rod End

MS21153 . . . . .REP-F . . . . .Female Rod End

Two additional groups of rod ends, referred to as the "Balanced Design" series, are manufactured to meet the National Aircraft Standards Specification NAS661. Under this specification Balanced Design rod ends conform to standards NAS659 and NAS660.

Table 1

RADIAL PLAY AND GREASE VARIATIONS FOR SAE-AS7949 BEARINGS

MS Series	RBC Series	Standard Radial Play MIL-PRF-81322 Grease		Reduced Radial Play MIL-PRF-81322 Grease		Standard Radial Play MIL-PRF-23827 Grease		Reduced Radial Play MIL-PRF-23827 Grease	
		MS Suffix	RBC Suffix	MS Suffix	RBC Prefix/Suffix	MS Suffix	RBC Suffix	MS Suffix	RBC Prefix/Suffix
27640	KP								
27641	KP-A	NONE	FS464	R	M/FS464	G	FS428	RG	M/FS428
27643	DSP								
27645	KSP								
27644	DPP								
27646	B500DD								
27648	KP-BS	NONE	FS464	N/A	N/A	G	FS428	N/A	N/A
27649	AW-AK								
21428	MB500DD								
27647	DW	NONE	FS464	R	M/FS464	L	M/FS464	RL	M/FS428
27642	KP-B(1)			S(1)	FS464	G		SG(1)	FS428

(1) MKP-B Series are used for MS27642 bearings with an S or SG suffix (MS27642-16S is RBC MKP16B FS464)

AIRFRAME CONTROL & ROD END BEARINGS

Bearings listed herein are tabulated in two groups: (1) full complement bearings, which have no ball separators (retainers or cages); and, (2) bearings with ball-separators (ball retainers or ball cages). As noted before, the full complement bearings should be used in applications where the motion is mainly oscillatory; whereas, the bearings with ball separators may be used in applications where the motion may be continuous rotation or oscillatory under relatively light loads.

Airframe Control Full Complement (No Cage) Bearings

KP, MKP, AMKP Series

KP-A, MKP-A, AMKP-A Series

KSP, MKSP, AMKSP Series

KSP-A, MKSP-A, AMKSP-A Series

KP-B, MKP-B, AMKP-B Series

KP-BS, MKP-BS, AMKP-BS Series

DPP Series

DPP-W Series

DSP, MDSP Series

DSRP, GDSRP Series

DW (except DWK, DWK2 and MDW-K), AMDWK Series

GDW (except GDW4K and GDW4K2)

B500DD, MB500DD, AMB500DD Series

B500, MB500, AMB500 Series

B5500WZZ Series

P8 Pulley Series

K Series, D Series

Rod End Full Complement (No Cage) Bearings

REP Series

RAP Series

RA Series (NAS659)

RR Series (NAS660)

Airframe Control Bearings with Ball Separators

AW-AK Series

DW4K and DW4K2 Series

GDW4K and GDW4K2 Series

P Series (except P8)

BCP Bell Crank Series

STANDARDS OF QUALITY

All RBC bearings are manufactured to the same high standards of quality and reliability. RBC strives to engineer and utilize the latest available manufacturing technologies for producing bearings which meet and exceed all existing customer standards and expectations. This is RBC's assurance that its bearings will be available to fill the most demanding performance requirements in a variety of applications.

BEARING SELECTION, KEY CONSIDERATIONS

When selecting bearings, the primary focus should be on application requirements. Once the application requirements are clearly understood and specified, selecting bearing type and design is relatively straightforward. What are the main application requirements for bearings? Loads (radial, axial, moment, and magnitude), motion (oscillatory, rotating, or intermittent), speed (fast or slow), bearing life requirements (long or short), operating temperature (hot or cold), and operating medium (clean or contaminated air, water, vacuum, etc.) are among key application requirements. Depending on combination and severity of such factors, RBC engineering can offer guidance in selecting bearings for optimum service in the application.

As an aid in the preliminary stages of bearing selection, but not as a substitute for the services of a skilled bearing engineer, the following points are listed for the guidance of designers and inspectors:

1. If the bearing is used for continuous rotation, or in a delicate instrument application, do not consider any of the control type series, such as KP, KP-A, KP-B, KSP, DPP, DSP, etc., but refer to standard radial bearings or other more specialized types listed in other RBC catalogs.
2. All control surface hinge bearings should be of the sealed type. The sealed type is recommended on installations exposed to salt water spray, aircraft cleaning solutions, and where subjected to severe dust or dirt. Bearings having no shields or seals should be completely enclosed by the housing in which they are mounted to provide protection against external contaminants from entering the bearing and prevent lubricant inside from migrating or escape out of the bearing.
3. Airframe control self-aligning bearings of the KSP series are intended to compensate for misalignment due to initial setup and deflection in structure. They

should not be used as rod end bearings in non-planar linkages. For such applications, the DSP or DSRP series should be considered.

4. Bearing design intent and installation guidelines should be followed closely. Due consideration should be given to how a bearing would perform as installed and loaded in the next level assembly, as opposed to how it performs during free-state handling. Inspectors, therefore, should not reject KSP, DSP and DSRP series bearings because of tightness and/or roughness when the bearing is spun in a misaligned position. A study of the internal design will show that in pure misalignment (not accompanied by rotation) the balls do not roll, but skid across the ball raceway due to their wedging action. Any inspector's insistence that bearings be loosely fitted to ensure ease of misalignment would be unjustified and might cause flutter because of sloppy controls. A reasonable amount of tightness in self-aligning bearings (not excess binding) will ensure the desired rigidity in the control linkage system. Please adhere to instructions on shaft and housing fits provided in this catalog.
5. On applications in which a pair of bearings is assembled in a housing, such as on a bell crank pivot, for example, the following considerations are vital to satisfactory service:
   a. Bearings should not be preloaded when the nut is tightened up on the bolt or shaft supporting the two bearings.
   b. Ensure concentricity of bearing seats in the housing to avoid binding of bearing with respect to each other, when the bolt is passed through. As rule of thumb, to prevent premature bearing failures, the size and form precision of the supporting housing and shaft should be comparable to those of the bearing itself.

Questions concerning information in this section should be directed to the appropriate RBC Aerospace Bearings sales engineer.

LOAD RATINGS, LIMIT, AND STATIC RATINGS

The limit load ratings published in this catalog for airframe control bearings are the product of a special study undertaken jointly in 1949 by the Bureau of Aeronautics, the United States Air Force, the National Aircraft Standards Committee (NASC), and the American Bearing Manufacturers Association (ABMA). The purpose of this study was to develop a system for rating airframe control bearings based on criteria that would simulate more closely conditions encountered in real flight.

The basic equation is:

Limit load rating = Knd^2

where K = Load rating constant
n = Number of balls
d = Ball diameter

Typical K factors for radial limit load ratings are about 10,000 for deep groove bearings, 4800 for single row self-aligning bearings, 3800 for double row self-aligning bearings and 3200 for rod end bearings. In no case does the limit load rating exceed two-thirds of the bearing's minimum static fracture strength. That is, the minimum static fracture strength is 1.5 times the limit load rating.

OSCILLATING LOAD RATINGS

For bearing life and load calculations under oscillating conditions, consult the RBC Aerospace Engineering Department.

Full complement type bearings should not be used for rotating applications either intermittent or continuous. If it becomes necessary to consider these bearings in such applications, consult the RBC Aerospace Engineering Department prior to making selections.

An oscillating load rating system was accepted by AFBMA as an unpublished standard in 1959.

This standard permits selection of the smallest bearing that will operate under the normal loading for the desired life. This data is presented as tables of radial load ratings for 10,000 complete 90° oscillatory cycles. The 90° angle was selected as typical, a good value for test work, and conservative for bearing selection until more data is accumulated on the effect of various angles of oscillation. Rating are given for:

- Case I: where the load is fixed with respect to the outer race (inner ring oscillation)
- Case II: where the load is fixed with respect to the inner race. (outer ring oscillation)

Radial load ratings for any other number of oscillatory cycles may be readily obtained by multiplying the basic 10,000 cycle rating by a life factor obtained from a life factor curve.

The formulas for the ratings and life factors were derived from data accumulated by testing many bearings of different sizes and types under several different radial loads.

Briefly then, in selecting a bearing there are two steps:

1. Select a bearing that has a radial limit load rating equal to or in excess of application limit load.
2. Check the oscillatory rating of this bearing to ensure that the desired average life will be obtained under the normal loading.

In actual service, the load on any control position varies as the number of times the various loads are applied. Knowing the different loads and their duration, it is possible to calculate one equivalent load that would give the same number of cycles average life as the various loads. No one load may be greater than the limit load rating of the bearing. The equivalent load may be calculated from the formula:

$$P = [\sum K_i (P_i)^{3.6}]^{1/3.6}$$

where P = Equivalent load – Pounds or Newtons

P_i = Actual applied load – Pounds or Newtons

K_i = Proportion of service time that Pi is applied

For example, suppose a particular application carries a radial load of 500 lbs. for 15% of the total service time, 1000 lbs. for 75% and 2000 lbs. for 10%. Then the equivalent load on this bearing is:

$$P = [.15(500)^{3.6} + .75(1000)^{3.6} + .10(2000)^{3.6}]^{1/3.6}$$
$$= 1208 \text{ lbs.}$$

The tabulated values shown in various load rating tables will give an average life of 10,000 complete oscillatory cycles for two conditions of operation. Case I values are for bearing capacities with the load fixed with respect to the outer race. Case II values are for loads fixed with respect to the inner race.

A Life Factor Chart is provided to determine bearing capacity for an average life greater than 10,000 cycles and is used with the load rating tables. The life factor for the required average life is taken from the chart. The Case I or Case II rating of the bearing is then multiplied by this life factor. This product is the load which the bearing can carry to give the required average life. For life requirements of less than 10,000 cycles, we advise using the 10,000 cycle rating. Beyond this point, the criteria that determined this graph do not remain constant.

The proportionate amount of time that the various service loads are carried by a bearing can best be determined by the designer, who is familiar with the type of aircraft under consideration. With accumulated experience it is expected that shortcuts in using this method of bearing selection will be developed for each type of aircraft.

Following are typical examples of bearing selection based upon the procedure described previously.

Example 1

Taking the 1208 lb. equivalent load (above) in an application in which the heaviest of three radial loads is 2000 lbs., we can proceed through the KP and KP-A Series locating the smallest acceptable bearing as follows:

If there is no oscillatory life requirement stated and set-up of an overhaul period according to oscillatory life indicated, then proceed through the KP Series until the KP4 is reached, which is the first size having a radial limit load rating exceeding 2000 lbs. (2680 lbs.) and Case II rating 2030 lbs. Both of which exceed the 1208 lb. equivalent. The average oscillatory life for 1208 lbs. on a KP4 for Case I condition is 120,200 cycles for a Life Factor of 1208/2410 = .501. The average oscillatory life for 1208 lbs. on a KP4 for Case II condition is 64,700 cycles for a Life Factor of 1208/2030 = .595. The overhaul schedule can be set up for these average lives or on the basis of one-fifth of these lives for minimum life (90% survival).

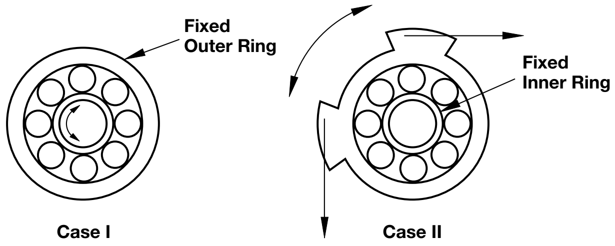
Similar procedure in the KP-A Series shows KP5A as the smallest acceptable size with an average life of 43,700 cycles for Case I and 27,500 cycles for Case II. Minimum life is again one-fifth of these average life values.

Example 2

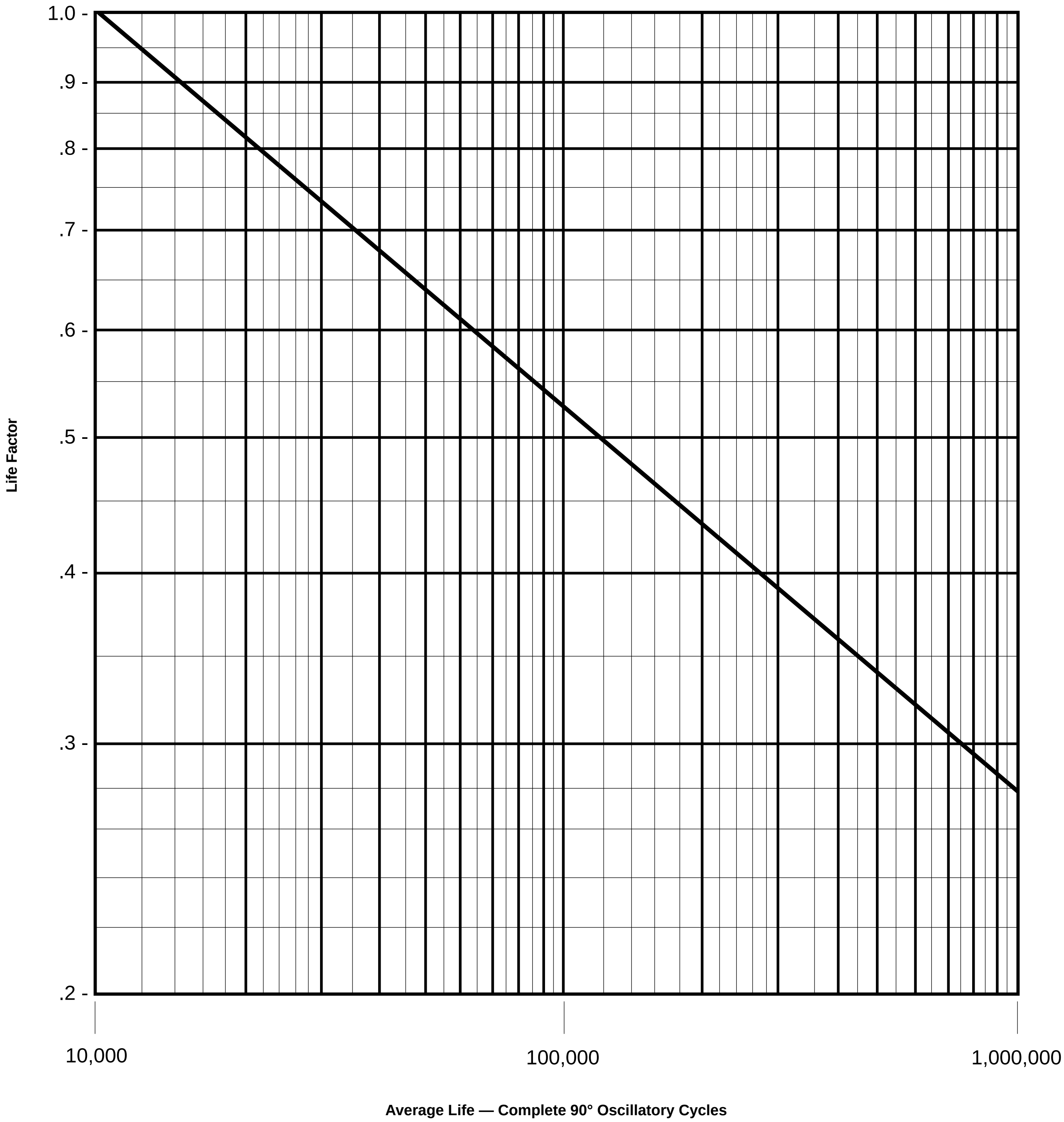
For another case, keep this 1208 lb. equivalent load and 2000 lb. maximum load and select a bearing which would have a Case I average life requirement of 690,000 cycles. The Life Factor to give this life is .309 or the Case I range must exceed 3910 (from 1208/.309). A KP5 or KP10A are the smallest bearing sizes in these series to satisfy this condition.

RATED RADIAL CAPACITIES

The rated radial capacities for complete rotation given in this catalog are based on AFBMA Standard Section 9, Method of Evaluating Load Ratings for Ball Bearings. The Life Basis is for 2500 hours average life at 100,300 and 500 rpm. For other Life Basis and/or speed conditions, consult RBC Aerospace Engineering.



LIFE FACTOR CHART



EXAMPLES OF BEARING SELECTION UNDER COMBINED LOADING CONDITIONS

Equivalent Limit Load – Combined Loading

When radial load, thrust load and moment load are encountered in combination (all three or any two) on a single bearing mounting, an equivalent thrust limit load is obtained and the customer can select an airframe bearing of a size having a thrust limit rating exceeding the equivalent thrust load. This is for static conditions and disregards life requirements under oscillation.

The formula for an individual size of bearing follows here and footnotes under various series tables give approximations for sizes within a series with applicable approximate ratios of ratings given:

$$\text{Equiv. thrust load} = \frac{\text{Thrust limit load rating}}{\text{Radial limit load rating}} \times \text{Radial load} + \text{Thrust load} + \text{Moment constant} \times \text{Moment in inch pounds}$$

As an example on a KP6A bearing

Equiv. thrust load = (1100/2500) x Radial load + Thrust load + 7.68 x Moment

Note that it is necessary to be dealing with a certain bearing size especially when moment is involved, and trial sizes are chosen having pure moment ratings larger than moment load involved to leave the capacity to be absorbed by radial and thrust components. If moment load is a big part of the loading, then it is necessary to select a bearing from a series having good moment ratings. When only radial and thrust loads are present, the problem is not so involved as any certain series has a fairly constant ratio of radial and thrust limit load ratings.

COMBINED LOADS INCLUDING MOMENT LOADS FOR SINGLE AND DOUBLE ROW BEARINGS

Note that the dynamic thrust load should not exceed 60% of the applied radial load for a full type bearing.

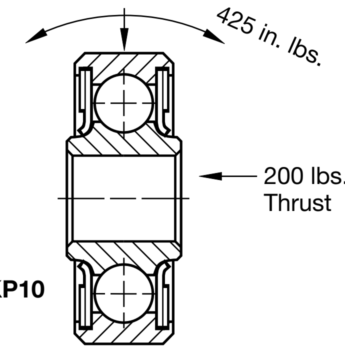
To illustrate the use of the moment constants given in the load rating tables, here are two typical calculations.

Using the safety factor formula:

$$\text{Safety factor} = \frac{\text{Static thrust}}{\text{Equivalent thrust load}}$$

Problem 1

We want to figure the equivalent thrust load and the safety factor on a KP10 (single row) bearing in an application where the radial load imposed is 4000 lbs., the thrust load is 200 lbs., and the overturning moment load is 425 in. lbs.



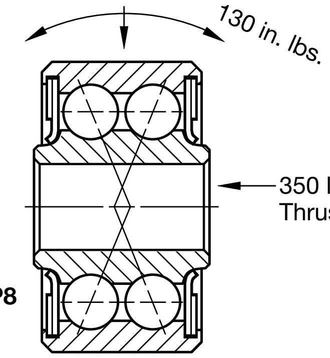
Substituting in the formula:

Equivalent thrust load = (.44 x 4000 lbs.) + 200 lbs. + (4.09 x 425 in. lbs.) = 3698 lbs.

Safety factor =(6200 lbs./3698 lbs.) = 1.68

Problem 2

Consider a DPP8 (double row) bearing in an application where the loads imposed are as follows: 1000 lbs. radial load, 350 lbs. thrust load and an overturning moment load of 130 in. lbs.



Substituting in the formula:

Equivalent thrust load = (.3 x 1000 lbs.) + 350 lbs. + (13.2 x 130 in. lbs.) = 2366 lbs.

Safety factor = (7800 lbs./2366 lbs.) = 3.30

TORQUE

Torque in ball bearings can be conveniently classified under two headings: inherent torque and induced torque.

Inherent Torque

The first, inherent torque, is the cumulative effect of the following factors:

Geometry: Surface finish of mating parts, deviations from roundness in the races, ball sphericity, and tolerances between functional surfaces.

Internal fit-up: Race curvatures, contact angle, radial internal clearance, and number of balls.

Bearing type: Full complement, radial or angular contact, type of retainer, shields, and seals, if any.

Lubricant: Type and quantity.

The term "inherent torque" is used to emphasize the nature of the torque due to the above causes. While the amount of torque in inch-ounces or gram-centimeters varies according to the degree of precision exercised in the manufacture of a bearing, a certain mean value is attained for each set of conditions, and that level of torque cannot practically be further reduced. The actual no-load, slow-speed inherent torque is very small compared with the torque induced by external causes during operation. At best, inherent torque is a comparative quality for bearing evaluation. Therefore, it is often measured with only a few drops of oil in the bearing. It is controlled almost entirely by the manufacturer, rather than by the customer.

Induced Torque

The second category, induced torque, is the cumulative effect of the following factors, all of which are external in origin to the bearing:

Loads: Both the magnitude and direction of the loads.

Speeds: The variation of, and maximum rpm.

Fits: The shaft and housing fits, plus the alignment of shaft and housing.

Temperature: The effect on fits and lubricant properties.

Contamination: Both foreign matter that enters the bearing and by-products of lubricant breakdown within the bearing.

The term "Induced Torque" as used herein denotes torque resulting from the method of bearing operation and its environment. With the exception of very lightly loaded, slow-speed applications, induced torque far exceeds inherent torque in a ball bearing, by a factor of 50 or more. The customer, therefore, has the final control over how much torque the bearings he uses will exhibit. Reduction of induced torque is primarily the customer's responsibility.

Design Criteria

The designer or engineer who strives to achieve the lowest economical torque must begin this task before placing the order. The bearing manufacturer can furnish bearings with minimum inherent torque and the least potential for induced torque only if a complete description of the application is made available. Such description will include the following:

Speeds: Maximum; normal; acceleration, if it is rapid.

Loads: Radial, axial or moment loading; magnitude; and relation to speed when possible.

Temperature: Minimum; maximum; normal operating; duration at extremes; shut-down conditions if soak-back is involved when the bearing is stationary; loads during high temperatures.

Lubrication: Whether grease or oil is required; if a circulating or splash-feed oil system is used, accurate determination of the quantity of oil available.

Materials: Specification of shaft and housing material and configurations (i.e., wall thickness, hollow, solid or splined shaft).

Environment: Specify if air, hot gases, fluids, dust, mud, etc. If a foreign substance, either a liquid or slurry, is present, indicate whether it is present continuously or only as a spray or occasional splashing.

Frequently, an inquiry for a ball bearing application includes most of the above, but no drawing accompanies the data. Both a drawing and a complete description as outlined above are required to properly specify the bearing to be used.

Shaft and Housing Fits

Once the bearings are ordered, the designer must ensure that the mating components are consistent with requirements. Housing and shaft fits must be held within specified limits while maintaining close control on roundness for these two dimensions. Interference fits directly affect the internal clearance in ball bearings — as much as 50% to 80% of the interference translates into reduced radial internal clearance, depending on the size of the bearing involved. Paralleling this situation, unequal heating of the inner and outer rings can have the same effect. Frequently, both conditions exist simultaneously; a press fit on the shaft, and higher shaft temperatures than housing temperatures. The result can be an increase in bearing torque or even complete failure due to damage caused by internal interference. Heat soak-back can also damage bearings due to thermal expansion occurring while the bearing is not rotating.

Effect of Low Temperature

Very low temperature conditions can also cause torque to increase sharply. The increase results from a change in housing fits due to thermal contraction and is very pronounced with dissimilar metals such as aluminum housings and steel bearings. There is also a marked increase in lubricant viscosity, particularly with greases. An example is found in aircraft control bearings, which are frequently mounted in aluminum housings and sealed with a quantity of grease enclosed. During ground handling and take-off, there is no detrimental torque in the bearings. However, during extended cruise at altitudes where the air temperature drops to -65°F (-54°C) or lower, the bearing may be literally frozen, due to interference and/or stiffened lubricant. After returning to more normal temperatures, the bearing may operate satisfactorily if only the stiff grease caused it to freeze; however, if the housing interference was excessive, and the races are brinnelled, subsequent operation will be rough and noisy.

Misalignment

Misalignment of the rotating member and the housing can cause high torque by applying a preload as the balls travel from one side of the race to the other during each revolution of the bearing. At sustained speeds, there is also a temperature rise, and the possibility of exceeding the load capacity of the lubricant. This condition, if self-sustaining, rapidly worsens to the point of bearing failure.

Loading

Torque in bearings increases directly as a function of load: either radial, axial, or a combination of the two. When loads are substantial, the designer should allow for the largest bearing possible, consistent with overall requirements early in the design stage. High torque due to loading cannot be significantly reduced for a given size bearing.

Seals

In applications where low speeds or oscillation are involved and where seals are needed to protect the bearing and retain lubricant, it is essential that information relative to contaminants be included with the description of the application. A variety of materials is available for seals; however, each one is unique in its ability to resist chemical attack by lubricants, hydraulic fluids, etc., and in its physical characteristics such as flexibility. For a particular condition of temperature, lubricant, and outside contamination, there is usually only one specific seal material that will best satisfy all requirements. The standard seal material used in the RBC airframe control and rod end bearings is PTFE.

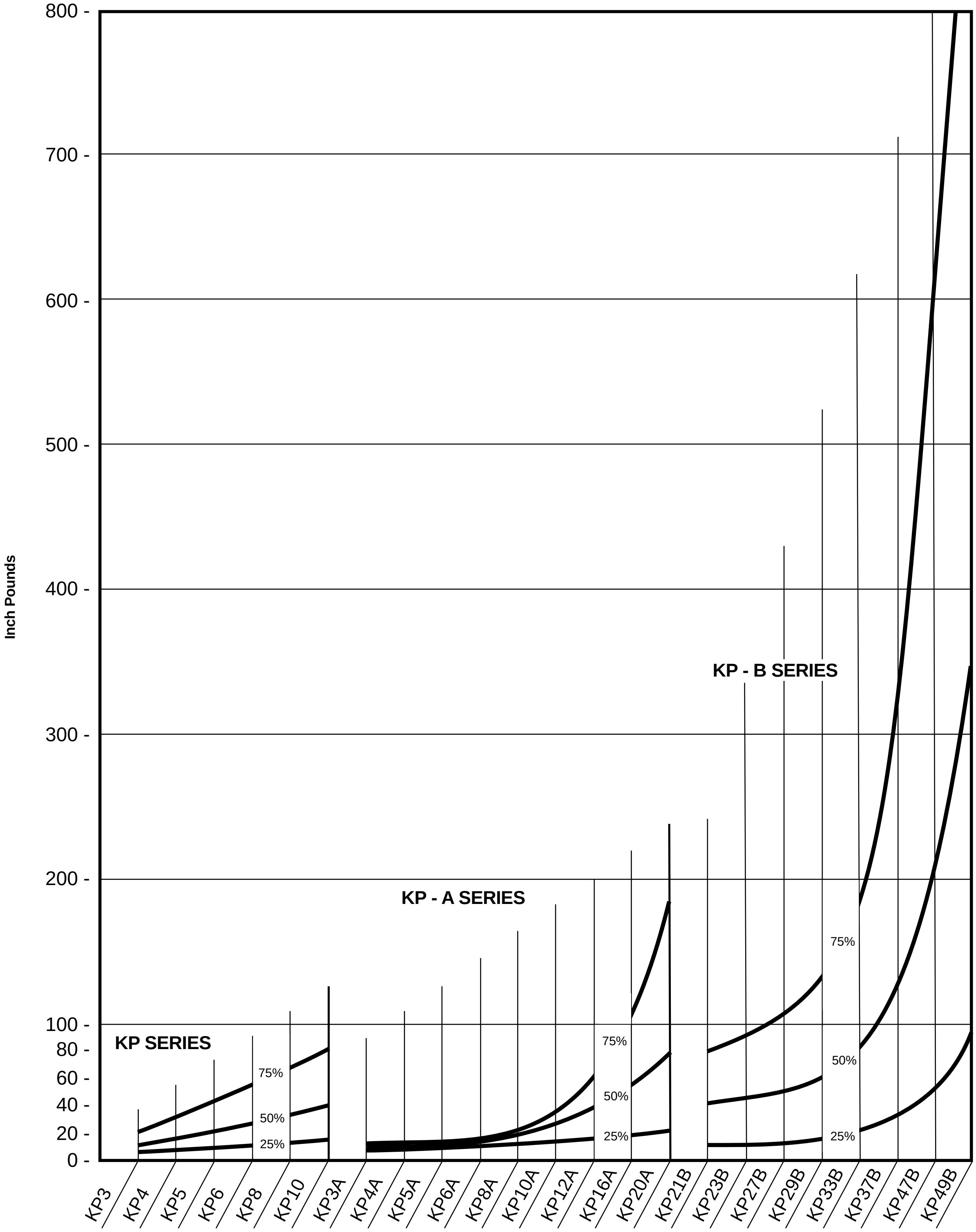
STARTING TORQUE LEVELS

Proper interpretation of the graph on page 16 on starting torque levels under radial loads requires that the user keep the following limitations in mind. The values were obtained under laboratory conditions with controlled fits, pure radial loading, and at room temperature. Therefore, the torque values are probably lower than those expected in airframe installations. The numerous other external factors that contribute to induced torque, as previously discussed, are not accounted for in the chart. For example, the effect of low temperature on starting torque due to grease stiffness varies widely. A KP3A bearing may show a 100% increase in starting torque at -65°F (-54°C), whereas a KP47B may show only about 10% greater torque, when both bearings are radially loaded to 75% of their rated capacity. Interference fits in housings, differential thermal expansion and contraction of steel bearings and aluminum housings, thrust loads, moment loads, etc., will all add significantly to the chart values for starting torque.

For applications in which low torque is critical, consult RBC Aerospace Engineering for recommendations, giving full particulars of the application.

STARTING TORQUE CHART

Note: This chart is intended only as a guide.



Representative Starting Torque Levels at 25%-50% and 75% of Radial Limit Load: KP, KP-A, and KP-B Series

SHAFT AND HOUSING FITS FOR AIRFRAME BEARINGS

It is essential for proper operation that small, heavily loaded bearings in oscillating service be mounted in housings with a light, but positive, interference (press) fit. Staking or spinning of the housing over the outer ring chamfer is recommended to secure the bearing axially. In some applications involving considerable thrust load, a housing shoulder is desirable.

Minimum and Maximum Fits

The minimum and maximum press fits shown in the following tables represent a compromise condition. Actually, the optimum press fit is approximately .0005 in., .013mm for steel and approximately .0007 in., .018mm for aluminum or magnesium. However, since the bearing outside diameter tolerance is .0005 in., .013mm and a housing bore tolerance of .0005 in., 013mm is the least which can be maintained by usual manufacturing practice, a total possible range of fit of .0010 in., .025mm results. The average outside diameter pressed into the average housing bore results in a press fit range of approximately .0006 in., .015mm; namely, for steel .0002 in. - .0008 in., .005mm - .020mm and for aluminum or magnesium .0005 in. - .0010 in., .010mm - .025mm. Housing bores should not be allowed to run consistently to the low side of the tolerance, as this will obviously increase the average interference and raise the percentage of extreme fits.

Radial Clearance

In all but specially assembled aircraft bearings, a small amount (less than .0010 in., .025mm) of radial clearance is provided between balls and races. When the outer ring is press-fitted into a housing, a portion of the interference is absorbed by contraction of the outer ring, the balance by the expansion of the housing – the proportions, depending on the relative sections, and the modulus of elasticity of the material.

When the press fit becomes too heavy, the initial radial clearance in the bearing may be removed, resulting in a radially preloaded bearing. Such preloading lessens the capacity of the bearing for applied loads. Hence, excessive press fits should be carefully avoided.

Mean Fits (Tight or Loose)

The expected mean fits listed in the tables result when bearings are mounted on shafts and in housings having the recommended diameters. In the manufacture of ball bearings, most of the bores and outside diameters are near the mean diameter of the tolerance. Similarly, the majority of shafts and housings are held to diameters near the mean of the recommended tolerances. Experience has shown that when standard bearings are mounted on shafts and in housings, the diameters of which are held to recommended tolerances, 85% to 90% of the assemblies will be close to the mean expected fits, and less than 2% will be near the extremes for tightness and looseness.

Although selective assembly is not feasible in most aircraft plants, when extreme fits are encountered, as evidenced by pronounced drag in bearing rotation after mounting, it is recommended that the bearing be removed and fitted to a slightly larger housing bore. This is seldom necessary with rigid type bearings, but may be desirable with self-aligning bearings.

SHAFT AND HOUSING FITS FOR OSCILLATORY SERVICE
AW-AK, KP, KP-A, KSP, KSP-A, DPP, DPP-W, DSP, DSRP, GDSRP, DW, GDW, P SERIES

Housing Fits — Standard Series

Bearing O.D.		Steel Housing Bore		Mean Fit Tight		Aluminum or Magnesium Housing Bore		Mean Fit Tight	
in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
0.6250	15.875	0.6245	15.862	0.0005	0.013	0.6243	15.857	0.0007	0.018
0.6245	15.862	0.6240	15.849			0.6238	15.844		
0.7500	19.050	0.7495	19.037	0.0005	0.013	0.7493	19.032	0.0007	0.018
0.7495	19.037	0.7490	19.024			0.7488	19.019		
0.7774	19.746	0.7769	19.733	0.0005	0.013	0.7767	19.728	0.0007	0.018
0.7769	19.733	0.7764	19.720			0.7762	19.715		
0.8125	20.638	0.8120	20.625	0.0005	0.013	0.8118	20.620	0.0007	0.018
0.8120	20.625	0.8115	20.612			0.8113	20.607		
0.8750	22.225	0.8745	22.212	0.0005	0.013	0.8743	22.207	0.0007	0.018
0.8745	22.212	0.8740	22.199			0.8738	22.194		
0.9014	22.896	0.9009	22.883	0.0005	0.013	0.9007	22.878	0.0007	0.018
0.9009	22.883	0.9004	22.870			0.9002	22.865		
0.9375	23.812	0.9370	23.800	0.0005	0.013	0.9368	23.795	0.0007	0.018
0.9370	23.800	0.9365	23.787			0.9363	23.782		
1.0625	26.988	1.0620	26.975	0.0005	0.013	1.0618	26.970	0.0007	0.018
1.0620	26.975	1.0615	26.962			1.0613	26.957		
1.1250	28.575	1.1245	28.562	0.0005	0.013	1.1243	28.557	0.0007	0.018
1.1245	28.562	1.1240	28.546			1.1238	28.544		
1.1875	30.162	1.1870	30.149	0.0005	0.013	1.1868	30.145	0.0007	0.018
1.1870	30.149	1.1865	30.136			1.1863	30.132		
1.2500	31.750	1.2495	31.737	0.0005	0.013	1.2493	31.732	0.0007	0.018
1.2495	31.737	1.2490	31.724			1.2488	31.719		
1.3750	34.925	1.3745	34.912	0.0005	0.013	1.3743	34.907	0.0007	0.018
1.3745	34.912	1.3740	34.899			1.3738	34.894		
1.4375	36.512	1.4370	36.499	0.0005	0.013	1.4368	36.495	0.0007	0.018
1.4370	36.499	1.4365	36.486			1.4363	36.482		
1.6250	41.275	1.6245	41.262	0.0005	0.013	1.6243	41.257	0.0007	0.018
1.6245	41.262	1.6240	41.249			1.6238	41.244		
1.6875	42.862	1.6870	42.849	0.0005	0.013	1.6868	42.845	0.0007	0.018
1.6870	42.849	1.6865	42.836			1.6863	42.832		
1.9375	49.212	1.9370	49.199	0.0005	0.013	1.9368	49.195	0.0007	0.018
1.9370	49.199	1.9365	42.186			1.9363	49.182		
2.0000	50.800	1.9995	50.787	0.0005	0.013	1.9993	50.782	0.0007	0.018
1.9995	50.787	1.9990	50.774			1.9988	50.769		
2.2500	57.150	2.2495	50.137	0.0005	0.013	2.2493	57.132	0.0007	0.018
2.2495	57.137	2.2490	57.124			2.2488	57.119		

Shaft Fits – Standard Series

For oscillating service in which bearings are not mounted on standard aircraft bolts, and are not clamped axially on shafts, it is recommended that shaft diameters from nominal bearing bore size -.0005 in. (-.013mm) to nominal bearing bore size -.0010 in. (.025mm) be used.

SHAFT AND HOUSING FITS FOR OSCILLATORY SERVICE
MKP, MKP-A, MKSP, MKSP-A, MDPP, MDSP, MDW(K) SERIES

Housing Fits – Precision M Series

Bearing O.D.		Steel Housing Bore		Mean Fit Tight		Aluminum or Magnesium Housing Bore		Mean Fit Tight	
in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
0.6250	15.875	0.6246	15.865	0.00045	0.0115	0.6244	15.860	0.00065	0.0165
0.6246	15.865	0.6241	15.852			0.6239	15.847		
0.7500	19.050	0.7496	19.040	0.00045	0.0115	0.7494	19.035	0.00065	0.0165
0.7496	19.040	0.7491	19.027			0.7489	19.072		
0.7774	19.746	0.7770	19.736	0.00045	0.0115	0.7768	19.731	0.00065	0.0165
0.7770	19.736	0.7765	19.723			0.7763	19.718		
0.8125	20.638	0.8121	20.628	0.00045	0.0115	0.8119	20.622	0.00065	0.0165
0.8121	20.628	0.8116	20.615			0.8114	20.609		
0.8750	22.225	0.8746	22.215	0.00045	0.0115	0.8744	22.210	0.00065	0.0165
0.8746	22.215	0.8741	22.202			0.8739	22.197		
0.9014	22.896	0.9010	22.886	0.00045	0.0115	0.9008	22.880	0.00065	0.0165
0.9010	22.886	0.9005	22.873			0.9003	22.867		
1.0625	26.988	1.0621	26.978	0.00045	0.0115	1.0619	26.972	0.00065	0.0165
1.0621	26.978	1.0616	26.965			1.0614	26.959		
1.1250	28.575	1.1246	28.565	0.00045	0.0115	1.1244	28.560	0.00065	0.0165
1.1246	28.565	1.1241	28.552			1.1239	28.547		
1.2500	31.750	1.2496	31.740	0.00045	0.0115	1.2494	31.735	0.00065	0.0165
1.2496	31.740	1.2491	31.727			1.2489	31.722		
1.3750	34.925	1.3746	34.915	0.00045	0.0115	1.3744	34.910	0.00065	0.0165
1.3746	34.915	1.3741	34.902			1.3739	34.897		
1.4375	36.512	1.4371	36.502	0.00045	0.0115	1.4369	36.497	0.00065	0.0165
1.4371	36.502	1.4366	36.489			1.4364	36.484		
1.6250	41.275	1.6246	41.265	0.00045	0.0115	1.6244	41.260	0.00065	0.0165
1.6246	41.265	1.6241	41.252			1.6239	41.247		
1.6875	42.862	1.6871	42.852	0.00045	0.0115	1.6869	42.847	0.00065	0.0165
1.6871	42.852	1.6866	42.839			1.6864	42.834		
1.9375	49.212	1.9371	49.202	0.00045	0.0115	1.9369	49.197	0.00065	0.0165
1.9371	49.202	1.9366	49.189			1.9364	49.184		
2.0000	50.800	1.9996	50.790	0.00045	0.0115	1.9994	50.785	0.00065	0.0165
1.9996	50.790	1.9991	50.777			1.9889	50.782		
2.2500	57.150	2.2496	57.140	0.00045	0.0115	2.2494	57.135	0.00065	0.0165
2.2496	57.140	2.2491	57.127			2.2489	57.122		

Shaft Fits – Precision M Series

For oscillating service in which bearings are not mounted on standard aircraft bolts, and are not clamped axially on shafts, it is recommended that shaft diameters from nominal bearing bore size -.0003 in. (-.008mm) to nominal bearing bore size -.0008 in. (.020mm) be used.

COMPARISON OF INSPECTION LIMITS - STANDARD SERIES VERSUS PRECISION SERIES

Bearing Series		Standard KP, KP-A, KSP(2), KSP-A(2), DPP, DSP, DW, DSRP, GDSRP		Precision MKP, MKP-A, MKSP, MKSP-A, MDPP, MDSP, MDW, MDSRP		Standard KP-B and KP-BS		Precision MKP-B and MKP-BS		Standard B538(DD) thru B543(DD)		Precision MB538(DD) thru MB543(DD)		Standard B544(DD) and up		Precision MB544(DD) and up	
		in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
bore:	**mean**	+0.0000	+0.000	+0.0000	+0.000	+0.0000(1)	+0.000	+0.0000	+0.000	+0.0007	+0.018	+0.0000	+0.000	+0.0010	+0.025	+0.0000	+0.000
	diameter	-0.0005	-0.013	-0.0003	-0.008	-0.0010(1)	-0.025	-0.0005	-0.013	-0.0007	-0.018	-0.0005	-0.013	-0.0010	-0.025	-0.0008	-0.020
O.D.:	**mean**	+0.0000	+0.000	+0.0000	+0.000	+0.0000	+0.000	+0.0000	+0.000	+0.0000	+0.000	+0.0000	+0.000	+0.0000	+0.000	+0.0000	+0.000
	diameter	-0.0005	-0.013	-0.0004	-0.010	-0.0010	-0.025	-0.0010	-0.025	-0.0010	-0.025	-0.0005	-0.013	-0.0015	-0.038	-0.0007	-0.018
width:	**inner**	+0.0000	+0.000	+0.0000	+0.000	+0.0000	+0.000	+0.0000	+0.000	+0.0000	+0.000	+0.0000	+0.000	+0.0000	+0.000	+0.0000	+0.000
		-0.0050	-0.130	-0.0025	-0.064	-0.0050	-0.130	-0.0025	-0.064	-0.0050	-0.130	-0.0025	-0.064	-0.0050	-0.130	-0.0025	-0.064
width:	**outer**	+0.0000	+0.000	+0.0000	+0.000	+0.0000	+0.000	+0.0000	+0.000	+0.0000	+0.000	+0.0000	+0.000	+0.0000	+0.000	+0.0000	+0.000
		-0.0050	-0.130	-0.0050	-0.130	-0.0050	-0.130	-0.0050	-0.130	-0.0050	-0.130	-0.0050	-0.130	-0.0050	-0.130	-0.0050	-0.130
parallelism:	**inner**	0.0008	0.020	0.0005	0.013	0.0008	0.020	0.0004	0.010	0.0008	0.020	0.0004	0.010	0.0008	0.020	0.0004	0.010
	outer	0.0008	0.020	0.0005	0.013	0.0008	0.020	0.0004	0.010	0.0008	0.020	0.0004	0.010	0.0008	0.020	0.0004	0.010
squareness:	**inner**	0.0010	0.025	0.0005	0.013	0.0010	0.025	0.0005	0.013	0.0010	0.025	0.0005	0.013	0.0010	0.025	0.0005	0.013
	outer	0.0010	0.025	0.0005	0.013	0.0010	0.025	0.0005	0.013	0.0010	0.025	0.0005	0.013	0.0010	0.025	0.0005	0.013
radial eccentricity:	**inner**	0.0010	0.025	0.0005	0.013	0.0010	0.025	0.0008	0.020	0.0020	0.050	0.0008	0.020	0.0020	0.050	0.0008	0.020
	outer	0.0016	0.040	0.0008	0.020	0.0016	0.040	0.0008	0.020	0.0016	0.040	0.0008	0.020	0.0016	0.040	0.0008	0.020
face runout:	**inner**	0.0010	0.025	0.0007	0.018	0.0010	0.025	0.0008	0.020	0.0020	0.050	0.0008	0.020	0.0020	0.050	0.0008	0.020
	outer	0.0016	0.040	0.0010	0.025	0.0016	0.040	0.0010	0.025	0.0016	0.040	0.0008	0.020	0.0016	0.040	0.0008	0.020

(1) All bore and O.D. tolerances including those for MKP-B are referred to the nominal fractional dimensions except the bores of the KP-B and KP-BS series whose "nominal" dimensions are .0005 in., .013mm above the nominal fractional dimension.
(2) Radial play for KSP and KSP-A series is .000 in. / .0010 in..
(3) Not applicable to self-aligning bearings.

Note: These tolerances conform to those shown in ANSI\ABMA standard 16.2

INTERNAL CLEARANCES

Bearing Sizes		Radial Play(2)			
Standard	Precision M Series				
		in.		mm	
KP, KP-A(1)		0.0004	0.0010	0.010	0.025
	MKP, MKP-A	0.0002	0.0005	0.005	0.013
KSP, KSP-A		0.0000	0.0010	0.000	0.025
	MKSP, MKSP-A	0.0001	0.0005	0.003	0.013
	MKP-B(S)	0.0001	0.0005	0.003	0.013
DSRP, GDSRP	**MDSRP**	0.0004	0.0008	0.010	0.020
KP16B(S)-KP49B(S)		0.0003	0.0010	0.008	0.025
KP52B(S) and up		0.0003	0.0015	0.008	0.038
B538(DD)-B546(DD)		0.0008	0.0018	0.020	0.046
	MB538(DD)- MB546(DD)	0.0001	0.0005	0.003	0.013
DW, DPP(1)		0.0010	0.0030	0.025	0.076
DSP(1)	**MDSP**	0.0035	0.0055	0.089	0.140
	MDW, MDPP	0.0010	0.0020	0.025	0.051

(1) For reduced radial play of .0002 in.\.0005 in., .005mm\.013mm.

(2) Under 5.5 lb. (2.49kg) gage load.

SHAFT AND HOUSING FITS FOR OSCILLATORY SERVICE
(M)*KP-B, (M)*KP-BS SERIES

Bearing Number		Shaft Fits: Bearing Bore		Shaft Fits: Steel, Aluminum or Magnesium Shaft		Shaft Fits: Mean Fit Loose		Housing Fits: Bearing O.D. KP-B		Housing Fits: Bearing O.D. KP-BS		Housing Fits: Steel, Aluminum or Magnesium Housing KP-B		Housing Fits: Steel, Aluminum or Magnesium Housing KP-BS		Housing Fits: Mean Fit Loose	
		in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
KP16B	KP16BS	1.0000	25.400	0.9995	25.387	0.0005	0.013	1.7500	44.450	1.9375	49.212	1.7510	44.475	1.9385	49.238	0.0010	0.025
		0.9995	25.387	0.9990	25.375			1.7490	44.425	1.9365	49.187	1.7500	44.450	1.9375	49.213		
KP21B	KP21BS	1.3130	33.350	1.3120	33.325	0.0010	0.025	2.0625	52.388	2.2500	57.150	2.0635	52.413	2.2510	57.175	0.0010	0.025
		1.3120	33.325	1.3110	33.299			2.0615	52.362	2.2490	57.125	2.0625	52.388	2.2500	57.150		
KP23B	KP23BS	1.4380	36.525	1.4370	36.500	0.0010	0.025	2.1875	55.562	2.3750	60.325	2.1885	55.588	2.3760	60.350	0.0010	0.025
		1.4370	36.500	1.4360	36.474			2.1865	55.537	2.3740	60.300	2.1875	55.562	2.3750	60.325		
KP25B	KP25BS	1.5630	39.700	1.5620	39.675	0.0010	0.025	2.3125	58.738	2.5000	63.500	2.3135	58.763	2.5010	63.525	0.0010	0.025
		1.5620	39.675	1.5610	39.649			2.3115	58.712	2.4990	63.475	2.3125	58.738	2.5000	63.500		
KP29B	KP29BS	1.8130	46.050	1.8120	46.025	0.0010	0.025	2.5625	65.088	2.7500	69.850	2.5635	65.113	2.7510	69.875	0.0010	0.025
		1.8120	46.025	1.8110	45.999			2.5615	65.062	2.7490	69.825	2.5625	65.088	2.7500	69.850		
KP33B	KP33BS	2.0630	52.400	2.0620	52.375	0.0010	0.025	2.8125	71.438	3.0000	76.200	2.8135	71.463	3.0010	76.225	0.0010	0.025
		2.0620	52.375	2.0610	52.349			2.8115	71.412	2.9990	76.175	2.8125	71.438	3.0000	76.200		
KP37B	KP37BS	2.3130	58.750	2.3120	58.725	0.0010	0.025	3.0625	77.788	3.2500	82.550	3.0635	77.813	3.2510	82.575	0.0010	0.025
		2.3120	58.725	2.3110	58.699			3.0615	77.762	3.2490	82.525	3.0625	77.788	3.2500	82.550		
KP47B	KP47BS	2.9380	74.625	2.9370	74.600	0.0010	0.025	3.8750	98.425	4.1250	104.775	3.8760	98.450	4.1260	104.800	0.0010	0.025
		2.9370	74.600	2.9360	74.574			3.8740	98.400	4.1240	104.750	3.8750	98.425	4.1250	104.775		
—	KP48BS	3.0000	76.200	2.9990	76.175	0.0010	0.025	—	—	4.2500	107.950	—	—	4.2510	107.975	0.0010	0.025
		2.9990	76.175	2.9980	76.149			—	—	4.2490	107.925	—	—	4.2500	107.950		
KP49B	KP49BS	3.0630	77.800	3.0620	77.775	0.0010	0.025	4.0000	101.600	4.2500	107.950	4.0010	101.625	4.2510	107.975	0.0010	0.025
		3.0620	77.775	3.0610	77.749			3.9990	101.575	4.2490	107.925	4.0000	101.600	4.2500	107.950		
KP52B	—	3.2500	82.550	3.2490	82.525	0.0010	0.025	4.1875	106.363	—	—	4.1885	106.388	—	—	0.0010	0.025
		3.2490	82.525	3.2480	82.499			4.1865	106.337	—	—	4.1875	106.363	—	—		
KP56B	—	3.5000	88.900	3.4990	88.875	0.0010	0.025	4.4375	112.713	—	—	4.4385	112.738	—	—	0.0010	0.025
		3.4990	88.875	3.4980	88.849			4.4365	112.687	—	—	4.4375	112.713	—	—		
KP60B	—	3.7500	95.250	3.7490	92.225	0.0010	0.025	4.6875	119.063	—	—	4.6885	119.088	—	—	0.0010	0.025
		3.7490	95.225	3.7480	95.199			4.6865	119.037	—	—	4.6875	119.063	—	—		

* For precision (M) series, KP-B and KP-BS, 16–49, use the same shaft outside diameter and housing bore diameter.

AIRFRAME CONTROL & BALL BEARING ROD ENDS

SHAFT AND HOUSING FITS FOR OSCILLATORY SERVICE (M)*B500 AND (M)*B500DD SERIES

Bearing Number	Shaft Fits						Housing Fits					
	Bearing Bore		Steel, Aluminum or Magnesium Shaft		Mean Fit Loose		Bearing O.D.		Steel, Aluminum or Magnesium Housing		Mean Fit Loose	
	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
B538, B538DD	0.6257	15.893	0.6243	15.857	0.0012	0.030	1.0625	26.988	1.0635	27.013	0.0010	0.025
	0.6243	15.857	0.6233	15.832			1.0615	26.962	1.0625	26.988		
B539, B539DD	0.7507	19.068	0.7493	19.032	0.0012	0.030	1.1875	30.162	1.1885	30.187	0.0010	0.025
	0.7493	19.032	0.7483	19.007			1.1865	30.137	1.1875	30.162		
B540, B540DD	0.8757	20.243	0.8743	22.207	0.0012	0.030	1.3125	33.338	1.3135	33.363	0.0010	0.025
	0.8743	22.207	0.8733	22.182			1.3115	33.313	1.3125	33.338		
B541, B541DD	1.0632	27.005	1.0618	26.970	0.0012	0.030	1.5000	38.100	1.5010	38.125	0.0010	0.025
	1.0618	26.970	1.0608	26.944			1.4990	38.075	1.5000	38.100		
B542, B542DD	1.3132	33.355	1.3118	33.320	0.0012	0.030	1.7500	44.450	1.7510	44.475	0.0010	0.025
	1.3118	33.320	1.3108	33.294			1.7490	44.425	1.7500	44.450		
B543, B543DD	1.5632	39.705	1.5618	39.670	0.0012	0.030	2.0000	50.800	2.0010	50.825	0.0010	0.025
	1.5618	39.670	1.5608	39.644			1.9990	50.775	2.0000	50.800		
B544, B544DD	1.8135	46.063	1.8115	46.012	0.0015	0.038	2.2500	57.150	2.2510	57.175	0.0012	0.030
	1.8115	46.012	1.8105	45.987			2.2485	57.112	2.2500	57.150		
B545, B545DD	2.0635	52.413	2.0615	52.362	0.0015	0.038	2.6250	66.675	2.6260	66.700	0.0012	0.030
	2.0615	52.362	2.0605	52.337			2.6235	66.637	2.6250	66.675		
B546, B546DD	2.3135	58.763	2.3115	58.712	0.0015	0.038	2.8750	73.025	2.8760	73.050	0.0012	0.030
	2.3115	58.712	2.3105	58.687			2.8735	72.987	2.8750	73.025		

* For precision (M) series, B500 and B500DD, 538-546, use the same shaft outside diameter and housing bore diameter.

SHAFT AND HOUSING FITS FOR OSCILLATORY SERVICE
B500WZZ SERIES

Bearing Number	Shaft Fits						Housing Fits					
	Bearing Bore		Steel, Aluminum or Magnesium Shaft		Mean Fit Loose		Bearing O.D.		Steel, Aluminum or Magnesium Housing		Mean Fit Loose	
	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
B5538WZZ	0.6250 0.6245	15.875 15.862	0.6245 0.6240	15.862 15.849	0.0005	0.013	1.0625 1.0620	26.988 26.975	1.0625 1.0620	26.988 26.975	LINE	
B5539WZZ	0.7500 0.7495	19.050 19.037	0.7495 0.7490	19.037 19.024	0.0005	0.013	1.1875 1.1870	30.162 30.150	1.1875 1.1870	30.163 30.150	—	
B5540WZZ	0.8750 0.8745	22.225 22.212	0.8745 0.8740	22.212 22.199	0.0005	0.013	1.3125 1.3120	33.338 33.325	1.3125 1.3120	33.338 33.325	—	
B5541WZZ	1.0625 1.0620	26.988 26.975	1.0620 1.0615	26.975 26.962	0.0005	0.013	1.5000 1.4995	38.100 38.087	1.5000 1.4995	38.100 38.087	—	
B5542WZZ	1.3125 1.3120	33.338 33.325	1.3120 1.3115	33.325 33.312	0.0005	0.013	1.7500 1.7495	44.450 44.437	1.7500 1.7495	44.450 44.437	—	
B5543WZZ	1.5625 1.5620	39.688 39.675	1.5620 1.5615	39.675 39.662	0.0005	0.013	2.0000 1.9995	50.800 50.787	2.0000 1.9995	50.800 50.787	LINE	
B5544WZZ	1.8125 1.8117	46.038 46.018	1.8117 1.8112	46.018 46.005	0.0007	0.016	2.2500 2.2493	57.150 57.132	2.2500 2.2495	57.150 57.137	0.0001	0.003
B5545WZZ	2.0625 2.0617	52.388 52.368	2.0617 2.0612	52.368 52.355	0.0007	0.016	2.6250 2.6243	66.675 66.657	2.6250 2.6245	66.675 66.662	0.0001	0.003
B5546WZZ	2.3125 2.3117	58.738 58.718	2.3117 2.3112	58.718 58.705	0.0007	0.016	2.8750 2.8743	73.025 73.007	2.8750 2.8745	73.025 73.012	0.0001	0.003

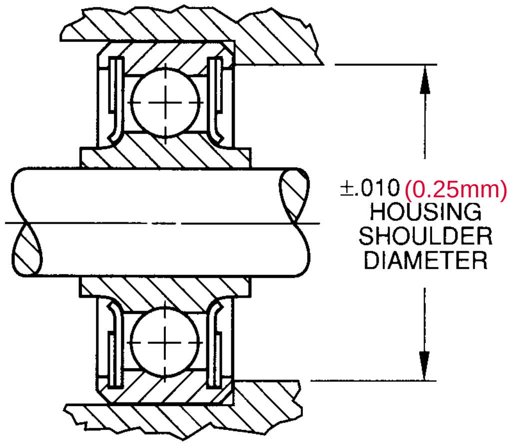
Shaft diameter = Same dimensions as bearing bore.

Maximum housing bore = Maximum bearing O.D. plus the O.D. tolerance.

Minimum housing bore = Maximum bearing O.D.

The ideal fit for these series is “line-to-line”. Therefore, wherever possible, selective assembly should be used.

HOUSING SHOULDER DIAMETERS



Bearing Number	Housing Shoulder Diameter in.	Housing Shoulder Diameter mm
KP3L	0.564	14.30
KP3	0.622	15.80
KP4	0.732	18.60
KP5	1.014	25.80
KP6	1.234	31.30
KP8	1.454	36.90
KP10	1.646	41.80
KP3A	0.520	13.20
KP4A	0.620	15.70
KP5A	0.684	17.40
KP6A	0.754	19.20
KP8A	0.976	24.80
KP10A	1.214	30.80
KP12A	1.464	37.20
KP16A	1.764	44.80
KP20A	2.026	51.50
KSP3L	0.564	14.30
KSP4A	0.661	16.80
KSP5A	0.717	18.20
KSP6A	0.786	20.00
KSP3	0.656	16.70
KSP4	0.798	20.30
KSP5	1.058	26.90
KSP6	1.202	30.50
KSP8	1.532	38.90
KSP10	1.608	40.80

Bearing Number	Housing Shoulder Diameter in.	Housing Shoulder Diameter mm
KP16B	1.593	40.50
KP21B	1.894	48.10
KP23B	2.016	51.20
KP25B	2.132	54.20
KP29B	2.372	60.20
KP33B	2.672	67.90
KP37B	2.910	73.90
KP47B	3.600	91.40
KP49B	3.768	95.70
KP52B	3.928	99.80
KP56B	4.188	106.40
KP60B	4.448	113.00
KP21BS	2.028	51.50
KP23BS	2.155	54.70
KP25BS	2.282	58.00
KP29BS	2.535	64.40
KP33BS	2.787	70.80
KP37BS	3.039	77.20
KP47BS	3.846	97.70
KP48BS	3.972	100.90
KP49BS	3.972	100.90

Bearing Number	Housing Shoulder Diameter in.	Housing Shoulder Diameter mm
DPP3	0.634	16.10
DPP3W	0.634	16.10
DPP4	0.718	18.20
DPP4W	0.718	18.20
DPP5	1.078	27.40
DPP5W	1.078	27.40
DPP6	1.248	31.70
DPP6W	1.248	31.70
DPP	1.468	37.30
DPP8W	1.468	37.30
DPP10	1.638	41.60
DPP10W	1.638	41.60
DSP3	0.610	15.50
DSP4	0.714	18.10
DSP5	0.974	24.70
DSP6	1.168	29.70
DSP8	1.400	35.60
DSP10	1.638	41.60
DSRP4	0.714	18.10
DSRP5	0.974	24.70
DSRP6	1.168	29.70
DSRP8	1.400	35.60
DSRP10	1.638	41.60
DSRP12	1.850	47.00

Bearing Number	Housing Shoulder Diameter in.	Housing Shoulder Diameter mm
B538	0.924	23.50
B539	1.042	26.50
B540	1.162	29.50
B541	1.360	34.50
B542	1.598	40.60
B543	1.838	46.70
B544	2.116	53.70
B545	2.434	61.80
B546	2.678	68.00
DW4K2	0.530	13.50
DW4K	0.644	16.40
DW4	0.644	16.40
DW5	0.758	19.30
DW6	0.938	23.80
DW8	1.232	31.30
BCP4W10	0.634	16.10
BCP5W11	0.758	19.30
P4K	0.728	18.50
P5K	0.724	18.40
PD5K	0.768	19.50
P8(FT)	1.454	36.90
P10K	1.022	26.00