

RBC[®] AEROSPACE BEARINGS



unique design solutions
to complex problems.

The Global Leader in Gimbal Bearings

air.

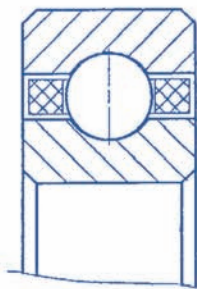
space.

land and sea.

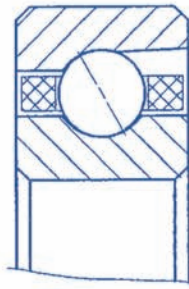
www.rbcbearings.com

RBC Thin Section Ball Bearing Selection

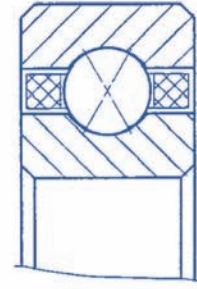
LOAD CONDITION						
Bearing Type	Ball Contact	Radial	Axial	Moment	Reversing Axial	Combined Radial, Axial, & Moment
C	Radial	Good	Fair	Poor	Fair	Poor
A	Angular	Good	Very Good	Do Not Use	Do Not Use	Do Not Use
X	4-Point	Fair	Good	Good	Good	Fair
B	Double Angular	Very Good	Very Good	Very Good	Very Good	Good
F	Double Angular	Very Good	Very Good	Very Good	Very Good	Good
T	Double Angular	Excellent	Excellent	Do Not Use	Do Not Use	Do Not Use
M	Double Angular	Excellent	Excellent	Excellent	Excellent	Excellent
W	Double Angular	Excellent	Excellent	Excellent	Excellent	Excellent



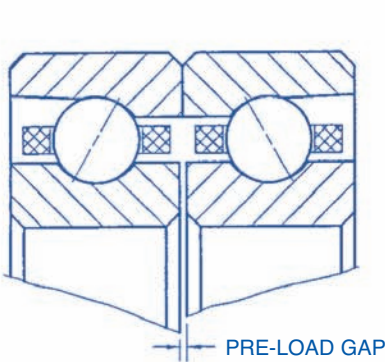
C-Type
(Radial Contact)



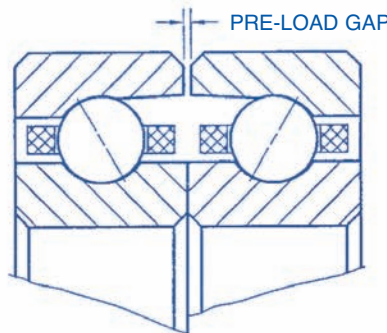
A-Type
(Angular Contact)



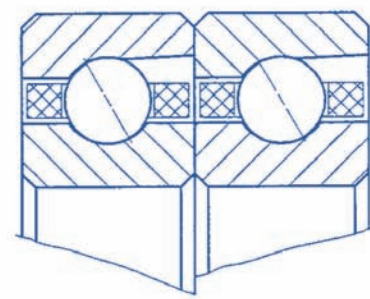
X-Type
(4-Point Contact)



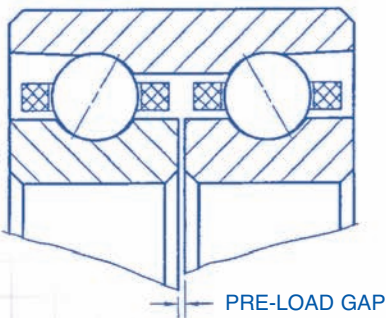
B-Type
Duplex Back-to-Back (DB)



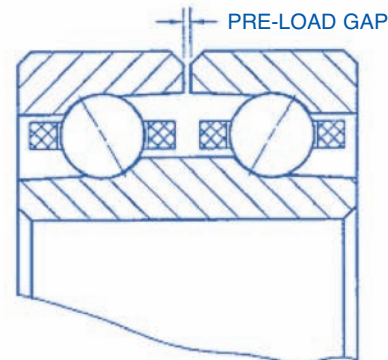
F-Type
Duplex Face-to-Face (DF)



T-Type
Duplex Tandem (DT)



M-Type
SuperDuplex™ Back-to-Back



W-Type
SuperDuplex™ Face-to-Face

General Features and Technical Specifications

Integral Shields

Optional shields are machined integral to the bearing outer ring to provide superior shielding. In addition, they provide enhanced free-state bearing stiffness.

440C Ring Material

Eliminates thin dense chrome plating while providing corrosion resistance protection and maintaining the precision, tolerance, and finish.

Low Torque/High Stiffness

Internal design characteristics result in an optimized bearing solution for demanding low torque, high stiffness applications.

440C Spacer Balls

Spacer balls are smaller than load balls by 0.5-1%. In pre-loaded bearings, other separator options may generate particle shedding – resulting in erratic torque fluctuations.

Silicon Nitride Load Balls (Si_3N_4)

Si_3N_4 balls promote a much lower coefficient of friction versus steel balls, therefore providing enhanced survivability under marginal lubrication. Si_3N_4 balls also have a higher modulus of elasticity – 50% higher than steel balls to provide higher stiffness.

SuperDuplex™ Design

A one-piece ring on a double row set design offers improved ring stiffness and reduced distortion, improved face-to-face runout, and parallelism. As a result, the bearing offers superior accuracy and performance reliability, including improved alignment and ease of next level assemblies.

Integrated Assemblies



- Bearing fit-ups are factory-optimized and pre-loaded for repeatable stiffness and torque.
- Integrated assemblies are simply bolted in place, eliminating individual bearing fit-up time and assembly errors in the field.
- Most integrated assemblies are integrally shielded to prevent contamination and ensure long bearing life.
- Superior performance compared to conventional approach to bearing assemblies.
- Lower total cost of ownership.

More than just bearings...

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RBC Aerospace Applications

THERMAL-COMP™ Bearings

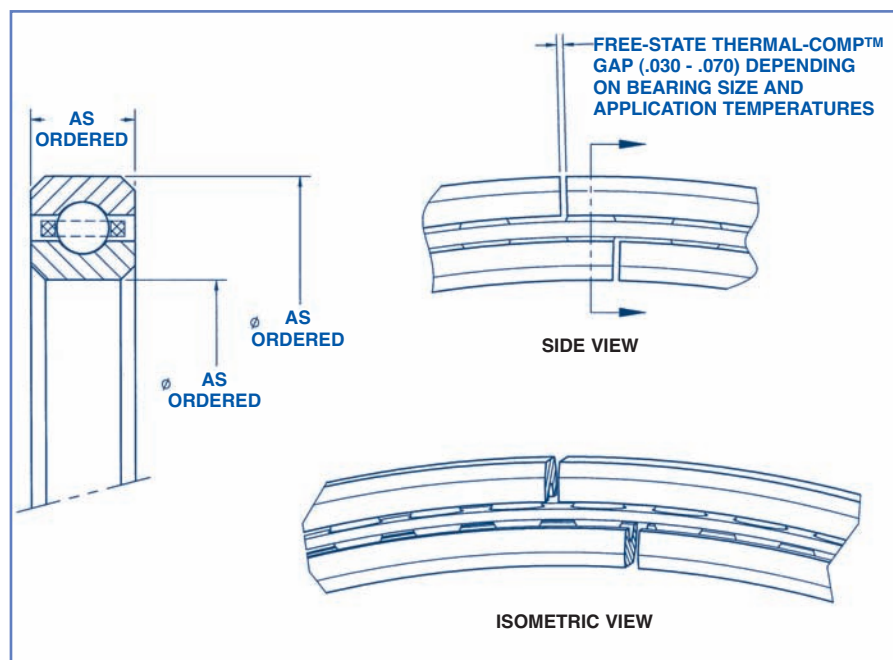
THERMAL-COMP™ bearings are custom designed to compensate for adverse effects of temperature extremes on bearing performance in airborne applications.

THERMAL-COMP™ bearings have a double-split ring design. Once properly installed in the bearing support structure at ambient temperature, they will maintain steady and predictable stiffness and torque characteristics throughout a temperature range, regardless of differences in coefficient of thermal expansion (CTE) of the bearing and the support structure materials.

In most airborne systems, large azimuth bearings are installed in support structures (shaft and housing), which must be made from light aluminum alloys to control weight. While conventional bearings may be installed and fitted for optimum stiffness and rotational torque at ambient temperature, significant variations in bearing performance will be experienced at extremes of temperature in the actual application. Such variations are caused by differences in CTE of bearing materials (hardened steels) and the aluminum alloys used for the support structure. At one temperature extreme, the bearing will be internally overloaded to a much higher stiffness and rolling friction torque; yet at another extreme, the bearing internal pre-load may be compromised resulting in loss of stiffness or excessive deflection.

Such undesirable variations in conventional bearing performance at extremes of temperature will have to be carefully analyzed and consequences mitigated. This often necessitates utilization of larger drive motors and/or using more expensive support structure alloys with CTE properties as close to bearing steel as possible. With THERMAL-COMP™ bearings, such uncertainties in performance are greatly reduced.

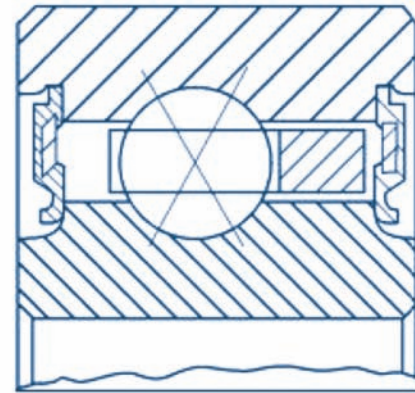
The following is a typical illustration of THERMAL-COMP™ bearings. Note that the free-state gap in ring split is determined based on bearing size and application temperatures involved. The gap will be closed to near zero when the bearing is operating at the coldest temperature in the application. The gap will be slightly wider when the bearing is operating at higher temperatures. However, bearing performance will remain consistent.



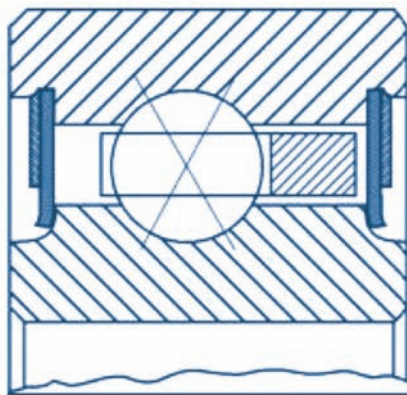
Elastomer Molded Seals vs. PTFE/SS300 Seals

Many molded seals used in bearings are made out of nitrile material (Buna-N rubber per MIL-R-6855). The material has a relatively high coefficient of friction. In order to meet low torque bearing requirements, seal fit-up during installation must be adjusted to minimize contact pressure on the sealing surfaces - reducing torque by reducing sealing effectiveness. The inherent variability in the seal molding process can further aggravate these issues. Over time, torque fluctuations are nearly inevitable, since seals may reset or the amount of lube between the seal and the sealing surface may change.

Based on these performance characteristics, molded seals are often marginal and unreliable solutions for torque sensitive applications.



Typical Elastomer Molded Design



Typical PTFE/SS300 Design

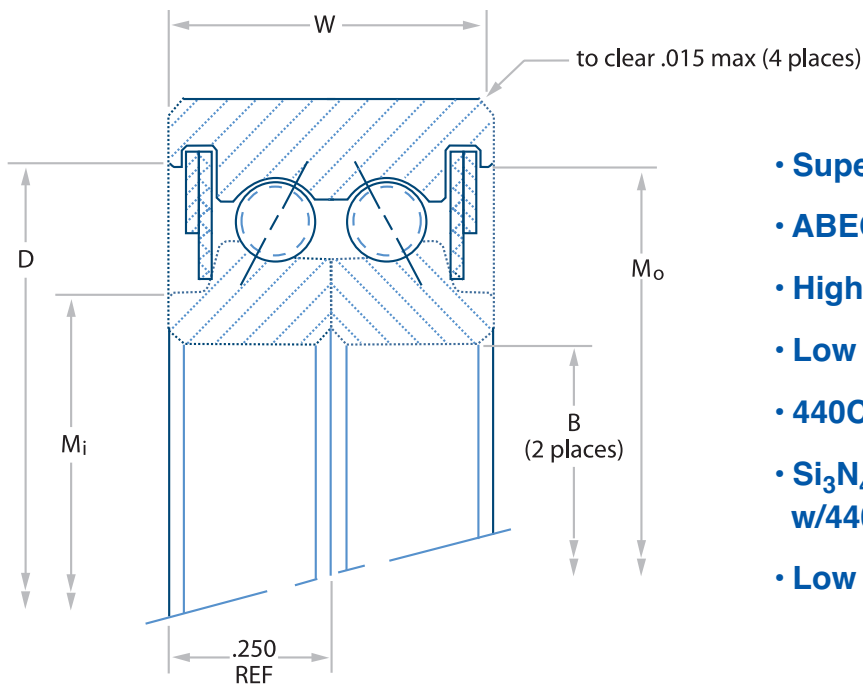
RBC's solution is a combination seal-shield design. The seal is made from either pure PTFE Teflon® or glass fiber reinforced PTFE Armalon®. PTFE is chemically inert, has a very low coefficient of friction (inherent lubricity), and provides the widest operating temperature range of any sealing material. The seal is held in place and shielded with a stainless steel (300 series) flat ring. The seal drag torque in this design is minimal, predictable, and consistent over time.

RBC invariably recommends this design for all low torque or torque sensitive applications that require sealing. RBC can readily retrofit problematic molded seal designs with a PTFE/300SS optimized solution.

Teflon® is a registered trademark of Dupont.
Armalon® is a registered trademark of Indaco®.

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Simplex™ Bearing Series – SuperDuplex™ (DB) Sealed Bearings



- SuperDuplex™ back-to-back
- ABEC-3
- High-stiffness
- Low torque
- 440C stainless steel rings
- Si₃N₄ ceramic load balls w/440C spacer balls
- Low torque PTFE seals

PART NUMBER	NOMINAL DIMENSIONS IN INCHES						Ball Quantity Per Row
	B Bore	D Outside Diameter	W Width	M _i	M _o	Ball Diameter	
ZU040MZ3 *RBC	4.0000	4.7500	0.500	4.155	4.550	1/8	54
ZU042MZ3 *RBC	4.2500	5.0000	0.500	4.405	4.800	1/8	57
ZU045MZ3 *RBC	4.5000	5.2500	0.500	4.655	5.050	1/8	60
ZU047MZ3 *RBC	4.7500	5.5000	0.500	4.905	5.300	1/8	63
ZU050MZ3 *RBC	5.0000	5.7500	0.500	5.155	5.550	1/8	66
ZU055MZ3 *RBC	5.5000	6.2500	0.500	5.655	6.050	1/8	72
ZU060MZ3 *RBC	6.0000	6.7500	0.500	6.155	6.550	1/8	79
ZU065MZ3 *RBC	6.5000	7.2500	0.500	6.655	7.050	1/8	85
ZU070MZ3 *RBC	7.0000	7.7500	0.500	7.155	7.550	1/8	91
ZU075MZ3 *RBC	7.5000	8.2500	0.500	7.655	8.050	1/8	97
ZU080MZ3 *RBC	8.0000	8.7500	0.500	8.155	8.550	1/8	104
ZU090MZ3 *RBC	9.0000	9.7500	0.500	9.155	9.550	1/8	116
ZU100MZ3 *RBC	10.0000	10.7500	0.500	10.155	10.550	1/8	129
ZU110MZ3 *RBC	11.0000	11.7500	0.500	11.155	11.550	1/8	141
ZU120MZ3 *RBC	12.0000	12.7500	0.500	12.155	12.550	1/8	154

The alphanumeric identification system is used under license.



	Approx. Weigh (lbs)	LOAD RATINGS						Limiting Speed (RPM)
		Radial (lbf)*		Thrust (lbf)		Moment (lbf - in)		
		Static	Dynamic	Static	Dynamic	Static	Dynamic	
	.55	(2x) 905	(2x) 640	2,710	1,850	4,130	1,555	3,660
	.58	(2x) 950	(2x) 655	2,850	1,900	4,540	1,670	3,460
	.61	(2x) 995	(2x) 660	2,990	1,915	5,070	1,840	3,280
	.65	(2x) 1,050	(2x) 675	3,140	1,955	5,575	1,990	3,120
	.68	(2x) 1,090	(2x) 685	3,285	1,995	6,105	2,130	2,980
	.74	(2x) 1,190	(2x) 700	3,580	2,035	7,235	2,450	2,720
	.81	(2x) 1,305	(2x) 730	3,925	2,125	8,575	2,835	2,510
	.87	(2x) 1,400	(2x) 755	4,210	2,185	9,910	3,200	2,330
	.93	(2x) 1,500	(2x) 760	4,495	2,200	11,340	3,565	2,170
	.99	(2x) 1,600	(2x) 775	4,780	2,250	12,870	3,950	2,030
	1.06	(2x) 1,710	(2x) 815	5,130	2,350	14,630	4,405	1,910
	1.18	(2x) 1,905	(2x) 840	5,705	2,420	18,180	5,275	1,700
	1.31	(2x) 2,110	(2x) 875	6,330	2,550	22,290	6,250	1,540
	1.43	(2x) 2,300	(2x) 905	6,915	2,625	26,620	7,235	1,410
	1.56	(2x) 2,515	(2x) 935	7,545	2,720	31,560	8,330	1,300

*Radial load rating is two times the value per row ideally if both rows share load equally.

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OPERATING CONDITIONS

Lubrication

Lubricants serve a number of very important purposes in ball bearings, including:

- Protecting bearing surfaces from corrosion
- Reducing rolling and sliding friction
- Preventing metal-to-metal contact between balls and raceway
- Providing a barrier against external contaminants (grease)
- Removing heat (oil)

Lack of lubrication or inadequate lubrication is the most common cause of bearing failure.

Standard RBC thin section ball bearings are lubricated with either oil or grease. The unsealed bearings, the K series, are thoroughly coated in MIL-PRF-3150 oil and drained of excess. Sealed bearings are lubricated with MIL-PRF-23827 grease. The external surfaces of sealed bearings are lightly coated with the same grease for corrosion resistance. Additional lubricants are also available. RBC Applications Engineering can help select the appropriate lubricant for special applications.

Temperature

Standard RBC thin section ball bearings can operate at temperatures from -65°F to 250°F. Temperatures up to 350°F can be reached if the bearings are temperature stabilized. By the use of special materials, RBC can provide bearings for operation to 700°F. Contact RBC Sales Engineers for recommendations on bearings operating above 250°F.

Limiting Speed

The limiting speed of a bearing is dependent upon a number of different factors including bearing size, bearing type, ball separator design, lubrication, and loading. The limiting speeds for the bearings shown in this catalog are determined using the following:

$$N = \frac{1000 \cdot k}{E} \quad \text{with } N = \text{Speed (RPM)} \quad E = \text{Pitch Diameter}$$

$$E = \frac{D+B}{2} \quad (\text{Bearing Pitch Diameter})$$

k = constant, see table below

Bearing Type	Load Condition	k Value	
		Grease	Oil
C or A	Radial or Thrust	16	20
X	Thrust	10	12
X	Radial, Combined Radial and Thrust, or Moment	3	4

The k values shown give the maximum speeds at which a typical thin section ball bearing can operate. It is recommended that operating speeds of large diameter bearings in a given series be reduced up to 40% of the calculated rating to avoid high bearing temperatures. Speed ratings can also be impacted by load conditions, lubrication, alignment, and ambient temperature. All of these factors must be considered when designing thin section ball bearings into your application.

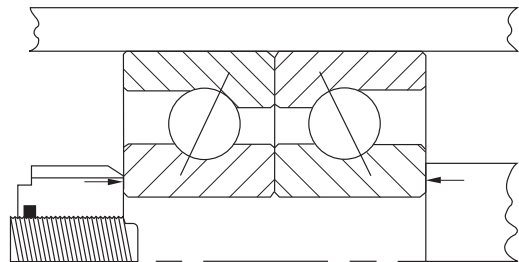
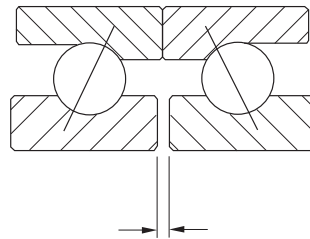
DUPLEX PAIRS AND AXIAL PRE-LOADING

Duplex Pairs

Duplex bearings are a pair of angular contact RBC thin section ball bearings specially ground for use as a matched set. A duplexed pair can be used to provide accurate shaft location, to increase capacity, or to increase stiffness of the bearing assembly. A duplex pair of RBC thin section ball bearings is ground so that when mounted using recommended fits, there will be no internal clearance in the bearings. There are three basic mounting methods to accommodate different loading requirements:

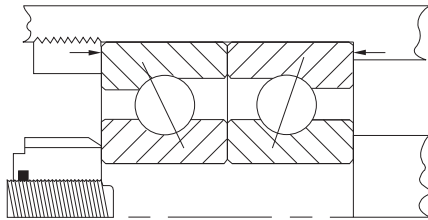
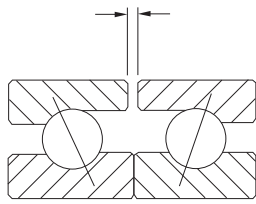
- Back-to-Back (DB), B-Type
- Face-to-Face (DF), F-Type
- Tandem (DT), T-Type

**Back-to-Back, DB
B-Type**



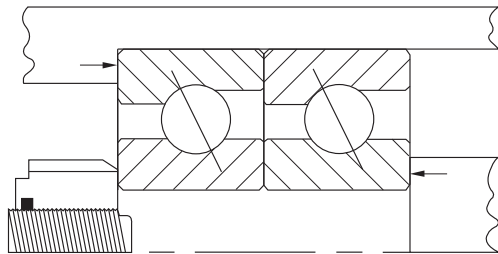
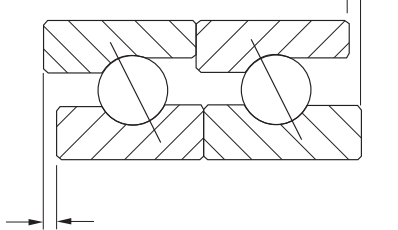
- Heavy radial loads
- Combined radial and thrust loads
- Reversing thrust loads
- Excellent rigidity
- Moment loads

Face-to-Face, DF F-Type



- Heavy radial loads
- Combined radial and thrust loads
- Reversing thrust loads
- Moment loads

Tandem, DT T-Type



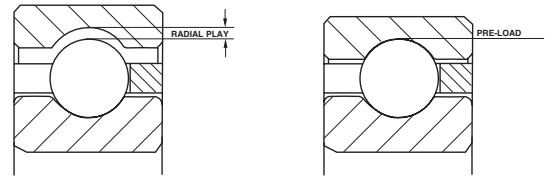
- High one-direction thrust loads
- Minimum axial shaft deflection
- Heavy radial loads

Axial Pre-loading

Standard duplex bearings are ground so that there will be a light axial pre-load induced on the bearing at nominal conditions. In some applications increased bearing stiffness may be required. In these cases the duplex grinding can be done such that a heavier axial load is induced in the mounted bearing. This load can be increased or decreased to meet the requirements of a particular application. Consult RBC Sales Engineers for special requirements.

Radial Play

Radial play (diametral clearance) is the distance the inner ring can be moved radially from one extreme position to the other. Standard RBC thin section ball bearings are manufactured with enough radial play that some clearance remains after the bearing is properly installed.



When there is negative radial play (diametral pre-load) there is interference rather than clearance between the balls and the races. As the interference increases, the friction, stiffness, and torque also increases. RBC thin section ball bearings can be manufactured with customer specified diametral pre-load or clearance.

Radial and Axial Runout

Radial runout of RBC thin section ball bearings is a measurement of the thickness variation of the bearing rings. The outer ring is measured from the ball path to the outer diameter of the ring, and the inner ring is measured from the ball path to the bore. Radial runout is defined as the wall thickness variation of the rotating ring.

Axial runout is measured from the ball path to the face of the bearing rings. The variation in thickness measured is the axial runout.

TOLERANCES

Precision Grades

RBC thin section ball bearings are available in 4 precision grades. RBC precision classes 0, 3, 4, and 6 correspond to ABMA ABEC grades 1F, 3F, 5F, and 7F respectively.

Shaft and Housing Fits

Proper shaft and housing fits are critical to the successful operation of a thin section ball bearing. The internal clearance of the bearing will be reduced proportionally by an interference fit. In addition, the roundness of the shaft and housing will directly effect the roundness of the inner and outer ring raceways. For most applications the inner ring is rotating and the load is stationary with respect to the outer ring. In this circumstance a light press fit onto the shaft is recommended.

RBC Thin Section Ball Bearings Availability Chart

BEARING TYPE		BORE SIZE IN INCHES																											
Cross Section		1.00	1.50	1.75	2.00	2.50	3.00	3.50	4.00	4.25	4.50	4.75	5.00	5.50	6.00	6.50	7.00	7.50	8.00	9.00	10.00	11.00	12.00	14.00	16.00	18.00	20.00	30.00	
KAA Series 3/16"	A	▲	▲	▲																									
	C	▲	▲	▲																									
	X	▲	▲	▲																									
**JA Series 1/4"	A																												
	C				✓	✓	✓	✓	✓	✓			✓	✓	✓														
	X				✓	✓	✓	✓	✓	✓				✓	✓														
KA Series 1/4"	A				▲	▲	▲	▲	▲	✓	✓	✓	▲	✓	✓	✓		▲	✓	✓	✓		✓						
	C				▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲		▲	▲	▲	▲		▲						
	X				▲	▲	▲	▲	▲	✓	▲	▲	▲	▲	▲	✓		✓	✓	✓	▲		▲						
**JB Series 5/16"	A																												
	C						✓	✓						✓															
	X							✓																					
KB Series 5/16"	A				▲	▲	▲	▲	▲	✓	✓		✓	✓		✓				✓									
	C				▲	▲	▲	▲	▲	✓	✓		▲	✓		✓				✓									
	X				▲	▲	▲	▲	▲	▲	▲		▲	▲		▲				▲									
KC Series 3/8"	A								▲		▲		▲	✓	▲	✓	✓	✓	✓	✓	✓	✓	✓						
	C								▲		▲		▲	▲	▲	▲	▲	▲	✓	✓	✓	▲	✓	✓					
	X								▲		▲		▲	▲	▲	▲	▲	✓	▲	▲	▲	▲	▲	▲					
**JU Series 1/2"	A																												
	C								▲		▲		▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	✓					
	X								▲		▲		▲	▲	▲	▲	✓	▲	▲	✓	▲	▲	▲	▲					
KD Series 1/2"	A								▲	✓	✓		▲	▲	▲	▲	▲		▲	▲	✓	▲	✓	✓		✓		✓	
	C								▲	▲	✓		▲	▲	▲	▲	▲		▲	▲	▲	✓	▲	▲	▲		✓		✓
	X								▲	✓	▲		▲	▲	▲	▲	✓		▲	▲	▲	▲	▲	▲	▲		▲		▲
KF Series 3/4"	A								✓		✓	▲	✓	▲	✓	▲	✓	✓	✓	✓	▲	✓	✓	✓	✓				
	C								▲		▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲				
	X								▲		✓	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲				
KG Series 1"	A												✓		✓	✓	✓	▲	▲	▲	✓	✓	▲	▲	✓	▲			
	C												▲		✓	▲	✓	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
	X												▲		▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲

LOAD CONDITION						
Bearing Type	Contact	Radial	Axial	Moment	Reversing Axial	Combined Radial Thrust
A	Angular	Good	Excellent	Do Not Use	Do Not Use	Good
C	Radial	Excellent	Good	Good	Good	Good
X	4-Point	Fair	Good	Excellent	Excellent	Fair

** Sealed bearings ▲ Bearings in stock ✓ Bearings with limited availability
All other bearings check availability.

Engineering Application Data

For assistance in selecting the correct bearings for your design, complete this form and fax or mail it to:

RBC Bearings
Industrial Tectonics Division
18301 S. Santa Fe Avenue
Rancho Dominguez, CA 90221-9998
Fax: 310.537.2909
www.rbcbearings.com

Company Name: _____ Date: _____

Street Address: _____

City: _____ State: _____ Zip Code: _____

Name: _____ Title: _____

Phone: _____ Fax: _____ e-mail: _____

Description of application: _____

Speed:

Rotational _____ rpm

Inner Ring Rotating

Oscillatory _____ cpm

Outer Ring Rotating

Temperature:

Average running _____ min _____ max _____

Loading:

Shock

Vibration

Safety factor (Please specify) _____

Dynamic radial _____ Lbs.

Stationary Load

Rotating Load

Dynamic thrust _____ Lbs.

Dynamic moment _____ Ft. Lbs.
(show application of load on sketch)

Stationary Load

Rotating Load

Static radial _____ Lbs.

Static thrust _____ Lbs.

Static moment _____ Ft. Lbs. (show application of load on sketch)

Life: _____

Lubricant:

Grease

Oil

Special (Please specify) _____

Size limitations:

Max. OD _____ inches

Min. Bore _____ inches

Max. Width _____ inches

Other data:

Seals

Shields

Special (Please specify)

Housing material _____ Shaft material _____

Further description of application and/or special requirements:

Sketch included

RBC Aerospace Bearing Products

RBC Bearings has been producing bearings in the USA since 1919.
RBC offers a full line of aerospace bearings, including unique custom configurations.



Spherical Bearings

- MS approved to AS81820 (formerly MIL-B-81820)
- Boeing and Airbus approved
- Self-lubricating • Metal-to-Metal
- Slot loaders • High temperature
- Low coefficient of friction
- Special configurations and materials



Rod End Bearings

- MS approved to AS81935 (formerly MIL-B-81935)
- Boeing and Airbus approved
- Self-lubricating • Metal-to-Metal
- Slot loaders • High temperature
- Low coefficient of friction
- Special configurations and materials



Thin Section Ball Bearings

- Standard cross sections to one inch
- Stainless steel and other materials are available • Sizes to 40 inches
- Seals available on all sizes and standard cross sections
- Super duplex configurations



Cargo Roller Bearings

- Boeing Approved
- Features precision ground, semi-ground, and unground ball bearings
- Offered in caged and full complement configurations



Journal Bearings

- MS Approved to AS81934 (formerly MIL-B-81934)
- Boeing and Airbus Approved
- Plain and flanged • Self-lubricating
- High temperature • High loads
- Available in inch and metric sizes



Track Rollers

- MS approved to AS39901 (formerly MIL-B-3990)
- Boeing and Airbus approved
- ATF single row and ATL double row
- Sealed with lube holes and grooves
- Heavy duty cross sections
- Advanced AeroCres® materials available



Airframe Control Ball Bearings

- MS Approved to AS7949 (formerly MIL-B-7949)
- Boeing and Airbus Approved
- Single and double row
- Radial, self-aligning, and pulley series
- 52100 Cad plated and 440C stainless



Cam Followers

- MS approved to AS39901 (formerly MIL-B-3990)
- Advanced AeroCres® materials available
- Maximum corrosion resistance
- Superior lubricants and seals to reduce maintenance



Ball Bearing Rod Ends

- MS Approved to AS6039 (formerly MIL-B-6039) • Boeing Approved
- Various shank configurations
- Low coefficient of friction
- Advanced AeroCres® materials available



Load Slot Bearings

- Spherical and rod end designs
- Superior ball-to-race conformity
- Reduced maintenance cost
- Variety of race materials available
- Boeing approved



Specials

- Many specialty bearings, custom-designed and configured for diverse aerospace applications
- Capability for advanced aerospace specialty corrosion resistant and high temperature materials



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