TORRINGTON®

Mounting guide

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INTRODUCTION

The intent of this mounting guide is to provide the information you need to properly mount The Torrington Company's ball, roller and needle bearings. For additional assistance please feel free to contact a Torrington Authorized Distributor or sales office in your area. For your convenience a listing of our engineering sales locations can be found on the last page of this publication.

Fafnir Bearings Division of the Torrington Company, originated the wide inner ring bearing design for ball bearings which could be easily mounted on straight shafts and positioned without shoulders, locknuts or adapters.

The internal bearing construction is basically the same as the deep race, single row radial type with ability to carry radial, thrust and combined loads, while providing low friction qualities which are characteristic of high-grade bearings. The inner ring is generally extended on both sides of the race to provide additional shaft support, and is locked to the shaft by specially designed setscrews or by the Fafnir-originated, eccentric self-locking collar or concentric collar. The wide inner ring bearings are also available with cylindrical or spherical outside diameters. The cylindrical or straight O.D. type is used for mounting in straight-bored housings. The spherical O.D. type must be mounted in a corresponding spherical seat and is used to compensate for shaft or housing misalignments.

WIDE INNER RING BEARINGS WITH LOCKING COLLARS

The following series are available with the cam (self-locking) collar.

RR Series

These bearings feature the flareout, contact type R-seal which encloses a synthetic rubber impregnated washer between two metal caps. Most sizes incorporate Fafnir's Shroud-Seal design. R-seal wide inner ring bearings are available in the following non-relubricatable variations: KR (one seal, cylindrical O.D.), KRR and KRRB (two seals). Relubricatable versions are: G-KRR, G-KRRB and GN-KRRB (heavy-duty).

RR Series

RA-RR Series

The RA-RR series features an extended inner ring and self-locking collar for simple effective shaft retention in a standard series bearing. The newly developed, positive contact, land-riding R-seal provides improved protection against the heavy contamination encountered in many applications. All sizes have a heat stabilized, moisture conditioned 6/6 nylon retainer which has proven extremely effective under conditions of misalignment.

RA-RR extended inner ring bearings are available as RA-RR (two-seals, straight O.D.) and RA-RRB (two seals, spherical O.D.). Relubricatable versions are GRA-RR and GRA-RRB.

RA-RR Series

Tri-Ply-Seal Series

Tri-Ply Seal bearings are designed for environments where severe conditions and moisture are present. The new one piece Tri-Ply seals incorporate a highly effective seal design molded to an exterior shroud cap. The shroud cap protects the seal lips from fiber wrap and abrasion while enhancing the overall sealing effectiveness of the unit. All units incorporate the self-locking collar and have a nylon retainer.

Tri-ply Seal bearings are available in both a non-relubricatable (KPPB) and relubricatable version (G- KPPB).

Tri-Ply-Seal Series

External Self-Aligning Series

The construction of this series permits the inner assembly, which contains an open type ball bearing with spherical O.D. to align in the seat of the mating outer ring. The seat of this outer ring is matched with the spherical O.D. of the ball bearing outer ring providing unrestricted self-alignment which allows the inner assembly to become square and true with the shaft. Self-aligning units are available in both standard SM-S or heavy SMN-S series.

External Self-Aligning Series

RA-DD Series Bearings

The new RA-DD series bearings are extended inner ring type with cam locking collars. They incorporate two close fitting non-contact grease shields to effectively retain lubricant and provide protection against harmful contaminants. The non-contact metallic shields provide improved high speed and low torque performance such as required for high speed printing press applications. The 6/6 molded nylon retainer has proven extremely effective under conditions of misalignment. These bearings are dimensionally inter-changable and have the same load capacities as the RA-RR series. (Available in ⅝"-1 ½" shaft sizes.)

RA-DD Series

WIDE INNER RING BEARINGS WITH SETSCREW LOCKING DEVICE

The following series are available with the setscrew locking device with special setscrews that are resistant to loosening during operation.

YA-RR series

The (G)YA-RR(B)series relubricatable and non-relubricatable bearings are an extended inner ring type with specially designed setscrews. Positive contact land-riding R-Seals provide protection against harmful contaminants and retain lubricant.

Setscrew Series bearings are available in both non-relubricatable version YA-RRB and relubricatable version GYA-RRB. Both types have nylon retainers.

YA-RR Series

ER Series

This series offers industry standard mounting dimensions and standard nomenclature for a large variety of sizes of relubricatable, extended inner ring bearings for through-bored housings. All bearings in this series have nylon retainers and are equipped with snap rings which eliminate the need for machining housing shoulders.

Positive contact landriding R Seals provide protection against harmful contaminants and retain lubricant. ER bearings are all black oxide coated for corrosion resistance.

ER Series

WIDE INNER RING BEARINGS WITH CONCENTRIC COLLARS

GC-KRRB Series

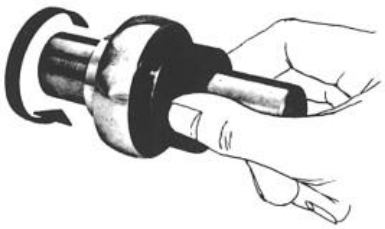
The GC-KRRB wide inner ring bearings are relubricatable with spherical outside diameters, nylon retainers and shroud seals. The metal shroud maintains tight seal contact against the inner ring and shields the rubber seals from damage due to dirt or fiber wrap. The concentric collar is locked to the shaft by two setscrews, located 120° apart, which are mated with threaded holes in the collar and drilled holes in the bearing inner ring.

GC-KRRB Series

CAM (SELF-LOCKING) COLLAR

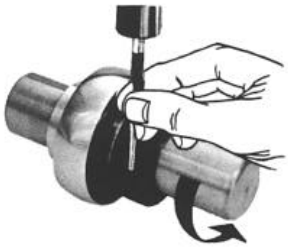
1. Observe cam design of the wide inner ring and self locking collar.

2. Mate the cam of the collar with the cam of the wide inner ring.



3. Press the locking collar against the wide inner ring and turn in the direction of shaft rotation until tightly engaged.

4. With drift pin in collar hole, strike **in direction of shaft** rotation to lock.



For Stationary shafts and outer ring rotation, turn collar in opposite direction of rotation.

5. Tighten setscrew in collar.

CONCENTRIC COLLAR

For simplified installation, the concentric collar is normally assembled to the wide inner ring for shipment. Slip the complete unit on the shaft and tighten both setscrews.

Ball Bearing housed units, originated by Fafnir, are available in a wide variety of types and sizes to accomodate a complete range of operating conditions.

These units generally have cast iron housings and are designed for mounting on straight shafts with a slip fit. The self-locking collar and the setscrew inner bearing designs provide ease in mounting, bolt holes in housings take standard bolts for assembling these units to machinery frames. Several series are also available with the concentric locking collar.

As most of these units are made with a self aligning feature, it is unnecessary for the user to refine his design in excess of practicle limits. If desired, units incorporating prelubricated wide inner ring bearings may be furnished without grease fittings.

There are several basic types of housed units available: Pillow Blocks, Flanged Cartridges, Flangette Units, Cylindrical Cartridges and Take-up Units. The type required is generally determined by its application and mounting requirements. Within the basic type selected, numerous variations allow for load factors, shaft sizes, mounting surface dimensions, base to shaft center line heights and lubrication requirements.

PILLOW BLOCKS

Pillow blocks, the most commonly used type of mounted units, are designed to provide shaft support where the mounting surface is parallel to the shaft axis. The bolt holes are usually slotted for adjustment during mounting.

Pillow blocks are supplied in both standard and heavy duty series. Pressed steel and rubber pillow blocks are also available for light duty applications.

FLANGED CARTRIDGES

Flanged cartridges are used where a shaft passes through the machine frame at a right angle. A four bolt mounting is the most common, however, where the mounting area is restricted, three and two bolt versions are available. A piloted flanged cartridge, also available, provides additional mounting accuracy and support.

Flanged cartridges are supplied in both standard and heavy duty series. Iron and rubber flanged cartridges are also available.

A complete line of Flangette Units, pressed steel flanged cartridges, provides an economical solution to light duty applications. Two, three and four bolt mountings are available along with a relubricable version.

CYLINDRICAL CARTRIDGES

Cylindrical cartridges, like flanged cartridges, provide shaft support where the shaft axis is perpendicular to and passing through a machined housing which is generally very thick. The outside diameter of the cylindrical cartridges permits mounting with a press fit into a straight, through-bored housing.

Cylindrical cartridges have a machined spherical bearing seat to provide initial shaft alignment in standard duty applications. Synthetic, conductive rubber cylindrical cartridges are also available for applications where low cost, light duty, low noise operation is essential.

TAKE-UP UNITS

Take-up units are used where shaft adjustment and belt tightening devices are required, such as conveyor applications. Frames for take-up units provide for either side or top mounting.

Take-up units are available in cast iron for standard duty and pressed steel for economical, light duty applications.

FAFNIR SELF-LOCKING COLLAR INSTALLATION

Most Fafnir housed units come equipped with the self-locking collar to facilitate the mounting of wide inner ring bearings. This self-locking collar eliminates the need for locknuts, washers, shoulders, sleeves, and adapters.

The locking collar has a counterbored recess which is made purposely eccentric to the bore. The collar recess and the end of the bearing inner ring with which it engages are both machined so that they act as mating cams when on the shaft.

When the collar is engaged to the inner ring, it grips the shaft tightly with a positive binding action that increases with use. No adjustments of any kind are necessary.

1. Slip the shaft through the pillow block or other Fafnir housed unit which incorporates the wide inner ring bearing. Be certain the bearing is aligned in position along the shaft to eliminate any possibility of cramping loads.

2. Fasten the unit securely to the base using the proper bolt size.

3. Place the self-locking collar on the shaft with its cam adjacent to the cam on the end of the bearing's inner ring. Turn the collar in the direction of shaft rotation. The eccentric recessed cam will slide over and engage the corresponding cam on the bearing inner ring.

4. Using a lightweight hammer and a drift pin inserted in the drift pin hole strike in the direction of shaft rotation to positively engage the collar. The wide inner ring is now locked to the shaft.

5. As a final step, fully tighten the setscrew. It exerts a wedging action to hold the collar always in the engaged position, even under shock load. This Fafnir design will operate effectively after the cams are tightly locked in most cases with no setscrews at all.

FAFNIR SETSCREW LOCKING BEARING

Steps 1 and 2 can be repeated from the Self Locking Collar Installation above. To lock the setscrew bearing, simply tighten each inner ring set-screw to the recommended torque listed by shaft size. See chart below.

Shaft Size		Recommended Torque	
in	mm	in. lbs.	(n•m)
½-$^{11}/_{16}$	17 mm	35 in. lbs.	4 (n•m)
¾-1	20-25 mm	80 in. lbs.	9 (n•m)
1$^{1}/_{16}$-1¾	30-45 mm	155 in. lbs.	18(n•m)
1$^{13}/_{16}$-2 $^{3}/_{16}$	50-55 mm	275 in. lbs.	31(n•m)

It may be necessary to rotate the shaft to provide an easy access of the setscrew wrench to the setscrews. To disassemble, loosen the setscrews.

CONCENTRIC COLLAR

For simplified installation of Fafnir housed units equipped with concentric collar bearings, the collar is normally assembled to the wide inner ring for shipment. Slip the complete unit on the shaft following steps 1 and 2 described for the self-locking collar procedure, and tighten both setscrews.

MOUNTING PROCEDURES–SPHERICAL ROLLER BEARINGS

Depending on the size of bearing and the application, there are different methods for mounting rolling bearings. In all methods, however, certain basic rules must be observed.

Cleanliness

Choose a clean environment. Work in an atmosphere free from dust or moisture. If this is not obtainable, and sometimes in the field it isn't, the installer should make every effort to insure cleanliness by use of protective screens, clean clothes, etc.

Plan the work

Know in advance what you are going to do and have all necessary tools at hand. This reduces the amount of time for the job and lessens the chance for dirt to get into the bearing.

Inspection and preparation

All component parts of the machine should be on hand and thoroughly cleaned before proceeding. Housings should be cleaned, including blowing out the oil holes. **Do not use an air hose on bearings.** If blind holes are used, insert a magnetic rod to remove metal chips that might have become lodged there during fabrication.

Shaft shoulders and spacer rings contacting the bearing should be square with the shaft axis. The shaft fillet must be small enough to clear the radius of the bearing.

On original installations, all component parts should be checked against the detail specification prints for dimensional accuracy. Shaft and housing should be carefully checked for size and roundness.

Shaft and housing finish

Shaft surfaces on which the bearing will be mounted must be clean and free from nicks or burrs. For an application with stationary housing and rotating shaft, it is suggested the bearing seat on the shaft be ground to 63 RMS maximum. If it is impractical to use a ground finish, a machined finish of 125 RMS is acceptable in many cases, but the amount of interference fit should be slightly increased. Consult our Engineering Department for recommendations.

For a stationary outer ring which is required to float (i.e. slide axially in the housing), a housing surface finish of 63 RMS maximum is suggested. Where the outer ring is not required to float, a surface finish of 125 RMS maximum is generally satisfactory.

DON'T REMOVE THE BEARING FROM ITS WRAPPER UNTIL ACTUALLY READY TO MOUNT IT.

MOUNTING STRAIGHT BORE BEARINGS

Heat expansion method

Most applications require a tight interference fit on the shaft. Mounting is simplified by heating the bearing to expand it sufficiently to slide easily onto the shaft. Two methods of heating are in common use:

1. Tank of heated oil.
2. Induction heating.

The first is accomplished by heating the bearing in a tank of oil having a **high flash** point. The oil temperature should not be allowed to exceed 250° F. A temperature of 200°F is sufficient for most applications. The bearing should be heated at this temperature, generally for 20 or 30 minutes, until it is expanded sufficiently to slide onto the shaft very easily.

The induction heating method is particularly suited for mounting small bearings in production line assembly. Induction heating is rapid, and care must be taken to prevent bearing temperature from exceeding 200° F. Trial runs with the unit and bearing are usually necessary to obtain the proper timing. Thermal crayons (such as Tempilstics*) which melt at predetermined temperatures can be used to check the bearing temperature.

While the bearing is still hot, it should be positioned squarely against the shoulder. Lockwashers and locknuts, or clamping plates, are then installed to hold the bearing against the shoulder of the shaft. As the bearing cools, the locknut or clamping plate should be tightened. In cases of outer ring rotation, where the outer ring is a tight fit in the housing, the housing member can be expanded by heating.

* Registered Trademark, Tempil Corp.

The oil bath is shown in Figure 1. The bearing should not be in direct contact with the heat source. The usual arrangement is to have a screen several inches off the bottom of the tank. Small support blocks separate the bearing from the screen. It is important to keep the bearing away from any localized high-heat source that may raise its temperature excessively, resulting in race hardness reduction.

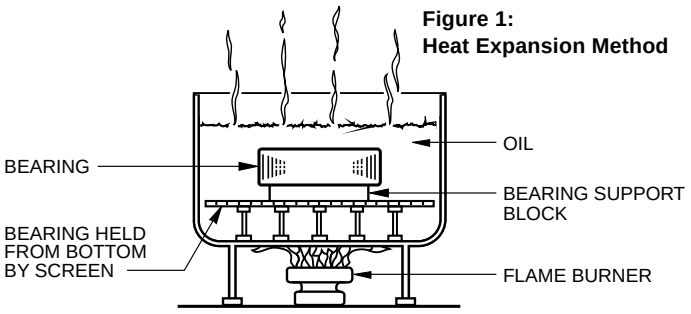


Figure 1: Heat Expansion Method

Flame-type burners are commonly used. An automatic device for temperature control is desirable. If safety regulations prevent the use of an open heated oil bath, a mixture of 15% soluble-oil in water may be used. This mixture may be heated to a maximum temperature of about 200° F., without being flammable. The bath should be checked from time to time to insure its proper composition as the water evaporates. The bath leaves a thin film of oil on the bearing sufficient for temporary rust prevention, but normal lubrication should be supplied to the bearing as soon as possible after installation. Be sure all of the soluble-oil in water solution has been drained away from the bearing.

Arbor press method

The alternative method of mounting, generally used only on smaller sizes, is to press the bearing onto the shaft or into the housing. This can be done by using an arbor press and a mounting tube as shown in Figure 2. The tube can be of soft steel with inside diameter slightly larger than the shaft. The O.D. of the tube should not exceed the maximum shoulder height. The tube should be faced square at both ends, thoroughly clean inside and out, and long enough to clear the end of the shaft after the bearing is mounted.

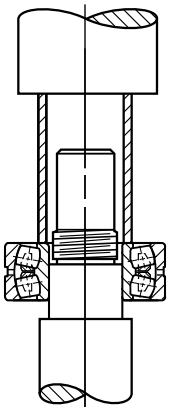


Figure 2: Arbor Press Method

If the outer ring is being pressed into the housing, the O.D. of the mounting tube should be slightly smaller than the housing bore, and the I.D. should not be less than the recommended housing shoulder diameter in the tables of dimensions.

Coat the shaft with light machine oil to reduce the force needed for the press fit. Carefully place the bearing on the shaft making sure it is square with the shaft axis. Apply steady pressure from the arbor ram to drive the bearing firmly against the shoulder.

Never attempt to make a press fit on a shaft by applying pressure to the outer ring, or a press fit in a housing by applying pressure to the inner ring.

SHAFT MOUNTING TAPERED BORE SPHERICAL ROLLER BEARINGS

Although the fit of a tapered bore spherical roller bearing can be determined by measuring the distance the bearing is forced onto the tapered seat, it is more practical to measure the **reduction of radial internal clearance** caused by expansion of the inner ring. This procedure requires determining the **initial** RIC before mounting, and checking the RIC during mounting until the proper **reduction of RIC** has been accomplished.

To determine initial RIC, the following procedure should be observed. A feeler gauge with the thinnest blade of 0.0015" is used. Place the bearing in an upright position with inner and outer ring faces parallel. Place thumbs on the inner ring bore and oscillate inner ring two or three times, pressing down firmly. This “seats” the inner ring and rolling elements. Position the individual roller assemblies so that a roller is at the top of the inner ring – on both sides of the bearing. Press the two top rollers inward to assure proper contact with the inner ring raceways. With the rollers in correct position, insert a thin blade of the feeler gauge between the rollers. Move it carefully over the top

roller, between the roller and outer ring raceway. Repeat this procedure, using thicker feeler gauge blades, until one is found that will not go through. The blade thickness that preceded the “no-go” blade is a measure of radial internal clearance (RIC) before installation.

Determine the target value of the **reduction of RIC** following procedure outlined in the example following. Start the mounting procedure by lubricating the tapered shaft with a light coat of machine oil. Slide the bearing onto the shaft as far as it will go. As the locknut is tightened, the interference fit builds up resulting in expansion of the inner ring. Periodically measure the RIC to keep track of the **reduction in** RIC.

Continue the procedure until the proper amount of reduction is obtained do not exceed recommended amount of reduction. As a final check, make sure that the remaining RIC equals or exceeds the **minimum mounted** clearance shown on page 10.

During mounting, the RIC should be checked at the unloaded roller. If this happens to be at the bottom, make sure that the roller is raised to seat firmly on the inboard portion of the inner race.

MOUNTING

Adapters vs. Straight Bore

Usually a spherical roller bearing Pillow block assembly is mounted to a straight shaft using a tapered bore bearing and adapter assembly. Standard commercial shafting can be used without additional machining. (Recommended shaft diameters are shown on page 18-21).

Adapter mount also permits maximum flexibility in the axial positioning of the bearing on the shaft and will accommodate light locational thrust loads. Torrington pillow blocks for tapered bore and adapter-mounted bearings are available in Series 225, 226, 230, 231K and 232K.

Adapter mounted spherical roller bearings require the correct removal of diametral clearance from the bearing to prevent relative rotation between inner race and sleeve or shaft. Failure to employ proper mounting procedures can cause heating and reduced bearing performance.

When application conditions produce heavy thrust loads or a need exists for exact axial location or a positive shaft interference fit, a direct straight bore mounting may be the best option. This requires a shouldered shaft, machined for proper fit and a straight bore bearing. Torrington pillow block assemblies for straight bore applications are available in Series 222, 223, 231, and 232.

Recommended fits for shafts in cylindrical bore spherical roller bearings are shown on pages 17 through 25. For applications involving heavy shock, vibration, unbalanced rotating loads or other abnormal conditions, consult the Torrington Engineering department.

Fixed and Float Pillow Blocks

Any style of Torrington pillow blocks can be easily installed either at the float or fixed position on the shaft. For the fixed position, a stabilizing ring is added between the bearing outer ring face and the housing shoulder to positively locate the shaft and prevent axial movement.

Some applications require centering of the bearing in its housing. To accomplish this, two special width stabilizing rings can be ordered.

In the float position, the ring is not used allowing the bearing to move axially (a maximum of ⅜") to compensate for thermal expansion or contraction of the shaft.

Pillow blocks ordered by the numbers in the dimensional tables are fixed units. To order float units specify by adding suffix “Float” or “FL” to the pillow block number.

Closed End Installations

In some applications, the shaft end is designed to terminate inside the pillow block. For such a design, positive fitting end-closure inserts are available to seal out contaminants and retain lubricants. Torrington heavy-duty end plugs include O-rings for positive sealing.

Designers and installers need to make sure the shaft end does not contact the closure. A minimum of ⅛" clearance at maximum thermal expansion is recommended between the end of the shaft and the closure. Dimension “Y” in the product catalog tables defines the maximum permissible length of the shaft from center line of the pillow block housing. If end closure is desired, specify by adding “CL” (one end closed) to the pillow block assembly number.

RADIAL BALL BEARINGS

In the manufacture of ball bearings, it is standard practice to assemble rings and balls with a specified internal clearance. This characteristic is necessary to absorb the effect of press fitting the bearing rings at mounting.

Internal clearances sometimes are utilized to compensate for thermal expansion of bearings, shafts and housings or to provide a contact angle in the bearing after mounting.

Internal clearance can be measured either by gauging radially or axially.

Radial measurement is accepted as the more significant characteristic because it is more directly related to shaft and housing fits. It also is the method prescribed by the American Bearing Manufacturers Association (ABMA).

Radial Internal Clearance

The radial internal clearance of a radial contact ball bearing can be defined as the average outer ring raceway diameter minus the average inner ring raceway diameter minus twice the ball diameter.

Radial internal clearance can be measured mechanically by moving the outer ring horizontally as pictured in Figure 1. The total movement of the outer ring when the balls are properly seated in the raceways determines the radial internal clearance. Several readings should be taken using different circumferential orientations of the rings in order to get a comprehensive average reading.

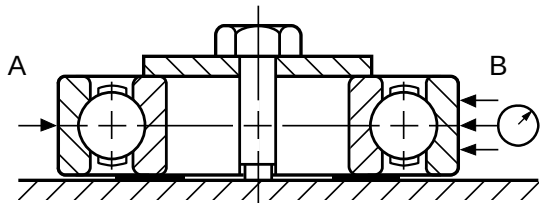


Figure 1

LIMITS FOR RADIAL INTERNAL CLEARANCE OF SINGLE ROW, RADIAL CONTACT BALL BEARINGS UNDER NO LOAD

(Applies to Bearings of ABEC-1, ABEC-3, ABEC-5, ABEC-7, and ABEC-9 Tolerances)

Tolerance Limits in ten-thousandths inches (.0001") and micrometers (µm)

Basic Bore Diameter MM		H (2)		R (0)		P (3)		J (4)		JJ (5)	
		Acceptance Limits		Acceptance Limits		Acceptance Limits		Acceptance Limits		Acceptance Limits	
Over	Incl.	low	high	low	high	low	high	low	high	low	high
2.5	10	0	3	1	5	3	9	6	11	8	15
		0	7	2	13	8	23	14	29	20	37
10	18	0	3.5	1	7	4	10	7	13	10	18
		0	9	3	18	11	25	18	33	25	45
18	24	0	4	2	8	5	11	8	14	11	19
		0	10	5	20	13	28	20	36	28	48
24	30	0.5	4.5	2	8	5	11	9	16	12	21
		1	11	5	20	13	28	23	41	30	53
30	40	0.5	4.5	2	8	6	13	11	18	16	25
		1	11	6	20	15	33	28	46	40	64
40	50	0.5	4.5	2.5	9	7	14	12	20	18	29
		1	11	6	23	18	36	30	51	45	73
50	65	0.5	6	3.5	11	9	17	15	24	22	35
		1	15	8	28	23	43	38	61	55	90
65	80	0.5	6	4	12	10	20	18	28	26	41
		1	15	10	30	25	51	46	71	65	105
80	100	0.5	7	4.5	14	12	23	21	33	30	47
		1	18	12	36	30	58	53	84	75	120
100	120	1	8	6	16	14	26	24	38	35	55
		2	20	15	41	36	66	61	97	90	140
120	140	1	9	7	19	16	32	28	45	41	63
		2	23	18	48	41	81	71	114	105	160
140	160	1	9	7	21	18	36	32	51	47	71
		2	23	18	53	46	91	81	130	120	180
160	180	1	10	8	24	21	40	36	58	53	79
		2	25	20	61	53	102	91	147	135	200
180	200	1	12	10	28	25	46	42	64	59	91
		2	30	25	71	63	117	107	163	150	230
200	240	1	14	12	32	29	54	50	76	72	105
		3	36	30	81	74	137	127	193	183	267

Continued on the next page

LIMITS FOR RADIAL INTERNAL CLEARANCE OF SINGLE ROW, RADIAL CONTACT BALL BEARINGS UNDER NO LOAD

(Applies to Bearings of ABEC-1, ABEC-3, ABEC-5, ABEC-7, and ABEC-9 Tolerances)
Tolerance Limits in ten-thousandths inches (.0001") and micrometers (μm)

Basic Bore Diameter MM		H (2)		R (0)		P (3)		J (4)		JJ (5)	
		Acceptance Limits		Acceptance Limits		Acceptance Limits		Acceptance Limits		Acceptance Limits	
Over	Incl.	low	high	low	high	low	high	low	high	low	high
240	280	1	16	13	38	34	62	58	88	84	122
		3	41	33	97	86	157	147	224	213	310
280	320	2	19	16	45	41	71	67	101	97	139
		5	48	41	114	104	180	170	257	246	353
320	370	2	21	18	50	46	82	78	116	112	161
		5	53	46	127	117	208	198	295	284	409
370	430	3	25	22	58	54	95	91	134	130	187
		8	64	56	147	137	241	231	340	330	475
430	500	4	29	26	67	63	110	106	156	152	217
		10	74	66	170	160	279	269	396	386	551
500	570	4	32	29	76	72	125	121	177	173	248
		10	81	74	193	183	318	307	450	439	630
570	640	5	36	33	85	81	140	136	199	195	278
		13	91	85	216	206	356	345	505	495	706
640	710	8	45	42	94	90	155	151	222	218	307
		20	114	107	239	229	394	384	564	554	780
710	800	8	55	51	106	102	175	171	248	244	346
		20	140	130	269	259	445	434	630	620	879
800	1060	11	83	79	139	136	231	227	328	324	452
		28	211	201	353	345	587	577	833	823	1148

The Torrington Company radial clearance designations correlate with ABMA symbols as follows:

Fafnir Bearing Number Prefix	AFBMA Symbol	Description
H	2	**Snug** fit; slight internal clearance; sometimes used to achieve a minimum of radial or axial play in an assembly, Example: H204K
R	0	**Medium** fit; internal clearance generally satisfactory with recommended shaft and housing fits shown on pages 26-30. Example: RMM204K.
P	3	**Loose** fit; considerable internal clearance required for applications involving press fits on both inner and outer rings, extra interference fits, or temperature differentials. Example: P204K.
J	4	**Extra Loose** fit; large amount of internal clearance for applications involving large interference fits or temperature differentials. Example: J204K.
JJ	5	**Extra-Extra Loose** fit; extra large amount of internal clearance for applications with large temperature differential and interference fits on both rings.

End play

End play is an alternate method of measuring internal clearance and is rarely used except for certain special applications. End play is determined by mounting the bearing, as shown in Figure 2, with one of its rings clamped to prevent axial movement. A reversing measuring load is applied to the unclamped ring so that the resultant movement of that ring is parallel to the bearing axis. End play is the total movement of the unclamped ring when the load is applied first in one direction and then in the other.

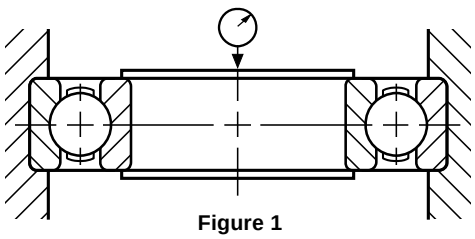


Figure 1

When the inner and outer ring raceway curvatures are accurately known, the free end play can readily be calculated from the values of no load radial clearance by the following formula:

$$E = \sqrt{4dR_D(K_O + K_i - 1) - R_D^2} \text{ or } \cong \sqrt{4dR_D(K_O + K_i - 1)}$$

(Where R_D^2 is generally a very small value and can be omitted for most calculations without introducing undue inaccuracy.)

E = Free end play where

K_O = outer race contour radius expressed as a decimal fraction of the ball diameter.

K_i = inner race contour radius expressed as a decimal fraction of the ball diameter

R_D = radial clearance (no load)

d = ball diameter

Contact Angle

The contact angle (α) is related to internal clearance as follows:

$$\alpha = \sin^{-1}\left(\frac{E}{2\,(Ko + Ki - 1)d}\right)$$

The contact angle (α) may also be accurately determined in a production bearing from its pitch diameter (P.D.) and by measuring the number of revolutions (N_c) of the ball and cage assembly relative to rotation (N_i) of the inner ring under a light thrust load.

$$(N_c) = .5N_i\left(1 - \frac{d}{P.D.}\cos\alpha\right)$$

$$\cos\alpha = \frac{P.D.}{d}\left(\frac{N_c}{1 - .5N_i}\right)$$

The accuracy of this method of measurement depends greatly upon the care taken in set-up. Balanced weight for thrust loading, vertical truing, slow turning, many turns, minimum lubricant of low viscosity and prerotation are all essential for instance. The races should not be radially restrained during the contact angle measurement.

RADIAL SPHERICAL ROLLER BEARINGS

Radial Internal Clearance (RIC) is the radial play within a bearing. Torrington bearing RIC's allow a tight fit, with sufficient internal clearance after installation for normal operating conditions.

Spherical Roller Bearings with tapered bore (K) require a slightly greater interference fit on the shaft than would a cylindrical bore bearing. The effect of this greater interference fit is a reduction of RIC. For tapered bore bearings, it is critical to select the RIC that allows for this reduction.

For example, bearing number 22328K C3 (140 mm bore with C3 clearance) is to be mounted on a tapered shaft. By feeler gauging, RIC is found to be 0.007" (0.178mm). The chart indicates that the proper fit will be obtained when RIC is reduced by 0.0025" to 0.0035" (0.064 to 0.089 mm). Clearance after mounting is computed: 0.007"-0.003"= 0.004" (0.178-0.076=0.102mm). The locknut should be tightened until RIC reaches 0.004" (0.102mm).

Several factors influence RIC reduction. Inner rings pressed into solid steel shafts expand approximately 80% of the interference fit. Outer rings pressed into steel or cast iron housings reduce RIC by about 60%, of the interference fit. For RIC reduction on hollow shafts or non-steel materials consult Torrington sales engineers.

Torrington bearings are supplied with NORMAL RIC, unless otherwise specified. The desired RIC code must be added to the bearing number, FOLLOWING ALL OTHER SUFFIXES.

Min./max. values for each RIC are shown in the two adjacent columns directly beneath the selected RIC. For example, the minimum values shown for C5 are also the maximum values for C4; minimum values for C4 are also the maximum values for C3; etc.

RADIAL INTERNAL CLEARANCE LIMITS

All data on this page, except Bore I.D. are in inches/millimeters

Bore (nominal) mm		Cylindrical Bore						Tapered Bore						Recommended Reduction of RIC Due to Installation		Recommended RIC after Installation[1]
			Normal (Standard)		C4				Normal (Standard)		C4					
			min.	max.	min.	max.			min.	max.	min.	max.				
		C2		C3		C5		C2		C3		C5				
		min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.
over	incl.	inch mm	inch mm	inch mm	inch mm	inch mm	inch mm	inch mm	inch mm	inch mm	inch mm	inch mm	inch mm	inch mm	inch mm	inch mm
24	30	0.0006 0.015	0.0010 0.025	0.0016 0.040	0.0022 0.055	0.0030 0.075	0.0037 0.095	0.0008 0.020	0.0012 0.030	0.0016 0.040	0.0022 0.055	0.0030 0.075	0.0037 0.095	0.0006 0.015	0.0008 0.020	0.0006 0.015
30	40	0.0006 0.015	0.0012 0.030	0.0018 0.045	0.0024 0.060	0.0031 0.080	0.0039 0.100	0.0010 0.025	0.0014 0.035	0.0020 0.050	0.0026 0.065	0.0033 0.085	0.0041 0.105	0.0008 0.020	0.0010 0.025	0.0006 0.015
40	50	0.0008 0.020	0.0014 0.035	0.0022 0.055	0.0030 0.075	0.0039 0.100	0.0049 0.125	0.0012 0.030	0.0018 0.045	0.0024 0.060	0.0031 0.080	0.0039 0.100	0.0051 0.130	0.0010 0.025	0.0012 0.030	0.0008 0.020
50	65	0.0008 0.020	0.0016 0.040	0.0026 0.065	0.0035 0.090	0.0047 0.120	0.0059 0.150	0.0016 0.040	0.0022 0.055	0.0030 0.075	0.0037 0.095	0.0047 0.120	0.0063 0.160	0.0012 0.030	0.0015 0.038	0.0010 0.025
65	80	0.0012 0.030	0.0020 0.050	0.0031 0.080	0.0043 0.110	0.0057 0.145	0.0071 0.180	0.0020 0.050	0.0028 0.070	0.0037 0.095	0.0047 0.120	0.0059 0.150	0.0079 0.200	0.0015 0.038	0.0020 0.051	0.0010 0.025
80	100	0.0014 0.035	0.0024 0.060	0.0039 0.100	0.0053 0.135	0.0071 0.180	0.0089 0.225	0.0022 0.055	0.0030 0.080	0.0043 0.110	0.0055 0.140	0.0071 0.180	0.0091 0.230	0.0018 0.046	0.0025 0.064	0.0014 0.036
100	120	0.0016 0.040	0.0030 0.075	0.0047 0.120	0.0063 0.160	0.0083 0.210	0.0102 0.260	0.0026 0.065	0.0039 0.100	0.0053 0.135	0.0067 0.170	0.0087 0.220	0.0110 0.280	0.0020 0.051	0.0028 0.071	0.0020 0.051
120	140	0.0020 0.050	0.0037 0.095	0.0057 0.145	0.0075 0.190	0.0094 0.240	0.0118 0.300	0.0031 0.080	0.0047 0.120	0.0063 0.160	0.0079 0.200	0.0102 0.260	0.0130 0.330	0.0025 0.064	0.0035 0.089	0.0022 0.056
140	160	0.0024 0.060	0.0043 0.110	0.0067 0.170	0.0087 0.220	0.0110 0.280	0.0138 0.350	0.0035 0.090	0.0051 0.130	0.0071 0.180	0.0091 0.230	0.0118 0.300	0.0150 0.380	0.0030 0.076	0.0040 0.102	0.0022 0.056
160	180	0.0026 0.065	0.0047 0.120	0.0071 0.180	0.0094 0.240	0.0122 0.310	0.0154 0.390	0.0039 0.100	0.0055 0.140	0.0079 0.200	0.0102 0.260	0.0134 0.340	0.0169 0.430	0.0030 0.076	0.0045 0.114	0.0024 0.061
180	200	0.0028 0.070	0.0051 0.130	0.0079 0.200	0.0102 0.260	0.0134 0.340	0.0169 0.430	0.0043 0.110	0.0063 0.160	0.0087 0.220	0.0114 0.290	0.0146 0.370	0.0185 0.470	0.0035 0.089	0.0050 0.127	0.0028 0.071
200	225	0.0031 0.080	0.0055 0.140	0.0087 0.220	0.0114 0.290	0.0150 0.380	0.0185 0.470	0.0047 0.120	0.0071 0.180	0.0098 0.250	0.0126 0.320	0.0161 0.410	0.0205 0.520	0.0040 0.102	0.0055 0.140	0.0030 0.076
225	250	0.0035 0.090	0.0059 0.150	0.0094 0.240	0.0126 0.320	0.0165 0.420	0.0205 0.520	0.0055 0.140	0.0079 0.200	0.0106 0.270	0.0138 0.350	0.0177 0.450	0.0224 0.570	0.0045 0.114	0.0060 0.152	0.0035 0.089
250	280	0.0039 0.100	0.0067 0.170	0.0102 0.260	0.0138 0.350	0.0181 0.460	0.0224 0.570	0.0059 0.150	0.0087 0.220	0.0118 0.300	0.0154 0.390	0.0193 0.490	0.0244 0.620	0.0045 0.114	0.0065 0.165	0.0040 0.102
280	315	0.0043 0.110	0.0075 0.190	0.0110 0.280	0.0146 0.370	0.0197 0.500	0.0248 0.630	0.0067 0.170	0.0094 0.240	0.0130 0.330	0.0169 0.430	0.0213 0.540	0.0268 0.680	0.0050 0.127	0.0070 0.178	0.0040 0.102
315	355	0.0047 0.120	0.0079 0.200	0.0122 0.310	0.0161 0.410	0.0217 0.550	0.0272 0.690	0.0075 0.190	0.0106 0.270	0.0142 0.360	0.0185 0.470	0.0232 0.590	0.0291 0.740	0.055 0.140	0.0075 0.190	0.0045 0.114
355	400	0.0051 0.130	0.0087 0.220	0.0134 0.340	0.0177 0.450	0.0236 0.600	0.0295 0.750	0.0083 0.210	0.0118 0.300	0.0157 0.400	0.0205 0.520	0.0256 0.650	0.0323 0.820	0.0060 0.152	0.0080 0.203	0.0050 0.127

[1]For bearings with normal initial clearance

Continued on the next page

RADIAL SPHERICAL ROLLER BEARINGS (continued)

Min./Max. values for each RIC are shown in the two adjacent columns directly beneath the selected RIC. Each single column represents a boundary between adjacent RIC's. For example, the minimum values shown for C5 are also the maximum values for C4 ; minimum values for C4 are also the maimum values for C3; etc.

Bore (nominal) mm		Cylindrical Bore						Tapered Bore						Recommended Reduction of RIC Due to Installation		Recommended RIC after Installation[1]
			Normal (Standard) min.	max.	C4 min.	max.			Normal (Standard) min.	max.	C4 min.	max.				
		C2		C3		C5		C2		C3		C5				
		min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.
over	incl.	inch mm	inch mm	inch mm	inch mm	inch mm	inch mm	inch mm	inch mm	inch mm	inch mm	inch mm	inch mm	inch mm	inch mm	inch mm
400	450	0.0055 0.140	0.0094 0.240	0.0146 0.370	0.0197 0.500	0.0260 0.660	0.0323 0.820	0.0091 0.230	0.0130 0.330	0.0173 0.440	0.0224 0.570	0.0283 0.720	0.0358 0.910	0.0065 0.165	0.0085 0.216	0.0060 0.152
450	500	0.0055 0.140	0.0102 0.260	0.0161 0.410	0.0217 0.550	0.0283 0.720	0.0354 0.900	0.0102 0.260	0.0146 0.370	0.0193 0.490	0.0248 0.630	0.0311 0.790	0.0394 1.000	0.0070 0.178	0.0090 0.229	0.0065 0.165
500	560	0.0059 0.150	0.0110 0.280	0.0173 0.440	0.0236 0.600	0.0307 0.780	0.0394 1.000	0.0114 0.290	0.0161 0.410	0.0213 0.540	0.0268 0.680	0.0343 0.870	0.0433 1.100	0.0080 0.203	0.0100 0.254	0.0070 0.178
560	630	0.0067 0.170	0.0122 0.310	0.0189 0.480	0.0256 0.650	0.0335 0.850	0.0433 1.100	0.0126 0.320	0.0181 0.460	0.0236 0.600	0.0299 0.760	0.0386 0.980	0.0484 1.230	0.0090 0.229	0.0110 0.279	0.0080 0.203
630	710	0.0075 0.190	0.0138 0.350	0.0209 0.530	0.0276 0.700	0.0362 0.920	0.0469 1.190	0.0138 0.350	0.0201 0.510	0.0264 0.670	0.0335 0.850	0.0429 1.090	0.0535 1.360	0.0100 0.254	0.0120 0.305	0.0080 0.203
710	800	0.0083 0.210	0.0154 0.390	0.0228 0.580	0.0303 0.770	0.0398 1.010	0.0512 1.300	0.0154 0.390	0.0224 0.570	0.0295 0.750	0.0378 0.960	0.0480 1.220	0.0591 1.500	0.0110 0.279	0.0140 0.356	0.0090 0.229
800	900	0.0091 0.230	0.0169 0.430	0.0256 0.650	0.0339 0.860	0.0441 1.120	0.0567 1.440	0.0173 0.440	0.0252 0.640	0.0331 0.840	0.0421 1.070	0.0539 1.370	0.0665 1.690	0.0120 0.305	0.0150 0.381	0.0100 0.252
900	1000	0.0102 0.260	0.0189 0.480	0.0280 0.710	0.0366 0.930	0.0480 1.220	0.0618 1.57	0.0193 0.490	0.0280 0.710	0.0366 0.930	0.0469 1.190	0.0598 1.520	0.0732 1.860	0.0140 0.356	0.0170 0.432	0.0110 0.279

[1]For bearings with normal initial clearance

RADIAL CYLINDRICAL ROLLER BEARINGS

Min./Max. values for each RIC are shown in the two adjacent columns directly beneath the selected RIC. Each single column represents a boundary between adjacent RIC's. For example, the minimum values shown for R5 are also the maximum values for R4 ; minimum values for R4 are also the maimum values for R3; etc. The desired RIC code (R1, R2, etc.) must be added to the bearing number, FOLLOWING ALL OTHER SUFFIXES.

RADIAL INTERNAL CLEARANCE LIMITS

All data on this chart are in inches/millimeters.

Bore (nominal)		R2 min.	max.	R4 min.	max		
		R1		R3		R5	
Over	Incl.	min.	max.	min.	max.	min.	max.
in. mm	in. mm	in. mm	in. mm	in mm	in. mm	in. mm	in. mm
3.1496 80	3.9370 100	0.0005 0.013	0.0016 0.041	0.0032 0.081	0.0051 0.130	0.0077 0.196	0.0107 0.272
3.9370 100	4.7244 120	0.0005 0.013	0.0018 0.046	0.0036 0.091	0.0060 0.152	0.0089 0.226	0.0122 0.310
4.7244 120	5.5118 140	0.0009 0.023	0.0022 0.056	0.0041 0.104	0.0067 0.170	0.0101 0.256	0.0139 0.353
5.5118 140	6.2992 160	0.0010 0.025	0.0026 0.066	0.0049 0.124	0.0077 0.196	0.0112 0.284	0.0151 0.384
6.2992 160	7.0866 180	0.0011 0.028	0.0027 0.069	0.0052 0.132	0.0082 0.208	0.0118 0.300	0.0158 0.401
7.0866 180	7.8740 200	0.0014 0.036	0.0032 0.081	0.0060 0.152	0.0092 0.234	0.0130 0.330	0.0172 0.437
7.8740 200	8.6614 220	0.0016 0.041	0.0034 0.086	0.0062 0.157	0.0094 0.239	0.0132 0.335	0.0174 0.4420
8.6614 220	10.2362 260	0.0022 0.056	0.0040 0.102	0.0068 0.173	0.0100 0.254	0.0138 0.351	0.018 0.455
10.2362 260	11.8110 300	0.0024 0.061	0.0042 0.107	0.0070 0.178	0.0102 0.259	0.0140 0.356	0.0182 0.462

Bore (nominal)		R2 min.	max.	R4 min.	max		
		R1		R3		R5	
Over	Incl.	min.	max.	min.	max.	min.	max.
in. mm	in. mm	in. mm	in. mm	in mm	in. mm	in. mm	in. mm
11.8110 300	13.7795 350	0.0032 0.081	0.0050 0.127	0.0078 0.198	0.0110 0.279	0.0148 0.376	0.0190 0.483
13.7795 350	15.7480 400	0.0042 0.107	0.0065 0.165	0.0093 0.236	0.0125 0.318	0.0163 0.414	0.0205 0.521
15.7480 400	17.7165 450	0.0055 0.14	0.0080 0.203	0.0110 0.279	0.0142 0.361	0.0180 0.457	0.0222 0.564
17.7165 450	19.6850 500	0.0060 0.152	0.0085 0.216	0.0115 0.292	0.0150 0.381	0.0200 0.508	0.0254 0.645
19.6850 500	22.0472 560	0.0065 0.165	0.0090 0.229	0.0120 0.305	0.0160 0.406	0.0210 0.533	0.0264 0.671
22.0472 560	24.8031 630	0.0070 0.178	0.0100 0.254	0.0140 0.356	0.0190 0.483	0.0240 0.610	0.0294 0.747
24.8031 630	27.9528 710	0.0075 0.190	0.0110 0.279	0.0150 0.381	0.0200 0.508	0.0250 0.635	0.0304 0.772
27.9528 710	31.4961 800	0.0085 0.216	0.0130 0.330	0.0180 0.457	0.0230 0.584	0.0280 0.711	0.0334 0.848

RADIAL TAPERED ROLLER BEARINGS - TWO ROW

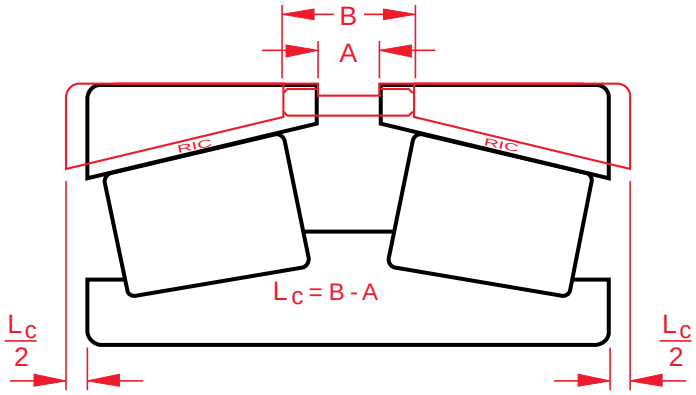
In two row tapered roller bearings, Internal Clearance is usually defined as Lateral Clearance (L_C) or end play, which is related to Radial Internal Clearance (RIC) by the formula:

$$L_C = \frac{RIC \times K}{0.39}$$

K being a thrust factor which is different for every bearing and is included in the table of dimensions.

Lc is determined by the relative axial position of cup and cone, and is a function of spacer width in the two element member (cup or cone). In the illustration , the cups shown in black are positioned for zero RIC, allowing no end play. The cups shown in green provide lateral clearance equal to (B-A).

The desired Lc must be specified by adding designation codes G1, G2, etc. to the bearing number, FOLLOWING ALL OTHER SUFFIXES..



Bore		Nominal Clearance (Lc) Tolerance: ±0.001 inch (±0.025 mm)								
Over	Incl.	G1	G2	G3	G4	G5	G6	G7	G8	G9
in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm
7.5000 190.500	12.0000 304.800	0.006 0.15	0.009 0.23	0.018 0.46	0.021 0.53	0.024 0.61	0.027 0.69	0.030 0.76	0.033 0.84	0.036 0.91
12.0000 304.800	24.0000 609.600	0.007 0.18	0.018 0.46	0.021 0.53	0.024 0.61	0.027 0.69	0.030 0.76	0.034 0.86	0.040 1.02	0.046 1.17
24.0000 609.600	36.0000 914.400	0.019 0.48	0.023 0.58	0.027 0.69	0.031 0.79	0.035 0.89	0.039 0.99	0.042 1.07	0.046 1.17	0.050 1.27

INSTALLATION PROCEDURES

A drawn cup bearing must be pressed into its housing. An installation tool similar to the one illustrated must be used in conjunction with a standard press.

It is advisable to utilize a positive stop on the press tool to locate the bearing properly in the housing. The assembly tool should have a leader or pilot, as shown, to aid in starting the bearing true in the housing.

The installation tool must be coaxial with the housing bore. The ball detent shown on the drawing is used to assist in aligning the rollers of a full complement bearing during installation and to hold the bearing on the installation tool.

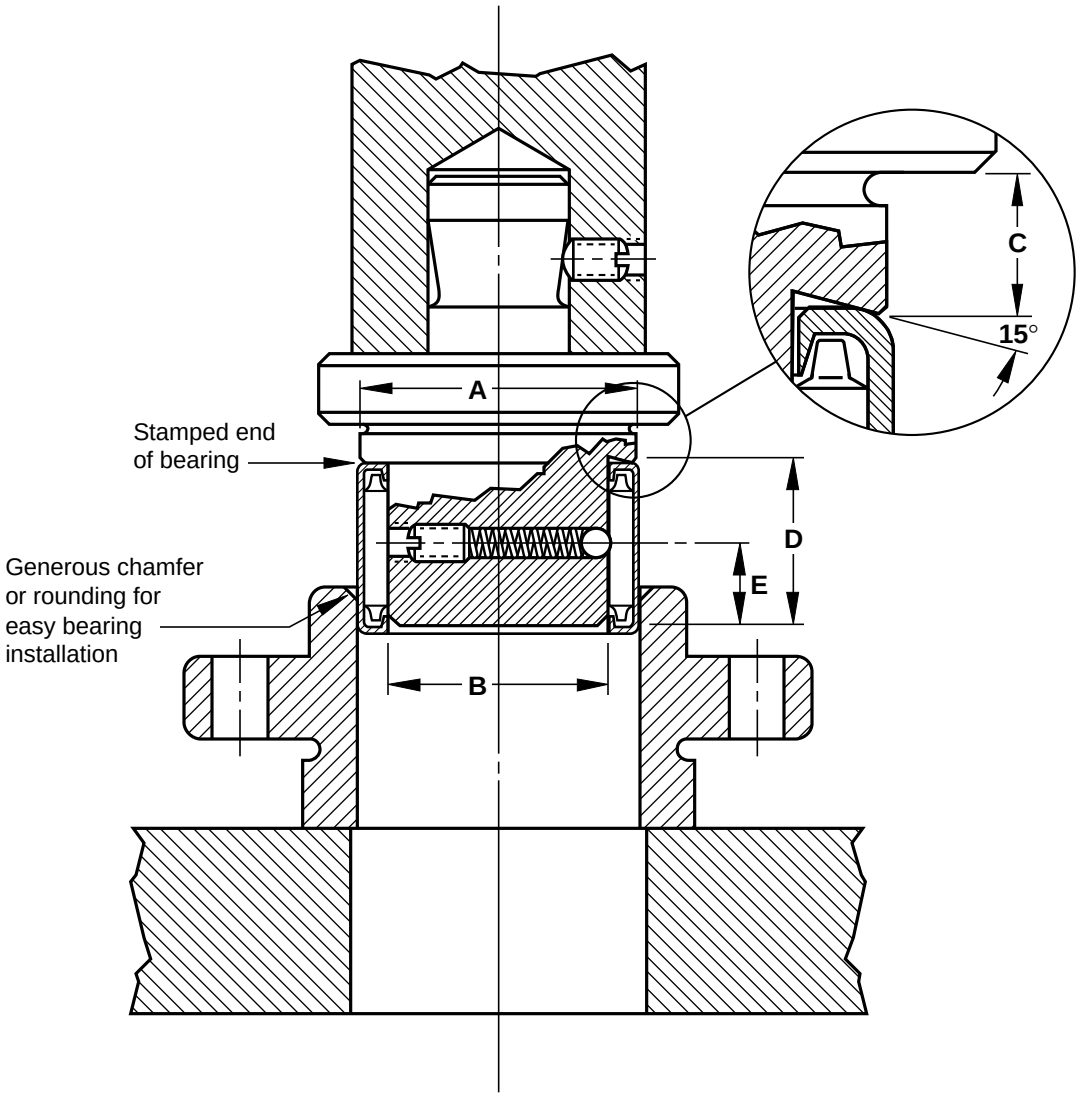
Assemble the bearing with the stamped end (the end with identification markings) against the angled shoulder of the pressing tool.

Never hammer the bearing into its housing even in conjunction with the proper assembly mandrel.

Never press the bearing tightly against a shoulder in the housing. If it is necessary to use a shouldered housing, the depth of the housing bore must be sufficient to ensure the housing shoulder fillet, as well as the shoulder face, clears the bearing.

To remove a drawn cup bearing from a through-bored housing, use a tool similar to the installation tool illustrated, but without the stop. For suggested methods of removing bearings from blind and shouldered bores, consult the Torrington Engineering Sales Office personnel.

A– 1/64" (0.4 mm) less than housing bore
B– .003" (0.08 mm) less than shaft diameter
C– distance bearing will be inset into housing, minimum of .008" (0.2 mm)
D– pilot length should be length of bearing less 1/32" (0.8 mm)
E– approximately ½ D



HOW TO INSPECT A BEARING JOURNAL OR HOUSING BORE

A twelve-point inspection is recommended to properly inspect a bearing journal or housing bore. Verification of mating component geometry is achieved by comparing the inspection measurements to the recommended (mating component) tolerance limits. Shaft and housing limits are selected using specific application criteria. Tables of these limits are published in The Torrington Company Service Catalog.

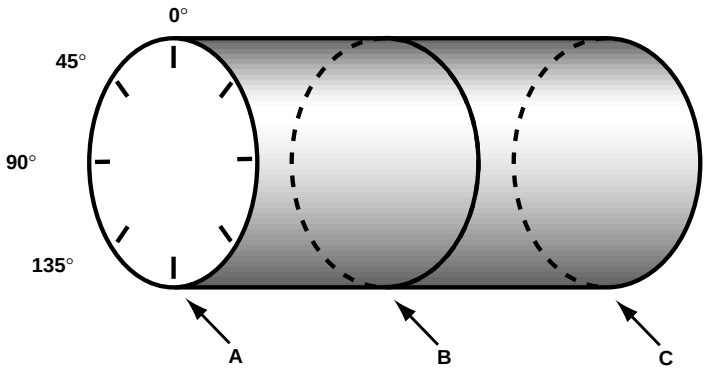
Diameter (size), roundness and taper (form) can be confirmed after the twelve measurements are recorded.

THE TWELVE-POINT MEASUREMENT PROCEDURE:

1) Use two-point gauges that are accurate to .0001". It is recommended that gauges with accuracy to 1/10 of the units that are being inspected to be used (resolution to .00001"). We recognize readily available gauges read to .0001", however.

2) Measure four position at 0°, 45°, 90°, and 135° in three different planes of the mating surface (that is in direct contact with the bearing). The three planes should be evenly spaced across the contact area. The outboard measurements should be 1/8" to 1/2" in from each end.

3) Record the measurements on a chart like the one listed below. Keep all three sets of measurements oriented with respect to each other. Take an average of each plane.



	0°	45°	90°	135°	AVERAGES
PLANE A	_____	_____	_____	_____	A = _____
PLANE B	_____	_____	_____	_____	B = _____
PLANE C	_____	_____	_____	_____	C = _____

DIAMETER (SIZE) EVALUATION:
Compare the average diameter measurement (A, B, C) to the recommended tolerance limits. Each average diameter should be within the recommended limits. The mating component diameter is out of specification if any average is over or under the recommended limits.

ROUNDNESS (FORM) EVALUATION:
Compare the individual measurements in a lane to each other. The maximum permissible deviation of these measurements is one-half (1/2) of the recommended limit. An out-of-round condition exists if differences greater than one-half (1/2) of the limit are found.

TWELVE POINT MEASUREMENT WORKSHEET

Application: _____ Machine: _____

Comments: _____

Shaft Tolerances Required: Max: _____ Min: _____ ½ Limit: _____

Housing Tolerances Required: Max: _____ Min: _____ ½ Limit: _____

MEASUREMENTS (gauges accurate to .0001" minimum is recommended)

	0°	45°	90°	135°	AVERAGES
PLANE A	_____	_____	_____	_____	A = _____
PLANE B	_____	_____	_____	_____	B = _____
PLANE C	_____	_____	_____	_____	C = _____

DIAMETER (SIZE) EVALUATION:

Compare the average diameter measurement (A, B, C) to the recommended tolerance limits. Each average diameter should be within the recommended limits. The mating component diameter is out of specification if any average is over or under the recommended limits.

ROUNDNESS (FORM) EVALUATION:

Compare the individual measurements in a plane to each other. The maximum permissible deviation of these measurements is one-half (½) of the recommended limit. An out-of-round condition exists if differences greater than one-half (½) of the limit are found.

TAPER (FORM) EVALUATION:

Taper is determined by taking the difference between the plane averages as follows:

AVERAGE A = _____	AVERAGE B = _____	AVERAGE A = _____
– AVERAGE B = _____	– AVERAGE C = _____	– AVERAGE C = _____
DIFFERENCE = _____	DIFFERENCE = _____	DIFFERENCE = _____

Excessive taper exists If the resultant differences exceed one-half (½) of the specified tolerance range.

SURFACE FINISH REFERENCE:

- Common surface finishes required for shafts are:
  - ≤ 2" diameter = 32rms Micro Finish maximum
  - > 2" diameter = 63rms Micro Finish maximum
- Common surface finishes required for housings are:
  - Stationary outer ring required to float = 63rms maximum
  - Stationary outer ring **not** required to float = 125rms maximum

EXAMPLE:

A 22324YMW33W800C4 “shaker screen” bearing housing inspection. This application requires a “P6” housing tolerance limit. The “P6” housing diameters are 10.2331"/ 10.2343".

Size is verified when the housing “plane” average diameters are between 10.2331" and 10.2343".

Roundness and taper inspections require that one-half (½) of the permissible tolerance limits be calculated. Thus,

$$\begin{array}{r} 10.2343" \\ \underline{-10.2331"} \\ .0012" \end{array} \quad \text{maximum limit} \qquad \text{AND} \qquad \frac{.0012"}{2} = .0006"$$

Roundness is verified by comparing the differences of the four measurements of a given plane. **No** difference should exceed .0006".

Taper is verified by comparing the differences of the three **averages.** No difference should exceed .0006".

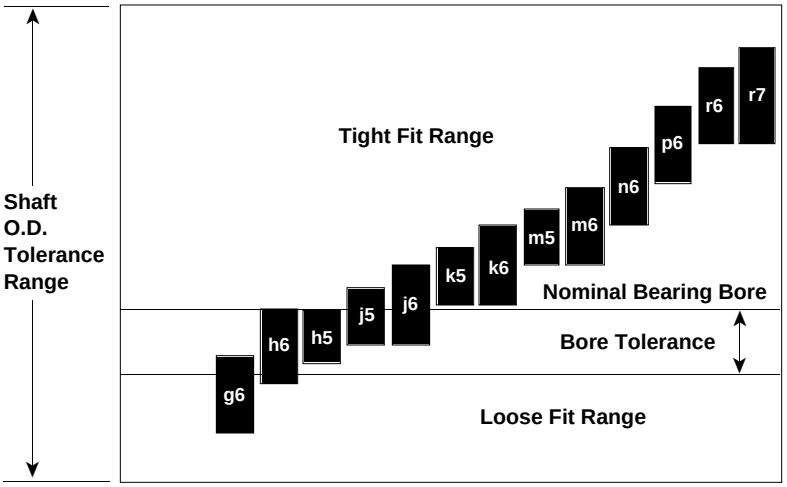
CONCLUDING COMMENTS:

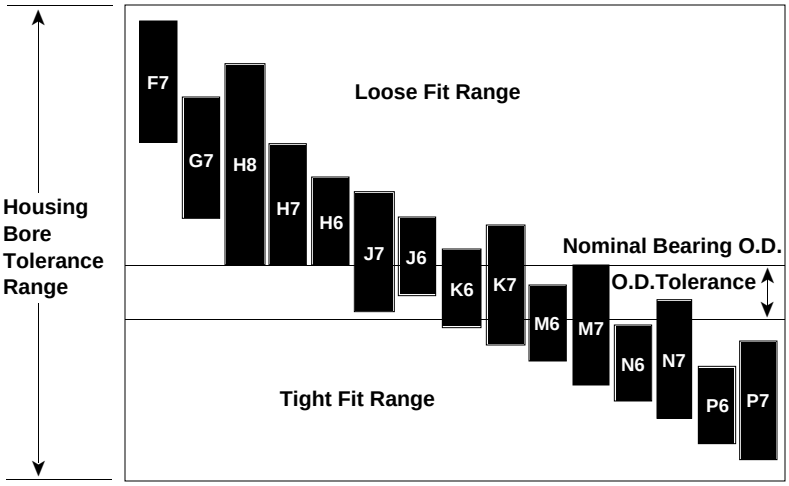
Precision ground anti-friction, rolling element bearings are extremely precise and refined industrial products. Their performance and life can be greatly enhanced by the following:

- The working environment must be clean during installation.
- Accepted care, handling techniques, and tools and fixtures must be employed during removal and installation of bearings during repair.
- Mating component geometry and material should meet industry standards as published in The Torrington Company Service Catalog.
- Common surface finishes required for shafts are:
  - ≤ 2" diameter = 32rms Micro Finish maximum
  - > 2" diameter = 63rms Micro Finish maximum
- Common surface finishes required for housings are:
  - Stationary outer ring required to float = 63rms maximum
  - Stationary outer ring **not** required to float = 125rms maximum

RADIAL BALL, SPHERICAL,CYLINDRICAL ROLLER BEARINGS

Below is a graphical representation of shaft and housing fit selection for these bearings conforming to ANSI/ABMA Standard 7. The bars designated by g6, h6 etc. represent shaft/housing diameter and tolerance ranges to achieve various loose and interference fits required for various load and ring rotation conditions.





RADIAL BALL, SPHERICAL AND CYLINDRICAL ROLLER BEARINGS

Tolerance and shaft diameters shown as variance from nominal bearing bore, using the symbols in the graph. All data except nominal dimensions are in ten-thousands of an inch (5 = 0.0005") and thousandths of a millimeter or micrometer (5 = 0.005mm).

See pages 26 through 31 for actual shaft and housing diameters for normal loading of ABEC-1 and ABEC-3 radial ball bearings and 7000WN Series angular contact ball bearings.

For particular operating conditions of radial ball, spherical and cylindrical roller bearings, see pages 32, 33 and 34.

SHAFT

Bearing Bore			g6			h6			h5			j5			j6			k5			k6			m5		
Nominal (max.) Over	Incl.	Tol. +0 To	Shaft Dia. max.	Shaft Dia. min.	Fit	Shaft Dia. max.	Shaft Dia. min.	Fit	Shaft Dia. max.	Shaft Dia. min.	Fit	Shaft Dia. max.	Shaft Dia. min.	Fit	Shaft Dia. max.	Shaft Dia. min.	Fit	Shaft Dia. max.	Shaft Dia. min.	Fit	Shaft Dia. max.	Shaft Dia. min.	Fit	Shaft Dia. max.	Shaft Dia. min.	Fit
		in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
mm		mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
3	6	-3	-2	-5	5L 1T	0	-3	3L 3T	0	-2	2L 3T	+1	-1	1L 4T	+2	-1	1L 5T	+2	+0	0T 5T				+4	+2	2T 7T
		-8	-4	-12	12L 4T	0	-8	8L 8T	0	-5	5L 8T	+3	-2	2L 11T	+6	-2	2L 14T	+6	+1	1T 14T				+9	+4	4T 17T
6	10	-3	-2	-6	6L 1T	0	-4	4L 3T	0	-2	2L 3T	+2	-1	1L 5T	+3	-1	1L 6T	+3	+0	0T 6T				+5	+2	2T 8T
		-8	-5	-14	14L 3T	0	-9	9L 8T	0	-6	6L 8T	+4	-2	2L 12T	+7	-2	2L 15T	+7	+1	1T 15T				+12	+6	6T 20T
10	18	-3	-2	-7	7L 1T	0	-4	4L 3T	0	-3	3L 3T	+2	-1	1L 5T	+3	-1	1L 6T	+4	+0	0T 7T				+6	+3	3T 9T
		-8	-6	-17	17L 2T	0	-11	11L 8T	0	-8	8L 8T	+5	-3	3L 13T	+8	-3	3L 16T	+9	+1	1T 17T				+15	+7	7T 23T
18	30	-4	-3	-8	8L 1T	0	-5	5L 4T				+2	-2	2L 6T	+4	-2	2L 8T	+4	+1	1T 8T				+7	+3	3T 11T
		-10	-7	-20	20L 3T	0	-13	13L 10T				+5	-4	4L 15T	+9	-4	4L 19T	+11	+2	2T 21T				+17	+8	8T 27T
30	50	-4.5	-4	-10	10L 0.5T	0	-6	6L 4.5T				+2	-2	2L 6.5T	+4	-2	2L 8.5T	+5	+1	1T 9.5T	+7	+1	1T 11.5T	+8	+4	4T 12.5T
		-12	-9	-25	25L 3T	0	-16	16L 12T				+6	-5	5L 18T	+11	-5	5L 23T	+13	+2	2T 25T	+18	+2	2T 30T	+20	+9	9T 32T
50	80	-6	-4	-11	11L 2T	0	-7	7L 6T				+2	-3	3L 8T	+5	-3	3L 11T	+6	+1	1T 12T	+8	+1	1T 14T	+9	+4	4T 15T
		-15	-10	-29	29L 5T	0	-19	19L 15T				+6	-7	7L 21T	+12	-7	7L 27T	+15	+2	2T 30T	+21	+2	2T 36T	+24	+11	11T 39T
80	120	-8	-5	-13	13L 3T	0	-9	9L 8T				+2	-4	4L 10T	+5	-4	4L 13T	+7	+1	1T 15T	+10	+1	1T 18T	+11	+5	5T 19T
		-20	-12	-34	34L 8T	0	-22	22L 20T				+6	-9	9L 26T	+13	-9	9L 33T	+18	+3	3T 38T	+25	+3	3T 45T	+28	+13	13T 48T
120	180	-10	-6	-15	15L 4T	0	-10	10L 10T				+3	-4	4L 13T	+6	-4	4L 16T	+8	+1	1T 18T	+11	+1	1T 21T	+13	+6	6T 23T
		-25	-14	-39	39L 11T	0	-25	25L 25T				+7	-11	11L 32T	+14	-11	11L 39T	+21	+3	3T 46T	+28	+3	3T 53T	+33	+15	15T 58T
180	200	-12	-6	-17	17L 6T	0	-11	11L 12T				+3	-5	5L 15T	+6	-5	5L 18T	+9	+2	2T 21T				+15	+7	7T 27T
		-30	-15	-44	44L 15T	0	-29	29L 30T				+7	-13	13L 37T	+16	-13	13L 46T	+24	+4	4T 54T				+37	+17	17T 67T
200	225	-12	-6	-17	17L 6T	0	-11	11L 12T				+3	-5	5L 15T	+6	-5	5L 18T	+9	+2	2T 21T				+15	+7	7T 27T
		-30	-15	-44	44L 15T	0	-29	29L 30T				+7	-13	13L 37T	+16	-13	13L 46T	+24	+4	4T 54T				+37	+17	17T 67T
225	250	-12	-6	-17	17L 6T	0	-11	11L 12T				+3	-5	5L 15T	+6	-5	5L 18T	+9	+2	2T 21T				+15	+7	7T 27T
		-30	-15	-44	44L 15T	0	-29	29L 30T				+7	-13	13L 37T	+16	-13	13L 46T	+24	+4	4T 54T				+37	+17	17T 67T
250	280	-14	-7	-19	19L 7T	0	-13	13L 14T				+3	-6	6L 17T	+6	-6	6L 20T	+11	+2	2T 25T				+17	+8	8T 31T
		-35	-17	-49	49L 18T	0	-32	32L 35T				+7	-16	16L 42T	+16	-16	16L 51T	+27	+4	4T 62T				+43	+20	20T 78T
280	315	-14	-7	-19	19L 7T	0	-13	13L 14T				+3	-6	6L 17T	+6	-6	6L 20T	+11	+2	2T 25T				+17	+8	8T 31T
		-35	-17	-49	49L 18T	0	-32	32L 35T				+7	-16	16L 42T	+16	-16	16L 51T	+27	+4	4T 62T				+43	+20	20T 78T

The tolerances in this table are in conformance with ANSI/ABMA Standard7-1988

RADIAL BALL, SPHERICAL AND CYLINDRICAL ROLLER BEARINGS

Tolerance and shaft diameters shown as variance from nominal bearing bore, using the symbols in the graph. All data except nominal dimensions are in ten-thousands of an inch (5 = 0.0005") and thousandths of a millimeter or micrometer (5 = 0.005mm).

See pages 26 through 31 for actual shaft and housing diameters for normal loading of ABEC-1 and ABEC-3 radial ball bearings and 7000WN Series angular contact ball bearings.

For particular operating conditions of radial ball, spherical and cylindrical roller bearings, see pages 32, 33 and 34.

SHAFT

Bearing Bore			m6			n6			p6			r6			r7		
Nominal (max.) Over	Incl.	Tol. + 0 To	Shaft Dia. max.	Shaft Dia. min.	Fit	Shaft Dia. max.	Shaft Dia. min.	Fit	Shaft Dia. max.	Shaft Dia. min.	Fit	Shaft Dia. max.	Shaft Dia. min.	Fit	Shaft Dia. max.	Shaft Dia. min.	Fit
mm		in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm
3	6	-3 -8															
6	10	-3 -8															
10	18	-3 -8															
18	30	-4 -10															
30	50	-5 -12	+10 +25	+4 +9	4T 14.5T 9T 37T												
50	80	-6 -15	+12 +30	+4 +11	4T 18T 11T 45T	+15 +39	+8 +20	8T 21T 20T 54T									
80	120	-8 -20	+14 +35	+5 +13	5T 22T 13T 55T	+18 +45	+9 +23	9T 26T 23T 65T	+23 +59	+15 +37	15T 31T 37T 79T						
120	180	-10 -25	+16 +40	+6 +15	6T 26T 15T 65T	+20 +52	+11 +27	11T 30T 27T 77T	+27 +68	+17 +43	17T 37T 43T 93T	+35 +90	+26 +65	26T 45T 65T 115T			
180	200	-12 -30	+18 +46	+7 +17	7T 30T 17T 76T	+24 +60	+12 +31	12T 36T 31T 90T	+31 +79	+20 +50	20T 43T 50T 109T	+42 +106	+30 +77	30T 54T 77T 136T			
200	225	-12 -30	+18 +46	+7 +17	7T 30T 17T 76T	+24 +60	+12 +31	12T 36T 31T 90T	+31 +79	+20 +50	20T 43T 50T 109T	+43 +109	+31 +80	31T 55T 80T 139T	+50 +126	+31 +80	31T 62T 80T 156T
225	250	-12 -30	+18 +46	+7 +17	7T 30T 17T 76T	+24 +60	+12 +31	12T 36T 31T 90T	+31 +79	+20 +50	20T 43T 50T 109T	+44 +113	+33 +84	33T 56T 84T 143T	+51 +130	+33 +84	33T 63T 84T 160T
250	280	-14 -35	+20 +52	+8 +20	8T 34T 20T 87T	+26 +66	+13 +34	13T 40T 34T 101T	+35 +88	+22 +56	22T 49T 56T 123T	+50 +126	+37 +94	37T 64T 94T 161T	+57 +146	+37 +94	37T 71T 94T 181T
280	315	-14 -35	+20 +52	+8 +20	8T 34T 20T 87T	+26 +66	+13 +34	13T 40T 34T 101T	+35 +88	+22 +56	22T 49T 56T 123T	+51 +130	+39 +98	39T 65T 98T 165T	+59 +150	+39 +98	39T 73T 98T 185T

The tolerances in this table are in conformance with ANSI/ABMA Standard 7-1988

Continued on the next page

RADIAL BALL, SPHERICAL AND CYLINDRICAL ROLLER BEARINGS *(continued)*

Tolerance and shaft diameters shown as variance from nominal bearing bore, using the symbols in the graph. All data except nominal dimensions are in ten-thousands of an inch (5 = 0.0005") and thousandths of a millimeter or micrometer (5 = 0.005mm).

See pages 26 through 31 for actual shaft and housing diameters for normal loading of ABEC-1 and ABEC-3 radial ball bearings and 7000WN Series angular contact ball bearings.

For particular operating conditions of radial ball, spherical and cylindrical roller bearings, see pages 32, 33 and 34.

SHAFT

Bearing Bore			g6			h6			h5			j5			j6			k5			k6			m5		
Nominal (max.) Over	Incl.	Tol. +0 To	Shaft Dia. max.	Shaft Dia. min.	Fit	Shaft Dia. max.	Shaft Dia. min.	Fit	Shaft Dia. max.	Shaft Dia. min.	Fit	Shaft Dia. max.	Shaft Dia. min.	Fit	Shaft Dia. max.	Shaft Dia. min.	Fit	Shaft Dia. max.	Shaft Dia. min.	Fit	Shaft Dia. max.	Shaft Dia. min.	Fit	Shaft Dia. max.	Shaft Dia. min.	Fit
		in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
mm		mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
315	355	-16	-7	-21	21L 9T	0	-14	14L 16T				+3	-7	7L 19T	+7	-7	7L 23T	+11	+2	2T 27T				+18	+8	8T 34T
		-40	-18	-54	54L 22T	0	-36	36L 40T				+7	-18	18L 47T	+18	-18	18L 58T	+29	+46	4T 9T				+46	+21	21T 86T
355	400	-16	-7	-21	21L 9T	0	-14	14L 16T				+3	-7	7L 19T	+7	-7	7L 23T	+11	+2	2T 27T				+18	+8	8T 34T
		-40	-18	-54	54L 22T	0	-36	36L 40T				+7	-18	18L 47T	+18	-18	18L 58T	+29	+4	4T 69T				+46	+21	21T 86T
400	450	-18	-8	-24	24L 10T	0	-16	16L 18T				+3	-8	8L 21T	+8	-8	8L 26T	+13	+2	2T 31T				+20	+9	9T 38T
		-45	-20	-60	60L 25T	0	-40	40L 45T				+7	-20	20L 52T	+20	-20	20L 65T	+32	5	5T 77T				+50	+23	23T 95T
450	500	-18	-8	-24	24L 10T	0	-16	16L 18T				+3	-8	8L 21T	+8	-8	8L 26T	+13	2	2T 31T				+20	+9	9T 38T
		-45	-20	-60	60L 25T	0	-40	40L 45T				+7	-20	20L 52T	+20	-20	20L 65T	+32	5	5T 77T				+50	+23	23T 95T
500	560	-20	-9	-26	26L 11T	0	-17	17L 20T				+3	-9	9L 23T	+9	-9	9L 29T	+12	0	0T 32T				+22	+10	10T 42T
		-50	-22	-66	66L 28T	0	-44	44L 50T				+8	-22	22L 58T	+22	-22	22L 72T	+30	0	0T 80T				+56	+26	26T 106T
560	630	-20	-9	-26	26L 11T	0	-17	17L 20T				+3	-9	9L 23T	+9	-9	9L 29T	+12	0	0T 32T				+22	+10	10T 42T
		-50	-22	-66	66L 28T	0	-44	44L 50T				+8	-22	22L 58T	+22	-22	22L 72T	+30	0	0T 80T				+56	+26	26T 106T
630	710	-30	-9	-29	29L 21T	0	-20	20L 30T				+4	-10	10L 34T	+10	-10	10L 40T	+14	0	0T 44T				+26	+12	12T 56T
		-75	-24	-74	74L 51T	0	-50	50L 75T				+10	-25	25L 85T	+25	-25	25L 100T	+35	0	0T 110T				+65	+30	30T 140T
710	800	-30	-9	-29	29L 21T	0	-20	20L 30T				+4	-10	10L 34T	+10	-10	10L 40T	+14	0	0T 44T				+26	+12	12T 56T
		-75	-24	-74	74L 51T	0	-50	50L 75T				+10	-25	25L 85T	+25	-25	25L 100T	+35	0	0T 110T				+65	+30	30T 140T
800	900	-39	-10	-32	32L 29T	0	-22	22L 39T				+5	-11	11L 44T	+11	-11	11L 50T	+16	0	0T 55T				+29	+13	13T 68T
		-100	-26	-82	82L 74T	0	-56	56L 100T				+12	-28	28L 112T	+28	-28	28L 128T	+40	0	0T 140T				+74	+34	34T 174T
900	1000	-39	-10	-32	32L 29T	0	-22	22L 39T				+5	-11	11L 44T	+11	-11	11L 50T	+16	0	0T 55T				+29	+13	13T 68T
		-100	-26	-82	82L 74T	0	-56	56L 100T				+12	-28	28L 112T	+28	-28	28L 128T	+40	0	0T 140T				+74	+34	34T 174T
1000	1120	-49	-11	-37	37L 38T	0	-26	26L 49T				+5	-13	13L 54T	+13	-13	13L 62T	+18	0	0T 67T				+34	+16	16T 83T
		-125	-28	-94	94L 97T	0	-66	66L 125T				+13	-33	33L 138T	+33	-33	33L 158T	+46	0	0T 171T				+86	+40	40T 211T
1120	1250	-49	-11	-37	37L 38T	0	-26	26L 49T				+5	-13	13L 54T	+13	-13	13L 62T	+18	0	0T 67T				+34	+16	16T 83T
		-125	-28	-94	94L 97T	0	-66	66L 125T				+13	-33	33L 138T	+33	-33	33L 158T	+46	0	0T 171T				+86	+40	40T 211T

The tolerances in this table are in conformation with ANSI/ABMA Standard 7-1988

RADIAL BALL, SPHERICAL AND CYLINDRICAL ROLLER BEARINGS *(continued)*

Tolerance and shaft diameters shown as variance from nominal bearing bore, using the symbols in the graph. All data except nominal dimensions are in ten-thousands of an inch (5 = 0.0005") and thousandths of a millimeter or micrometer (5 = 0.005mm).

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SHAFT

Bearing Bore			m6			n6			p6			r6			r7		
Nominal (max.) Over	Incl.	Tol. + 0 To	Shaft Dia. max.	Shaft Dia. min.	Fit	Shaft Dia. max.	Shaft Dia. min.	Fit	Shaft Dia. max.	Shaft Dia. min.	Fit	Shaft Dia. max.	Shaft Dia. min.	Fit	Shaft Dia. max.	Shaft Dia. min.	Fit
mm		in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm
315	355	-16	+22	+8	8T 38T	+29	+15	15T 45T	+39	+24	24T 55T	+57	+43	43T 73T	+65	+43	43T 81T
		-40	+57	+21	21T 97T	+73	+37	37T 113T	+98	+62	62T 138T	+144	+108	108T 184T	+165	+108	108T 205T
355	400	-16				+29	+15	15T 45T	+39	+24	24T 55T	+59	+45	45T 75T	+67	+45	45T 83T
		-40				+73	+37	37T 113T	+98	+62	62T 138T	+150	+114	114T 190T	+171	+114	114T 211T
400	450	-18				+31	+16	16T 49T	+43	+27	27T 61T	+65	+50	50T 83T	+74	+50	50T 92T
		-45				+80	+40	40T 125T	+108	+68	68T 153T	+166	+126	126T 211T	+189	+126	126T 234T
450	500	-18				+31	+16	16T 49T	+43	+27	27T 61T	+68	+52	52T 86T	+77	+52	52T 95T
		-45				+80	+40	40T 125T	+108	+68	68T 153T	+172	+132	132T 217T	+195	+132	132T 240T
500	560	-20							+48	+31	31T 68T	+76	+59	59T 96T	+87	+59	59T 107T
		-50							+122	+78	78T 172T	+194	+150	150T 244T	+220	+150	150T 270T
560	630	-20							+48	+31	31T 68T	+78	+61	61T 98T	+89	+61	61T 109T
		-50							+122	+78	78T 172T	+199	+155	155T 249T	+225	+155	155T 275T
630	710	-30							+54	+35	35T 84T	+89	+69	69T 119T	+100	+69	69T 130T
		-75							+138	+88	88T 213T	+225	+175	175T 300T	+255	+175	175T 330T
710	800	-30							+54	+35	35T 84T	+93	+73	73T 123T	+104	+73	73T 134T
		75							+138	+88	88T 213T	+235	+185	185T 310T	+265	+185	185T 340T
800	900	-39							+61	+39	39T 100T	+105	+83	83T 144T	+118	+83	83T 157T
		-100							156	+100	100T 256T	+266	+210	210T 366T	+300	+210	210T 400T
900	1000	-39							+61	+39	39T 100T	+109	+87	87T 148T	+122	+87	87T 161T
		-100							+156	+100	100T 256T	+276	+220	220T 376T	+310	+220	220T 410T
1000	1120	-49							+73	+47	47T 122T	+124	+98	98T 173T	+140	+98	98T 189T
		-125							+186	+120	120T 311T	+316	+250	250T 441T	+355	+250	250T 480T
1120	1250	-49							+73	+47	47T 122T	+128	+102	102T 177T	+144	+102	102T 193T
		-125							+186	+120	120T 311T	+326	+260	260T 451T	+365	+260	260T 490T

The tolerances in this table are in conformance with ANSI/ABMA Standard 7– 1988.

RADIAL BALL, SPHERICAL AND CYLINDRICAL ROLLER BEARINGS

Tolerance and housing bore shown as variance from nominal bearing O.D. All data except nominal dimensions are in ten-thousands of an inch (5 = 0.0005") and thousandths of a millimeter or micrometer (5 = 0.005mm).

See pages 26 through 31 for actual shaft and housing diameters for normal loading of ABEC-1 and ABEC-3 radial ball bearings and 7000WN Series angular contact ball bearings.

For particular operating conditions of radial ball, spherical and cylindrical roller bearings, see pages 32, 33 and 34.

HOUSING

Bearing O.D.			F7			G7			H8			H7			H6			J6			J7			K6			K7		
Nominal (max.) Over	Incl.	Tol. +0 To	Housing Bore min.	max	Fit	Housing Bore min.	max	Fit	Housing Bore min.	max	Fit	Housing Bore min.	max	Fit	Housing Bore min.	max	Fit	Housing Bore min.	max	Fit	Housing Bore min.	max	Fit	Housing Bore min.	max	Fit	Housing Bore min.	max	Fit
		in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
mm		mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
10	18	-3	+6	+13	6L 16L	+2	+9	2L 12L	0	+11	0L 14L	0	+7	0L 10L	0	+4	0L 7L	-2	+2	2T 5L	-3	+4	3T 7L	-4	+1	4L 4T	-5	+2	5T 5L
		-8	+16	+34	16L 42L	+6	+24	6L 32L	0	+27	0L 35L	0	+18	0L 26L	0	+11	0L 19L	-5	+6	5T 14L	-8	+10	8T 18L	-9	+2	9T 10L	-12	+6	12T 14L
18	30	-3.5	+8	+16	8L 19.5L	+3	+11	3L 14.5L	0	+13	0L 16.5L	0	+8	0L 11.5L	0	+5	0L 8.5L	-2	+3	2T 6.5L	-4	+5	4T 8.5L	-4	+1	4T 4.5L	-6	+2	6T 5.5L
		-9	+20	+41	20L 50L	+7	+28	7L 37L	0	+33	0L 42L	0	+21	0L 30L	0	+13	0L 22L	-5	+8	5T 17L	-9	+12	9T 21L	-11	+2	11T 11L	-15	+6	15T 15L
30	50	-4.5	+10	+20	10L 24.5L	+4	+13	4L 17.5L	0	+15	0L 19.5L	0	+10	0L 14.5L	0	+6	0L 10.5L	-2	+4	2T 8.5L	-4	+6	4T 10.5L	-5	+1	5T 5.5L	-7	+3	7T 7.5L
		-11	+25	+50	25L 61L	+9	+34	9L 45L	0	+39	0L 50L	0	+25	0L 36L	0	+16	0L 27L	-6	+10	6T 21L	-11	+14	11T 25L	-13	+3	13T 14L	-18	+7	18T 18L
50	80	-5	+12	+24	12L 29L	+4	+16	4L 21L	0	+18	0L 23L	0	+12	0L 17L	0	+7	0L 12L	-2	+5	2T 10L	-5	+7	5T 12L	-6	+2	6T 7L	-8	+4	8T 9L
		-13	+30	+60	30L 73L	+10	+40	10L 53L	0	+46	0L 59L	0	+30	0L 43L	0	+19	0L 32L	-6	+13	6T 26L	-12	+18	12T 31L	-15	+4	15T 17L	-21	+9	21T 22L
80	120	-6	+14	+28	14L 34L	+5	+19	5L 25L	0	+21	0L 27L	0	+14	0L 20L	0	+9	0L 15L	-2	+6	2T 12L	-5	+9	5T 15L	-7	+2	7T 8L	-10	+4	10T 10L
		-15	+36	+71	36L 86L	+12	+47	12L 62L	0	+54	0L 69L	0	+35	0L 50L	0	+22	0L 37L	-6	+16	6T 31L	-13	+22	13T 37L	-18	+4	18T 19L	-25	+10	25T 25L
120	150	-7	+17	+33	17L 40L	+6	+21	6L 28L	0	+25	0L 32L	0	+16	0L 23L	0	+10	0L 17L	-3	+7	3T 14L	-6	+10	6T 17L	-8	+2	8T 9L	-11	+5	11T 12L
		-18	+43	+83	43L 101L	+14	+54	14L 72L	0	+63	0L 81L	0	+40	0L 58L	0	+25	0L 43L	-7	+18	7T 36L	-14	+26	14T 44L	-21	+4	21T 22L	-28	+12	28T 30L
150	180	-10	+17	+33	17L 43L	+6	+21	6L 31L	0	+25	0L 35L	0	+16	0L 26L	0	+10	0L 20L	-3	+7	3T 17L	-6	+10	6T 20L	-8	+2	8T 12L	-11	+5	11T 15L
		-25	+43	+83	43L 108L	+14	+54	14L 79L	0	+63	0L 88L	0	+40	0L 65L	0	+25	0L 50L	-7	+18	7T 43L	-14	+26	14T 51L	-21	+4	21T 29L	-28	+12	28T 37L
180	250	-12	+20	+38	20L 50L	+6	+24	6L 36L	0	+28	0L 40L	0	+18	0L 30L	0	+11	0L 23L	-3	+9	3T 21L	-6	+12	6T 24L	-9	+2	9T 14L	-13	+5	13T 17L
		-30	+50	+96	50L 126L	+15	+61	15L 91L	0	+72	0L 102L	0	+46	0L 76L	0	+29	0L 59L	-7	+22	7T 52L	-16	+30	16T 60L	-24	+5	24T 35L	-33	+13	33T 43L
250	315	-14	+22	+43	22L 57L	+7	+27	7L 41L	0	+32	0L 46L	0	+20	0L 34L	0	+13	0L 27L	-3	+10	3T 24L	-6	+14	6T 28L	-11	+2	11T 16L	-14	+6	14T 20L
		-35	+56	+108	56L 143L	+17	+69	17L 104L	0	+81	0L 116L	0	+52	0L 87L	0	+32	0L 67L	-7	+25	7T 60L	-16	+36	16T 71L	-27	+5	27T 40L	-36	+16	36T 51L

The tolerances in this table are in conformance with ANSI/ABMA Standard 7– 1988.

RADIAL BALL, SPHERICAL AND CYLINDRICAL ROLLER BEARINGS

Tolerance and housing bore shown as variance from nominal bearing O.D. All data except nominal dimensions are in ten-thousands of an inch (5 = 0.0005") and thousandths of a millimeter or micrometer (5 = 0.005mm).

See pages 26 through 31 for actual shaft and housing diameters for normal loading of ABEC-1 and ABEC-3 radial ball bearings and 7000WN Series angular contact ball bearings.

For particular operating conditions of radial ball, spherical and cylindrical roller bearings, see pages 32, 33 and 34.

HOUSING

Bearing O.D.			M6			M7			N6			N7			P6			P7		
Nominal (max.)		Tol. +0	Housing Bore		Fit	Housing Bore		Fit	Housing Bore		Fit	Housing Bore		Fit	Housing Bore		Fit	Housing Bore		Fit
Over	Incl.	To	min.	max		min.	max		min.	max		min.	max		min.	max		min.	max	
		in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
mm		mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
0	18	-3	-6	-2	6T 1L	-7	0	7T 3L	-8	-4	8T 1T	-9	-2	9T 1L	-10	-6	10T 3T	-11	-4	11T 1T
		-8	-15	-4	15T 4L	-18	0	18T 8L	-20	-9	20T 1T	-23	-5	23T 3L	-26	-15	26T 7T	-29	-11	29T 3T
18	30	-3.5	-7	-2	7T 1.5L	-8	0	8T 3.5L	-9	-4	9T 0.5T	-11	-3	11T 0.5L	-12	-7	12T 3.5T	-14	-6	14T 2.5T
		-9	-17	-4	17T 5L	-21	0	21T 9L	-24	-11	24T 2T	-28	-7	28T 2L	-31	-18	31T 9T	-35	-14	35T 5T
30	50	-4.5	-8	-2	8T 2.5L	-10	0	10T 4.5L	-11	-5	11T 0.5T	-13	-3	13T 1.5L	-15	-8	15T 3.5T	-17	-7	17T 2.5T
		-11	-20	-4	20T 7L	-25	0	25T 11L	-28	-12	28T 1T	-33	-8	33T 3L	-37	-21	37T 10T	-42	-17	42T 6T
50	80	-5	-9	-2	9T 3L	-12	0	12T 5L	-13	-6	13T 1T	-15	-4	15T 1L	-18	-10	18T 5T	-20	-8	20T 3T
		-13	-24	-5	24T 8L	-30	0	30T 13L	-33	-14	33T 1T	-39	-9	39T 4L	-45	-26	45T 13T	-51	-21	51T 8T
80	120	-6	-11	-2	11T 4L	-14	0	14T 6L	-15	-6	15T 0T	-18	-4	18T 2L	-20	-12	20T 6T	-23	-9	23T 3T
		-15	-28	-6	28T 9L	-35	0	35 15L	-38	-16	38T 1T	-45	-10	45T 5L	-52	-30	52T 15T	-59	-24	59T 9T
120	150	-7	-13	-3	13T 4L	-16	0	16T 7L	-18	-8	18T 1T	-20	-5	20T 2L	-24	-14	24T 7T	-27	-11	27T 4T
		-18	-33	-8	33T 10L	-40	0	40T 18L	-45	-20	45T 2T	-52	-12	52T 6L	-61	-36	61T 18T	-68	-28	68T 10T
150	180	-10	-13	-3	13T 7L	-16	0	16T 10L	-18	-8	18T 2L	-20	-5	20T 5L	-24	-14	24T 4T	-27	-11	27T 1T
		-25	-33	-8	33T 17L	-40	0	40T 25L	-45	-20	45T 5L	-52	-12	52T 13L	-61	-36	61T 11T	-68	-28	68T 3T
180	250	-12	-15	-3	15T 9L	-18	0	18T 12L	-20	-9	20T 3L	-24	-6	24T 6L	-28	-16	28T 4T	-31	-13	31T 1T
		-30	-37	-8	37T 22L	-46	0	46T 30L	-51	-22	51T 8L	-60	-14	60T 16L	-70	-41	70T 11T	-79	-33	79T 3T
250	315	-14	-16	-4	16T 10L	-20	0	20T 14L	-22	-10	22T 4L	-26	-6	25T 8L	-31	-19	31T 5T	-35	-14	35T 0L
		-35	-41	-9	41T 26L	-52	0	52T 35L	-57	-25	57T 10L	-66	-14	66T 21L	-79	-47	79T 12T	-88	-36	88T 1T

The tolerances in this table are in conformance with ANSI/ABMA Standard 7 – 1988.

Continued on the next page

RADIAL BALL, SPHERICAL AND CYLINDRICAL ROLLER BEARINGS *(continued)*

Tolerance and housing bore shown as variance from nominal bearing O.D. All data except nominal dimensions are in ten-thousands of an inch (5 = 0.0005") and thousandths of a millimeter or micrometer (5 = 0.005mm).

See pages 26 through 31 for actual shaft and housing diameters for normal loading of ABEC-1 and ABEC-3 radial ball bearings and 7000WN Series angular contact ball bearings.

For particular operating conditions of radial ball, spherical and cylindrical roller bearings, see pages 32, 33 and 34.

HOUSING

Bearing O.D. Nominal (max.) Over	Incl.	Tol. + 0 To	F7 Housing Bore min.	max	Fit	G7 Housing Bore min.	max	Fit	H8 Housing Bore min.	max	Fit	H7 Housing Bore min.	max	Fit	H6 Housing Bore min.	max	Fit	J6 Housing Bore min.	max	Fit	J7 Housing Bore min.	max	Fit	K6 Housing Bore min.	max	Fit	K7 Housing Bore min.	max	Fit
		in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
mm		mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
		-16	+24	+47	24L	+7	+30	7L	0	+35	0L	0	+22	0L	0	+14	0L	-3	+11	3T	-7	+15	7T	-11	+3	11T	-16	+7	16T
					63L			46L			51L			38L			30L			27L			31L			19L			23L
315	400	-40	+62	+119	62L	+18	+75	18L	0	+89	0L	0	+57	0L	0	+36	0L	-7	+29	7T	-18	+39	18T	-29	+7	29T	-40	+17	40T
					159L			115L			129L			97L			76L			69L			79L			47L			57L
		-18	+27	+52	27L	+8	+33	8L	0	+38	0L	0	+25	0L	0	+16	0L	-3	+13	3T	-8	+17	8T	-13	+3	13T	-18	+7	18T
					70L			51L			56L			43L			34L			31L			35L			21L			25L
400	500	-45	+68	+131	68L	+20	+83	20L	0	+97	0L	0	+63	0L	0	+40	0L	-7	+33	7T	-20	+43	20T	-32	+8	32T	-45	+18	45T
					176L			128L			142L			108L			85L			78L			88L			53L			63L
		-20	+30	+57	30L	+9	+36	9L	0	+43	0L	0	+28	0L	0	+17	0L	-3	+15	3T	-9	+19	9T	-17	0	17T	-28	0	28T
					77L			56L			63L			48L			37L			35L			39L			20L			20L
500	630	-50	+76	+146	76L	+22	+92	22L	0	+110	0L	0	+70	0L	0	+44	0L	-7	+37	7T	-22	+48	22T	-44	0	44T	-70	0	70T
					196L			142L			160L			120L			94L			87L			98L			50L			50L
		-30	+31	+63	31L	+9	+41	9L	0	+49	0L	0	+31	0L	0	+20	0L	-4	+16	4T	-9	+22	9T	-20	0	20T	-31	0	31T
					93L			71L			79L			61L			50L			46L			52L			30L			30L
630	800	-75	+80	+160	80L	+24	+104	24L	0	+125	0L	0	+80	0L	0	+50	0L	-10	+40	10T	-24	+56	24T	-50	0	50T	-80	0	80T
					235L			179L			200L			155L			125L			115L			131L			75L			75L
		-39	+34	+69	34L	+10	+46	10L	0	+55	0L	0	+35	0L	0	+22	0L	-4	+18	4T	-10	+25	10T	-22	0	22T	-35	0	35T
					108L			85L			94L			74L			61L			57L			64L			39L			39L
800	1000	-100	+86	+176	86L	+26	+116	26L	0	+140	0L	0	+90	0L	0	+56	0L	-10	+46	10T	-26	+64	26T	-56	0	56T	-90	0	90T
					276L			216L			240L			190L			156L			146L			164L			100L			100L
		-49	+39	+80	39L	+11	+52	11L	0	+65	0L	0	+41	0L	0	+26	0L	-4	+22	4T	-11	+30	11T	-26	0	26T	-41	0	41T
					129L			101L			114L			90L			75L			71L			79L			49L			49L
1000	1250	-125	+98	+203	98L	+28	+133	28L	0	+165	0L	0	+105	0L	0	+66	0L	-10	+56	10T	-28	+77	28T	-66	0	66T	-105	0	105T
					328L			258L			290L			230L			191L			181L			202L			125L			125L
		-63	+43	+93	43L	+12	+61	12L	0	+77	0L	0	+49	0L	0	+31	0L	-4	+27	4T	-12	+37	12T	-31	0	31T	-49	0	49T
					156L			124L			140L			112L			94L			90L			100L			63L			63L
1250	1600	-160	+110	+235	110L	+30	+155	30L	0	+195	0L	0	+125	0L	0	+78	0L	-10	+68	10T	-30	+95	30T	-78	0	78T	-125	0	125T
					395L			315L			355L			285L			238L			228L			255L			160L			160L
		-79	+47	+106	47L	+13	+72	13L	0	+91	0L	0	+59	0L	0	+36	0L	-4	+32	4T	-13	+46	13T	-36	0	36T	-59	0	59T
					185L			151L			170L			138L			115L			111L			125L			79L			79L
1600	2000	-200	+120	+270	120L	+32	+182	32L	0	+230	0L	0	+150	0L	0	+92	0L	-10	+82	10T	-32	+118	32T	-92	0	92T	-150	0	150T
					470L			382L			430L			350L			292L			282L			318L			200L			200L
		-98	+51	+120	51L	+13	+82	13L	0	+110	0L	0	+69	0L	0	+43	0L	-4	+39	4T	-13	+56	13T	-43	0	43T	-69	0	69T
					218L			180L			208L			167L			141L			137L			154L			98L			98L
2000	2500	-250	+130	+305	130L	+34	+209	34L	0	+280	0L	0	+175	0L	0	+110	0L	-10	+100	10T	-34	+141	34T	-110	0	110T	-175	0	175T
					555L			459L			530L			425L			360L			350L			391L			250L			250L

The tolerances in this table are in conformance with ANSI/ABMA Standard 7 – 1988.

RADIAL BALL, SPHERICAL AND CYLINDRICAL ROLLER BEARINGS *(continued)*

Tolerance and housing bore shown as variance from nominal bearing O.D. All data except nominal dimensions are in ten-thpusands of an inch (5 = 0.0005") and thousandths of a millimeter or micrometer (5 = 0.005mm).

See pages 26 through 31 for actual shaft and housing diameters for normal loading of ABEC-1 and ABEC-3 radial ball bearings and 7000WN Series angular contact ball bearings.

For particular operating conditions of radial ball , spherical and cylindrical roller bearings, see pages 32, 33 and 34.

HOUSING

Bearing O.D.			M6			M7			N6			N7			P6			P7		
Nominal (max.)		Tol. + 0	Housing Bore		Fit	Housing Bore		Fit	Housing Bore		Fit	Housing Bore		Fit	Housing Bore		Fit	Housing Bore		Fit
Over	Incl.	To	min.	max		min.	max		min.	max		min.	max		min.	max		min.	max	
		in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
mm		mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
315	400	-16	-18	-4	18T 12L	-22	0	22T 16L	-24	-10	24T 6L	-29	-6	29T 10L	-34	-20	34T 4T	-39	-16	39T 0T
		-40	-46	-10	46T 30L	-57	0	57T 40L	-62	-26	62T 14L	-73	-16	73T 24L	-87	-51	87T 11T	-98	-41	98T 1T
400	500	-18	-20	-4	20T 14L	-25	0	25T 18L	-26	-11	26T 7L	-31	-7	31T 11L	-37	-22	37T 4T	-43	-18	43T 0T
		-45	-50	-10	50T 35L	-63	0	63T 45L	-67	-27	67T 18L	-80	-17	80T 28L	-95	-55	95T 10T	-108	-45	108T 0T
500	630	-20	-28	-10	28T 10L	-38	-10	38T 10L	-35	-17	35T 3L	-45	-17	45T 3L	-48	-31	48T 11T	-58	-31	58T 11T
		-50	-70	-26	70T 24L	-96	-26	96T 24L	-88	-44	88T 6L	-114	-44	114T 6L	-122	-78	122T 28T	-148	-78	148T 28T
630	800	-30	-31	-12	31T 18L	-43	-12	43T 18L	-39	-20	39T 10L	-51	-20	51T 10L	-54	-35	54T 5T	-66	-35	66T 5T
		-75	-80	-30	80T 45L	-110	-30	110T 45L	-100	-50	100T 25L	-130	-50	130T 25L	-138	-88	138T 13T	-168	-88	168T 13T
800	1000	-39	-35	-13	35T 26L	-49	-13	49T 26L	-44	-22	44T 17L	-57	-22	57T 17L	-61	-39	61T 0T	-75	-39	75T 0T
		-100	-90	-34	90T 66L	-124	-34	124T 66L	-112	-56	112T 44L	-146	-56	146T 44L	-156	-100	156T 0T	-190	-100	190T 0T
1000	1250	-49	-42	-16	42T 33L	-57	-16	57T 33L	-52	-26	52T 23L	-67	-26	67T 23L	-73	-47	73T 2L	-89	-47	89T 2L
		-125	-106	-40	106T 85L	-145	-40	145T 85L	-132	-66	132T 59L	-171	-66	171T 59L	-186	-120	186T 5L	-225	-120	225T 5L
1250	1600	-63	-50	-19	50T 44L	-68	-19	68T 44L	-61	-31	61T 32L	-80	-31	80T 23L	-86	-55	86T 8L	-104	-55	104T 8L
		-160	-126	-48	126T 112L	-173	-48	173T 112L	-156	-78	156T 82L	-203	-78	203T 82L	-218	-140	218T 20L	-265	-140	265T 20L
1600	2000	-79	-59	-23	59T 56L	-82	-23	82T 56L	-72	-36	72T 43L	-95	-36	95T 43L	-103	-67	103T 12L	-126	-67	126T 12L
		-200	-150	-58	150T 142L	-208	-58	208T 142L	-184	-92	184T 108L	-242	-92	242T 108L	-262	-170	262T 30L	-320	-170	320T 30L
2000	2500	-98	-70	-27	70 71L	-96	-27	96T 71L	-87	-43	87T 55L	-112	-43	112T 55L	-120	-77	120T 21L	-146	-77	146T 21L
		-250	-178	-68	178T 182L	-243	-68	243T 182L	-220	-110	220T 140L	-285	-110	285T 140L	-305	-195	305T 55L	-370	-195	370T 55L

The tolerances in this table are in conformance with ANSI/ABMA Standard 7 – 1988.

RADIAL BALL BEARINGS

ABEC-1 AND ABEC-3 BALL BEARINGS

Shaft and Housing Fits

The tables on the following pages show information supplemental to and coherent with that found on pages 17 through 25 as applied to ball bearings. Actual shaft and housing diameters are listed for ABEC-1, ABEC-3 and angular contact 7000WN series. These recommendations can be used for most applications having light to normal loads. Shaft and housing fits for wide inner ring ball bearings are found on page 44.

ABEC-7 BALL BEARINGS

Shaft fits;

As a general rule, it is recommended that the shaft size and tolerance for seating ABEC-7 superprecision bearings be the same as the bearing bore thus producing an average line-to-line fit. For larger shaft sizes the average fit increases to a slight interference.

Example:

Bore Size, Inches	Shaft Diameter, Inches	Resultant Mounting Fits, Inches	Average Fit
max. 2.1654	min. 2.1652	.0002 tight	line-to-line
min. 2.1652	max. 2.1654	.0002 loose	

Housing fits;

Under normal conditions of rotating shaft, the outer ring is stationary and should be mounted with a hand push or light tapping fit. Should the housing be the rotating member, the same fundamental considerations apply in mounting the outer race as in the case of an inner ring omunted on a rotating shaft.

As a general rule, the minimum housing bore dimensions for superprecision bearings may be established as the same as the maximum bearing outside diameter. If the bearing O.D. tolerance is .0003 inch, the maximum housing bore should be established as .0003 inch larger than the minimum housing bore dimension.

Example:

Outside Diameter, Inches	Housing Bore, Inches	Resultant Mounting Fits, Inches	Average Fit, Inches
max. 3.5433	min. 3.5433	.0000 tight	.0003 loose
min. 3.5430	max. 3.5436	.0006 loose	

On high-speed applications, it is extremely important that the floating bearing or pair can move axially to compensate for thermal changes. It cannot float laterally if restricted by a tight housing bore or by the radial expansion of the bearing itself. Cases involving unusual conditions should be submitted to the Fafnir Engineering Department for complete recommendations.

It is equally important that all shaft and housing shoulders be absolutely square, and that the faces of the spacers be square and parallel.

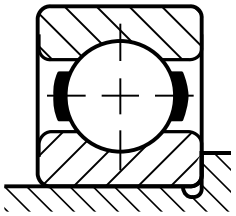
SELECTIVE ASSEMBLY

Under certain conditions it may be desirable to control fits more accurately without the added expense of using closer-tolerence bearings and mating parts. This can be accomplished by selective assembly of bearings, shafts and housings after they have been sized and grouped according to bores and outside diameters. Generally, however, it is more satisfactory for production and servicing to use closer shaft and housing tolerences with bearings having a higher degree of precision.

Bearings with coded bores and O.D.'s are available on special order to facilitate this selective assembly process.

SHAFTS AND HOUSING FILLETS

The recommended shaft and housing fillet radii listed in the dimension tables of the product catalogs should be used to assure proper seating of the bearings against shaft and housing shoulders. The manufacturing tolerences on bearing corner radii are such that the corners will clear the cataloged fillet radii when the bearings are tightly seated against shoulders. Shaft and housing radii and shoulders should be free from nicks and burrs. Whenever possible, undercutting of bearing seats and adjacent shoulders per figure below is advisable to help avoid tapered bearing seats, and assure clearing corners.



FINISH OF SHAFTS AND HOUSINGS

For ABEC-1 bearing applications shaft finish should be 32 micro inches AA maximum regardless of size.

These figures are to be used as a guide only. Special situations may demand better finishes.

RADIAL BALL BEARING

SHAFT FITS, ABEC-1, ABEC-3

NOTE: These tables are to used for applications where only one ring (either inner or outer) has an interference fit with its shaft and housing. The guidelines for operating conditions covering these tables are found on page 32. In cases where interference fits are used for both rings, bearings with a special internal clearance may be required. Shaft diameter dimensions are for solid steel shafts. Consult the Torrington Company when using hollow shafts.

These diameters result in shaft to bearing bore fit which closely conforms to G6 listed on pages 18 and 20.

These diameters result in shaft to bearing bore fit which closely conforms to J5 listed on pages 18 and 20.

SHAFT FITS, ABEC-1, ABEC-3

Basic Bearing Number	Bore Tolerance				Shaft Rotating, Load Stationary or Shaft Stationary, Load Rotating								Shaft Stationary, Load Stationary or Shaft Rotating, Load Rotating							
	max.		min.		shaftdiameter max.		min.		mean fit tight ABEC-1		ABEC-3		shaft diameter max.		min.		mean fit loose ABEC-1		ABEC-3	
	in.	mm	in	mm	in.	mm	in	mm	in.	mm	in.	mm	in.	mm	in	mm	in.	mm	in.	mm
EXTRA-SMALL 30, S, F-FLANGED SERIES																				
33K3, F33K3	0.1250	3.175	0.1247	3.167	0.1252	3.180	0.1250	3.175	0.00025	0.006	0.00020	0.005	0.1248	3.170	0.1245	3.162	0.00020	0.005	0.00025	0.006
33K4	0.1250	3.175	0.1247	3.167	0.1252	3.180	0.1250	3.175	0.00025	0.006	0.00020	0.005	0.1248	3.170	0.1245	3.162	0.00020	0.005	0.00025	0.006
33K5	0.1875	4.762	0.1872	3.754	0.1877	4.768	0.1875	4.762	0.00025	0.006	0.00020	0.005	0.1873	4.752	0.1870	4.750	0.00020	0.005	0.00025	0.006
34K	0.1575	4.000	0.1572	3.992	0.1577	4.006	0.1575	4.001	0.00025	0.006	0.00020	0.005	0.1573	3.995	0.1570	3.988	0.00020	0.005	0.00025	0.006
35K	0.1969	5.000	0.1966	4.992	0.1971	5.006	0.1969	5.001	0.00025	0.006	0.00020	0.005	0.1967	4.996	0.1964	4.989	0.00020	0.005	0.00025	0.006
36K	0.2362	6.000	0.2359	5.992	0.2364	6.005	0.2362	5.999	0.00025	0.006	0.00020	0.005	0.2360	5.994	0.2357	5.987	0.00020	0.005	0.00025	0.006
37K	0.2756	7.000	0.2753	6.992	0.2758	7.005	0.2755	6.998	0.00020	0.005	0.00015	0.004	0.2754	6.995	0.2750	6.985	0.00025	0.006	0.00030	0.008
38K,38KV	0.3150	8.000	0.3147	7.992	0.3152	8.006	0.3149	7.998	0.00020	0.005	0.00015	0.004	0.3148	7.996	0.3144	7.986	0.00025	0.006	0.00030	0.008
39K	0.3543	9.000	0.3540	8.992	0.3545	9.004	0.3542	8.997	0.00020	0.005	0.00015	0.004	0.3541	8.994	0.3537	8.984	0.00025	0.006	0.00030	0.008
S1K,S1K7,FS1K7	0.2500	6.350	0.2497	6.342	0.2502	6.355	0.2499	6.347	0.00020	0.005	0.00015	0.004	0.2498	6.345	0.2494	6.335	0.00025	0.006	0.00030	0.008
S3K,FS3K	0.3750	9.525	0.3747	9.517	0.3752	9.530	0.3749	9.522	0.00020	0.005	0.00015	0.004	0.3748	9.520	0.3744	9.510	0.00025	0.006	0.00030	0.008
S5K	0.5000	12.700	0.4997	12.692	0.5002	12.705	0.4999	12.697	0.00020	0.005	0.00015	0.004	0.4998	12.695	0.4993	12.682	0.00030	0.008	0.00035	0.009
S7K	0.6250	15.875	0.6247	15.867	0.6252	15.880	0.6249	15.872	0.00020	0.005	0.00015	0.004	0.6248	15.870	0.6243	15.857	0.00030	0.008	0.00035	0.009
S8K	0.7500	19.050	0.7496	19.040	0.7504	19.060	0.7501	19.053	0.00045	0.011	0.00035	0.009	0.7497	19.042	0.7492	19.030	0.00035	0.009	0.00045	0.011
S9K	0.8750	22.225	0.8746	22.215	0.8754	22.235	0.8751	22.228	0.00045	0.011	0.00035	0.009	0.8747	22.217	0.8742	22.205	0.00035	0.009	0.00045	0.011
S10K	1.0000	25.400	0.9996	25.390	1.0004	25.410	1.0001	25.403	0.00045	0.011	0.00035	0.009	0.9997	25.392	0.9992	25.380	0.00035	0.009	0.00045	0.011
S11K	1.1250	28.575	1.1246	28.565	1.1254	28.585	1.1251	28.578	0.00045	0.011	0.00035	0.009	1.1247	28.567	1.1242	28.555	0.00035	0.009	0.00045	0.011
S12K	1.2500	31.750	1.2495	31.737	1.2505	31.763	1.2501	31.753	0.00055	0.014	0.00045	0.011	1.2496	31.740	1.2490	31.725	0.00045	0.011	0.00055	0.014
F2DD-2	0.1253	3.183	0.1250	3.175	0.1250	3.175	0.1247	3.167	0.00030	0.008	0.00025	0.006	0.1250	3.175	0.1247	3.167	0.00030	0.008	0.00025	0.006
F2	0.1878	4.770	0.1875	4.762	0.1875	4.762	0.1872	4.755	0.00030	0.008	0.00025	0.006	0.1875	4.762	0.1872	4.755	0.00030	0.008	0.00025	0.006
F3	0.1878	4.770	0.1875	4.762	0.1875	4.762	0.1872	4.755	0.00030	0.008	0.00025	0.006	0.1875	4.762	0.1872	4.755	0.00030	0.008	0.00025	0.006
F4	0.2503	6.358	0.2500	6.350	0.2500	6.350	0.2497	6.342	0.00030	0.008	0.00025	0.006	0.2500	6.350	0.2497	6.342	0.00030	0.008	0.00025	0.006
F5	0.3128	7.946	0.3125	7.938	0.3125	7.938	0.3122	7.930	0.00030	0.008	0.00025	0.006	0.3125	7.938	0.3122	7.930	0.00030	0.008	0.00025	0.006

[(1)]Mean fit loose. These sizes have plus bore tolerances.

RADIAL BALL BEARING

SHAFT FITS, ABEC-1, ABEC-3

NOTE: These tables are to used for applications where only one ring (either inner or outer) has an interference fit with its shaft and housing. The guidelines for operating conditions covering these tables are found on page 32. In cases where interference fits are used for both rings, bearings with a special internal clearance may be required. Shaft diameter dimensions are for solid steel shafts. Consult the Torrington Company when using hollow shafts.

SHAFT FITS, ABEC-1, ABEC-3

These diameters result in shaft to bearing bore fit which closely conforms to G6 listed on pages 18 and 20.

These diameters result in shaft to bearing bore fit which closely conforms to J5 listed on pages 18 and 20.

Basic Bearing Number	Bore Tolerance max.		Bore Tolerance min.		Shaft Rotating, Load Stationary or Shaft Stationary, Load Rotating: shaft diameter max.		shaft diameter min.		mean fit tight ABEC-1		mean fit tight ABEC-3		Shaft Stationary, Load Stationary or Shaft Rotating, Load Rotating: shaft diameter max.		shaft diameter min.		mean fit loose ABEC-1		mean fit loose ABEC-3	
	in.	mm	in	mm	in.	mm	in	mm	in.	mm	in.	mm	in.	mm	in	mm	in.	mm	in.	mm
9100, 9300, 200, 300, 5200, 5300 SERIES																				
00	0.3937	10	0.3934	9.992	0.3939	10.005	0.3936	9.997	0.0002	0.005	0.00015	0.004	0.3935	9.995	0.3931	9.985	0.00025	0.006	0.00030	0.008
01	0.4724	12	0.4721	11.992	0.4726	12.004	0.4723	11.996	0.0002	0.005	0.00015	0.004	0.4722	11.994	0.4717	11.981	0.00030	0.008	0.00035	0.009
02	0.5906	15	0.5903	14.992	0.5908	15.006	0.5905	14.999	0.0002	0.005	0.00015	0.004	0.5904	14.996	0.5899	14.983	0.00030	0.008	0.00035	0.009
03	0.6693	17	0.6690	16.992	0.6695	17.005	0.6692	16.998	0.0002	0.005	0.00015	0.004	0.6691	16.995	0.6686	16.982	0.00030	0.008	0.00035	0.009
04	0.7874	20	0.7870	19.990	0.7879	20.010	0.7875	20.002	0.0005	0.013	0.00035	0.009	0.7871	19.992	0.7866	19.980	0.00035	0.009	0.00045	0.011
05	0.9843	25	0.9839	24.990	0.9848	25.014	0.9844	25.004	0.0005	0.013	0.00035	0.009	0.9840	24.994	0.9835	24.981	0.00035	0.009	0.00045	0.011
06	1.1811	30	1.1807	29.990	1.1816	30.010	1.1812	30.002	0.0005	0.013	0.00035	0.009	1.1808	29.992	1.1803	29.980	0.00035	0.009	0.00045	0.011
07	1.378	35	1.3775	34.987	1.3785	35.014	1.3781	35.004	0.0006	0.014	0.00045	0.011	1.3776	34.991	1.3770	34.976	0.00045	0.011	0.00055	0.014
08	1.5748	40	1.5743	39.987	1.5753	40.013	1.5749	40.002	0.0006	0.014	0.00045	0.011	1.5744	39.990	1.5738	39.975	0.00045	0.011	0.00055	0.014
09	1.7717	45	1.7712	44.987	1.7722	45.014	1.7718	45.004	0.0006	0.014	0.00045	0.011	1.7713	44.991	1.7707	44.976	0.00045	0.011	0.00055	0.014
10	1.9685	50	1.9680	49.987	1.9690	50.013	1.9686	50.002	0.0006	0.014	0.00045	0.011	1.9681	49.990	1.9675	49.974	0.00045	0.011	0.00055	0.014
11	2.1654	55	2.1648	54.985	2.1660	55.016	2.1655	55.004	0.0007	0.017	0.00055	0.014	2.1650	54.991	2.1643	54.973	0.00045	0.011	0.00055	0.014
12	2.3622	60	2.3616	59.985	2.3628	60.015	2.3623	60.002	0.0007	0.017	0.00055	0.014	2.3618	59.990	2.3611	59.972	0.00045	0.011	0.00055	0.014
13	2.5591	65	2.5585	64.985	2.5597	65.016	2.5592	65.004	0.0007	0.017	0.00055	0.014	2.5587	64.991	2.5580	64.973	0.00045	0.011	0.00055	0.014
14	2.7559	70	2.7553	69.985	2.7565	70.015	2.7560	70.002	0.0007	0.017	0.00055	0.014	2.7555	69.990	2.7548	69.972	0.00045	0.011	0.00055	0.014
15	2.9528	75	2.9552	74.985	2.9534	75.016	2.9529	75.004	0.0007	0.017	0.00055	0.014	2.9524	74.991	2.9517	74.973	0.00045	0.011	0.00055	0.014
16	3.1496	80	3.1490	79.985	3.1502	80.015	3.1497	80.002	0.0007	0.017	0.00055	0.014	3.1492	79.990	3.1485	79.972	0.00045	0.011	0.00055	0.014
17	3.3465	85	3.3457	84.980	3.3472	85.019	3.3466	85.004	0.0008	0.020	0.00065	0.017	3.3460	84.988	3.3452	84.968	0.00050	0.013	0.00065	0.017
18	3.5433	90	3.5425	89.980	3.5440	90.018	3.5434	90.002	0.0008	0.020	0.00065	0.017	3.5428	89.987	3.5420	89.967	0.00050	0.013	0.00065	0.017
19	3.7402	95	3.7394	94.980	3.7409	95.019	3.7403	95.004	0.0008	0.020	0.00065	0.017	3.7397	94.988	3.7389	94.968	0.00050	0.013	0.00065	0.017
20	3.9370	100	3.9362	99.980	3.9377	100.018	3.9371	100.002	0.0008	0.020	0.00065	0.017	3.9365	99.987	3.9357	99.967	0.00050	0.013	0.00065	0.017
21	4.1339	105	4.1331	104.980	4.1346	105.019	4.1340	105.004	0.0008	0.020	0.00065	0.017	4.1334	104.988	4.1326	104.968	0.00050	0.013	0.00065	0.017
22	4.3307	110	4.3299	109.980	4.3314	110.018	4.3308	110.002	0.0008	0.020	0.00065	0.017	4.3302	109.987	4.3294	109.967	0.00050	0.013	0.00065	0.017
EXTRA-LARGE SERIES																				
124, 224, 324	4.7244	120	4.7236	119.980	4.7251	120.018	4.7245	120.002	0.0008	0.020	0.00065	0.017	4.7239	119.987	4.7231	119.967	0.00050	0.013	0.00065	0.017
126, 226, 326	5.1181	130	5.1171	129.975	5.1189	130.020	5.1182	130.002	0.0010	0.024	0.00075	0.019	5.1175	129.984	5.1166	129.962	0.00055	0.014	0.00075	0.019
128, 228, 328	5.5118	140	5.5108	139.975	5.5126	140.020	5.5119	140.002	0.0010	0.024	0.00075	0.019	5.5112	139.984	5.5103	139.962	0.00055	0.014	0.00075	0.019
9130, 130, 230, 330	5.9055	150	5.9045	149.975	5.9063	150.020	5.9056	150.002	0.0010	0.024	0.00075	0.019	5.9049	149.984	5.9040	149.962	0.00055	0.014	0.00075	0.019
9132, 132, 232	6.2992	160	6.2982	159.975	6.3000	160.020	6.2993	160.002	0.0010	0.024	0.00075	0.019	6.2986	159.984	6.2977	159.962	0.00055	0.014	0.00075	0.019
9134, 134, 234	6.6929	170	6.6919	169.975	6.6937	170.020	6.6930	170.002	0.0010	0.024	0.00075	0.019	6.6923	169.984	6.6914	169.962	0.00055	0.014	0.00075	0.019
9136, 136, 236, 336	7.0866	180	7.0856	179.975	7.0874	180.020	7.0867	180.002	0.0010	0.024	0.00075	0.019	7.0860	179.984	7.0851	179.962	0.00055	0.014	0.00075	0.019
9138, 138, 238, 338	7.4803	190	7.4791	189.970	7.4813	190.025	7.4805	190.005	0.0012	0.030	0.00095	0.024	7.4797	189.984	7.4786	189.956	0.00055	0.014	0.00080	0.020
9140, 240, 340	7.8740	200	7.8728	199.969	7.8750	200.025	7.8742	200.005	0.0012	0.030	–	–	7.8734	199.984	7.8722	199.954	0.00060	0.015	–	–
9142, 240, 340	8.2677	210	8.2665	212.509	8.2587	209.771	8.2678	210.002	0.0012	0.030	–	–	8.2672	209.987	8.2658	209.951	0.00060	0.015	–	–
9144, 244, 344	8.6614	220	8.6602	219.969	8.6624	220.025	8.6616	220.005	0.0012	0.030	–	–	8.6608	219.984	8.6596	219.954	0.00060	0.015	–	–
9146, 246	9.0551	230	9.0539	229.969	9.0561	230.025	9.0553	230.005	0.0012	0.030	–	–	9.0545	230.022	9.0533	229.951	0.00060	0.015	–	–
248, 348	9.4488	240	9.4476	239.969	9.4498	240.025	9.4490	240.005	0.0012	0.030	–	–	9.4482	239.984	9.4470	239.954	0.00060	0.015	–	–
250	9.8425	250	9.8411	249.964	9.8434	250.020	9.8426	250.005	0.0012	0.030	–	–	9.8418	250.022	9.8406	249.972	0.00060	0.015	–	–
9152, 252, 352	10.2362	260	10.2348	259.964	10.2373	260.027	10.2364	260.005	0.0014	0.036	–	–	10.2355	259.982	10.2343	259.951	0.00060	0.015	–	–
9156, 256, 356	11.0236	280	11.0222	279.964	11.0247	280.027	11.0238	280.005	0.0014	0.036	–	–	11.0229	279.982	11.0217	279.951	0.00060	0.015	–	–
9160, 260	11.8110	300	11.8096	299.964	11.8121	300.027	11.8112	300.005	0.0014	0.036	–	–	11.8103	299.982	11.8091	299.951	0.00060	0.015	–	–
9164, 264	12.5984	320	12.5970	319.964	12.5996	320.030	12.5986	320.005	0.0015	0.038	–	–	12.5977	319.982	12.5963	319.946	0.00060	0.015	–	–
9180	15.7480	400	15.7464	399.969	15.7492	400.030	15.7482	400.005	0.0015	0.038	–	–	15.7473	399.982	15.7459	399.946	0.00060	0.015	–	–

RADIAL BALL BEARING

SHAFT FITS, 7000 WN

NOTE: These tables are to be used for applications where only one ring (either inner or outer) has an interference fit with its shaft and housing. The guidelines for operating conditions covering these tables are found on page 32. In cases where interference fits are used for both rings, bearings with a special internal clearance may be required. Shaft diameter dimensions are for solid steel shafts. Consult the Torrington Company when using hollow shafts.

SHAFT FITS, 7000 WN
Single Row Angular Contact Bearings

These diameters result in shaft to bearing bore fit which closely conforms to J5 listed on pages 18 and 20.

Bearing Bore Number	Bearing Bore Diameter max.		Bearing Bore Diameter min.		Shaft Rotating, Load Stationary shaft diameter max.		Shaft Rotating, Load Stationary shaft diameter min.		Mean Tight Fit	
	in.	mm	in	mm	in.	mm	in	mm	in.	mm
00	0.3937	10	0.3934	9.992	0.3936	9.997	0.3939	10.005	0.0002	0.005
01	0.4724	12	0.4721	11.991	0.4723	11.996	0.4726	12.004	0.0002	0.005
02	0.5906	15	0.5903	14.994	0.5905	14.999	0.5908	15.006	0.0002	0.005
03	0.6693	17	0.6690	16.993	0.6692	16.998	0.6695	17.005	0.0002	0.005
04	0.7874	20	0.7871	19.992	0.7873	19.997	0.7876	20.005	0.0002	0.005
05	0.9843	25	0.9840	24.994	0.9842	24.999	0.9845	25.006	0.0002	0.005
06	1.1811	30	1.1808	29.992	1.1810	29.997	1.1813	30.005	0.0002	0.005
07	1.3780	35	1.3777	34.994	1.3779	34.999	1.3783	35.009	0.00025	0.006
08	1.5748	40	1.5745	39.992	1.5747	39.997	1.5751	40.008	0.00025	0.006
09	1.7717	45	1.7714	44.994	1.7716	44.999	1.7720	45.009	0.00025	0.006
10	1.9685	50	1.9682	49.992	1.9684	49.997	1.9688	50.008	0.00025	0.006
11	2.1654	55	2.1650	54.991	2.1653	54.999	2.1658	55.011	0.00035	0.009
12	2.3622	60	2.3618	59.990	2.3621	59.997	2.3626	60.010	0.00035	0.009
13	2.5591	65	2.5587	64.991	2.5590	64.999	2.5595	65.011	0.00035	0.009
14	2.7559	70	2.7555	69.990	2.7558	69.997	2.7563	70.010	0.00035	0.009
15	2.9528	75	2.9524	74.991	2.9527	74.999	2.9532	75.011	0.00035	0.009
16	3.1496	80	3.1492	79.990	3.1495	79.997	3.1500	80.010	0.00035	0.009
17	3.3465	85	3.3460	84.988	3.3464	84.999	3.3470	85.014	0.00045	0.011
18	3.5433	90	3.5428	89.987	3.5432	89.997	3.5438	90.013	0.00045	0.011
19	3.7402	95	3.7397	94.988	3.7401	94.999	3.7407	95.014	0.00045	0.011
20	3.9370	100	3.9365	99.987	3.9369	99.997	3.9375	100.013	0.00045	0.011
21	4.1339	105	4.1334	104.988	4.1338	104.999	4.1344	105.014	0.00045	0.011
22	4.3307	110	4.3302	109.987	4.3306	109.997	4.3312	110.012	0.00045	0.011
24	4.7244	120	4.7239	119.987	4.7243	119.997	4.7249	120.012	0.00045	0.011
26	5.1181	130	5.1174	129.982	5.1180	129.997	5.1187	130.015	0.0006	0.015
28	5.5118	140	5.5111	139.982	5.5117	139.997	5.5124	140.015	0.0006	0.015
30	5.9055	150	5.9048	149.982	5.9054	149.997	5.9061	150.015	0.0006	0.015

RADIAL BALL BEARING

HOUSING FITS, ABEC-1, ABEC-3

NOTE: These tables are to used for applications where only one ring (either inner or outer) has an interference fit with its shaft and housing. The guidelines for operating conditions covering these tables are found on page 32. In cases where interference fits are used for both rings, bearings with a special internal clearance may be required. Shaft diameter dimensions are for solid steel shafts. Consult the Torrington Company when using hollow shafts.

HOUSING FITS, ABEC-1, ABEC-3

These diameters result in a bearing O.D. to to housing bore fit which closely conforms to H6 listed on pages 22 and 24.

These diameters result in a bearing O.D. housing bore fit which closely conforms to M7 listed on pages 23 and 25.

Basic Bearing Number					Housing Stationary, Load Stationary or Housing Rotating, Load Rotating								Housing Rotating, Load Stationary or Housing Stationary, Load Rotating							
					Housing Bore,				Mean Fit Loose				Housing Bore,				Mean Fit Tight			
Extra Small	Extra Light	Light	Medium	Heavy	minimum		maximum		ABEC–1		ABEC–3		minimum		maximum		ABEC–1		ABEC–3	
30, S, F SERIES	9100, 9300 SERIES	200, 7200 SERIES	300, 7300 SERIES	7400 SERIES	in.	mm	in	mm	in.	mm	in.	mm	in.	mm	in	mm	in.	mm	in.	mm
33K3, F33K3	–	–	–	–	0.3750	9.525	0.3754	9.535	0.00040	0.010	0.00035	0.009	0.3743	9.507	0.3750	9.525	0.00015	0.004	0.00020	0.005
33K4	–	–	–	–	0.5000	12.700	0.5004	12.710	0.00040	0.010	0.00035	0.009	0.4993	12.682	0.5000	12.700	0.00015	0.004	0.00020	0.005
33K5, F33K5	–	–	–	–	0.5000	12.700	0.5004	12.710	0.00040	0.010	0.00035	0.009	0.4993	12.682	0.5000	12.700	0.00015	0.004	0.00020	0.005
34K	–	–	–	–	0.6299	15.999	0.6303	16.010	0.00040	0.010	0.00035	0.009	0.6292	15.982	0.6299	15.999	0.00015	0.004	0.00020	0.005
35K	–	–	–	–	0.7480	18.999	0.7485	19.012	0.00045	0.011	0.00040	0.010	0.7472	18.979	0.7480	18.999	0.00020	0.005	0.00025	0.006
36K	–	–	–	–	0.7480	18.999	0.7485	19.012	0.00045	0.011	0.00040	0.010	0.7472	18.979	0.7480	18.999	0.00020	0.005	0.00025	0.006
37K	–	–	–	–	0.8661	21.999	0.8666	22.012	0.00045	0.011	0.00040	0.010	0.8653	21.979	0.8661	29.999	0.00020	0.005	0.00025	0.006
38K	–	–	–	–	0.8661	21.999	0.8666	22.012	0.00045	0.011	0.00040	0.010	0.8653	21.979	0.8661	21.999	0.00020	0.005	0.00025	0.006
38KV	–	–	–	–	0.9449	24.000	0.9454	24.013	0.00045	0.011	0.00040	0.010	0.9441	23.980	0.9449	24.000	0.00020	0.005	0.00025	0.006
39K	**9100**	–	–	–	1.0236	25.999	1.0241	26.012	0.00045	0.011	0.00040	0.010	1.0228	25.979	1.0236	25.999	0.00020	0.005	0.00025	0.006
S1K7, FS1K7	–	–	–	–	0.6250	15.875	0.6254	15.885	0.00040	0.010	0.00035	0.009	0.6243	15.857	0.6250	15.875	0.00015	0.004	0.00020	0.005
S1K	–	–	–	–	0.7500	19.050	0.7505	19.063	0.00045	0.011	0.00040	0.010	0.7492	19.030	0.7500	19.050	0.00020	0.005	0.00025	0.006
S3K, FS3K	–	–	–	–	0.8750	22.225	0.8755	22.238	0.00045	0.011	0.00040	0.010	0.8742	22.205	0.8750	22.225	0.00020	0.005	0.00025	0.006
S5K	–	–	–	–	1.1250	28.575	1.1255	28.588	0.00045	0.011	0.00040	0.010	1.1242	28.555	1.1250	28.575	0.00020	0.005	0.00025	0.006
S7K	–	–	–	–	1.3750	34.925	1.3756	34.940	0.00055	0.014	0.00045	0.011	1.3740	34.900	1.3750	34.925	0.00025	0.006	0.00035	0.009
S8K	–	–	–	–	1.6250	41.275	1.6256	41.290	0.00055	0.014	0.00045	0.011	1.6240	41.250	1.6250	41.275	0.00025	0.006	0.00035	0.009
S9K	–	–	–	–	1.8750	47.625	1.8756	47.640	0.00055	0.014	0.00045	0.011	1.8740	47.600	1.8750	47.625	0.00025	0.006	0.00035	0.009
S10K	–	–	–	–	2.0000	50.800	2.0007	50.818	0.00060	0.015	0.00055	0.014	1.9988	50.770	2.0000	50.800	0.00035	0.009	0.00040	0.010
S11K	–	–	–	–	2.1250	53.975	2.1257	53.993	0.00060	0.015	0.00055	0.014	2.1238	53.945	2.1250	53.975	0.00035	0.009	0.00040	0.010
S12K	–	–	–	–	2.2500	57.150	2.2507	57.168	0.00060	0.015	0.00055	0.014	2.2488	57.120	2.2500	57.150	0.00035	0.009	0.00040	0.010
F2002	–	–	–	–	0.3750	9.525	0.3753	9.533	0.00000	0.000	0.00000	0.000	0.3749	9.522	0.3753	9.533	0.00000	0.000	0.00000	0.000
F2	–	–	–	–	0.4375	11.112	0.4378	11.120	0.00000	0.000	0.00000	0.000	0.4374	11.110	0.4378	11.120	0.00000	0.000	0.00000	0.000
F3	–	–	–	–	0.5624	14.285	0.5628	14.295	0.00000	0.000	0.00000	0.000	0.5624	14.285	0.5628	14.295	0.00000	0.000	0.00000	0.000
F4	–	–	–	–	0.6249	15.872	0.6253	15.883	0.00000	0.000	0.00000	0.000	0.6249	15.872	0.6253	15.883	0.00000	0.000	0.00000	0.000
F5	–	–	–	–	0.6874	17.460	0.6878	17.470	0.00000	0.000	0.00000	0.000	0.6874	17.460	0.6878	17.476	0.00000	0.000	0.00000	0.000
–	**9101, 9302**	–	–	–	1.1024	28.001	1.1029	28.014	0.00045	0.011	0.00040	0.010	1.1016	27.981	1.1024	28.001	0.00020	0.005	0.00025	0.006
–	**9303**	**200**	–	–	1.1811	30.000	1.1816	30.013	0.00045	0.011	0.00040	0.010	1.1803	29.980	1.1811	39.000	0.00020	0.005	0.00025	0.006
–	**9102**	**201**	–	–	1.2598	31.999	1.2604	32.014	0.00055	0.014	0.00045	0.011	1.2588	31.974	1.2598	31.999	0.00025	0.006	0.00035	0.009
–	**9103**	**202**	**300**	–	1.3780	35.001	1.3786	35.016	0.00055	0.014	0.00045	0.011	1.3770	34.976	1.3780	35.001	0.00025	0.006	0.00035	0.009
–	**9304**	–	**301**	–	1.4567	37.000	1.4573	37.015	0.00055	0.014	0.00045	0.011	1.4557	36.975	1.4567	37.000	0.00025	0.006	0.00035	0.009
–	–	**203**	–	–	1.5748	40.000	1.5754	40.015	0.00055	0.014	0.00045	0.011	1.5738	39.975	1.5748	40.000	0.00025	0.006	0.00035	0.009
–	**9104, 9305**	–	**302**	–	1.6535	41.999	1.6541	42.014	0.00055	0.014	0.00045	0.011	1.6525	41.974	1.6535	41.999	0.00025	0.006	0.00035	0.009
–	**9105, 9306**	**204**	**303**	–	1.8504	47.000	1.8510	47.015	0.00055	0.014	0.00045	0.011	1.8494	46.975	1.8504	47.000	0.00025	0.006	0.00035	0.009
–	–	**205**	**304**	–	2.0472	51.999	2.0479	52.017	0.00060	0.015	0.00055	0.014	2.0460	51.968	2.0472	51.999	0.00035	0.009	0.00040	0.010
–	**9106, 9307**	–	–	–	2.1654	55.001	2.1661	55.019	0.00060	0.015	0.00055	0.014	2.1642	54.971	2.1654	55.001	0.00035	0.009	0.00040	0.010
–	**9107, 9308**	**206**	**305**	**403**	2.4409	61.999	2.4416	62.017	0.00060	0.015	0.00055	0.014	2.4397	61.968	2.4409	61.999	0.00030	0.009	0.00040	0.010
–	**9108**	–	–	–	2.6772	68.001	2.6779	68.019	0.00060	0.015	0.00055	0.014	2.6760	67.970	2.6772	68.001	0.00030	0.009	0.00040	0.010
–	**9310**	**207**	**306**	**404**	2.8346	71.999	2.8353	72.017	0.00060	0.015	0.00055	0.014	2.8334	71.968	2.8346	71.999	0.00030	0.009	0.00040	0.010
–	**9109**	–	–	–	2.9528	75.001	2.9535	75.019	0.00060	0.015	0.00055	0.014	2.9516	74.971	2.9528	75.001	0.00030	0.009	0.00040	0.010
–	**9110**	**208**	**307**	**405**	3.1496	80.000	3.1503	80.018	0.00060	0.015	0.00055	0.014	3.1484	79.969	3.1496	80.000	0.00030	0.009	0.00040	0.010
–	**9312**	**209**	–	–	3.3456	85.001	3.3474	85.024	0.00080	0.019	0.00065	0.017	3.3451	84.966	3.3465	85.001	0.00040	0.010	0.00050	0.013
–	**9111**	**210**	**308**	**406**	3.5433	90.000	3.5442	90.023	0.00080	0.019	0.00065	0.017	3.5419	89.964	3.5433	90.000	0.00040	0.010	0.00050	0.013
–	**9112**	–	–	–	3.7402	95.001	3.7411	120.424	0.00080	0.019	0.00065	0.017	3.7388	94.965	3.7402	95.001	0.00040	0.010	0.00050	0.013
–	**9113**	**211**	**309**	**407**	3.9370	100.000	3.9379	100.023	0.00080	0.019	0.00065	0.017	3.9356	99.964	3.9370	100.000	0.00040	0.010	0.00050	0.013
–	**9114**	**212**	**310**	**408**	4.3307	110.000	4.3316	110.023	0.00080	0.019	0.00065	0.017	4.3293	109.964	4.3307	110.000	0.00040	0.010	0.00050	0.013

RADIAL BALL BEARING

HOUSING FITS, ABEC-1, ABEC-3

NOTE: These tables are to used for applications where only one ring (either inner or outer) has an interference fit with its shaft and housing. The guidelines for operating conditions covering these tables are found on page 32. In cases where interference fits are used for both rings, bearings with a special internal clearance may be required. Shaft diameter dimensions are for solid steel shafts. Consult the Torrington Company when using hollow shafts.

These diameters result in a bearing O.D. to housing bore fit which closely conforms to H6 listed on pages 22 and 24.

These diameters result in a bearing O.D. to housing bore fit which closely conforms to M7 listed on pages 23 and 25.

HOUSING FITS, ABEC-1, ABEC-3

Basic Bearing Number					Housing Stationary, LoadStationary or Housing Rotating, Load Rotating								Housing Rotating, Load Stationary or Housing Stationary, Load Rotating							
					Housing Bore				mean fit loose				Housing Bore				mean fit tight			
Extra Small	Extra Light	Light	Medium	Heavy	minimum		maximum		ABEC–1		ABEC–3		minimum		maximum		ABEC–1		ABEC–3	
30,S,F SERIES	9100,9300 SERIES	200,7200 SERIES	300,7300 SERIES	7400 SERIES	in.	mm	in	mm	in.	mm	in.	mm	in.	mm	in	mm	in.	mm	in.	mm
–	**9115**	–	–	–	4.5276	115.001	4.5285	115.024	0.0008	0.019	0.00065	0.017	4.5262	114.965	4.5276	115.001	0.0004	0.010	0.00050	0.013
–	–	**213**	**311**	**409**	4.7244	120.000	4.7253	120.023	0.0008	0.019	0.00065	0.017	4.7230	119.964	4.7244	120.000	0.0004	0.010	0.00050	0.013
–	–	**214**	–	–	4.9213	125.001	4.9223	125.026	0.0009	0.023	0.00075	0.019	4.9197	124.960	4.9213	125.001	0.0004	0.010	0.00055	0.014
–	**9117**	**215**	**312**	**410**	5.1181	130.000	5.1191	130.025	0.0009	0.023	0.00075	0.019	5.1165	129.959	5.1181	130.000	0.0004	0.010	0.00055	0.014
–	**9118**	**216**	**313**	**411**	5.5118	140.000	5.5128	140.025	0.0009	0.023	0.00075	0.019	5.5102	139.959	5.5118	140.000	0.0004	0.010	0.00055	0.014
–	**9120**	**217**	**314**	**412**	5.9055	150.000	5.9065	150.025	0.0009	0.023	0.00075	0.019	5.9039	149.959	5.9055	150.000	0.0004	0.010	0.00055	0.014
–	**120–2**	**218**	**315**	–	6.2992	160.000	6.3002	160.025	0.0010	0.025	0.00080	0.020	6.2976	159.959	6.2992	160.000	0.0003	0.008	0.00050	0.013
–	**9121**	–	–	**413**	6.2992	160.000	6.3002	160.025	0.0010	0.025	0.00080	0.020	6.2976	159.959	6.2992	160.000	0.0003	0.008	0.00050	0.013
–	**9122**	**129**	**316**	–	6.6929	170.000	6.6939	170.025	0.0010	0.025	0.00080	0.020	6.6913	169.959	6.6929	170.000	0.0003	0.008	0.00050	0.013
–	**122**	–	–	–	6.8898	175.000	6.8908	175.026	0.0010	0.025	0.00080	0.020	6.8882	174.960	6.8898	175.001	0.0003	0.008	0.00050	0.013
–	**9124**	**220**	**317**	**414**	7.0866	180.000	7.0876	180.025	0.0010	0.025	0.00080	0.020	7.0850	179.959	7.0866	180.000	0.0003	0.008	0.00050	0.013
–	**124**	**221**	**318**	**415**	7.4803	190.000	7.4815	190.028	0.0012	0.029	0.00090	0.023	7.4785	189.954	7.4803	190.000	0.0003	0.008	0.00055	0.014
–	**9126**	**222**	**319**	**416**	7.8740	200.000	7.8752	200.028	0.0012	0.029	0.00090	0.023	7.8722	199.954	7.8740	200.000	0.0003	0.008	0.00055	0.014
–	**126**	–	–	–	8.0709	205.001	8.0721	205.029	0.0012	0.029	0.00090	0.023	8.0691	204.955	8.0709	205.001	0.0003	0.008	0.00055	0.014
–	**9128**	–	–	–	8.2677	210.000	8.2689	210.028	0.0012	0.029	0.00090	0.023	8.2659	209.954	8.2677	210.000	0.0003	0.008	0.00055	0.014
–	–	**224**	**320**	–	8.4646	215.001	8.4658	215.029	0.0012	0.029	0.00090	0.023	8.4628	214.955	8.4646	215.001	0.0003	0.008	0.00055	0.014
–	**128**	–	–	–	8.6614	220.000	8.6626	220.028	0.0012	0.029	0.00090	0.023	8.6596	219.954	8.6614	220.000	0.0003	0.008	0.00055	0.014
–	**9130**	–	**321**	**418**	8.8583	225.001	8.8595	225.029	0.0012	0.029	0.00090	0.023	8.8565	224.955	8.8583	225.001	0.0003	0.008	0.00055	0.014
–	–	**226**	–	–	9.0551	230.000	9.0563	230.027	0.0012	0.029	0.00090	0.023	9.0533	229.954	9.0551	230.000	0.0003	0.008	0.00055	0.014
–	**130**	–	–	–	9.2520	235.001	9.2532	235.029	0.0012	0.029	0.00090	0.023	9.2502	234.955	9.2520	235.001	0.0003	0.008	0.00055	0.014
–	**9132**	–	**322**	–	9.4488	240.000	9.4506	240.027	0.0012	0.029	0.00090	0.023	9.4470	239.954	9.4488	240.000	0.0003	0.008	0.00055	0.014
–	**132**	**228**	–	–	9.8425	250.000	9.8437	250.027	0.0012	0.029	0.00090	0.023	9.8407	249.954	9.8425	250.000	0.0003	0.008	0.00055	0.014
–	**9134**	–	**324**	–	10.2362	259.999	10.2374	260.032	0.0013	0.033	0.00105	0.027	10.2342	259.942	10.2362	259.999	0.0003	0.008	0.00060	0.015
–	**134**	–	–	**420**	10.4331	265.001	10.4343	265.034	0.0013	0.033	0.00105	0.027	10.4311	264.950	10.4331	265.001	0.0003	0.008	0.00060	0.015
–	–	**230**	–	–	10.6299	269.999	10.6311	270.032	0.0013	0.033	0.00105	0.027	10.6279	269.949	10.6299	269.999	0.0003	0.008	0.00060	0.015
–	**136,9136**	–	**326**	–	11.0236	279.999	11.0248	280.032	0.0013	0.033	0.00105	0.027	11.0216	279.949	11.0236	279.999	0.0003	0.008	0.00060	0.015
–	**9138**	**232**	–	–	11.4173	289.999	11.4185	290.039	0.0013	0.033	0.00105	0.027	11.4153	289.949	11.4173	289.999	0.0003	0.008	0.00060	0.015
–	**138**	–	**328**	–	11.8110	299.999	11.8122	300.032	0.0013	0.033	0.00105	0.027	11.8090	299.949	11.8110	299.999	0.0003	0.008	0.00060	0.015
–	**9140**	**234**	–	–	12.2047	309.999	12.2059	310.029	0.0013	0.033	–	–	12.2027	309.949	12.2047	309.999	0.0003	0.008	–	–
–	–	**236**	**330**	–	12.5984	319.999	12.5998	320.035	0.0015	0.038	–	–	12.5962	319.943	12.5984	319.999	0.0003	0.008	–	–
–	**9144**	**238**	–	–	13.3858	339.999	13.3872	340.035	0.0015	0.038	–	–	13.3836	339.943	13.3858	339.999	0.0003	0.008	–	–
–	**9146**	**240**	–	–	14.1732	359.999	14.1746	360.035	0.0015	0.038	–	–	14.1710	359.943	14.1732	359.999	0.0003	0.008	–	–
–	–	**242**	**336**	–	14.9606	380.007	14.9620	380.035	0.0015	0.038	–	–	14.9584	379.943	14.9606	379.999	0.0003	0.008	–	–
–	**9152**	**244**	**338**	–	15.7480	399.999	15.7494	400.035	0.0015	0.038	–	–	15.7458	399.943	15.7480	399.999	0.0003	0.008	–	–
–	**9156**	**246**	**340**	–	16.5354	419.999	16.5370	420.040	0.0017	0.038	–	–	16.5329	419.936	16.5354	419.999	0.0004	0.010	–	–
–	–	**248**	**342**	–	17.3228	439.999	17.3244	440.040	0.0017	0.038	–	–	17.3203	439.936	17.3228	439.999	0.0004	0.010	–	–
–	**9160**	**250**	**344**	–	18.1102	459.999	18.1118	460.040	0.0017	0.038	–	–	18.1077	459.936	18.1102	459.999	0.0004	0.010	–	–
–	**9164**	**252**	–	–	18.8976	479.999	18.8992	480.040	0.0017	0.038	–	–	18.8951	479.936	18.8976	479.999	0.0004	0.010	–	–
–	–	**256**	**348**	–	19.6850	499.999	19.6866	500.040	0.0017	0.038	–	–	19.6825	499.936	19.6850	499.999	0.0004	0.010	–	–
–	–	**260**	**352**	–	21.2598	539.999	21.2615	540.042	0.0019	0.048	–	–	21.2571	539.930	21.2598	539.999	0.0004	0.010	–	–
–	–	**264**	**356**	–	22.8346	579.999	22.8363	580.042	0.0019	0.048	–	–	22.8319	579.930	22.8346	579.999	0.0004	0.010	–	–
–	**9180**	–	–	–	23.6220	599.999	23.6237	600.042	0.0019	0.048	–	–	23.6193	599.930	23.6220	599.999	0.0004	0.010	–	–

RADIAL BALL AND CYLINDRICAL ROLLER BEARINGS

These charts are guidelines for specifying shaft and housing fits related to particular operating conditions.

SHAFT

Ball Bearings (For all nominal diameters)			Operating Conditions	Examples	Cylindrical Roller Bearings (Except 5200 Series)						
Loads		Shaft			Loads		Shaft Diameter mm		Shaft Tolerance Symbol	Shaft Diameter inch	
Lower Load Limit	Upper Load Limit	Tolerance Symbol			Lower Load Limit	Upper Load Limit					
INNER RING STATIONARY											
0	C_e [7]	**g6**	Inner ring to be easily dislaced on shaft	Wheels Non-rotating shafts	0	C[6]	All	g6	All		
0	C_e	**h6**	Inner ring does not need to be easily displaced	Tension pulleys	0	C	All	h6	All		
INNER RING ROTATING, OR UNDETERMINATE											
0	0.07C_e	**j6**	Light loads	Electrical apparatus Machine tools Pumps Ventilators Industrial trucks	0	0.08C	100 140 320 500	140 320 500 –	k6[4] m6[5] n6 p6	3.94 5.51 12.60 19.68	5.51 12.60 19.68 –
0.07C_e	0.15C_e	**k5**	Normal loads	Electrical motors Turbines Pumps Combustion engines Gear transmissions etc.	0.08C	a 0.18C	100 140 320 500 100	140 320 500 – 140	m6 n6 p6 r6 n6[3]	3.94 5.51 12.60 19.68 3.94	5.51 12.60 19.68 – 5.51
0.15C_e	C_e	**m5**	Heavy loads Shock loads	Rail vehicles Traction motors	0.18C	140 C	320 320 500	p6[3] 500 –	5.51 r6[3] r7[3]	12.60 12.60 19.68	 19.68 –
THRUST LOADS											
0	C_e	**j6**[3]	Pure thrust loads	All	Not recommended, consult Torrington sales office.						

[1] For solid shaft. See pages 18, 19, 20, and 21 for numerical values.
[2] Use j5 for accurate applications.
[3] Bearings with greater than nominal clearance must be used.
[4] Use k5 for accurate applications.
[5] Use m5 for accurate applications.
[6] C = Dynamic Load Rating.
[7] C_e = Extended Dynamic Load Rating (Ball Bearings).

HOUSING

Operating Conditions		Examples Tolerence Symbol[1]	Housing Displaceable Axially	Outer Ring
OUTER RING ROTATING				
Heavy loads with thin-wall housing		Crane support wheels Wheel hubs (roller bearings) Crank bearings	P6	No
Normal to heavy loads		Wheel hubs (ball bearings) Crank bearings	N6	No
Light loads		Conveyor rollers Rope sheaves Tension pulleys	M6	No
INDETERMINATE LOAD DIRECTION				
Heavy shock loads		Electric traction motors	M7	No
Normal to heavy loads, axial displacement of outer ring not required.		Electric motors Pumps Crankshaft main bearings	K6	no, normally
Light to normal loads, axial displacement of outer ring desired.		Electric motors Pumps Crankshaft main bearings	J6	Yes, normally
OUTER RING STATIONARY				
Shock loads, temporary complete unloading		Heavy rail vehicles	J6	Yes, normally
All loads	One-piece housing	General applications Heavy rail vehicles	H6	Easily
	Radially split housing	Transmission drives	H7	Easily
Heat supplied through shaft		Drier cylinders	G7	Easily

* Below this line, housing can either be one – piece or split; above this line, a split housing is not recommended.

[1] Cast iron steel housing. See pages 22,23, 24 and 25 for numerical values.
Where wider tolerances are permissible, P7, N7, M7, K7, J7 and H7 values may be used in place of P6, N6, M6, K6, J6, and H6 values respectively.

RADIAL SPHERICAL ROLLER BEARINGS

These charts are guidelines for specifying shaft and housing fits related to particular operating conditions.

SHAFT

	Conditions	Examples	Shaft Diameter mm		Tolerance Symbol	Remarks
BEARINGS WITH STRAIGHT BORE						
Stationary inner ring load	The inner ring to be easily displaced on the shaft	Two-bearing shaft mechanism	All diameters		**s4**	See table below for shaft size.
	The inner ring not to be easily displaced on the shaft	Wheel on non-rotating shaft			**g6**	
		Tension pulleys and rope sheaves			**h6**	
Rotating inner ring load or indeterminate load direction	Light and variable loads P ≤ 0.07C	Electrical apparatus, machine tools, pumps, ventilators, industrial trucks	Over 18	Incl. 100	**k6**	In very accurate applications k5 and m5 are used instead of k6 and m6 respectively.
			100	200	**m6**	
	Normal and heavy loads P > 0.07C ≤ 0.25C	Applications in general, electrical motors, turbines, pumps, combustion engines, gear transmissions, woodworking machines	18	65	**m5**	
			65	100	**m6**	
			100	140	**n6**	
			140	280	**p6**	
			280	500	**r6**	
			500	and up	**r7**	
	Very heavy loads and shock loads P > 0.25C	Journal boxes for locomotives and other heavy rail vehicles, traction motors	18	65	**m6**	
			65	100	**n6**	Bearings with greater clearance than normal must be used.
			100	140	**p6**	
			140	200	**r6**	
			200	500	**r7**	
BEARINGS WITH TAPERED BORE ANDADAPTER SLEEVE						
	All loads	Applications in general	All diameters			See tables for Reduction of RIC on page 10

[1]For solid steel shaft. See tables on pages 18, 19, 20, and 21 for numerical value.

s4 FITS

A centrifugal force load produces a rotating outer ring load and a stationary inner ring load, even though the inner ring rotates. This makes it desirable to fit the outer ring tight in the housing (using a P6 fit as shown on page 24), and the inner ring loose on the shaft using an s4 fit as listed in the table. The standard W33 bearing with oil groove and oil holes can be used.

Data shown in ten-thousandths of an inch (6=.0006") or thousandths of a millimeter (15=0.15 mm.). See dimensional tables for nominal bore.

s4 FITS

Bore mm Over	Incl.	Variance fromNominal Bore Tolerence +0 in. mm	Shaft Diameter max. in. mm	min. in. mm	Fit in. mm
50	80	-6	-10	-14	4L 14L
		-15	-25	-36	10L 36L
80	120	-8	-13	-17	5L 17L
		-20	-33	-43	13L 43L
120	180	-10	-16	-21	6L 21L
		-25	-41	-53	15L 53L
180	250	-12	-19	-25	7L 25L
		-30	-48	-64	18L 64L

RADIAL SPHERICAL ROLLER BEARINGS

This chart is a guideline for specifying housing fits for particular operating conditions.

HOUSING

Conditions			Examples	Tolerance Symbol[2]	Remarks
One piece bearing housing	Rotating outer ring load	Variable load direction	Two-bearing shaft mechanism	**P6**	The outer ring is not displaceable axially
		Heavy loads on bearings in thin walled housings	Supporting wheels in cranes, wheel hubs, crank bearings	**P7**	
		Normal and heavy loads	Wheel hubs, crank bearings	**N7**	
		Light and variable loads	Conveyor rollers, rope sheaves, tension pulleys	**M7**	
	Indeterminate load direction	Heavy shock loads	Electrical traction motors		
		Heavy and normal loads, axial displacement of outer ring not required	Electrical motors, pumps, crankshaft main bearings	**K7**	The outer ring is, as a rule not displaceable axially.
Split or one piece bearing housing		Normal and light loads, axial displacement of the outer ring desirable	Electrical motors, pumps, crankshaft main bearings	**J7**	The outer ring is, as a rule displaceable axially.
	Stationary outer ring load	Shock loads, temporarily complete unloading	Journal boxes for rail vehicles		
		All loads	Bearing applications in general, journal boxes for rail vehicles	**H7**	The outer ring is easily displaced axially.
		Normal and light loads, loads under simple operating conditions	Line shaftings	**H8**	
		Heat supplied through the shaft	Dryer cylinders	**G7**	
One piece bearing housing	Applications requiring particular accuracy	Very accurate running and small deflections under variable loads	For main spindles in machine tools: O.D. less than 125mm / O.D. 125 to 250 mm / O.D. over 250mm	**M6** **N6** **P6**	The outer ring is not displaceable axially
		Very accurate running under light loads and indeterminate load direction	Held bearings in high speed centrifugal force compressors	**K6**	The outer ring is, as a rule not displaceable axially.
		Very accurate running, axial displacement of outer ring desirable	Floating bearings in high speed centrifugal force compressors	**J6**	The outer ring is easily displaced axially.

[2] Cast iron or steel housing. For numerical values see tables on pages 22, 23,24, and 25. For housings of light metal, tolerances generally are selected which give a slightly tighter fit than those given in the table.

RADIAL TAPERED ROLLER BEARINGS

Tolerences, shaft diameters and housing bores are shown as variances from the nominal bearing dimension. All data except nominal dimensions are in ten-thousanths of an inch (5=0.0005) and thousandths of a millimeter or micrometers (5=0.005mm).

Shaft and housing data shown in inches over millimeters.

SHAFT

Bearing Bore			t1			t2			t3			t4			t5			
Nominal (min.)		Tol.	Shaft Diam.			Shaft Diam.			Shaft Diam.			Shaft Diam.			Shaft Diam.			
Over	Incl.	–0	max.	min.	Fit	max.	min.	Fit	max.	min.	Fit	max.	min.	Fit	max.	min.	Fit	
in mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	
7.5000	12.0000	+10	+25	+15	5T 25T		—		+10	+0	+10L 10T	0	-10	0L 20L	-2	-12	2L 22L	For Class 2 or Class 4 bearings
190.500	304.800	+25	+64	+38	+13T 64T				+25	0	25L 25T	0	-25	0L 51L	-5	-30	5L 56L	
12.0000	24.0000	+20	+50	+30	+10T 50T		—		+20	+0	20L 20T	0	-20	0L 40L		—		
304.800	609.600	+51	+127	+76	+25T 127T				+51	+0	+51L 51T	0	-51	0L 102L				
24.0000	36.0000	+30	+75	+45	15T 75T	+150	+120	90T 150T	+30	0	30L 30T	0	-30	0L 60L		—		For Class 4 bearings only
609.600	914.400	+76	+191	+114	38T 191T	+381	+305	229T 381T	+76	0	76L 76T	0	-76	0L 152L				

HOUSING

Bearing O.D.			T1			T2			T3			T4			T5			
Nominal (min.)		Tol.	Housing Bore		Fit	Housing Bore		Fit	Housing Bore		Fit	Housing Bore		Fit	Housing Bore		Fit	
Over	Incl.	–0	max.	min.		max.	min.		max.	min.		max.	min.		max.	min.		
in mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	
10.5000	12.0000	+10	+20	+30	10L 30L	+10	+20 –	0L 20L	0	+20	10T 20L	-20	-10	10T 30T	-30	-20	20T 40T	For Class 2 or Class 4 bearings
266.700	304.800	+25	+51	+76	25L 76L	+25	+51	0L 51L	0	+51	25T 51L	-51	-25	25T 76T	-76	-51	51T 102T	
12.0000	24.0000	+20	+40	+60	20L 60L	+20	+40 –	0L 40L	+10	+30	10T 30L	-30	-10	10T 50T	-40	-20 –	20T 60T	
304.800	609.600	+51	+102	+152	51L 152L	+51	+102	0L 102L	+25	+76	25T 76L	-76	-25	25T 127T	-102	-51	51T 152T	
24.0000	36.0000	+30	+60	+90	30L 90L	+30	+60	0L 60L	+20	+50	10T 50L	-40	-10	10T 70T		—		For Class 4 bearings only
609.600	914.400	+76	+152	+114	76L 229L	+76	+152	0L 152L	+51	+127	25T 127L	-102	-25	25T 178T				

SHAFT

Shaft and housing diameter are shown in inches over millimeters with millimeters printed in red.

Mounting Conditions	Service	Shaft Finish	Shaft Diameter Over	Shaft Diameter Incl.	Shaft Tolerance Symbol
Rotating Cone	Steady load moderate shock	Ground	7.5 190.5	36.0 914.0	t1
Rotating or Stationary Cone	Heavy loads, high speeds or shock	Ground or Turned	7.5 190.5	24.0 610.0	*
		Ground	24.0 610.0	36.0 914.0	t2
Stationary Cone	Moderate loads, no shock	Turned	7.5 190.5	36.0 914.0	t3
		Ground			
	Sheaves, wheels, etc.	Turned			t4
	Wheel spindles	Hardened	7.5 190.5	12.0 305.0	t5

*Use "Turned Shaft Fitting Practice, " an average cone interference fit of 0.0005 inches (0.013mm) per inch (25.4mm) of bore diameter.

HOUSING

Mounting Conditions	Service	Housing Diameter Over	Housing Diameter Incl.	Housing Tolerance Symbol
Stationary Cup	Clamped or floating (TDO) styles	10.5 266.7	36.0 914.0	T1
	Alternate clamp only (TDO, TDOC)	10.5 266.7	36.0 914.0	T2
	Adjustable	10.5 266.7	36.0 914.0	T3
Rotating Cup	Sheaves unclamped (TDOC)	10.5 266.7	24.0 160.0	T5

THRUST BALL BEARINGS

Shaft and housing diameters shown as variance from nominal dimensions. Shaft and housing data shown in inches over millimeters.

TYPE TVB SHAFT

Bearing Bore nominal (min.) Over	Incl.	Shaft Diameter Max.	Min.
in.	in.	in.	in.
mm	mm	mm	mm
0.0000	6.7500	+0	-0.0012
0.000	171.450	+0	-0.030
6.7500	20.0000	+0	-0.0015
171.450	508.000	+0	-0.038

HOUSING

Bearing O.D. nominal (max.) Over	Incl.	Housing Bore Max.	Min.
in.	in.	in.	in.
mm	mm	mm	mm
4.7188	17.3750	+0.0090	+0.0050
119.858	441.325	+0.229	+0.127
17.3750	39.3701	+0.0100	+0.0060
441.325	1000.000	+0.254	+0.152

TYPE TVL AND DTVL SHAFT

Bearing Bore nominal (max.) Over	Incl.	Shaft Diameter Interference Fit* Max.	Min.	Loose Fit** Max.	Min.
in.	in.	in.	in.	in.	in.
mm	mm	mm	mm	mm	mm
0.0000	19.8750	+0.0030	+0	-0.0060	-0.0030
0.000	504.825	+0.076	+0	-0.152	-0.076
19.8750	60.0000	+0.0050	+0	-0.0100	-0.0050
504.825	1524.000	+0.127	+0	-0.254	-0.127

* Dowel pin suggested. ** Dowel pin required.

HOUSING

Bearing O.D. nominal (min.) Over	Incl.	Shaft Diameter Loose Fit** Max.	Min.	Interference Fit* Max.	Min.
in.	in.	in.	in.	in.	in.
mm	mm	mm	mm	mm	mm
0.0000	23.0000	+0.0060	0.0030	-0.0060	-0.0030
0.000	584.000	+0.152	0.076	-0.152	-0.076
23.0000	70.0000	+0.0100	0.0050	-0.0100	-0.0050
584.000	1778.000	+0.254	0.127	-0.254	-0.127

* Dowel pin suggested. ** Dowel pin required.

THRUST CYLINDRICAL ROLLER BERARINGS

TYPE TP AND TPS SHAFT

Bearing Bore nominal (max.) Over	Incl.	Shaft Diameter Max.	Min.
in.	in.	in.	in.
mm	mm	mm	mm
1.8750	2.1250	-0.0010	-0.0020
47.625	53.975	-0.025	-0.051
2.1250	2.5000	-0.0011	-0.0021
53.975	63.500	-0.028	-0.053
2.5000	3.0000	-0.0012	-0.0022
63.500	76.200	-0.030	-0.056
3.0000	3.5000	-0.0012	-0.0023
76.200	88.900	-0.033	-0.058
3.5000	7.0000	-0.0015	-0.0025
88.900	177.800	-0.038	-0.064
7.0000	9.0000	-0.0015	-0.0030
177.800	228.600	-0.038	-0.076
9.0000	12.0000	-0.0018	-0.0330
228.600	304.800	-0.046	-0.084
12.0000	15.0000	-0.0020	-0.0035
304.800	381.000	-0.051	-0.089
15.0000	19.0000	-0.0020	-0.0040
381.000	482.600	-0.051	-0.102
19.0000	23.0000	-0.0025	-0.0045
482.600	584.200	-0.064	-0.114
23.0000`	30.0000	-0.0030	-0.0055
` 584.200	762.000	-0.076	-0.140

TYPE TP HOUSING

Bearing O.D. nominal (min.) Over	Incl.	Housing Bore Max.	Min.
in.	in.	in.	in.
mm	mm	mm	mm
4.5312	10.0000	+0.0030	+0.0015
115.092	254.000	+0.076	+0.038
10.0000	18.0000	+0.0040	+0.002
254.000	457.200	+0.102	+0.051
18.0000	22.0000	+0.0050	+0.0025
457.200	558.800	+0.127	+0.064
22.0000	26.0000	+0.0055	+0.0025
558.800	660.400	+0.140	+0.064
26.0000	28.0000	+0.0060	+0.0030
660.400	711.200	+0.152	+0.076
28.0000	34.0000	+0.0070	+0.0030
711.200	863.600	+0.178	+0.076
34.0000	38.0000	+0.0080	+0.0035
863.600	965.200	+0.203	+0.089
38.0000	44.0000	+0.0090	+0.0040
965.200	1117.600	+0.229	+0.102

Note: Housing fits for Type TPS are on the following page.

THRUST CYLINDRICAL ROLLER BEARINGS

Tolerances for housing bore and for shaft diameters shown as variance from nominal bearing dimension.

Data shown in inches over millimeters

TYPE TPS HOUSING Deviations in 0.0001 inches/0.001 micrometers

Bearing O.D. nominal (min.)		Housing Diameter Deviation from D	
Over	Incl.	High	Low
in. mm	in. mm	in. mm	in. mm
2.0000 50.800	2.3750 60.325	+15 +38	+5 +13
2.3750 60.325	3.2500 82.550	+17 +43	+7 +18
3.2500 82.550	3.6875 93.663	+19 +48	+9 +23
3.6875 93.663	4.0000 101.600	+21 +53	+11 +28
4.0000 101.600	4.5312 115.092	+28 +71	+13 +33
4.5312 115.092	10.0000 254.000	+30 +76	+15 +38
10.0000 254.000	18.0000 457.200	+40 +102	+20 +51
18.0000 457.200	22.0000 558.800	+50 +127	+25 +64
22.0000 558.800	26.0000 660.400	+55 +140	+25 +64
26.0000 660.400	28.0000 711.200	+60 +152	+30 +76
28.0000 711.200	34.0000 863.600	+70 +178	+30 +76
34.0000 863.600	38.0000 965.200	+80 +203	+35 +89
38.0000 965.200	44.0000 1117.600	+90 +229	+40 +102

THRUST TAPERED ROLLER BEARINGS

TYPE TTHD SHAFT

Bearing Bore nominal (min.)			Shaft Diameter	
		Spring Loaded Max.+0	Rolling Mill Screwdown & Piercing Mill Thrust Blocks	
Over	Incl.	Min.	Max.	Min.
in. mm	in. mm	in. mm	in. mm	in. mm
0.0000 0.000	6.8750 174.625	-0.0010 -0.025	+0.0030 +0.076	+0.0020 +0.051
6.8750 174.625	7.9999 203.197	-0.0010 -0.025	+0.0040 +0.102	+0.0030 +0.076
7.9999 203.197	12.0000 304.800	-0.0015 -0.038	+0.0050 +0.127	+0.0040 +0.102
12.0000 304.800	24.0000 609.600	-0.0020 -0.051	+0.0070 +0.178	+0.0050 +0.127
24.0000 609.600	36.0000 914.400	-0.0025 -0.064	+0.0095 +0.241	+0.0070 +0.178
36.0000 914.400	48.0000 1219.200	-0.0030 -0.076	+0.0120 +0.304	+0.0090 +0.229

TYPE TTHD HOUSING

Bearing O.D. nominal (min.)		Housing Bore	
Over	Incl.	max.	min.
in. mm	in. mm	in. mm	in. mm
6.3750 161.925	10.5000 266.700	+0.0025 +0.064	+0.0010 +0.025
10.5000 266.700	13.0000 330.200	+0.0030 +0.076	+0.0010 +0.025
13.0000 330.200	20.0000 508.000	+0.0040 +0.102	+0.0020 +0.051
20.0000 508.000	25.0000 635.000	+0.0045 +0.114	+0.0020 +0.051
25.0000 635.000	30.0000 762.000	+0.0060 +0.152	+0.0030 +0.076
30.0000 762.000	35.0000 889.000	+0.0070 +0.178	+0.0030 +0.076

THRUST TAPERED ROLLER BEARINGS

Tolerences for housing bore and shaft diameters shown as variance from nominal bearing dimension.

Data shown in inches over millimeters.

When one washer is piloted by the housing, sufficient clearances must be allowed at the outside diameter of the other washer as well as at the bore of both washers to prevent cross-threading of the rollers. For most applications, this clearance is approximately 1/16" (.0625", .1588mm).

TYPES TTV AND TTVF
SHAFT

Bearing Bore nominal (min.) Over	Incl.	Shaft Diameter Max. +O Min.
in. mm	in. mm	in. mm
0.0000 0.000	12.0000 304.800	-0.0020 -0.051
12.0000 304.800	20.0000 508.000	-0.0020 -0.051
20.0000 508.000	28.0000 711.200	-0.0030 -0.076
28.0000 711.200	48.0000 1219.200	-0.0040 -0.102
48.0000 1219.200	68.0000 1727.200	-0.0050 -0.127

HOUSING

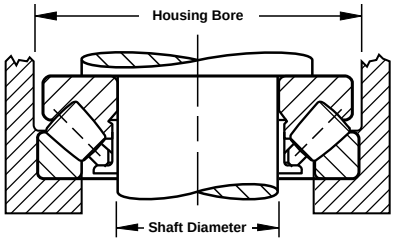
Bearing Bore nominal (min.) Over	Incl.	Housing Bore max.	min.
in. mm	in. mm	in. mm	in. mm
6.3750 161.925	10.4375 265.113	+0.0025 +0.060	+0.0010 +0.025
10.3475 265.113	12.5000 317.500	+0.0030 +0.076	+0.0010 +0.025
12.5000 317.500	19.0000 482.600	+0.0040 +0.102	+0.0020 +0.051
19.0000 482.600	23.7500 603.250	+0.0045 +0.113	+0.0020 +0.051
23.7500 603.250	28.0000 711.200	+0.0060 +0.152	+0.0030 +0.076
28.0000 711.200	33.0000 838.200	+0.0070 +0.178	+0.0030 +0.076

THRUST SPHERICAL ROLLER BEARING

Tolerances for housing bore and for shaft diameters shown as variance from nominal bearing dimension.

Data shown in inches over millimeters.

When application calls for thrust loads only, the housing must be relieved by 1/16" on diameter so that no radial load is carried on the bearing.



SHAFT

Tolerances are 1/10,000 of an inch (5 =.0005") and 1/1000 of a millimeter(µm)

Bearing Bore nominal (max.) inches Over	Incl.	Shaft Diameter Stationary Load max.	min.	Rotating Load max.	min.
in. mm	in. mm	in. mm	in. mm	in. mm	in. mm
3.1496 80	4.7244 120	+5 +13	-4 -10	+10 +25	+1 +3
4.7244 120	7.0866 180	+6 +15	-4 -10	+11 +28	+1 +3
7.0866 180	7.8740 200	+7 +18	-5 -13	+1 +36	+2 +5
7.8740 200	9.4488 240	+7 +18	-5 -13	+18 +46	+6 +15
9.4488 240	12.4016 315	+7 +18	-6 -15	+20 +51	+8 +20
12.4016 315	15.7480 400	+7 +18	-7 -18	+22 +56	+8 +20
15.7480 400	19.6850 500	+9 +23	-7 -18	+34 +86	+18 +46
19.6850 500	24.8031 630	+9 +23	-8 -20	+34 +86	+17 +43

HOUSING

Tolerances are 1/10,000 of an inch (5 =.0005") and 1/1000 of a millimeter(µm)

Bearing O.D. nominal (max.) inches Over	Incl.	Housing Bore Springs in Housing Light Radial Load min.	max.	Combined Axial &Radial Load Stationary Outer Ring min.	max.	Rotating Outer Ring min.	max.
in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm
7.0866 180	9.8425 250	+6 +15	+24 +61	-7 -18	+11 +28	-13 -33	+5 +13
9.8425 250	12.4016 315	+7 +18	+27 +69	-7 -18	+13 +33	-14 -36	+6 +15
12.4016 315	15.7480 400	+7 +18	+29 +74	-7 -18	+15 +38	-16 -41	+6 +15
15.7480 400	19.6850 500	+8 +20	+33 +84	-9 -23	+16 +41	-18 -46	+7 +18
19.6850 500	24.8031 630	+9 +23	+36 +91	-9 -23	+18 +46	-19 -48	+8 +20
24.8031 630	31.4960 800	+9 +23	+40 +102	-9 -23	+20 +51	-20 -51	+9 +23
31.4960 800	39.3700 1000	+10 +25	+43 +109	-10 -25	+23 +58	-23 -58	+10 +25
39.3700 1000	49.2126 1250	+11 +28	+48 +122	-11 -28	+26 +66	-25 -64	+12 +30

Shaft and housing shoulder diameters for radial roller and thrust ball and thrust ball and roller bearings are also found in the respective dimension tables. Shaft and Housing shoulders for ball bearings are shown below.

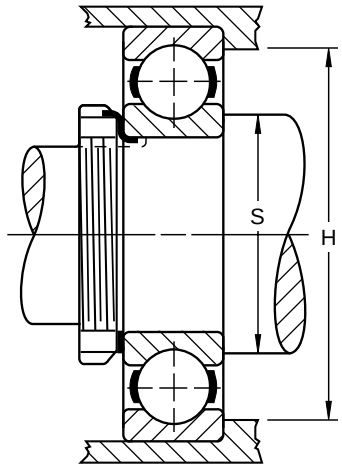
RADIAL BALL BEARINGS

The preferred method of locating bearings on shafts and in housings is to provide accurate shoulders perpendicular to the shaft axis. Shoulders should be large enough to exceed the theoretical point of tangency between the corner radius and the face of the bearing , and small enough to permit bearing removal with proper pullers.

These tables give the recommended maximum and minimum shaft and housing shoulder diameters for the majority of applications. Where design limitations do not permit conformance to these recommended diameters, the Engineering department should be consulted.

Recommended shaft and housing fillet radii are listed in the dimensional tables of each product catalog and must be used to assure proper seating against shaft and housing shoulders.

Shaft and housing diameters for radial ball bearings are shown below and on the following two pages. For radial cylindrical, spherical and tapered roller bearings refer to the respective dimension tables. Housing shoulders for wide inner ring bearings are shown on page 44.



EXTRA LIGHT 9300

Basic Bearing Number	shaft shoulder ±.010"		housing shoulder ±.010"	
	in.	mm	in.	mm
9301K	0.58	14.7	0.85	21.6
9302K	0.70	17.8	1.00	25.4
9303K	0.78	19.8	1.08	27.4
9304K	0.94	23.9	1.32	33.5
9305K	1.14	29.0	1.52	38.6
9306K	1.32	33.5	1.71	43.4
9307K	1.56	39.6	2.00	50.8
9308K	1.77	45.0	2.26	57.4
9309K	1.98	50.3	2.49	63.2
9310K	2.16	54.9	2.66	67.6
9311K	2.40	61.0	2.94	74.7
9312K	2.59	65.8	3.14	79.8

EXTRA-SMALL SERIES

Basic Bearing Number	Shoulder Diameters shaft, S max.		shaft, S min.		housing, H max.		housing, H min.	
	in.	mm	in.	mm	in.	mm	in.	mm
33K3	0.20	5.1	0.19	4.8	0.32	8.1	0.31	7.9
33K4	0.24	6.1	0.23	5.8	0.44	11.2	0.43	10.9
33K5	0.26	6.6	0.25	6.4	0.44	11.2	0.43	10.9
34K	0.26	6.6	0.25	6.4	0.56	14.2	0.55	14.0
35K	0.37	9.4	0.36	9.1	0.67	17.0	0.66	16.8
36K	0.37	9.4	0.36	9.1	0.67	17.0	0.66	16.8
37K	0.44	11.2	0.42	10.7	0.79	20.1	0.77	19.6
38K	0.45	11.4	0.43	10.9	0.79	20.1	0.77	19.6
38KV	0.45	11.4	0.43	10.9	0.79	20.1	0.77	19.6
39K	0.51	13.0	0.49	12.5	0.91	23.1	0.89	22.6
S1K7	0.34	8.6	0.32	8.1	0.56	14.2	0.54	13.7
S1K	0.37	9.4	0.35	8.9	0.69	17.5	0.67	17.0
S3K	0.50	12.7	0.48	12.2	0.80	20.3	0.78	19.8
S5K	0.63	16.0	0.61	15.5	0.99	25.1	0.97	24.6
S7K	0.84	21.3	0.80	20.3	1.24	31.5	1.20	30.5
S8K	0.97	24.6	0.93	23.6	1.46	37.1	1.40	35.6
S9K	1.14	28.9	1.10	27.9	1.65	41.9	1.61	40.9
S10K	1.24	31.5	1.20	30.5	1.84	46.7	1.80	45.7
S11K	1.34	34.0	1.30	33.0	1.95	49.5	1.91	48.5
S12K	1.55	39.4	1.51	38.4	2.20	55.9	2.00	50.8

SHAFT DESIGN – NEEDLE BEARINGS

When the shaft is used as the inner raceway for needle roller bearings the following specifications must be met:

1. **metallurgy** – either case hardening or through hardening grades of good bearing quality steel are satisfactory for raceways. Steels which are modified for free machining, such as those high in sulfur content and particularly those containing lead, are seldom satisfactory for raceways.

   To realize full bearing capacity, the raceway area must be at least surface hard with a reasonable core strength. The preferred surface hardness is equivalent to 58 HRC. If the raceway is of lesser hardness, see the modification factors shown in Tables 2 and 3.

   Shaft raceways for all needle roller bearings, in diameters up to 3.5 inches or 90mm should have an effective case depth of 0.030 inch or 0.8mm. (Effective case depth is defined as the distance from the surface, after final grinding, to the 50 HRC hardness level.) For raceways larger than 3.5 inches or 90 mm in diameter the effective case depth should be 0.050 inch or 1.3 mm.

2. **strength** – the shaft must be of sufficient size to keep the operating deflections within the limits outlined in Table 4.

3. **tolerance** – the recommended shaft diameter tolerances for each type of needle roller bearing are indicated on the tabular pages.

4. **taper** – the taper within the length of the bearing raceway should not exceed 0.0003 inch (0.008 mm), or one-half the diameter tolerance, whichever is smaller.

5. **out-of-roundness** – the radial deviation from true circular form of the raceway should not exceed .0001 inch (0.0025mm) for diameters up to and including 1.0 inch (25mm). For raceways greater than 1.0 inch or 25mm the allowable radial deviation may be greater than .0001 inch (0.0025mm) by a factor of raceway diameter (in inches) divided by 1.0 or a factor of raceway diameter (in mm) divided by 25.

6. **surface finish** – the raceway finish should not exceed 16 microinches aa (arithmetic average) or 0,4 µm (on the Ra scale). In addition, the raceway area must be free of nicks, scratches and dents. Oil holes are permissible in the raceway area but care must be taken to blend the edges gently into the raceway.

   Care must be taken to prevent grind reliefs, fillets, etc., from extending into the raceway area. If the rollers overhang a grind relief or step on the shaft, there will be high stress concentration with resultant early failure.

7. **end chamfer** – for most effective assembly of the shaft into a bearing, the end of the shaft should have a large chamfer or rounding. This should help in preventing damage to the roller complement, scratching of the raceway surface and nicking of the shaft end.

8. **sealing surface** – in some instances bearings have integral or immediately adjacent seals that operate on the surface ground for the bearing raceway. Here, particular attention should be paid to the pattern of the shaft finish. In no instance should there be a “lead”, or spiral effect, as often occurs with through feed centerless grinding. Such a “lead” may pump lubricant past the seal.

When it is undesirable or impractical to prepare the shaft to be used as a raceway, inner rings are available as listed in the tabular pages. If the shaft is not used directly as a raceway, the following design specifications must be met:

1. **strength** – the shaft must be of sufficient size to keep the operating deflections within the limits outlined in Table 4.

2. **tolerance** – the recommended shaft diameter tolerances for mounting inner rings are indicated on the tabular pages.

3. **taper and out-of-roundness** – the taper and out-of-roundness should not exceed one-half the shaft diameter tolerance.

4. **surface finish** – the surface finish should not exceed 125 microinches, aa (arithmetic average) or 3.2 µm (on the Ra scale).

5. **locating shoulders or steps** – locating shoulders or steps in the shaft must be held to close concentricity with the bearing seat to prevent imbalance and resultant vibrations.

HOUSING DESIGN – NEEDLE BEARINGS

BEARINGS WITH OUTER RINGS

For bearings with outer rings the function of the housing is to locate and support the outer ring. The following specifications must be met:

1. strength – housings should be designed so that the radial loads which will be placed on the bearings will cause a minimum of deflection or distortion of the housing.

2. tolerance – the recommended housing bore tolerances for each type of needle roller bearing are indicated on the tabular pages.

3. taper – the taper within the length of the outer ring should not exceed .0005 inch (0.013 mm).

4.out-of-roundness – the housing bore should be round within one-half the housing bore diameter tolerance.

5. parallelism – when possible, line bore housings which are common to one shaft to obtain parallelism of the housing bores and the shaft axis.

6. surface finish – the surface finish of housing bore should not exceed 125 microinches, aa (arithmetic average) or 3.2 µm (on the Ra scale).

7. end chamfer – to permit easy introduction of the bearing into the housing, the end of the housing should have a generous chamfer.

Heavy duty roller bearings can be installed into housings with a transition fit or a clearance fit. The outer ring should be a transition fit in the housing when it rotates relative with the load. The outer ring may be a clearance fit in the housing when it is stationary relative to the load.In either case, locate the bearings by shoulders, or other locating devises, to prevent axial movement.

Since the heavy duty roller bearing does not require an interference fit in the housing to round and size it properly, a split housing may be used if desired. Dowels should be used to maintain proper register of the housing sections.

Drawn cup bearings have a thin case-hardened outer ring which is out-of-round from the hardening operation. For proper mounting it must always be pressed into the housing. Split housing will not round and size a drawn cup bearing. When split housings must be used, the bearing should first be mounted in a cylindrical sleeve.

The housing should be of sufficient tensile strength and section to round and size the bearing. It must be designed for minimum distortion under load. Steel or cast iron housings are preferred. Housing bores in low tensile strength materials such as aluminum, magnesium, phenolics, etc., should be reduced to provide more interference fit. Thin section cast iron and steel housings may also require reduced bores. Consult the Torrington engineering department for recommendations when working with these lower strength housings.

The housing should be through bored if possible. When shouldered housing bores are unavoidable, the bearing should be located far enough from the shoulder to avoid the danger of crushing the end of the drawn cup during installation.

When the drawn cup bearing is mounted close to the housing face, care should be taken to mount the bearing at least 0.008 inch (0.20 mm) within the housing face to protect the bearing lip.

BEARINGS WITHOUT OUTER RINGS

In many cases, such as with gear bores, it is desirable to have the housing bore serve as the outer raceway for caged needle roller assemblies or loose needle roller complements. In those instances, the following specifications must be met:

1. strength – the housing must be of sufficient cross section to maintain proper roundness and running clearance under the maximum load.

2. metallurgical – material selection, hardness and case depth should be consistent with the requirements for inner raceways given in the SHAFT DESIGN recommendations on page 40.

3. taper and out-of-roundness – the raceway out-of-roundness and taper should not exceed 0.0003 inch (0.008 mm) or one-half the bore tolerance, whichever is smaller. In addition, the bore diameter must never be smaller at both ends than in the center (sway-back).

4. surface finish – the raceway surface finish should not exceed 32 microinches, aa (arithmetic average) or 0.8 µm (on the Ra scale). In addition, the surface must be free of nicks, dents and scratches.

5. grind reliefs – care must be exercised to ensure that grind reliefes, fillets, etc. do not extend to the raceway. Oil holes in the raceway area are permissible but the edges must be blended smoothly with the raceway.

RADIAL BALL BEARINGS

Extra-Light • 9100 Series									Light • 200, 7200WN Series									Medium • 300, 7300WN Series								
Basic Bearing Number	Shoulder Diameters shaft, S max.		min.		housing, H max.		min.		Basic Bearing Number	Shoulder Diameters shaft, S max.		min.		housing, H max.		min.		Basic Bearing Number	Shoulder Diameters shaft, S max.		min.		housing, H max.		min.	
	in.	mm	in.	mm	in.	mm	in.	mm		in.	mm	in.	mm	in.	mm	in.	mm		in.	mm	in.	mm	in.	mm	in.	mm
9100	0.52	13.2	0.47	11.9	0.95	24.1	0.91	23.1	**200**	0.56	14.2	0.50	12.7	0.98	24.9	0.97	24.6	**300**	0.59	15.0	0.50	12.7	1.18	30.0	1.15	29.2
9101	0.71	18.0	0.55	14.0	1.02	25.9	0.97	24.6	**201**	0.64	16.3	0.58	14.7	1.06	26.9	1.05	26.7	**301**	0.69	17.5	0.63	16.0	1.22	31.0	1.21	30.7
9102	0.75	19.0	0.67	17.0	1.18	30.0	1.13	28.7	**202**	0.75	19.0	0.69	17.5	1.18	30.0	1.15	29.2	**302**	0.81	20.6	0.75	19.0	1.42	36.1	1.40	35.6
9103	0.81	20.6	0.75	19.0	1.30	33.0	1.25	31.8	**203**	0.84	21.3	0.77	19.6	1.34	34.0	1.31	33.3	**303**	0.91	23.1	0.83	21.1	1.61	40.9	1.60	40.6
9104	0.98	24.9	0.89	22.6	1.46	37.1	1.41	35.8	**204**	1.00	25.4	0.94	23.9	1.61	40.9	1.58	40.1	**304**	1.06	26.9	0.94	23.9	1.77	45.0	1.75	44.4
9105	1.18	30.0	1.08	27.4	1.65	41.9	1.60	40.6	**205**	1.22	31.0	1.14	29.0	1.81	46.0	1.78	45.2	**305**	1.31	33.3	1.14	29.0	2.17	55.1	2.09	53.1
9106	1.38	35.1	1.34	34.0	1.93	49.0	1.88	47.8	**206**	1.47	37.3	1.34	34.0	2.21	56.1	2.16	54.9	**306**	1.56	39.6	1.34	34.0	2.56	65.0	2.44	62.0
9107	1.63	41.4	1.53	38.9	2.21	56.1	2.15	54.6	**207**	1.72	43.7	1.53	38.9	2.56	65.0	2.47	62.7	**307**	1.78	45.2	1.69	42.9	2.80	71.1	2.72	69.1
9108	1.81	46.0	1.73	43.9	2.44	62.0	2.39	60.7	**208**	1.94	49.3	1.73	43.9	2.87	72.9	2.78	70.6	**308**	2.00	50.8	1.93	49.0	3.19	81.0	3.06	77.7
9109	2.03	51.6	1.94	49.3	2.72	69.1	2.67	67.8	**209**	2.13	54.1	1.94	49.3	3.07	78.0	2.97	75.4	**309**	2.28	57.9	2.13	54.1	3.58	90.9	3.41	86.6
9110	2.22	56.4	2.13	54.1	2.91	73.9	2.86	72.6	**210**	2.34	59.4	2.13	54.1	3.27	83.1	3.17	80.5	**310**	2.50	63.5	2.36	59.9	3.94	100.1	3.75	95.2
9111	2.48	63.0	2.33	59.2	3.27	83.1	3.22	81.8	**211**	2.54	64.5	2.41	61.2	3.68	93.5	3.56	90.4	**311**	2.75	69.8	2.56	65.0	4.33	110.0	4.13	104.9
9112	2.67	67.8	2.53	64.3	3.47	88.1	3.42	86.9	**212**	2.81	71.4	2.67	67.8	3.98	101.1	3.87	98.3	**312**	2.94	74.7	2.84	72.1	4.65	118.1	4.44	112.8
9113	2.84	72.1	2.72	69.1	3.66	93.0	3.61	81.7	**213**	3.03	77.0	2.86	72.6	4.37	111.0	4.19	106.4	**313**	3.19	81.0	3.03	77.0	5.04	128.0	4.81	122.2
9114	3.11	79.0	2.91	73.9	4.06	103.1	3.97	100.8	**214**	3.22	81.8	3.06	77.7	4.57	116.1	4.41	112.0	**314**	3.44	87.4	3.23	82.0	5.43	137.9	5.13	130.3
9115	3.31	84.1	3.11	79.0	4.25	108.0	4.16	105.7	**215**	3.44	87.4	3.25	82.6	4.76	120.9	4.59	116.6	**315**	3.88	98.6	3.43	87.1	5.83	148.1	5.50	139.7
9116	3.56	90.4	3.31	84.1	4.65	118.1	4.50	114.3	**216**	3.69	93.7	3.55	90.2	5.12	130.0	4.93	125.2	**316**	3.94	100.1	3.62	91.9	6.22	158.0	5.88	149.4
9117	3.75	95.2	3.50	88.9	4.84	122.9	4.71	119.6	**217**	3.88	98.6	3.75	95.2	5.51	140.0	5.31	134.9	**317**	4.13	104.9	3.90	99.1	6.54	166.1	6.19	157.2
9118	4.03	102.4	3.84	97.5	5.16	131.1	5.13	130.3	**218**	4.16	105.7	3.94	100.1	5.91	150.1	5.62	142.7	**318**	4.38	111.3	4.09	103.9	6.93	176.0	6.50	165.1
9120	4.38	111.3	4.23	107.4	5.55	141.0	5.44	138.2	**219**	4.38	111.3	4.21	106.9	6.22	158.0	6.06	153.9	**319**	4.63	117.6	4.29	109.0	7.32	185.9	6.88	174.8
9121	4.66	118.4	4.53	115.1	5.91	150.1	5.75	146.0	**220**	4.63	117.6	4.41	112.0	6.61	167.9	6.31	160.3	**320**	4.88	124.0	4.49	114.0	7.91	200.9	7.38	187.4
9122	4.91	124.7	4.72	119.9	6.30	160.0	6.18	157.0	**221**	4.88	124.0	4.61	117.1	7.01	178.1	6.88	174.8	**321**	5.13	130.3	4.69	119.1	8.31	211.1	7.75	196.8
9124	5.28	134.1	5.12	130.0	6.69	169.9	6.50	165.1	**222**	5.13	130.3	4.80	121.9	7.40	188.0	7.06	179.3	**322**	5.50	139.7	4.88	124.0	8.90	226.1	8.25	209.6
9126	5.81	147.6	5.51	140.0	7.48	190.0	7.25	184.1	**224**	5.63	143.0	5.20	132.1	7.99	202.9	7.56	192.0	**324**	6.00	152.4	5.28	134.1	9.69	246.1	8.93	226.8
9128	6.06	153.9	5.81	147.6	7.88	200.2	7.68	195.1	**226**	6.00	152.4	5.67	144.0	8.50	215.9	8.13	206.5	**326**	6.44	163.6	5.83	148.1	10.32	262.1	9.69	246.1
9130	6.59	167.4	6.38	162.1	8.39	213.1	8.13	206.5	**228**	6.50	165.1	6.06	153.9	9.29	236.0	8.81	223.8	**328**	6.93	176.0	6.22	158.0	11.10	281.9	10.38	263.7
9132	6.96	176.8	6.56	166.6	9.00	228.6	8.75	222.2	**230**	6.97	177.0	6.46	164.1	10.08	256.0	9.50	241.3	**330**	7.44	189.0	6.61	167.9	11.89	302.0	11.06	280.9
9134	7.56	192.0	7.17	182.1	9.76	247.9	9.44	239.8	**232**	7.36	186.9	6.85	174.0	10.87	276.1	10.25	260.4	**332**	7.84	188.0	7.01	178.0	12.68	322.1	11.58	294.1
9138	8.38	212.9	7.95	201.9	10.95	278.1	10.50	266.7	**234**	7.98	202.7	7.40	188.0	11.50	292.1	10.88	276.4	**334**	8.40	213.4	7.40	188.0	13.47	342.1	12.27	311.7
9140	8.84	224.5	8.35	212.1	11.73	297.9	11.22	285.0	**236**	8.38	212.9	7.80	198.1	11.89	302.0	11.09	281.7	**336**	8.80	223.5	7.80	198.1	14.25	362.0	13.05	331.5
9144	9.70	246.4	9.21	233.9	12.84	326.1	12.24	310.9	**238**	8.77	222.8	8.19	208.0	12.68	322.1	11.88	301.8	**338**	9.35	237.5	8.35	212.1	14.89	378.2	13.59	345.2
9148	10.50	266.7	10.00	254.0	13.62	345.9	13.02	330.7	**240**	9.42	239.3	8.58	217.9	13.47	342.1	12.57	319.3	**340**	9.84	249.9	8.74	222.0	15.67	398.0	14.37	365.0
9152	11.49	291.8	10.95	278.1	15.04	382.0	14.44	366.8	**242**	9.69	246.1	8.87	225.3	14.26	362.2	13.26	336.8	**342**	10.24	260.1	9.14	232.2	16.47	418.3	15.17	385.3
9156	12.33	313.2	11.73	297.9	15.83	402.1	15.23	386.8	**244**	10.14	257.6	9.37	238.0	15.04	382.0	14.04	356.6	**344**	10.73	272.5	9.53	242.1	17.24	437.9	15.96	405.4
9160	13.36	339.3	12.52	318.0	17.40	442.0	16.60	421.6	**246**	10.58	268.7	9.76	247.9	15.83	402.1	14.60	370.8	**348**	11.52	292.6	10.32	262.1	18.82	478.0	17.32	439.9
9164	14.19	360.4	13.31	338.1	18.19	462.0	17.39	441.7	**248**	11.16	283.5	10.16	258.1	16.61	421.9	15.18	385.6	**352**	12.54	318.5	11.34	288.0	20.16	512.1	18.66	474.0
9180	18.00	457.2	17.00	431.8	22.12	561.8	21.62	549.1	**250**	11.55	293.4	10.55	268.0	17.40	442.0	15.70	398.8	**356**	13.43	341.1	12.13	308.1	21.73	551.9	20.13	511.3

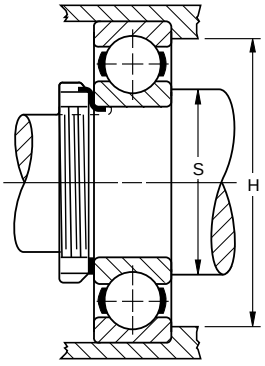
RADIAL BALL BEARINGS

Heavy • 7400 Series

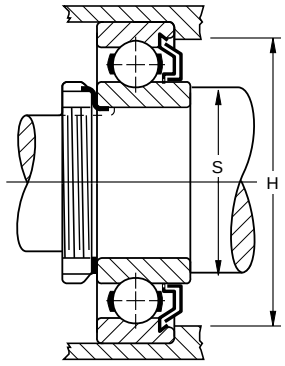
Basic Bearing Number	shaft, S max.	shaft, S min.	housing, H max.	housing, H min.
	in	in.	in	in.
	mm	mm	mm	mm
7405	1.47	1.34	2.80	2.63
	37.3	34.0	71.1	66.8
7406	1.72	1.54	3.19	3.00
	43.7	39.1	81.0	76.2
7407	1.93	1.73	3.58	3.38
	49.0	43.9	90.9	85.9
7408	2.19	1.97	3.94	3.69
	55.6	50.0	100.1	93.7
7409	2.44	2.17	4.33	4.00
	62.0	55.1	110.0	101.6
7410	2.69	2.44	4.65	4.38
	68.3	62.0	118.1	111.3

Heavy • 7400 Series (Continued)

Basic Bearing Number	shaft, S max.	shaft, S min.	housing, H max.	housing, H min.
	in	in.	in	in.
	mm	mm	mm	mm
7411	2.93	2.64	5.04	4.75
	74.4	97.1	128.0	120.7
7412	3.19	2.84	5.43	5.13
	81.0	72.1	137.9	130.3
7413	3.50	3.03	5.83	5.50
	88.9	77.0	148.1	139.7
7414	3.69	3.31	6.54	6.13
	93.7	84.1	166.1	155.7
7415	3.93	3.50	6.93	6.44
	99.8	88.9	176.0	163.6
7416	4.13	3.70	7.32	6.81
	104.9	94.0	185.9	173.0
7418	4.69	4.25	8.15	7.75
	119.1	108.0	207.0	196.9
7420	5.17	4.72	9.21	8.79
	131.3	119.9	233.9	223.3



Non-Standard Extra-Large



Mechani-Seal KL, KLD, KLL Types

Non-Standard Extra-Large

Basic Bearing Number	Shoulder Diameters shaft, S max. in.	mm	shaft, S min. in.	mm	housing, H max. in.	mm	housing, H min in.	mm
120W2	4.63	117.6	4.40	111.8	5.91	150.1	5.75	146.0
122W	4.91	124.7	4.73	120.1	6.41	162.8	6.25	158.8
124W	5.28	134.1	5.12	130.0	7.01	178.1	6.87	174.5
126W	5.82	147.8	5.50	139.7	7.60	193.0	7.31	185.7
128W	6.19	157.2	5.91	150.1	8.18	207.8	7.96	202.2
130W	6.59	167.4	6.38	162.1	8.78	223.0	8.51	216.2
132W	7.44	189.0	6.85	174.0	9.24	234.7	8.81	223.8
134W	7.52	191.0	7.29	185.2	9.83	249.7	9.61	244.1
136W	8.00	203.2	7.69	195.3	10.42	264.7	10.15	257.8
138W	8.44	214.4	8.08	205.2	11.21	284.7	10.87	276.1
224W	5.63	143.0	5.20	132.1	8.00	203.2	7.56	192.0
226	6.00	152.4	5.67	144.0	8.50	215.9	8.13	206.5
228	6.50	165.1	6.06	153.9	9.29	236.0	8.81	223.8
276–2	15.82	401.8	15.75	400.1	18.25	463.6	18.17	461.5

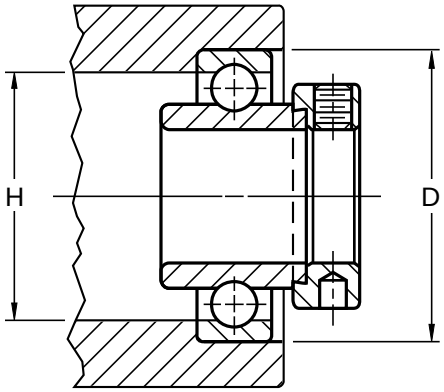
Housing shoulder diamters of bearings with Mechani-Seals differ slightly from those of other types to allow for clearance between the external rotating member of the seal and the housing shoulder.

Mechani-Seal KL, KLD, KLLTypes

Basic Bearing Number	housing shoulder diameter,H max. in.	mm	min. in.	mm
36	0.67	17.0	0.66	16.8
36V	0.67	17.0	0.66	16.8
37	0.79	20.1	0.77	19.6
37V	0.79	20.1	0.77	19.6
34	0.79	20.1	0.77	19.6
38V	0.79	20.1	0.77	19.6
39	0.91	23.1	0.89	22.6
39V	0.91	23.1	0.89	22.6
200	1.09	27.7	1.03	26.2
201	1.16	29.5	1.09	27.7
201–2	1.16	29.5	1.09	27.7
201–3	1.16	29.5	1.09	27.7
202	1.28	32.5	1.22	31.0
202–2	1.28	32.5	1.22	31.0
202–3	1.28	32.5	1.22	31.0
202–4	1.28	32.5	1.22	31.0
203	1.44	36.6	1.41	35.8
204	1.72	43.7	1.62	41.1
204–2	1.72	43.7	1.62	41.1
205	1.91	48.5	1.84	46.7
205–2	1.91	48.5	1.84	46.7
206	2.28	57.9	2.22	56.4
207	2.66	67.6	2.53	64.3
208	2.97	75.4	2.81	71.4
209	3.16	80.3	3.03	77.0
209–2	6.16	80.3	3.03	77.
211	3.69	93.7	3.56	90.4

WIDE INNER RING BALL BEARINGS

When shafts are selected for use with wide inner ring bearings, a minimum slip fit is very desirable for the most satisfactory mounting. Special shaft limits are required in certain cases, and a variety of standard fits can be used, even including a press fit. The recommended figures are noted below. In some applications it may be permissable to use increased shaft tolerances. In such cases, applications should be forwarded to our Engineering department for complete recommendations.



Bearing bore tolerance: ½" - 2 3⁄16" = nominal to +.0005, + .013mm;
2 ¼" - 3 3⁄16" = nominal to +.0006",+.015mm;
3 7⁄16" - 1 15⁄16" = nominal to +.0007",+.018mm
Recommended shaft tolerances: ½" - 1 15⁄16" = nominal to -.0005", -.013mm;
2" - 3 15⁄16" = nominal to -.0010", -.025mm.

HOUSING, SHOULDERS AND SHAFT DIAMETERS

Bearing Number					Shaft Size	Basic Outer Ring Size	Housing Stationary[1]			Shoulder Diameter H	
KRR Type	G-KRR Type	RA-RR Type	GRA-RR Type	GYA-RR* Type			Housing Bore,D min.	max	mean fit loose	max.	min.
					in.		in.	in.	in.	in.	in.
					mm		mm	mm	mm	mm	mm
1008KRR	–	RA008RR	GRA008RR	GYA0008RR	½						
–	–	RA009RR	GRA009RR	GYA009RR	9⁄16	203					
1010KRR(KR)	G1010KRR	RA010RR	GRA010RR	GYA010RR	5⁄8		1.5748	1.5754	0.0005	1.37	1.34
1011KRR	G1011KRR	–	–	–	11⁄16		40.000	40.015	0.013	34.8	34.0
E17KRR	GE17KRR	RAE17RR	GRAE17RR	GYAE17RR	17						
1012KRR(KR)	G1012KRR	RA012RR	GRA012RR	GYA012RR	¾	204	1.8504	1.8510	0.0005	1.61	1.60
E20KRR	GE20KRR	RAE20RR	GRAE20RR	GYAE20RR	20		47.000	47.015	0.013	40.9	40.6
1013KRR	–	RA013RR	GRA013RR	GYA013RR	13⁄16						
1014KRR	G1014KRR	RA014RR	GRA014RR	GYA014RR	7⁄8	205					
1015KRR(KR)	G1015KRR	RA015RR	GRA015RR	GYA015RR	15⁄16		2.0472	2.0479	0.0006	1.81	1.80
1100KRR(KR)	G1100KRR	RA100RR	GRA100RR	GYA100RR	1		51.999	52.017	0.015	46.0	45.7
E25KRR	GE25KRR	RAE25RR	GRAE25RR	GYAE25RR	25						
–	G1101KRR	RA101RR	GRA101RR	GYA101RR	1 1⁄16						
1102KRR(KR)	G1102KRR	RA102RR	GRA102RR	GYA102RR	1 1⁄8	206					
1103KRR(KR)	G1103KRR	RA103RR	GRA103RR	GYA103RR	1 3⁄16		2.4409	2.4416	0.0006	2.21	2.16
–	–	–	–	GYA103RR2	1¼		61.999	62.017	0.015	56.1	54.9
E30KRR	GE30KRR	RAE30RR	GRAE30RR	GYAE30RR	30						
1104KRR(KR)	G1104KRR	RA104RR	GRA104RR	GYA104RR	1¼						
1105KRR	–	RA105RR	GRA105RR	GYA105RR	1 5⁄16	207					
1106KRR	G1106KRR	RA106RR	GRA106RR	GYA106RR	1 3⁄8		2.8346	2.8353	0.0006	2.21	2.16
1107KRR(KR)	G1107KRR	RA107RR	GRA107RR	GYA107RR	1 7⁄16		71.999	72.017	0.015	56.1	54.9
E35KRR	GE35KRR	RAE35RR	GRAE35RR	GYAE35RR	35						
1108KRR(KR)	G1108KRR	RA108RR	GRA108RR	GYA108RR	1½	208					
–	–	RA106RR	GRA109RR	GYA109RR	1 9⁄16		3.1496	3.1503	0.0006	2.87	2.78
–	–	–	GRAE40RR	GYAE40RR	40		80.000	80.018	0.015	72.9	70.6
1110KRR	G1110KRR	RA110RR	GRA110RR	GYA110RR	1 5⁄8						
1111KRR(KR)	G1111KRR	RA111RR	GRA111RR	GYA111RR	1 11⁄16	209	3.3465	3.3474	0.0008	3.07	2.97
1112KRR(KR)	G1112KRR	RA112RR	GRA112RR	GYA112RR	1¾		85.001	85.024	0.020	78.0	75.4
E45KRR	–	–	GRAE45RR	GYAE45RR	45						
–	–	RA113RR	GRA113RR	GYA113RR	1 13⁄16						
1114KRR	–	RA114RR	GRA114RR	GYA114RR	1 7⁄8	210					
1115KRR(KR)	G1115KRR	RA115RR	GRA115RR	GYA115RR	1 15⁄16		3.5433	3.5442	0.0008	3.27	3.19
–	–	–	GRA115RR2	–	2		90.000	90.023	0.020	83.1	81.0
E50KRR	GE50KRR	RAE50RR	GRAE50RR	GYAE50RR	50						
1200KRR(KR)	G1200KRR	RA200RR	GRA200RR	GYA200RR	2						
–	–	RA201RR	GRA201RR	GYA201RR	2 1⁄16	211					
1202KRR	–	RA202RR	GRA202RR	GYA202RR	2 1⁄8		3.9370	3.9379	0.0008	3.58	3.56
1203KRR(KR)	G1203KRR	RA203RR	GRA203RR	GYA203RR	2 3⁄16		100.000	100.023	0.020	90.9	90.4
E55KRR	GE55KRR	RAE55RR	GRAE55RR	GYAE55RR	55						
1204KRR	–	–	–	–	2¼	212					
1207KRR(KR)	G1207KRR	–	–	–	2 7⁄16		4.3307	4.3316	0.0008	3.98	3.87
E60KRR	GE60KRR	–	–	–	60		110.000	110.023	0.020	101.1	98.3
1215KRR	–	–	–	–	2 15⁄16	215	5.1181	5.1191	0.0009	4.76	4.59
E75KRR	–	–	–	–	75		130.000	130.025	0.023	120.9	116.6

[1] When the housing revolves in relation to the shaft, housing bore dimensions shown on page 33 should be used. Outer ring tolerances and housing fillet radii correspond to equivalent 200 Series single row radial bearings.

ISO BORE TOLERANCES-MILLIMETERS

Nominal Diameters		F7		G7		H8		N6		N7		R6		R7	
Over	Incl.	high	low	high	low	high	low	high	low	high	low	high	low	high	low
6	10	+0.028	+0.013	+0.020	+0.005	+0.022	0	-0.007	-0.016	-0.004	-0.019	-0.016	-0.025	-0.013	-0.028
10	18	+0.034	+0.016	+0.024	+0.006	+0.027	0	-0.009	-0.02	-0.005	-0.023	-0.020	-0.031	-0.016	-0.034
18	30	+0.041	+0.020	+0.028	+0.007	+0.033	0	-0.011	-0.024	-0.007	-0.028	-0.024	-0.037	-0.020	-0.041
30	50	+0.050	+0.025	+0.034	+0.009	+0.039	0	-0.012	-0.028	-0.008	-0.033	-0.029	-0.045	-0.025	-0.050
50	65	+0.060	+0.030	+0.040	+0.010	+0.046	0	-0.014	-0.033	-0.009	-0.039	-0.035	-0.054	-0.030	-0.060
65	80	+0.060	+0.030	+0.040	+0.010	+0.046	0	-0.014	-0.033	-0.009	-0.039	-0.037	-0.056	-0.032	-0.062
80	100	+0.071	+0.036	+0.047	+0.012	+0.054	0	-0.016	-0.038	-0.010	-0.045	-0.044	-0.066	-0.038	-0.073
100	120	+0.071	+0.036	+0.047	+0.012	+0.054	0	-0.016	-0.038	-0.010	-0.045	-0.047	-0.069	-0.041	-0.076
120	140	+0.083	+0.043	+0.054	+0.014	+0.063	0	-0.020	-0.045	-0.012	-0.052	-0.056	-0.081	-0.048	-0.088
140	160	+0.083	+0.043	+0.054	+0.014	+0.063	0	-0.020	-0.045	-0.012	-0.052	-0.058	-0.083	-0.050	-0.090
160	180	+0.083	+0.043	+0.054	+0.014	+0.063	0	-0.020	-0.045	-0.012	-0.052	-0.061	-0.086	-0.053	-0.093
180	200	+0.096	+0.050	+0.061	+0.015	+0.072	0	-0.022	-0.051	-0.014	-0.060	-0.068	-0.097	-0.060	-0.106
200	225	+0.096	+0.050	+0.061	+0.015	+0.072	0	-0.022	-0.051	-0.014	-0.060	-0.071	-0.100	-0.063	-0.109
225	250	+0.096	+0.050	+0.061	+0.015	+0.072	0	-0.022	-0.051	-0.014	-0.060	-0.075	-0.104	-0.067	-0.113

ISO SHAFT TOLERANCES-MILLIMETERS

Nominal Diameters		f5		f6		h5		h6		j6		m6	
Over	Incl.	high	low	high	low	high	low	high	low	high	low	high	low
3	6	-0.010	-0.015	-0.010	-0.018	0	-0.005	0	-0.008	+0.006	-0.002	+0.012	+0.004
6	10	-0.013	-0.019	-0.013	-0.022	0	-0.006	0	-0.009	+0.007	-0.002	+0.015	+0.006
10	18	-0.016	-0.024	-0.016	-0.027	0	-0.008	0	-0.011	+0.008	-0.003	+0.018	+0.007
18	30	-0.020	-0.029	-0.020	-0.033	0	-0.009	0	-0.013	+0.009	-0.004	+0.021	+0.008
30	50	-0.025	-0.036	-0.025	-0.041	0	-0.011	0	-0.016	+0.011	-0.005	+0.025	+0.009
50	80	-0.030	-0.043	-0.030	-0.049	0	-0.013	0	-0.019	+0.012	-0.007	+0.030	+0.011
80	120	-0.036	-0.051	-0.036	-0.058	0	-0.015	0	-0.022	+0.013	-0.009	+0.035	+0.013
120	180	-0.043	-0.061	-0.043	-0.068	0	-0.018	0	-0.025	+0.014	-0.011	+0.040	+0.015

ISO BORE TOLERANCES - INCH

Nominal Diameters		F7		G7		H8		N6		N7		R6		R7	
Over	Incl.	high	low	high	low	high	low	high	low	high	low	high	low	high	low
0.2362	0.3937	+0.0011	+0.0005	+0.0008	+0.0002	+0.0009	0	-0.0003	-0.0006	-0.0002	-0.0007	-0.0006	-0.001	-0.0005	-0.0011
0.3937	0.7087	+0.0013	+0.0006	+0.0009	+0.0002	+0.0011	0	-0.0004	-0.0008	-0.0002	-0.0009	-0.0008	-0.0012	-0.0006	-0.0013
0.7087	1.1811	+0.0016	+0.0008	+0.0011	+0.0030	+0.0013	0	-0.0004	-0.0009	-0.0003	-0.0011	-0.0009	-0.0015	-0.0008	-0.0016
1.1811	1.9685	+0.0020	+0.0010	+0.0013	+0.0004	+0.0015	0	-0.0005	-0.0011	-0.0003	-0.0013	-0.0012	-0.0018	-0.001	-0.002
1.9685	2.5591	+0.0024	+0.0012	+0.0016	+0.0004	+0.0018	0	-0.0006	-0.0013	-0.0004	-0.0015	-0.0014	-0.0021	-0.0012	-0.0024
2.5591	3.1496	+0.0024	+0.0012	+0.0016	+0.0004	+0.0018	0	-0.0006	-0.0013	-0.0004	-0.0015	-0.0015	-0.0022	-0.0013	-0.0024
3.1496	3.9370	+0.0028	+0.0014	+0.0018	+0.0005	+0.0021	0	-0.0006	-0.0015	-0.0004	-0.0018	-0.0017	-0.0026	-0.0015	-0.0029
3.9370	4.7244	+0.0028	+0.0014	+0.0018	+0.0005	+0.0021	0	-0.0006	-0.0015	-0.0004	-0.0018	-0.0018	-0.0027	-0.0016	-0.003
4.7244	5.5118	+0.0033	+0.0017	+0.0021	+0.0006	+0.0025	0	-0.0008	-0.0018	-0.0005	-0.002	-0.0022	-0.0032	-0.0019	-0.0035
5.5118	6.2992	+0.0033	+0.0017	+0.0021	+0.0006	+0.0025	0	-0.0008	-0.0018	-0.0005	-0.002	-0.0023	-0.0033	-0.002	-0.0035
6.2992	7.0866	+0.0033	+0.0017	+0.0021	+0.0006	+0.0025	0	-0.0008	-0.0018	-0.0005	-0.002	-0.0024	-0.0034	-0.0021	-0.0037
7.0866	7.8740	+0.0038	+0.0020	+0.0024	+0.0006	+0.0028	0	-0.0009	-0.002	-0.0006	-0.0024	-0.0027	-0.0038	-0.0024	-0.0042
7.8740	8.8583	+0.0038	+0.0020	+0.0024	+0.0006	+0.0028	0	-0.0009	-0.002	-0.0006	-0.0024	-0.0028	-0.0039	-0.0025	-0.0043
8.8583	9.8425	+0.0038	+0.0020	+0.0024	+0.0006	+0.0028	0	-0.0009	-0.002	-0.0006	-0.0024	-0.003	-0.0041	-0.0026	-0.0044

ISO SHAFT TOLERANCES - INCH

Nominal Diameters		f5		f6		h5		h6		j6		m6	
Over	Incl.	high	low	high	low	high	low	high	low	high	low	high	low
0.1181	0.2362	-0.0004	-0.0006	-0.0004	-0.0007	0	-0.0002	0	-0.0003	+0.0002	-0.0001	+0.0005	+0.0002
0.2362	0.3937	-0.0005	-0.0007	-0.0005	-0.0009	0	-0.0002	0	-0.0004	+0.0003	-0.0001	+0.0006	+0.0002
0.3937	0.7087	-0.0006	-0.0009	-0.0006	-0.0011	0	-0.0003	0	-0.0004	+0.0003	-0.0001	+0.0007	+0.0003
0.7087	1.1811	-0.0008	-0.0011	-0.0008	-0.0013	0	-0.0004	0	-0.0005	+0.0004	-0.0002	+0.0008	+0.0003
1.1811	1.9685	-0.001	-0.0014	-0.001	-0.0016	0	-0.0004	0	-0.0006	+0.0004	-0.0002	+0.0010	+0.0004
1.9685	3.1496	-0.0012	-0.0017	-0.0012	-0.0019	0	-0.0005	0	-0.0007	+0.0004	-0.0003	+0.0012	+0.0004
3.1496	4.7244	-0.0014	-0.002	-0.0014	-0.0023	0	-0.0006	0	-0.0009	+0.0005	-0.0004	+0.0014	+0.0005
4.7244	7.0866	-0.0017	-0.0024	-0.0017	-0.0027	0	-0.0007	0	-0.0010	+0.0006	-0.0004	+0.0016	+0.0006

HYDRAULIC NUTS

INTRODUCTION

Torrington hydraulic nuts have been designed to install and remove tapered bore bearings with minimal effort. The use of hydraulic nuts allows for better control of the bearing internal clearance reduction without damaging the bearing or other components. Also, the hydraulic nut will considerably reduce the downtime during installation or removal of tapered bore bearings.

DESCRIPTION

The Torrington hydraulic nut consists of an internally threaded ring and an externally threaded ring with two o-ring seals.
All hydraulic nuts are supplied with:

- Quick connection fittings (external thread ¼" B.S.P. and internal thread ⅜" N.P.T.)
- Two pipe plugs ¼" B.S.P.
- One set of spare o-rings.

INSTRUCTIONS

When the hydraulic nut is used, the piston must be in the innermost position. For this operation, please ensure that the valve of the hydraulic hose is disconnected from the nut so that the nut is not under pressure.

To contract the piston inside the internally threaded ring, insert a rod bar in one of the four drilled holes located on the outside diameter of the internally threaded ring. Screw the hydraulic nut on the thread with the piston in contact with the surface until the groove machined on the outside diameter of the piston near the outboard face is level with the face of the internally threaded ring.

One of the two threaded holes must be plugged with the ¼" B.S.P. pipe plug before the hydraulic nut is pressurized. The maximum pressure permissible in the hydraulic nut is 14,000 psi (100 Kpa). The oil viscosity recommended is 1,400 **SUS** (300 cst) at operating temperature, (SAE 90 oil). To avoid over extension of the piston, a second groove has been machined on the outside diameter of the piston inboard of the one used to judge contraction. When this second groove is level with the face of the internally threaded ring, the piston has reached its length of travel as shown on the tables. If the second groove of the piston travels past the face of the internally threaded ring, the piston will not be correctly guided inside the threaded ring and the hydraulic nut can be damaged.

Should the oil start to leak from the piston area, it is certain that the o-ring seals are damaged or worn and need to be replaced.

When the hydraulic nut is not in use, ensure that the threaded holes are plugged to prevent the entry of contaminants in the piston cavity. To preserve against corrosion during storage, apply a coat of light oil on the hydraulic nut surfaces.

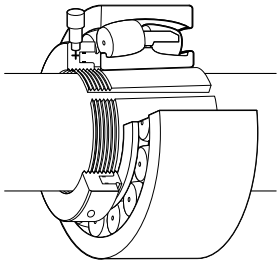
ORDERING COMPONENTS

Contact your local Torrington District office or nearest authorized Torrington bearing distributor for ordering Torrington hydraulic nut systems.

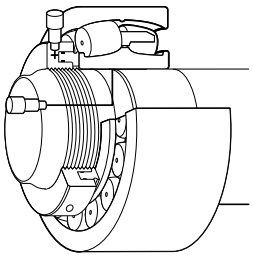
ENGINEERING SERVICES

Special applications should be referred to a Torrington District Sales Engineer for recommendations. The location of the Torrington District Office nearest you is listed on the last page.

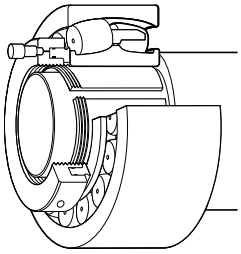
Installation



Hydraulic nut used to mount the bearing on a pull type sleeve.

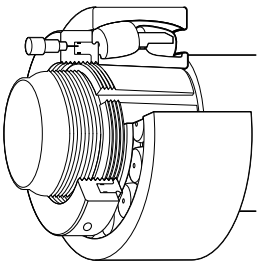


Hydraulic nut used to mount the bearing on tapered journal.



Hydraulic nut used to mount the bearing on a push type adapter sleeve.

Removal



Hydraulic nut used to withdraw a push type adapter sleeve.

Engineering Sales Offices

NORTH AMERICA

ALABAMA
1855 Data Drive
Birmingham, AL 35244-1237
Tel: (205) 987-4966
Fax: (205) 987-4933

CALIFORNIA
12641 East 166th Street
Cerritos, CA 90701-2101
Tel: (562) 404-3500
Fax: (562) 404-4638

3170 Crow Canyon Place
San Ramon,CA 94583-1347
Tel: (510) 866-0910
Fax: (510) 866-0911

COLORADO
Academy Park Commons
7114 West Jefferson Ave.
Lakewood,CO 80235-2309
Tel: (303) 986-0133
Fax: (303) 989-8485

CONNECTICUT
197 Scott Swamp Rd.
Farmington, CT 06032
Tel: (860) 677-1911
Fax: (860) 677-2024

FLORIDA
3751 Maguire Blvd.
Orlando, FL 32803
Tel: (407) 896-1444
Fax: (407) 896-4007

GEORGIA
3200 Highlands Pkwy.
Smyrna, GA 30082-5193
Tel: (770) 438-7313
Fax: (770) 859-7718

ILLINOIS
1701 52nd Avenue
Moline, IL 61265-6377
Tel: (309) 762-5254
Fax: (309) 762-7975

1400 Opus Place
Downers Grove,IL 60515-5701
Tel: (708) 663-0290
Fax: (708) 663-0296

401 N.E. Jefferson Street
Peoria, IL 61603-3725
Tel: (309) 676-9560
Fax: (309) 676-9938

INDIANA
10585 North Meridian St.
Indianapolis IN 46290-1066
Tel: (317) 846-3411
Fax: (317) 846-4434

KANSAS
Cloverleaf Bldg. #2
6901 West 63rd St.
Overland Park, KS 66202-4005
Tel: (913) 362-4640
Fax: (913) 362-1233

MICHIGAN
44670 Ann Arbor Road
Plymouth, MI 48170-3908
Tel: (313) 455-7300
Fax: (313) 455-8154

38701 Seven Mile Road
Livonia ,MI 48152-1058
Tel: (313) 462-4870
Fax: (313) 462-1934

MINNESOTA
7901 Xerxes Ave. So.
Bloomington, MN 55431-1200
Tel: (612) 887-2155
Fax: (612) 887-2163

NEW YORK
349 W. Commercial St.
E. Rochester, NY 14445-2404
Tel: (716) 381-3643
Fax: (716) 381-1909

NORTH CAROLINA
English Oaks Bldg.
8848 Red Oak Blvd.

Charlotte, NC 28217-5518
Tel: (704) 525-7710
Fax: (704) 525-9289

OHIO
9039 Springboro Pike
Miamisburg, OH 45342-4418
Tel: (937) 847-1691
Fax: (937) 847-8275

24651 Center Ridge Road
Westlake, OH 44145-5628
Tel: (216) 899-2200
Fax: (216) 899-2209

PENNSYLVANIA
650 Louis Drive
Warminster, PA 18974-2828
Tel: (215) 672-5280
Fax: (215) 672-7585

Brookside Office Pk.
71 McMurray Road
Pittsburgh, PA 15241-1688
Tel: (412) 831-5454
Fax: (412) 833-0320

TEXAS
9802 FM 1960 Bypass
Humble, TX
Tel: (281) 319-6212
Fax: (281) 319-5414

TEXAS (cont.)
4545 Fuller Drive
Irving, TX 75038-6530
Tel: (972) 717-4567
Fax: (972) 717-4448

WASHINGTON
One Lake Bellevue Bldg.
Bellevue, WA 98005-2417
Tel: (206) 455-4466
Fax: (206) 455-8304

WISCONSIN
The Rosewood Bldg.
250 Bishop's Way
Brookfield, WI 53005-6265
Tel: (414) 784-4844
Fax: (414) 784-8903

CANADA (Sales Off./DSC)
4246 97th Street
Edmonton, Alberta
Canada T6E 5Z9
Tel: (403) 433-9590
Fax: (514) 433-9823

132 Lindsey Avenue
Dorval, Quebec
Canada H9P 2T8
Tel: (514) 631-6757
Fax: (514) 631-4782

5598 McAdam Road
Mississauga, Ontario
Canada L4Z 1P1
Tel: (905) 890-2033
Fax: (905) 890-0086

LATIN AMERICA
To obtain the name of nearest office or distributor, please contact Torrington's Latin American Marketing & Engineering Center

8600 N.W. 36th St
Miami, Florida 33166
Tel: (305) 477-4141
FAX: (305) 477-5333

EUROPE
To obtain the name of nearest office or distributor, please contact Torrington's Consolidated European Marketing & Engineering Center

8 Rue Henri Becquerel
Odyssee 2000
F-92508 Rueil Malmaison
CEDEX
Paris, France
Tel: (33) (1) 47 16 90 00
Fax: (33) (1) 47 51 29 09
TLX: 631150 TOR FAF

ASIA – PACIFIC

AUSTRALIA
The Torrington Bearing Company
80-100 Frankstone Rd.
A.C.N. 004 099 861
Dandenong, Victoria 3175
Australia
Tel: (61) (3) 9794-1699
Fax: (61) (3) 9791-8742

SINGAPORE
The Torrington Company
42 Benoi Rd.
Singapore 2262
SINGAPORE
Tel: (65) 860-1555
Fax: (65) 861-1968

JAPAN
The Torrington Company
1-6-3 Ohsaki
Shinagawa-ku
Tokyo 141, Japan
Tel: (81) (3) 3779-7484
Fax: (81) (3) 3779-7493
TLX: 857642 TORINTL

TAIWAN
Room 1109,
142 Min-Chuan E. Rd. Sec. 3
Taipei, R.O.C. Taiwan
Tel: (886-2) 716-0642
Fax: (886-2) 717-6102
TLX: 9102508082 TORINTL

Distribution Service Centers

SOUTHEAST DSC (Atlanta)
3200 Highlands Parkway
Smyrna, GA. 30082-5192
Tel: (800) 372-4669
FAX: (404) 438-8811

SOUTHWEST DSC (Dallas)
4545 Fuller Drive
Carrollton, TX. 75038-6530
Tel: (800) 372-4669
FAX: (972) 717-4499

NORTHEAST DSC (Philadelphia)
650 Louis Drive
Warminster, PA. 18974-2828
Tel: (800) 372-4669
FAX: (215) 675-1206

MIDWEST DSC (Chicago)
1400 Opus Place,
Downers Grove, IL. 60515-5701
Tel: (800) 372-4669
FAX: (708) 241-0890

WEST COAST DSC (Reno)
245 E. Liberty Street
Reno, NV. 89501-2220
Tel: (800) 372-4669
FAX: (702) 334-4510

INTERNATIONAL
European Customer Service (ECS)
Torrington GmbH
Carlstrasse 50
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Übach-Palenburg
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Fax: (49) 2451-971-480