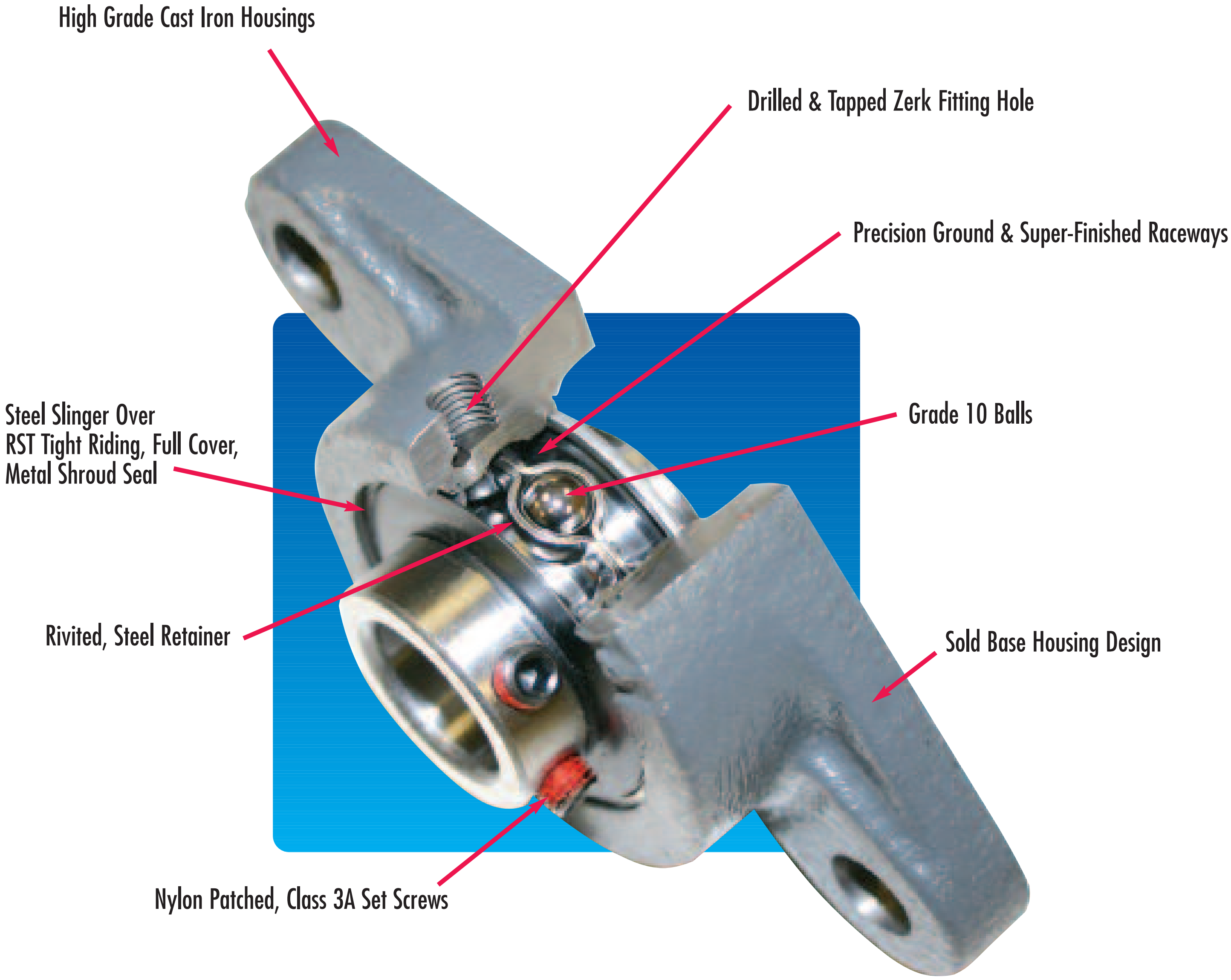
Engineering Data



A. Construction and features of ball bearing mounted units.

PEER mounted ball bearing units consist of a double sealed, single row, deep groove ball bearing and any one of many types of housings. The outer ring of the self-contained ball bearing is ground to a sphere along with the matching bore of the corresponding housing to provide self alignment capabilities. Cylindrical outer ring ball bearings are also available.

Figure 1

A. Figure 1 shows a cut away view of a standard 2-Bolt flange with set screw locking (UC series shown).
B. Figure 2 shows a cut away view of a standard pillow block housing with an eccentric locking collar bearing (HC Series shown).
C. Figure 3 shows a cut away view of a standard pillow block housing with a Grip-It locking bearing (GR Series).

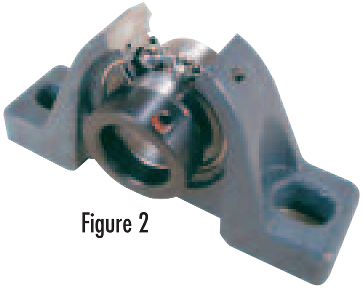


Figure 2

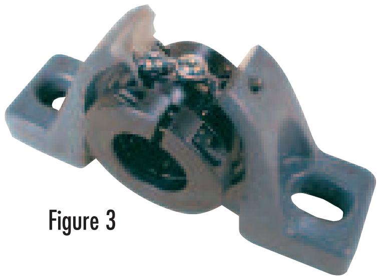


Figure 3

B. Typical features of PEER ball bearing mounted units.

(1) Internal construction of single row deep groove bearings in mounted units.
The ball bearings used in mounted units are quite similar to the 6200 and 6300 series of single row, deep groove, radial ball bearings. These bearings are designed to operate under radial and to a lesser degree thrust loads and combined loads. They have considerably greater load carrying capacity than double row, self aligning bearings used in some other types of mounted units.

(2) Bearing materials.
52100 Bearing Grade Steel.
PEER bearings inner ring, outer ring and balls are made of 52100 vacuum degassed steel. This high quality steel coupled with precision grinding and super finishing techniques increases bearing life and reduces bearing noise.

Stainless Steel
Peer Bearing Company's line of stainless steel bearings are designed to meet the demanding requirements of the FDA and USDA where wash-down and corrosion resistance are necessary. The full stainless steel bearings provide contamination and corrosion protection for long life.

Component	Material
Rings	Grade 440 Stainless Steel
Balls	Grade 440 Stainless Steel
Retainer	Grade 304 Stainless Steel
Slingers	Grade 304 Stainless Steel
Set Screws	Grade 304 Stainless Steel
Seals	Silicone (Si)
Grease	FDA Approved.

(3) Seals used on standard 52100 bearings. (See representative drawings on page 83)
PEER offers a multitude of bearing seal designs allowing users to select the one that is best suitable for their particular application.
a) The most common seal design is the PEER "R" seal. This incorporates a full shroud contact seal with rubber lip and slinger assuring positive dirt exclusion. The inboard contact seal is staked securely to the outer ring and the curved Buna-N rubber lip seals along the outside of the inner ring. The metal slinger is attached to the outside of the inner ring creating a complex path for contaminants to enter the bearing.
b) The PEER "RST" seal is similar to the contact seal used in the "R" seal design but without the slinger. It has a full cover shroud and positive rubber lip contact to the inner ring.
c) The PEER "TRL" triple lip seals are full cover shroud style with three individual wiping lips for the most complete protection against contaminants.

d) The PEER "DBL" double lip seals are full cover shroud style with two distinct rubber wiping lips. These are useful where additional protection is needed but high RPM's will not allow for the extra torque they require.
e) The PEER "Z" seal is a full cover shroud non-contact shield used where high RPM's and the need for a free spinning bearing are present. Available with slinger on wide inner ring bearings.

(3a) Seals used on Stainless Steel bearings.
PEER Stainless steel bearings incorporate silicone rubber seals in compliance with FDA guidelines. Stainless steel slingers are also available on wide inner ring stainless steel bearings.

Seal Materials Comparison:

BASE POLYMER	NITRILE	SILICONE	FLUOROELASTOMER
Material Code	NBR	Si	Viton
Temperature Range	-40 F ~ 250 F (-35 C ~ 120 C)	-80 F ~ 400 F (-60 C ~ 200 C)	-30 F ~ 400 F (-35 C ~ 200 C)
Oil Resistance	E	G	E
Acid Resistance	G	F	E
Alkali Resistance	G	X	F
Water Resistance	G	G	G
Heat Resistance	G	E	E
Cold Resistance	G	E	F
Wear Resistance	E	G	E
Ozone Resistance	G	E	E

E=Execllent G=Good F=Fair X=Not Recommended

(4) Locking Mechanisms.
PEER offers 3 distinct methods of locking the bearing to the shaft.

a) Set Screw Locking
This incorporates two class 3 set screws with nylon patch spaced 62 degrees apart in the inner ring extension. The areas around the set screws are high frequency annealed to allow the use of larger diameter set screws further increasing their effectiveness. The addition of a nylon patch to the set screws prevents their backing out under high vibration situations. See Photo A

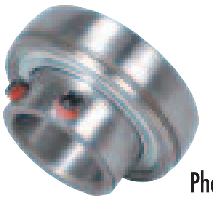


Photo A

b) Eccentric Locking Collar
The PEER eccentric locking collars are designed for use in applications where the shafts rotate in a single direction. They incorporate a matching eccentricity between the inner ring and locking collar. A radiused area in both the collar and inner ring where the eccentricity begins is instrumental in preventing cracks in this high stress area. Matching angles between the inner ring and locking collar provide optimal contact and security. PEER locking collars come standard with class 3 nylon patched set screws. See photo B

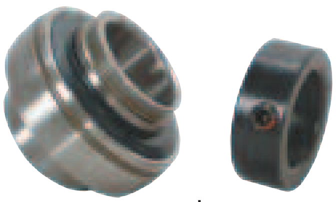


Photo B

c) "GR" Series locking
The PEER "GR" series or 'Grip It' locking design uses a concentric split collar which assembles over six split wedges of the inner ring. When the collar is tightened it forces the inner ring to grip the shaft creating a concentric bearing to shaft lock. In addition, there is no damage to the shaft from set screws which eliminates shaft refinishing after disassembly or replacement. High strength Torx drive cap screws provide maximum clamping force. See photo C


Photo C

Engineering Data

(5) Housings.

(a) Cast Iron. One piece cast iron housings provide solid construction and maximum wear resistance. Machined mounting surfaces and bearing seat insure proper mounting heights and bearing to housing alignment values. Cast or machined bolt holes make PEER interchangeable with most competitors.

(b) Ductile Iron. One piece ductile or malleable iron housings are made to the same exacting standards as the PEER cast iron housings with the addition of higher tensile strength values.

(c) Nickel Plating. For applications in the food, chemical and where added corrosion protection is needed, Cast iron and ductile housings are available with high phosphorous electroless nickel plating.

(d) Stamped Steel. PEER offers a wide variety of stamped steel housings of various thicknesses for light load applications. These stampings are available in a wide variety of finishes such as zinc plated, yellow dichromate, black electroless or raw.

(e) Thermoplastic Housings. PEER polymer housings are made of FDA recognized material and incorporate solid bases and stainless steel bolt inserts and grease fittings. When combined with PEER stainless steel or black oxide insert bearings, they are extremely resistant to corrosion and suited for use in washdown applications.

(f) Rubber Insulators. PEER Nitrile rubber insulators provide insulation and noise reduction properties. The conductive rubber interliners are available for use with most styles of stamped steel housings.

(g) Stainless Steel. PEER stainless steel housings are made of series 304 stainless steel and incorporate series 300 stainless steel grease fittings. Solid mounting surfaces make them ideally suited for food and chemical applications. These housings incorporate all the same machined features as our cast and ductile housings such as bearing seat, bolt holes and consistent mounting heights.

(6) Self Alignment.

The outer rings of Peer insert bearings are spherically ground to correspond with a matching spherical bearing seat on Peer housings. This spherical combination provides self-alignment features, which compensate for alignment errors, uneven mounting surfaces and shaft flexing. Misalignment of up to 5 degrees for non-relube units and 1.5 degrees for relube units is possible.

(7) Anti-rotation device.

The use of an anti-rotation pin in the outer ring prevents the bearing outer ring from turning in the housing. Located in the housing loading slot, this feature does not interfere with the self-aligning capability of the assembly. The anti-rotation pin is standard on wide inner ring bearings and an available option on flush back inner ring bearings.

(8) Interchangeability of bearings in housings.

Peer mounted units offer complete interchangeability of self-contained insert bearings in housings. This allows easy replacement of bearings in the field.

(9) Serviceability of assemblies.

Peer bearings are pre-lubricated with specially selected greases at the factory. Bearings and housings are available in a relubricable and non-relubricable version. Specialty greases and fill amounts are readily available. Relube fittings on Peer housings are available in a wide variety of styles and sizes.

(10) Handling of bearings.

Sealed bearings used in mounted units are packaged to prevent contamination of grease and damage during shipping and handling. To protect bearings and assemblies during storage, it is recommended all components remain intact. Locking collars, grease fittings and dust caps are matched to provide the optimum performance.

C. Tolerances

1. Tolerances for bearings.
1.1 Tolerances for inner ring.

Table 1: Tolerances on inner rings of insert bearings with cylindrical bore.

Unit: 0.001mm
(0.0001 in)

Nominal bore diameter d				Cylindrical bore					Radial run-out (max.)
				Bore Diameter			Width		
Over		Including		d_{mp} Deviations		V_{dp}	Bi Deviations		
mm	in.	mm	in.	High	Low	Max	High	low	
10	.03937	18	0.7087	+15 (+6)	0	10 (4)	0	-120 (-47)	10 (4)
18	0.7087	31.750	1.2500	+18 (+7)	0	12 (5)	0	-120 (-47)	13 (5)
31.750	1.2500	50.800	2.0000	+21 (+8)	0	14 (5.5)	0	-120 (-47)	15 (6)
50.800	2.0000	80	3.1496	+24 (+9)	0	16 (6)	0	-150 (-59)	20 (8)
80	3.1496	120	4.7244	+28 (+11)	0	19 (7.5)	0	-200 (-79)	25 (10)

d_{mp} = Single plane mean bore diameter deviation
V_{dp} = Bore diameter variation in a single radial plane

Table 1a: Bearing IR Tolerances Stainless steel bearings

Unit: 0.001mm

Bore Size		Bore Diameter				Width	
		dm		d		Bi	
Over	Incl.	High	Low	High	Low	High	Low
10	18	+18	0	+22	-4	0	-120
18	30	+21	0	+25	-4	0	-120
30	50	+25	0	+30	-5	0	-120
50	80	+30	0	+36	-6	0	-150

Note: dm is defined as the arithmetical mean of the largest and the smallest diameter obtained by two point measurements.

1.2 Tolerances for outer rings.

Table 2: tolerances on outer rings

Unit: 0.001mm (0.0001 in)

Nominal outside diameter				Dm deviations		Radial Run-out (Max.)
Over		Incl.				
mm	in.	mm	in.	High	Low	
30	1.1811	50	1.9685	0	-11 (-4)	20 (8)
50	1.9685	80	3.1496	0	-13 (-5)	25 (10)
80	3.1496	120	4.7244	0	-15 (-6)	35 (14)
120	4.7244	150	5.9055	0	-18 (-7)	40 (16)
150	5.9055	180	7.0866	0	-25 (-10)	45 (18)
180	7.0866	250	9.8425	0	-30 (-12)	50 (20)
250	9.8425	315	12.402	0	-35 (-14)	60 (24)

Note:

1. dm is defined as arithmetical mean of the largest and smallest diameter obtained by two point measurements.

2. The low deviation of outside diameter dm does not apply within the distance of 1/4 the width of outer ring from the side.

Table 2a: Bearing OR Tolerances Stainless Steel bearings

Unit: 0.001mm

Nominal OD "D"		Dm Deviations		Radial Run-out
Over	Incl.	High	Low	Max.
30	50	0	-11	20
50	80	0	-13	25
80	120	0	-15	35
120	150	0	-18	40

Note: dm is defined as the arithmetical mean of the largest and the smallest diameter obtained by two point measurements.

2. Tolerances for cast iron housings.

2.1 Tolerances for spherical inner diameter of housings

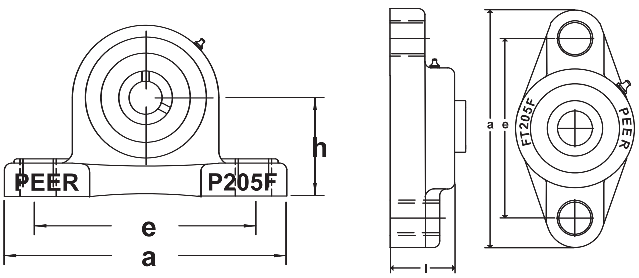
Table 3. Tolerances for spherical inner diameter of housings And resultant fits.

Unit: 0.001mm
(0.0001 in)

Nominal Spherical inside diameter (D1)				J7				K7				N6			
Over		Incl.		D1m Deviations		Resultant fit		D1m Deviations		Resultant fit		D1m Deviations		Resultant fit	
mm	in	mm	in	High	Low			High	Low			High	low		
30	1.1811	50	1.9685	+14 (+6)	-11 (-4)	25L (11L)	11T (4T)	+7 (+3)	-18 (-7)	18L (7.5L)	18T (7T)	-12 (-5)	-28 (-11)	1T (0.5T)	28T (11T)
50	1.9685	80	3.1496	+18 (+7)	-12 (-5)	31L (12L)	12T (5T)	+9 (+4)	-21 (-8)	22L (9L)	21T (8T)	-14 (-6)	-33 (-13)	1T (1T)	33T (13T)
80	3.1496	120	4.7244	+22 (+9)	-13 (-5)	37L (15L)	13T (5T)	+10 (+4)	-25 (-10)	25L (10L)	25T (10T)	-16 (-6)	-38 (-15)	1T (0)	38T (15T)
120	4.7244	150	5.9055	+26 (+10)	-14 (-6)	44L (17L)	14T (6T)	+12 (+5)	-28 (-11)	30L (12L)	28T (11T)	-20 (-8)	-45 (-18)	2T (1T)	45T (18T)
150	5.9055	180	7.0866	+26 (+10)	-14 (-6)	51L (20L)	14T (6T)	+12 (+5)	-28 (-11)	37L (15L)	28T (11T)	-20 (-8)	-45 (-18)	5L (2L)	45T (18T)
180	7.0866	250	9.8425	+30 (+12)	-16 (-6)	60L (24L)	16T (6T)	+13 (+5)	-33 (-13)	43L (17L)	33T (13T)	-22 (-9)	-51 (-20)	8L (3L)	51T (20T)
250	9.8425	315	12.402	+36 (+14)	-16 (-6)	71L (28L)	16T (6T)	+16 (+6)	-36 (-14)	51L (20L)	36T (14T)	-25 (-10)	-57 (-22)	10L (4L)	57T (22T)

D1m is defined as the arithmetical mean of the largest and the smallest diameter obtained by two point measurements.

Table 3a: Housing Tolerances (Thermoplastic PBT)



Unit: 0.01mm

Size	Pillow Blocks (P200-PBT, PAS200-PBT Series)			Flanges (FT200-PBT, F200-PBT, FB200-PBT Series)		
Dimension	h	a	e	a	e	l
204	±15	±150	±50	±150	±60	±50
205	±15	±150	±50	±150	±60	±50
206	±15	±150	±50	±150	±60	±50
207	±15	±150	±50	±150	±60	±50
208	±15	±150	±50	±150	±60	±50
209	±15	±150	±50	±150	±60	±50
210	±15	±150	±50	±150	±60	±50
211	±20	±200	±70	±200	±80	±70
212	±20	±200	±70	±200	±80	±70

Pillow Block (P200-PBT) and 2-Bolt flange (FT200-PBT) shown

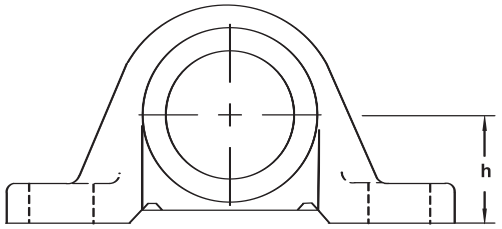
Table 3b: Thermoplastic Housing Properties:

Max. Operating Temperature	Tensile Strength	Flexural strength	Compression Strength	Impact
280°F	17,300 PSI	27,500 PSI	18,000 PSI	15 ft-lbs/inch

2.2 Tolerances for pillow block housings.
Table 4. Tolerances for "h" dimension for ductile and cast iron pillow block housings.

Unit: 0.0001 in (mm)

Housing No. P, PSB, LP, PWC, PW, PA, PAS	PX00	Tolerance of h
203	--	±59 (±.15)
204	--	
205	X05	
206	X06	
207	X07	
208	X08	
209	X09	
210	X10	
211	X11	±79 (±.20)
212	X12	
213	X13	
214	X14	
215	X15	
216	X16	
217	X17	
218	X18	
--	--	±118 (±.30)
--	X20	

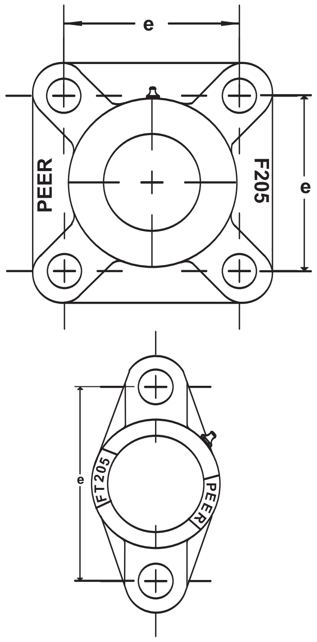


Note: h = height of mounting surface to shaft centerline

2.3 Tolerances for flange unit housings.
Table 5: tolerances for "e" dimension of ductile and cast iron flange unit housings.

Unit: 0.0001 in. (mm)

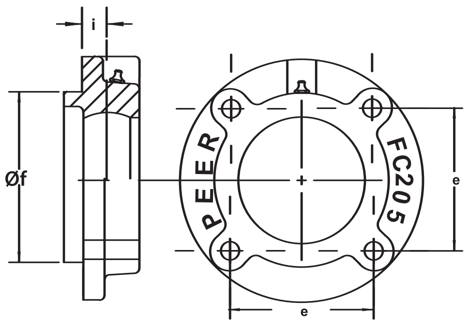
Housing No. F, FS, FT, FTS, LF, FD, FLCT, FJ, FX, F4X, F3X, F3C, FTJ	Casted tolerance of e	Machined tolerance of e
203	±236 (±.6)	±197 (±.5)
204		
205		
206		
207		
208		
209		
210		
211	±315 (±.8)	
212		
213		
214		
215		
216		
217		
218		



Note: 1) e = bolt holes centerline dimension.

2.4 Tolerances for machined back (Piloted) flange unit housings. (FC)

Table 6: Machined back flange unit housings (FC)



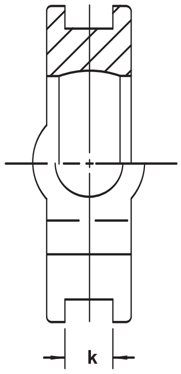
Unit: 0.0001 in. (mm)

Housing No.		Machined tolerance of e	Machined tolerance of i	Radial runout of spigot joint (Max)	Tolerance of f FC200		Tolerance of f FCX00	
					High	Low	High	Low
FC204	--	±157 (±.4)	±157 (±.4)	79	0	-39 (-.1)	0	-39 (-.1)
FC205	FCX05	±197 (±.5)	±157 (±.4)	79	0	-39 (-.1)	0	-39 (-.1)
FC206	FCX06	±197 (±.5)	±157 (±.4)	79	0	-39 (-.1)	0	-39 (-.1)
FC207	FCX07	±197 (±.5)	±157 (±.4)	79	0	-39 (-.1)	0	-39 (-.1)
FC208	FCX08	±197 (±.5)	±157 (±.4)	79	0	-39 (-.1)	0	-39 (-.1)
FC209	FCX09	±197 (±.5)	±157 (±.4)	79	0	-39 (-.1)	0	-39 (-.1)
FC210	FCX10	±197 (±.5)	±157 (±.4)	79	0	-39 (-.1)	0	-39 (-.1)
FC211	FCX11	±197 (±.5)	±157 (±.4)	79	0	-39 (-.1)	0	-39 (-.1)
FC212	FCX12	±197 (±.5)	±197 (±.5)	118	0	-39 (-.1)	0	-39 (-.1)
FC213	FCX13	±197 (±.5)	±197 (±.5)	118	0	-39 (-.1)	0	-39 (-.1)
FC214	FCX14	±197 (±.5)	±197 (±.5)	118	0	-39 (-.1)	0	-39 (-.1)
FC215	FCX15	±197 (±.5)	±197 (±.5)	118	0	-39 (-.1)	0	-39 (-.1)
FC216	FCX16	±197 (±.5)	±197 (±.5)	118	0	-39 (-.1)	0	-39 (-.1)
FC217	FCX17	±197 (±.5)	±197 (±.5)	118	0	-39 (-.1)	0	-39 (-.1)
FC218	FCX18	±197 (±.5)	±197 (±.5)	118	0	-39 (-.1)	0	-39 (-.1)
--	--	±197 (±.5)	±197 (±.5)	118	0	-39 (-.1)	0	-39 (-.1)
--	FCX20	±197 (±.5)	±197 (±.5)	157	0	-39 (-.1)	0	-39 (-.1)

Note: 1) e = bolt holes centerline dimensions.
2) i = bearing centerline distance from mounting surface.
3) f = outside diameter of spigot joint.

Table 7: Take up slot widths - "K" dimensions

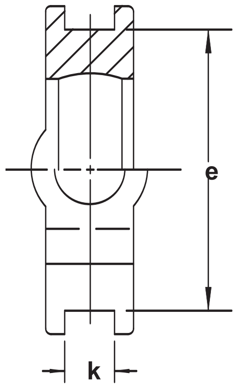
Housing No.	PEER Standard	Option	Option	Option
T-204	17/32	15/32	_	5/16
T-205	17/32	15/32	_	5/16
T-206	17/32	15/32	_	5/16
T-207	17/32	15/32	_	5/16
T-208	11/16	5/8		
T-209	11/16	5/8		
T-210	11/16	5/8		
T-211	.866	17/16	11/16	
T-212	.866	17/16	11/16	
T-213	17/16			
T-214	17/16			
T-215	17/16			
T-216	17/16			
T-217	17/16			



2.5 Tolerances for take up housings. (T)
Table 8: Tolerances for "K" and "e" dimensions
For take up housings (T)

Unit: 0.0001 in.

Housing No.		Tolerance Of K	Tolerance of e	Tolerance of parallelism between both grooves (Max.)
T-204	--			
T-205	T-X05			
T-206	T-X06	+79	0	157
T-207	T-X07	0	-197	
T-208	T-X08			
T-209	T-X09			
T-210	T-X10			
T-211	T-X11			
T-212	T-X12			
T-213	T-X13	+118	0	236
T-214	T-X14	0	-315	
T-215	T-X15			
T-216	T-X16			
T-217	T-X17			



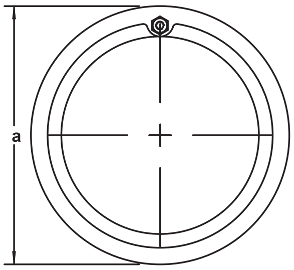
Note: 1) K = width of guide rail grooves
2) e = the span of guide rail grooves

2.6 Tolerances for cartridge unit housings[LL11].

Table 9: Tolerances for cartridge unit housings (C)

Unit 0.0001 in.

Housing No.		Tolerance of a				Radial runout of outside surface (Max.)	Tolerance of l
		C200		CX00			
		High	Low	High	Low		
C204	--			--	--		
C205	CX05	0	-12				
C206	CX06			0	-14		
C207	CX07					79	±79
C208	CX08	0	-14				
C209	CX09			0	-14		
C210	CX10						
C211	CX11						
C212	CX12	0	-16			118	±118
C213	--			--	--		



Note: 1) a = outside diameter of cartridge housings.
2) l = width of cartridge housings.

2.7 Tolerances for standard castings.

Table 10: Standard casted tolerances.

Unit: inches (mm)

Nominal Dimensions	Up to 3.4 inches	3.4 up to 7.87 inches	7.87 up to 15.65 inches	15.65 up to 31.50 inches
Tolerances	±.039 (±1.0)	±.059 (±1.5)	±.098 (±2.5)	±.118 (±3.0)

Tolerances of thickness

Unit: inches (mm)

Nominal Dimension	Up to .197 inches	.197 up to .394 inches	.394 up to .787 inches	.787 up to 1.181 inches	1.181 up to 1.575 inches
tolerances	±.039 (±1.0)	±.059 (±1.5)	±.079 (±2.0)	±.118 (±3.0)	±.157 (±4.0)

Table 11: Machined tolerances For all machined tolerances not otherwise specified in this catalog.

Unit: inches (mm)

Nominal dimension				Dimensional Tolerances
Over		Incl.		
mm	in	mm	in	
4	0.1575	16	0.6299	±.0118 (±.3)
16	0.6299	63	2.4803	±.0159 (±.4)
63	2.4803	250	9.8425	±.0197 (±.5)

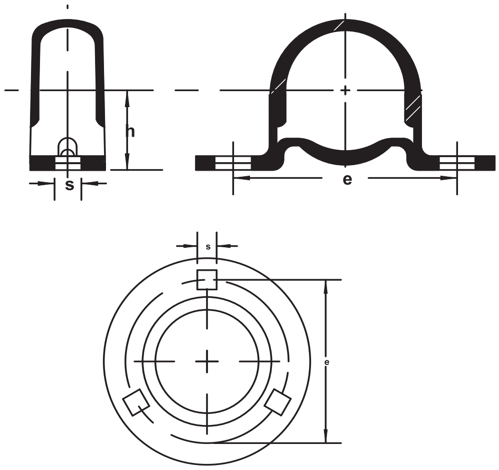
3. Tolerances for pressed steel units.

Table 12: Tolerances for pressed steel housings [LL12].

Unit: 0.0001 in.

Housing No.	e	s	h
PP-3Z TO PP-9Z	±118	±79	±100
PF-3R TO PF-7R			
PFF-7R TO PFF-11R			
PFL-3R TO PFL-7R			

Note: 1) e = centerline dimension
2) s = bolt hole dimension
3) h = base to center height.



4. Suggested tolerances for shaft

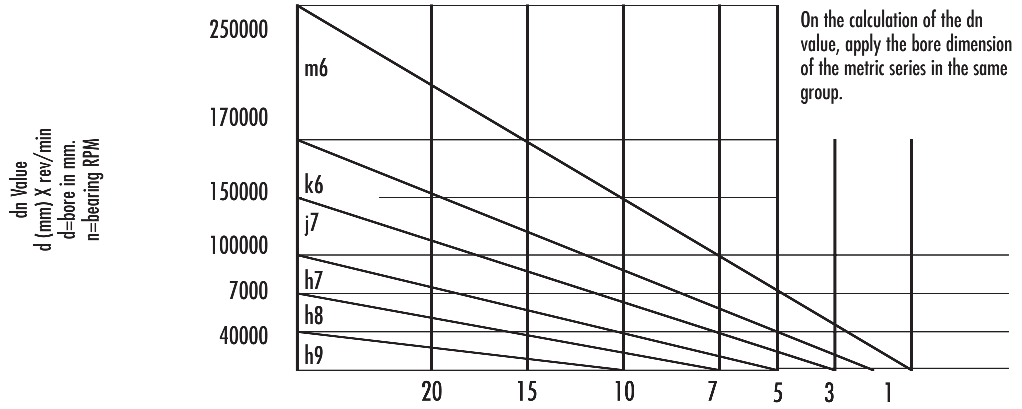
Table 13: Shaft tolerances for cylindrical bore insert bearings.

Unit: 0.0001 in

Shaft Diameter				Shaft Tolerances											
Over		Incl.		h7		h8		h9		j7		k6		m6	
mm	in	mm	in	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
10	0.3937	18	0.7087	0	-7	0	-11	0	-17	+5	-2	+5	0	+7	+3
18	0.7087	30	1.1811	0	-8	0	-13	0	-20	+5	-3	+6	+1	+8	+3
30	1.1811	50	1.9685	0	-10	0	-15	0	-24	+6	-4	+7	+1	+10	+4
50	1.9685	80	3.1496	0	-12	0	-18	0	-29	+7	-5	+8	+1	+12	+4
80	3.1496	120	4.7244	0	-14	0	-21	0	-34	+8	-6	+10	+1	+14	+5
120	4.7244	140	5.5118	0	-16	0	-25	0	-39	+9	-7	+11	+1	+16	+6

4.1 Suggested shaft tolerances using set screw locking bearings.

Table 14: Suggested shaft tolerances for set screw locking bearing units.

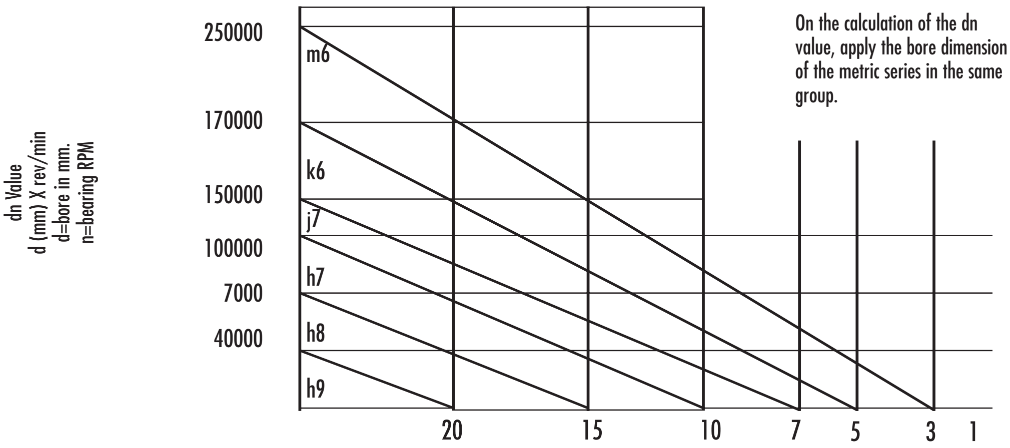


C/P
C = bearing radial load rating
P = equivalent radial load applied to bearing

Note: For low speed and/or low load applications, loose fits are adequate.
However, for higher speed and/or load applications, tighter fits are suggested.

4.2 Suggested shaft tolerances using eccentric locking collar bearings.

Table 15: Suggested shaft tolerances for eccentric locking collar bearing units.



C/P
C = bearing radial load rating
P = equivalent radial load applied to bearing

As in the case of the set screw system, it is usual under normal operating conditions, to fit the inner ring to the shaft by means of a clearance fit for ease of assembly.

Table 15.1: Eccentric locking collar shaft tolerance quick reference chart.

Unit: 0.0001 in.

Shaft Diameter	Shaft Tolerance
1/2"– 1 15/16"	Nominal to -10
2" – 3 15/16"	Nominal to -16

D. Mounting
Locking to the shaft.

Cylindrical bore bearings- Set screw locking.
For normal operating conditions, ball bearings are fixed to the shaft with socket head set screws as illustrated in figures 4 and 5. It is recommended that the shaft have flats or recesses in the areas where the set screws will contact it. This eliminates the formation of burrs on the shafting

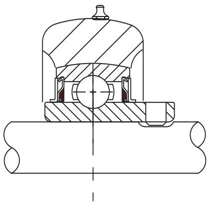


Figure 4

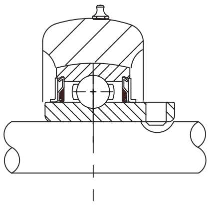


Figure 5

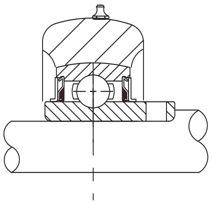


Figure 6

Where vibration, shock and or thrust loads are anticipated, it is recommended that the shaft have a machined shoulder or auxiliary locking collar against which the bearing inner ring can be mounted. See figure 6. Set screws on cylindrical bore bearings should be tightened incrementally and firmly to prevent rotation of the shaft in the bearing bore. Tighten one set screw to sufficiently contact the shaft, then tighten the second set screw to the full torque requirement, and then tighten the first set screw to the full torque requirement. It is also recommended the set screws be re-tightened after 24 hours of operation. Tightening torque values are shown in table 16. Caution should be taken to not over tighten the set screws as this can cause inner ring distortion instigating an eccentric rotation and out of balance situation.

It is important to mention that PEER high frequency anneals the inner ring in the areas around the set screws. In addition to preventing cracking of the inner ring during set screw tightening, this allows the use of larger diameter set screws increasing the holding power. Set screw sizes and hex sizes are shown in table 16.
PEER also uses a special set screw spacing to increase holding power of the set screws during operation.

Table 16: Tightening torque of set screws in set screw locking bearings.

Bearing No.			Size	Hex width	Tightening torque In-Lbs.
UC/SER	UCX	FHS			
201-205	X05	201-206	1/4-28x1/4	1/8	77.9
201-205(mm)		201-206(mm)	M6xP1.0		77.9
206-209	X06-X08	207-209	5/16-24x5/16	5/32	156
206-209(mm)		207-209(mm)	M8xP1.0		156
210-213	X10-X12	210-213(mm)	3/8-24x3/8	3/16	273
210-213(mm)			M10xP1.25		273
214-217	X13-X16		7/16-20x7/16	7/32	428
214-217(mm)			M12xP1.5		428
218	X17		1/2-20x1/2	1/4	615
218(mm)			M12xp1.5		428

Note: based on class 3A, alloy steel, knurled cup point set screws, cold forged with black oxide finish. Hardness value of 45-53 used in annealed inner rings with class 3B set screw holes. Other set screw styles and types are available upon request.

Table 16:a Stainless Steel Set Screw Tightening Torque Requirements

Size	Set Screw	Torque (in-lbs)
201-206	1/4-28	54
207-209	5/16-24	110
210-212	3/8-24	205

Cylindrical bore bearings-Eccentric locking collars.
Eccentric locking collar bearings are locked to the shaft by aligning the eccentric area of the collar against the corresponding eccentric area of the inner ring and rotating the collar in the direction of shaft rotation. Using a punch in the blind hole on the collar, tap the punch in the direction of shaft rotation. The eccentric locking collar will continually tighten during shaft rotation. Tightening the set screw in the locking collar to the shaft using the torque values shown in table 17 will provide limited holding power and is not to be relied upon solely for securing the shaft.

Eccentric Locking collar bearings are to be used in single direction rotating applications only. If a reversing rotation is desired or expected, set screw locking or "Grip-It" style bearings are required. If thrust or axial loads are expected on locking collar bearings, the use of a machined shoulder or auxiliary locking device is required.

Table 17: Tightening torque of set screw in eccentric locking collar.

Eccentric Locking Collar	Inch Size		
	Set screw Dimensions		Tightening Torque
	UNF Threading	Width across flats	In-Lbs.
ER6004-6006	10-32x1/4	3/32	33.5
ER201-203	1/4-28x1/4	1/8	77.9
ER204	1/4-28x1/4	1/8	77.9
ER205	1/4-28x1/4	1/8	77.9
ER206	5/16-24x5/16	5/32	156
ER207-210	3/8-24x3/8	3/16	273
ER211-213	7/16-20x7/16	7/32	428

Note: Metric bore bearings use metric size set screws in the locking collars. See table 16 for tightening torque of metric size set screws.

ECCENTRIC LOCKING COLLAR ASSEMBLY PROCEDURES

Slide Shaft into bearing bore.
Shaft must be straight, true and
free of nicks and burrs.
properly aligned in the housing.

Locate bearing/shaft on mounting surface.
Mounting surface should be flat and stable.
If needed, align bearing to insure it is

Secure housing to mounting
surface.

If possible, rotate shaft by hand
in direction of final rotation
to insure the bearing turns freely
and smoothly.
Slide locking collar over shaft.

Engage locking collar by rotating
Collar IN DIRECTION OF SHAFT
ROTATION so the eccentricity of
the collar mates with the eccentricity
of the inner ring.

Insert a drift punch in blind
hole of locking collar. Punch
must be positioned so striking
it rotates the collar IN THE
DIRECTION OF SHAFT
ROTATION

Using a lightweight hammer, strike
Drift punch smartly to engage the
Collar IN THE DIRECTION OF
SHAFT ROTATION.
(Illustration shown for counter-
Clockwise shaft rotation)

DO NOT STRIKE PUNCH IN
SUCH A MANNER AS TO
EXERT FORCE STRAIGHT
DOWN ONTO THE BEARING
INNER RING.

Tighten the set screw to prescribed torque.

Cylindrical bore bearings-Concentric "Grip-It" bearings.
"GR" series or Grip-It bearings are locked to the shaft by tightening the concentric collar over the inner ring extension via the cap screw. As the cap screw is tightened, the collar compresses the inner ring extensions capturing the shaft in a concentric manner. Recommended cap screw torque values can be found in table 18.

This mounting style maintains superb shaft to bore concentricity eliminating vibration and fretting corrosion normally associated with insert bearings. In addition, since there is no screw intrusion into the shaft, there is no need to refinish or dress the shaft after removal or replacement of the Bearing.

Table 18: Grip-It series cap screw torque recommendations

"GR" Grip-It Locking			
Size	Cap Screw Size	Wrench Size	Tightening Torque in-lbs
GR204 – GR206	8-32	T-25	55-60
GR207 – GR209	10-24	T-27	70-80
GR210 – GR211	1/4-20	T-30	140-160
GR212 – GR214	5/16-18	T-45	340-360
GR215 – GR216	3/8-16	T-50	400-550

5 Greasing:
5.1 greasing intervals.
PEER mounted unit insert bearings are pre-lubricated at the factory and are ready for operation. Under normal operating conditions it is normal for a small amount of grease to purge from the seals during initial start up. This condition will stop once optimum grease fill has been obtained. Re-lubrication of PEER insert bearings is determined by operating conditions and environment. Greases used in re-lubricating PEER bearings should be NLGI # 2 compatible with a lithium thickener, mineral base oil and a temperature range of -10 to +260 degrees F. General greasing intervals based on RPM and operating conditions are shown in table 19. However, experience is the preferred method of determining greasing intervals and fill amounts.

Table 19: Greasing intervals.

Type of unit	dn value	Environmental conditions	Operating temperature F	Relubrication Frequency	
				Hours	Period
Standard	40,000 and below	Ordinary	5 to 176	1500 to 3000	6 to 12 months
Standard	70,000 and below	Ordinary	5 to 176	1000 to 2000	3 to 6 months
Standard	70,000 and below	Ordinary	176 to 212	500 to 700	1 month
Heat-resistant	70,000 and below	Ordinary	212 to 284	300 to 700	1 month
Heat-resistant	70,000 and below	Ordinary	284 to 338	300 to 700	1 month
Heat-resistant	70,000 and below	Ordinary	338 to 392	100	1 week
Cold-resistant	70,000 and below	Ordinary	76 to 176	1000 to 2000	3 to 6 months
Standard	70,000 and below	Very Dusty	5 to 212	100 to 500	1 week to 1 month
Standard	70,000 and below	Exposed to water	5 to 212	30 to 100	Daily to weekly

d = inner diameter of bearing (mm)
n = speed in RPM

5.2 Grease fill amounts

Care should be taken when re-greasing bearings to avoid overfilling. Overfilling can lead to excessive heat and or unseating of the seals. Grease should be introduced in small increments and under light pressure. The use of pneumatic greasing equipment is not recommended unless low pressure is assured. Whenever possible, the shaft should be rotated during relubrication to insure proper grease distribution throughout the raceways.

The grease fill shown in table 20 provides a general rule for re-greasing amounts. However, it is preferred that experience dictates fill amounts due to wide variances in applications and operating environments.

Table 20: Grease fill amounts.

Series	Fill Amount
201-205	2 grams
206-208	3 grams
209-212	5 grams
213-218	8 grams

5.3 Grease fittings.

PEER offers many styles and types of grease fittings. Figure 7 illustrates some of the many styles and sizes PEER units can be equipped with. Optional fitting materials, thread designs and additional styles are available by special order. Table 21 shows the standard fitting sizes used on PEER units.

Table 21: Grease fitting equipped in PEER ball bearing mounted units.

Bearing Number	Fitting Name	Thread Size
203-209	Zerk-1/4-28	1/4-28 UNF
210-218	Zerk-PS-18	1/8-27 NPT

Note: Optional 90° and 45° fittings available.

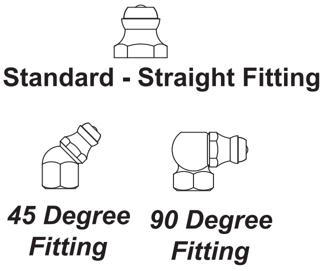


Figure 7

Location of zerk hole on pillow block units.

PEER has the ability to locate the zerk hole in a wide variety of locations on the pillow block housings.
Table 22 shows our standard location. See figure 8 and figure 9. Special locations are available by request.

Table 22: Location of zerk fitting on pillow block units.

Unit no.	Location
203-209	Angle - Figure 8
210-218	Top - Figure 9

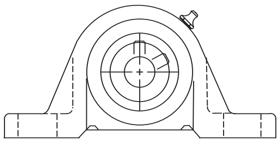


Figure 8

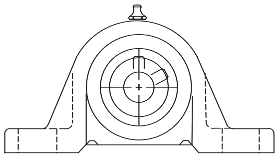


Figure 9

5.4 Grease types.

PEER bearings are pre-lubricated with standard grease suitable for a wide variety of applications, speeds, temperatures and environments. Special greases are readily available. Shown in table 23 is a small sampling of standard and special greases offered.

Table 23: Greases and operating temperatures.

Manufacturer trade name.	Recommended operating temperature range F	Properties				
		Thickener	Base oil	Water resistant	Viscosity CST @	
					40C	100C
Shell Alvania RL2	-10 to +260	Lithium	Mineral	Yes	98	9.4
Shell Alvania RL3	0 to +230	Lithium	Mineral	Yes	98	9.4
Exxon Polyrex EM	-40 to +350	Polyurea	Mineral	Yes	115	12.2
Chevron SRI #2	-20 to +350	Polyurea	Mineral	Yes	110	11
Chevron FM NLGI #2	-40 to +300	Polyurea	Mineral	Yes	220	18
Krytox 240AC / GPL	-30 to +550	Synthetic	Synthetic	Yes	270	26

Note: Operating temperature, environment, RPM and load all play a role in selecting the appropriate grease for each application. Experience and field data are the best method of selecting the correct grease.

6. Internal radial clearance.

Internal clearance between the balls and ball raceways in insert ball bearings permits interference fits on the bearing rings without preloading the bearings. In addition, the internal clearance is designed to allow for slight thermal expansion of the shafting in the inner ring and slight misalignment of the inner and outer rings. Proper internal clearance is particularly important for bearings operating at high speeds or under high temperatures and or loads.

Radial clearance can be defined as the average diameter of the outer ring raceway, minus the average diameter of the inner ring raceway, minus twice the ball diameter. The result is the amount of radial internal clearance. Generally, radial clearance is measured on assembled bearings by displacing the outer ring radially with respect to the inner ring under a reversing light gauge load. Table 24 shows the most common internal clearance classifications.

Table 24: Internal radial clearance for cylindrical bore insert bearings

Unit: 0.001mm / 0.0001 in.

Nominal bore diameter d				Radial internal clearance																			
				C2				C0				Standard / C3				C4				C5			
Over		Incl.		min.		max.		min.		max.		min.		max.		min.		max.		min,		max.	
mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	In
10	0.3937	18	0.7087	0	0	9	4	3	1	18	7	11	4	25	10	18	7	33	13	25	10	45	18
18	0.7087	24	0.9449	0	0	10	4	5	2	20	8	13	5	28	11	20	8	36	14	28	11	48	19
24	0.9449	30	1.1811	1	0	11	4	5	2	20	8	13	5	28	11	23	9	41	16	30	12	53	21
30	1.1811	40	1.5748	1	0	11	4	6	2	20	8	15	6	33	13	28	11	46	18	40	16	64	25
40	1.5748	50	1.9685	1	0	11	4	6	2	23	9	18	7	36	14	30	12	51	20	45	18	73	29
50	1.9685	65	2.5591	1	0	15	6	8	3	28	11	23	9	43	17	38	15	61	24	55	22	90	35
65	2.5591	80	3.1496	1	0	15	6	10	4	30	12	25	10	51	20	46	18	71	28	65	26	105	41
80	3.1496	100	3.9370	1	0	18	7	12	5	36	14	30	12	58	23	53	21	84	33	75	30	120	47
100	3.9370	120	4.7244	2	1	20	8	15	6	41	16	36	14	66	26	61	24	97	38	90	35	140	55
120	4.7244	140	5.5118	2	1	23	9	18	7	48	19	41	16	81	32	71	28	114	45	105	41	160	63

Note: Peer standard is C3 clearance for all ball bearing units except SER series, which utilizes C4 internal clearance.

6.1 Load ratings

The load ratings shown in table 25a apply to all PEER deep groove, mounted unit, ball bearings manufactured using 52100 bearing grade steel. See table 25b for load ratings of PEER stainless steel bearings.

Load ratings for cylindrical bore UC, HC, FHS, FHSR, FH, FHR, GR and SER series bearings are identical. The load ratings in table 25a have been calculated per ABMA standard 9-1990 and conform to ISO standard 281.

Table 25a; Load rating data 52100 steel bearings.
Unit: Lbf

Bearing Number							Basic Load Rating	
UC	HC	GR	FH	FHS	UCX	SER	Dynamic (Cr)	Static (Cor)
201S-203S	201S-203S		201-203	201-203			2160	1000
201-204	201-204	201-204	204	204		8-12	2900	1410
205	205	205	205	205		14-16	3150	1610
206	206	206	206	206	X05	17-20s	4370	2320
207	207	207	207	207	X06	20-23	5770	3150
208	208	208	208	208	X07	24-25	7340	3650
209	209	209	209	209	X08	26-28	7350	4150
210	210	210	210	210	X09	29-31	7880	4650
211	211	211	211	211	X10	32-25	9740	5850
212	212	212			X11	36-39	11780	7250
213	213				X12	40	13980	8000
214	214				X13		14000	8800
215	215				X14		14830	9750
216	216				X15		16280	10500

NOTE: These dynamic load ratings (Cr) are based on an interference shaft fit. ABMA standard 9-1990 recommends that for slip or loose shaft fits, divide the basic dynamic load rating (Cr) by 1.3 to obtain the de-rated value. For PEER GR series bearings, where shaft to bore concentricity is maintained, the de-rating factor can be reduced to 1.1 or eliminated depending on application parameters.

Table 25b: Load Rating data Stainless Steel Bearings
Unit: Lbf

Bearing Number		Load Rating	
SUC	SFHS	Cr Dynamic	Cor Static
204	204	2227	1500
205	205	2425	1763
206	206	3373	2535
207	207	4431	3439
208	208	5026	4012
209	209	5666	4586
210	210	6063	5225
211	211	7496	5622
212	212	9039	6944

E. Load Capacity and Life

Many factors influence the selection of a bearing for a particular application. The most common of these is the selection of a bearing based on its load carrying capacity and life calculations. A numerical value termed BASIC LOAD RATING has been assigned each insert bearing to be used in the life calculations. Values for the basic dynamic (Cr) and static (Cor) load capacity can be found in table 25 and on the individual insert bearing dimension pages of this catalog.

1) Basic Load Rating

The basic dynamic load rating (Cr) is used in calculations involving dynamically stressed bearings, when selecting a bearing which is to rotate under a radial load. This load rating expresses the dynamic load a specific bearing will operate under for a life of 1,000,000 revolutions (33 1/3 RPM for 500 hours).

2) Life

The life of an individual bearing is defined as the number of revolutions which the bearing is capable of enduring before fatigue occurs on the rings or balls.

Dynamic load ratings are based on the life that 90% of a group of identical bearings can be expected to reach or exceed. The majority of PEER bearings attain much longer life than this. The median life is approximately five times the calculated life rating.

2.1) Life calculation

The relationship between the basic rating life, the basic dynamic load rating and the applied load is expressed by the equation:

$L10 = (Cr/P)^p$

Where
L10 = basic rating life in millions of revolutions.
Cr = basic dynamic load rating, Lbf.
P = equivalent dynamic applied load, Lbf.
p = exponent for the life equation. For ball bearings the p value is 3.
For bearings operating under a steady applied load and at a constant speed, a basic life expressed in operating hours uses the equation:

$L10h = (Cr/P)^3 \times 16667/n$

Where
L10h = basic life in operating hours
n = operating speed, RPM.

The basic rating life expressed as either L10 or L10h should be used when selecting a bearing size.

Example 1: Determining L10h life.
An UC205-16 bearing is operating at 700 RPM with an applied radial load of 350 Lbf. The calculation for minimum (L10h) is;

From table 25 we know an UC205-16 bearing has a basic dynamic load rating (Cr) of 3150 Lbf. Therefore $(Cr/P)^3 = (3150/350)^3$ or 729. Given the RPM of 700 we know 16667/700 = 23.81. Therefore, 729 x 23.81 = 17,357.5 hours.

Example 2: Selecting a bearing.
A bearing is required to operate under a radial load (P) of 674 Lbf. At a constant speed of 2000 RPM and achieve a L10h life of 15,000 hours. To select the bearing we use the equation;

$Cr = P \times ((L10 \times RPM) / 16{,}667)^{1/3}$ or $674 \times ((15{,}000 \times 2000) / 16667)^{1/3}$ or Cr = 8199 Lbf.

Using this information and table 24 we find we need to use a bearing of size 211 at minimum to achieve this.

Example 3: Finding maximum load (P).
An UC204-12 bearing is to achieve a L10h of 10,000 hours while operating at 1500 RPM. To calculate the maximum steady radial load we can apply use the formula;

$P = Cr / ((L10 \times RPM) / 16667)^{1/3}$ or $P = 2900 / ((10{,}000 \times 1500) / 16667)^{1/3}$ or P = 300 Lbf.

Load Rating tables:
52100 Steel Bearings
Table 26a shows PEER standard duty 52100 steel ball bearings radial load capacity based on L10 life, operating speed and ring (bearing) size. The values in this table represent those loads a particular bearing can operate at, under ideal circumstances, and achieve a predetermined life (L10) at a selected RPM. ABMA standard 9-1990 recommends the use of a mounting factor multiplier de-rating these loads when a slip fit or loose fit shaft is used. To obtain the de-rated load multiply the load by 1.3.

Units: Lbf

		Revolutions Per Minute										
Size	L10 Hours	33.1/3	50	150	500	1000	1500	2000	3000	4000	5000	6000
201-203(S)	500	**2160**	1887	1308	876	695	607	552	482	438	407	383
	5000	1003	876	607	407	323	282	256	224	203	189	178
	10000	796	695	482	323	256	224	203	178	161	150	141
	30000	552	482	334	224	178	155	141	123	112	104	---
	50000	465	407	282	189	150	131	119	104	---	---	---
	100000	496	323	224	150	119	104	---	---	---	---	---
201-204	500	**2900**	2533	1757	1176	933	815	741	647	588	546	514
	5000	1346	1176	815	546	433	379	344	300			
	10000	1068	933	647	433	344	300	273	238	217	201	189
	30000	741	647	449	300	238	208	189	165	150	139	131
	50000	625	546	379	253	201	176	160	139	127	118	111
	100000	539	433	300	201	160	139	127	111	101	---	---
205	500	**3150**	2752	1908	1277	1014	886	805	703	639	593	---
	5000	1462	1277	886	593	471	411	374	326	296	275	
	10000	1161	1014	703	471	374	326	296	259	235	218	---
	30000	805	703	487	326	259	226	206	180	163	151	---
	50000	679	593	411	275	218	191	173	151	138	128	---
	100000	747	471	326	218	173	151	138	120	109	101	---
206	500	**4370**	3818	2647	1772	1407	1229	1116	975	886	---	---
	5000	2029	1772	1229	823	653	570	518	453	411		
	10000	1610	1407	975	653	518	453	411	359	326	---	---
	30000	1116	975	676	453	359	314	285	249	226	---	---
	50000	942	823	570	382	303	265	241	210	191	---	---
	100000	987	653	453	303	241	210	191	167	152	---	---
207	500	**5770**	5041	3495	2340	1857	1622	1474	1288	1170	---	---
	5000	2678	2340	1622	1086	862	753	684	598	543		
	10000	2126	1857	1288	862	684	598	543	474	431	---	---
	30000	1474	1288	893	598	474	414	377	329	299	---	---
	50000	1243	1086	753	504	400	350	318	277	252	---	---
	100000	1255	862	598	400	318	277	252	220	200	---	---
208	500	**7340**	6412	4446	2977	2363	2064	1875	1638	---	---	---
	5000	3407	2977	2064	1382	1097	958	870	760			
	10000	2704	2363	1638	1097	870	760	691	604	---	---	---
	30000	1875	1638	1136	760	604	527	479	418	---	---	---
	50000	1582	1382	958	641	509	445	404	353	---	---	---
	100000	1257	1097	760	509	404	353	321	280	---	---	---
209	500	**7350**	6421	4452	2981	2366	2067	1878	1640	---	---	---
	5000	3412	2981	2067	1384	1098	959	872	761			
	10000	2708	2366	1640	1098	872	761	692	604	---	---	---
	30000	1878	1640	1137	761	604	528	480	419	---	---	---
	50000	1584	1384	959	642	510	445	405	353	---	---	---
	100000	1348	1098	761	510	405	353	321	281	---	---	---
210	500	**7880**	6884	4773	3195	2536	2216	2013	1759	---	---	---
	5000	3658	3195	2216	1483	1177	1029	934	816			
	10000	2903	2536	1759	1177	934	816	742	648	---	---	---
	30000	2013	1759	1219	816	648	566	514	449	---	---	---
	50000	1698	1483	1029	689	547	477	434	379	---	---	---
	100000	1666	1177	816	547	434	379	344	301	---	---	---
211	500	**9740**	8509	5900	3950	3135	2739	2488	---	---	---	---
	5000	4521	3950	2739	1833	1455	1271	1155				
	10000	3589	3135	2174	1455	1155	1009	917	---	---	---	---
	30000	2488	2174	1507	1009	801	700	636	---	---	---	---
	50000	2099	1833	1271	851	676	590	536	---	---	---	---
	100000	2015	1455	1009	676	536	468	426	---	---	---	---
212	500	**11780**	10291	7136	4777	3792	3312	3009	---	---	---	---
	5000	5468	4777	3312	2217	1760	1538	1397				
	10000	4340	3792	2629	1760	1397	1220	1109	---	---	---	---
	30000	3009	2629	1823	1220	969	846	769	---	---	---	---
	50000	2538	2217	1538	1029	817	714	648	---	---	---	---
	100000	2391	1760	1220	817	648	566	515	---	---	---	---
213	500	**13980**	12213	8468	5669	4500	3931	3572	---	---	---	---
	5000	6490	5669	3931	2632	2089	1825	1658				
	10000	5151	4500	3120	2089	1658	1448	1316	---	---	---	---
	30000	3572	3120	2163	1448	1150	1004	912	---	---	---	---
	50000	3012	2632	1825	1222	970	847	770	---	---	---	---
	100000	2394	2089	1448	970	770	672	611	---	---	---	---
214	500	**14000**	12230	8480	5677	4506	3937	3577	---	---	---	---
	5000	6499	5677	3937	2635	2092	1827	1660				
	10000	5158	4506	3125	2092	1660	1450	1318	---	---	---	---
	30000	3577	3125	2166	1450	1151	1006	914	---	---	---	---
	50000	3017	2635	1827	1223	971	848	771	---	---	---	---
	100000	2536	2092	1450	971	771	673	612	---	---	---	---
215	500	**14830**	12955	8983	6014	4773	4170	3789	---	---	---	---
	5000	6884	6014	4170	2792	2216	1936	1759				
	10000	5464	4773	3310	2216	1759	1536	1396	---	---	---	---
	30000	3789	3310	2295	1536	1219	1065	968	---	---	---	---
	50000	3196	2792	1936	1296	1029	899	816	---	---	---	---
	100000	0	2216	1536	1029	816	713	648	---	---	---	---

Values shaded and in bold are that series basic dynamic load (Cr) value.

2.2 Static load rating

In cases where the bearings are to rotate at relatively low speeds, have slow oscillating movements, or are exposed to shock loads, a basic static (Cor) load rating must be taken into consideration.

2.21 Thrust Load rating

PEER inserts are manufactured to the same standards as deep groove Conrad bearings and therefore designed mainly for radial loads. While they will accept a certain amount of thrust or axial loading their core intent is for radial loading. In cases where there is a thrust or axial load applied to PEER insert bearings, it is desired that the thrust load be less than 1/3 of the bearings basic dynamic load rating (Cr) value. In no case should the thrust load exceed the bearings static load capacity (Cor) value.

2.22 Combined loads.

Deep groove ball bearings are designed to accept a radial load. However, they are capable of handling a small degree of axial or thrust load in addition to the radial load.

In applications where both a radial and axial load is acting on a bearing, a combined load value needs to be used in the life calculations. This equivalent dynamic radial load is defined as the hypothetical load, constant in magnitude and direction, acting radially on insert radial bearings, which would have the same influence on bearing life as the actual loads to which the bearing is to be subjected. Assuming constant load, Po = C1(xFr + yFa) where C1 = impact factor, fr = the radial load and fa = the axial load, x and y vary depending on the Fa/Cor and Fa/Fr ratios. Table 27 shows C1 or impact factors and Table 27a shows the x and y factors.

Table 27: Impact Factors

Type of Load	C1
Constant or steady	1.0
Light shocks	1.5
Moderate shocks	2.0
Heavy shocks	3.0 +

Table 27a: Radial and axial factors x and y for determining equivalent bearing load for ball bearings.

Fa/Cor	e	Fa/Fr ≤ e		Fa/Fr ≥ e	
		x	y	x	y
0.014	0.19	1	0	0.56	2.30
0.028	0.22				1.99
0.056	0.26				1.71
0.084	0.28				1.55
0.11	0.30				1.45
0.17	0.34				1.31
0.28	0.38				1.15
0.42	0.42				1.04
0.56	0.44				1.00

Note: It is not recommended that Fa exceed 1/3 of the basic dynamic load rating (Cr) from table 25. If Fa is greater than or equal to 1/3 of the basic load rating (Cr) from table 25, consult Peer engineering department. In no instances should Fa exceed the bearings static load capacity Cor.

2.3 Variable load and speed.

In applications with a constant speed, where the load grows linearly from a minimum value (Pmin) to a maximum (Pmax), then drops back to the minimum value, the average load is;

$Pm = (Pmin + 2Pmax) / 3$

Where Pm = equivalent dynamic bearing load in Lbs.

P_1 = constant load at n_1 RPM for T_1 minutes.

P_2 = constant load at n_2 RPM for T_2 minutes.

Pn = constant load at nn RPM for Tn minutes.

n = RPM

T = Time

When a bearing is subjected to consecutive runs at different constant speeds and different periods of load application, the ideal constant load Pm can be calculated by: $Pm = (((P_1^3 \times n_1 \times T_1) + (P_2^3 \times n_2 \times T_2) + ... + (Pn^3 \times nn \times Tn)) / ((n_1 \times T_1) + (n_2 \times T_2) + ... + (nn \times Tn)))^{1/3}$

2.4 Life Adjustment Factors, a1, a2, a3 for insert ball bearings.

a1, Life adjustment factor for reliability.

L10 is the life based upon a 90% or greater survival rate of a group of bearings. When the application requires a higher reliability the a1 adjustment factor can be obtained from table 28.

Table 28

Reliability %	Ln	Factor a1
90	L10	1
95	L5	0.62
96	L4	0.53
97	L3	0.44
98	L2	0.33
99	L1	0.21

a2, Life adjustment factors for bearing materials.

Adjustments for special bearing steel properties such as low impurity levels, heat treating, etc. is covered under adjustment a2. However, per ABMA standard 9-1990 7.4.2, this is not sufficient justification for an a2 value greater than 1. Therefore, the a2 factor for Peer insert bearings will remain consistent at 1 as shown in table 29.

Table 29

Bearing Steel	Factor a2
PEER vacuum degassed 52100 chrome steel	1

a3, life adjustment for operating conditions.

The a3 adjustment factor is the result of any number of operating factors the end user wishes to consider in the life analysis. These include but are not limited to, cleanliness of environment, temperature, viscosity of lubrication, shaft size and alignment. These factors combined reflect the a3 adjustment factor. However, in calculating the a3 for insert ball bearings with slip fit shafts and set screw or eccentric locking collars, it is accepted that a3 will equal 0.456 per ABMA Standard 9-1990 7.5.4. This is the result of the mounting and assembly methods insert bearings with slip fit shafts employ. Since there is normally a slip fit between the bearing bore and shaft diameter for set screw and eccentric locking collar insert bearings, the a3 will be consistent at 0.456. For Peers' "GR" series Grip-It bearings, which maintain a concentric shaft to bore alignment, the a3 factor may be increased to 0.800. If the basic dynamic load rating (Cr) used in the L10 or L10h calculation has already been de-rated, there is no need for further de-ration under the a3 adjustment factor.

The above 3 adjustment factors can be added to the L10 life calculation by the formula; Lna = (a1 x a2 x a3) L10

2.5 Calculating Applied Loads (P):

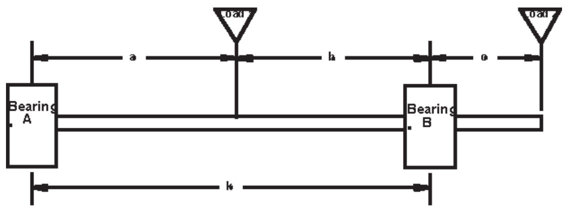
The applied load acting on a bearing is a primary factor in selecting the appropriate bearing and calculating L10 life for a given application. For proper insert bearing selection and L10 life calculations, it is necessary to know the applied load(s) in a given application. These loads may be any one or a combination of the following factors;

1. Weights of components being supported by the bearings.
2. Tightness or tension from chain or belt pressure.
3. Vibration, varying loads or eccentricity of rotation.

To correctly calculate the applied load(s) it is necessary to know the;

1. Amount of the load.
2. Load direction.
3. Distances between support bearings and loads.

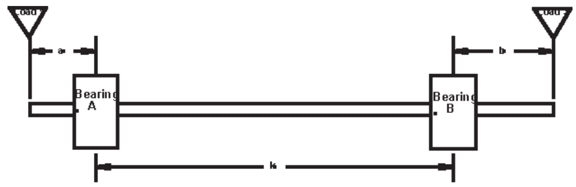
Once these factors are known, one of the following calculations can be employed;



Load on Beaing A =
(Load 1 x b) - (Load 2 x c) / k

Load on Beaing B =
(Load 1 x a) + (C + K) x (Load 2) / k

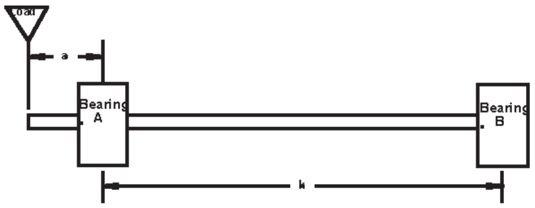
or



Load on Beaing A =
Load 1 x (a + k) - (Load 2 x b) / k

Load on Beaing B =
(Load 2 x (k + b) - (Load 1 x a) / k

or



Load on Beaing A =
Load 1 x (a + k) / k

Load on Beaing B =
- (Load 1 x a) / k

Vibratory Loads;

For applications where there is an applied eccentric motion or vibration is designed into the design, it is necessary to calculate the effective force acting on the bearings resulting from this motion. This is calculated through the basic physics law of centrifugal force or "Force = Mass x Acceleration" using the equation
F = .000341 x W x (R/12) x (N)^2 where;
F = load
W = weight of rotating component in lbs.
R = radius of rotation in inches
N = RPM of shaft.
Example: the centrifugal load acting on a bearing operating under a vibratory rotation consisting of 1500 lbs weight with rotation radius of .125"(1/8") at 500 RPM is; F = .000341 x 1500 x .125/12 x (500)^2 = 1332lbs

Limiting Speeds:
Table 30 lists the limiting speeds or maximum allowable RPM a bearing can operate at. The values listed in table 30 represent set screw or eccentric locking collar bearings with slip fit shafts and a 40% - 50% lubricant fill. For "GR" or Grip-It style 360o locking bearing or bearings with press fit shafts, these values can be increased 30% or multiplied by a value of 1.3.

Speed limits are greatly influenced by the bearings seal design and therefore, the more seal contact the lower the allowable maximum speed rating. All limiting speeds are based on horizontally mounted shafts and radial loads.

Table 30:

Ring Size	Shaft Size	"Z" Shield	"R" seal	"RST" Seal	"Y" Seal	"DBL" Seal	"TRL" Seal
	1/2	7300	6500	6500	1950	1463	650
	12mm	7300	6500	6500	1950	1463	650
	9/16	7300	6500	6500	1950	1463	650
201-203	5/8	7300	6500	6500	1950	1463	650
	15mm	7300	6500	6500	1950	1463	650
	11/16	7300	6500	6500	1950	1463	650
	17mm	7300	6500	6500	1950	1463	650
	3/4	7300	6500	6500	1950	1463	650
204	13/16	7300	6500	6500	1950	1463	650
	20mm	7300	6500	6500	1950	1463	650
	13/16	6500	5850	5850	1755	1316	585
	7/8	6500	5850	5850	1755	1316	585
205	15/16	6500	5850	5850	1755	1316	585
	1	6500	5850	5850	1755	1316	585
	25mm	6500	5850	5850	1755	1316	585
206	1 1/16	5500	5000	5000	1500	1125	500
(X05)	1 1/8	5500	5000	5000	1500	1125	500
	1 3/16	5500	5000	5000	1500	1125	500
	1 1/4 (s)	5500	5000	5000	1500	1125	500
	30mm	5500	5000	5000	1500	1125	500
207	1 1/4	4700	4300	4300	1290	968	430
(X06)	1 5/16	4700	4300	4300	1290	968	430
	1 3/8	4700	4300	4300	1290	968	430
	1 7/16	4700	4300	4300	1290	968	430
	35mm	4700	4300	4300	1290	968	430
208	1 1/2	4200	3750	3750	1125	844	375
(X07)	1 9/16	4200	3750	3750	1125	844	375
	40mm	4200	3750	3750	1125	844	375
209	1 5/8	3800	3400	3400	1020	765	340
(X08)	1 11/16	3800	3400	3400	1020	765	340
	1 3/4	3800	3400	3400	1020	765	340
	45mm	3800	3400	3400	1020	765	340
210	1 15/16	3600	3300	3300	990	743	330
(X09)	2 (s)	3600	3300	3300	990	743	330
	50mm	3600	3300	3300	990	743	330
211	2	3300	3000	3000	900	675	300
(X10)	2 1/8	3300	3000	3000	900	675	300
	2 3/16	3300	3000	3000	900	675	300
	55mm	3300	3000	3000	900	675	300
212	2 1/4	3000	2700	2700	810	608	270
(X11)	2 3/8	3000	2700	2700	810	608	270
	2 7/16	3000	2700	2700	810	608	270
	60mm	3000	2700	2700	810	608	270
213	2 1/2	2600	2350	2350	705	529	235
(X12)	2 9/16	2600	2350	2350	705	529	235
	65mm	2600	2350	2350	705	529	235
214	2 5/8	2500	2250	2250	675	506	225
(X13)	2 11/16	2500	2250	2250	675	506	225
	2 3/4	2500	2250	2250	675	506	225
	70mm	2500	2250	2250	675	506	225
215	2 7/8	2300	2100	2100	630	473	210
(X14)	2 15/16	2300	2100	2100	630	473	210
	3	2300	2100	2100	630	473	210
	75mm	2300	2100	2100	630	473	210