S2000 & Type-E Spherical Roller Bearings

Selection Criteria

Load:
The service factor (S.F) for light uniform loads is 1.0. For medium loads use 2.0 and for heavy or shock loads, use 3.0 times the load. ***Basic bearing load limit = Static load capacity/S.F.***

Speed:
The maximum speed published is intended only as a guide. It is generally assumed in life calculations that heavy loads are not applied at the maximum speed but rather light loads at high speeds and heavier loads at lower speeds. Heavy loads and high speeds will increase the bearing operating temperature and seal friction.

Life:
The **L10** life is the expected life of a bearing based on normal conditions. Factors involving temperatures and ambient conditions, i.e., chemicals, moisture, and maintenance intervals, are not factored into the basic life formula. For industrial applications such as conveying machinery, kilns, hoists, pumps, cable reeling equipment, industrial fans, and similar applications, a design life for bearings of 30,000 hours to 100,000 hours is typical. To determine the **L10** hours of life for a spherical roller bearing, use the following formula:

Life Equation: $L_{10} = (C/P)^{3.33} \times 16667/RPM$

L_{10} = Expected bearing life in hours.
C = Dynamic capacity (lb).
P = Equivalent radial load (lb).
RPM = shaft speed in revolutions per minute.

When **P** is a radial load only, then **P** = the actual radial load. If a thrust and radial load is acting on the bearing, these loads must be converted into an equivalent load to calculate **L10**.

The Equivalent Radial Load Formula:
For combined axial and radial load

$P = X F_R + Y F_A$
P = Equivalent load (lbs)
F_R = Radial load (lbs)
F_A = Thrust axial load (lbs)
e = Thrust load divided by Radial load factor (**X**) (Chart 1)
X = Radial load factor (See Chart 1)
Y = Thrust load factor (See Chart 1)

To find **X** and **Y**, divide F_A/F_R to determine **e** for the bearing shaft size. Determine **X** and **Y** from Chart 1 depending on whether F_A/F_R is equal to or less than **e** or if F_A/F_R is greater than **e**. Insert known values into the Equivalent Dynamic Load formula.

Next substitute all values into $P = X F_R + Y F_A$ equation. Then insert the value of **P** into the L_{10} life formula to determinethe life hours of the bearing.

Insert the resulting **P** value into the life equation to determine bearing life. The **C** (Dynamic Load Rating) for each bearing can be found in **Chart 2**. Do not exceed the Static Load Rating **Co** of any bearing.

Chart 1

Shaft Size	Bearing Size	e	$F_A/F_R \le e$		$F_A/F_R > e$	
			X	Y	X	Y
1-7/16, 1-1/2	208	0.28	1	2.4	0.67	3.6
1-1/2, 1-11/16, 1-3/4	209	0.26	1	2.6	0.67	3.9
1-3/4, 1-15/16, 2	210	0.24	1	2.8	0.67	4.2
2/3/2016	211	0.24	1	2.8	0.67	4.2
2-7/16, 2-1/2	213	0.24	1	2.8	0.67	4.2
2-11/16, 2-3/4, 2-15/16, 3	215	0.22	1	3	0.67	4.6
3-7/16, 3-1/2	218	0.23	1	2.9	0.67	4.4
3-11/16, 3-15/16,4	220	0.24	1	2.8	0.67	4.2
4-7/16, 4-1/2	222	0.25	1	2.7	0.67	4
4-15/16, 5	226	0.26	1	2.6	0.67	3.9

Spherical Bearing Capacity Limits:

Chart 2

Shaft Size	Spherical Bearing Part No.	Dynamic C (Lbs)	Static Co (Lbs)	Max Speed (RPM)		
				Grease-Triple Lip	Teflon Labyrinth	Metal Labyrinth
1-7/16	476208-107	17,540	20,270	2750	3600	3600
1-1/2	476208-108	17,540	20,270	2750	3600	3600
1-1/2	476209-108	17,980	21,360	2425	3360	3200
1-11/16	476209-111	17,980	21,360	2425	3360	3200
1-3/4	476209-112	17,980	21,360	2425	3360	3200
1-3/4	476209-112	20,230	24,730	2225	3180	3150
1-15/16	476210-115	20,230	24,730	2225	3180	3150
2	476210-200	20,230	24,730	2225	3180	3150
2-3/16	476211-203	23,600	28,100	2000	2700	2800
2-7/16	476213-207	37,090	46,090	1700	2160	2300
2-1/2	476213-208	37,090	46,090	1700	2160	2300
2-11/16	476215-211	41,590	52,830	1500	2040	2150
2-3/4	476215-212	41,590	52,830	1500	2040	2150
2-15/16	476215-215	41,590	52,830	1500	2040	2150
3	476215-300	41,590	52,830	1500	2040	2150
3-7/16	476218-307	62,950	83,180	1250	1560	1600
3-1/2	476218-308	62,950	83,180	1250	1560	1600
3-15/16	476220-315	84,300	112,400	1100	1320	1350
4	476220-400	84,300	112,400	1100	1320	1350
4-7/16	476222-407VSB	94,420	134,890	1040	1200	1200
4-1/2	476222-408VSB	94,420	134,890	1040	1200	1200
4-15/16	476222-415VSB	128,140	185,470	900	1020	1000
5	476222-500VSB	128,140	185,470	900	1020	1000

Minimum Loads:

Spherical Roller Bearings must operate under a minimum load to prevent roller skidding. Minimum Load is at least 2% of the dynamic load rating. Often the weight of the shaft and coupling meets this requirement.

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Allowable Cap Loads for Pillow Blocks:

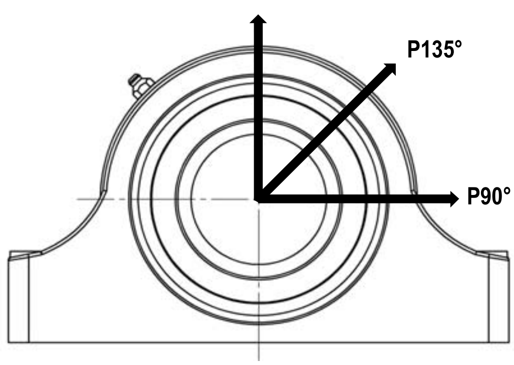
The application load should be directed through the pillow block base. However, use the following Allowable Cap Loads (Safe Loads) listed below when loads are directed through the cap. Use grade 8 bolts, adequately tightened, with chalk blocks next to the housing to restrict side or end movement of the housing. According to general engineering practice, allowable Cap Loads represent a nominal safety factor of six (6) (approximately 17% of the breaking load). Some thrust loads may be allowed as long as the radial load is at least four (4) times greater.

2-Bolt Base Pillow Block Housing (load in lbs.)

Shaft Size (in)	Housing	P90°	P135°	P180°
1-7/16 & 2	208	8,060	4,160	5,070
1-11/16 & 1-3/4	209	10,140	5,720	6,760
1-15/16 & 2	210	11,700	6,760	8,320
2-3/16	211	13,520	8,060	9,620
2-7/16 & 2-1/2	213	15,080	9,100	10,790
2-11/16, 2-3/4, 2-15/16 & 3	215	16,900	10,660	13,000
3-7/16 & 3-1/2	218	18,980	11,960	14,690
3-15/16 & 4	220	20,800	13,000	16,120

4-Bolt Base Pillow Block Housing (load in lbs.)

Shaft Size (in)	Housing	P90°	P135°	P180°
2-7/16 & 2-1/2	213	22,360	11,440	12,350
2-11/16, 2-3/4, 2-15/16 & 3	215	27,040	14,300	15,600
3-7/16 & 3-1/2	218	30,680	17,680	18,720
3-15/16 & 4	220	34,840	21,060	21,580
4-7/16 & 4-1/2	222	38,480	24,180	24,960
4-15/16 & 5	226	42,640	26,780	27,560



Axial Load and Shaft Tolerance:

Normal shafting tolerances are typically nominal to minus 0.0005" per inch of shaft diameter. Undersized shafting relative to the bore will result in fretting wear on the shaft, increase vibration and reduce the allowable top bearing speed. A close or interference fit of the bearing to the shaft will improve bearing performance. Shaft collars or stepped shafting adjacent to the bearing inner race may be used to fix the bearing against higher thrust loads.

Chart 4: Set screw Torque & Allowable Axial Load

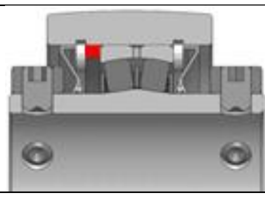
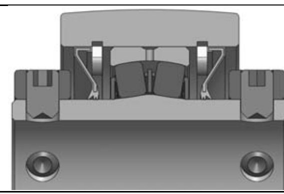
Shaft Size (in)	Set Screw	Torque	Allowable Axial Load
	No. & Size	in-lbs.	lbs.
1-7/16, 1-1/2	(2) 3/8-24	250	515
1-11/16, 1-3/4	(2) 3/8-24	250	515
1-15/16, 2	(2) 3/8-24	250	515
2/3/2016	(2) 3/8-24	250	515
2-7/16, 2-1/2	(2) 1/2-20	620	900
2-11/16, 2-3/4, 2-15/16, 3	(2) 1/2-20	620	900
3-7/16, 3-1/2	(2) 1/2-20	620	900
3-11/16, 3-15/16, 4	(2) 5/8-18	1325	1200
4-7/16, 4-1/2	(2) 5/8-18	1325	1200
4-15/16, 5	(2) 5/8-18	1325	1200

Misalignment:

There are two types of misalignment: **Static,** which usually refers to a bearing alignment in the housing or the alignment of the bearing/housing to the shaft. **Dynamic** is typically a misalignment that can be handled within the bearing while operating. Aligned bearings run smoother, cooler, and quieter than misaligned units. S2000 and Type-E Spherical Roller Bearings have +/- 1-1/2° of static or dynamic misalignment.

Expansion & Non-Expansion Unit:

Expansion capability within a bearing indicates the ability to accommodate shaft length changes due to changing ambient temperatures that cause steel mounting structures or shafts to expand or contract. A typical installation involves both a Non-Expansion unit and an Expansion Unit. The Non-Expansion bearing should be installed first and generally next to the drive equipment to prevent displacement and axial stress on the drive. If two Non-Expansion bearings are used on the same shaft, a temperature change may cause the shaft length to change and impose a high thrust force on the bearings. The bearing in the expansion unit housing will float axially (by hand force). Center the expansion insert in the housing (by pushing it back and forth to the center point) and tighten the setscrews per the recommended levels on chart 4.

	
Non-Expansion Unit (**Fixing Ring**)	Expansion Unit (Without Fixing Ring)