Tolerances

Radial Ball, Spherical and Cylindrical Roller Bearings

Depending upon requirements, various degrees of bearing accuracy may be required.

Among the tolerance classes P0 applies to ball bearings for normal useage. The other classes P6, P5, P4, P2 apply to ball bearings of increased precision as required.

P0 applies to roller bearings for normal usage. P6 and P5 apply to roller bearings of increased precision as required.

公差

向心球、调心滚子和圆柱滚子轴承

不同的使用场合要求不同的轴承精度。

按公差等级，P0级适用于正常使用情况下的球轴承，其它P6、P5、P4、P2级适用于要求精度更高的球轴承。

P0级适用于正常使用情况下的滚子轴承，P6及P5级适用于要求精度更高的滚子轴承。

Tolerances Symbols-inner Ring

- $\triangle d_{mp}$ Single plane mean bore diameter deviation from basic bore diameter, i. e. bore tolerance for a basically tapered bore, $\triangle d_{mp}$ refers only to the theoretical small bore end of the bore.
- K_{ia} Radial runout of assembled bearing inner ring, i.e., radial runout of raceway.
- V_{Bs} Inner ring width variation, i. e. parallelism.
- S_d Inner ring reference face runout with bore, i. e., squareness - bore to face.
- S_{ia} Axial runout of assembled bearing inner ring, i. e., lateral (axial) runout of raceway.
- $\triangle B_s$ Single inner ring width deviation from basic, i. e., width tolerance.

公差符号 - 内圈

- $\triangle d_{mp}$ 单一平面平均内径的偏差(对于圆锥孔，$\triangle d_{mp}$仅指内孔的理论小端)
- K_{ia} 成套轴承内圈的径向跳动。
- V_{Bs} 内圈宽度的变动量，即平行度。
- S_d 内圈基准面对内孔的跳动，即垂直度。
- S_{ia} 成套轴承内圈端面(背面)对滚道的跳动。
- $\triangle B_s$ 内圈单一宽度偏差，即宽度公差。

Tolerances Symbols-outer Ring

- $\triangle D_{mp}$ Single plane mean outside diameter deviation from basic outside diameter, i. e. O.D. tolerance.
- K_{ea} Radial runout of assembled bearing outer ring, i. e., radial runout of raceway.
- V_{Cs} Outer ring width variation, i. e. parallelism.
- S_D Outside cylindrical surface runout with outer ring reference face, i. e., squareness O.D. to face.
- S_{ea} Axial runout of assembled bearing outer ring, i. e. lateral (axial) runout of raceway.
- $\triangle C_s$ Outer ring width deviation from basic, i. e., width tolerance.

公差符号 - 外圈

- $\triangle D_{mp}$ 单一平面内平均外径的偏差，即外径公差。
- K_{ea} 成套轴承外圈的径向跳动。
- V_{Cs} 外圈宽度的变动量，即平行度。
- S_D 外径表面母线对基准端面(背面)的倾斜度的变动量，即外径对端面的垂直度。
- S_{ea} 成套轴承外圈端面的轴向跳动，即滚道的内部轴向跳动。
- $\triangle C_s$ 外圈单一宽度的偏差，即宽度公差。

Tolerances

Radial Ball, Spherical and Cylindrical roller Bearings

Standard ISO Tolerances-Inner Ring

公差

向心球、调心滚子和圆柱滚子轴承

内圈公差

Bearing Bore 轴承内径 d		Bore Diameter (1) 内径(1) △d_{mp}					Width Variation (Parallelism) 宽度变动量（平行度） V_{Bs}					Raceway Radial Runout 滚道径向跳动 K_{ia}					Face Runout With Bore (Squareness) 端面对内孔的跳动（垂直度） S_d			Raceway Axial Runout 滚道轴向跳动 S_{ia}			Width Inner & Outer Rings 内外圈宽度 △B_s & △C_s	
over 超过	Incl. 至	P0	P6	P5	P4	P2	P0	P6	P5	P4	P2	P0	P6	P5	P4	P2	P5	P4	P2	P5	P4	P2	P0, P6	P5, P4, P2
mm		μm					μm					μm					μm			μm			μm	
0	10	-8	-7	-5	-4	-2.5	15	15	5	2.5	1.5	10	6	4	2.5	1.5	7	3	1.5	7	3	1.5	-120	-40
10	18	-8	-7	-5	-4	-2.5	20	20	5	2.5	1.5	10	7	4	2.5	1.5	7	3	1.5	7	3	1.5	-120	-80
18	30	-10	-8	-6	-5	-2.5	20	20	5	2.5	1.5	13	8	4	3	2.5	8	4	1.5	8	4	2.5	-120	-120
30	50	-12	-10	-8	-6	-2.5	20	20	5	3	1.5	15	10	5	4	2.5	8	4	1.5	8	4	2.5	-120	-120
50	80	-15	-12	-9	-7	-4	25	25	6	4	1.5	20	10	5	4	2.5	8	5	1.5	8	5	2.5	-150	-150
80	120	-20	-15	-10	-8	-5	25	25	7	4	2.5	25	13	6	5	2.5	9	5	2.5	9	5	2.5	-200	-200
120	150	-25	-18	-13	-10	-7	30	30	8	5	2.5	30	18	8	6	2.5	10	6	2.5	10	7	2.5	-250	-250
150	180	-25	-18	-13	-10	-7	30	30	8	5	4	30	18	8	6	5	10	6	4	10	7	5	-250	-250
180	250	-30	-22	-15	-12	-8	30	30	10	6	5	40	20	10	8	5	11	7	5	13	8	5	-300	-300
250	315	-35	-25	-18	-	-	35	35	13	-	-	50	25	13	-	-	13	-	-	15	-	-	-350	-350
315	400	-40	-30	-23	-	-	40	40	15	-	-	60	30	15	-	-	15	-	-	20	-	-	-400	-400
400	500	-45	-35	-	-	-	50	45	-	-	-	65	35	-	-	-	-	-	-	-	-	-	-450	-
500	630	-50	-40	-	-	-	60	50	-	-	-	70	40	-	-	-	-	-	-	-	-	-	-500	-

The tolerances in this table are in conformity with GB/T 307. 1-94 (equal to ISO 492-1986) radial bearing tolerance.
(1)d_{mp} (the smallest single diameter of a bore) and d_{max} (the largest single diameter of a bore) may fall outside limits shown $\frac{d_{mp} + d_{mp}}{2}$ must be within outside diameter tabulated.

本表的公差适合于GB/T 307.1-94 (等同于 ISO 492-1986)向心轴承公差。
(1)d_{mp} (内径的最小值)和 d_{max} (内径的最大值)可能超出范围，但 $\frac{d_{mp} + d_{mp}}{2}$ 必须符合要求。

Tolerances
Radial Ball, Spherical and Cylindrical Roller Bearings
Standard ISO Tolerances-Outer Ring

公差
向心球、调心滚子和圆柱滚子轴承
外圈公差

Bearing O.D. 轴承外径 D		Outside Diameter (1) 外径(1) △Dmp					Width Variation (Parallelism) 宽度变动量（平行度） VCs				Raceway Radial Runout 滚道径向跳动 KEa					Raceway Axial Runout 滚道轴向跳动 SEa			Outside Diqmeter Runout With Face (Squareness) 外径对端面的跳动（垂直度） SD		
over 超过	incl. 至	P0	P6	P5	P4	P2	P0,P6	P5	P4	P2	P0	P6	P5	P4	P2	P5	P4	P2	P5	P4	P2
mm		μm					μm				μm					μm			μm		
18	30	-9	-8	-6	-5	-4	20	5	2.5	1.5	15	9	6	4	2.5	8	5	2.5	8	4	1.5
30	50	-11	-9	-7	-6	-4	20	5	2.5	1.5	20	10	7	5	2.5	8	5	2.5	8	4	1.5
50	80	-13	-11	-9	-7	-4	25	6	3	1.5	25	13	8	5	4	10	5	4	8	4	1.5
80	120	-15	-13	-10	-8	-5	25	8	4	2.5	35	18	10	6	5	11	6	5	9	5	2.5
120	150	-18	-15	-11	-9	-5	30	8	5	2.5	40	20	11	7	5	13	7	5	10	5	2.5
150	180	-25	-18	-13	-10	-7	30	8	5	2.5	45	23	13	8	5	14	8	5	10	5	2.5
180	250	-30	-20	-15	-11	-8	30	10	7	4	50	25	15	10	7	15	10	7	11	7	4
250	315	-35	-25	-18	-13	-8	35	11	7	5	60	30	18	11	7	18	10	7	13	8	5
315	400	-40	-28	-20	-15	-10	40	13	8	7	70	35	20	13	8	20	13	8	13	10	7
400	500	-45	-33	-23	-	-	45	15	-	-	80	40	23	-	-	23	-	-	15	-	-
500	630	-50	-38	-28	-	-	50	18	-	-	100	50	25			25	-	-	18	-	-

The tolerances in this table are in conformity with GB/T 307. 1-94 (equal to ISO 492-1986) radial bearing tolerance.
(1)D_{min} (the smallest single diameter of an O.D.) and D_{max} (the largest single diameter of an O.D.) may fall outside limits shown $\frac{D_{min} + D_{max}}{2}$ must be within outside diameter tabulated.

本表的公差适合于 GB/T 307. 1-94 (等同于 ISO 492-1986)向心轴承公差，
(1)D_{min} (外径的最小值)和 D_{max} (外径的最大值)可能超出范围，但 $\frac{D_{min} + D_{max}}{2}$ 必须符合要求，

Internal Clearances

Our radial clearance designations are the same as ISO symbols as follows:

径向游隙

径向游隙代号与ISO代号相同，说明如下：

Designations

	Description
C2	**Snug** fit; slight internal clearance; sometimes use to achieve a minimum of radial or axial play in an assembly. Example: 6208/C2
C0	**Medium** fit; internal clearance generally satisfactory with recommended shaft and housing fits shown on pages. Example: 6208.
C3	**Loose** fit; considerable internal clearance required for applications involving press fits on both inner and outer rings, extra interference fits, or temperature differentials. Example: 6208/C3
C4	**Extra Loose** fit; large amount of internal clearance for applications involving large interference fits or temperature differentials. Example: 6208/C4
C5	**Extra-Extra Loos** fit; extra large amount of internal clearance for applications with large temperature differential and interference fits on both rings. Example: 6208/C5

	说　明
C2	紧游隙，装配后得到最小的径向或轴向位移，如 6208/C2
C0	基本游隙，一般能满足配合一节所推荐的与轴和座的配合，如 6208
C3	松游隙，用于内圈和外圈都处于额外过盈配合或存在温差的场合，如 6208/C3
C4	超松游隙，用于大过盈配合或大温差场合，如 6208/C4
C5	特松游隙，用于内外圈都处于大过盈配合同时存在大温差的场合，如 6208/C5

Internal Clearances

Radial Spherical Roller Bearings

Radial Internal Clearance (RIC) is the radial play within a 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 22328 K/C3 (140mm bore with C3 clearance) is to be mounted on a tapered shaft. By feeler gauging, RIC is found to be 0.178mm. The chart indicates that the proper fit will be obtained when RIC is reduced by 0.064 to 0.089mm. Clearance after mounting is computed; 0.178-0.076=0.102mm. The locknut should be tightened until RIC reaches 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 the engineering dept.

We 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. 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 maximum values for C3; etc.

径向游隙

调心滚子轴承

径向游隙(RIC)是轴承内部的径向游隙， 的径向游隙可以允许轴承在紧配合安装和正常运行条件下有足够的内部游隙。

调心滚子轴承如带有锥孔(K)则要求其配合时的过盈量比圆柱孔轴承的更大一点， 更大的过盈量则引起RIC的减少，对于锥孔轴承，选择时要考虑到RIC的减少，这很重要。

例: 22328 K/C3轴承,(内径为140mm，C3组游隙)是装在锥轴上的。用塞尺测量后，RIC为0.178mm。从表内查得在RIC减少0.064至0.089mm时可达到合适的配合。装配后的游隙(0.178-0.076=0.102mm),所以锁紧螺母必须旋至RIC达到0.102mm为止。

几种引起RIC减少的因素，内圈压入实心的钢轴上会引起内圈胀大大约80%的过盈量。外圈压入钢或铸铁外壳上过盈配合会引起RIC减少约60%的过盈量，对于空心轴或非钢性的材料，RIC减少量请与我公司销售技术人员联系。

轴承除特殊说明外，一般为正常的RIC，RIC代号应加在轴承基本代号后。

在相应的RIC下相邻两列内列出了RIC的最小、最大值。每一单列代表相邻RIC的界限。例如：C5的最小值为C4的最大值，C4的最小值也是C3的最大值等等。

Internal Clearances
Radial Spherical Roller Bearings
Radial Internal Clearance Limits

径向游隙
调心滚子轴承
径向游隙

Bore (nominal) 公称内径 d		Cylindrical Bore 圆柱孔						Tapered Bore 圆锥孔							
			Normal (Standard) 基本组（标准）		C4				Normal (Standard) 基本组（标准）		C4			Recommended Reduction of RIC Due to Installation 建议安装中 RIC 的减少量	Recom mended RIC after Installation[1] 建议安装后 RIC[1]
			min. 最小	max. 最大	min. 最小	max. 最大			min. 最小	max. 最大	min. 最小	max. 最大			
over 超过	Incl 至	C2 min. 最小	C2 max. 最大	C3 min. 最小	C3 max. 最大	C5 min. 最小	C5 max. 最大	C2 min. 最小	C2 max. 最大	C3 min. 最小	C3 max. 最大	C5 min. 最小	C5 max. 最大	min. 最小	max. 最大	min. 最小
mm		μm						μm						μm		μm
24	30	15	25	40	55	75	95	20	30	40	55	75	95	15	20	15
30	40	15	30	45	60	80	100	25	35	50	65	85	105	20	25	15
40	50	20	35	55	75	100	125	30	45	60	80	100	130	25	30	20
50	65	20	40	65	90	120	150	40	55	75	95	120	160	30	38	25
65	80	30	50	80	110	145	180	50	70	95	120	150	200	38	51	25
80	100	35	60	100	135	180	225	55	80	110	140	180	230	46	64	36
100	120	40	75	120	160	210	260	65	100	135	170	220	280	51	71	51
120	140	50	95	145	190	240	300	80	120	160	200	260	330	64	89	56
140	160	60	110	170	220	280	350	90	130	180	230	300	380	76	102	56
160	180	65	120	180	240	310	390	100	140	200	260	340	430	76	114	61
180	200	70	130	200	260	340	430	110	160	220	290	370	470	89	127	71
200	225	80	140	220	290	380	470	120	180	250	320	410	520	102	140	76
225	250	90	150	240	320	420	520	140	200	270	350	450	570	114	152	89
250	280	100	170	260	350	460	570	150	220	300	390	490	620	114	165	102
280	315	110	190	280	370	500	630	170	240	330	430	540	680	127	178	102
315	355	120	200	310	410	550	690	190	270	360	470	590	740	140	190	114
355	400	130	220	340	450	600	750	210	300	400	520	650	820	152	203	127
400	450	140	240	370	500	660	820	230	330	440	570	720	910	165	216	152
450	500	140	260	410	550	720	900	260	370	490	630	790	1,000	178	229	165
500	560	150	280	440	600	780	1,000	290	410	540	680	870	1,100	203	254	178
560	630	170	310	480	650	850	1,100	320	460	600	760	980	1,230	229	279	203
630	710	190	350	530	700	920	1,190	350	510	670	850	1,090	1,360	254	305	203
710	800	210	390	580	770	1,010	1,300	390	570	750	960	1,220	1,500	279	356	229
800	900	230	430	650	860	1,120	1,440	440	640	840	1,070	1,370	1,690	305	381	252
900	1,000	260	480	710	930	1,220	1,570	490	710	930	1,190	1,520	1,860	356	432	279

[1] For bearings with normal initial clearance

[1] 为最初标准游隙轴承

Internal Clearances

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.

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.

径向游隙

向心球轴承

在球轴承的制造过程中，球和内外圈之间是按一定的游隙来进行组合的，这个性能有助于减少轴承内外圈的挤压装配的影响。

游隙还可以用来补偿轴承、轴及外壳热膨胀的影响，也可用于使轴承装配后产生一个接触角。

可采用专用仪器测量轴承的径向和轴向游隙。

径向测量更富有参考价值，因为它与轴及外壳直接相关。

径向游隙

向心球轴承的径向游隙就是外圈滚道直径减去内圈滚道直径再减二倍的球径。

径向游隙的测量在机械上如图1所示，水平推动外圈，当钢球正确在滚道中到位后，外圈的总移动量就是径向游隙，可以在不同的圆周位置测几个点以得到一个平均读数。

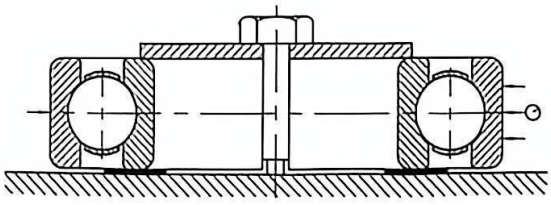


Figure1
图1

Internal Clearances

Limits for Radial Internal Clearance of Single Row, Radial Contact Ball Bearings Under No Load

(Applies to Bearings of P0, P6, P5, P4, P2 Tolerances)

径向游隙

无负荷情况下单列向心球轴承径向游隙范围

（适用于P0、 P6、 P5 、P4、P2级公差等级的轴承）

Basic Bore Diameter 公称内径 d		Acceptance Limits 范围		Acceptance Limits 范围		Acceptance Limits 范围		Acceptance Limits 范围		Acceptance Limits 范围	
		C2		C0		C3		C4		C5	
over 超过	Incl 至	min. 最小	max. 最大	min. 最小	max. 最大	min. 最小	max. 最大	min. 最小	max. 最大	min. 最小	max. 最大
mm		μm		μm		μm		μm		μm	
2.5	10	0	7	2	13	8	23	14	29	20	37
10	18	0	9	3	18	11	25	18	33	25	45
18	24	0	10	5	20	13	28	20	36	28	48
24	30	1	11	5	20	13	28	23	41	30	53
30	40	1	11	6	20	15	33	28	46	40	64
40	50	1	11	6	23	18	36	30	51	45	73
50	65	1	15	8	28	23	43	38	61	55	90
65	80	1	15	10	30	25	51	46	71	65	105
80	100	1	18	12	36	30	58	53	84	75	120
100	120	2	20	15	41	36	66	61	97	90	140
120	140	2	23	18	48	41	81	71	114	105	160
140	160	2	23	18	53	46	91	81	130	120	180
160	180	2	25	20	61	53	102	91	147	135	200
180	200	2	30	25	71	63	117	107	163	150	230
200	225	2	35	25	85	75	140	125	195	175	265
225	250	2	40	30	95	85	160	145	225	205	300
250	280	2	45	35	105	90	170	155	245	225	340
280	315	2	55	40	115	100	190	175	270	245	370
315	355	3	60	45	125	110	210	195	300	275	410
355	400	3	70	55	145	130	240	225	340	315	460
400	450	3	80	60	170	150	270	250	380	350	510
450	500	3	90	70	190	170	300	280	420	390	570
500	560	10	100	80	210	190	330	310	470	440	630
560	630	10	110	90	230	210	360	340	520	490	690
630	710	20	130	110	260	240	400	380	570	540	760
710	800	20	140	120	290	270	450	430	630	600	840
800	900	20	160	140	320	300	500	480	700	670	940
900	1000	20	170	150	350	330	550	530	770	740	1040
1000	1120	20	180	160	380	360	600	580	850	820	1150
1120	1250	20	190	170	410	390	650	630	920	890	1260

Internal Clearances

径向游隙

Cylindrical Roller Bearing Radial Internal Clearance Limits

圆柱滚子轴承径向游隙

Basic Bore Diameter 公称内径 d		Acceptance Limits 范围		Acceptance Limits 范围		Acceptance Limits 范围		Acceptance Limits 范围		Acceptance Limits 范围	
		C2		C0		C3		C4		C5	
over 超过	incl 至	min. 最小	max. 最大	min. 最小	max. 最大	min. 最小	max. 最大	min. 最小	max. 最大	min. 最小	max. 最大
mm		μm		μm		μm		μm		μm	
-	10	0	25	20	45	35	60	50	75	-	-
10	24	0	25	20	45	35	60	50	75	65	90
24	30	0	25	20	45	35	60	50	75	70	95
30	40	5	30	25	50	45	70	60	85	80	105
40	50	5	35	30	60	50	80	70	100	95	125
50	65	10	40	40	70	60	90	80	110	110	140
65	80	10	45	40	75	65	100	90	125	130	165
80	100	15	50	50	85	75	110	105	140	155	190
100	120	15	55	50	90	85	125	125	165	180	220
120	140	15	60	60	105	100	145	145	190	200	245
140	160	20	70	70	120	115	165	165	215	225	275
160	180	25	75	75	125	120	170	170	220	250	300
180	200	35	90	90	145	140	195	195	250	275	330
200	225	45	105	105	165	160	220	220	280	305	365
225	250	45	110	110	175	170	235	235	300	330	395
250	280	55	125	125	195	190	260	260	330	370	440
280	315	55	130	130	205	200	275	275	350	410	485
315	355	65	145	145	225	225	305	305	385	455	535
355	400	100	190	190	280	280	370	370	460	510	600
400	450	110	210	210	310	310	410	410	510	565	665
450	500	110	220	220	330	330	440	440	550	625	735

Dynamic Load Ratings and Life Calculations

Rating Life

Life: For an individual rolling bearing, the number of revolutions which one of the bearing rings makes in relation to the other ring before the first evidence of fatigue develops in the material of one of the rings or rolling elements.

Basic rating life: For an individual rolling bearing, or a group of apparently identical rolling bearings, operating under the same conditions, the life associated with 90% reliability, with contemporary, commonly used material and manufacturing quality, and under conventional operating conditions. Basic rating life L_{10} can be calculated with following formulas:

For radial ball bearing $L_{10}=(C_r/P_r)^3$ in million revolutions
For radial roller bearing $L_{10}=(C_r/P_r)^{10/3}$ in million revolutions

Here C_r is basic dynamic radial load rating, in newtons.
P_r is dynamic equivalent radial load, in newtons.

Adjusted rating life: The rating life obtained by adjustment of basic rating life for a desired reliability level, special bearing properties and specific operating conditions. Adjusted rating life can be calculated with following formula:
$L_{na}=a_1a_2a_3L_{10}$
Here a_1 is life adjustment factor for reliability. Its values are given in following table.

Rellabllity %	90	95	96	97	98	99
a_1	1	0.62	0.53	0.44	0.33	0.21

a_2 is life adjustment factor for special bearing properties. a_2 =1 for the bearings commonly ordered from US . When the bearing with a_2 >1 is desired, please specially order from US under guidance of the Sales Engineer.
a_3 is life adjustment factor for operating conditions. Operating conditions taken into account here include the adequacy of lubrication, presence of foreign matter, and conditions causing changes in material properties, for example, high temperature causing reduced hardness. Where the negative influence of above mentioned would not exist, a_3 could be equal to 1, otherwise values of a_3 less than 1 should be considered. Values of a_3 greater than 1 may be considered only where the lubrication conditions are so favorable that the probability of failure caused by surface distress is greatly reduced.

额定动负荷和寿命计算

额定寿命

寿命：在一套滚动轴承的套圈或滚动体的材料中出现第一个疲劳扩展迹象之前，一个套圈相对另一个套圈运行的转数。由于同样的轴承在同样的工作条件下的疲劳寿命具有离散性，所以应该用统计方法来定义轴承的寿命。

基本额定寿命：对于一套滚动轴承或一组在同一条件下运转的近于相同的滚动轴承，该寿命是与90%的可靠度，常用的材料和加工质量以及常规的运转条件相关的寿命。基本额定寿命 L_{10} 按照下式计算：
向心球轴承：$L_{10}=(C_r/P_r)^3$ 单位：百万转
向心滚子轴承：$L_{10}=(C_r/P_r)^{10/3}$ 单位：百万转

上式中，C_r 径向基本额定动负荷，单位：N
P_r 径向当量动负荷，单位：N

修正额定寿命：考虑所要求的可靠性水平、特殊的轴承性能和具体的工作条件，而对基本额定寿命进行修正所得到的额定寿命。修正额定寿命 L_{na} 按照下式计算：
$L_{na}=a_1a_2a_3L_{10}$
上式中，a_1 可靠性寿命修正系数，其数值列于下表。

可靠度%	90	95	96	97	98	99
a_1	1	0.62	0.53	0.44	0.33	0.21

a_2特殊轴承性能寿命修正系数，对于从我们一般订购的轴承，a_2取为1。若需要 a_2>1，请联络我们技术部门特殊订货。
a_3特殊运行条件寿命修正系数。该系数考虑的运行条件包括润滑是否充分，外来有害物质，以及其它会引起材料性能改变的条件，如高温造成硬度降低等。无上述不利影响时，则取a_3=1。如有上述不利影响时，应考虑取a_3小于1。只有当润滑条件非常理想而大大降低表面引起的疲劳破坏概率时，才能考虑取a_3值大于1。

Dynamic Load Ratings and Life Calculations

Basic Dynamic Load Rating

Basic dynamic radial load rating C_r: That constant stationary radial load which a rolling bearing could theoretically endure for a basic rating life of one million revolutions. In the case of a single row angular contact bearing, the radial load rating refers to the radial component of that load which causes a purely radial displacement of the bearing ring in relation to each other.

The basic dynamic radial load ratings of various bearings can be obtained from the catalog.

Basic dynamic radial load rating for bearing combinations

For two similar row radial ball or roller bearings mounted side by side on the same shaft such that they operate as a unit (paired mounting), the basic radial load rating of the pair is the basic radial load rating of the single bearing multiplied by 1.6 for ball bearing or by 1.7 for roller bearing.

Dynamic Equivalent Load

Dynamic equivalent radial load P_r: That constant stationary radial load under the influence of which a rolling bearing would have the same life as it will attain under the actual load conditions.

The dynamic equivalent radial load P_r, for radial ball bearing and spherical roller bearing, under constant radial and axial loads, is given by

$$P_r = X F_r + Y F_a$$

Here F_r is radial component of actual bearing load, in newtons.

F_a is axial component of actual bearing load, in newtons.

X is dynamic radial load factor.

Y is dynamic axial load factor.

Values of X and Y for radial ball bearings are listed in Table3. For spherical roller bearing X and Y are variable on two different conditions:

$$X = 1,\ Y = Y_1, \quad \text{when } \frac{F_a}{F_r} \le e$$

$$X = 0.67,\ Y = Y_2, \quad \text{when } \frac{F_a}{F_r} > e$$

Values of e, Y_1, Y_2 are given in the catalogue.

For cylindrical roller bearing, under radial load only

$$P_r = F_r$$

Note- The ability of cylindrical roller bearing to support axial loads varies considerably with bearing design execution. The bearing user should therefore consult Technology Section of US for recommendations regarding the evaluation of equivalent load and life in case where cylindrical roller bearing is subjected to axial load.

额定动负荷和寿命计算

基本额定动负荷

径向基本额定动负荷C_r是指一套轴承假设能承受的径向负荷，在这负荷作用下的基本额定寿命为1百万转。对于单列角接触轴承，该负荷是指引起轴承套圈相互间产生纯径向位移的负荷的径向分量。各种轴承的径向基本额定动负荷可从本样本内查得。

轴承组配时的基本额定动负荷。

两套相同的单列径向球或滚子轴承并排安装在同一轴上，组成一个整体(成对安装)，这一轴承组的径向基本额定负荷是单个这种轴承的基本额定负荷的1.6倍(对球轴承)或1.7倍(对于滚子轴承)。

当量动负荷

径向当量动负荷P_r是指一恒定的径向负荷，在该负荷作用下轴承具有与实际负荷作用下相同的寿命。

对于向心球轴承和调心滚子轴承，在不变的径向和轴向载荷作用下，径向当量动负荷P_r为：

$$P_r = X F_r + Y F_a$$

上式中，F_r 为轴承实际载荷的径向分量，单位：N

F_a 为轴承实际载荷的轴向分量，单位：N

X 为径向动载荷系数

Y 为轴向动载荷系数。

向心球轴承的X,Y的值列于表3。调心滚子轴承的X,Y的值应分两种情况考虑：

当 $\frac{F_a}{F_r} \le e$ 时，$X = 1,\ Y = Y_1$,

当 $\frac{F_a}{F_r} > e$ 时，$X = 0.67,\ Y = Y_2$,

e, Y_1, Y_2 的值在本样本中给出

对于圆柱滚子轴承，只承受径向载荷时，径向当量动负荷P_r为：

$$P_r = F_r$$

注：圆柱滚子轴承承受轴向载荷能力与轴承的结构和工艺关系极大，圆柱滚子轴承需要承受轴向载荷时，用户可与我们技术部门联系询问有关当量负荷和寿命的估计值。

Dynamic Load Ratings and Life Calculations

额定动负荷和寿命计算

Dynamic Equivalent Load

当量动负荷

Table3-Values of X and Y for radial ball bearings

表 3：向心球轴承的 X 和 Y 值

Bearing Type 轴承类型		"Relative Axial Load" [1),2)] "相对轴向载荷" [1),2)]		Single Row Bearings 单列轴承				Double Row Bearings 双列轴承				e
				$\frac{F_a}{F_r} \le e$		$\frac{F_a}{F_r} > e$		$\frac{F_a}{F_r} \le e$		$\frac{F_a}{F_r} > e$		
				X	Y	X	Y	X	Y	X	Y	
		$\frac{f_0 F_a}{C_{or}}$ [3)]	$\frac{F_a}{iZD_w^2}$									
Radial Contact Groove Ball Bearings 径向接触沟型球轴承		0.172	0.172				2.3				2.3	0.19
		0.345	0.345				1.99				1.99	0.22
		0.689	0.689				1.71				1.71	0.26
		1.03	1.03				1.55				1.55	0.28
		1.38	1.38	1	0	0.56	1.45	1	0	0.56	1.45	0.3
		2.07	2.07				1.31				1.31	0.34
		3.45	3.45				1.15				1.15	0.38
		5.17	5.17				1.04				1.04	0.42
		6.89	6.89				1				1	0.44
		$\frac{f_0 i F_a}{C_{or}}$ [3)]	$\frac{F_a}{ZD_w^2}$									
Angular Contact Groove Ball Bearings 角接触沟型球轴承	α=15°	0.178	0.172				1.47		1.65		2.39	0.38
		0.357	0.345				1.4		1.57		2.28	0.4
		0.714	0.689				1.3		1.46		2.11	0.43
		1.07	1.03				1.23		1.38		2	0.46
		1.43	0.38	1	0	0.44	1.19	1	1.34	0.72	1.93	0.47
		2.14	2.07				1.12		1.26		1.82	0.5
		3.57	3.45				1.02		1.14		1.66	0.55
		5.35	5.17				1		1.12		1.63	0.56
		7.14	6.89				1		1.12		1.63	0.56
	α=25°	-	-			0.41	0.87		0.92	0.67	1.41	0.68
	α=40°	-	-			0.35	0.57		0.55	0.57	0.93	1.14

Note: [1)] Permissible maximum value depends on the bearing design (internal clearance and raceway groove depth). Use the first or second column depending on available information.

[2)] Values of X, Y and e for intermediate "relative axial loads" and/or contact angles are obtained by linear interpolation.

[3)] For values of f_0 see ISO 76.

注 [1)]允许的最大值决定于轴承设计(游隙与滚道沟深度)，根据已知条件确定采用第一栏或第二栏的值。

[2)]对于"相对轴向载荷"或接触角的中间值，X、Y 和 e 值可由线性内插法求得。

[3)] f_0 值参见 GB/T4662 (ISO 76)

Fits

Shaft and Housing Fits

Radial Ball, Spherical, Cylindrical Roller Bearings

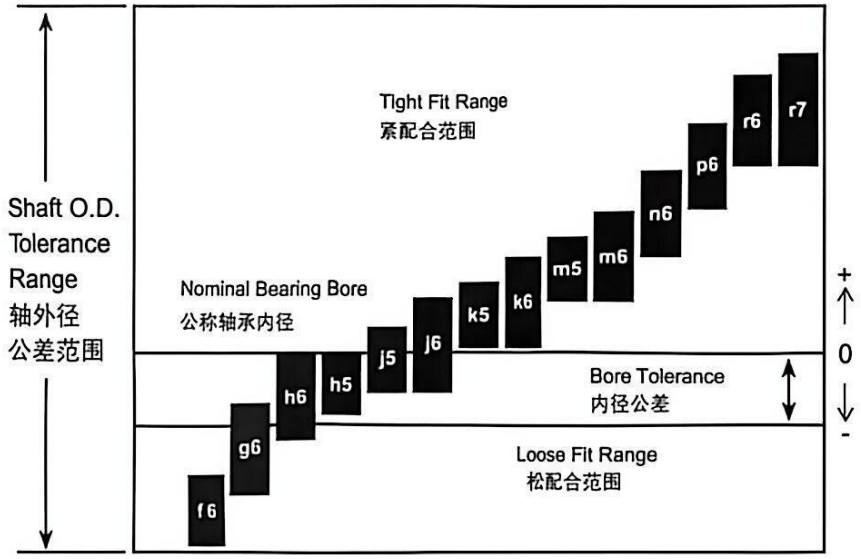
Below is a graphical representation of shaft and housing fit selection for these bearings conforming to ISO standard. The bars designated by g6, h6 etc. represent shaft/housing diameter and tolerance ranges to achieve various loose and interference fits required for various load and ring rotation conditions.

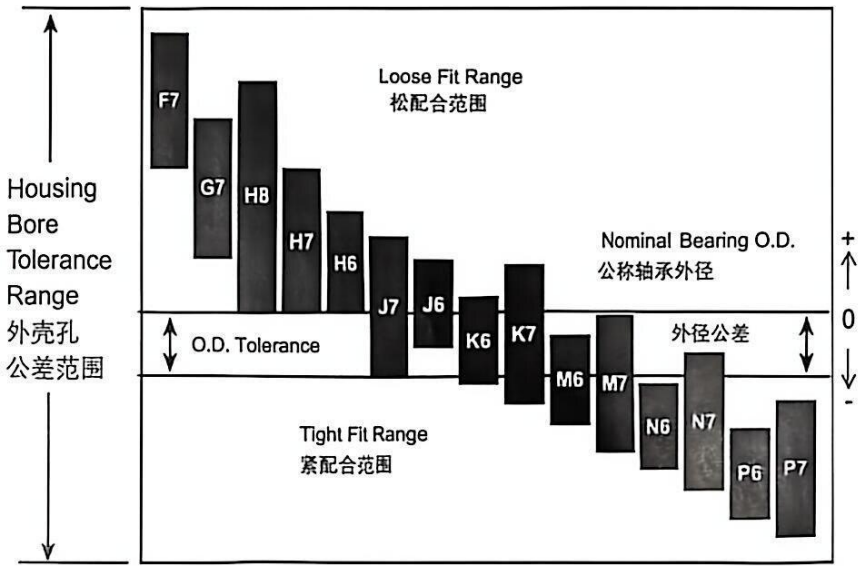
配合

轴和外壳的配合

向心球、球面滚子、圆柱滚子轴承

下图是符合 ISO 标准的轴承与轴和外壳的配合的选择。这些标有 g6、h6 等的块标表示在不同负荷和套圈旋转的情况下，为满足不同松和紧配合的要求，轴和外壳的直径和公差范围。





Fits

Shaft and Housing Fits

Radial Ball, Spherical, 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 thousandths of a millimeter.

配合

轴和外壳的配合

向心球、调心滚子、圆柱滚子轴承

表内所示的孔公差和各种公差符号下的轴直径是相对于公称轴承内径的偏差。配合一栏列出该种配合可能出现的最紧和最松状态的数值，"L" 代表松或间隙，"T" 代表紧或过盈。

除公称尺寸外，其余数据均以微米为单位。

Shaft 轴

Bearing Bore 轴承内径		f6		g6		h6		h5		j5		j6		k5		k6	
Nominal (max.) 公称(最大)	Tol. 公差	Shaft Dia. 轴直径	Fit 配合	Shaft Dia. 轴直径	Fit 配合	Shaft Dia. 轴直径	Fit 配合	Shaft Dia. 轴直径	Fit 配合	Shaft Dia. 轴直径	Fit 配合	Shaft Dia. 轴直径	Fit 配合	Shaft Dia. 轴直径	Fit 配合	Shaft Dia. 轴直径	Fit 配合
over Incl 超过 至	0 To 0 至	max. min. 最大 最小		max. min. 最大 最小		max. min. 最大 最小		max. min. 最大 最小		max. min. 最大 最小		max. min. 最大 最小		max. min. 最大 最小		max. min. 最大 最小	
mm	μm	μm		μm		μm		μm		μm		μm		μm		μm	
3 6	-8	-10 -18	18L 2L	-4 -12	12L 4T	0 -8	8L 8T	0 -5	5L 8T	+3 -2	2L 11T	+6 -2	2L 14T	+6 +1	1T 14T		
6 10	-8	-13 -22	22L 5L	-5 -14	14L 3T	0 -9	9L 8T	0 -6	6L 8T	+4 -2	2L 12T	+7 -2	2L 15T	+7 +1	1T 15T		
10 18	-8	-16 -27	27L 8L	-6 -17	17L 2T	0 -11	11L 8T	0 -8	8L 8T	+5 -3	3L 13T	+8 -3	3L 16T	+8 +1	1T 17T		
18 30	-10	-20 -33	33L 10L	-7 -20	20L 3T	0 -13	13L 10T			+5 -4	4L 15T	+9 -4	4L 19T	+11 +2	2T 21T		
30 50	-12	-25 -41	41L 13L	-9 -25	25L 3T	0 -16	16L 12T			+6 -5	5L 18T	+11 -5	5L 23T	+13 +2	2T 25T	+18 +2	2T 30T
50 80	-15	-30 -49	49L 15L	-10 -29	29L 5T	0 -19	19L 15T			+6 -7	7L 21T	+12 -7	7L 27T	+15 +2	2T 30T	+21 +2	2T 36T
80 120	-20	-36 -58	58L 16L	-12 -34	34L 8T	0 -22	22L 20T			+6 -9	9L 26T	+13 -9	9L 33T	+18 +3	3T 38T	+25 +3	3T 45T
120 180	-25	-43 -68	68L 18L	-14 -39	39L 11T	0 -25	25L 25T			+7 -11	11L 32T	+14 -11	11L 39T	+21 +3	3T 46T	+28 +3	3T 53T
180 200	-30	-50 -79	79L 20L	-15 -44	44L 15T	0 -29	29L 30T			+7 -13	13L 37T	+16 -13	13L 46T	+24 +4	4T 54T		
200 225	-30	-50 -79	79L 20L	-15 -44	44L 15T	0 -29	29L 30T			+7 -13	13L 37T	+16 -13	13L 46T	+24 +4	4T 54T		
225 250	-30	-50 -79	79L 20L	-15 -44	44L 15T	0 -29	29L 30T			+7 -13	13L 37T	+16 -13	13L 46T	+24 +4	4T 54T		
250 280	-35	-56 -88	88L 21L	-17 -49	49L 18T	0 -32	32L 35T			+7 -16	16L 42T	+16 -16	16L 51T	+27 +4	4T 62T		
280 315	-35	-56 -88	88L 21L	-17 -49	49L 18T	0 -32	32L 35T			+7 -16	16L 42T	+16 -16	16L 51T	+27 +4	4T 62T		

The tolerances in this table are in conformity with ISO standard.

表中公差与 ISO 标准一致

Fits

Shaft and Housing Fits

Radial Ball, Spherical, 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 thousandths of a millimeter.

配合

轴和外壳的配合

向心球、调心滚子、圆柱滚子轴承

表内所示的孔公差和各种公差符号下的轴直径是相对于公称轴承内径的偏差。配合一栏列出该种配合可能出现的最紧和最松状态的数值，"L" 代表松或间隙，"T" 代表紧或过盈。

除公称尺寸外，其余数据均以微米为单位。

Shaft 轴

Bearing Bore 轴承内径		m5			m6			n6			P6			r6			r7		
Nominal (max.) 公称(最大)	Tol. 公差	Shaft Dia. 轴直径		Fit 配合	Shaft Dia. 轴直径		Fit 配合	Shaft Dia. 轴直径		Fit 配合	Shaft Dia. 轴直径		Fit 配合	Shaft Dia. 轴直径		Fit 配合	Shaft Dia. 轴直径		Fit 配合
over Incl 超过 至	0 To 0 至	max. 最大	min. 最小		max. 最大	min. 最小		max. 最大	min. 最小		max. 最大	min. 最小		max. 最大	min. 最小		max. 最大	min. 最小	
mm	μm	μm			μm			μm			μm			μm			μm		
3 6	-8	+9	+4	4T 17T															
6 10	-8	+12	+6	6T 20T															
10 18	-8	+15	+7	7T 23T															
18 30	-10	+17	+8	8T 27T															
30 50	-12	+20	+9	9T 32T	+25	+9	9T 37T												
50 80	-15	+24	+11	11T 39T	+30	+11	11T 45T	+39	+20	20T 54T									
80 120	-20	+28	+13	13T 48T	+35	+13	13T 55T	+45	+23	23T 65T	+59	+37	37T 79T						
120 180	-25	+33	+15	15T 58T	+40	+15	15T 65T	+52	+27	27T 77T	+68	+43	43T 93T	+90	+65	65T 115T			
180 200	-30	+37	+17	17T 67T	+46	+17	17T 76T	+60	+31	31T 90T	+79	+50	50T 109T	+106	+77	77T 136T			
200 225	-30	+37	+17	17T 67T	+46	+17	17T 76T	+60	+31	31T 90T	+79	+50	50T 109T	+109	+80	80T 139T	+126	+80	80T 156T
225 250	-30	+37	+17	17T 67T	+46	+17	17T 76T	+60	+31	31T 90T	+79	+50	50T 109T	+113	+84	84T 143T	+130	+84	84T 160T
250 280	-35	+43	+20	20T 78T	+52	+20	20T 87T	+66	+34	34T 101T	+88	+56	56T 123T	+126	+94	94T 161T	+146	+94	94T 181T
280 315	-35	+43	+20	20T 78T	+52	+20	20T 87T	+66	+34	34T 101T	+88	+56	56T 123T	+130	+98	98T 165T	+150	+98	98T 185T

The tolerances in this table are in conformity with ISO standard.

表中公差与 ISO 标准一致

Fits

Shaft and Housing Fits
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 thousandths of a millimeter.

配合

轴和外壳的配合
向心球、调心滚子、圆柱滚子轴承

表内所示外径公差和外壳孔径是相对于公称轴承外径的偏差。配合一栏列出该种配合可能出现的最紧和最松状态的数值，"L" 代表松或间隙，"T" 代表紧或过盈。

除公称尺寸外，其余数据均以微米为单位。

Bearing Bore 轴承外径		F7		G7		H8		H7		H6		J6		J7		K6	
Nominal (max.) 公称(最大)	Tol 公差	Housing Bore 外壳孔径	Fit 配合	Housing Bore 外壳孔径	Fit 配合	Housing Bore 外壳孔径	Fit 配合	Housing Bore 外壳孔径	Fit 配合	Housing Bore 外壳孔径	Fit 配合	Housing Bore 外壳孔径	Fit 配合	Housing Bore 外壳孔径	Fit 配合	Housing Bore 外壳孔径	Fit 配合
over incl 超过 至	0 To 0至	min. max. 最小 最大		min. max. 最小 最大		min. max. 最小 最大		min. max. 最小 最大		min. max. 最小 最大		min. max. 最小 最大		min. max. 最小 最大		min. max. 最小 最大	
mm	μm	μm		μm		μm		μm		μm		μm		μm		μm	
10 18	-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
18 30	-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
30 50	-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
50 80	-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
80 120	-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
120 150	-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
150 180	-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
180 250	-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
250 315	-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
315 400	-40	+62 +119	62L 159L	+18 +75	18L 115L	0 +89	0L 129L	0 +57	0L 97L	0 +36	0L 76L	-7 +29	7T 69L	-18 +39	18T 79L	-29 +7	29T 47L
400 500	-45	+68 +131	68L 176L	+20 +83	20L 128L	0 +97	0L 142L	0 +63	0L 108L	0 +40	0L 85L	-7 +33	7T 78L	-20 +43	20T 88L	-32 +8	32T 53L
500 630	-50	+76 +146	76L 196L	+22 +92	22L 142L	0 +110	0L 160L	0 +70	0L 120L	0 +44	0L 94L	-7 +37	7T 87L	-22 +48	22T 98L	-44 0	44T 50L
630 800	-75	+80 +160	80L 235L	+24 +104	24L 179L	0 +125	0L 200L	0 +80	0L 155L	0 +50	0L 125L	-10 +40	10T 115L	-24 +56	24T 131L	-50 0	50T 75L

The tolerances in this table are in conformity with ISO standard.

表中公差与 ISO 标准一致

Fits

Shaft and Housing Fits

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 thousandths of a millimeter.

配合

轴和外壳的配合

向心球、调心滚子、圆柱滚子轴承

表内所示的外径公差和外壳孔径是相对于公称轴承外径的偏差。配合一栏列出该种配合可能出现的最紧和最松状态的数值，"L" 代表松或间隙，"T" 代表紧或过盈。

除公称尺寸外，其余数据均以微米为单位。

Housing 外壳

Bearing O.D. 轴承外径		K7		M6		M7		N6		N7		P6		P7	
Nominal (max.) 公称（最大）	Tol. 公差	Housing Bore 外壳孔径	Fit 配合	Housing Bore 外壳孔径	Fit 配合	Housing Bore 外壳孔径	Fit 配合	Housing Bore 外壳孔径	Fit 配合	Housing Bore 外壳孔径	Fit 配合	Housing Bore 外壳孔径	Fit 配合	Housing Bore 外壳孔径	Fit 配合
Over incl 超过 至	0 To 0 至	min. max 最小 最大		min max. 最小 最大		min. max. 最小 最大		min. max. 最小 最大		min. max. 最小 最大		min. max. 最小 最大		min. max. 最小 最大	
mm	μm	μm		μm		μm		μm		μm		μm		μm	
10 18	-8	-12 +6	12T 14L	-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	-9	-15 +6	15T 15L	-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	-11	-18 +7	16T 18L	-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	-13	-21 +9	21T 22L	-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	-15	-25 +10	25T 25L	-28 -6	28T 0L	-35 0	35T 15L	-38 -16	38T 1T	-45 -10	45T 5L	-52 -30	52T 15T	-59 -24	59T 9T
120 150	-18	-28 +12	28T 30L	-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	-25	-28 +12	28T 37L	-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	-30	-33 +13	33T 43L	-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	-35	-36 +16	36T 51L	-41 -9	41T 26L	-52 0	52T 35L	-57 -25	57T 10L	-66 -14	66T 21L	-79 -47	79T 12T	-88 -36	88T 1T
315 400	-40	-40 +17	40T 57L	-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	-45	-45 +18	45T 63L	-50 -10	50T 35L	-63 0	63T 46L	-67 -27	67T 18L	-80 -17	80T 28L	-95 -55	95T 10T	-108 -45	108T 0T
500 630	-50	-70 0	70T 50L	-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	-75	-80 0	80T 75L	-80 -30	80T 45L	-110 -30	110T 45L	-100 -50	100T 25L	-130 -50	130T 25L	-138 -88	138T 13T	-168 -88	168T 13T

The tolerances in this table are in conformity with ISO standard.

表中公差与 ISO 标准一致

Fits

Shaft and Housing Fits

Radial Ball and Cylindrical Roller Bearings

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

配合

轴和外壳的配合

向心球、圆柱滚子轴承

此表列出相对于特定工作条件下所推荐的主轴和外壳的配合。

Shaft 轴

Ball Bearings (For all nominal diameters) 球轴承(对于所有公称直径)			Operating Conditions 运行条件	Examples 运行实例	Cylindrical Roller Bearings 圆柱滚子轴承			
Loads 负荷		Shaft			Loads 负荷		Shaft Diameter 轴直径 mm	Shaft Tolerance Symbol 轴公差符号
Lower Load Limit 下限	Upper Load Limit 上限	Tolerance Symbol 轴公差符号			Lower Load Limit 上限	Upper Load Limit 下限		
INNER RING STATIONARY 内圈静止								
0	C[5]	g6	Inner ring to be easily displaced on shaft 内圈要在轴上容易位移	Wheels Non-rotating shafts 飞轮，不旋转的轴	0	C	All 全部 g6	All 全部
0	C	h6	Inner ring does not need to be easily displaced 内圈不需要容易位移	Tension pulleys 张紧轮	0	C	All 全部 h6	All 全部
INNER RING ROTATING, OR INDETERMINATE 内圈旋转或方向不确定							over 超过 incl 至.	
0	0.07C	j6[1]	Light loads 轻负荷	Electrical apparatus, Machine tools, Pumps, Ventilators landustrial trucks 电器、机床、泵、换气风扇、工业卡车	0	0.08C	100 140 k6[2] 140 320 m6[4] 320 500 n6 500 - p6	
0.07C	0.15C	k5	Normal loads 一般负荷	Electrical motors, Turbines, Pumps, Combustion engines, Gear transmissions etc. 电机、涡轮、泵、内燃机、齿轮传动等	0.08C	0.18C	100 140 m6 140 320 n6 320 500 p6 500 - r6	
0.15 C 0	C C	m5 j6[2]	Heavy loads Shock loads 重负荷，冲击负荷	Rail vehicles, Traction motors 铁路车辆 ，牵引马达	0.18C	C	100 140 n6[2] 140 320 p6[2] 320 500 r6[2] 500 - r7[2]	
THRUST LOADS 轴向负荷								
			Pure thrust loads 纯轴向力	All 全部	Not recommended, consult engineering dept. 不建议，请垂询技术部门			

[1] Use j6 accurate applications.
[2] Bearings with greater than nominal clearance must use.
[3] Use k5 for accurate applications.
[4] Use m5 for accurate applications.
[5] C=Dynamic Load Rating.

[1] j6 用于更精确的场合
[2] 游隙大基本组值的轴承一定要用
[3] k5 用于更精确的场合
[4] m5 用于更精确的场合
[5] C= 额定动负荷

Fits

Shaft and Housing Fits

Radial Ball and Cylindrical Roller Bearings

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

配合

轴和外壳的配合

向心球、圆柱滚子轴承

此表列出相对特定工作条件下所推荐的主轴和外壳的配合。

Housing 外壳

Operating Conditions 运行条件		Examples 运行实例	Housing Tolerance Symbol 外壳公差符号	Outer Ring Displaceable Axially 外圈轴向位移
OUTER RING ROTATING 外圈旋转				
Heavy loads with thin-wall housing 重负荷且外壳壁薄		Crane support wheels, Wheel hubs (roller bearings), Crank bearings 吊车支撑轮、车毂（滚子轴承） 曲柄轴承	P6	No 无需
Normal to heavy loads 一般到重负荷		Wheel hubs(ball bearings), Chank bearings 车毂(球轴承)、曲柄轴承	N6	No 无需
		Conveyor rollers,Rope sheaves, Tension pulleys 传输带托辊、滑轮、张紧轮	M6	No 无需
INDETERMINATE LOAD DIRECTION 外圈不确定负载方向				
Heavy shock loads 重冲击负荷		Electric traction motors 牵引电机	M7	No 无需
Normal to heavy loads axial displacement of outer ring not required 一般负荷到重负荷，外圈无需轴向位移		Electric motors, Pumps, Crankshaft main bearings 电机、泵、曲柄主轴承	K6	no, normally 一般不需要
Light to normal loads axial displacement of outer ring desired. 轻负荷到一般负荷，外圈需轴向位移		Electric motors, Pumps, Crankshaft main bearings 电机、泵、曲柄主轴承	J6	Yes, normally 一般需要
OUTER RING STATIONARY 外圈静止				
Shock loads, temporary complete unloading 冲击负荷，暂时空载		Heavy rail vehicles 重型铁路车辆	J6	Yes, normally 一般需要
All loads 各种负荷	One-piece housing 一体的外壳	General applications, Heavy rail vehicles 重型铁路车辆、一般情况	H6	Easily 容易
	Radially split housing 径向分体外壳	Transmission drives 传动驱动	H7	Easily 容易
Heat supplied through shaft 通过轴传输热量		Drier cylinders 干燥机缸	G7	Easily 容易

*Below this line, housing can either be one-piece or split; above this line, a split housing is not recommended.
* 此线以下的外壳可以是一体的，也可以是分开的，此线以上不建议使用分开外壳

Where wider tolerances are permissible, P7, N7, M7, K7, J7 and H7 values may be used in place of P6, M6, N6, K6, J6 and H6 values respectively.
当允许较大的公差时，可用 P7, N7, M7, K7, J7, H7 去替换 P6, M6, N6, K6, J6, H6。

Fits

Shaft and Housing Fits

Radial Spherical Roller Bearings

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

配合

轴和外壳的配合

调心滚子轴承

此表列出在特定工作条件下所推荐的轴和外壳的配合。

Shaft 轴

	Conditions 条件	Examples 运行实例	Shaft Diameter 轴直径 mm	Tolerance Symbol 公差符号	Remarks 备注
BEARINGS WITH STRAIGHT BORE 圆柱内孔					
Stationary inner ring load 静止的内圈负荷	The inner ring to be easily displaced on the shaft 内圈要在轴上容易位移	Two - bearing shaft mechanism 两轴承主轴结构	All diameters 所有的直径	f6	
		Wheel on non - rotating shaft 静止主轴上的轮子		g6	
	The inner ring not to be easily displaced on the shaft 内圈不需要在轴上位移	Tension pulleys and rope sheaves 张紧轮和滑轮		h6	
Rotating inner ring load or indeterminate load direction 旋转的内圈负荷或负荷方向无法判断	Light and variable loads P < 0.07 C 轻负荷和可变负荷 P < 0.07 C	Electrical apparatus, Machine tools, Pumps, Ventilators, Industrial trucks 电器、机床、泵、换气扇、工业卡车	over 超过 18 100 incl. 至 100 200	k6 m6	In very accurate applications k5 and m5 are used instead of k6 and m6 respectively 在非常精确的情况下，k5、m5分别用来代替k6、m6
	Normal and heavy loads P > 0.07C P < 0.25C 普通负荷和重负荷 P > 0.07C P < 0.25C	Applications in general, Electrical motors, Turbines, Pumps, Combustion engines, Gear transmission, Wood - working machines 适用通用机械、电机、涡轮、泵、内燃机、齿轮传动、木工机械等	18 65 65 100 100 140 140 280 280 500 500 and up	m5 m6 n6 p6 r6 r7	
	Very heavy loads and shock loads P>0.25 C 超重负荷和冲击负荷 P>0.25 C	Journal boxes for locomotives and other heavy rail vehicles, traction motors 火车头及其它铁路用重型车辆的轴颈箱、牵引马达		m6 n6 p6 r6 r7	Bearings with greater clearance than normal 大于正常游隙
BEARINGS WITH TAPERED BORE ANDADAPTER SLEEVE 带锥孔及紧定套的轴承					
	All loads 各种负荷	Applications in general 通用情况	All diameters 所有的直径		See tables for Reduction of RIC on page 10 . 见 5 页上的径向内部间隙的减小值

Fits

Shaft and Housing Fits

Radial Spherical Roller Bearings

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

配合

轴和外壳的配合

调心滚子轴承

此表列出特殊情况下所推荐的轴和外壳的配合值。

Housing 外壳

Conditions 条件			Examples 运行实例		Tolerance Symbol 公差符号	Remarks 备注
One piece bearing housing 一体的外壳	Rotating outer ring load 旋转的外圈负荷	Variable load direction 可变负荷方向	Two - bearing eccentric shaft mechanism 双轴承偏心轴结构		P6	The outer ring is not displaceable axially 外圈不能轴向位移
		Heavy loads on bearings in thin walled housings 薄壁外壳，重负荷的轴承	Supporting wheels in cranes, Wheel hubs, Crank bearings 吊车用支撑轮车毂、曲柄轴承		P7	
		Normal and heavy loads 普通负荷和可变负荷	Wheel hubs, Crank bearings 车毂、曲柄轴承		N7	
		Light and variable loads 轻负荷和可变负荷	Conveyor rollers, Rope sheaves, Tension pulleys 传送辊、滑轮、张紧轮		M7	
	Indeterminate load direction 不确定的负荷方向	Heavy shock loads 重冲击负荷	Electrical traction motors 牵引电机			
Split or one piece bearing housing 分开或一体的外壳		Heavy and normal loads, axial displacement of outer ring not required 重负荷，普通，外圈无需轴向位移	Electrical motors, Pumps, Crankshaft main bearings 电机、泵、曲轴主轴承		K7	The outer ring is as a rule not displaceable axially 外圈作为轴线的固定端
		Normal and light loads, axial displacement of the outer ring desirable 重负荷、轻负荷、需要轴向更换外圈	Electrical motors, Pumps, Crankshaft main bearings 电机、泵、曲轴主轴承		J7	The outer ring is as a rule displaceable axially 外圈作为轴线的浮动端
	Stationary outer ring load 静止的外圈负荷	Shock loads, temporarily complete unloading 冲击负荷、暂时完全空载	Journal boxes for rail vehicles 火车用轴颈箱			
		All loads 各种负荷	Bearing applications in general, Journal boxes for rail vehicles 通用，火车用轴颈箱		H7	The outer ring is easily displaced axially 外圈可轻易地轴向位移
		Normal and light loads, loads under simple operating conditions 普通负荷或轻负荷，单一操作状态下的负荷	Line shaftings 传动轴条		H8	
		Heat supplied through the shaft 通过轴供热	Dryer cylinders 烘干机		G7	
One piece bearing housing 一体的外壳	Applications requiring particular accuracy 需特别精度的情况	very accurate running and small deflections under variable loads 很精确的运行在不同负荷下变形小	For main spindles in machine tools 用于机床主轴	O.D.less than 125mm 外径小于 125mm	M6	The outer ring is not displaceable axially 外圈不可轴向位移
				O.D. 125 to 250mm 外径 125 至 250mm	N6	
				O.D. over 250mm 外径超过 250mm	P6	
		very accurate running under light loads and indeterminate load direction 在轻负荷或方向不确定负荷下的很精确的运行	Held bearings in high speed centrifugal force compressors 高速离心压缩机中的定位轴承		K6	The outer ring is as a rule not displaceable axially 外圈不可轴向位移
		very accurate running, axial displacement of outer ring desirable 很精确的运行，外圈需轴向位移	Floating bearings in high speed Centrifugal force compressors 高速离心压缩机中的浮动端轴承		J6	The outer ring is easily displaced axially 外圈可轻易地进行轴向位移

Bearing Mounting

Mounting Procedures

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

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 i nstaller should make every effort to insure cleanliness by use of protective screens, clean cloths, etc.

Plan The Work

Know in advance what you are going to do and have all the 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 air hose on bearings.** If blind holes are used, insert magnetic rod to remove metal chips that might have been 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 and burrs. For an application with stationary housing and rotating shaft, it is suggested the bearing seat on the shaft be ground to R_a=1.6μm maximum. If it is impractical to use a ground finish, a machined finish of R_a=3.2μm 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 finish of R_a=1.6μm maximum is suggested. Where the outer ring is not required to float, a surface finish of R_a=3.2μm maximum is generally satisfactory.

Don't remove the bearing from its wrapping until actually ready to mount it.

安装

安装程序

根据不同轴承尺寸和应用，可采用不同的安装方法，然而，必须遵循其基本原则。

清洁度

选择一个清洁的环境，在没有灰尘和水气的场合工作，如不能达到该要求，装配人员应尽最大努力使用保护屏罩和清洁布来保持清洁等。

工作计划

需知道先要做什么并准备好所需的全部工具，这可以节省工作时间，减少轴承染上灰尘的机会。

检查和准备

准备好所有需要的机器零件，并在安装前彻底地清洗。外壳孔要清洗干净，油孔吹干净。**不可使用空气软管朝轴承吹风。**如使用盲孔，要用磁辊将生产中残留的金属碎片清除掉。与轴承接触的轴台肩和衬垫套应与轴线垂直，轴与台肩相接处圆角必须小到不与轴承孔圆角的半径相接触。

在最初安装时，要按图纸对所有零件的尺寸精度进行检查，对轴和外壳孔的尺寸和圆度应进行仔细的检查。

轴和外壳孔的表面粗糙度

安装轴承的轴表面必须干净无任何划痕和毛刺。对于在外壳固定而轴旋转的应用情况下，轴上安装轴承的外圆的粗糙度建议最大为R_a=1.6μm。如无法磨削加工，在许多情况下，可用精车达到表面粗糙度为R_a=3.2μm，但过盈配合的量略需增加。可向本公司技术部门咨询推荐值。

对于要求浮动的静止外圈（如在外壳孔内轴向滑动），建议外壳孔粗糙度最大为R_a=1.6μm，如果外圈不要求浮动，表面粗糙度最大R_a=3.2μm一般已令人满意了。

注意：当一切准备工作做好开始安装轴承时，才可将它们的包装拆掉。

Bearing Mounting

Roughness and Tolerance of Shaft and Housing

Roughness and tolerance of shaft and housing, that bearing is fitted to, will directly affect performance of bearing, e.g. wear-proof, anti-corrosion property and fit kind. Therefore proper roughness and tolerance of shaft and housing are essential for a steady fit kind and high connection strength of an interference fit.

Roughness and tolerance of shaft and housing are specified in table 1, table 2 and figure 1.

安装

配合表面的粗糙度和形位公差

配合表面的粗糙度和形位公差，直接影响产品的使用性能，如耐磨性，抗腐蚀性和配合性质等。为此，合理规定轴和外壳孔的形位公差和提出配合表面的粗糙度要求，对于稳定配合性质，提高过盈配合的联结强度至关重要。

轴和外壳孔的配合表面粗糙度及形位公差见表1，表2和图1。

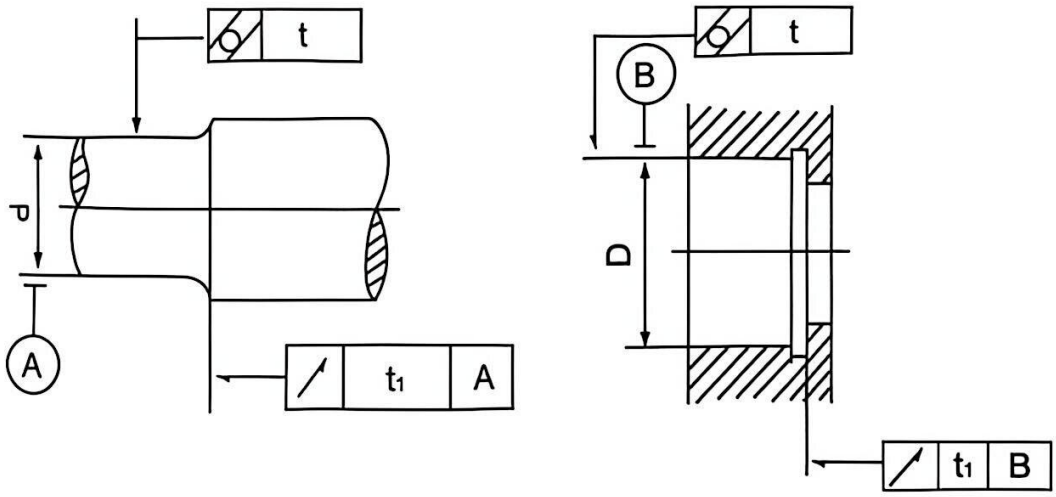


figure 1　图 1

Table 1　Roughness of Shaft and Housing　表 1 配合表面的粗糙度

Fitting Surface 配合表面	Precision Grade of Bearing 轴承精度等级	Tolerance Grade of Fitting Surface 配合表面的尺寸公差等	Nominal Bore or O.D. 轴承公称内径或外径(mm)	
			-80	> 80–500
			Ra(μm) (GB1031-95) 表面粗糙度参数 Ra(μm)按 GB1031-95	
Shaft 轴　颈	P0	IT6	1	1.60
	P6	IT5	0.63	1
	P5		0.40	0.63
	P4		0.25	0.40
Housing 外壳孔	P0	IT7	1.60	2.50
	P6	IT6	1	1.60
	p5		0.63	1
	p4		0.40	0.63
Face of Shoulder 轴肩和外壳孔肩端面	p0		2	2.50
	P6		1.25	2
	P5		1	1.60
	P4		0.80	1.25

注：轴承装在紧定套或退卸套上时，轴颈表面的粗糙度 Ra 不应大于 2.5μm

Shaft Ra < 2.5 μm when the shaft is fitted on a sleeve

Table 2 Tolerance of Shaft and Housing 表2轴和外壳孔的形位公差

Basic Dimension 基本尺寸 (mm)		Cylindricity 圆柱度 t								Runout of Shoulder 端面圆跳动 t_1							
		Shaft 轴 颈				Housing 外壳孔				Shaft 轴 肩				Housing 外壳孔肩			
		Precision Grade of Bearing 轴承精度等级															
		P0	P6	P5	P4	P0	P6	P5	P4	P0	P6	P5	P4	P0	P6	P5	P4
Over 超过	Incl. 到	Tolerance (μm) 公差值 μm															
	6	2.5	1.5	1	0.6	4	2.5	1.5	1	5	3	2	1.2	8	5	3	2
6	10	2.5	1.5	1	0.6	4	2.5	1.5	1	6	4	2.5	1.5	10	6	4	2.5
10	18	3	2	1.2	0.8	5	3	2	1.2	8	5	3	2	12	8	5	3
18	30	4	2.5	1.5	1	6	4	2.5	1.5	10	6	4	2.5	15	10	6	4
30	50	4	2.5	1.5	1	7	4	2.5	1.5	12	8	5	3	20	12	8	5
50	80	5	3	2	1.2	8	5	3	2	15	10	6	4	25	15	10	6
80	120	6	4	2.5	1.5	10	6	4	2.5	15	10	6	4	25	15	10	6
120	180	8	5	3.5	2	12	8	5	3.5	20	12	8	5	30	20	12	8
180	250	10	7	4.5	3	14	10	7	4.5	20	12	8	5	30	20	12	8

Bearing Mounting

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 121℃. A temperature of 93℃ 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 93℃. Trial runs with the unit and bearing are usually necessary to obtain proper timing. Thermal crayons 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.

The oil bath is shown in Figure 2. The bearing should not be in direct contact with the heat source. The usual arrangement is to have a screen 5cm 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.

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 maximum of 93℃, without being flammable. The bath should be checked from time to time to insure its proper combination 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 applied 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.

安装

直孔轴承的安装

热膨胀法

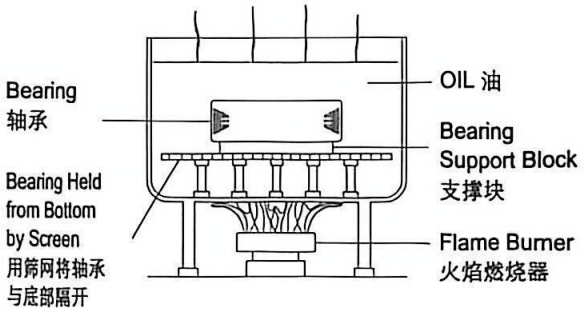
绝大多数情况下，轴承需要在轴上采用紧过盈配合。将轴承加热，使其足够膨胀，以便可以容易地滑上轴，因此安装十分简便，下面是两种常见加热法:

1. 油池加热
2. 感应加热

第一种方法是将轴承放在装有高燃点油的油池中加热。油温不可超过121℃，大多数应用情况，93℃就足够了，通常轴承在油中停留时间为20或30分钟，使其充分膨胀，以便很容易地套上轴。
感应加热法特别适用于装配生产线上对小型轴承的安装，这种方法速度快，但必须小心，温度不可超过93℃。有必要通过试运行来获得准确的时间。可使用在预定温度下溶化的热电蜡笔来测量轴承温度。
当轴承还热的时候，使其垂直地靠在轴肩上，然后用锁紧垫圈，锁紧螺母或夹板来进行固定。轴承冷却后，应旋紧锁紧螺母或夹板。
在外圈旋转的情况下，外圈与外壳孔为紧配合，此时，可对外壳进行加热。
轴承不可直接与热源相接触，一般是在离底部5cm的地方放上一个网板，并用小的支撑块将轴承和网板分开。将轴承和局部温度很高的热源分开是很重要的，不然，轴承温度过高会降低其硬度。
火焰燃烧器是常用的加热器，还需使用一个自动温度控制装置，如果安全规则不允许使用开式加热油池，可在水中混合15%的可溶油，但这种混合剂最高可加热到93℃，而不会产生火焰。使用这种方法，必须经常检查油池，以确信水蒸发后的油水混合是否合适。这种油浴在轴承表面留下一层薄薄的可起到临时防锈功能的油膜，但在安装后，应尽早地进行正常润滑。并保证轴承内的可溶油都被排干净。

Figure 2:
Heat Expansion
Method

图2　油池加热



Bearing Mounting

Mounting Straight Bore Bearings

Arbor Press Method

The alternate 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 3. 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 given in the tables of dimensions. 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.

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 a light machine oil to reduce the force needed for a 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 a press fit on a shaft by applying pressure to the outer ring, or a press fit in a housing be applying pressure to the inner ring.

安装

直孔轴承的安装

心棒压力法

对于小尺寸的轴承，另一种可选择的安装法是使用一台图3所示的心棒压力机和安装管将轴承压到轴上或压入座孔中，安装管可用软钢制成，内径比主轴承稍大一些，外径不应超过表中规定的最大台肩，管子两端应与管子轴承垂直，内外需干净，并具有足够的长度以保证轴承安装后，主轴端不露出。

如果外圈被压入到外壳孔中，安装管的外径应比外壳孔稍小一些，且内径不应小于规定的轴承座台肩的直径。

在轴上涂上一些轻机油以减少压配合所需要的力。小心将轴承放置于轴上，保证它与主轴轴线垂直。

切不可当轴承与轴为紧配合时，对外圈施加压力，或当轴承与外壳孔为紧配合时，对内圈施加压力。

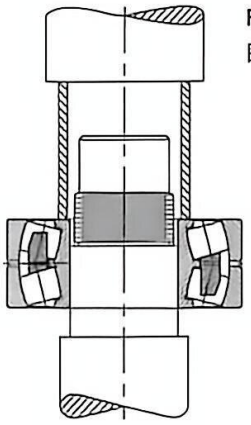


Figure 3: Arbor Press Method
图 3　心棒压力法

Bearing Mounting

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 the 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 feller gauge with the thinnest blade of 0. 04mm is used. Place the bearing in an upright position with the inner and outer ring faces parallel. Place the thumbs on inner ring bore and osillate 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 top two rollers inward to assure proper contact with the inner ring raceways. With the rollers in correct position, insert a thin blade of the feeler gage between the rollers. Move it carefully along the top roller, between the roller and the 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 the 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 reduclion. As a final check, make sure that the remaining RIC equals or exceeds the minimum mounted clearance shown in the table below.

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 at the inboard position of the inner race.

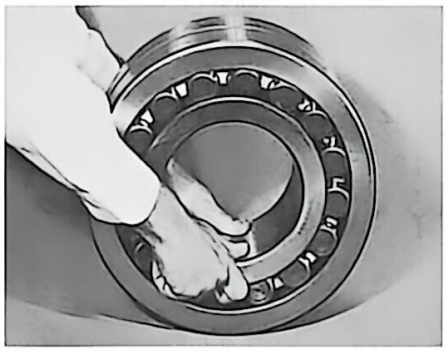
When the recommended amount of reduction of RIC has been accomplished, the bearing is properly fitted. Complete the procedure by peening the lockwasher tang into the locknut slot, or securing the lockplate.

安装

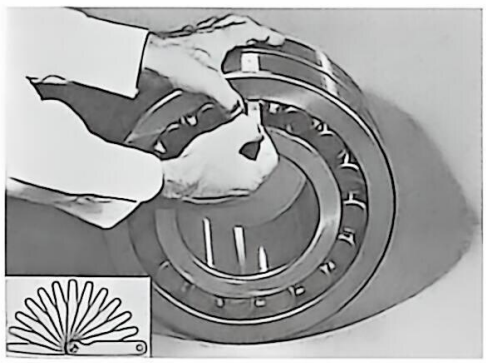
锥孔调心滚子轴承在轴上的安装

尽管我们可以通过测量轴承装配到圆锥轴上的距离来决定锥孔调心滚子轴承的配合，但更实用的方法是测量由于内圈的受力膨胀而减少的径向游隙。这需要确定安装前的起始径向游隙，并在安装时不断测量直至降低到合适的径向游隙。

为了确定起始径向游隙，可采用下列程序。使用最薄到0.04mm的塞尺。先将轴承竖起，使内、外圈端面平行。将大姆指按住内圈并摆动2~3次，向下按紧，使内圈和滚动体定位入座。定位各滚子位置，使在内圈滚道顶部两边各有一个滚子，将顶部两个滚子向内推，以保证它们和内圈滚道保持合适的接触，当滚子处于正确位置时，塞入一个薄塞尺，沿着顶部的滚子慢慢地在滚子和外圈滚道间移动，然后换上一个厚些的塞片重复一遍，直至厚到无法移动为止。最大能通过的塞尺厚度就是安装前的径向游隙。



然后用下面例子里介绍的方法确定径向游隙减少量的目标值。安装时，先在主轴锥体上涂上一层稀机油。将轴承尽可能深地滑移到主轴上去。当锁紧螺母上紧后，内圈的膨胀就达到了过盈配合。定期地测量径向游隙，以获得它的减少量，重复此操作，直到获得了合适的减少量（不可超过推荐的减少量），做最后一次检查时，要保证残留的径向游隙等于或超过下表所示的最小安装游隙。



安装时，应检查无负荷滚子的径向游隙，如果无负荷滚子是在底部，检查时要确保滚子被抬起并可靠地坐定在内圈滚道内。

当达到推荐的径向游隙时，轴承就合适地配合好了。然后，将锁紧垫圈齿卡入锁紧螺母的槽中，或固紧夹板。

Bearing Mounting

安装

Shaft Mounting Tapered Bore Spherical Roller Bearings

锥孔调心滚子轴承在轴上的安装

The following chart indicates the recommended reduction of RIC to be used in mounting tapered bore spherical roller bearings on shafts or adapter sleeves.

下表为锥孔调心滚子轴承安装到轴或接头套上时的推荐径向游隙。

Recommended Reduction of RIC 推荐的径向游隙减小值

Bearing Bore 轴承内径 d		Recommended Reduction of RIC 推荐的径向游隙减小值		Minimum RIC after mounting Bearings with Initial Clearances 具有起始游隙的轴承安装后最小径向游隙		
over 超过	Inch. 至	min. 最小	max. 最大	Normal (standard) 一般（标准）	C3	C4
mm		μm	μm	μm	μm	μm
30	40	20	25	15	25	41
40	50	25	30	20	30	51
50	65	30	36	25	36	64
65	80	38	51	25	43	76
80	100	46	64	36	51	76
100	120	51	71	51	64	102
120	140	64	89	56	76	114
140	160	76	102	56	76	127
160	180	76	114	61	89	152
180	200	89	127	71	102	165
200	225	102	140	76	114	176
225	250	114	152	89	114	203
250	280	114	165	102	140	229
280	315	127	178	102	152	254
315	355	140	190	114	165	279
355	400	152	203	127	191	330
400	450	165	216	152	229	356
450	500	178	229	165	267	406
500	560	203	254	178	292	445
560	630	229	279	203	318	508
630	710	254	305	203	368	546
710	800	279	356	229	394	610
800	900	305	381	254	457	686
900	1000	356	432	279	495	762
1000	1120	406	483	279	546	813
1120	1250	432	508	330	610	914

Bearing Mounting

Shaft Mounting Tapered Bore Spherical Roller Bearings

Example: Bearing 22328 K/C3(140mm bore with a C3 clearance pattern) is being mounted on a tapered shaft.

a. By measuring with feeler gauge, initial RIC is established to be 0.178mm..

b. Reference to chart above indicates proper fit is obtained when RIC is reduced by 0.064mm to 0.089mm, or approximately 0.076mm.

Initial clearance	0.178mm
Reduction of RIC	- 0.076mm
	0.102mm

c. Locknut is tightened until RIC reaches 0.102mm. Final check against minimum RIC after mounting shows this value to be safe.

Note: Tapered bore bearings must have the proper amount of radial internal clearance before installation to provide for the required reduction of RIC during mounting and to compensate for any further internal reduction from abnormal temperature conditions. For special applications, send complete operating data to our engineering department for recommendations on radial internal clearance.

安装

锥孔调心滚子轴承在轴上的安装

例: 22328 K/C3 轴承（内径为 140mm，C3 组游隙）装配到锥形轴上。

a. 用塞尺测到起始径向游隙为 0.178mm。

b. 从上表查出当径向游隙下降 0.064－0.089mm 或约为 0.076mm，就获得合适的配合。

起始游隙	0.178mm
径向游隙减少量	－0.076mm
	0.102mm

c. 上紧锁紧螺母，使径向游隙达到 0.102mm，最后检查安装后的最小径向游隙，表明此值是安全的。

注: 锥孔调心滚子轴承在安装前必须要有合适的径向游隙，以便在安装时提供所需的径向游隙减少量，以及补偿在异常温度情况下，径向游隙的减少。对于特殊的应用，可向我公司技术部门垂询推荐径向游隙。

Lubrication

In order to help maintain a rolling bearing's anti-friction characteristics, lubrication is needed to minimize rolling resistance and sliding friction. Modern lubricants do this very effectively, although in many applications the means by which they accomplish this are extremely complex and not completely understood.

Bearings Grease

In order to increase working life of bearing and to enable equipment to run in high efficiency without any additional cost, a series of bearing greases suitable for various working conditions have been specially developed by Bearing application engineers

For detail information and expertise, please contact with our sales engineers.

润滑

为维持滚动轴承的减摩特性，需要用润滑剂来减少滚动阻力和滑动摩擦。现代润滑材料能非常有效地达到此目的，尽管在许多应用场合它们的工作机理非常复杂并且尚未完全清楚。

轴承润滑脂

为了有效地提高轴承的使用寿命，使设备高效运转，而又不增加用户的额外成本负担，我们专业的应用工程师专门研究并开发了适用于不同工况的轴承润滑脂。

如需详细信息，请与我公司销售员联系，将有专业的工程应用人员为您服务。

Lubrication

Lubrication Selection

The wide range of bearing types and operating conditions precludes any simple, all inclusive statement or guideline allowing the selection of the proper lubricant. At the design level, the first consideration is whether oil or grease is the best for the particular operation. The advantages of oil and grease are outlined in Table 1. Where heat must be carried away for the bearing, oil must be used, and it is nearly always preferred for very high speed applications.

Table 1

Advantages of Oil and Grease

Oil	Grease
Carries heat away from the bearings	Simplifies seal design and acts as a sealant
Carries away moisture and particular matter	Permits prelubrication of sealed or shielded bearings
Easily controlled lubrication	Generally requires less frequent lubrication

Oil Lubrication

Oils used for bearing lubrication should be high quality, non-oxidizing mineral oils. Selection of the proper type of oils depends on bearing speed, load, operating temperature, and method of lubrication.

Oil may be introduced to the bearing housing in many ways. The most common systems are:

(1) **Oil Bath** Generally, the oil level should be no higher than the center point of the lowest rolling element. If speed is high, lower oil levels should be used to reduce churning.

(2) **Circulating System** A typical circulating oil system consists of an oil reservoir, pump, piping, and filter. A cooler may be required.

(3) **Oil-Mist Lubrication** Oil-mist lubrication systems are used in high speed, continuous operation applications. This system permits close control of the amount of lubricant reaching the bearings. Control of this type of lubrication system is accomplished by monitoring the operating temperatures of the bearings being lubricated.

Grease Lubrication

Lubricating grease is a solid to semi-fluid product of the dispersion of a thickening agent in a liquid lubricant; other ingredients imparting special properties may be included. At this time there is no known universal anti-friction bearing grease. Each individual grease has certain limiting properties and characteristics. The successful use of lubricating grease in roller bearings depends on the physical and chemical properties of the lubricant as they pertain to the bearing, its application, installation and general environmental factors.

润滑

润滑剂的选择

轴承类型和工作条件的复杂性决定了不可能有任何简单的选择合适润滑剂的包罗万象的指南。在设计阶段，首先要考虑的是对于某种特定的工作条件最合适的是采用润滑油还是润滑脂。润滑油和润滑脂的优点概括在表1。如果轴承的热量需要不断带走，应该用润滑油。对于很高速度的应用场合，几乎总是首先选择润滑油。

表 1

润滑油和润滑脂的优点

润滑油	润滑脂
从轴承中带走热量	简化密封设计，本身有密封作用
带走湿汽和异常物质	可以给密封轴承预润滑
容易控制	一般很少需要频繁加脂

油润滑

用于轴承的润滑油应是高质量的不易氧化的矿物性油。应根据轴承转速，负荷，工作温度和润滑方式来选择合适的润滑油。

润滑油可以用多种方式引入轴承，最通常的方式有：

(1)油池　通常油位应不高于最低的滚动体中心。如果速度很高，油位应控制得较低以减少搅拌发热。

(2)循环系统　典型的系统包括油箱，油泵，管路系统，过滤器，可能还需要冷却器。

(3)油雾润滑　油雾润滑系统用于高速，连续工作的应用场合。这种系统可以精确控制到达轴承的润滑油的量。通过监视轴承的工作温度来控制该系统。

润滑脂

润滑脂是一种固体到半流体产品，其中主要是在液体润滑剂中掺混着离散分布的增稠剂，还可能包含形成某种特殊性质的其它成分。目前还没有一种已知的万能的轴承润滑脂。各种润滑脂都有某些有限的性能和特性。润滑脂在滚动轴承内的成功使用取决于润滑脂的物理化学性能，它们应适合于这种轴承，以及轴承的应用场合，安装条件和综合环境因素。

Lubrication

Low Temperatures

Starting torque in a grease lubricated ball bearing at low temperatures can be critical. Some greases may function adequately as long as the bearing is operating, but resistance to initial movement is such that the starting torque is excessive. In certain smaller machines, starting is an impossibility when very cold. Under such operating circumstances the greases containing low temperature characteristic oils are generally required.

High Temperatures

The high temperature limit for modern grease is generally a function of the thermal and oxidation stability of the fluid and the effectiveness of the oxidation inhibitors.

A rule of thumb, developed from years of testing grease lubricated bearings, indicates that grease life is halved for every 25˚F (14˚C) increase in temperature.

In non-relubricatable applications highly refined mineral oils or chemically stable synthetic fluids are required as the oil component of greases for operation at temperatures above 2500 F (121˚C).

Wet Conditions

Water and moisture can be particularly conducive to bearing failure. Lubricating greases may provide a measure of protection from this contamination. Certain greases, the calcium, lithium and non-soap type, for example, are highly water resistant.

Grease Lubrication for Bearing/Housing Assemblies

The grease must be carefully selected with regard to its consistency at operating temperature. It should not exhibit thickening, separation of oil, acid formation or hardening to any marked degree. It should be smooth, non-fibrous, and entirely free from chemically active ingredients. Its melting point should be considerably higher than the operating temperature.

Frictional torque is influenced by the quantity and the quality of lubricant present. Excessive quantities of grease cause churning. This results in excessive temperatures, separation of the grease components, and break down in lubrication values. On normal speed applications the housings should be kept approximately 1/3 to 1/2 full. Re-lubricate at regular intervals to prevent damage to the bearing.

润滑

低温

在低温条件下脂润滑的球轴承的启动力矩是很关键的。有些润滑脂在轴承运转中能正常发挥作用，但是在开始运转时启动力矩过大。某些小型机械在很寒冷时不能启动。在这种工作环境下一般要求润滑脂含有低温特性油成分。

高温

现代润滑脂的高温限制一般是流体的热稳定性和氧化稳定性以及抗氧化能力。

从多年对脂润滑的轴承试验所得出的经验规律表明，每增加摄氏 14 度润滑脂寿命减少一半。

在不可能重新加脂的场合，工作在摄氏 121 度的轴承需要高度精炼的矿物油或化学性质稳定的合成流体作为润滑脂内的油成分。

潮湿条件

水和湿汽特别能引起轴承失效。润滑脂能够提供一种防止这种污染的方法。某些润滑脂，如钙基，锂基和非皂类润滑脂，都是高度防水的。

轴承和轴承箱组件的脂润滑

应该根据在工作温度下润滑脂的稠度小心地选择润滑脂，它不应该出现任何明显的稠化，油的分离，酸化或变硬，它应该是非常细腻，无纤维，完全无活泼化学元素，它的滴点应相当多地超过工作温度。

摩擦力矩受到所加的润滑脂的品质和数量的影响。过量的润滑脂会引起搅拌发热，导致高温，脂成分分离和失去润滑作用。对于通常速度的应用场合，轴承内应大约保持 1/3 到 1/2 空间的润滑脂填充量。应定期重新加脂以防止轴承损坏。

Limiting Speeds

Radial Ball and Roller Bearings

There is no precise method for determining the maximum speed at which a ball or roller bearing may operate. Bearing characteristics and features of surrounding parts, shafts, housings and other components, as well as basic service conditions, are all variables which are dependent upon each other for continued satisfactory high-speed performance.

The safe operating speed of a bearing is often limited by the temperature within the bearing, which in turn, is dependent upon the temperature surrounding the application, accuracy of bearings, shafts, housings, auxiliary parts, etc. and the type and amount of lubricant. Radial bearings with proper internal refinements will operate at high speeds for long periods if properly installed and lubricated. Tolerance grade, cage design, and lubricant are bearing characteristics which affect speed limitations.

Bearings with normal tolerances are generally satisfactory for normal speeds with grease or oil lubrication.

Ball bearings with P5 tolerances or better and ring piloted composition cages lubricated with an efficient, non-churning, cooling oil mist systems have exceptional high-speed ability.

In the case of duplex mountings, as frequently used in high-speed machine tool spindles, bearing preload and contact angle affect the permissible speeds.

The Limiting Speeds of various bearings listed in the catelog are defined as grease or oil bath lubrication were used respectively, besides on following conditions:

- P0 tolerance class
- Pure radial load for radial or radial-thrust bearings
- The load $P < 0.1C$ (C is the basic dynamic load rating)
- Rigid shaft and housing
- Normal lubrication and cooling
- Normal clearance at running time
- Rotating inner ring

For conditions other than above, please consult Technology Section

极限转速

向心球及滚子轴承

目前还没有一种用来测定球和滚子轴承运行的最高转速的精确方法。轴承持续良好的高速运转性能取决于轴承自身性能和其附件、轴、外壳和其它部件以及工作条件的特性。

轴承的可靠转速需受轴承运转温度所限制，而轴承的运转温度又取决于工作环境温度、轴承精度、轴、外壳、附件等等以及润滑剂的种类和用量。

内部设计合理的向心轴承如果安装正确，正常润滑就可以在高速下运行很长一段时间。公差等级，保持架的设计及润滑剂都是影响轴承转速的因素。

公差为标准公差、带脂或油润滑的轴承通常具有良好的额定转速。

公差等级为P5或以上的轴承并使用套圈引导的塑料保持架加上一种有效的，非搅拌的冷却油雾系统，可以得到更高的转速。

在成对安装的情况下，就象高速机床的主轴上常见的，轴承的预负荷和接触角就会影响其允许转速。

列于本样本内的各型号轴承的极限转速分别是下列条件下采用脂润滑和油浴润滑时的极限转速:

- P0级公差轴承
- 向心轴承和向心推力轴承仅承受径向载荷
- 轴承载荷 $P < 0.1C$ (C为基本额定动负荷)
- 刚性的轴和轴承座
- 润滑和冷却条件正常
- 轴承工作游隙正常
- 内圈旋转

不同于上述条件下的轴承的极限转速，请垂询**技术部门**。