Table 8.8 Radial internal clearance of deep groove ball bearings

Unit: μm

Nominal bearing bore diameter d mm		C2		CN		C3		C4		C5	
Over	Incl.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
—	2.5	0	6	4	11	10	20	—	—	—	—
2.5	6	0	7	2	13	8	23	—	—	—	—
6	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

Table 1.1 Comparison of ball bearings and roller bearings

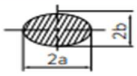
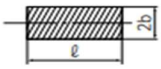
	Ball bearing	Roller bearing
Contact with raceway	 **Point contact** Contact surface is oval when a load is applied.	 **Linear contact** Contact surface is generally rectangular when a load is applied.
Characteristics	Because of point contact, where there is little rolling resistance, ball bearings are suitable for low torque and high-speed applications. They also have superior acoustic characteristics.	Because of linear contact, rotational torque is higher for roller bearings than for ball bearings, but rigidity is also higher.
Load capacity	Load capacity is lower for ball bearings, but radial bearings are capable of bearing loads in both the radial and axial direction.	Load capacity is higher for rolling bearings. Cylindrical roller bearings equipped with a lip can bear slight axial loads. Combining tapered roller bearings in pairs enables the bearings to bear an axial load in both directions.

Table 1.2 Configuration of sealed ball bearings

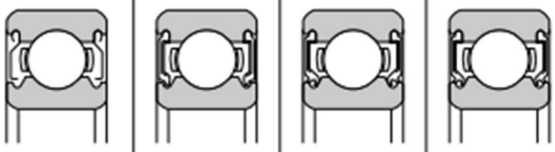
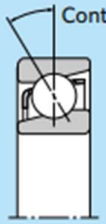
Type and code	Shielded type	Sealed type		
	Non-contact type ZZ	Non-contact type LLB	Contact type LLU	Low torque type LLH
Structure				

Table 1.3 Contact angle and symbol



Contact angle and contact angle symbol

Contact angle	15°	30°	40°
Contact angle symbol	C	A[1)]	B

Note: 1. Contact angle symbol has been abbreviated as "A".

Table 1.4 Configuration of double row angular contact ball bearings

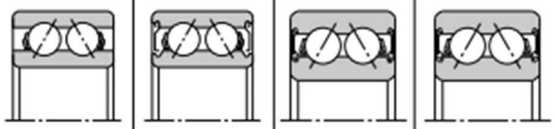
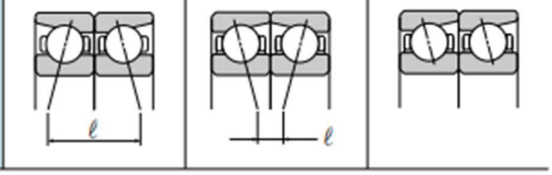
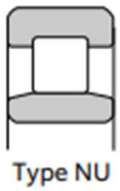
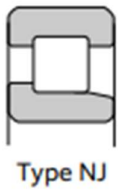
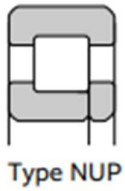
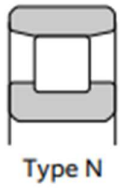
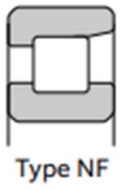
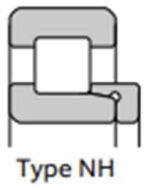
Type and code	Open type	Shielded type ZZ	Non-contact sealed type LLM	Contact sealed type LLD
Structure				

Table 1.5 Combinations of duplex angular contact ball bearings

Type and symbol	Back-to-back arrangement DB	Face-to-face duplex DF	Tandem arrangement DT
Structure			

ℓ : Distance between load centers

Table 1.6 Types of cylindrical roller bearings

Type code	Type NU Type N	Type NJ Type NF	Type NUP Type NH (NJ HJ)
Design	 Type NU	 Type NJ	 Type NUP
	 Type N	 Type NF	 Type NH

(Bearing number examples)

6205ZZC3／2AS

- Grease: Alvania Grease S2
- Radial internal clearance C3
- Double side steel shield
- Nominal bore diameter 25 mm
- Diameter series 2
- **Deep groove ball bearing**

23034EAD1

- Lubrication hole/lubrication groove
- ULTAGE basket-shaped pressed steel cage
- Nominal bore diameter 170 mm
- Diameter series 0
- Width series 3
- **Self-aligning roller bearing**

7012BDB／GMP6

- Tolerances JIS Class 6
- Medium preload
- Back-to-back arrangement
- Contact angle 40°
- Nominal bore diameter 60 mm
- Diameter series 0
- **Angular contact ball bearing**

240／750BK30

- Bore diameter : tapered inner ring bore, standard taper ratio 1:30
- Machined cage
- Nominal bore diameter 750 mm
- Diameter series 0
- Width series 4
- **Self-aligning roller bearing**

NU320G1C3

- Radial internal clearance C3
- High strength machined brass rivetless cage with square holes
- Nominal bore diameter 100 mm
- Diameter series 3
- **Cylindrical roller bearing NU type**

51120L1P5

- Tolerances JIS Class 5
- High strength, machined brass cage
- Nominal bore diameter 100 mm
- Diameter series 1
- Height series 1
- **Thrust ball bearing**

4T–30208

- Nominal bore diameter 40mm
- Diameter series 2
- Width series 0
- **Tapered roller bearing**
- Spec. 4T

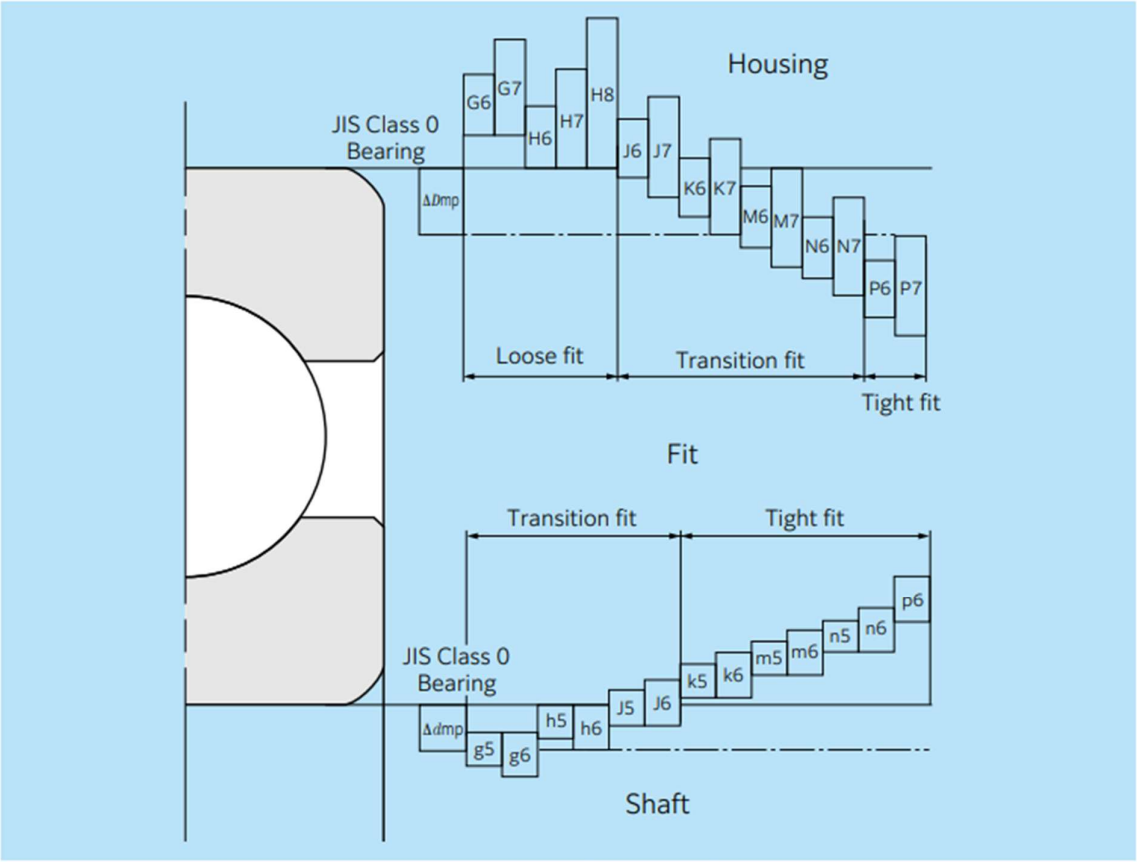


Fig 7.1 State of resultant fit

Table 7.4 Fits for electric motor bearings

Bearing type	Shaft fits			Housing fits	
	Shaft diameter mm Over	Incl.	Tolerance class	Housing bore diameter	Tolerance class
Deep groove ball bearing	~	18	j5	All sizes	H6 or J6
	18 ~	100	k5		
	100 ~	160	m5		
Cylindrical roller bearing	~	40	k5	All sizes	H6 or J6
	40 ~	160	m5		
	160 ~	200	n6		

Table 8.2 Examples of applications where bearing clearances other than CN (normal) clearance are used

Operating conditions	Applications	Selected clearance
With a heavy or shock load, high fit.	Railway vehicle axles	C3
	Vibration screens	C3, C4
With an indeterminate load, both inner and outer rings are tight fit.	Railway vehicle traction motors	C4
	Tractors and final reduction gear	C4
Shaft or inner ring is heated.	Paper making machines and driers	C3, C4
	Table rollers for rolling mill	C3
Required low noise and vibration when rotating.	Small electric motors	C2, CM
Adjustment of clearance to minimize shaft runout.	Main spindles of lathes (Double-row cylindrical roller bearings)	C9NA, C0NA
Loose fit for both inner and outer rings.	Roll neck of steel mill	C2

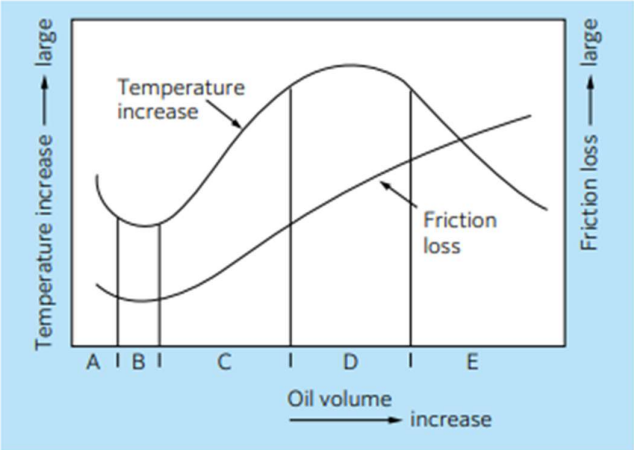


Fig. 11.1

Table 11.1 Oil volume, friction loss, and temperature increase (See Fig. 11.1)

Range	Characteristics	Lubrication method
A	When oil volume is extremely low, direct metallic contact occurs in places between the rolling elements and raceway surfaces. Bearing abrasion and seizing may occur.	—
B	A thin oil film develops over all surfaces, friction is minimal and bearing temperature is low.	Grease lubrication Oil mist Air-oil lubrication
C	As oil volume increases, heat buildup is balanced by cooling.	Circulating lubrication
D	Regardless of oil volume, temperature increases at a fixed rate.	Circulating lubrication
E	As oil volume increases, cooling dominates and bearing temperature decreases.	Forced circulation lubrication Oil jet lubrication