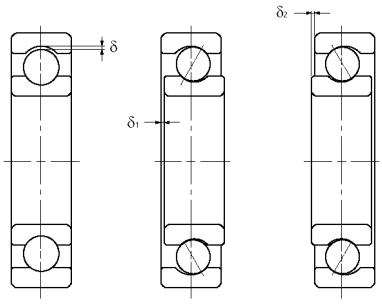
8. Bearing Internal Clearance and Preload

8.1 Bearing internal clearance

Bearing internal clearance (initial clearance) is the amount of internal clearance a bearing has before being installed on a shaft or in a housing.

As shown in **Fig. 8.1**, when either the inner ring or the outer ring is fixed and the other ring is free to move, displacement can take place in either an axial or radial direction. This amount of displacement (radially or axially) is termed the internal clearance and, depending on the direction, is called the radial internal clearance or the axial internal clearance.

The internal clearance values for deep groove ball bearings are shown in **Tables 8.3**. The radial internal clearance of bearings for electric motor is given in **Tables 8.4**.



Radial clearance= δ Axial clearance= $\delta_1 + \delta_2$

Fig 8.1 Internal clearance

8.2 Internal clearance selection

The internal clearance of a bearing under operating conditions (effective clearance) is usually smaller than the same bearing's initial clearance before being installed and operated. This is due to several factors including bearing fit, the difference in temperature between the inner and outer rings, etc. As a bearing's operating clearance has an effect on bearing life, heat generation, vibration, noise, etc.; care must be taken in selecting the most suitable operating clearance.

Table 8.2 Radial internal clearance of deep groove ball bearings

Nominal bore diameter d(mm)		Radial internal clearance Unit μm									
		C2		CN		C3		C4		C5	
over	Incl.	min	max	min	max	min	max	min	max	min	max
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	23	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

8.3 Preload

Giving preload to a bearing results in the rolling elementand raceway surfaces being under constant elastic compressive forces at their contact points. This has the effect of making the bearing extremely rigid so that evenwhen load is applied to the bearing, radial or axial shaft displacement does not occur. Thus, the natural frequency of the shaft is increased, which is suitable for high speeds.

Preload is also used to prevent or suppress shaft runout, vibration, and noise; improve running accuracy and locating accuracy; reduce smearing, and regulate rolling element rotation.

The most common method of preloading is to apply an axial load to two duplex bearings so that the inner and outer

Table 8.3 Radial internal clearance of bearings for electric motor

Nominal bore diameter d (mm)		Radial internal clearance CM (μm)	
over	incl.	min	max
10 (incl.)	18	4	11
18	24	5	12
24	30	5	12
30	40	9	17
40	50	9	17
50	65	12	22

rings are displaced axially in relation to each other, illustrated in **Fig 8.2**.

The most common method of preloading is to apply an axial load to two duplex bearings so that the inner and outer rings are displaced axially in relation to each other. This preloading method is divided into fixed position preload and constant pressure preload. In the electric motor applications, preloading is accomplished by using coil or Belleville springs. Recommended preloads are as follows:

For deep groove ball bearings:

$4\sim8d$ N

or $0.4\sim0.8d$ kgf

d: shaft diameter mm

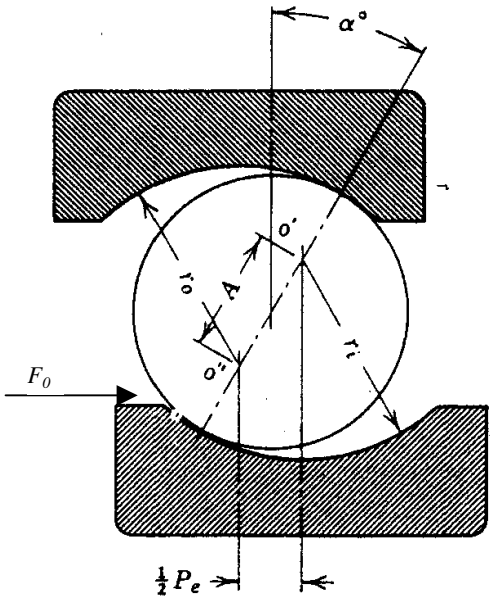


Fig 8.2 Preload