17. Technical data

17.1 Deep groove ball bearing radial internal clearances and axial internal clearances

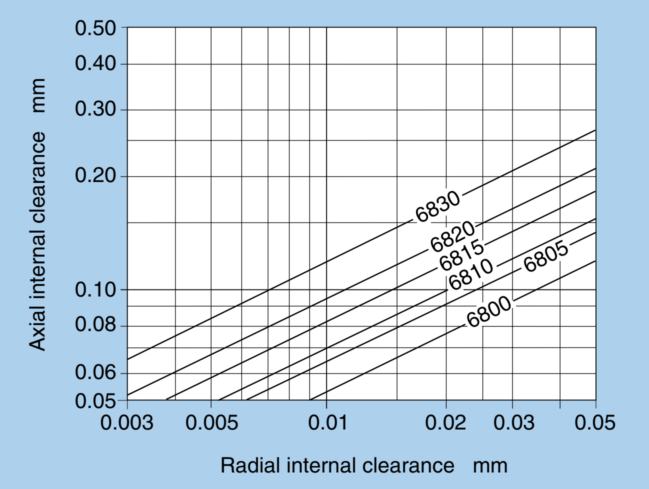


Fig. 17.1.1 Series 68 radial internal/axial internal clearances

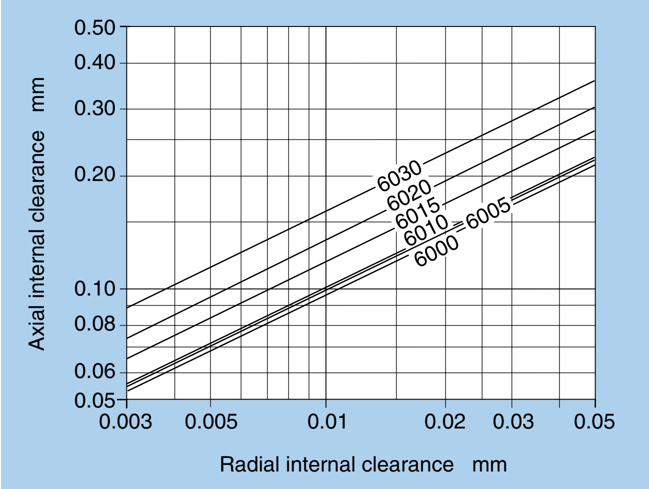


Fig. 17.1.3 Series 60 radial internal/axial internal clearances

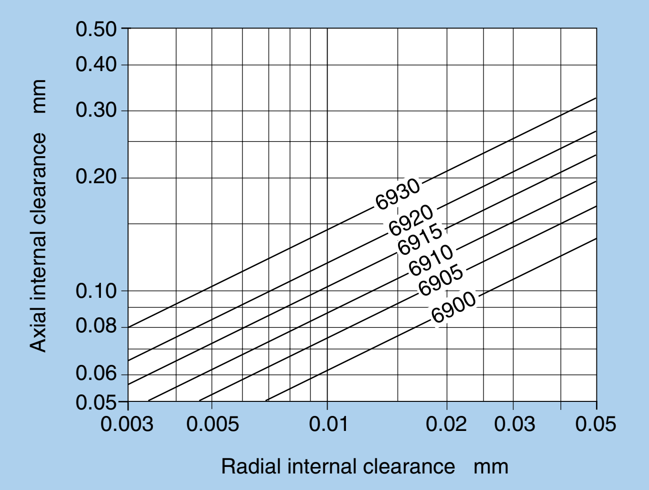


Fig. 17.1.2 Series 69 radial internal/axial internal clearances

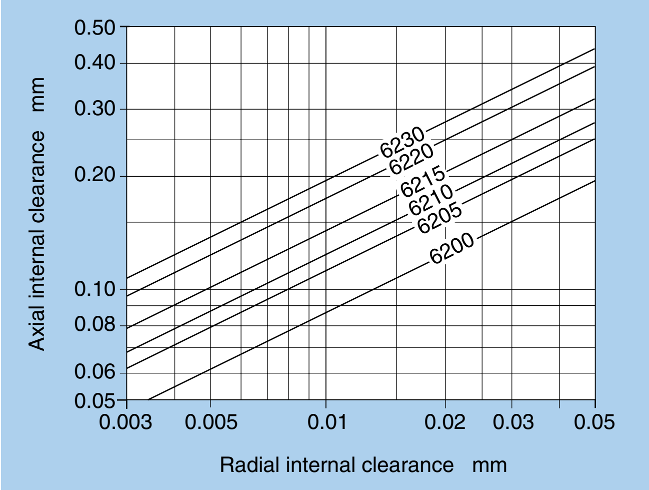


Fig. 17.1.4 Series 62 radial internal/axial internal clearances

※This data is based on typical dimensions. NTN do not guarantee at this data.

17.2 Angular contact ball bearing axial load and axial displacement

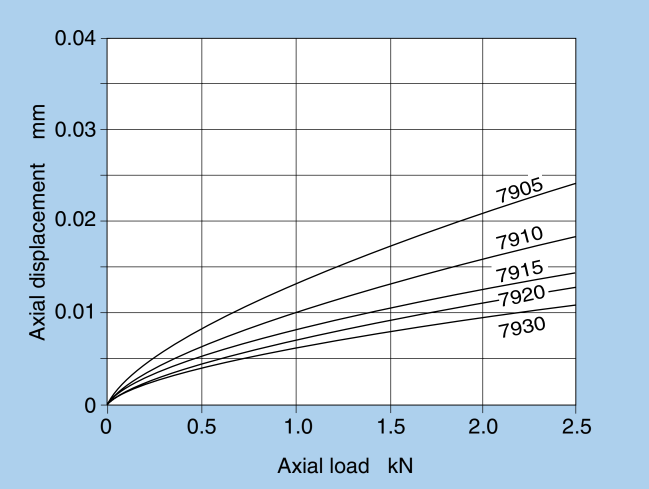


Fig. 17.2.1 Series 79 axial load and axial displacement

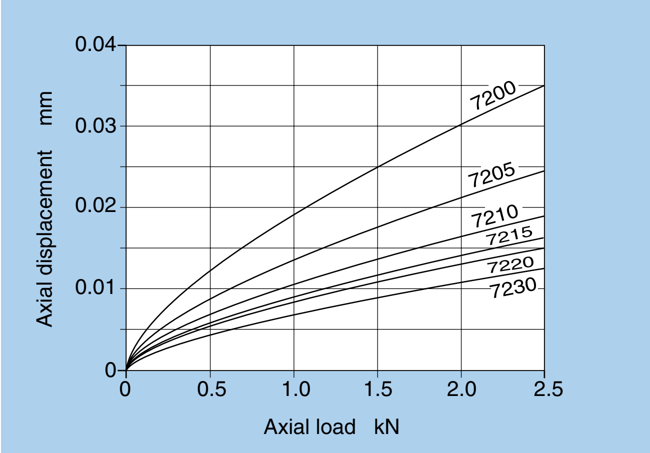


Fig. 17.2.4 Series 72 axial load and axial displacement

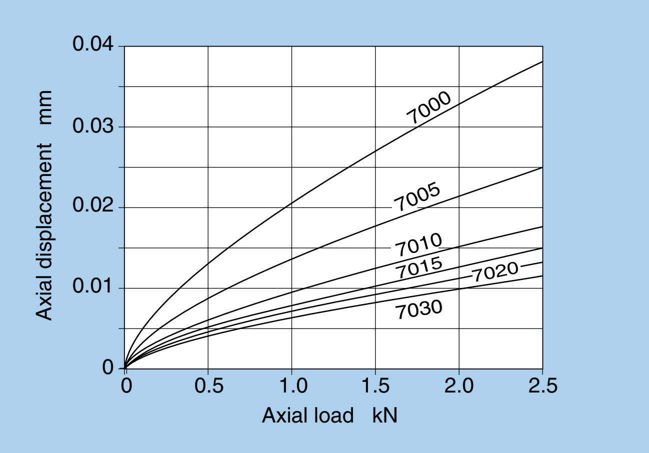


Fig. 17.2.2 Series 70 axial load and axial displacement

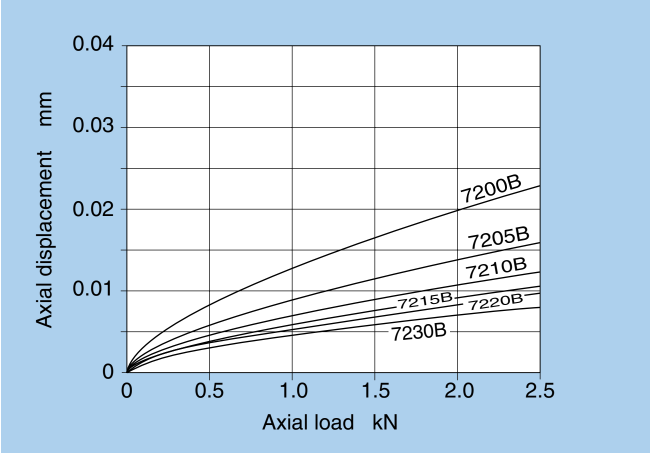


Fig. 17.2.5 Series 72 B axial load and axial displacement

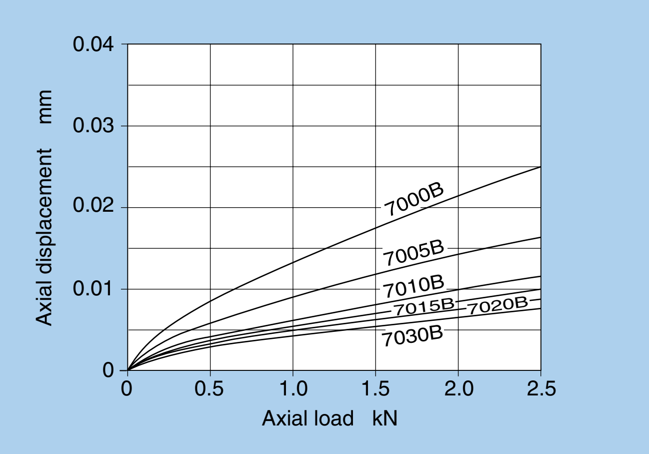


Fig. 17.2.3 Series 70 B axial load and axial displacement

※This data is based on typical dimensions. **NTN** do not guarantee at this data.

17.3 Tapered roller bearing axial load and axial displacement

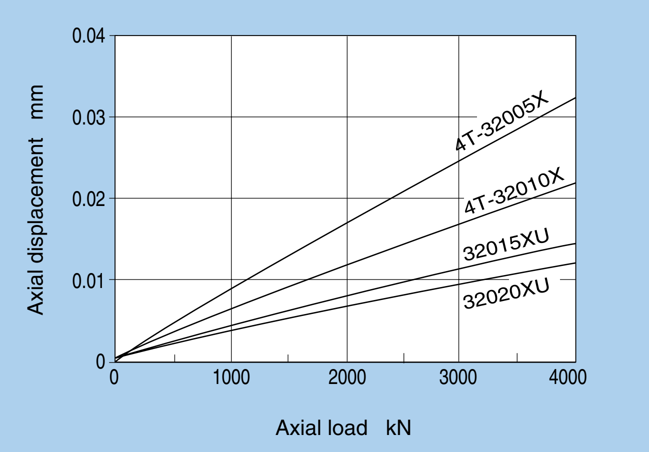


Fig. 17.3.1 Series 320 axial load and axial displacement

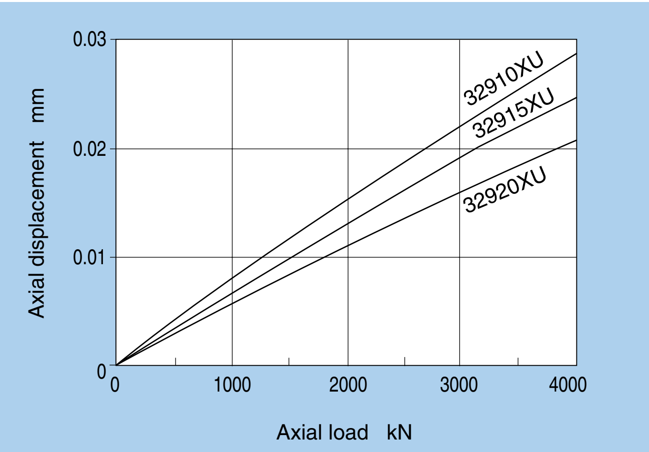


Fig. 17.3.2 Series 329 axial load and axial displacement

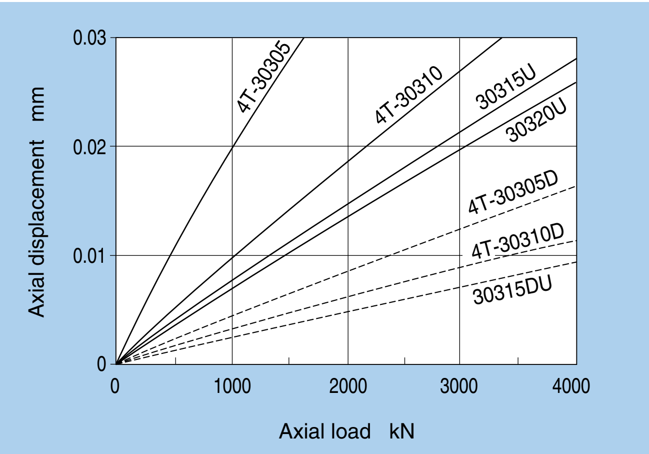


Fig. 17.3.3 Series 303/303 D axial load and axial displacement

Note: Values when bearing and housing are rigid bodies.
Axial displacement may become large depending on shape of shaft/housing and fitting conditions.

17.4 Allowable axial load for ball bearings

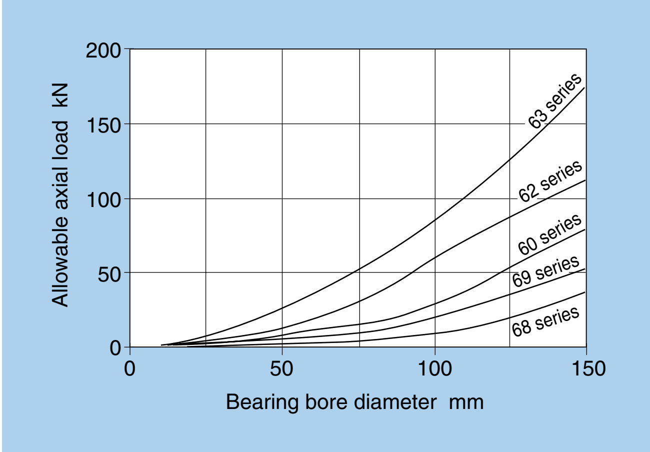


Fig. 17.4.1 Allowable axial load for deep groove ball bearings

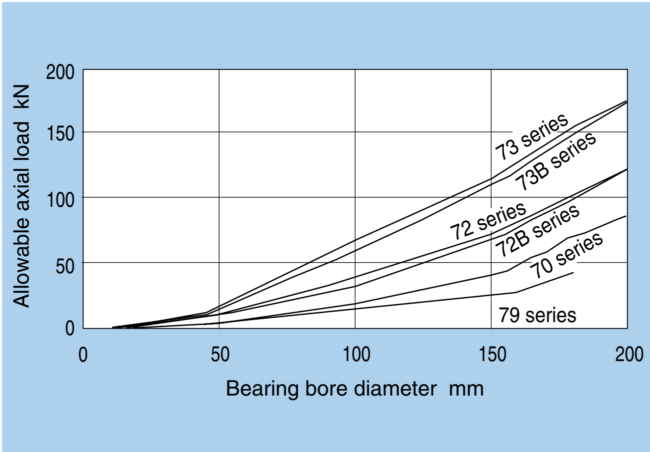


Fig. 17.4.2 Allowable axial load for angullar contact ball bearings

Note: When an axial load acts upon deep groove or angular contact ball bearings, allowable axial load is the load whereby the contact ellipse exceeds the shoulder of the raceway.

17.5 Fitting surface pressure

Table 17.5.1 lists equations for calculating the pressure and maximum stress between fitting surfaces.

Table 17.5.2 can be used to determine the approximate average groove diameter for bearing inner and outer rings.

The effective interference, in other words the actual interference Δ_{deff} after fitting, is smaller than the apparent interference Δd derived from the measured valued for the bearing bore diameter and shaft. This difference is due to the roughness or variations of the finished surfaces to be fitted, and therefore it is necessary to assume the following reductions in effective interference:

For ground shafts: 1.0 ～ 2.5 μm
For lathed shafts : 5.0 ～ 7.0 μm

Table 17.5.1 Fitting surface pressure and maximum stress

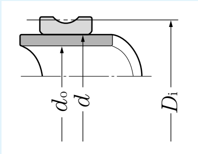
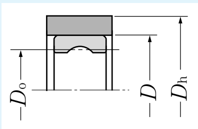
Fit conditions		Equation	Codes (units: N {kgf} , mm)
Fitting surface pressure MPa {kgf / mm²}	Solid steel shaft/ inner ring fit	$P = \frac{E}{2}\frac{\Delta_{deff}}{d}\left[1-\left(\frac{d}{D_i}\right)^2\right]$	d : Shaft diameter, inner ring bore diameter d_o : Hollow shaft inner diameter D_i : Inner ring average groove diameter Δ_{deff} : Effective interference E : Elasticity factor = 208,000 MPa {21,200 kgf / mm²} 
	Hollow steel shaft/ inner ring fit	$P = \frac{E}{2}\frac{\Delta_{deff}}{\Delta_d}\frac{[1-(d/D_i)^2]\,[1-(d_o/d)^2]}{[1-(d_o/D_i)^2]}$	
	Steel housing/ outer ring fit	$P = \frac{E}{2}\frac{\Delta_{Deff}}{D}\frac{[1-(D_o/D)^2]\,[1-(D/D_h)^2]}{[1-(D_o/D_h)^2]}$	D : Housing inner diameter, bearing outer diameter D_o : Outer ring average groove diameter D_h : Housing outer diameter Δ_{Deff} : Effective interference 
Maximum stress MPa {kgf / mm²}	Shaft / inner ring fit	$\sigma_t \max = P\frac{1+(d/D_i)^2}{1-(d/D_i)^2}$	Inner ring bore diameter face maximum tangential stress
	Housing/ outer ring fit	$\sigma_t \max = P\frac{2}{1-(D_o/D)^2}$	Outer ring inner diameter face maximum tangential stress

Table 17.5.2 Average groove diameter (approximate expression)

Bearing type		Average groove diameter	
		Inner ring (D_i)	Outer ring (D_o)
Deep groove ball bearings	All types	$1.05\,\frac{4d+D}{5}$	$0.95\,\frac{d+4D}{5}$
Cylindrical roller bearings❶	All types	$1.05\,\frac{3d+D}{4}$	$0.98\,\frac{d+3D}{4}$
Spherical roller bearings	All types	$\frac{2d+D}{3}$	$0.97\,\frac{d+4D}{5}$

d: Inner ring bore diameter mm D: Outer ring outer diameter mm
❶ Average groove diameter values shown for double-flange type.

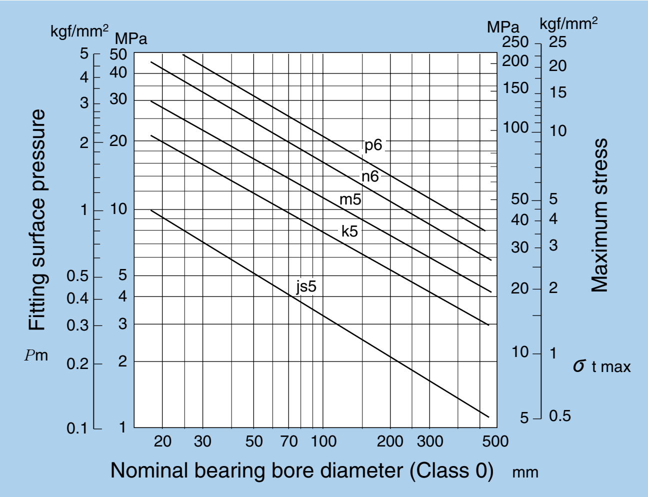


Fig. 17.5.1 Average fit interference as it relates to surface pressure P_m and max. stress $\sigma_{t\,max}$

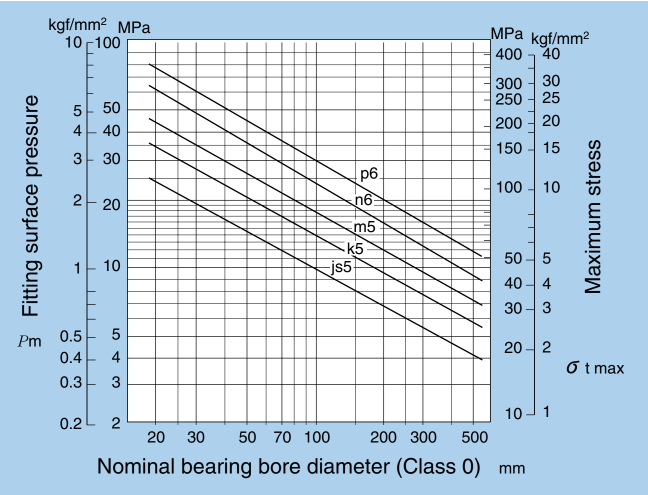


Fig. 17.5.2 Maximum fit interference as it relates to surface pressure P_m and max. stress $\sigma_{t\,max}$

❶ For recommended fitting, see page A-50.

17.6 Necessary press fit and pullout force

Equations (17.1) and (17.2) below can be used to calculate the necessary pullout force for press fit for inner rings and shafts or outer rings and housings.

For shaft and inner rings:

$$K_d = \mu \cdot P \cdot \pi \cdot d \cdot B \cdots\cdots\cdots\cdots (17.1)$$

For housing and outer rings:

$$K_D = \mu \cdot P \cdot \pi \cdot D \cdot B \cdots\cdots\cdots\cdots (17.2)$$

Where,

K_d : Inner ring press fit or pullout force N {kgf}
K_D : Outer ring press fit or pullout force N {kgf}
P : Fitting surface pressure MPa {kgf/mm²} (Refer to **Table 17.5.1**)
d : Shaft diameter, inner ring bore diameter mm
D : Housing inner diameter, outer ring outer diameter mm
B : Inner or outer ring width
μ : Sliding friction coefficient (Refer to **Table 17.6.1**)

Table 17.6.1 Press fit and pullout sliding friction coefficient

Type	μ
Inner (outer) ring press fit onto cylindrical shaft (bore)	0.12
Inner (outer) ring pullout from cylindrical shaft (bore)	0.18
Inner ring press fit onto tapered shaft or sleeve	0.17
Inner ring pullout from tapered shaft	0.14
Sleeve press fit onto shaft/bearing	0.30
Sleeve pullout from shaft/bearing	0.33