4.8.3 Misalignment of Inner/Outer Rings and Fatigue Life of Deep Groove Ball Bearings

A rolling bearing is manufactured with high accuracy, and careful attention to machining and assembly accuracies of the surrounding shafts and housing is critical for this accuracy is to be maintained. In practice however, the machining accuracy of parts around the bearing is limited, and bearings are subject to misalignment of inner/outer rings caused by the shaft deflection under external load.

The allowable misalignment is generally 0.0006 – 0.003 rad (2′ to 10′) but this varies depending on the size of the deep groove ball bearing, internal clearance during operation, and load.

This section introduces the relationship between the misalignment of inner/outer rings and fatigue life. Four Series 62 and 63 deep groove ball bearings of different sizes were selected as examples.

Assume the fatigue life without misalignment as $L_{\theta=0}$ and the fatigue life with misalignment as L_θ. The effect of the misalignment on the fatigue life may be found by calculating $L_\theta / L_{\theta=0}$. Results are shown in Figs. 4.31 to 4.34.

To represent ordinary running conditions in calculations, radial load F_r (N) {kgf} and axial load F_a (N) {kgf} were assumed to be approximately 9 % (normal load) and 1 % (light preload) of the dynamic load rating C_r (N) {kgf} respectively. Normal radial clearance was used and the shaft fit was set to around j5. Decrease of the internal clearance due to expansion of the inner ring was also taken into account.

Moreover, assuming that the temperature difference between the inner and outer rings was 5 °C during operation, inner/outer ring misalignment, $L_\theta / L_{\theta=0}$ was calculated for the maximum, minimum, and mean effective clearances.

As shown in Figs. 4.31 to 4.34, degradation of the fatigue life is limited to 5 to 10 % or less when the misalignment ranges from 0.0006 to 0.003 rad (2′ to 10′), thus not presenting much of a problem.

When misalignment exceeds a certain limit however, the fatigue life degrades rapidly as shown in the figures; therefore, pay careful attention to this matter.

When the clearance is small, not much effect is observed as long as misalignment is also small, as shown in the figures; however, life decreases substantially when misalignment increases. As previously mentioned, aim to minimize mounting error as much as possible.

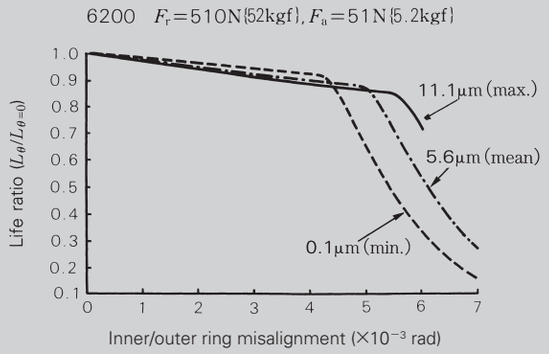


Fig. 4.31 Life Vs. Misalignment

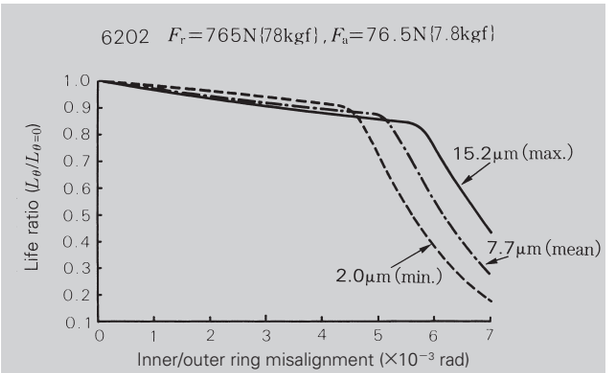


Fig. 4.32 Life Vs. Misalignment

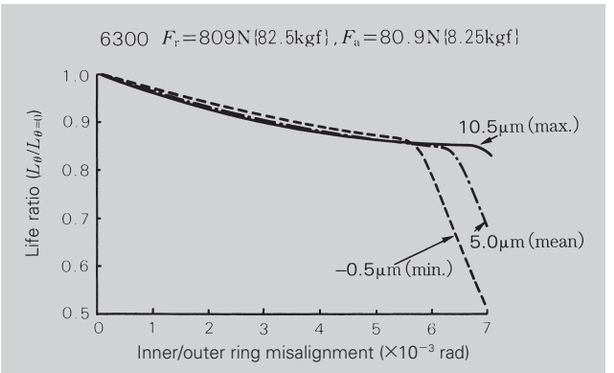


Fig. 4.33 Life Vs. Misalignment

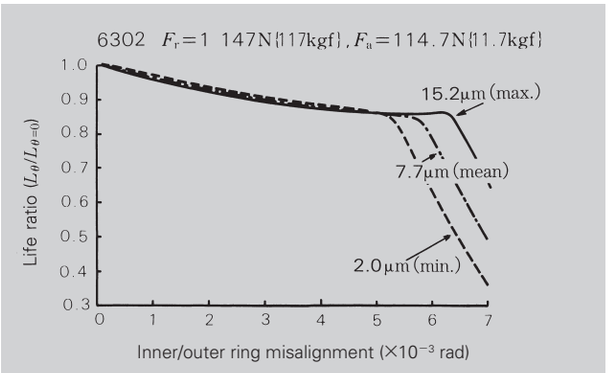


Fig. 4.34 Life Vs. Misalignment