

## 9. Allowable Speed

As rotational speed of the bearing increase, the temperature of the bearing also rises due to heat produced inside the bearing by friction. This causes damage to the bearing such as seizure, and the bearing will be unable to continue stable operation. Therefore, the maximum speed at which it is possible for the bearing to continuously operate without the generation of excessive heat beyond specified limits, is called the **allowable speed** ( $\text{min}^{-1}$ ).

The allowable speed of a bearing depends on the type of bearing, bearing dimensions, type of cage, load, lubricating conditions, and cooling conditions.

The bearing dimensions table gives approximate allowable rotational speeds for grease and oil lubrication. The values are based on the following:

- The bearing must have the proper internal clearance prescribed in the NTN Engineering standard design specifications and must be properly installed.
- A quality lubricant must be used. The lubricant must be replenished and changed when necessary.
- The bearing must be operated at normal operating temperature under ordinary load conditions ( $P \leq 0.09 C_r, F_a / F_r \leq 0.3$ ).

If load is  $P \leq 0.04 C_{or}$ , the rolling elements may not turn smoothly. If so, please contact NTN Engineering for more information. Allowable rotational speed for deep groove ball bearings with contact seal (LLU type) or low-torque seal (LLH type) is determined according to the circumferential speed of the seal.

For bearings to be used under heavier than normal load conditions, the allowable speed values listed in the bearing tables must be multiplied by an adjustment factor. The adjustment factors  $f_L$  and  $f_C$  are given in **Figs. 9.1** and **9.2**.

**Also, when radial bearings are mounted on vertical shafts**, lubricant retentions and cage guidance are not favorable compared to horizontal shaft mounting.

Therefore, the allowable speed should be reduced to **approximately 80% of the listed speed**.

For speeds other than those mentioned above, and for which data is incomplete, please consult NTN Engineering.

If rotational speed is to exceed allowable rotational speed given in the dimensions table, it will require special considerations such as using a bearing for which cage specifications, internal clearance and precision have been thoroughly checked. It will also require adopting forced circulation, jet oil or mist oil lubrication as the lubrication method.

Under such high speed operating conditions, when special care is taken, the standard allowable speeds given in the bearing tables can be adjusted upward. The maximum speed adjustment values,  $f_B$ , by which the bearing table speeds can be multiplied, are shown in **Table 9.1**. However, for any application requiring speeds in excess of the standard allowable speed, please consult NTN Engineering.

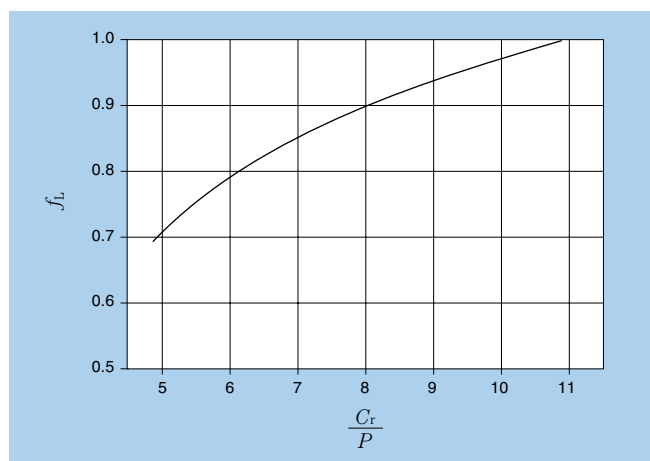


Fig. 9.1 Value of adjustment factor  $f_L$  depends on bearing load

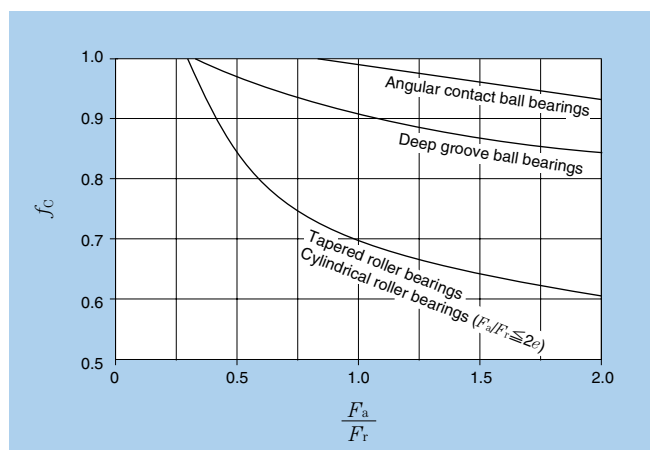


Fig. 9.2 Value of adjustment factor  $f_C$  depends on combined load

Table 9.1 Adjustment factor,  $f_B$ , for allowable number of revolutions

Type of bearing	Adjustment factor $f_B$
Deep groove ball bearings	3.0
Angular contact ball bearings	2.0
Cylindrical roller bearings	2.5
Tapered roller bearings	2.0