5. LIMITING SPEEDS

Limiting Speeds
The limiting speeds listed in the Bearing Dimensional Tables are guideline values. They are based on a single bearing that is lightly preloaded by means of a spring and subjected to relatively light loads with good heat dissipation. The limiting speeds with grease lubrication are determined using high quality grease in appropriate amounts. Those listed for oil lubrication are based on the use of oil-air or oil mist lubrication. In situations where the lubricating oil is used as a means to remove heat, higher speeds can be achieved, however a large amount of oil must be pressure fed through the bearing, so there is a significant loss of power. When single bearings are used in two, three or four row combinations, the preload is increased to improve spindle rigidity, limiting speeds will be lower than those listed. Please consult NSK for grease lubrication, as grease life must be also taken into consideration.

Factors Influencing Limiting Speeds

1. Lubrication Method
The thickness of the lubricating film created by the oil-air or oil mist lubrication replenishment method is larger compared to the thickness created by the grease lubrication method. Therefore the limiting speed is higher when the oil-air or oil mist lubrication method is used. In the case of jet lubrication, the large volume of oil supplied into the bearing for lubrication also removes heat efficiently so that much higher operating speeds are possible.

2. Combination
If bearings are used as multiple bearing sets, the number of bearings in the set affects the limiting speed. As the number is increased, the limiting speed becomes lower because the ability to dissipate heat becomes lower.

3. Preload
The limiting speed of a matched bearing set operating under position preload conditions is calculated by multiplying the adjustment factor listed in Table 5.1. In this table, preloads mean the preload values after the bearing has been mounted on the spindle. Preload values after the bearing has been mounted on the spindle will change as a result of the shaft fit requirements of high speed operation and spacer deformation due to tightening force. In such case, especially in high speed applications, it is necessary to adjust the spacer lengths relative to each other in order to compensate for the changes in preload after bearing mounting.

Factors that Change Preload

4. Drive Method
The limiting speed of a bearing will also change depending on the spindle drive system. In the case of motor built-in spindles the heat inside of the spindles is higher. If there is also a jacket-cooling system, the temperature difference between the inner ring and the outer ring becomes higher, so the preload is increased and the limiting speed becomes lower (see Fig. 5.2). Jacket cooling also affects the clearance between the bearing and the housing (see Fig. 5.3).