MOTION & CONTROL NSK

TECHNICAL INSIGHT

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Getting a good fit – selecting the right shaft and housing tolerance

The first step toward long bearing life is selecting a bearing of the proper type and size. But that's not enough, because even a properly selected bearing will fail prematurely if the shaft and housing fits are incorrect.

Too much or too little interference between the mating parts can cause problems – or early failure. This becomes even more critical when bearings are replaced. A failed bearing can damage the shaft and housing, causing them to be out of tolerance.

A loose fit between the shaft and bearing inner ring (or the housing and the outer ring) can lead to relative movement, or "creep" between these parts. Creep wears out the mating surfaces, increasing the clearance between them. Eventually, the process can generate abnormal heat, vibration and possible contamination from accumulated wear particles, as can be seen in the accompanying photograph.

At the other end of the spectrum, excessive interference causes other problems that can decrease service life. Two key concerns are fracturing the inner ring and reducing the bearing's internal clearance. Too much interference builds high stress, which can sometimes fracture inner rings. Also, an interference fit can decrease the internal clearance of a bearing due to growth of the inner ring or shrinkage in the outer ring. When the interference is too great, internal clearance becomes negative, resulting in excessive heat buildup and premature bearing failure.

The shaft is worn from an improper fit which creates contamination that could lead to early failure.

Staying Fit for Life

Clearly, proper fit selection has a narrow margin for error. As a rule of thumb, the rotating part should have the interference fit. To specify the correct fit, you should understand the main factors that influence fit recommendations:

Operating Conditions

Which ring rotates, the inner or the outer one? Is the load stationary? These factors tell you which ring should have the interference fit. There are three possible combinations:

1. Tight (or interference) fit on the inner ring and loose on outer – a common approach
2. Tight fit on the outer ring and loose on inner – also common
3. Tight fit on both rings – rarely seen

Table 1 shows recommendations for fits (loose or tight) based on typical operating conditions.

Load: Load decreases the interference of the inner ring. Thus, heavier loads require more interference.

Housing and Shaft Materials: Look at the composition of the housing and shaft materials. Varying material strengths and thermal expansion rates make the proper fit different for each material. For example, aluminum expands more than steel. Thus, an interference fit on an outer ring with an aluminum housing requires more interference than a steel housing would require.
In addition, special conditions should be given to thin wall housings, hollow shafts, split housings and high vibration when making fit recommendations. And you should avoid split housings when using a tight fit on an outer ring – the combination often leads to an oval-shaped housing and bearing ring. Applications with heavy vibration may need tight fits on both inner and outer rings.

Using these guidelines, you should inspect the shaft and housing to verify that they meet the manufacturer's original specifications. This will insure maximum life for the replacement bearing.

The relationship between Fit Codes and the amount of interference for shafts

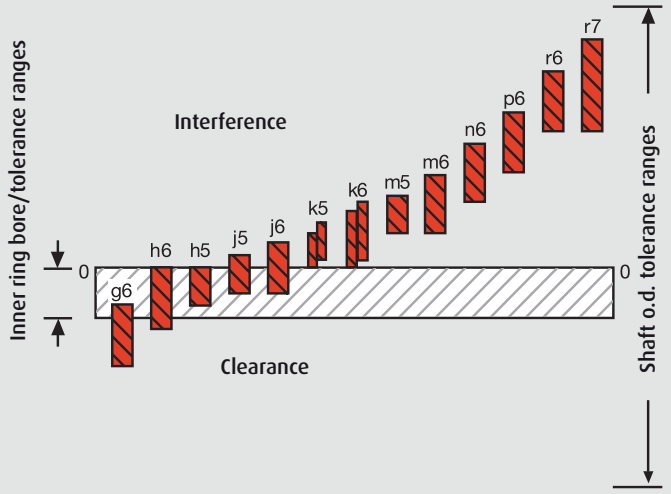
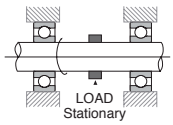
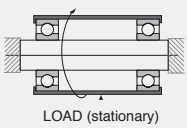


Figure 1 shows the relationship between Fit Codes and the amount of interference for shafts.

Table 1 – Loading conditions and fit

Load Application	Bearing Operation		Load Conditions	Fitting		Examples
	Inner Ring	Outer Ring		Inner Ring	Outer Ring	
	Rotating	Stationary	Rotating Inner Ring Load	Tight Fit	Loose Fit	Electric Motor Pumps Machine Tools Gears
	Stationary	Rotating	Rotating Outer Ring Load	Loose Fit	Tight Fit	Conveyer Rollers Tension Pulleys Auto Wheel Hubs
Direction of load due to variation of direction or unbalanced load	Rotating or Stationary	Rotating or Stationary	Direction of Load Indeterminate	Tight Fit	Tight Fit	Auto Fan Clutch Special Applications

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