6.2 Rotational Speed Adjustment Due to Shaft Fit

A marginal degree of clearance is typically used to facilitate easy installation of a bearing to a shaft. The amount of clearance between the bearing and shaft must be factored in to determine the maximum allowable rotational speed, and as rotational speed is increased, the amount of clearance must be decreased.

Table 6.2 shows the factor that must be used to correct the allowable rotational speed. The maximum rotational speed is determined by multiplying the speed found in **Table 6.1** by the factors below. This table includes the multiplying factors for set screw bearings as well as bearings with adapters and eccentric locking collars. Due to the characteristics of bearings with adapters, a loose fit, h8 or h9, is acceptable. Bearings with eccentric locking collars function optimally with less clearance and therefore, an h5 or j5 fit is recommended to achieve the maximum allowable speed.

Table 6.2 Fitting factor of ball bearing units f_c (recommended)

Type of ball bearing units	Fitting factor f_c					
	Shaft tolerance range class					
	h5, j5	j6	h6	h7	h8	h9
With set screws						
Standard type	–	1	1	0.8	0.5	0.2
LⅢ type (Suffix code: L3)	–	–	–	1	1	0.9
Heat resistant type (Suffix code: D1K2)	–	–	–	1	1	0.7
Cold resistant type (Suffix code: D2K2)	–	–	–	1	1	0.7
For high speed (Suffix code: K3)	–	1	0.8	0.6	–	–
For blower (Suffix code: S3 · S5)	1	–	0.8	0.6	–	–
With adapters	–	–	–	–	1	1
With eccentric locking collar	1	–	–	–	–	–
NU concentric locking collar						

7 Operating Temperature and Bearing Specifications

7.1 Operating Temperature Range

The operating temperature of a ball bearing unit depends on the type of grease, the material of the seal, and the internal clearance of the bearing.

FYH Ball Bearing Units are available in high temperature (D1K2, D9K2) and low temperature (D2K2) series, in addition to the standard models, to allow selection of the correct bearing for your operational temperature (see **Table 2.1**).

The correct unit must be chosen for the desired temperature range, and it is equally important to use the appropriate grease according to the specified schedule.

7.2 Operating Temperature and Internal Clearance of Bearings

When bearings are operated in a high ambient temperature environment, or when the operating temperature is high because of rotational speed, differential expansion rates occur within the bearing components. This causes higher friction, grease breakdown, and eventual seizure.

If the temperature difference between the inner and outer ring is known, or can be approximated, then the following **Formula (7.1)** may be applied.

Under these conditions, decrease in the internal clearance must be calculated, and the internal clearance of bearing needs to be selected properly.

$$S_{t1} = \alpha \cdot D_e \cdot \Delta_t \quad \cdots\cdots (7.1)$$

Whereas,

S_{t1}: Decrease in the internal clearance of bearings depending on the difference in the temperatures of the bearing inner ring and the bearing outer ring can be found by formula, mm

α: Line expansion factor of bearing steel, 12.5×10^{-6}

D_e: Raceway dia. of bearing outer ring, mm

Diameter series 2, X ····· $D_e \approx 0.92\ D$

Diameter series 3 ····· $D_e \approx 0.9\ D$

D: Nominal bearing outer dia., mm

Δ_t: Difference in temperatures of bearing inner ring and outer ring, ℃

If a ball bearing unit is used in a high temperature environment, an abnormal load will result due to thermal expansion of the shaft. This must be compensated for by allowing free movement of one side of the shaft.

(See **"9 Design of Shaft and Base"**)