

Rated Load and Nominal Life

[Rated Loads in All Directions]

The basic load ratings (C_z and C_{0z}) in the specification table indicate the values per rolling element in the directions shown in the figure. When obtaining the nominal life, calculate the basic load ratings (C and C_0) of the actually used rolling elements from the equation below.

C_z : Basic dynamic load rating per rolling element in the specification table (kN)

C_{0z} : Basic static load rating per rolling element in the specification table (kN)

Z : Number of rolling elements used (number of rolling elements within the effective load range)

P : Roller pitch (Refer to pages **A7-8** to **A7-25**)

● For Model VR

Load direction		
Basic dynamic load rating C (kN)	$C = C_L = \left\{ \left(\frac{Z}{2} - 1 \right) \times 2P \right\}^{\frac{1}{36}} \times \left(\frac{Z}{2} \right)^{\frac{3}{2}} \times C_z$	$C_T = 2^{\frac{7}{9}} \times \left\{ \left(\frac{Z}{2} - 1 \right) \times 2P \right\}^{\frac{1}{36}} \times \left(\frac{Z}{2} \right)^{\frac{3}{4}} \times C_z$
Basic static load rating C ₀ (kN)	$C_0 = C_{0L} = \frac{Z}{2} \times C_{0z}$	$C_{0T} = 2 \times \frac{Z}{2} \times C_{0z}$

Note: For $\frac{Z}{2}$, truncate the decimals.

● For Model VB

Load direction		
Basic dynamic load rating C (kN)	$C = C_L = Z^{\frac{2}{3}} \times C_z$	$C_T = 2 \times Z^{\frac{2}{3}} \times C_z$
Basic static load rating C ₀ (kN)	$C_0 = C_{0L} = Z \times C_{0z}$	$C_{0T} = 2 \times Z \times C_{0z}$

Point of Selection

Rated Load and Nominal Life

[Static Safety Factor f_s]

Models VR and VB may receive an unexpected external force while it is stationary or operative due to the generation of an inertia caused by vibrations and impact or start and stop. It is necessary to consider a static safety factor against such a working load.

$$f_s = \frac{C_0}{P_c}$$

- f_s : Static safety factor (see Table1)
 C_0 : Basic static load rating (kN)
 P_c : Calculated load (kN)

Table1 Estimates of the Static Safety Factor (f_s)

Load conditions ¹	Lower limit of f_s
Without vibration or impact	1 to 1.3
With vibration or impact	2 to 3

¹ Vibrations and impacts are typically caused by factors such as acceleration and deceleration, sudden starting and stopping, vibrations and impacts from an external machine, and changes in processing power over time.

[Calculating the Nominal Life]

The nominal life is defined as 50 km for a THK LM Guide with balls and 100 km for a cross-roller guide. The nominal life (L_{10}) is calculated from the basic dynamic load rating (C) and the load acting on the LM Guide (P_c) using the following formulas.

- LM Guide with balls (50 km basic dynamic load rating)

$$L_{10} = \left(\frac{C}{P_c} \right)^3 \times 50 \quad \dots\dots\dots(1)$$

- L_{10} : Nominal life (km)
 C : Basic dynamic load rating (kN)
 P_c : Calculated load (kN)

- LM Guide with rollers (100 km basic dynamic load rating)

$$L_{10} = \left(\frac{C}{P_c} \right)^{\frac{10}{3}} \times 100 \quad \dots\dots\dots(2)$$

When comparing the nominal life (L_{10}), you must take into account whether the basic dynamic load rating was defined based on 50 km or 100 km. Convert the basic dynamic load rating based on ISO 14728-1 as necessary.

ISO-regulated basic dynamic load rating conversion formulas:

- LM Guide with balls

$$C_{100} = \frac{C_{50}}{1.26}$$

C_{50} : Basic dynamic load rating based on a nominal life of 50 km

- LM Guide with rollers

$$C_{100} = \frac{C_{50}}{1.23}$$

C_{100} : Basic dynamic load rating based on a nominal life of 100 km

[Calculating the Modified Nominal Life]

During use, a cross-roller guide/ball guide may be subjected to vibrations and shocks as well as fluctuating loads, which are difficult to detect. In addition, the surface hardness of the raceways, the operating temperature, and having blocks arranged directly behind one another will have a decisive impact on the service life. Taking these factors into account, the modified nominal life (L_{10m}) can be calculated according to the following formulas (3) and (4).

- Modified factor α

$$\alpha = \frac{f_T}{f_w}$$

- α : Modified factor
 f_T : Temperature factor

(see Fig.1 on **A7-6**)

- f_w : Load factor

(see Table 2 on **A7-6**)

● Modified nominal life L_{10m}

- LM Guide with balls

$$L_{10m} = \left(\alpha \times \frac{C}{P_c} \right)^3 \times 50 \quad \dots\dots\dots (3)$$

L_{10m} : Modified nominal life (km)

C : Basic dynamic load rating (kN)

P_c : Calculated load (kN)

- LM Guide with rollers

$$L_{10m} = \left(\alpha \times \frac{C}{P_c} \right)^{\frac{10}{3}} \times 100 \quad \dots\dots\dots (4)$$

[Calculating the Service Life Time]

When the nominal life (L_{10}) has been obtained, if the stroke length and the number of reciprocations per minute are constant, the service life time is obtained using the following equation.

$$L_h = \frac{L_{10} \times 10^6}{2 \times \ell_s \times n_1 \times 60}$$

L_h : Service life time (h)

ℓ_s : Stroke length (mm)

n_1 : Number of reciprocations per minute (min^{-1})

● f_t : Temperature Factor

If the temperature of the environment surrounding the operating model VR or VB exceeds 100 °C, take into account the adverse effect of the high temperature and multiply the basic load ratings by the temperature factor indicated in Fig.1.

Note: If the environment temperature exceeds 100°C, contact THK.

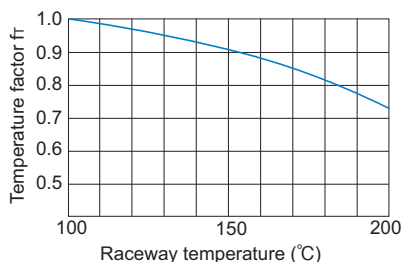


Fig.1 Temperature Factor (f_t)

● f_w : Load Factor

In general, reciprocating machines tend to experience vibrations or impacts during operation, and it is difficult to accurately determine the vibrations generated during high-speed operation and impacts during frequent starts and stops. Therefore, when the actual load applied to a Model VR or VB cannot be obtained, or when speed and vibrations have a significant influence, divide the basic dynamic load rating (C) by the corresponding load factor in Table 2, which has been empirically obtained.

Table 2 Load Factor (f_w)

Vibrations/ impact	Speed (V)	f_w
Faint	Very low $V \leq 0.25\text{m/s}$	1 to 1.2
Weak	Slow $0.25 < V \leq 1\text{m/s}$	1.2 to 1.5