Nominal Life

A cross-roller ring in motion under an external load receives repeated stress on its raceways and rolling elements. When the stress reaches the limit, the surface of the raceways and rolling elements flake in places due to rolling fatigue. This phenomenon is called flaking. The service life of the cross-roller ring is the total number of revolutions until the first flaking occurs on any of the raceways or the rolling elements as a result of rolling fatigue of the material.

The nominal life defined below is used as an estimate for the service life of a cross-roller ring. Nominal life is the total number of revolutions that 90% of a group of identical cross-roller rings independently operating under the same conditions can achieve without flaking.

Calculating the Nominal Life

The nominal life (L_{10}) is obtained from the following formula using the basic dynamic load rating (C) and the load applied to the cross-roller ring (P_C).

$$L_{10} = \left(\frac{C}{P_C}\right)^{\frac{10}{3}} \times 10^6 \quad \cdots\cdots\cdots\cdots\cdots\cdots (1)$$

L_{10}	: Nominal life	(rev.)
C	: Basic dynamic load rating[1]	(N)
P_C	: Dynamic equivalent radial load	(N)

Calculating the Modified Nominal Life

During use, a cross-roller ring may be subjected to vibrations and shocks as well as fluctuating loads, which are difficult to detect. In addition, the operating temperature 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 formula (2) below.

●Modified factor α

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

α	: Modified factor	
f_T	: Temperature factor	(see Fig. 2)
f_W	: Load factor	(see Table 2)

●Modified nominal life L_{10m}

$$L_{10m} = \left(\alpha \times \frac{C}{P_C}\right)^{\frac{10}{3}} \times 10^6 \quad \cdots\cdots\cdots (2)$$

L_{10m}	: Modified nominal life	(rev.)
C	: Basic dynamic load rating[1]	(N)
P_C	: Dynamic equivalent radial load	(N)

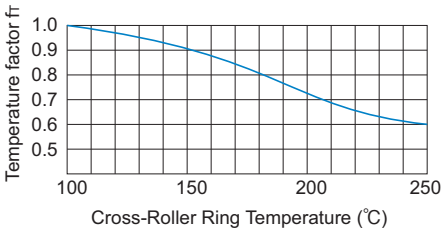


Fig. 2: Temperature Factor (f_T)

Note: The normal service temperature is 80℃ or below. If the product is to be used at a higher temperature, contact THK.

[1] The basic dynamic load rating (C) of the cross-roller ring shows the radial load under which the nominal life is 1 million revolutions when a group of identical cross-roller ring units independently operate, assuming a constant direction and magnitude of the load. The basic dynamic load ratings (C) are indicated in the dimensional tables.

Notes: Rated life is calculated according to load and presumes optimal mounting conditions and adequate lubrication. Usage involving back-and-forth motion or low-speed operation may affect lubrication requirements. Please consult THK for assistance in calculating service life for usage involving back-and-forth motion or low-speed operation.

f_w: Load Factor

Machines that perform rotary movements are often subjected to vibrations and impacts during operation. It is difficult to accurately identify vibrations from a motor, gears, or other drive components, or of impacts arising from frequent starts and stops.In the event of excessive vibrations or impacts, divide the basic dynamic load rating (C) by the corresponding load factor, using the empirically obtained figures in Table 2 as guidelines.

Table 2: Load Factor (f_w)

Operating conditions	f_w
Smooth motion without impacts	1 to 1.2
Normal motion	1.2 to 1.5
Excessive vibrations or impacts	1.5 to 3

Calculating the Service Life Time

- **For Rotary Motion**

$$L_h = \frac{L_{10}}{N \times 60}$$

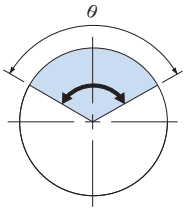
L_h : Service life time (h)
N : Revolutions per minute[1] (min^{-1})

- **For Oscillatory Motion**

$$L_h = \frac{360 \times L_{10}}{2 \times \theta \times n_o \times 60}$$

L_h : Service life time (h)
θ : Rocking angle[1] (°)
n_o : Number of reciprocations per minute (min^{-1})

[1] If rotated continuously, significant heat may be generated depending on the rotational speed. Consult with THK about the rotational speed.



[1] Oscillation angle: If θ is too small, this will hinder the formation of an oil film on the contact surfaces between the raceway and the roller and may cause fretting. If the product will be used in these conditions, contact THK.

Dynamic Equivalent Radial Load P_c

The dynamic equivalent radial load of the cross-roller ring is obtained from the following equation.

$$P_c = X \cdot \left(Fr + \frac{2M}{dp}\right) + Y \cdot Fa$$

P_c : Dynamic equivalent radial load (N)
Fr : Radial load (N)
Fa : Axial load (N)
M : Moment (N·mm)
X : Dynamic radial factor (see Table 3)
Y : Dynamic axial factor (see Table 3)
dp : Roller pitch circle diameter (mm)

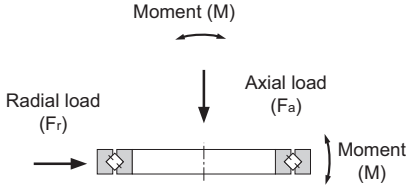


Fig. 3

Table 3: Dynamic Radial Factor and Dynamic Axial Factor

Classification	X	Y
$\frac{Fa}{Fr + 2M/dp} \leqq 1.5$	1	0.45
$\frac{Fa}{Fr + 2M/dp} > 1.5$	0.67	0.67

Notes: If Fr = 0N and M = 0 N·mm, perform calculation while assuming that X = 0.67 and Y = 0.67.
For service life calculation with a preload taken into account, contact THK.