# Calculating the Nominal Life

The service life of an LM Guide is subject to variations even under the same operational conditions. Therefore, it is necessary to use the nominal life defined below as a reference value for obtaining the service life of the LM Guide. The nominal life means the total travel distance that 90% of a group of units of the same LM Guide model can achieve without flaking (scale-like pieces on the metal surface) after individually running under the same conditions.



## Calculating the Nominal Life

The nominal life ($L_{10}$) of an LM Guide is obtained from the following formulas using the basic dynamic load rating (C), which is based on a reference distance of 50 km for an LM Guide with balls and 100 km for an LM Guide with rollers, and the calculated load acting on the LM Guide ($P_C$).

●LM Guide with balls (using a basic dynamic load rating based on a nominal life of 50 km)

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

| | | |
|---|---|---|
| $L_{10}$ | : Nominal life | (km) |
| C | : Basic dynamic load rating | (N) |
| $P_C$ | : Calculated load | (N) |

●LM Guide with rollers (using a basic dynamic load rating based on a nominal life of 100 km)

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

＊These nominal life formulas may not apply if the length of the stroke is less than or equal to twice the length of the LM block.

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

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

- LM Guide with rollers

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

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

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

## Calculating the Modified Nominal Life

During use, an LM 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 LM 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 $\alpha$

$$\alpha = \frac{f_H \cdot f_T \cdot f_C}{f_W}$$

$\alpha$ : Modified factor

$f_H$ : Hardness factor (see Fig. 8 on A1-69)

$f_T$ : Temperature factor (see Fig. 9 on A1-69)

$f_C$ : Contact factor (see Table 10 on A1-69)

$f_W$ : Load factor (see Table 11 on A1-70)

●Modified nominal life $L_{10m}$

• LM Guide with balls

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

• LM Guide with rollers

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

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

$C$ : Basic dynamic load rating (N)

$P_C$ : Calculated load (N)

Once the nominal life ($L_{10}$) has been obtained, the service life time can be obtained using the following equation if the stroke length and the number of reciprocations are constant.

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

$L_h$ : Service life time (h)

$\ell_s$ : Stroke length (mm)

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

## $f_H$: Hardness Factor

To ensure that the LM Guide achieves optimum load capacity, the raceway hardness must be between 58 and 64 HRC.

If the hardness is lower than this range, the basic dynamic load rating and the basic static load rating decrease. Therefore, it is necessary to multiply each rating by the respective hardness factor ($f_H$).

Since the LM Guide has sufficient hardness, the $f_H$ value for the LM Guide is normally 1.0 unless otherwise specified.

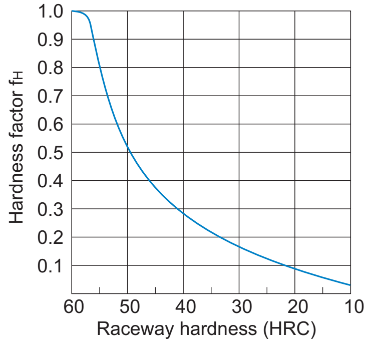


Fig. 8: Hardness Factor ($f_H$)

## $f_T$: Temperature Factor

If the temperature of the operating environment surrounding the LM Guide exceeds 100℃, take into account the adverse effect of the high temperature and multiply the basic load ratings by the temperature factor indicated in Fig. 9.

In addition, the selected LM Guide must also be of a high-temperature type.

Note: An LM Guide not designed to withstand high temperatures should be used at 80°C or less. Please contact THK if application requirements exceed 80°C.

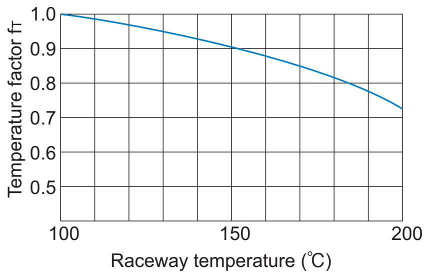


Fig. 9: Temperature Factor ($f_T$)

## $f_C$: Contact Factor

When multiple LM blocks are used in close contact with each other, it is difficult to achieve uniform load distribution due to moment loads and mounting-surface accuracy. When using multiple blocks in close contact with each other, multiply the basic load rating (C or $C_0$) by the corresponding contact factor indicated in Table 10.

Note: If uneven load distribution is expected in a large machine, take into account the respective contact factor indicated in Table 10.

Table 10: Contact Factor ($f_C$)

| Number of blocks used in close contact | Contact factor $f_C$ |
|---|---|
| 2 | 0.81 |
| 3 | 0.72 |
| 4 | 0.66 |
| 5 | 0.61 |
| 6 or more | 0.6 |
| Normal use | 1 |

### $f_W$: Load Factor

In general, reciprocating machines tend to involve vibrations or impacts during operation. It is extremely difficult to accurately determine vibrations generated during high-speed operation and impacts that occur during frequent starts and stops. Therefore, where the effects of speed and vibration are estimated to be significant, divide the basic dynamic load rating (C) by a load factor selected from Table 11, which contains empirically obtained data.

Table 11: Load Factor ($f_W$)

| Vibrations/ impacts | Speed (V) | $f_W$ |
|---|---|---|
| Faint | Very low<br>$V \leqq 0.25$ m/s | 1 to 1.2 |
| Weak | Low<br>0.25 m/s $< V \leqq 1$ m/s | 1.2 to 1.5 |
| Medium | Medium<br>1 m/s $< V \leqq 2$ m/s | 1.5 to 2 |
| Strong | High<br>$V > 2$ m/s | 2 to 3.5 |