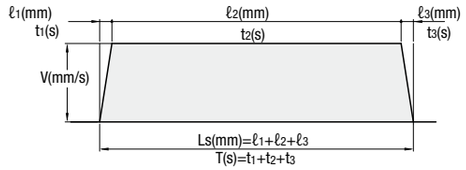
Selection is easy with Single Actuator calculation tool available at:
http://fawos.misumi.jp/FA_WEB/unit_en/web/misumi_LX_sg.html

## Rated lifetime calculation example

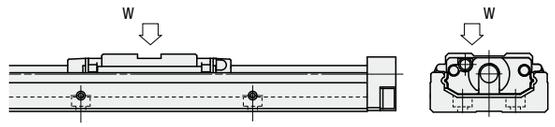
### 1 Model number for examination

Operating conditions : LX26
Rail : C (Basic dynamic load rating)=6522N Co (Basic static load rating)=11871N
Ball screw : Ca (Basic dynamic load rating)=1712N Coa (Basic static load rating)=2251N
Support bearings : Ca (Basic dynamic load rating)=1637N Poa (Basic static load rating)=1205N

Load mass : 10kg
Maximum speed : 250mm/s
Acceleration : 833mm/s$^2$
Stroke : 200mm
Gravity : g=9.81m/s$^2$
Position : Horizontal
Speed diagram : (Fig. 1)
Operating Conditions : (Fig. 2)




Speed diagram (Fig. 1)




Status of load applied (Fig. 2)

### 2 Examination

**Temporary selection**

Use a travel distance of 200 mm with an acceleration of 833 mm/s2 and a maximum speed of 250 mm/s. Based on these conditions, assume that the LX26 series is used. (The selection software can be used on the Misumi website after customer registration has been completed.)

### 3 Calculation

#### 3–1 Examination of rail

Multiply the moment equivalent coefficient in the table with the load according to the condition in which one nut block is used.

**Load for nut block**

1) At constant speed

$Fe_1=Yv\ \ Fv=Yv\cdot W\cdot g=1\cdot 10\cdot 9.81=98.1(N)$

2) At acceleration

$Fe_2=YvFv+Yp\ \ Kp\ \ Ma=0.5\cdot 98.1+1\cdot 0.17\cdot 70\cdot 0=60.95(N)$

3) At deceleration

$Fe_3=Yv\ \ Fv+Yp\ \ Kp\ \ Ma=0.5\cdot 98.1+1\cdot 0.17\times 70\cdot 0=60.95(N)$

Static safety coefficient

$$fs=\frac{Co}{Femax}=\frac{Co}{W\cdot g}=\frac{11871}{98.1}=121.1$$

**Rated life span**

Axial average load

$$Fm=\sqrt[3]{\frac{1}{Ls}\left(Fe_1^3\cdot L_1+Fe_2^3\cdot L_2+Fe_3^3\cdot L_3\cdot\cdot Fen^3\cdot Ln\right)}=87.72(N)$$

Rated life span

$$L=\left(\frac{C}{fw\cdot Fm}\right)^3\times 50=11.89\times 10^6$$

fw: Load coefficient 1.2
La: Travel distance 50(km)

#### 3–2 Examination of ball screw

Obtain the axial loads for the parts and the average load from the speed diagram.

**Lifetime of ball screw**

Axial load
1) At constant speed

$Fe_1=\mu\cdot W\cdot g=0.01\times 10\times 9.81=0.981(N)$

2) At acceleration

$Fe_2=Fe_1+W\cdot a\times 10^{-3}=0.981+10\cdot 0.833=9.311(N)$

3) At deceleration

$Fe_3=Fe_1-W\cdot a\times 10^{-3}=7.352(N)$

Static safety coefficient

$$fs=\frac{Coa}{Femax}=\frac{Coa}{Fe_2}=\frac{2251}{9.311}=241.76$$

**Buckling load**

$$P_1=\frac{n\cdot\pi^2\cdot E\cdot I}{\ell a^2}\times 0.5=5562.02(N)$$

$P_1$ : Buckling load
$\ell a$ : Distance between mounting points 250(mm)
E : Young's modules $2.06\times 10^5(N/mm^2)$
n : Coefficient according to mounting method
0.5: Safety factor
I : Minimum geometrical moment of inertia of screw shaft

$$I=\frac{\pi\cdot d_1^4}{64}=85.49(mm^4)$$

d1 : Root diameter of screw shaft 6.46(mm)

**Allowable tension/compression load**

$$P_2=\frac{\delta\cdot\pi\cdot d_1^2}{4}=4818.06$$

$P_2$ : Allowable tension/compression load (N)
$\delta$ : Allowable tension/compression stress 147(N/mm$^2$)
$d_1$ : Root diameter of screw shaft 6.46(mm)

**Critical speed**

$$N1=\frac{60\cdot\lambda^2}{2\pi\cdot\ell b^2}\cdot\sqrt{\frac{E\times 10^3\cdot I}{\gamma\cdot A}}\times 0.8=12485(min^{-1})$$

N1 : Critical speed
$\ell b$ : Distance between mounting points
E : Young's modules $2.06\times 10^5(N/mm^2)$
$\lambda$ : Coefficient according to mounting method (Fixed-Support 3.927)
$\gamma$ : Density ($7.85\times 10^{-6}kg/mm^3$)
0.8: Safety factor

**DN value**

$DN=62250(\leq 70000)$

D : Ball center to center diameter (8.3mm)
N : Maximum number of operating revolutions ($min^{-1}$)

**Rated life span**

Axial average load

$$Fm=\sqrt[3]{\frac{1}{Ls}\left(Fe_1^3\cdot L_1+Fe_2^3\cdot L_2+Fe_3^3\cdot L_3\cdot\cdot Fen^3\cdot Ln\right)}=6.096(N)$$

Rated life span

$$L=\left(\frac{Ca}{fw\cdot Fm}\right)^3\cdot\ell\times 10^6=25.64\times 10^6(km)$$

fw : Load coefficient 1.2
$\ell$ : Ball screw lead 2 (mm)

#### 3–3 Examination of support bearing

Axial load

$Fe_1=0.981(N)$
$Fe_2=9.311(N)$
$Fe_3=7.352(N)$

Static safety coefficient

$$fs=\frac{Poa}{Femax}=\frac{Poa}{Fe_2}=129.42$$

**Equivalent load**

Axial average load

$$Fm=\sqrt[3]{\frac{1}{Ls}\left(Fe_1^3\cdot L_1+Fe_2^3\cdot L_2+Fe_3^3\cdot L_3\cdot\cdot Fen^3\cdot Ln\right)}=6.096(N)$$

Rated lifetime

$$L=\left(\frac{Ca}{fw\cdot Fm}\right)^3\cdot\ell\times 10^6=22.41\times 10^6(km)$$

fw : Load coefficient 1.2
$\ell$ : Ball screw lead 2 (mm)

| LX2602 | Rail | Ball screw | Support bearing |
|---|---|---|---|
| Static safety factor | 121.1 | 241.76 | 129.42 |
| Buckling load (N) | – | 5562.02 | – |
| Allowable tension/compression load (N) | – | 4818.06 | – |
| Critical speed ($min^{-1}$) | – | 12485 | – |
| DN value | – | 62250 | – |
| Rated lifetime (km) | $11.89\times 10^6$ | $22.31\times 10^6$ | $19.505\times 10^6$ |
| Maximum axial load (N) | – | 9.311 | – |
| Maximum number of operating revolutions | – | 7500 | – |