[Technical Calculations]
Selection of Single Axis Actuator (1)

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

Select the nominal LX actuator from the travel and the rating list below. ➡ Determine the ball screw lead so that the operation speed will be within the maximum speed shown in (Table 4). At this stage, the selection is temporary. ➡ Examine the load applied to the rail and put it in formulas (1) and (2) on page 2808. Obtain the equivalent load Fe for each process and put it in formula (3) on page 2808. Obtain the average load Fm and calculate the lifetime. ➡ Examine the load applied to the ball screw and the support bearing. Put it in formula (3) on page 2808, obtain the average load Fm and calculate the lifetime.

☒Rated load (Table 1)

Item			LX2001	LX2602	LX3005	LX3010	LX4510	LX4520
Rail	Dynamic load rating Ca (N)		3277	6522	9732	6305	18450	11826
	Static load rating Coa (N)		6199	11871	17218	9271	32441	17175
			–3~0	–4~0	–4~0		–6~0	
Ball screw	Dynamic load rating Ca (N)	Advanced	482	1712	1831	1129	4167	2499
	Static load rating Coa (N)	Advanced	642	2251	2389	1386	5945	3381
	Thread shaft diameter (mm)		6	8	10	10	15	15
	Lead (mm)		1	2	5	10	10	20
	Core diameter		5.3	6.4	8.2		11.7	
	Ball center diameter		6.15	8.3	10.3	10.3	15.5	15.75
Bearing (fixed side)	Axial load	Dynamic load rating Ca (N)	730	1637	2702		4335	
		Static load rating Coa (N)	461	1205	2197		4106	

☒Moment equivalent coefficient at rail (Table 2)

Type	Block	Kp	Ky	Kr
LX2001	1 piece	0.228	0.228	0.0667
	Close contact between 2 pcs.	0.144	0.144	0.0667
LX2602	1 piece	0.17	0.17	0.0527
	Close contact between 2 pcs.	0.114	0.114	0.0527
LX30_ _	1 piece	0.137	0.137	0.0445
	Close contact between 2 pcs.	0.0917	0.0917	0.0445
LX45_ _	1 piece	0.1115	0.1115	0.0334
	Close contact between 2 pcs.	0.0840	0.0840	0.0334

☒Rail geometrical moment of inertia (Table 3)

Type	Lx (mm⁴)	Ly (mm⁴)	Mass (kg/100mm)	Center of Gravity h (mm)
LX2001	3.2×10^3	5.2×10^4	0.22	4.4
LX2606	1.0×10^4	1.4×10^5	0.37	6.1
LX30_ _	2.5×10^4	3.1×10^5	0.6	7.8
LX45_ _	8.8×10^4	10.4×10^5	1.10	11.0

☒Allowable Static Load / Allowable Static Moment (Table 4)

Type	No. of blocks	Allowable Static Load (kg)	Allowable Static Moment (N·m)		
		Horizontal	Ma	Mb	Mc
LX2001	B1	6199	27	27	93
	B2	12398	353	353	186
LX2001C	B1	6199	27	27	93
	B2	12398	353	353	186
LX2602	B1	11871	70	70	225
	B2	23742	902	902	450
LX2602C	B1	11871	70	70	225
	B2	23742	902	902	450
LX3005	B1	17218	126	126	387
	B2	34436	1515	1515	774
LX3005C	B1	17218	126	126	387
	B2	34436	1515	1515	774
LX3010	B1	17218	126	126	387
	B2	34436	1515	1515	774
LX3010C	B1	17218	126	126	387
	B2	34436	1515	1515	774
LX4510	B1	32441	291	291	972
	B2	64882	3945	3945	1944
LX4520	B1	32441	291	291	972
	B2	64882	3945	3945	1944

☒Allowable Static Load / Allowable Static Moment (Short Block) (Table 5)

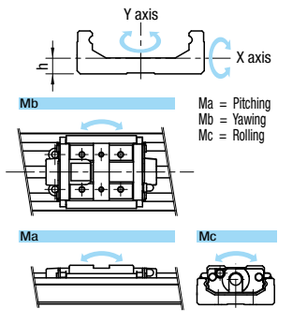
Type	No. of blocks	Allowable Static Load (kg)	Allowable Static Moment (N·m)		
		Horizontal	Ma	Mb	Mc
LX3005	S1	9271	63	63	208
	S2	18542	579	579	417
LX3010	S1	9271	63	63	208
	S2	18542	579	579	417
LX4510	S1	17175	145	145	515
	S2	34350	1444	1444	1029
LX4520	S1	17175	145	145	515
	S2	34350	1444	1444	1029

☒Maximum travel speed

Type	Lead	L (mm)	Maximum travel speed (mm/s)
			Advanced
LX2001	01	–	190
LX2602	02	–	290
LX30_ _	06	150	410
		200	410
		300	410
		400	410
		500	370
		600	250
	10	150	830
		200	830
		300	830
		400	830
		500	740
		600	500
LX45_ _	10	340	550
		390	550
		440	550
		490	550
		540	550
		590	550
	20	340	1110
		390	1110
		440	1110
		490	1110
		540	1110
		590	1110

☒Load coefficient fw

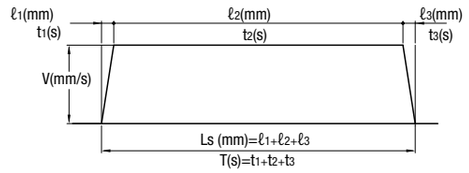
Vibration/ impact	Speed	fw
Subtle	Super-low speed V≤ 0.25m/s	1~1.2
Small	Low speed 0.25m/s<V≤ 1m/s	1.2~1.5
Medium	Medium speed 1m/s <V≤ 2m/s	1.5~2
Large	High speed 2m/s<V	2~3.5



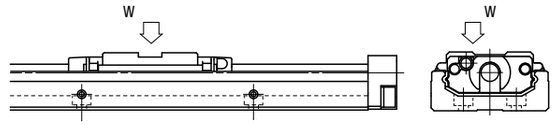
Life Span

For the LX actuator, calculate the life span of the rail, ball screw and support bearing. The actuator life span is determined to be the smallest value from among these results.

Load mass : W kg
Stroke : Ls mm
Acceleration : a mm/s²
Maximum speed : v mm/s
Gravity : g=9.81m/s²
acceleration : Horizontal
Speed diagram : (Fig. 1)
Operating conditions : (Fig. 2)



Speed diagram (Fig. 1)



Status of load applied (Fig. 2)

Examination Selection

Select the temporary model number based on the load mass W (kg) and the maximum speed V (mm/s). Then prepare a speed diagram based on the acceleration, maximum speed and travel. The conditions that can develop this speed diagram will serve as the basis for the selection calculation.

Calculation Rail

Examine the status of the load applied (Fig. 2) to the rail of the LX actuator. Put each load in the formula below (formula (1) for single nut block specifications and formula (2) for double nut block specifications), and obtain the equivalent load Fe.

Equivalent Load

•In the case of single block

$$Fe=Y_HF_H+Y_VF_V+Y_PK_PMa+Y_YK_YMb+Y_RK_RMc \quad –(1)$$

•In the case of double block

$$Fe=Y_HF_H/2+Y_VF_V/2+Y_RK_RMa+Y_PK_PMb+Y_YK_YMc \quad –(2)$$

Fe : Equivalent Load
FH : Horizontal load acting on blocks
FV : Vertical load applied to the block
Ma : Pitching direction moment applied to the block
Mb : Yawing direction moment applied to the block
Mc : Rolling direction moment applied to the block
Kp : Equivalent coefficient for pitching direction moment
Ky : Equivalent coefficient for yawing direction moment
Kr : Equivalent coefficient for rolling direction moment
YH,YV,Yp,YY,YR:1.0 or 0.5

When the actuator is used under moment loads, calculate the load by multiplying the guide moment equivalent coefficient in Table 2. In formulas (1) and (2), in order to obtain the equivalent load Fe, the maximum value among FH, FV, KpMa, KyMb and KrMc is determined to be 1.0, and the remaining items are set at 0.5.

Average load

As Ma and Mb for the LX actuator vary with acceleration and deceleration, obtain the average load Fm from formula (3).

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

Fm: Average load for fluctuating loads L: Total travel distance

Rail life span

Obtain the rail life span for the LX actuator from formula (4).

$$L=La\times\left(\frac{C}{fw\cdot Fm}\right)^3 \quad –(4)$$

L: Rail lifetime (km) La: Travel distance (km) fw: Load coefficient
C: Basic dynamic load rating (N)

When the travel length and the number of reciprocal motions per minute are constant, the number of life span hours can be calculated from formula (5).

$$Lh=\frac{L\times10^6}{2\cdot\ell s\cdot n1\times60} \quad –(5)$$

Lh: Life span hours (h) ℓs: Travel (mm) n1: Reciprocal motions per minute

Life span of ball screw and support areas

Obtain the average load from the load applied in the axial direction. Calculate life span for both ball screws and bearings from formula (6). Obtain the average load from formula (3).

$$Lr=\left(\frac{Ca}{fw\cdot Fm}\right)^3\cdot\ell\times10^6 \quad –(6)$$

Lr: Life span of ball screw (km) ℓ: Ball screw lead (mm))
fw: Load coefficient Ca: Basic dynamic load rating of screw and support (N)