

Features of the Precision Linear Pack

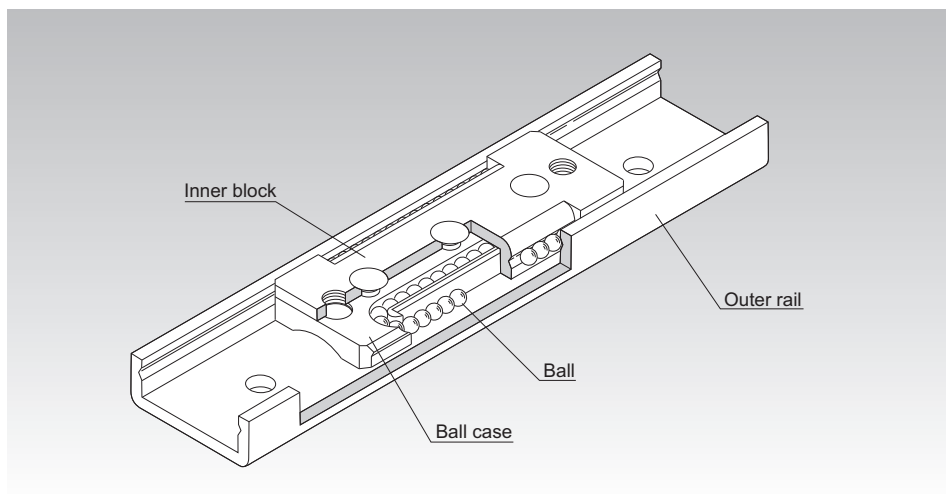


Fig. 1: Structure of Precision Linear Pack Model ER

Structure and Features

Model ER is a slide unit using a stainless steel plate that is precision formed, heat-treated, and then ground. It has a structure where balls roll between the V-shaped grooves machined on the outer rail and the inner block to allow the system to slide. It is an ultra-thin, lightweight unit in which the balls circulate in a ball case incorporated in the inner block to perform infinite linear motion.

This model is used in extensive applications such as magnetic disc devices, electronic equipment, semiconductor manufacturing equipment, medical equipment, measuring equipment, plotting machines, and photocopiers.

Reduced Design and Assembly Costs

It provides a highly accurate linear guide system with lower design cost and faster assembly than the conventional miniature ball bearings used in precision machines and other equipment.

Maintains Long-Term Stability

It is a ball-circulating slide unit with an extremely small friction coefficient. This slide unit maintains stable performance over a long period of time.

Lightweight and Compact with High-Speed Response

The outer rail and the inner block are composed of very thin stainless steel plates.

Since the linear pack is light, it has a small inertial moment and demonstrates superb high-speed response.

Load Rating and Nominal Life

Load Ratings in Each Direction

The basic load rating in the specification table indicates the load rating in the radial direction as shown in Fig. 2. The load ratings in the reverse-radial and lateral directions are obtained from Table 1 below.

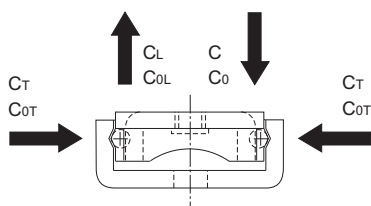


Fig. 2: Load Ratings in Each Direction

Table 1: Load Ratings in Each Direction

	Basic dynamic load rating	Basic static load rating
Radial direction	C (indicated in the dimensional table)	C ₀ (indicated in the dimensional table)
Reverse-radial direction	C _L =C	C _{0L} =C ₀
Lateral directions	C _T =1.47C	C _{0T} =1.73C ₀

Static Safety Factor f_s

When the Model ER is stationary or in motion, an unexpected external force may be applied due to vibrations, impacts, or inertia caused by starting and stopping. It is necessary to take a safety factor into account with regard to this type of applied load.

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

f_s : Static safety factor (see Table 2)

f_c : Contact factor (see Table 3 on **A6-4**)

C₀ : Basic static load rating (N)

P_c : Calculated load (N)

● Estimates of the Static Safety Factor

Treat the values in Table 2 as estimates for the lower limit of the static safety factor based on the operating conditions.

Table 2: Estimates of the Static Safety Factor (f_s)

Load conditions ¹	Lower limit of f _s
Without vibrations or impacts	1 to 1.3
With vibrations or impacts	2 to 7

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 of the THK precision linear pack is defined as 50 km. The nominal life (L_{10}) is calculated from the basic dynamic load rating (C) and the load acting on the precision linear pack (P_c) using the following formula.

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

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

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 formula:

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

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, a precision linear pack may be subjected to vibrations and shocks as well as fluctuating loads, which are difficult to detect. In addition, having precision linear packs arranged in close contact 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 formula (2).

- Modified factor α

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

α : Modified factor
 f_c : Contact factor (see Table 3)
 f_w : Load factor (see Table 4 on **A6-5**)

- Modified nominal life L_{10m}

$$L_{10m} = \left(\alpha \times \frac{C}{P_c} \right)^3 \times 50 \quad \dots\dots\dots(2)$$

L_{10m} : Modified nominal life (km)
 C : Basic dynamic load rating (N)
 P_c : Calculated load (N)

Calculating the Service Life Time

Once the nominal life (L_{10}) has been obtained, the service life time can be obtained using the following formula if the stroke length and the cycles per minute 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)
 ℓ_s : Stroke length (mm)
 n_1 : Number of reciprocations per minute (min^{-1})

● f_c : Contact Factor

When multiple inner blocks are used in close contact with each other, their linear motion is affected by a moment load and mounting accuracy, making it difficult to achieve uniform load distribution. In such applications, multiply the basic load rating (C) and (C_0) by the corresponding contact factor in Table 3.

Table 3: Contact Factor (f_c)

Number of inner blocks in close contact with each other	Contact factor f_c
2	0.81
3	0.72
Normal use 1	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, when the actual load applied on Model ER 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 4 of empirically obtained data.

Table 4: Load Factor (f_w)

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

Accuracy Standards

The running straightness of Model ER is indicated in Table 5. (See Fig. 3.)

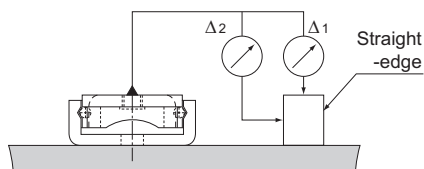


Fig. 3: Method for Measuring Running Straightness

Table 5: Running Straightness Unit: mm

Stroke length		Running straightness of inner block in vertical directions $\Delta 1$	Running straightness of inner block in horizontal directions $\Delta 2$
Above	Up to		
—	20	0.002	0.004
20	40	0.003	0.006
40	60	0.004	0.008
60	80	0.005	0.010
80	100	0.006	0.012
100	120	0.008	0.016

Radial Clearance

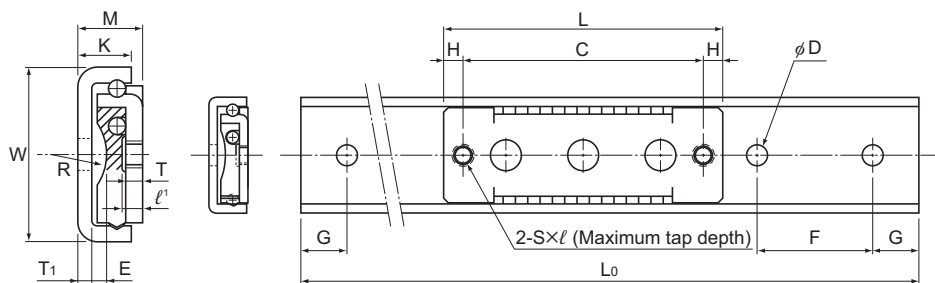
The radial clearance of Model ER means the value for the motion of the central part of the inner block when the inner block is slightly moved with a vertically constant force in the middle of the outer rail in the longitudinal direction. The negative values in Table 6 indicate that the respective models are provided with a preload when assembled and have no clearance between their inner blocks and the outer rails.

Table 6: Radial Clearance Unit: μm

Model No.	Radial clearance	
	Normal	C1
ER 513	± 2	-2 to 0
ER 616	± 2	-3 to 0
ER 920	± 2	-4 to 0
ER 1025	± 3	-6 to 0

Note: When desiring normal clearance, add no symbol; when desiring C1 clearance, indicate "C1" in the model number. (See "Model Number Coding" on **A6-8**)

Model ER



Magnified view

Model No.	Inner block dimensions									
	Width	Height	Length						Maximum tap depth	
	W	M ±0.05	L	C	H	E	R	S	l' ¹	T
ER 513	13	4.5	22	7	7.5	1.1	4.2	M2	1.3	0.9
ER 616	15.6	6	36	29	3.5	1.7	9.2	M3	1.8	1.1
ER 920	20	8.5	46	40	3	2.3	7.3	M3	2.5	1.9
ER 1025	25	10	56	48	4	2.9	9.3	M4	2.8	2.2

Model number coding

2 ER616 C1 +95L

Model number

Outer rail length (in mm)

Radial clearance symbol¹

Number of inner blocks used on the same rail
(no symbol for a single slider)

¹ See **A6-5**.

Unit: mm

	Outer rail dimensions						Basic load rating		Mass	
	K	T ₁	D	L ₀	F	G	C N	C ₀ N	Inner block g	Outer rail g/m
	4	1.1	2.4	40, 60, 80	20	10	54.9	72.5	2.4	166
	5.5	1.4	2.9	45, 70, 95	25	10	71.6	125	5.6	268
	7.5	1.9	3.5	50, 80, 110	30	10	144	201	14.4	474
	9	2.2	4.5	60, 100, 140	40	10	215	315	27	677

¹ Set the screw length so that it does not exceed the Maximum tap depth/.

Note: To secure the outer rail of models ER513 and ER616, use cross-recessed pan head screws for precision equipment (No. 0 screw). To secure the outer rail of models ER920 and ER1025, use cross-recessed pan head screws.

Model No.	Type	Screw type × pitch
ER 513	No. 0 pan head screw ¹ (class 1)	M2×0.4
ER 616		M2.6×0.45
ER 920	Cross-recessed pan head screw ²	M3×0.5
ER 1025		M4×0.7

¹ Japan Camera Industry Association Standard JCIS 10-70

Cross-recessed screw for precision equipment (No. 0 screw)

² Cross-recessed pan head screw JIS B 1111

Model Number Coding

Model number configurations differ depending on the model features. Refer to the corresponding sample model number configuration.

Precision Linear Pack

● Model ER

2	ER616	C1	+95L
	Model No.		Outer rail length (mm)
		Radial clearance symbol ¹	
Number of inner blocks used on the same rail (no symbol for products with one nut)			

¹ See **A6-5**.