

NSK Linear Guides™

Miniature Series PU/PE Models

NSK Miniature Linear Guides, ideal for semiconductor manufacturing and medical equipment



Smooth motion and unprecedented lightness

The advanced NSK Miniature Linear Guides

The new generation PU model/PE model inherit the outstanding lineage of the NSK miniature linear guides LU model/LE model. Improve dynamic friction characteristics and create smoother motion with reduced noise intensity. The new design supports a wide variety of applications.

1 Features

1. Motion performance

Highly smooth operation is achieved by smooth ball recirculation.

2. Lightweight

The ball slide is fabricated to be approximately 20% lighter than conventional models* by the application of resin to a part of its body.

* Miniature LU model/LE model

3. Reduced noise intensity

Resin components applied in the ball circulating system reduce collision noise between steel balls and the inner wall of circulating circuits.

4. Low dust generation

The new design generates less dust compared to conventional models.

5. Excellent dust resistance

Compact space between the side of the rails and the inner walls of the ball slide prevents the entrance of foreign matter.

6. High corrosion resistance

High corrosion-resistant martensite stainless steel is incorporated as a standard feature provides excellent resistance to corrosion.

7. Easy to handle

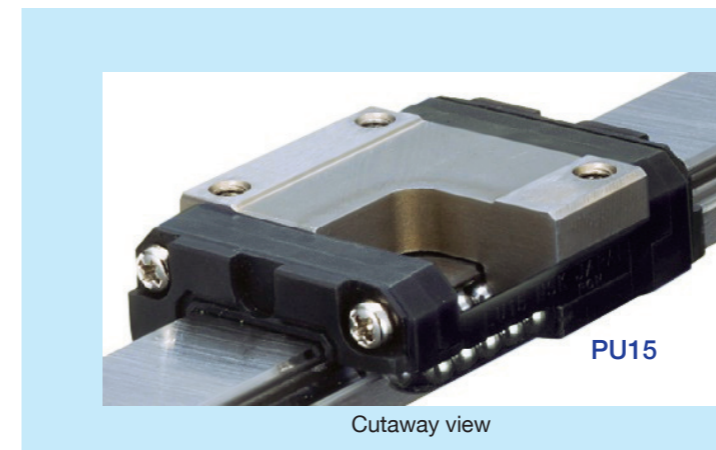
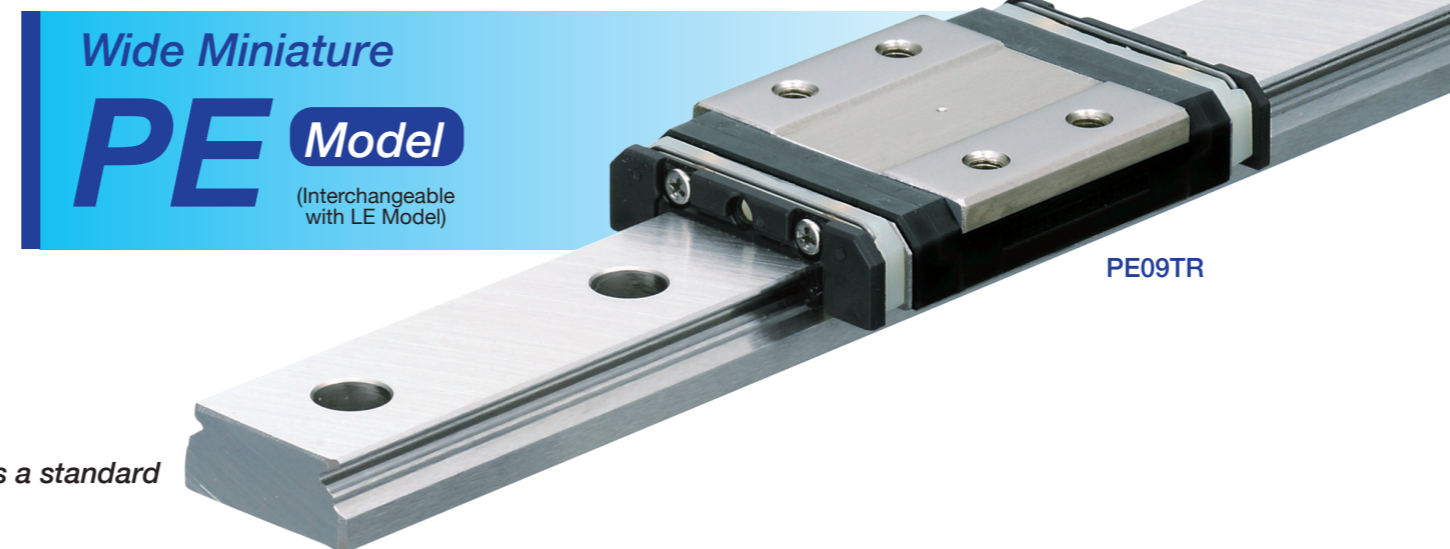
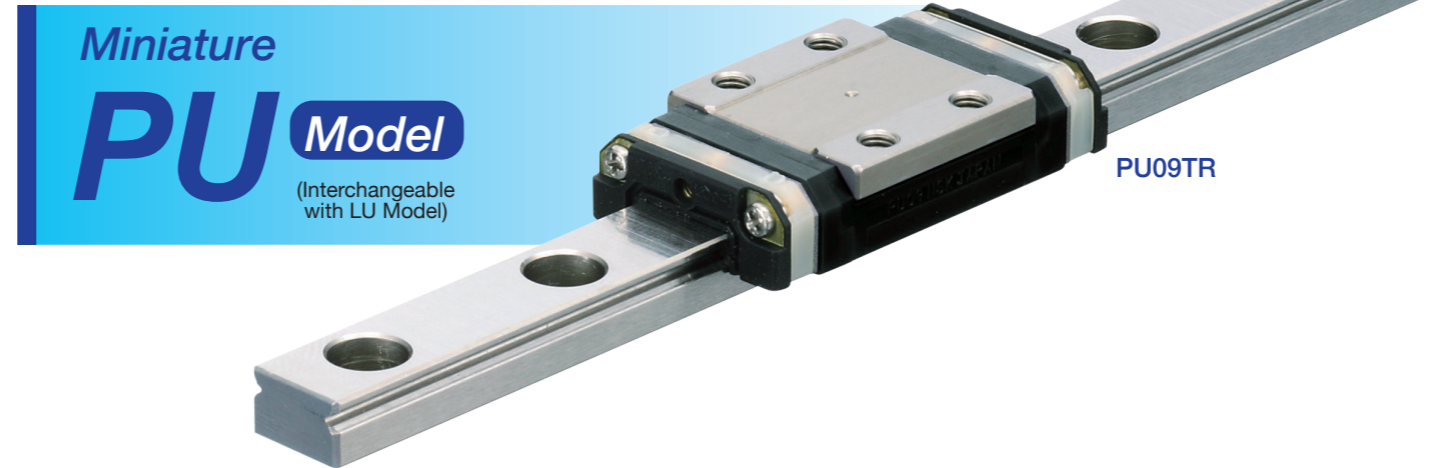
Safety design prevents steel balls from dropping out of the ball slide even when the slide is removed from the rail.

8. Long-term maintenance-free

Equipped with NSK K1™ Lubrication unit realizes long-term, maintenance-free use.

9. Fast delivery

Lineup of interchangeable rails and ball slides in the series facilitates fast delivery.



Miniature Series: PU/PE Models

Smoother motion

The resin ball recirculation component creates an optimal configuration, resulting in smoother motion.

Test conditions: Oil lubrication (VG68)
Operating speed: 1 000 mm/min
Load cell rated capacity: 5N

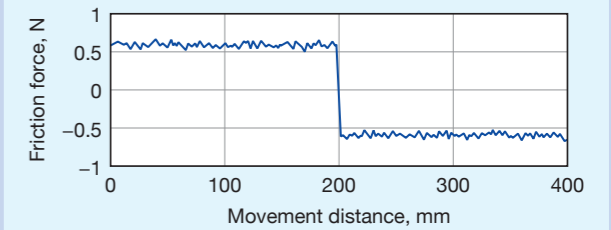


Fig. 1-1 Fluctuations in dynamic friction

Low dust generation

The PU model/PE model, with resin ball recirculation components, generates less dust than a conventional ball recirculation system that goes right through the ball slide.

Test conditions: Grease lubrication (LG2)
Operating speed: 600 mm/min
Stroke: 200 mm

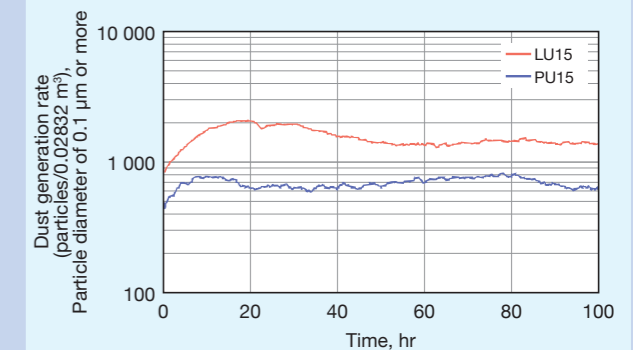


Fig. 1-2 Dust generation rate

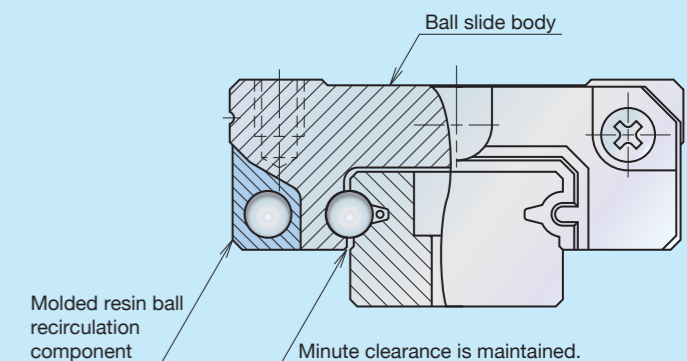


Fig. 2 Cross sectional front view

Developed for precision positioning tables, supporting cutting-edge equipment, including semiconductor manufacturing and medical devices

Miniature Series: PU/PE Models

2 Reference number

Reference numbers will be used as reference before finalizing all specifications. Please specify the reference number, except design serial number, to identify the product when ordering, requesting estimates, or inquiring about specifications from NSK.

2.1 Preloaded assembly type

Example: PU 15 0470 AL K 2 - P5 1**

Model name: PU
 Size: 15
 Rail length (mm): 0470
 Ball slide shape code: AL
 Material/surface treatment code: K: Stainless steel, H: Stainless steel + surface treatment
 Preload code: 0: Fine clearance (Z0), 1: Slight preload (Z1)
 Accuracy code: P4: Super precision, P5: High precision, P6: Precision, PN: Normal (with NSK K1) K4: Super precision, K5: High precision, K6: Precision, KN: Normal
 Design serial number: 2
 Number of ball slides per rail: -**
 Accuracy code: P5
 Added to the reference number: 1

2.2 Interchangeable type

(1) Reference number for rail and ball slide assembly

Example: PU 15 0470 AL K 2 - PC T**

Model name: PU
 Size: 15
 Rail length (mm): 0470
 Ball slide shape code: AL
 Material/surface treatment code: K: Stainless steel, H: Stainless steel + surface treatment
 Preload code: T: Fine clearance (ZT)
 Accuracy code: PC: Normal (with NSK K1) KC: Normal
 Design serial number: 2
 Number of ball slides per rail: -**
 Accuracy code: PC
 Added to the reference number: T

(2) Reference number for ball slide of interchangeable type

Example: PAU 15 AL S - K

Interchangeable ball slide model code: PAU
 PAU: PU Model interchangeable ball slide
 PAE: PE Model interchangeable ball slide
 Size: 15
 Ball slide shape code: AL
 Option code: -K: Equipped with NSK K1
 Material code: S: Stainless steel

(3) Reference number for rail of interchangeable type

Example: P1U 15 0470 R K N - PC T**

Interchangeable rail slide model code: P1U
 P1U: PU Model interchangeable rail
 P1E: PE Model interchangeable rail
 Size: 15
 Rail length (mm): 0470
 Rail shape code: R
 Material/surface treatment: K: Stainless steel, H: Stainless steel + surface treatment
 Preload code: T: Fine clearance (ZT)
 Accuracy code: PC: Normal
 Design serial number: N
 Added to the reference number: -**
 Accuracy code: PC
 Butting specification: (*) N: Non-butting, L: Butting specification
 (*) Please consult NSK for butting rail specification.

3 Accuracy standard

We offer the following accuracy grades: Super precision grade P4, High precision grade P5, Precision grade P6, and Normal grade PN for preloaded assembly type, and Normal grade PC for interchangeable type.

Table 1 Tolerance of preloaded assembly

Characteristics	Accuracy grade			
	Super precision P4	High precision P5	Precision grade P6	Normal grade PN
Mounting height H	±10	±15	±20	±40
Variation of H (All ball slides on a set of rails)	5	7	15	25
Mounting width W_2 or W_3	±15	±20	±30	±50
Variation of W_2 or W_3 (All ball slides on reference rail)	7	10	20	30
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	Shown in Table 3, Fig. 3, Fig. 4			

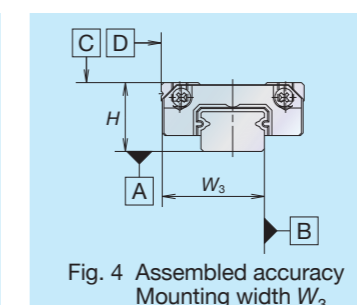
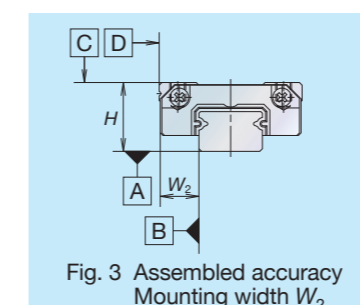
Table 3 Running parallelism of ball slide

Rail length (mm)	Accuracy grade		Preloaded assembly type				Interchangeable type
	over	or less	P4	P5	P6	PN	PC
50	2	2	4.5	6	6	6	
50 - 80	2	3	5	6	6	6	
80 - 125	2	3.5	5.5	6.5	6.5	6.5	
125 - 200	2	4	6	7	7	7	
200 - 250	2.5	5	7	8	8	8	
250 - 315	2.5	5	8	9	9	9	
315 - 400	3	6	9	11	11	11	
400 - 500	3	6	10	12	12	12	
500 - 630	3.5	7	12	14	14	14	
630 - 800	4.5	8	14	16	16	16	
800 - 1 000	5	9	16	18	18	18	
1 000 - 1 250	6	10	17	20	20	20	

Table 2 Tolerance of interchangeable type: Normal grade PC

Characteristics	Accuracy grade	Normal grade
	PC	PC
Mounting height H	±20	±20
Variation of mounting height H	15① 30②	
Mounting width W_2 or W_3	±20	±20
Variation of mounting width W_2 or W_3	20	
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	Shown in Table 3, Fig. 3, Fig. 4	

①Variation on the same rail
 ②Variation on multiple rails



4 Preload and rigidity

We offer three levels of preload: Slight preload (Z1) and Fine clearance (Z0) for preloaded assembly types, along with interchangeable types of Fine clearance (ZT). Values for preload and rigidity of the preloaded assembly types are shown in Tables 4 and 5.

Table 4 Preload and rigidity of preloaded assembly of PU model

	Model No.	Preload (N)		Rigidity (N / μm)	
		Slight preload (Z1)		Slight preload (Z1)	
Standard type	PU09TR	0 – 10		30	
	PU12TR	0 – 17		33	
	PU15AL	0 – 33		45	
High-load type	PU09UR	0 – 14		46	
	PU12UR	0 – 25		52	
	PU15BL	0 – 51		75	

Table 5 Preload and rigidity of preloaded assembly of PE model

	Model No.	Preload (N)		Rigidity (N / μm)	
		Slight preload (Z1)		Slight preload (Z1)	
Standard type	PE09TR	0 – 37		61	
	PE12AR	0 – 40		63	
	PE15AR	0 – 49		66	
High-load type	PE09UR	0 – 54		86	
	PE12BR	0 – 59		97	
	PE15BR	0 – 75		114	

Clearance of fine clearance Z0 is 0-3 μm. Therefore, preload is zero.

Clearance values of the interchangeable types are shown in Tables 6 and 7.

Table 6 Clearance of interchangeable type of PU model Unit: μm

	Model No.	Fine clearance ZT
Standard type	PU09TR	3 or less
	PU12TR	
	PU15AL	
High-load type	PU09UR	5 or less
	PU12UR	
	PU15BL	

Table 7 Clearance of interchangeable type of PE model Unit: μm

	Model No.	Fine clearance ZT
Standard type	PE09TR	3 or less
	PE12AR	
	PE15AR	
High-load type	PE09UR	5 or less
	PE12BR	
	PE15BR	

5 Shoulder height of the mounting surface and corner radius r

Figs. 5, 6 and Tables 8, 9 show the shoulder height and corner radius dimensions.

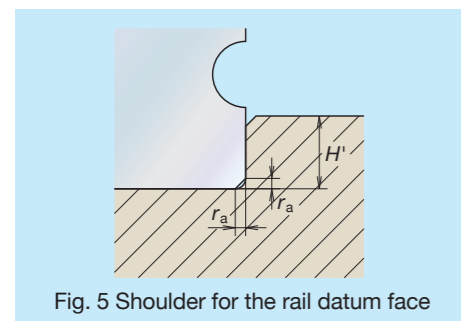


Fig. 5 Shoulder for the rail datum face

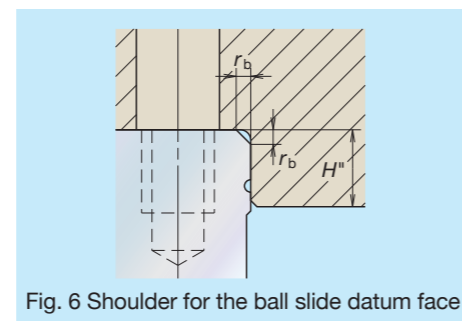


Fig. 6 Shoulder for the ball slide datum face

Table 8 Shoulder height of the mounting surface and corner radius r (PU model) Unit: mm

Model No.	Corner radius (Maximum)		Shoulder height	
	r _a	r _b	H'	H''(*)
PU09	0.3	0.3	1.9	2.6
PU12	0.3	0.3	2.5	3.4
PU15	0.3	0.5	3.5	4.4

(*)H'' is the minimum recommended value based on the dimension T in Table 13.

Table 9 Shoulder height of the mounting surface and corner radius r (PE model) Unit: mm

Model No.	Corner radius (Maximum)		Shoulder height	
	r _a	r _b	H'	H''(*)
PE09	0.3	0.3	3.5	2.8
PE12	0.3	0.3	3.5	3.2
PE15	0.3	0.5	3.5	4.1

(*)H'' is the minimum recommended value based on the dimension T in Table 14.

6 Lubrication

Selection of grease: Table 10 shows grease that is suitable for the PU model/PE model. We specify PS2 as the standard grease for miniature series.

Table 10 Available greases

Grease code	Thickener	Base oil	Base oil kinematic viscosity mm ² /s (40°C)	Temperature range for use (°C)	Characteristic/Application
PS2	Lithium soap	Synthetic oil + Mineral oil	15	-50 to 110	<ul style="list-style-type: none"> For low temperature operation Suitable for high speed and light load application
LG2	Lithium soap	Mineral oil + Synthetic hydrocarbon oil	30	-20 to 70	<ul style="list-style-type: none"> For clean environment
LGU	Urea	Synthetic hydrocarbon oil	100	-30 to 120	<ul style="list-style-type: none"> For clean environment

Long term maintenance free: NSK K1 Lubrication unit enables long term maintenance free.

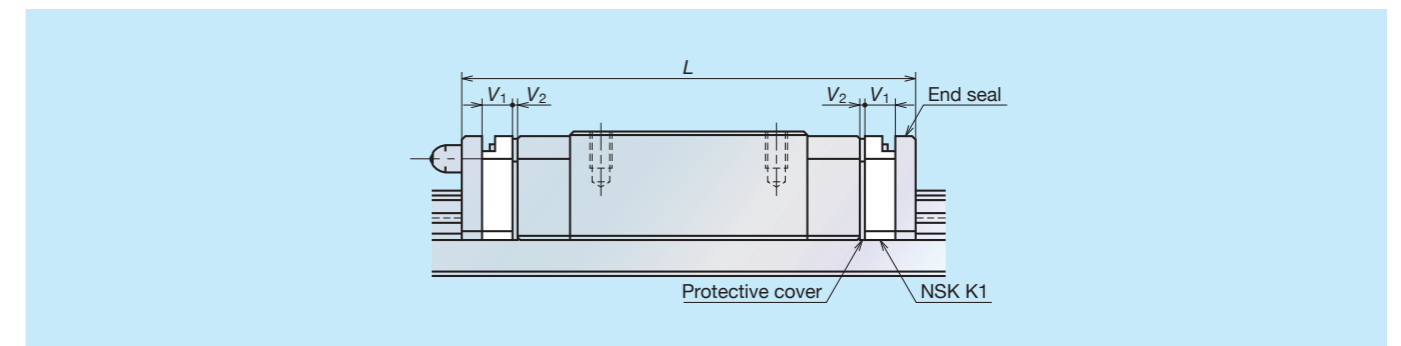


Table 11 Dimensions when equipped with NSK K1 (PU model) Unit: mm

	Model No.	Standard ball slide length	Ball slide length with two NSK K1 installed L	Thickness of single NSK K1, V ₁	Thickness of protective cover, V ₂
Standard type	PU09TR	30	36.4	2.7	0.5
	PU12TR	35	42	3	0.5
	PU15AL	43	51.2	3.5	0.6
High-load type	PU09UR	41	47.4	2.7	0.5
	PU12UR	48.7	55.7	3	0.5
	PU15BL	61	69.2	3.5	0.6

Table 12 Dimensions when equipped with NSK K1 (PE model) Unit: mm

	Model No.	Standard ball slide length	Ball slide length with two NSK K1 installed L	Thickness of single NSK K1, V ₁	Thickness of protective cover, V ₂
Standard type	PE09TR	39.8	46.8	3	0.5
	PE12AR	45	53	3.5	0.5
	PE15AR	56.6	66.2	4	0.8
High-load type	PE09UR	51.2	58.2	3	0.5
	PE12BR	60	68	3.5	0.5
	PE15BR	76	85.6	4	0.8

Slide length when equipped with NSK K1 = (Standard ball slide length) + (V₁ thickness of single NSK K1 unit) × (number of K1 units) + (V₂ thickness of the protective cover) × 2.

7 Dust resistance

End seal: Provided to both sides of the ball slide as a standard feature.

Bottom seal function: It is designed to minimize the clearance between the side faces of rail and the inner walls of the slide, and prevent foreign matters from entering the ball slide.

8 Applications

- Smoother motion and low dust generation
Liquid crystal manufacturing and printed circuit board manufacturing devices
- Lightweight and low dust generation
Semiconductor manufacturing devices (mounter, die bonder, and exposure device)
- Gentler tone and excellent dust resistant features
Medical machinery and various precision devices

9 Dimensions

9.1 Rail and ball slide assembly (preloaded type, interchangeable type)

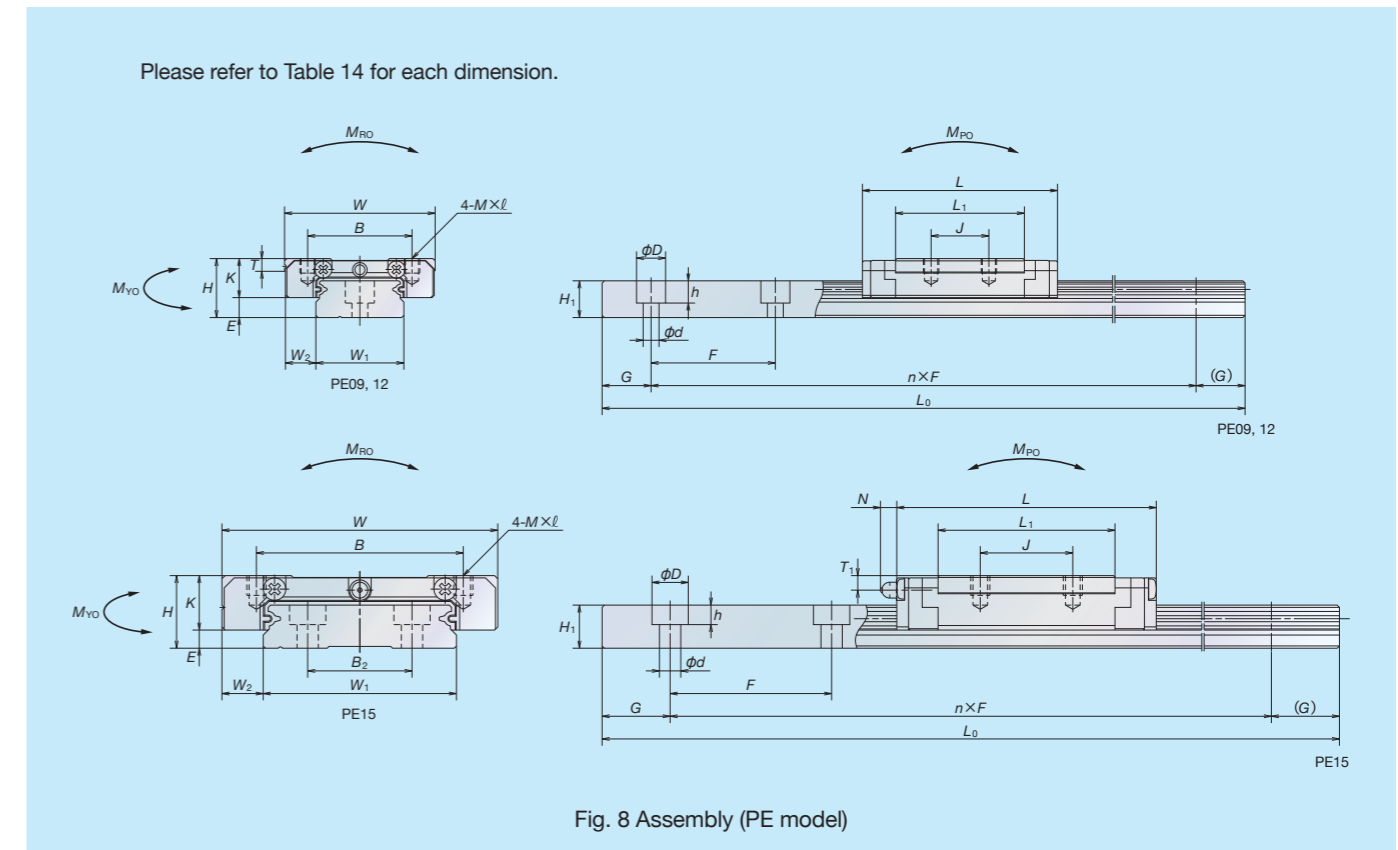
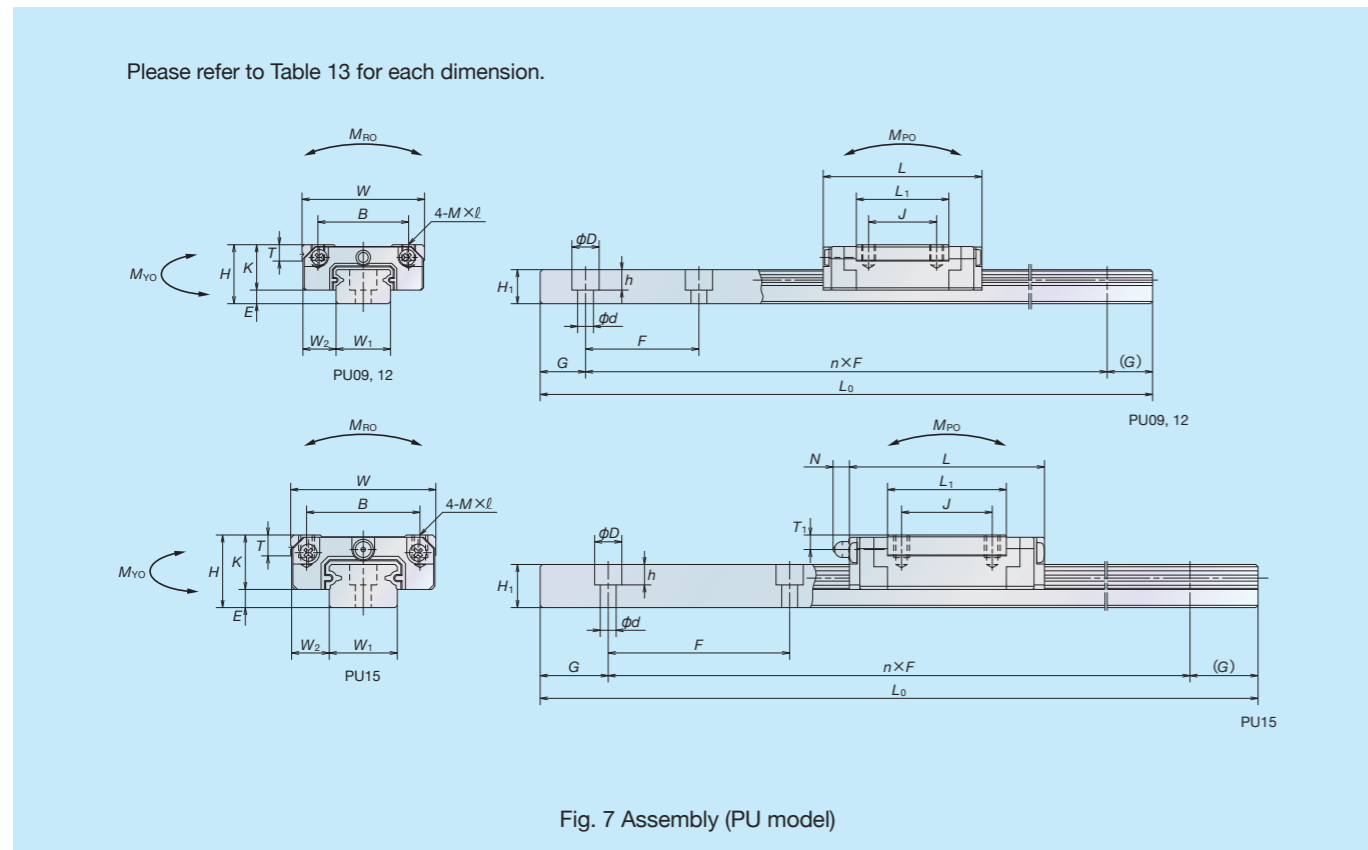


Table 13 Dimensions (PU model)

Model No.	Assembly			Ball slide									Rail					Basic load ratings								Weight				
	Height	E	W ₂	Width	Length	Mounting hole			L ₁	K	T	Oil hole			Width	Height	Pitch	Mounting bolt hole	G	Maximum length	Dynamic		Static	Static moment (N-m)				Ball slide	Rail	
						H	E	W ₂				W	L	B							J	M×Pitch×ℓ		Hole size	T ₁	N	W ₁			H ₁
	H	E	W ₂	W	L	B	J	M×Pitch×ℓ	L ₁	K	T	Hole size	T ₁	N	W ₁	H ₁	F	d×D×h	(reference)	L _{0max}	C ₅₀ (N)	C ₁₀₀ (N)	(N)	M _{RO}	One slide	Two slides	One slide	Two slides	(g)	(g/100 mm)
PU09TR PU09UR	10	2.2	5.5	20	30 41	15	10 16	M3×0.5×3	19.6 30.6	7.8	2.6	—	—	—	9	5.5	20	3.5×6×4.5	7.5	600	1 490 2 100	1 180 1 670	2 150 3 500	9.90 16.2	6.10 15.6	41.0 88.0	6.10 15.6	41.0 88.0	16 25	35
PU12TR PU12UR	13	3	7.5	27	35 48.7	20	15 20	M3×0.5×3.5	20.4 34.1	10	3.4	—	—	—	12	7.5	25	3.5×6×4.5	10	800	2 830 4 000	2 250 3 150	3 500 5 700	21.1 34.5	11.4 28.3	73.5 174	11.4 28.3	73.5 174	32 53	65
PU15AL PU15BL	16	4	8.5	32	43 61	25	20 25	M3×0.5×5	26.2 44.2	12	4.4	∅3	3.2	(3.6)	15	9.5	40	3.5×6×4.5	15	1 000	5 550 8 100	4 400 6 400	6 600 11 300	49.5 84.5	25.6 69.5	190 435	25.6 69.5	190 435	59 100	105

Note: The basic load ratings comply with ISO standards (ISO 14728-1, 14728-2).
 C₅₀: the basic dynamic load rating for 50 km rated fatigue life C₁₀₀: the basic dynamic load rating for 100 km rated fatigue life

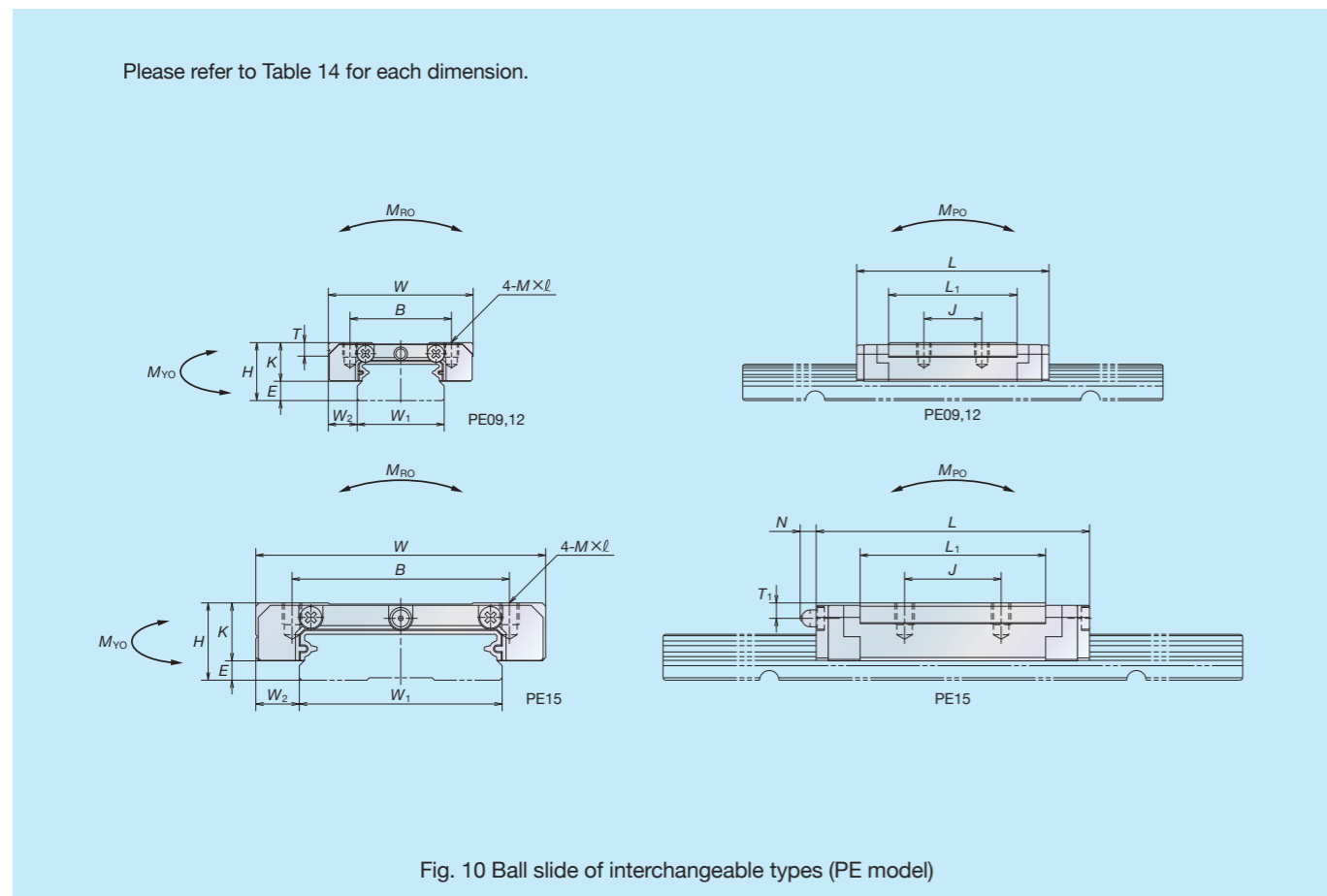
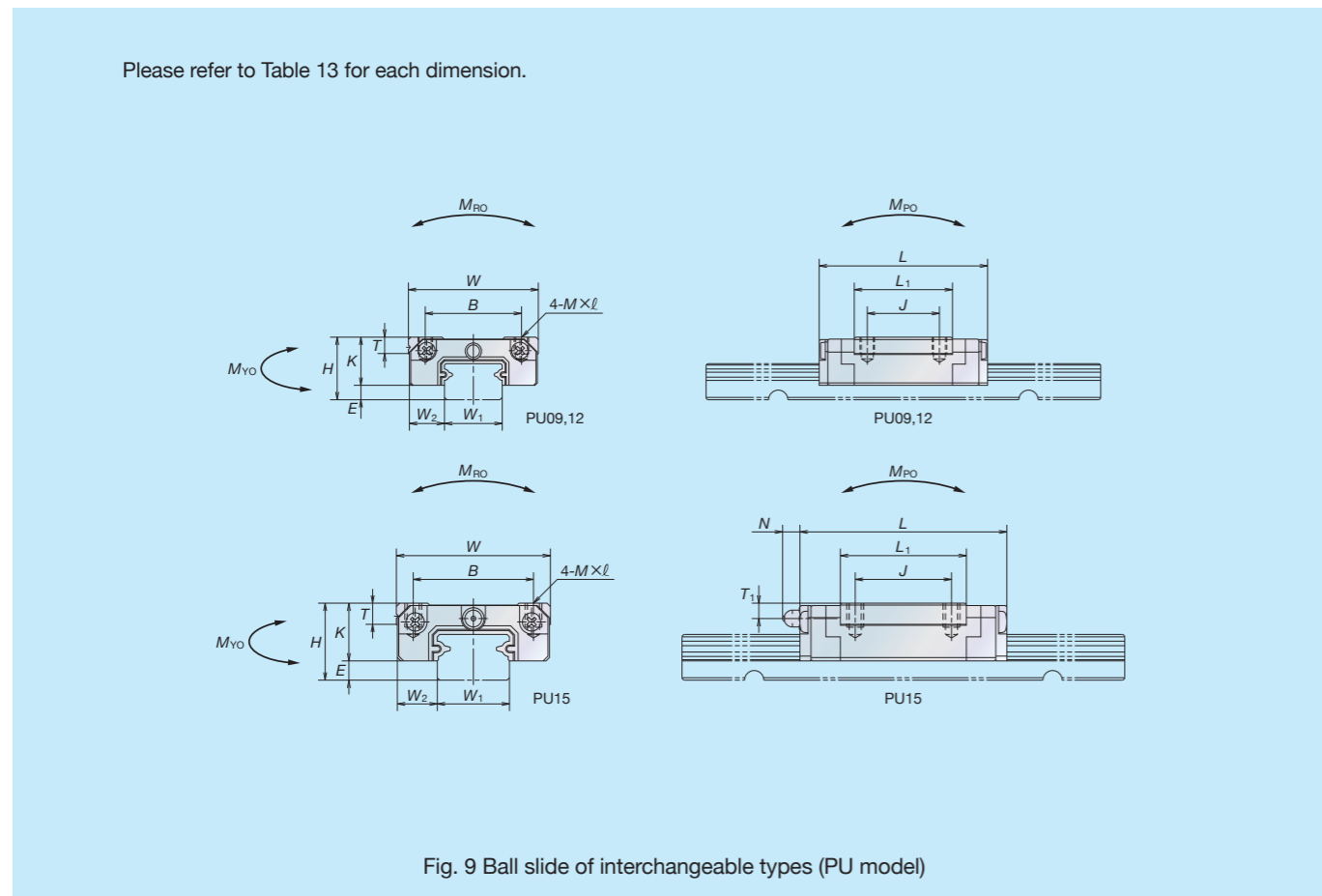
Table 14 Dimensions (PE model)

Model No.	Assembly			Ball slide									Rail					Basic load ratings								Weight					
	Height	E	W ₂	Width	Length	Mounting hole			L ₁	K	T	Oil hole			Width	Height	Pitch	Mounting bolt hole	G	Maximum length	Dynamic		Static	Static moment (N-m)				Ball slide	Rail		
						H	E	W ₂				W	L	B							J	M×Pitch×ℓ		Hole size	T ₁	N	W ₁			H ₁	B ₂
	H	E	W ₂	W	L	B	J	M×Pitch×ℓ	L ₁	K	T	Hole size	T ₁	N	W ₁	H ₁	B ₂	F	d×D×h	(reference)	L _{0max}	C ₅₀ (N)	C ₁₀₀ (N)	(N)	M _{RO}	One slide	Two slides	One slide	Two slides	(g)	(g/100 mm)
PE09TR PE09UR	12	4	6	30	39.8 51.2	21	12 24	M3×0.5×3	26.6 38	8	2.8	∅2	2.3	—	18	7.5	—	30	3.5×6×4.5	10	800	3 000 4 000	2 390 3 150	4 500 6 700	36.5 54.5	17.3 37.5	113 210	17.3 37.5	113 210	35 50	95
PE12AR PE12BR	14	4	8	40	45 60	28	15 28	M3×0.5×4	31 46	10	3.2	∅2.5	2.7	—	24	8.5	—	40	4.5×8×4.5	15	1 000	4 350 5 800	3 450 4 600	6 350 9 550	70.5 106	29.3 63.5	180 345	29.3 63.5	180 345	66 98	140
PE15AR PE15BR	16	4	9	60	56.6 76	45	20 35	M4×0.7×4.5	38.4 57.8	12	4.1	∅3	3.2	(3.3)	42	9.5	23	40	4.5×8×4.5	15	1 200	7 600 10 300	6 050 8 200	10 400 16 000	207 320	59.0 135	370 740	59.0 135	370 740	140 211	275

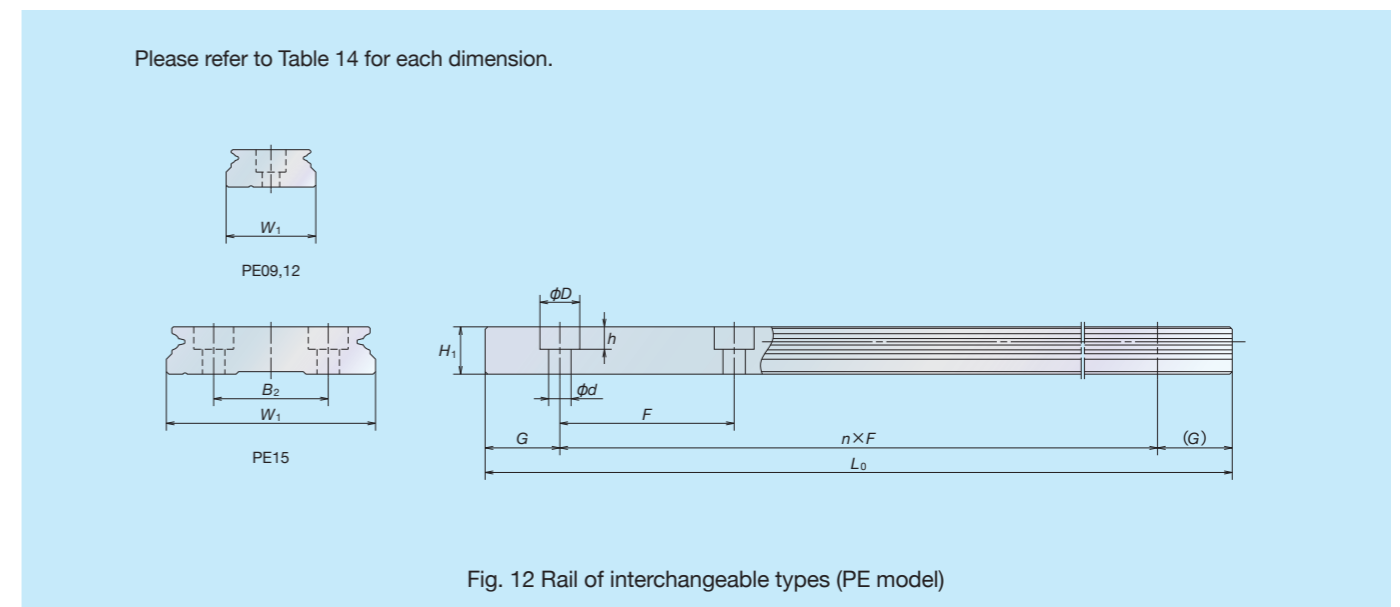
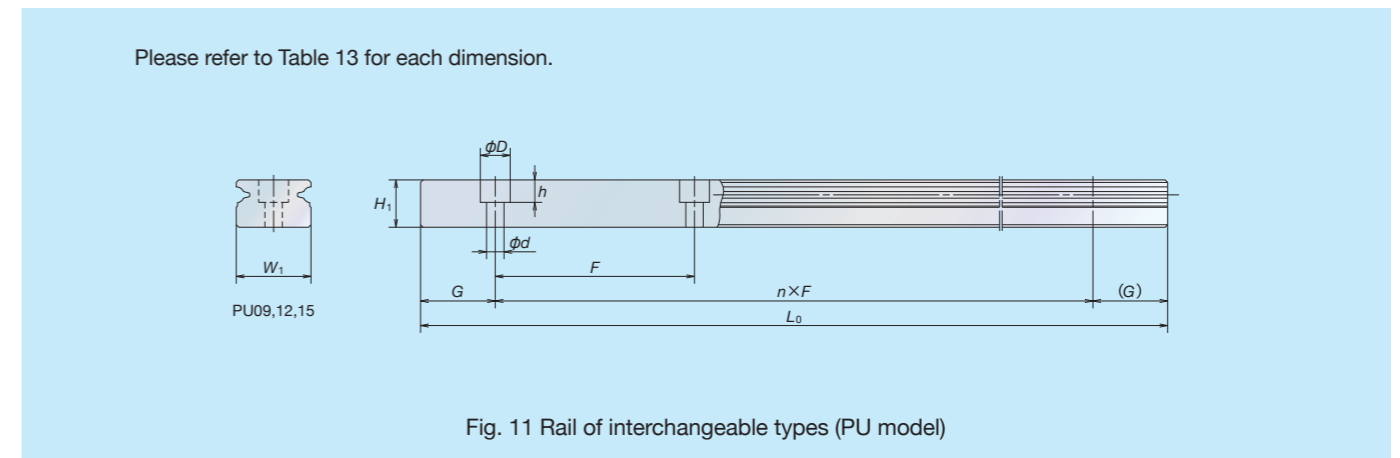
Note: The basic load ratings comply with ISO standards (ISO 14728-1, 14728-2).
 C₅₀: the basic dynamic load rating for 50 km rated fatigue life C₁₀₀: the basic dynamic load rating for 100 km rated fatigue life

9.2 Interchangeable type

(1) Ball slide of interchangeable types



(2) Rail of interchangeable types



10 Interchangeability with LU model/LE model

The PU model/PE model is designed to be interchangeable with the LU model/LE model for its mounting dimensions and load ratings.

Refer to Figs. 7, 8 and Tables 13, 14 for more details.

11 Handling precautions

- (1) NSK Linear Guide may become damaged when struck or hit.
- (2) Maximum operating temperature must be 80°C or below. Exceeding this limit may damage resin parts.
- (3) Maximum operating temperature must be 50°C (max. momentary 80°C) when attaching NSK K1. Also, avoid exposure to organic solvents with a degreasing effect. Do not immerse in kerosene or rust preventative oil (with kerosene ingredients).
- (4) Handling of interchangeable types
 - ① Interchangeable ball slide will be delivered with a provisional rail (inserting fixture).
 - ② Be sure to use the provisional rail when mounting ball slide(s) to a rail.
 - ③ Do not remove the ball slide from provisional rail until inserting into a rail.

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