



NSK LINEAR GUIDES

Miniature PU Series/PE Series

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

Features

1. Motion performance

Highly smooth operation is achieved by smooth ball recirculation.

2. Lightweight

The ball slide is designed to be approximately 20% lighter than conventional models* by using resin.

*Miniature LU series/LE series

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

Stainless steel is a standard feature that provides excellent corrosion resistance.

7. Easy handling

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 to extend product life.

9. Fast delivery

Wide selection of interchangeable rails and ball slides for PU/PE Series.

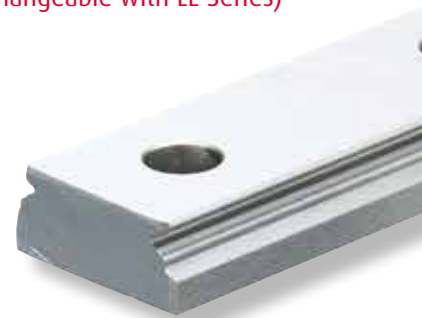
Miniature PU

(Interchangeable with LU Series)



Wide Miniature PE

(Interchangeable with LE Series)

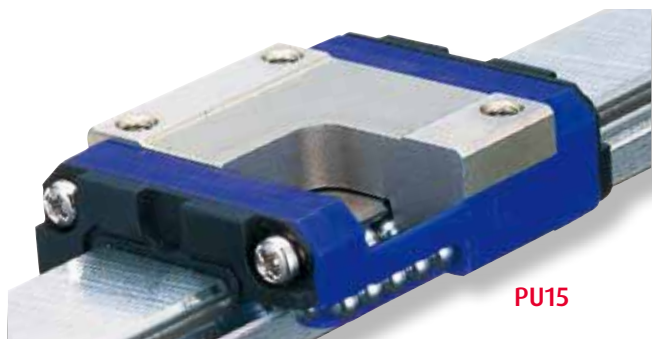




PU09TR



PE09TR



PU15

Cutaway View

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

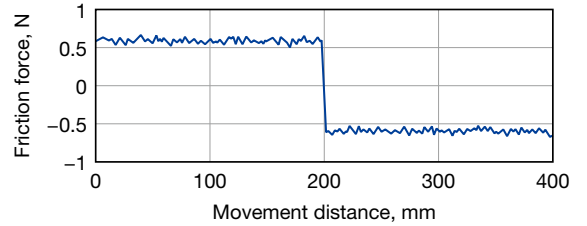


Fig. 1-1 Fluctuations in Dynamic Friction

Low dust generation

The PU series/PE series, 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

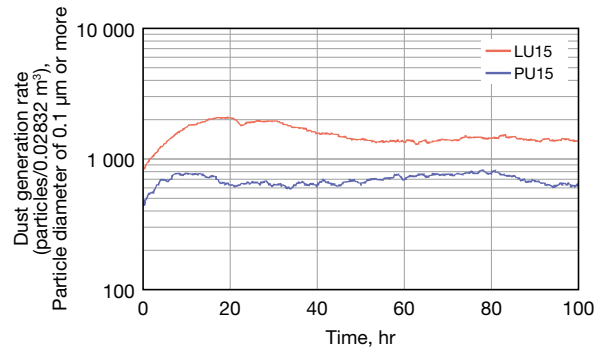


Fig. 1-2 Dust Generation Rate

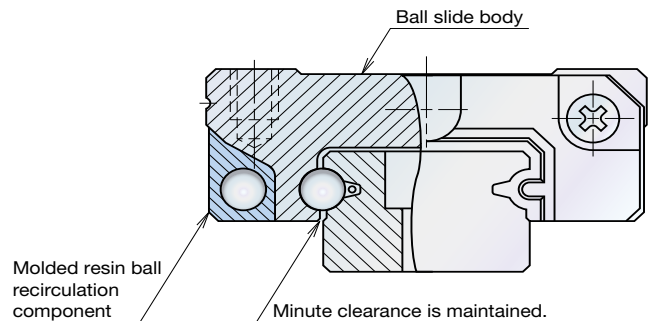



Fig. 2 Cross Sectional Front View

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

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.

Preloaded Assembly Type

PU	15	0470	AL	K	2	- 	P5	1
SERIES NAME	SIZE	RAIL LENGTH (MM)	BALL SLIDE SHAPE CODE	MATERIAL/SURFACE TREATMENT CODE K: Stainless Steel H: Stainless Steel + surface treatment	NUMBER OF BALL SLIDES PER RAIL	DESIGN SERIAL NUMBER	ACCURACY CODE P4: Super Precision P5: High Precision P6: Precision PN: Normal K4: Super Precision with K1 K5: High Precision with K1 K6: Precision with K1 KN: Normal with K1	PRELOAD CODE 0: Fine Clearance - Z0 1: Slight Preload - Z1

Interchangeable Type

Reference number for rail and ball slide assembly

PU	15	0470	AL	K	2	- 	PC	T
SERIES NAME	SIZE	RAIL LENGTH (MM)	BALL SLIDE SHAPE CODE	MATERIAL/SURFACE TREATMENT CODE K: Stainless Steel H: Stainless Steel + surface treatment	NUMBER OF BALL SLIDES PER RAIL	DESIGN SERIAL NUMBER	ACCURACY CODE PC: Normal KC: Normal with K1	PRELOAD CODE T: Fine Clearance - ZT

Reference number for ball slide of interchangeable type

PAU	15	AL	S	K
SERIES CODE PAU: PU Series Interchangeable Ball Slide PAE: PE Series Interchangeable Ball Slide	SIZE	BALL SLIDE SHAPE CODE	MATERIAL CODE S: Stainless Steel	OPTION CODE K: Equipped with K1

Reference number for rail of interchangeable type

P1U	15	0470	R	K	N		PC	T
SERIES CODE P1U: PU Series Interchangeable Rail P1E: PE Series Interchangeable Rail	SIZE	RAIL LENGTH (MM)	RAIL SHAPE CODE S: PU09-12 R: PU05-15, PE05-07-09-12 P: PE15	MATERIAL/SURFACE TREATMENT CODE K: Stainless Steel H: Stainless Steel + surface treatment	BUTTING SPECIFICATION N: Non-butting rails L: Butting specification	DESIGN SERIAL NUMBER	ACCURACY CODE PC: Normal	PRELOAD CODE T: Fine Clearance - ZT

* Please consult NSK for butting rail specification.

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

Unit: μm

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	20
Running parallelism of surface C to surface A	Shown in Table 3, Fig. 3, Fig. 4			
Running parallelism of surface D to surface B				

Table 3 Running parallelism of ball slide

Unit: μm

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

Table 2 Tolerance of interchangeable type:
Normal grade PC

Unit: μm

Characteristics	Accuracy grade	Normal grade
		PC
Mounting height H		± 20
Variation of mounting height H		15 ¹⁾ 30 ²⁾
Mounting width W_2 or W_3		± 20
Variation of mounting width W_2 or W_3		20
Running parallelism of surface C to surface A	Shown in Table 3, Fig. 3, Fig. 4	
Running parallelism of surface D to surface B		

¹⁾ Variation on the same rail

²⁾ Variation on multiple rails

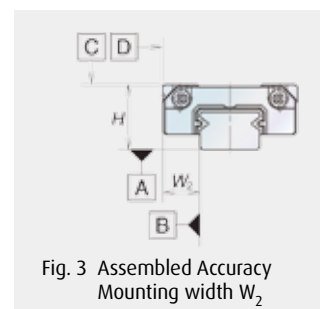


Fig. 3 Assembled Accuracy Mounting width W_2

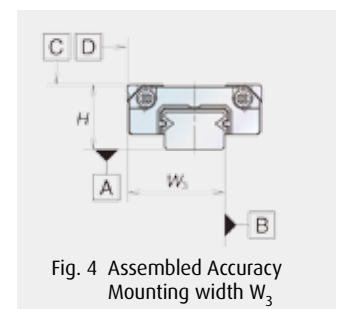


Fig. 4 Assembled Accuracy Mounting width W_3

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 series

	Model No.	Preload (N)		Rigidity (N / μ m)	
		Slight preload (Z1)		Slight preload (Z1)	
Standard type	PU05TR	0 - 3		17	
	PU07AR	0 - 8		22	
	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	

Clearance of fine clearance Z0 is 0-3 μ m. 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 Series

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

Table 5 Preload and rigidity of preloaded assembly of PE series

	Model No.	Preload (N)		Rigidity (N / μ m)	
		Slight preload (Z1)		Slight preload (Z1)	
Standard type	PE05AR	0 - 28		45	
	PE07TR	0 - 29		46	
	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	

Table 7 Clearance of interchangeable type of PE Series

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

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.

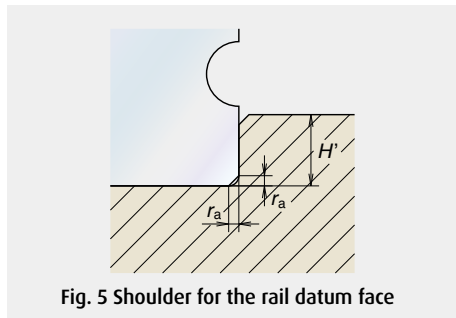


Fig. 5 Shoulder for the rail datum face

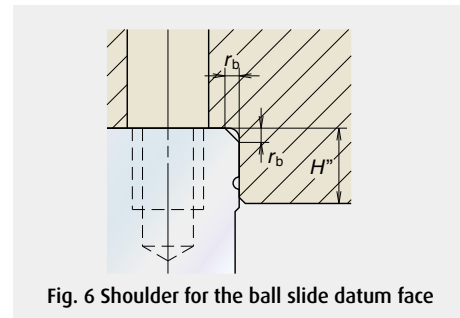


Fig. 6 Shoulder for the ball slide datum face

Table 8 Shoulder height of the mounting surface and corner radius r (PU Series)

Unit: mm				
Model No.	Corner radius (Maximum)		Shoulder height	
	r_a	r_b	H'	H'' (\circ)
PU05	0.2	0.2	0.7	2.3
PU07	0.2	0.3	1.2	2.5
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

(\circ) 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 Series)

Unit: mm				
Model No.	Corner radius (Maximum)		Shoulder height	
	r_a	r_b	H'	H'' (\circ)
PE05	0.2	0.2	1.1	2.5
PE07	0.2	0.3	1.7	3
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

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

Lubrication

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

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 type	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 type	Mineral oil + Synthetic hydrocarbon oil	30	-20 to 70	<ul style="list-style-type: none"> • For clean environment
LGU	Diurea type	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.

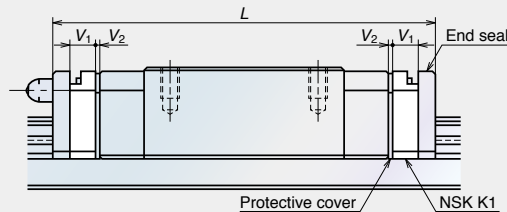


Table 11 Dimensions when equipped with NSK K1™ (PU Series)

Unit: mm

	Model No.	Standard ball slide length	Ball slide length equipped with two NSK K1, L	Thickness of NSK K1, V ₁	Thickness of protective cover, V ₂
Standard type	PU05TR	19.4	24.4	2	0.5
	PU07AR	23.4	29.4	2.5	0.5
	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 Series)

Unit: mm

	Model No.	Standard ball slide length	Ball slide length equipped with two NSK K1, L	Thickness of NSK K1, V ₁	Thickness of protective cover, V ₂
Standard type	PE05AR	24.1	28.9	2	0.4
	PE07TR	31.1	37.1	2.5	0.5
	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

Ball slide length equipped with NSK K1™ = (Standard ball slide length) + (Thickness of NSK K1™, V₁ × Number of NSK K1™) + (Thickness of the protective cover, V₂ × 2)
 * Additional NSK K1™ is available depending on the use conditions.

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.

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

Dimensions

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

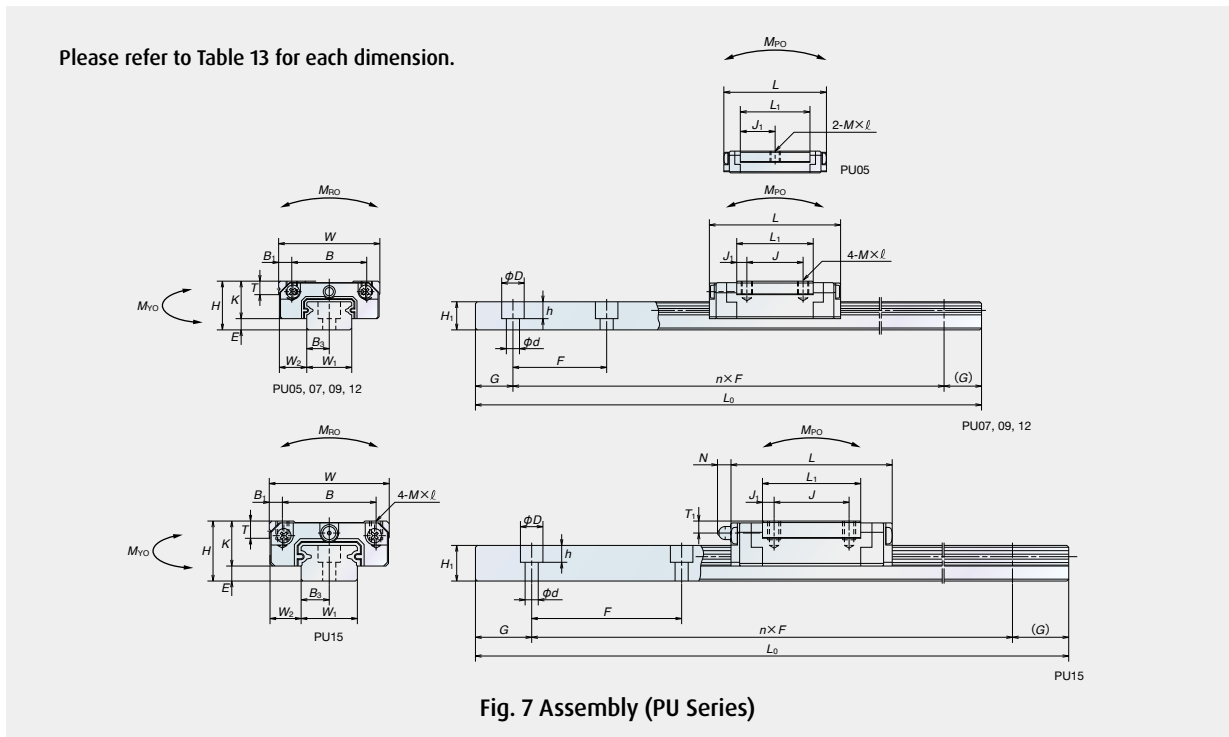


Table 13 Dimensions (PU Series)

Model No.	Interchangeable type	Assembly			Ball slide											Rail				
		Height	E	W ₂	Width	Length	Mounting hole			B ₁	L ₁	J ₁	K	T	Oil hole			Width	Height	Pitch
							W	L	B						J	M×Pitch×ℓ	Hole diameter			
PU05TR	—	6	1	3.5	12	19.4	8	—	M2×0.4×1.5	2	11.4	5.7	5	2.3	∅0.9	1.5	—	5	3.2	15
PU07AR	—	8	1.5	5	17	23.4	12	8	M2×0.4×2.4	2.5	13.3	2.65	6.5	2.45	∅1.5	1.8	—	7	4.7	15
PU09TR	○	10	2.2	5.5	20	30	15	10	M3×0.5×3	2.5	19.6	4.8	7.8	2.6	—	—	—	9	5.5	20
PU09UR	○	10	2.2	5.5	20	41	15	16	M3×0.5×3	2.5	30.6	7.3	7.8	2.6	—	—	—	9	5.5	20
PU12TR	○	13	3	7.5	27	35	20	15	M3×0.5×3.5	3.5	20.4	2.7	10	3.4	—	—	—	12	7.5	25
PU12UR	○	13	3	7.5	27	48.7	20	20	M3×0.5×3.5	3.5	34.1	7.05	10	3.4	—	—	—	12	7.5	25
PU15AL	○	16	4	8.5	32	43	25	20	M3×0.5×5	3.5	26.2	3.1	12	4.4	∅3 (°1)	3.2	(3.6)	15	9.5	40
PU15BL	○	16	4	8.5	32	61	25	25	M3×0.5×5	3.5	44.2	9.6	12	4.4	∅3 (°1)	3.2	(3.6)	15	9.5	40

○: Interchangeable type is available.

(¹) Drive-In grease fitting for ∅3 is available to PU15.

(²) Basic dynamic load rating is a load that allows for a 50-km rating fatigue life and is a vertical and constant load on the ball slide mounting surface. To convert C to C₁₀₀ for a 100-km rating fatigue life, divide C by 1.26.

Table 14 Dimensions (PE Series)

Model No.	Interchangeable type	Assembly			Ball slide											Rail				
		Height	E	W ₂	Width	Length	Mounting hole			B ₁	L ₁	J ₁	K	T	Oil hole			Width	Height	B ₂
							W	L	B						J	M×Pitch×ℓ	Hole diameter			
PE05AR	—	6.5	1.4	3.5	17	24.1	13	—	M2.5×0.45×1.5	2	16.4	8.2	5.1	2.5	∅0.9	1.3	—	10	4	—
PE07TR	—	9	2	5.5	25	31.1	19	10	M3×0.5×2.8	3	20.8	5.4	7	3	∅1.9	1.9	—	14	5.2	—
PE09TR	○	12	4	6	30	39.8	21	12	M3×0.5×3	4.5	26.6	7.3	8	2.8	∅2	2.3	—	18	7.5	—
PE09UR	○	12	4	6	30	51.2	23	24	M3×0.5×3	3.5	38	7	8	2.8	∅2	2.3	—	18	7.5	—
PE12AR	○	14	4	8	40	45	28	15	M3×0.5×4	6	31	8	10	3.2	∅2.5	2.7	—	24	8.5	—
PE12BR	○	14	4	8	40	60	28	28	M3×0.5×4	6	46	9	10	3.2	∅2.5	2.7	—	24	8.5	—
PE15AR	○	16	4	9	60	56.6	45	20	M4×0.7×4.5	7.5	38.4	9.2	12	4.1	∅3 (°3)	3.2	(3.3)	42	9.5	23
PE15BR	○	16	4	9	60	76	45	35	M4×0.7×4.5	7.5	57.8	11.4	12	4.1	∅3 (°3)	3.2	(3.3)	42	9.5	23

○: Interchangeable type is available.

(³) Drive-In grease fitting for ∅3 is available to PE15.

(⁴) Basic dynamic load rating is a load that allows for a 50-km rating fatigue life and is a vertical and constant load on the ball slide mounting surface. To convert C to C₁₀₀ for a 100-km rating fatigue life, divide C by 1.26.

Please refer to Table 14 for each dimension.

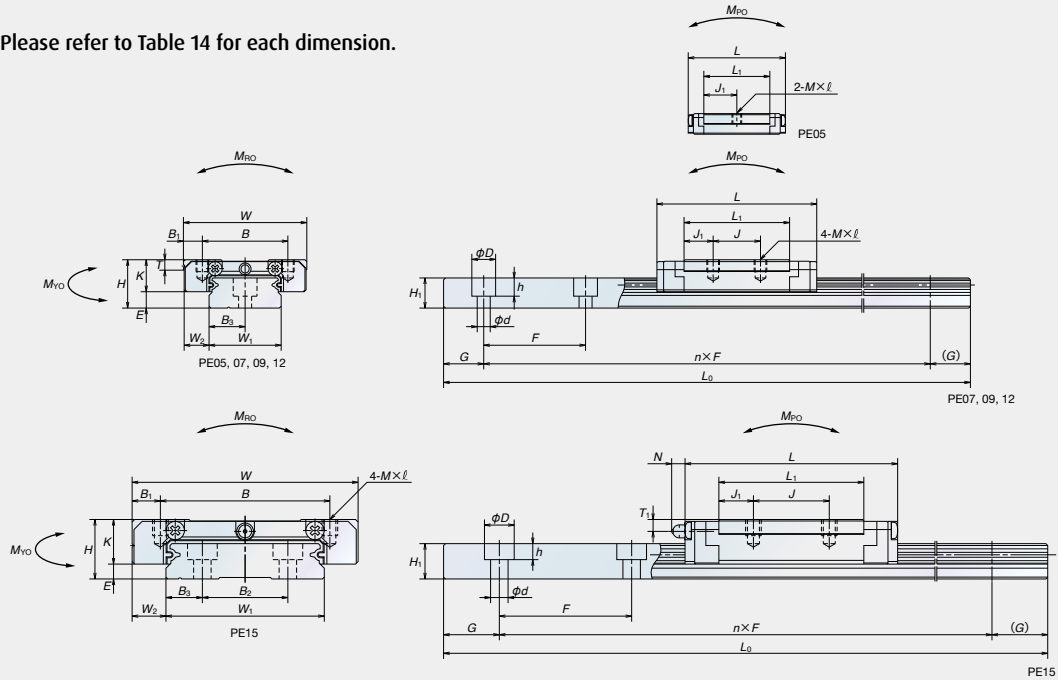


Fig. 8 Assembly (PE Series)

Unit: mm

Rail				Basic Load rating (²)								Weight	
Mounting bolt hole d×D×h	B ₃	G (Reference)	Maximum length L _{0max}	Dynamic	Static	Static moment (N-m)				Ball diameter D _w	Ball slide (g)	Rail (g/100 mm)	
				C (N)	C ₀ (N)	M _{RO}	M _{PO}		M _{YO}				
							one slide	two slides in close contact	one slide	two slides in close contact			
2.3×3.3×0.8	2.5	5	210	520	775	2.06	1.28	9.90	1.28	9.90	1	4	11
2.4×4.2×2.3	3.5	5	375	1 090	1 370	5.20	2.70	21.8	2.70	21.8	1.5875	8	23
3.5×6×4.5	4.5	7.5	600	1 490	2 150	9.90	6.10	41.0	6.10	41.0	1.5875	16	35
				2 100	3 500	16.2	15.6	88.0	15.6	88.0		25	
3.5×6×4.5	6	10	800	2 830	3 500	21.1	11.4	73.5	11.4	73.5	2.3812	32	65
				4 000	5 700	34.5	28.3	174	28.3	174		53	
3.5×6×4.5	7.5	15	1 000	5 550	6 600	49.5	25.6	190	25.6	190	3.175	59	105
				8 100	11 300	84.5	69.5	435	69.5	435		100	

To fix rails of PU05TR, use M2 × 0.4 cross-recessed pan head machine screw for precision instrument.
(JCS 10-70 No. 0 pan head machine screw No. 1) (JCS: Japanese Camera Industrial Standard)

Unit: mm

Rail					Basic load rating (⁴)								Weight	
Pitch F	Mounting bolt hole d×D×h	B ₃	G (Reference)	Maximum length L _{0max}	Dynamic	Static	Static moment (N-m)				Ball diameter D _w	Ball slide (g)	Rail (g/100 mm)	
					C (N)	C ₀ (N)	M _{RO}	M _{PO}		M _{YO}				
							one slide	two slides in close contact	one slide	two slides in close contact				
20	3×5×1.6	5	7.5	150	690	1 160	6.00	2.75	17.5	2.75	17.5	1	7	34
30	3.5×6×3.2	7	10	600	1 580	2 350	16.7	7.20	46.0	7.20	46.0	1.5875	19	55
30	3.5×6×4.5	9	10	800	3 000	4 500	36.5	17.3	113	17.3	113	2	35	95
					4 000	6 700	54.5	37.5	210	37.5	210		50	
40	4.5×8×4.5	12	15	1 000	4 350	6 350	70.5	29.3	180	29.3	180	2.3812	66	140
					5 800	9 550	106	63.5	345	63.5	345		98	
40	4.5×8×4.5	9.5	15	1 200	7 600	10 400	207	59.0	370	59.0	370	3.175	140	275
					10 300	16 000	320	135	740	135	740		211	

To fix rails of PE05AR, use M2.5 × 0.45 cross-recessed pan head machine screw for precision instrument.
(JCS 10-70 No. 0 pan head machine screw No. 3) (JCS: Japanese Camera Industrial Standard)

Interchangeable type

Ball slide of interchangeable types

Please refer to Table 13 for each dimension.

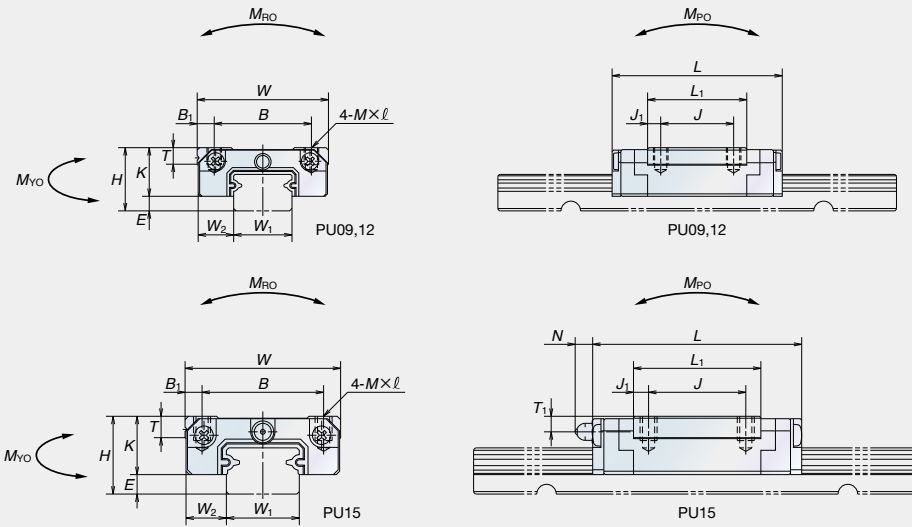


Fig. 9 Ball slide of interchangeable types (PU Series)

Please refer to Table 14 for each dimension.

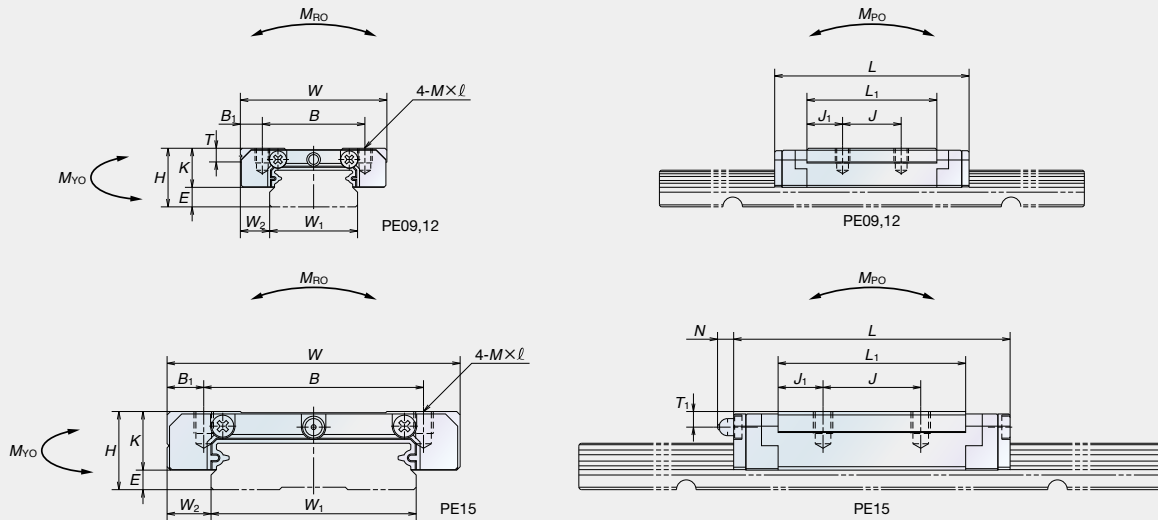


Fig. 10 Ball slide of interchangeable types (PE Series)

Rail of interchangeable types

Please refer to Table 13 for each dimension.

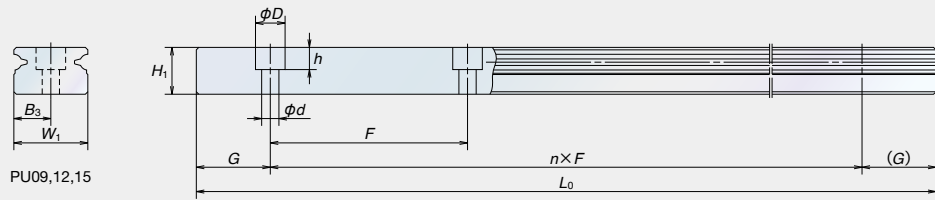


Fig. 11 Rail of interchangeable types (PU Series)

Please refer to Table 14 for each dimension.

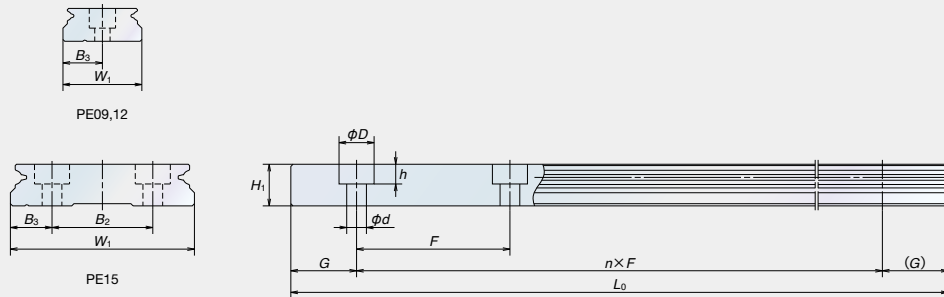


Fig. 12 Rail of interchangeable types (PE Series)

Interchangeability with LU Series/LE Series

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

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

(*) Load ratings for PU05 and PE05 are not interchangeable

Handling Precautions

- › NSK Linear Guides may become damaged when struck or hit.
- › Maximum operating temperature must be 80°C or below. Exceeding this limit may damage resin parts.
- › 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).
- › Handling of interchangeable types
 - Interchangeable ball slide will be delivered with a provisional rail (inserting fixture).
 - Be sure to use the provisional rail when mounting ball slide(s) to a rail.
 - Do not remove the ball slide from provisional rail until inserting into a rail.

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