A BLOCK NSK Linear Rolling Guide Product

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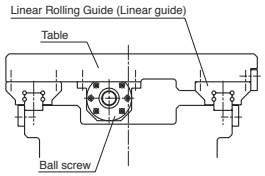
A-1 Characteristics of NSK Linear Rolling Guides

Characteristics of the NSK linear rolling guides are:

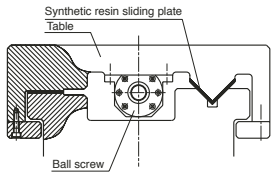
- Designs are simple and economic. This contributes to a highly accurate and low cost guide way system.
- Low friction coefficient facilitates a compact and low cost driving mechanism.
- Ultra-high purity of materials and superb processing technology ensure a long-term reliable operation.
- Prompt delivery thanks to a variety of interchangeable components.
- Users can select the most suitable guide from a wide variety of the ball guides and roller guides.

A-1-1 Comparision of Rolling Guides and Sliding Guides

The following describes a characteristic comparison between general rolling and sliding guide ways.



Example of rolling guide



Example of sliding guide

Comparative characteristics of rolling and sliding guide ways

Function	Rolling guide	Sliding guide
Friction	• Friction coefficient: 0.01 or lower • Difference between static and dynamic friction is small. • The fluctuation of friction force due to varying speed is far less than sliding guides.	• Friction is high. • The difference between static and dynamic friction coefficient is significant.
Positioning accuracy	• Lost motion is minimal. • Stick-slip is minimal. • Easy to achieve sub-micron positioning	• Larger lost motion • Stick-slip at low speed • Difficult to achieve sub-micron positioning
Life	• Possible to estimate useful life	• Difficult to estimate useful life
Static rigidity	• Generally high • No play because of preload • Easy to estimate rigidity	• Rigidity is great against load from a particular direction. • There is a mechanical play. • Difficult to estimate rigidity
Speed	• Wide range of use from low to high speed	• Unsuitable for extremely low or high speed
Maintenance, reliability	• Long life through a simple maintenance	• Precision is lost greatly by a worn out slide way surface.

In response to the demand for a high-speed, high-precision, high-quality, and easy maintenance, rolling guides which have above features are becoming prevalent.
Utilizing the technology we have sharpened in anti-friction rotating bearings, NSK makes various types of rolling linear guides which are highly accurate and reliable.

A-1-2 Structure and Characteristics of NSK Linear Guides

1. Structure of NSK Linear Guides

By avoiding structural complexity, and by reducing the number of components, we not only enhanced the precision of linear guides, but also are able to keep costs low. We have added NSK's patented unique structural feature to the original invention (**Fig. 1**). This contributes to higher precision and lower prices.
NSK linear guides consist of a rail and a slide (**Fig. 2**). The balls or rollers roll on the race way surface, and are scooped up by the end caps attached to both ends of the ball or roller slide. Then, the balls or rollers go through a passage made in the slide, and circulate back to the other end.

2. Characteristics of NSK Linear Guides

The use of a unique offset Gothic arch groove (**Fig. 3**) allows the ball type of NSK linear guides to satisfy groove designs required for specific purposes.
This unique ball groove design facilitates precise measurement of the ball groove, thus enabling the stable and highly accurate production of the rails and ball slides for random matching. (**Fig. 4**)
On top of that, we have developed and marketed the NSK Roller Guides, representing the culmination of NSK's analysis technology and tribology.
Such technologies ensure the features of NSK linear guides outlined below.

(1) High precision and quality

- High precision and quality come from our superb production and measuring technologies, strengthened by extensive experience in antifriction rotary bearings and ball screw production. Our quality assurance extends to the smallest components.

(2) High reliability and durability

- Logical simplicity in shape, along with stable processing, maintains high precision and reliability.
- Super-clean materials, our advanced heat treatment and processing technologies increase product durability.

(3) Abundant in type for any purpose

- Various series are available, and their slide models and size categories are standardized to satisfy any requirement. Our technology, polished by abundant experience in the use of special materials and surface treatments, meets the customer's most demanding expectations.

(4) Development of random-matching parts for short delivery time

- The adoption of the Gothic arch groove which makes measuring easy, and a new reliable quality control method has made random-matching of the rails and the ball slides possible. The parts are stocked as standard products, thereby reducing delivery time.

(5) Patented static load carrying capacity (impact-resistance)

- When a super-high load (impact) is applied, our Gothic arch groove spreads the load to surfaces which usually do not come into contact in the ball type NSK linear guides. This increases impact load resistance (**Fig. 5**).

(6) Lineup of extremely high-load capacity series

- The LA series provides a top class high-load capacity for the ball linear guides through a unique load carrying configuration with three ball recirculation circuits on the one side.
  By installing rollers that are the largest possible diameter and length, the NSK roller linear guides have realized the world's highest load capacity, far superior to the roller linear guides of other companies.

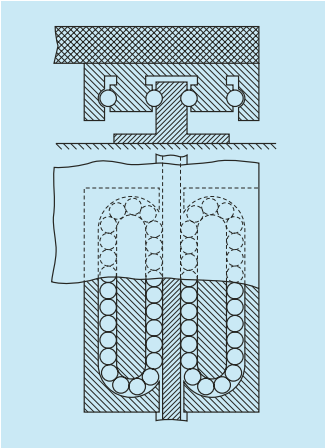


Fig. 1 • French Patent in 1932.
• Inventor: Gretsh (German)

NSK added its patented technology to the invention in Fig. 1, and improved the linear guide structure, thus realizing low cost design.

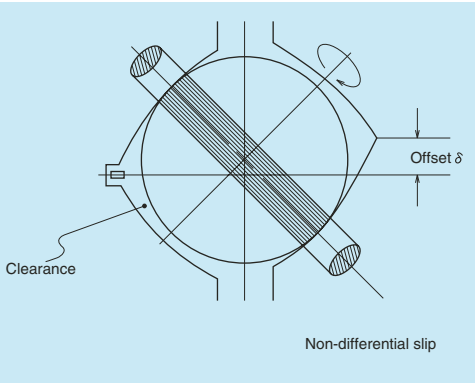


Fig. 3 Two point contacts of the offset Gothic arch groove

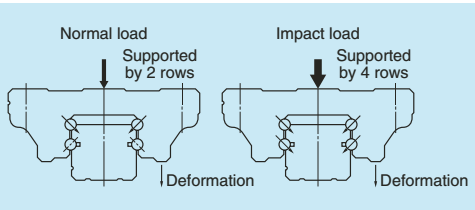


Fig. 5 Shock-resistance

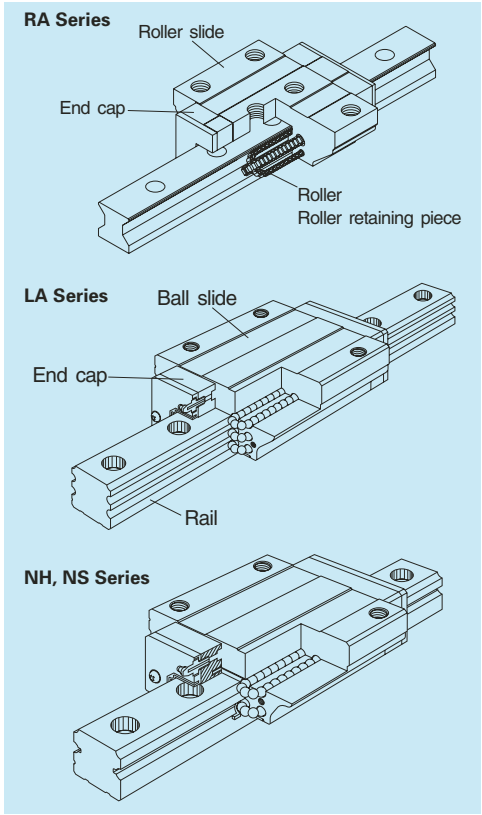


Fig. 2 Structure of NSK linear guides

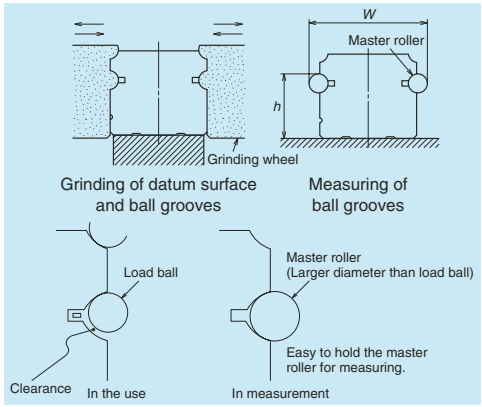
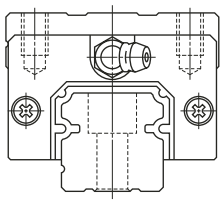
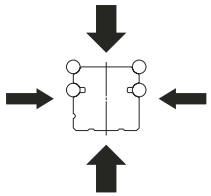
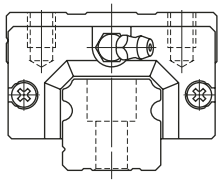
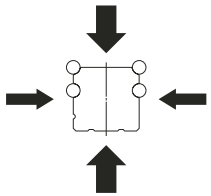
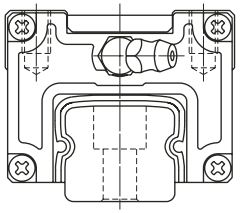
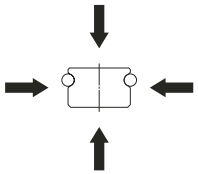


Fig. 4 Processing and measuring grooves

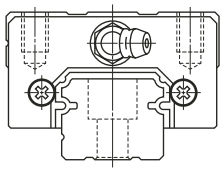
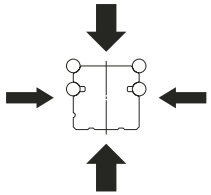
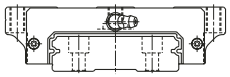
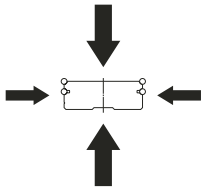
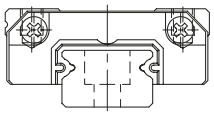
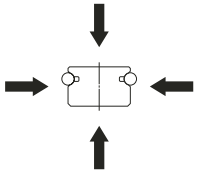
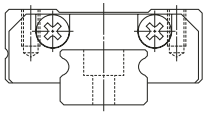
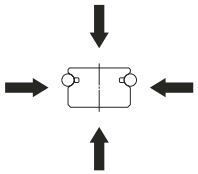
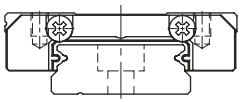
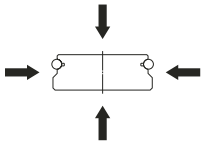
Measuring grooves is easy: you can obtain highly accurate results for all types of NSK series. This is why you can purchase rails and slides separately for random matching.

A-2 Types of NSK Linear Rolling Guides

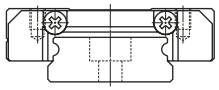
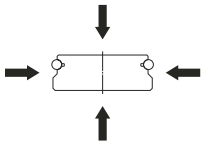
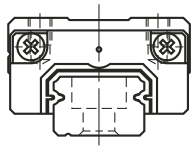
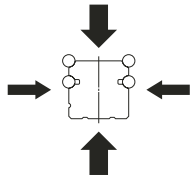
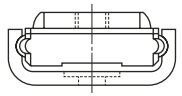
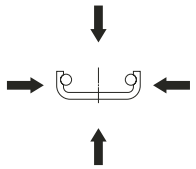
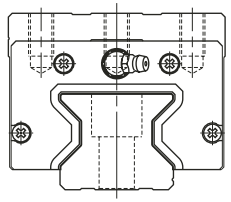
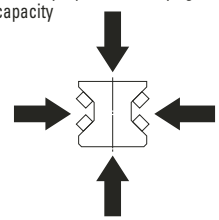
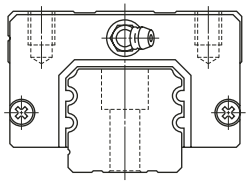
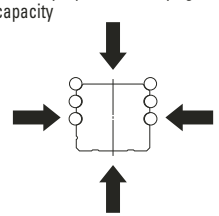
Rigidity: ☆, Extremely high; ◎, High; ◎, Medium; ○, Low
Friction characteristics: ◎, Low; ○, Normal
Assembly workability: ◎, Good; ○, Fair

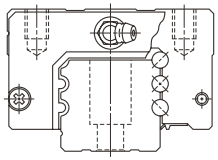
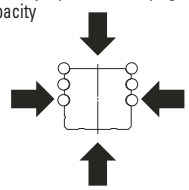
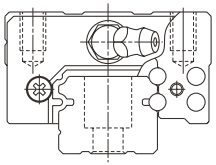
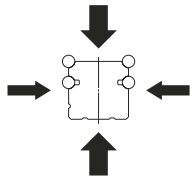
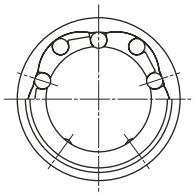
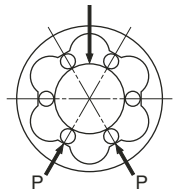
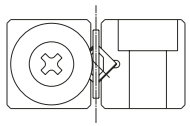
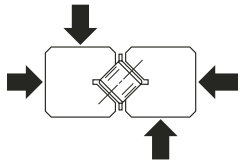
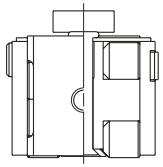
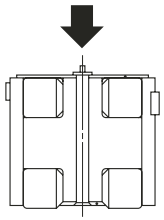
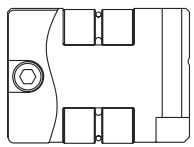
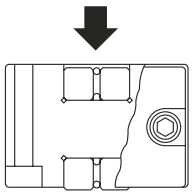
Product	Appearance	Shape	Rolling element	Load carrying characteristics	Rigidity	Friction characteristic	Assembly workability	Major applications	Page
NSK Linear Guides	NH Series 		Ball	High vertical load carrying capacity 	◎	◎	◎	• Industrial robots • Materials handling equipment • Semiconductor manufacturing equipment • Laser cutting machines • Electric discharge machines • Packaging/packing machines	A113
	VH Series 		Ball	High vertical load carrying capacity 	◎	◎	◎	• Industrial robots • Materials handling equipment • Woodworking machines • Laser cutting machines • Electric discharge machines • Packaging/packing machines	A133
	TS Series 		Ball	Four-way equal load carrying capacity 	◎	◎	◎	• Industrial robots • Materials handling equipment • Woodworking machines • Laser cutting machines • Electric discharge machines • Packaging/packing machines	A151

Note: For customers who have used the former LH or SH series, NH series is recommended as a substitute. Please confirm the correlation between NH series and former ones on the comparative table at A319.

Product	Appearance	Shape	Rolling element	Load carrying characteristics	Rigidity	Friction characteristic	Assembly workability	Major applications	Page
NSK Linear Guides	NS Series 		Ball	High vertical load carrying capacity 	◎	◎	◎	• Industrial robots • Materials handling equipment • Electric discharge machines • Woodworking machines • Semiconductor manufacturing equipment • Packaging/packing machines • Pneumatic equipment	A157
	LW Series 		Ball	High vertical load carrying capacity 	◎	◎	◎	• Industrial robots • Materials handling equipment • Electric discharge machines • Woodworking machines • Semiconductor manufacturing equipment • Packaging/packing machines • Pneumatic equipment	A175
	PU Series 		Ball	Four-way equal load carrying capacity 	○	◎	◎	• Semiconductor manufacturing equipment • LCD manufacturing equipment • Medical equipment • Optical stages • Microscope XY stages • Miniature robots • Pneumatic equipment • Computer peripherals	A191
	LU Series 		Ball	Four-way equal load carrying capacity 	○	◎	◎	• Semiconductor manufacturing equipment • LCD manufacturing equipment • Medical equipment • Optical stages • XY stage of microscope • Miniature robots • Pneumatic equipment • Computer peripherals	A201
	PE Series 		Ball	Four-way equal load carrying capacity 	○	◎	◎	• Semiconductor manufacturing equipment • LCD manufacturing equipment • Medical equipment • Optical stages • Microscope XY stages • Miniature robots • Pneumatic equipment • Computer peripherals	A213

Note: For customers who have used the former LS or SS series, NS series is recommended as a substitute. Please confirm the correlation between NS series and former ones on the comparative table at A319.

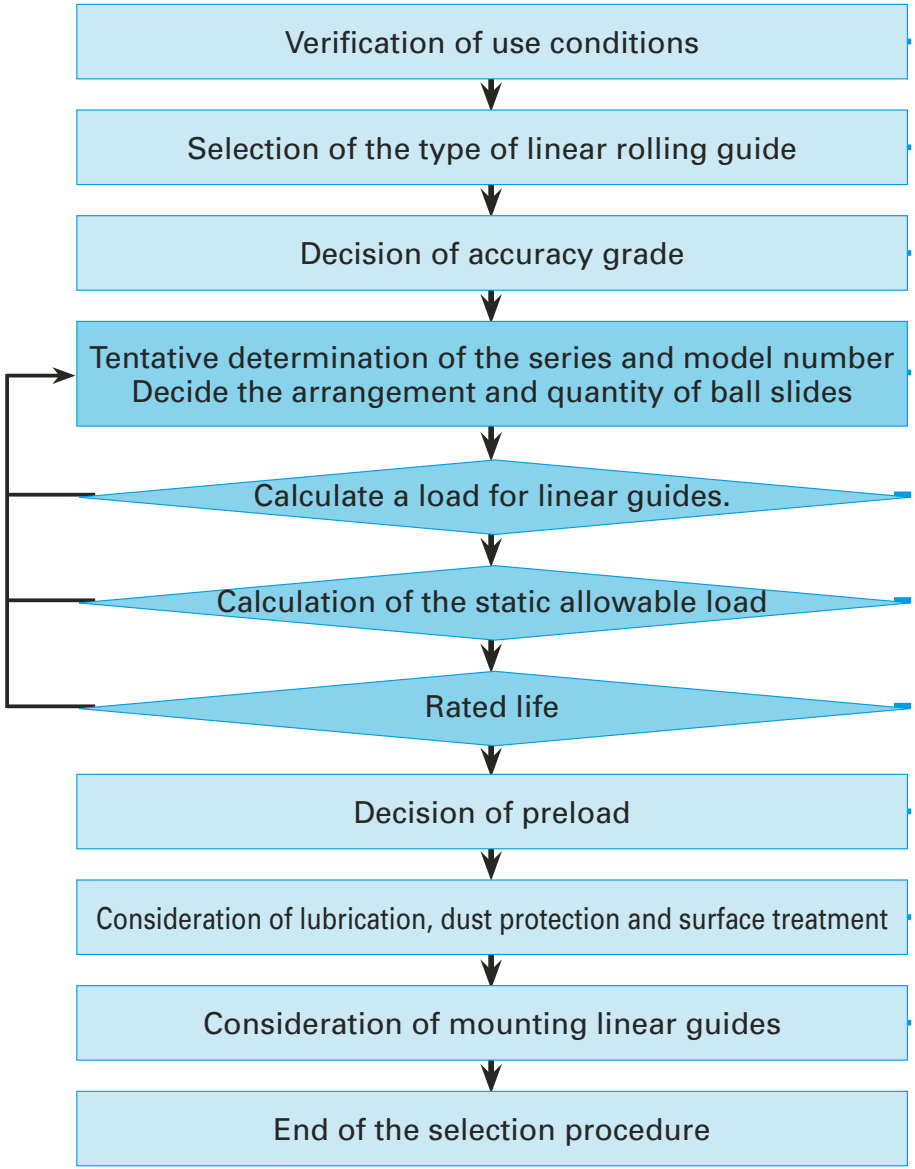
Product	Appearance	Shape	Rolling element	Load carrying characteristics	Rigidity	Friction characteristic	Assembly workability	Major applications	Page
NSK Linear Guides	LE Series 		Ball	Four-way equal load carrying capacity 	◯	◎	◎	• Semiconductor manufacturing equipment • LCD manufacturing equipment • Medical equipment • Optical stages • XY stages of microscope • Miniature robots • Pneumatic equipment • Computer peripherals	A223
	Miniature LH Series 		Ball	High vertical load carrying capacity 	◎	◎	◎	• Semiconductor manufacturing equipment • LCD manufacturing equipment • Medical equipment • Optical stages • Microscope XY stages • Miniature robots • Pneumatic equipment • Computer peripherals	A237
	LL Series 		Ball	Four-way equal load carrying capacity 	◯	◎	◎	• Knitting machines • Computer peripherals • Pneumatic equipment • Office equipment	A247
	RA Series 		Roller	Four-way equal load carrying capacity 	☆	◎	◎	• Machining centers • NC lathes • Heavy cutting machine tools • Various types of NC grinders • Gear-cutting machines • Press machines • Electric discharge machines	A253
	LA Series 		Ball	Four-way equal load carrying capacity 	◎	◯	◎	• Machining centers • NC lathes • Heavy cutting machine tools • Various types of NC grinders • Gear-cutting machines • Press machines • Electric discharge machines	A271

Product	Appearance	Shape	Rolling element	Load carrying characteristics	Rigidity	Friction characteristic	Assembly workability	Major applications	Page
NSK Linear Guides	HA Series 		Ball	Four-way equal load carrying capacity 	◎	○	◎	• Machining centers • Precision lathes • Various types of NC grinders • Electric discharge machines • Optical stages • LCD manufacturing equipment • Die molding machines • High-precision measuring equipment	A291
	HS Series 		Ball	High vertical load carrying capacity 	◎	◎	◎	• Machining centers • Precision lathes • Various types of grinders • Electric discharge machines • Optical stages • LCD manufacturing equipment • High-precision measuring equipment	A305
Linear rolling bushing			Ball		○	◎	○	• Materials handling equipment • Packaging/packing machines • Medical equipment • Pneumatic equipment • Office equipment • Assembling machines	A321
Crossed roller guide			Roller		◎	◎	○	• Precision stages • Measuring equipment • Test equipment • Printed circuit assembly machines	A332
Roller pack			Roller		◎	◎	○	• Large machine tools • Conveyor system for heavy objects (guide ways for heavy loads)	A338
Linear roller bearing			Roller		◎	◎	○	• Large machine tools • Conveyor system for heavy objects (guide ways for heavy loads)	A345

A-3 Selection of NSK Linear Rolling Guides

A-3-1 Selection Flow Chart

The flow chart below shows the basic steps for the selection.



		Page
Verification of use conditions	• Machine structure, installation space and position of the linear guides • Functional requirements (required life, rigidity and accuracy) and use environment	A15 Description of the rated life A28 Description of the preload A32 Description of the accuracy A57 Description of rust prevention and surface treatment A67 Description of arrangement and mounting A111 Technical descriotion and dimension table for NSK Linear Guides
Selection of the type of linear rolling guide	• Consider the load, rigidity, friction and installation position, and select the model and size of linear guide most suitable to the condition requirements.	
Decision of accuracy grade	• Decide by the required running accuracy of the machine.	A32 Description of the accuracy
Tentative determination of the series and model number Decide the arrangement and quantity of ball slides	• Select a model based on the installation space. • Select a model temporarily based on the mutual balance between the machine, its ancillaries and the size of ball screws, making use of your experience and actual results.	A15 Description of the rated life A111 Technical descriotion and dimension table for NSK Linear Guides
Calculate a load for linear guides.	• Calculate loads in the direction of up/down and right/left, and moment loads of the linear guide. • Consider loads caused by acceleration/deceleration and the fluctuation of load.	A15 Description of the rated life
Calculation of the static allowable load	• Calculate the static allowable load, and confirm that the total static load is within the permissible range. • Confirm the strength of fastening parts of linear guides such as bolts and their material.	A16 Description of the static load rating
Rated life	• Estimate the life and confirm it is within the scope of the use conditions.	A15 Description of the rated life
Decision of preload	• Select a preload and clearance most suitable to the requirements.	A28 Description of the preload
Consideration of lubrication, dust protection and surface treatment	• Select lubricant, grease or oil, and the lubrication method according to the use conditions. • Select suitable dust protection means (seals, bellows or surface treatment) for the use environment.	A38 Description of lubrication A52 Description of dust protection
Consideration of mounting linear guides	• Decision of an installation position, the shoulder height and corner radius R of mounting surface of a machine base • Confirm installation procedures.	A67 Description of arrangement and mounting CAT.No.E9008 Description of the mounting of linear guides

A-3-2 Rating Life and Basic Load Rating

A-3-2.1 Life and Basic Load Rating

1. Life

Although used in appropriate conditions, the linear guide deteriorates after a certain period of operation, and eventually becomes unusable. In broad definition, the period until the linear guide becomes unusable is called "life." There are "fatigue life " caused by flaking, and "accuracy life" which the result of wear components.

2. Rating fatigue life

When the linear guide runs under loads, the rolling elements and the rolling contact surface of the grooves are exposed to repetitive stress. This brings about fatigue to the material, and generates flaking. Flaking is scale-like damage to the surface of the rolling contact surface.

Total running distance until first appearance of flaking is called "fatigue life." This is "life" in the narrow sense. The fatigue life varies significantly even in linear guides produced in the same lot, and even when they are operated under the same conditions. This is attributable to the inherent variation of the fatigue of the material itself.

"Rating fatigue life" is the total running distance which allows 90% of the group of linear guides of the same reference number to run without causing flaking when they are independently run under the same conditions. The rating fatigue life is sometimes indicated by total operating hours when the linear guides run at a certain speed.

3. Basic load ratings in compliance with ISO standard

NSK defines the basic load rating in compliance with the ISO standard.

The basic load rating listed in "**A-5 Technical Description and Dimension Table for NSK Linear Guides.**" comply with the ISO standard.

ISO: International Organization for Standardization

[Basic dynamic load rating]

ISO 14728-1; Rolling bearings — Linear motion rolling bearings

Part 1: Dynamic load ratings and rating life

[Basic static load rating]

ISO 14728-2; Rolling bearings — Linear motion rolling bearings

Part 2: Static load ratings

4. Basic dynamic load rating

- ISO international standard, the basic dynamic load rating, which indicates load carrying capacity of the linear guide, is a load whose direction and volume do not change, and which furnishes 100 km of rating fatigue life.
- In case of the linear guides, it is a constant load applied to downward direction to the center of the slide.
- For balls as rolling element, some linear guide manufacturers in Japan and Asian countries define the load for the basic fatigue life of 50 km as the basic dynamic load ratings.

- The following formula may be used to convert the basic dynamic load rating for 50 km (C_{50}) into the dynamic load rating for 100 km (C_{100}) rated fatigue life.

- For balls as rolling element $$C_{100}=\frac{C_{50}}{1.26}$$
- For rollers as rolling element $$C_{100}=\frac{C_{50}}{1.23}$$

5. Calculation of rating fatigue life

- In general, the rating fatigue life "L" can be calculated from the basic dynamic load rating "C" and the load "F" to a slide using the following formula.

[For balls as rolling element] The third power of the index.

For the basic dynamic load rating for 100 km

$$L=100\times\left(\frac{C_{100}}{F}\right)^{3}$$

For the basic dynamic load rating for 50 km

$$L=50\times\left(\frac{C_{50}}{F}\right)^{3}$$

[For rollers as rolling element] The ten third power of the index.

For the basic dynamic load rating for 100 km

$$L=100\times\left(\frac{C_{100}}{F}\right)^{\frac{10}{3}}$$

For the basic dynamic load rating for 50 km

$$L=50\times\left(\frac{C_{50}}{F}\right)^{\frac{10}{3}}$$

L ; Rating fatigue life (km)

C_{100} ; Basic dynamic load rating for 100 km rated fatigue life (N)

C_{50} ; Basic dynamic load rating for 50 km rated fatigue life (N)

F ; Load to a slide (dynamic equivalent load) (N)

6. Dynamic equivalent load

- Loads applied to the linear guide (slide load) comes from various directions up/down and right/left directions and/or as moment loads. Sometimes more than one type of load is applied simultaneously. Sometimes the volume and direction of the load may change.

Various loads cannot be used as they are to calculate the life of the linear guide. Therefore, it is necessary to use a hypothetical load on the slide with a constant volume, which would generate a value equivalent to an actual fatigue life. This is called "dynamic equivalent load." For actual calculation, refer to "**A-3-2.2 3. Calculation of dynamic equivalent load**"

7. Basic static load rating

- When an excessive load or a momentary large impact is applied to the linear guide, local permanent deformation takes place on the rolling elements and on the rolling contact surfaces. After exceeding a certain level, the deformation hampers smooth linear guide operation.
- Basic static load rating is a static load when: [Permanent deformation of the rolling elements] + [permanent deformation of the rolling contact surfaces] becomes approximately 0.0001 times of the rolling element diameter.
- In the case of the linear guides, it is a load which is applied in downward direction to the center of the slide.
- Values of the basic static load rating C_0 are shown in "**A-5 Technical Description and Dimension Table for NSK Linear Guides.**"

8. Basic static moment load rating

- Generally, NSK linear guides use a set of two rails and four slides for the guide way of one axis. Under some operating condition, static moment load should be taken into account.

"M_0," which is the limit of static moment load , and calculated from permanent deformation in such use is shown in "**A-5 Technical Description and Dimension Table for NSK Linear Guides.**"

9. Basic load rating by load direction

- The basic load rating is considered to be a downward load to the slide and is indicated in the dimension tables as the dynamic load rating C and the static load rating C_0 respectively. However, the load may be applied to a slide in upward or lateral directions in actual use. In such a case the basic load rating shall be compensated as shown in **Table 2.1**. The basic dynamic load rating of the RA and LA Series is the same in C and C_0 for all load directions, up, down and lateral, while the NH Series, for an example, has different basic load ratings by the load direction as shown in the table.

Table 2.1 Basic load ratings by load direction

Series \ Load rating / Load direction	Basic dynamic load rating			Basic static load rating		
	Downward	Upward	Lateral	Downward	Upward	Lateral
NH,VH,NS, LW,LH,HS	C	C	$0.84C$	C_0	$0.78C_0$	$0.65C_0$
TS,PU,LU,PE,LE, LL,RA,LA,HA	C	C	C	C_0	C_0	C_0

A-3-2.2 How to Calculate the Life

1. Setting operating condition of linear guide

- First, set operating conditions to determine whether the temporarily selected model satisfies the required life.
- Major operating conditions are as follows. Set all values to calculate applied loads to each slide. (Refer to **Table 2.2**.)

Axis set up	: Horizontal or vertical
Rail combination	: Single rail or multiple rail
Applying loads	: F_x, F_y and F_z (N)
Slide span	: l (mm)
Rail span	: L (mm)
Position of load action point	: X, Y, Z (mm)
Center of driving mechanism	: X_b, Y_b, Z_b (mm)
Operating speed	: V (mm/sec)
Time in acceleration	: t (sec)
Operating frequency (duty cycle)	

2. Calculating load to a slide

- **Table 2.2** shows a formula to calculate loads that are going to be applied to each assembled slide into a machine.
  The Table shows six typical patterns of linear guide installing structure.
- In the Tables, directions indicated by arrows denote "plus" for the applied loads (F_x, F_y, F_z) and the loads which are applied to the slides. (F_r, F_s, M_r, M_p, M_y)
- Codes in the Tables are as follows:

F_r : Vertical loads to the slide (N)
F_s : Lateral loads to the slide (N)
M_r : Rolling moment to the slide (N · mm)
M_p : Pitching moment to the slide (N · mm)
M_y : Yawing moment to the slide (N · mm)
Suffixes (1, 2, ...) to the above F_r – M_y : Slide number
F_{xi} : Load applied in X direction (i = 1 to n; n is the number of loads applied in X direction) (N)
F_{yj} : Load applied in Y direction (j = 1 to n; n is the number of loads applied in Y direction) (N)
F_{zk} : Load applied in Z direction (k = 1 to n; n is the number of loads applied in Z direction) (N)
Coordinates (X_{xi}, Y_{xi}, Z_{xi}): Point where load F_{xi} (mm) is applied.
Coordinates (X_{yj}, Y_{yj}, Z_{yj}): Point where load F_{yj} (mm) is applied.
Coordinates (X_{zk}, Y_{zk}, Z_{zk}): Point where load F_{zk} (mm) is applied.
l: Slide span (mm)
L: Rail span (mm)
Coordinates (X_b, Y_b, Z_b): Center of driving mechanism

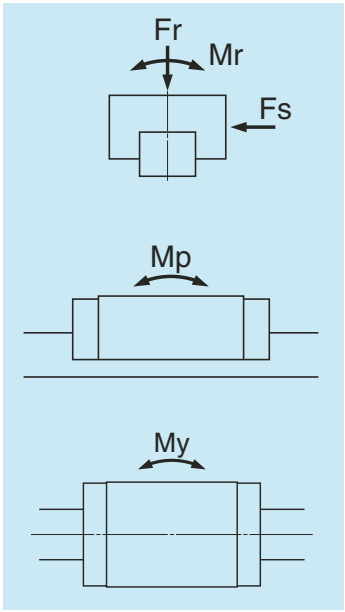
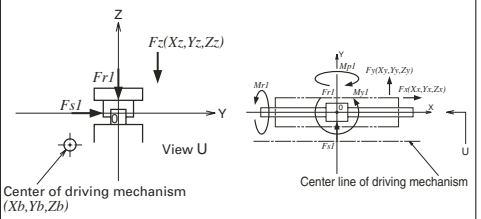
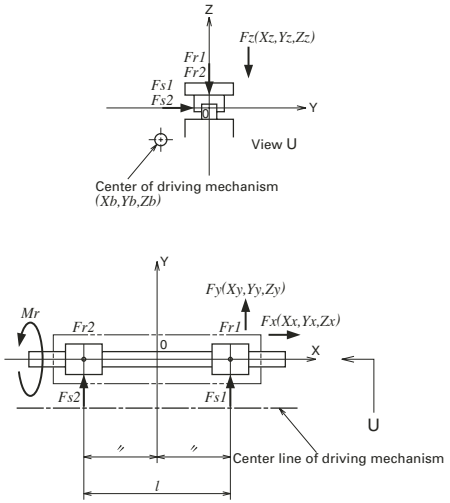
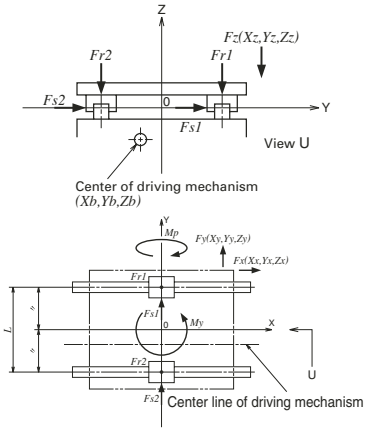
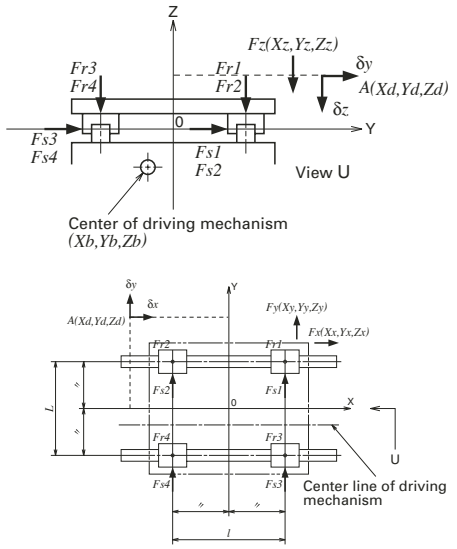
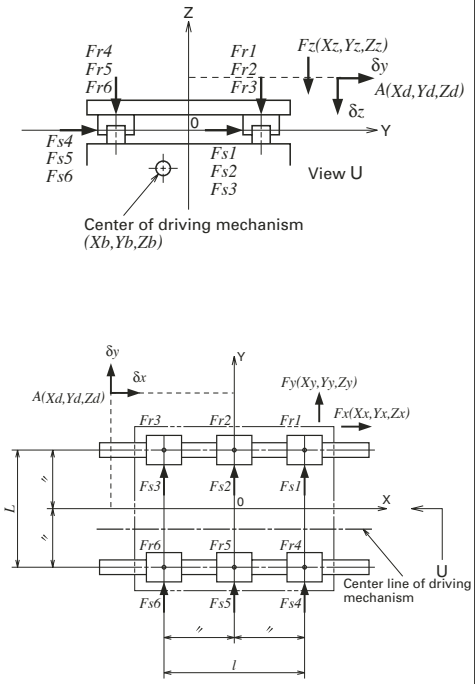
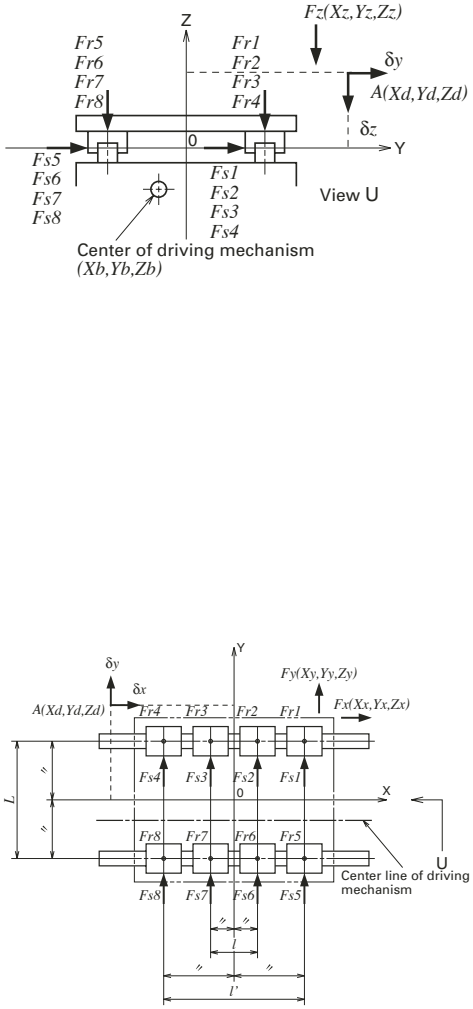


Fig. 2.1

Table 2.2 Loads applied to the slides

Pattern	Arrangement of slides	Load to slide and deformation at Point A
1		$Fr_1=\sum_{k=1}^{n}Fz_k \quad , \quad Fs_1=\sum_{j=1}^{n}Fy_j$ $Mr_1=\sum_{j=1}^{n}(Fyj\cdot Zyj)+\sum_{k=1}^{n}(Fzk\cdot Yzk)$ $Mp_1=\sum_{i=1}^{n}\{Fxi\cdot(Zxi-Zb)\}+\sum_{k=1}^{n}(Fzk\cdot Xzk)$ $My_1=-\sum_{i=1}^{n}\{Fxi\cdot(Yxi-Yb)\}+\sum_{j=1}^{n}(Fyj\cdot Xyj)$
2		$Fr_1=\frac{\sum_{k=1}^{n}Fz_k}{2}+\frac{M2}{l} \quad , \quad Fr_2=\frac{\sum_{k=1}^{n}Fz_k}{2}-\frac{M2}{l}$ $Fs_1=\frac{\sum_{j=1}^{n}Fy_j}{2}+\frac{M3}{l} \quad , \quad Fs_2=\frac{\sum_{j=1}^{n}Fy_j}{2}-\frac{M3}{l}$ $Mr_1=\frac{M1}{2} \quad , \quad Mr_2=\frac{M1}{2}$ $M1=\sum_{j=1}^{n}(Fy_j\cdot Zy_j)+\sum_{k=1}^{n}(Fz_k\cdot Yz_k)$ $M2=\sum_{i=1}^{n}\{Fx_i\cdot(Zx_i-Zb)\}+\sum_{k=1}^{n}(Fz_k\cdot Xz_k)$ $M3=-\sum_{i=1}^{n}\{Fx_i\cdot(Yx_i-Yb)\}+\sum_{j=1}^{n}(Fyj\cdot Xyj)$
3		$Fr_1=\frac{\sum_{k=1}^{n}Fz_k}{2}+\frac{M1}{L} \quad , \quad Fr_2=\frac{\sum_{k=1}^{n}Fz_k}{2}-\frac{M1}{L}$ $Fs_1=Fs_2=\frac{\sum_{j=1}^{n}Fy_j}{2}$ $Mp_1=Mp_2=\frac{M2}{2} \quad , \quad My_1=My_2=\frac{M3}{2}$ $M1=\sum_{j=1}^{n}(Fy_j\cdot Zy_j)+\sum_{k=1}^{n}(Fz_k\cdot Yz_k)$ $M2=\sum_{i=1}^{n}\{Fx_i\cdot(Zx_i-Zb)\}+\sum_{k=1}^{n}(Fz_k\cdot Xz_k)$ $M3=-\sum_{i=1}^{n}\{Fx_i\cdot(Yx_i-Yb)\}+\sum_{j=1}^{n}(Fy_j\cdot Xy_j)$

Pattern	Arrangement of slides	Load to slide and deformation at Point A
4		$Fr_1=\frac{\sum_{k=1}^{n}Fz_k}{4}+\frac{M1}{2L}+\frac{M2}{2l}$, $Fr_2=\frac{\sum_{k=1}^{n}Fz_k}{4}+\frac{M1}{2L}-\frac{M2}{2l}$ $Fr_3=\frac{\sum_{k=1}^{n}Fz_k}{4}-\frac{M1}{2L}+\frac{M2}{2l}$, $Fr_4=\frac{\sum_{k=1}^{n}Fz_k}{4}-\frac{M1}{2L}-\frac{M2}{2l}$ $Fs_1=Fs_3=\frac{\sum_{j=1}^{n}Fy_j}{4}+\frac{M3}{2l}$, $Fs_2=Fs_4=\frac{\sum_{j=1}^{n}Fy_j}{4}-\frac{M3}{2l}$ $M1=\sum_{j=1}^{n}(Fy_j\cdot Zy_j)+\sum_{k=1}^{n}(Fz_k\cdot Yz_k)$ $M2=\sum_{i=1}^{n}\{Fx_i(Zx_i-Zb)\}+\sum_{k=1}^{n}(Fz_k\cdot Xz_k)$ $M3=-\sum_{i=1}^{n}\{Fx_i(Yx_i-Yb)\}+\sum_{j=1}^{n}(Fy_j\cdot Xy_j)$ $\delta x=Y_d\cdot\frac{Fs_2-Fs_1}{l\cdot Ks}+Z_d\cdot\frac{Fr_1-Fr_2}{l\cdot Kr}$ $\delta y=\frac{\sum_{j=1}^{n}Fy_j}{4\cdot Ks}+X_d\cdot\frac{Fs_1-Fs_2}{l\cdot Ks}+Z_d\cdot\frac{Fr_1-Fr_3}{L\cdot Kr}$ $\delta z=\frac{\sum_{k=1}^{n}Fz_k}{4\cdot Kr}+X_d\cdot\frac{Fr_1-Fr_2}{l\cdot Kr}+Y_d\cdot\frac{Fr_1-Fr_3}{L\cdot Kr}$
5		$Fr_1=\frac{\sum_{k=1}^{n}Fz_k}{6}+\frac{M1}{3L}+\frac{M2}{2l}$, $Fr_2=\frac{\sum_{k=1}^{n}Fz_k}{6}+\frac{M1}{3L}$ $Fr_3=\frac{\sum_{k=1}^{n}Fz_k}{6}+\frac{M1}{3L}-\frac{M2}{2l}$, $Fr_4=\frac{\sum_{k=1}^{n}Fz_k}{6}-\frac{M1}{3L}+\frac{M2}{2l}$ $Fr_5=\frac{\sum_{k=1}^{n}Fz_k}{6}-\frac{M1}{3L}$, $Fr_6=\frac{\sum_{k=1}^{n}Fz_k}{6}-\frac{M1}{3L}-\frac{M2}{2l}$ $Fs_1=Fs_4=\frac{\sum_{j=1}^{n}Fy_j}{6}+\frac{M3}{2l}$, $Fs_2=Fs_5=\frac{\sum_{j=1}^{n}Fy_j}{6}$ $Fs_3=Fs_6=\frac{\sum_{j=1}^{n}Fy_j}{6}-\frac{M3}{2l}$ $M1=\sum_{j=1}^{n}(Fy_j\cdot Zy_j)+\sum_{k=1}^{n}(Fz_k\cdot Yz_k)$ $M2=\sum_{i=1}^{n}\{Fx_i\cdot(Zx_i-Zb)\}+\sum_{k=1}^{n}(Fz_k\cdot Xz_k)$ $M3=-\sum_{i=1}^{n}\{Fx_i\cdot(Yx_i-Yb)\}+\sum_{j=1}^{n}(Fy_j\cdot Xy_j)$ $\delta x=Y_d\cdot\frac{Fs_3-Fs_1}{l\cdot Ks}+Z_d\cdot\frac{Fr_1-Fr_3}{l\cdot Kr}$ $\delta y=\frac{\sum_{j=1}^{n}Fy_j}{6\cdot Ks}+X_d\cdot\frac{Fs_1-Fs_3}{l\cdot Ks}+Z_d\cdot\frac{Fr_1-Fr_4}{L\cdot Kr}$ $\delta z=\frac{\sum_{k=1}^{n}Fz_k}{6\cdot Kr}+X_d\cdot\frac{Fr_1-Fr_3}{l\cdot Kr}+Y_d\cdot\frac{Fr_1-Fr_4}{L\cdot Kr}$

Pattern	Arrangement of slides	Load to slide and deformation at Point A
6		$Fr_1=\frac{\sum_{k=1}^{n}Fz_k}{8}+\frac{M1}{4L}+\frac{M2\cdot l'}{2\cdot(l^2+l'^2)}$ $Fr_2=\frac{\sum_{k=1}^{n}Fz_k}{8}+\frac{M1}{4L}+\frac{M2\cdot l}{2\cdot(l^2+l'^2)}$ $Fr_3=\frac{\sum_{k=1}^{n}Fz_k}{8}+\frac{M1}{4L}-\frac{M2\cdot l}{2\cdot(l^2+l'^2)}$ $Fr_4=\frac{\sum_{k=1}^{n}Fz_k}{8}+\frac{M1}{4L}-\frac{M2\cdot l'}{2\cdot(l^2+l'^2)}$ $Fr_5=\frac{\sum_{k=1}^{n}Fz_k}{8}-\frac{M1}{4L}+\frac{M2\cdot l'}{2\cdot(l^2+l'^2)}$ $Fr_6=\frac{\sum_{k=1}^{n}Fz_k}{8}-\frac{M1}{4L}+\frac{M2\cdot l}{2\cdot(l^2+l'^2)}$ $Fr_7=\frac{\sum_{k=1}^{n}Fz_k}{8}-\frac{M1}{4L}-\frac{M2\cdot l}{2\cdot(l^2+l'^2)}$ $Fr_8=\frac{\sum_{k=1}^{n}Fz_k}{8}-\frac{M1}{4L}-\frac{M2\cdot l'}{2\cdot(l^2+l'^2)}$ $Fs_1=Fs_5=\frac{\sum_{j=1}^{n}Fyj}{8}+\frac{M3\cdot l'}{2\cdot(l^2+l'^2)}$ $Fs_2=Fs_6=\frac{\sum_{j=1}^{n}Fy_j}{8}+\frac{M3\cdot l}{2\cdot(l^2+l'^2)}$ $Fs_3=Fs_7=\frac{\sum_{j=1}^{n}Fy_j}{8}-\frac{M3\cdot l}{2\cdot(l^2+l'^2)}$ $Fs_4=Fs_8=\frac{\sum_{j=1}^{n}Fy_j}{8}-\frac{M3\cdot l'}{2\cdot(l^2+l'^2)}$ $M1=\sum_{j=1}^{n}(Fy_j\cdot Zy_j)+\sum_{k=1}^{n}(Fz_k\cdot Yz_k)$ $M2=\sum_{i=1}^{n}\{Fx_i\cdot(Zx_i-Zb)\}+\sum_{k=1}^{n}(Fz_k\cdot Xz_k)$ $M3=-\sum_{i=1}^{n}\{Fx_i\cdot(Yx_i-Yb)\}+\sum_{j=1}^{n}(Fy_j\cdot Xy_j)$ $\delta x=Y_d\cdot\frac{Fs_4-Fs_1}{l_2\cdot Ks}+Z_d\cdot\frac{Fr_1-Fr_4}{l_2\cdot Kr}$ $\delta y=\frac{\sum_{j=1}^{n}Fy_j}{8\cdot Ks}+X_d\cdot\frac{Fs_1-Fs_4}{l_2\cdot Ks}+Z_d\cdot\frac{Fr_1-Fr_5}{L\cdot Kr}$ $\delta z=\frac{\sum_{k=1}^{n}Fz_k}{8\cdot Kr}+X_d\cdot\frac{Fr_1-Fr_4}{l_2\cdot Kr}+Y_d\cdot\frac{Fr_1-Fr_5}{L\cdot Kr}$

3. Calculation of dynamic equivalent load

• For the calculation of dynamic equivalent load, use the load in **Table 2.3** which matches the intended use of the linear guide.

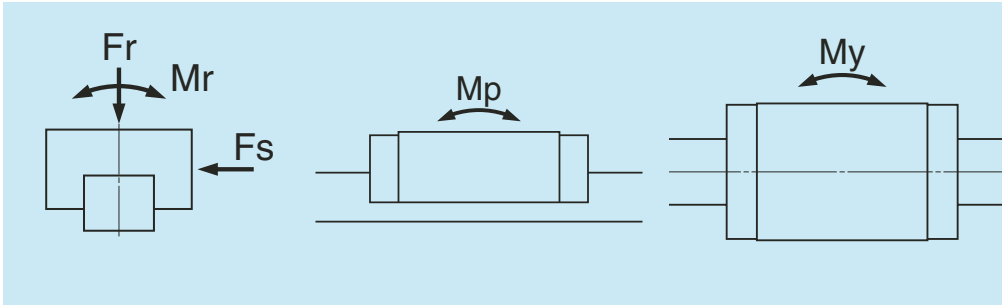
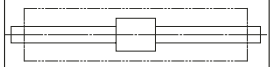
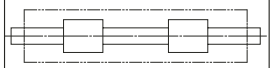
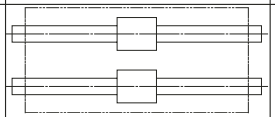
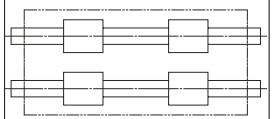


Fig. 2.2

Table 2.3 Loads in the arrangement of linear guides

Pattern	Arrangement of linear guide	Loads necessary to calculate dynamic equivalent load					Dynamic equivalent load
		Load		Moment load			
		Up/down (vertical)	Right/left (lateral)	Rolling	Pitching	Yawing	
1		F_r	F_s	M_r	M_p	M_y	$F_r = F_r$ $F_{se} = F_s \cdot \tan\alpha$ $F_{re} = \varepsilon_r \cdot M_r$ $F_{pe} = \varepsilon_p \cdot M_p$ $F_{ye} = \varepsilon_y \cdot M_y$ α : Contact angle NH, VH, NS, LW, LH, HS Series $\alpha = 50°$ TS, PU, LU, PE, LE, RA, LA, HA Series $\alpha = 45°$
2		F_r	F_s	M_r			
3		F_r	F_s		M_p	M_y	
4		F_r	F_s				

• Use the dynamic equivalent coefficient ε in the table below for an easy conversion of moment loads to the dynamic equivalent load.

• The coefficient of each moment direction is as follows.
ε_r: Rolling direction
ε_p: Pitching direction
ε_y: Yawing direction

Table 2.4 Dynamic equivalent coefficients

Unit: 1/m

Model No.	ε_r	ε_p	ε_y	Model No.	ε_r	ε_p	ε_y	Model No.	ε_r	ε_p	ε_y
NH15	188	111	132	NS35S	76	87	104	LE15L	50	68	68
NH15L	188	72	86								
NH20	142	81	97	LW17	66	125	149	LH08	316	269	321
NH20L	142	57	68	LW21	59	108	129	LH10	253	203	242
NH25	123	68	81	LW27	53	76	91	LH12	223	136	162
NH25L	123	51	61	LW35	32	51	61				
NH30A	98	70	83	LW50	25	38	46	RA15	105	95	95
NH30EF	98	58	69					RA15L	105	70	70
NH30L	98	44	52	PU05	377	431	431	RA20	79	74	74
NH35	78	51	61	PU07	267	349	349	RA20L	79	55	55
NH35L	78	36	43	PU09	215	222	222	RA25	71	64	64
NH45	60	38	45	PU09L	215	136	136	RA25L	71	50	50
NH45L	60	30	36	PU12	163	204	204	RA30	56	58	58
NH55	51	31	37	PU12L	163	125	125	RA30L	56	44	44
NH55L	51	25	30	PU15	133	174	174	RA35	46	52	52
NH65	43	27	32	PU15L	133	102	102	RA35L	46	39	39
NH65L	43	20	24					RA45	37	40	40
				LU05	385	359	359	RA45L	37	30	30
VH15	188	111	132	LU07	286	305	305	RA55	32	33	33
VH15L	188	72	86	LU09	217	242	242	RA55L	32	24	24
VH20	142	81	97	LU09L	217	138	138	RA65	26	28	28
VH20L	142	57	68	LU09R	217	203	203	RA65L	26	19	19
VH25	123	68	81	LU12	167	204	204				
VH25L	123	51	61	LU12L	167	116	116	LA25	122	76	76
VH30A	98	70	83	LU15	133	174	174	LA25L	122	47	47
VH30EF	98	58	69	LU15L	133	94	94	LA30	105	63	63
VH30L	98	44	52					LA30L	105	43	43
VH35	78	51	61	PE05	194	277	277	LA35	84	54	54
VH35L	78	36	43	PE07	141	203	203	LA35L	84	37	37
VH45	60	38	45	PE09	123	161	161	LA45	60	41	41
VH45L	60	30	36	PE09L	123	108	108	LA45L	60	31	31
VH55	51	31	37	PE12	90	136	136	LA55	51	33	33
VH55L	51	25	30	PE12L	90	90	90	LA55L	51	26	26
				PE15	50	111	111	LA65	43	29	29
TS15	128	122	122	PE15L	50	72	72	LA65L	43	20	20
TS20	97	90	90								
TS25	81	77	77	LE05	196	248	248	HA25	122	33	33
TS30	67	61	61	LE05S	196	323	323	HA30	105	27	27
TS35	55	54	54	LE07	141	188	188	HA35	84	23	23
				LE07S	141	349	349	HA45	60	20	20
NS15	177	116	138	LE07L	141	122	122	HA55	51	16	16
NS15S	177	174	208	LE09	123	149	149				
NS20	127	94	112	LE09S	123	277	277	HS15	177	45	54
NS20S	127	136	162	LE09L	123	102	102	HS20	127	39	47
NS25	111	70	83	LE12	90	125	125	HS25	111	33	39
NS25S	111	108	129	LE12S	90	233	233	HS30	94	27	32
NS30	94	63	75	LE12L	90	86	86	HS35	76	23	28
NS30S	94	102	121	LE15	50	102	102				
NS35	76	54	64	LE15S	50	174	174				

Definitions of codes appearing at the end of the model number in **Table 2.4**:

L	: Super-high-load type	; NH45L
S	: Medium load type	; NS25S
No code	: High-load type	; NH45__
A	: Ball slide shape is square	; NH30A (only NH30 and VH30)
EF	: Ball slide shape is flanged type (EL, FL type)	; NH30EF (only NH30 and VH30)
R	: Miniature Series with ball retainer	; LU09R (only LU and LE)

- The formula is determined by the relationship of loads in terms of volume. A full dynamic equivalent load can be easily obtained by using each coefficient.
  After obtaining the dynamic equivalent load of the necessary load directions from **Table 2.4**, use the formulas below to calculate full dynamic equivalent loads.

  - When ***Fr*** is the largest load : ***Fe* = *Fr* + 0.5*Fse* + 0.5*Fre* + 0.5*Fpe* + 0.5*Fye***
  - When ***Fse*** is the largest load : ***Fe* = 0.5*Fr* + *Fse* + 0.5*Fre* + 0.5*Fpe* + 0.5*Fye***
  - When ***Fre*** is the largest load : ***Fe* = 0.5*Fr* + 0.5*Fse* + *Fre* + 0.5*Fpe* + 0.5*Fye***
  - When ***Fpe*** is the largest load : ***Fe* = 0.5*Fr* + 0.5*Fse* + 0.5*Fre* + *Fpe* + 0.5*Fye***
  - When ***Fye*** is the largest load : ***Fe* = 0.5*Fr* + 0.5*Fse* + 0.5*Fre* + 0.5*Fpe* + *Fye***

  For the values of each dynamic equivalent load in the formulas above, disregard load directions and take the absolute value.

- It is necessary to include the amount of preload for the calculation of rating life when selecting "Z3 medium preload" or "Z4 heavy preload" as a preload. For the calculation of full dynamic equivalent loads that consider preload, see "**A-3-3 6**" on page A31.

4. Calculation of mean effective load

When the load to the slide deviates, obtain a mean effective load which becomes equal to the life of slide under variable load conditions. If the load does not vary, use the dynamic equivalent load as it is.

(1) When load and running distance vary stepwise (Fig. 2.3)

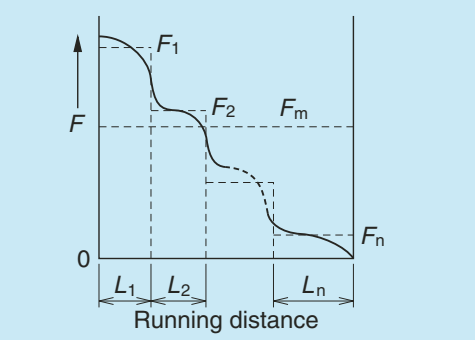


Fig. 2.3 Stepwise load change

Running distance while dynamic equivalent load F_1 is applied: L_1
Running distance while dynamic equivalent load F_2 is applied: L_2
Running distance while dynamic equivalent load F_3 is applied: L_3
• • • • • • • • • • • • • • • • • • •
Running distance while dynamic equivalent load F_n is applied: L_n

From the above, mean effective load *F*m can be obtained by the following formula.

In case of ball

$$Fm = \sqrt[3]{\frac{1}{L}(F_1^3 L_1 + F_2^3 L_2 + \cdots\cdots + F_n^3 L_n)}$$

In case of roller

$$Fm = \sqrt[\frac{10}{3}]{\frac{1}{L}(F_1^{\frac{10}{3}} L_1 + F_2^{\frac{10}{3}} L_2 + \cdots\cdots + F_n^{\frac{10}{3}} L_n)}$$

*F*m : Mean effective load of the deviating load (N)
L : Running distance (ΣLn)

(2) When load changes almost linearly (Fig. 2.4)

Approximate mean effective load *F*m can be obtained by the following formula.

$$Fm \fallingdotseq \frac{1}{3}(Fmin + 2Fmax)$$

*F*min : Minimum value of dynamic equivalent load (N)
*F*max : Maximum value of dynamic equivalent load (N)

(3) When load changes in sinusoidol pattern (Fig. 2.5)

At time of (a): *F*m = 0.65 *F*max
At time of (b): *F*m = 0.75 *F*max

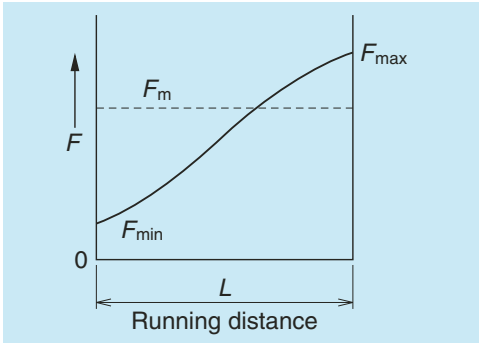


Fig. 2.4 Linear load change

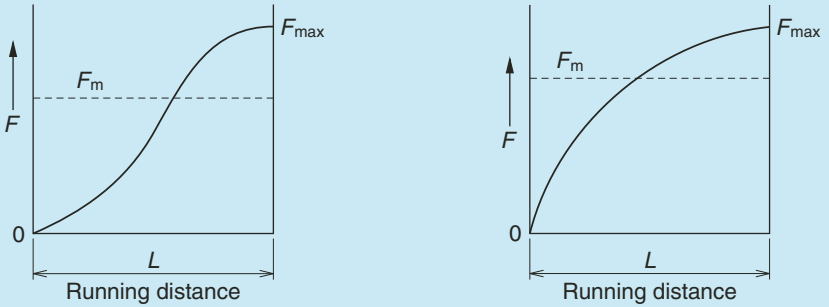


Fig. 2.5 Load that changes in sinusoidal pattern

5. Various coefficients

(1) Load factors

- Although a load applied to the slide can be calculated, the actual load becomes larger than the calculated value due to the machine's vibration and impact.
- Therefore, calculation of load on the slide should take into consideration the load factors in **Table 2.5**.

Table 2.5 Load factor fw

Impact/Vibration	Load factor
No external impact/ vibration	1.0 – 1.5
There is impact/ vibration from outside.	1.5 – 2.0
There is significant impact/vibration.	2.0 – 3.0

(2) Hardness coefficient

- For linear guides, in order to function optimally, both the rolling elements and the rolling contact surface must have a hardness of HRC58 to 62 to an appropriate depth.
- The hardness of NSK linear guide fully satisfies HRC58 to 62. Therefore, in most cases it is not necessary to consider hardness. If the linear guide is made of a special material by a customer's request, as the material hardness is lower than HRC58, use the following formula for adjustment.

$C_H = f_H \cdot C$

$C_{OH} = f_H' \cdot C_o$

C_H : Basic dynamic load rating adjusted by hardness coefficient

f_H : Hardness coefficient (Refer to **Fig. 2.6**)

C_{OH} : Basic static load rating adjusted by hardness coefficient

f_H' : Static hardness coefficient (Refer to **Fig. 2.6**)

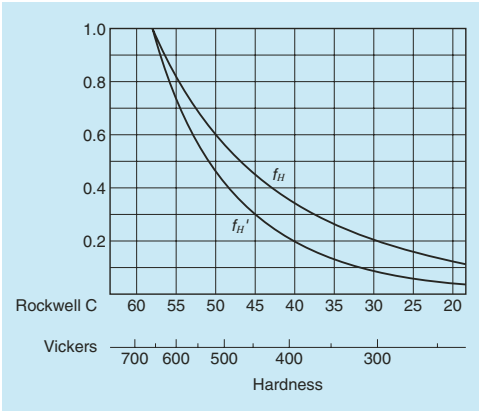


Fig. 2.6 Hardness coefficient

(3) Reliability coefficient

- In general, a reliability of 90% is customary. In this case, reliability coefficient is 1. Therefore, the reliability coefficient does not have to be included in calculation.

6. Calculation of rating life

(1) Life Calculating Formula

The life calculating formula in the stroke movement with normal lubrication, the following relationships exist between the slide mean effective load F_m (N), the basic dynamic load rating to load application direction C (N), and the rating fatigue life L (km).

[For balls as rolling element]

For the basic dynamic load rating for 100 km

$$L = 100 \times \left(\frac{f_H \cdot C_{100}}{f_w \cdot F_m} \right)^3$$

For the basic dynamic load rating for 50 km

$$L = 50 \times \left(\frac{f_H \cdot C_{50}}{f_w \cdot F_m} \right)^3$$

[For rollers as rolling element]

For the basic dynamic load rating for 100 km

$$L = 100 \times \left(\frac{f_H \cdot C_{100}}{f_w \cdot F_m} \right)^{\frac{10}{3}}$$

For the basic dynamic load rating for 50 km

$$L = 50 \times \left(\frac{f_H \cdot C_{50}}{f_w \cdot F_m} \right)^{\frac{10}{3}}$$

L : Rating fatigue life (km)

C_{100} : Basic dynamic load rating for 100 km rated fatigue life (N)

C_{50} : Basic dynamic load rating for 50 km rated fatigue life (N)

f_H : Hardness coefficient

f_W : Load coefficient

F_m : Average load (N)

Note: Do not use the basic static load rating C_0 and the basic static moment rating M_{R0}, M_{P0} or M_{Y0} for a calculation of the life.

(2) Life as an entire guide way system

In those cases when several slides comprise a single guide way system (such as a single-axis table), the life of the slide to which the most strenuous condition is applied is considered to be the life of the entire system.

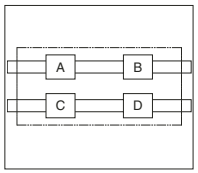


Fig. 2.7 Life of a system

For example, in **Fig. 2.7**, if "slide A" is the slide which receives the largest mean effective load, or if "slide A" is the one which has the shortest life, the life of the system is considered to be the life of "slide A."

7. Examination of the basic static load rating

(1) Examine from the basic static load rating

- Examine the static equivalent load P_0, which is applied to the slide, from the basic static load rating C_0 and the static permissible load factor fs.

$$fs = \frac{C_0}{P_0}$$

When the static equivalent load P_0 is a combination of vertical loads Fr and lateral load Fs, calculate it using formulas below.

For NH, VH, NS, LW, LH and HS Series:

If compressed load and lateral load are combined

$$P_0 = Fr + 1.54Fs$$

If tensile load and lateral load are combined

$$P_0 = 1.28Fr + 1.54Fs$$

For TS, PU, LU, PE, LE, LL, RA, LA and HA Series:

$$P_0 = Fr + Fs$$

- The table below shows guidelines of fs for general industrial use.

Table 2.6

Use conditions	fs
Under normal operating conditions	1 – 2
Operating under vibration/impact	1.5 – 3

- Basic static load rating is not a destructive force to the balls, rollers, rails, or slides. The balls can withstand a load more than seven times larger than the basic static load rating . It is sufficient as a safety factor to the destruction load designed for general machines.
- However, when a heavy load applied to the rail and slide in tension direction, the strength of the bolts which secures the rail and the ball slide affects the strength of the entire system. Strength of the bolt and its material should be considered.

(2) Examining from static moment load rating

- Also examine the static permissible moment load M_0 from the basic static moment load M_{p0} and the static permissible load factor fs.

$$fs = \frac{M_{p0}}{M_0}$$

If more than one moment load in any direction is combined, please consult NSK.

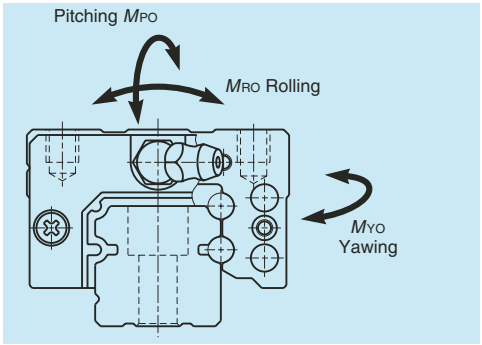


Fig. 2.8 Moment load directions

8. Precautions for the design in examining the life

The following points must be heeded in examining the life.

In case of oscillating motion

- If the rolling elements do not rotate all the way, but only halfway, and if this minute stroke is repeated, lubricant disappears from the contact surface of rolling elements and raceways. This generates "fretting," a premature wear. Fretting cannot be entirely prevented, but it can be mitigated.
- A grease which prevents fretting is recommended for oscillating stroke operations. When a standard grease is used, the life can be markedly prolonged by adding a normal stroke travel (about the slide length) once every several thousand cycles.

When applying pitching or yawing moment

- The load applied to the rolling element rows inside the slide is inconsistent if a pitching or yawing moment load is applied. Loads are heavy on the rolling elements on each end of the row.
- In such case, a heavy load lubricant grease or oil are recommended. Another countermeasure is using one size larger model of linear guide to reduce the load per rolling element.
- The moment load to a ball slide is insignificant for 2-rail, 4-slide combination which is commonly used.

When an extraordinary high load is applied during stroke

- If an extraordinary large load is applied at certain position of the stroke, calculate not only the life based on the mean effective load, but also the life based on the load in this range.
- When an extraordinary heavy load is applied and thus the application of high tensile stress to fixing bolts of the rails and slides is foreseen, the strength of the bolts should be considered.

When the calculated life is extraordinarily short (Less than 3 000 km in calculated life)

- In such case, the contact pressure to the rolling elements and the rolling contact surface is extraordinarily high.
- If the linear guides are operated under such state continually, the life is significantly affected by the loss of lubrication and the presence of dust, and thus the actual life becomes shorter than calculated.
- It is necessary to reconsider the arrangement of linear guides, the number of slide, and the type of model in order to reduce the load to the slides.
- It is necessary to consider preload for calculation of rating life when selecting Z3 (medium preload) or Z4 (heavy preload) as a preload. For the calculation of full dynamic equivalent loads that consider preload, see "**A-3-3 6**" on page A31.

Application at high speed

- The standard maximum allowable speed of a linear guide under normal conditions is 100 m/min. However, the maximum allowable speed can be affected by accuracy of installation, operating temperature, external loading etc.
- The end cap with high speed specification must be used when the operating speed exceeds the permissible speed. In such a case, please consult NSK.

A-3-3 Preload

1. Objective of preload

- An elimination of clearance between the raceways and rolling elements vanishes the mechanical play of the linear guide system.
- When a preload is applied, the deformation of linear guides by external vertical load is further improved thus increasing the system stiffness.
- Preloading method
  The preload is applied by inserting rolling elements slightly bigger than the space of two raceways as shown in **Fig. 3.1**.

2. Preload and rigidity

- In NSK linear guides, slight size changes of rolling elements, which are going to be inserted in the slide, control the clearance and amount of preload.
- In NSK linear guides, the rigidity is further increased and the elastic deformation is reduced by applying preload.
- In general, the load range of ball guide system in which the preload is effective, is about 2.8 times of the preload (**Fig.3.2**). For roller guide system, it becomes about 2.2 times of the preload.
- **Fig. 3.3** shows the relationship between the ball slide deformation and the external vertical load under a specified preload. NH35 is used as an example.
- The following show the definition of linear guide rigidity.

(1) Radial rigidity: Rigidity of vertical and lateral directions, up/down and right/left (**Fig. 3.4**).
(2) Moment rigidity: Three moment directions, pitching, rolling, and yawing (**Fig. 3.5**).

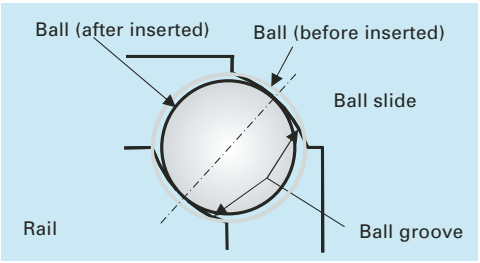


Fig. 3.1 Preloading method

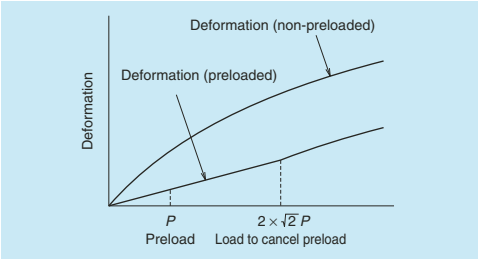


Fig. 3.2 Elastic deformation

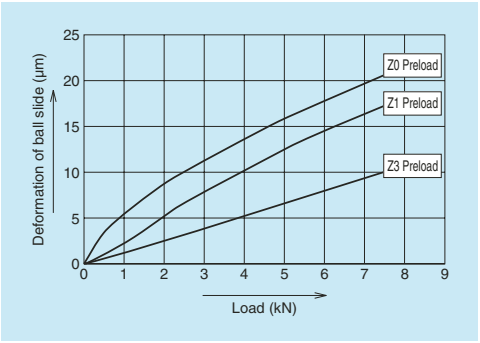


Fig. 3.3 Rigidity of NH35, downward direction load (example)

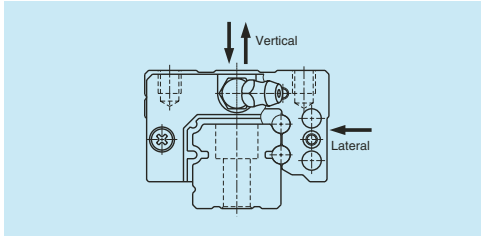


Fig. 3.4 Radial rigidity

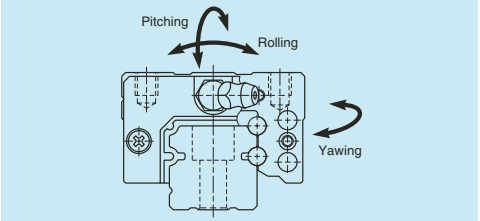


Fig. 3.5 Moment rigidity

- Since two rails and four slides are used in general as a pair, consideration only for the radial rigidity is sufficient.
- However, in cases as shown in **Fig. 3.6**, **Fig. 3.7** and **Fig. 3.8**, it is necessary to take into account the moment rigidity in addition to the radial rigidity.

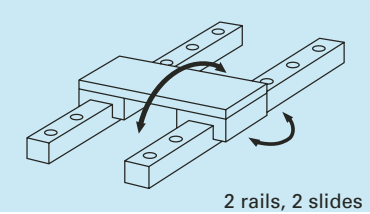


Fig. 3.6 Pitching and yawing direction

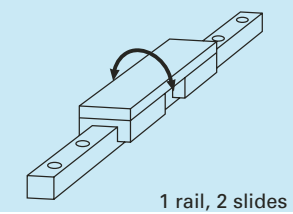


Fig. 3.7 Rolling direction

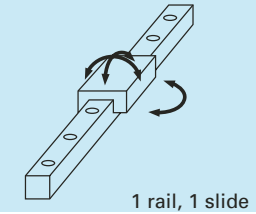


Fig. 3.8 All directions

3. Selection of preload classification

- Several types of preload that match the characteristic of each series are set for NSK linear guides.
- Types of preload classification for each series are shown in **Table 3.1**. **Table 3.2** shows the selection criterion of the preload classification.

Table 3.1 Classification of preload in each series

	Preload	Preloaded assembly (not random matching)				Random-matching type		
		Heavy preload	Medium preload	Slight preload	Fine clearance	Medium preload	Slight preload	Fine clearance
	Series	Z4	Z3	Z1	Z0	ZH	ZZ	ZT
Ball guide	NH, NS		○	○	○	○	○	○
	VH		○	○	○		○	○
	LW		(○)	○	○		○	○
	PU			○	○			○
	LU			○	○			○
	PE			○	○			○
	LE			○	○			○
	Miniature LH			○	○			
	LL				○			
	LA	○	○					
	HA		○	○				
	HS		○	○				
Roller guide	RA		○	○		○	○	

Table 3.2 Selection criterion of the preload

Classification of preload	Use condition	Applications
Z0 and ZT (Fine clearance)	• An application in which a set of two parallel linear guides (four ball slides/two rails) is used to sustain a unidirectional load with low vibration and impact. • An application in which the accuracy is not very necessary but a friction force must be minimized.	Welding machines, Glass processing machines, Packaging/packing machines, Materials handling equipment
Z1 and ZZ (Slight preload)	• Moment loads are applied. • Application for a highly accurate operation.	Industrial robots, Inspection/measuring equipment, Laser cutting machine, Electric discharge machines, PCB drillers, Chip mounters
Z3, ZH, and Z4 (Medium preload, Heavy preload)	• Application in which extremely high stiffness is essential. • Application in which vibration and impact load will be applied.	Machining centers, Lathes, Milling machines, Boring machines, Grinders

4. Estimation of the elastic deformation

The followings are the relation between load and deformation.

- Without the preload
  When the rolling element is ball
  The deformation is proportional to the 2/3 power of the load.
  When the rolling element is roller
  The deformation is proportional to the 9/10 power of the load.
- With the preload
  The deformation is directly proportional to the load.

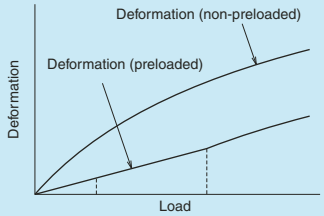


Fig. 3.9 Elastic deformation

A preloaded linear guide deforms proportionally to the load as shown in **Fig. 3.9**; the calculation of system deformation can be done using the deformation curve. The factors required for an estimation of the system deformation are listed below. The stiffness of slide is shown on the relevant explanation of each linear guide series.

<Required conditions to calculate deformation>
- Volume of load
- Direction of load
- Point of load application
- Position of deformation calculation
- Arrangement of rails and ball slides
- Position of a driving mechanism

Please refer to the calculation formula of deformation for typical table structures on the pages A18 to A20.

5. Application examples of preload

Table 3.3 shows typical application for each preload types of the NSK linear guides.
Refer to this table when selecting the preload type for your application.

Table 3.3 Application examples of preload

Type of machine	Application	Preload: Heavy preload Z4	Medium preload Z3, ZH	Slight preload Z1, ZZ	Fine clearance Z0, ZT
Machine tools	• Machining centers	○	○		
	• Grinders	○	○		
	• Lathes	○	○		
	• Milling machines	○	○		
	• Drilling machines	○	○		
	• Boring machines		○		
	• Gear cutters	○	○		
	• Diesinking machines		○	○	
	• Laser cutting machines		○	○	
	• Electric discharge machines		○		
Industrial machines and equipment	• Punch presses		○	○	
	• Press machines			○	○
	• Welding machines		○	○	○
	• Painting machines			○	○
	• Textile machines			○	○
	• Coil winders		○	○	
	• Woodworking machines		○	○	○
	• Glass processing machines			○	○
	• Stone cutting machines			○	○
	• Tire forming machines			○	○
	• ATC			○	○
	• Industrial robots		○	○	○
	• Materials handling equipment			○	○
	• Packing machines			○	○
	• Construction machines				○
Semiconductor facilities	• Probers		○		
	• Wire bonders		○	○	
	• PCB drillers		○	○	
	• Wafer slicers		○		
	• Wafer dicers		○		
	• Chip mounters		○	○	
	• IC handlers			○	
	• Scanners			○	
	• Lithographic machines		○	○	
Others	• Measuring/inspection equipment			○	
	• Three-dimensional measuring equipment		○	○	
	• Medical equipment			○	○
	• OA equipment			○	○
	• Railway cars			○	○
	• Stage systems				○
	• Pneumatic equipment			○	○

6. Load and rating life when the preload is taken into account

- It is necessary to include the amount of preload for the calculation of rating life when the Z3 (medium preload) or the Z4 (heavy preload) preload type is specified.

- Full dynamic equivalent load when the preload is taken into account can be obtained by the following formulas.

For balls as rolling element

$$Fe_P = P\left(1+\frac{Fe}{2.83\times P}\right)^{\frac{3}{2}}$$

***P*: Preload (N)**

However, when the full dynamic equivalent load taking account of preload is larger than the load at which preload is removed, $Fe_P = Fe$.
For this case, preload is lost at $F_{PO} = 2^{\frac{3}{2}}P$

For rollers as rolling element

$$Fe_P = P\left(1+\frac{Fe}{2.16\times P}\right)^{\frac{10}{9}}$$

***P*: Preload (N)**

However, when the full dynamic equivalent load taking preload into account is larger than the load at which preload is removed, $Fe_P = Fe$.
For this case, preload is lost at $F_{PO} = 2^{\frac{10}{9}}P$

7. Calculating friction force by preload

- Dynamic friction force per one slide of the ball guide can be calculated from a preload value.
- The following is a simple calculation to obtain the criterion of dynamic friction force.
  For the slight preload ZZ of a preloaded random-matching type linear guide, use the preload volume of slight preload Z1 type assembly.

$$F = iP$$

***F* : Dynamic friction force (N)**
***P* : Preload (N)**
***i* : Contact coefficient**

Use the following contact coefficient values (*i*) for each series of linear guides.

NH, VH, NS, LW, LH and HS Series	: 0.004
LA and HA Series	: 0.010
PU, LU, PE and LE Series	: 0.026

- The starting friction force when the slide begins to move depends on lubrication condition. Roughly estimate it at 1.5 to 2 times of the dynamic friction obtained by the above method.

Calculation example

In case of NH35AN - Z3
$i = 0.004$
$P = 2\,350$ (N) (refer to NH series preload)
$F = iP$
$= 0.004 \times 2\,350 = 9.4$ (N)
Therefore, the criteria of the dynamic friction force of NH35AN - Z3 is 9.4 N.

For seal friction, refer to seal friction of each Series.

A-3-4 Accuracy

1. Accuracy standard

The accuracy characteristics of linear guide are specified to each series in the variations of assembled height, assembled width, and running parallelism. We also specify the mutual variation of a pair of linear guides in the assembled height and assembled width. The accuracy of the table equipped with a set of linear guides is depending on other accuracies and many factors besides the accuracy of linear guides. Those are the accuracy of the mounting surface of the machine, the mounting span between two linear guides, the span of ball slides, the number of ball slides, and the location of the point at where the accuracy is really required. The NSK linear guides can deal with these factors and provide the best suited model for your specific application.

2. Definition of accuracy

- **Table 4.1**, **Fig. 4.1** and **Fig. 4.2** show accuracy characteristics.

Table 4.1 Definition of accuracy

Characteristics	Definition (**Figs. 4.1** and **4.2**)
Mounting height *H*	Distance from A (rail bottom datum surface) to C (slide top surface)
Variation of *H*	Variation of *H* in slides assembled to the rails of a set of linear guides
Mounting width W_2 or W_3	Distance from B (rail side datum surface) to D (slide side datum surface). Applicable only to the reference linear guide.
Variation of W_2 or W_3	Difference of the width (W_2 or W_3) between the assembled slides which are installed in the same rail. Applicable only to the reference linear guide.
Running parallelism of slide, surface C to surface A	Variation of C (slide top surface) to A (rail bottom datum surface) when slide is moving.
Running parallelism of slide, surface D to surface B	Variation of D (slide side datum surface) to B (rail side datum surface) when a slide is moving.

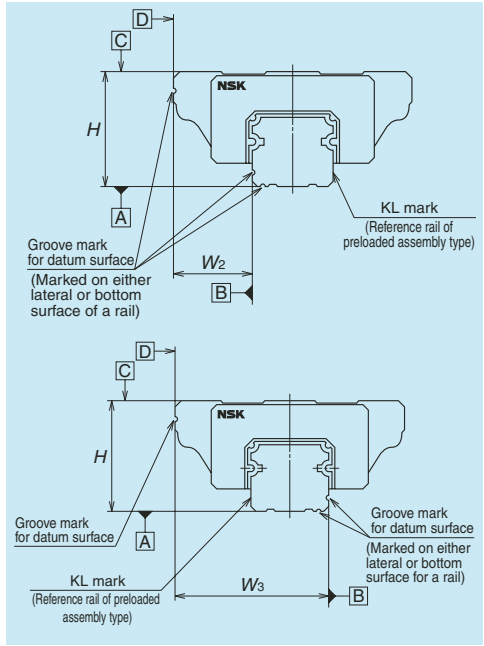


Fig. 4.1 Assembled dimensions

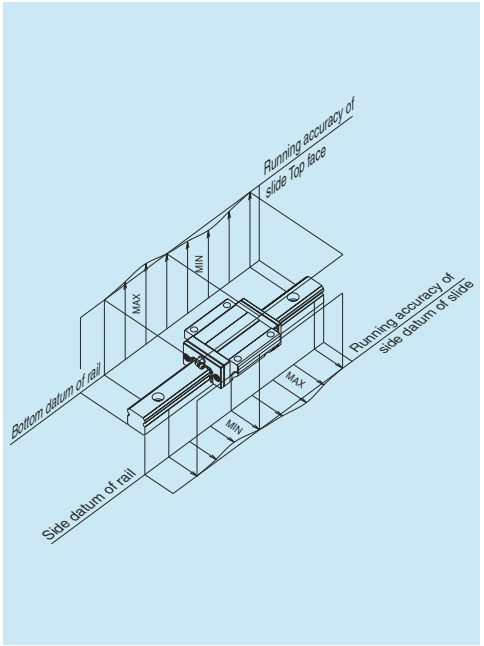


Fig. 4.2 Running parallelism of slide

Mounting width: W_2, and W_3

- Mounting width differs depending on the arrangement of the datum surfaces of the rail and slide on the reference linear guide (indicated as KL on the rail). (**Fig. 4.3** and **Fig. 4.4**)

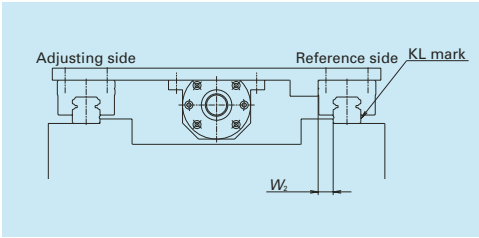


Fig. 4.3 Mounting width W_2

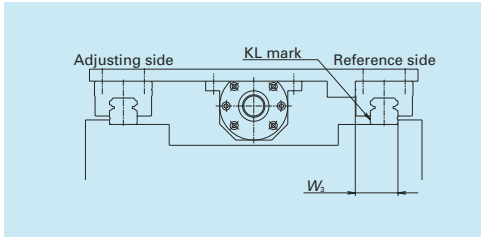


Fig. 4.4 Mounting width W_3

Running Parallelism of Ball Slide

- Running parallelism of slide is common in all series. Specifications of all accuracy grades are shown in **Table 4.2**. However, applicable accuracy grades differ by series. Please refer to "**Table 4.4 Accuracy grade and applicable series**" on page A35.

Table 4.2 Running parallelism of slide

Unit: μm

Rail length (mm) over	Rail length (mm) or less	Preloaded assembly (not random matching) Ultra precision P3	Super precision P4	High precision P5	Precision grade P6	Normal grade PN	Random-matching type Precision grade PH	Normal grade PC
–	50	2	2	2	4.5	6	2	6
50	80	2	2	3	5	6	3	6
80	125	2	2	3.5	5.5	6.5	3.5	6.5
125	200	2	2	4	6	7	4	7
200	250	2	2.5	5	7	8	5	8
250	315	2	2.5	5	8	9	5	9
315	400	2	3	6	9	11	6	11
400	500	2	3	6	10	12	6	12
500	630	2	3.5	7	12	14	7	14
630	800	2	4.5 (4)	8	14	16	8	16
800	1 000	2.5	5 (4.5)	9	16	18	9	18
1 000	1 250	3	6 (5)	10	17	20	10	20
1 250	1 600	4	7 (6)	11	19	23	11	23
1 600	2 000	4.5	8 (7)	13	21	26	13	26
2 000	2 500	5	10 (8)	15	22	29	15	29
2 500	3 150	6	11 (9.5)	17	25	32	17	32
3 150	4 000	9	16	23	30	34	23	34

Note: Value of ( ) is the running parallelism of RA Series.

3. Application examples of accuracy grade and preload

Table 4.3 shows examples of accuracy grade and preload of NSK linear guides for specific purposes. Refer to this table when selecting accuracy grade and preload type for your application.

Table 4.3 Application examples of accuracy grade and preload

Type of machine	Application	Accuracy grade: Ultra precision P3	Super precision P4	High precision P5, PH	Precision grade P6	Normal grade PN, PC	Preload: Heavy preload Z4	Medium preload Z3, ZH	Slight preload Z1, ZZ	Fine clearance Z0, ZT
Machine tools	• Machining centers		○	○	○		○	○		
	• Grinders	○	○	○			○	○		
	• Lathes		○	○	○		○	○		
	• Milling machines		○	○	○		○	○		
	• Drilling machines			○	○		○	○		
	• Boring machines		○	○	○		○	○		
	• Gear cutters		○	○	○		○	○		
	• Diesinking machines		○	○	○			○	○	
	• Laser cutting machines		○	○	○			○	○	
	• Electric discharge machines	○	○	○			○	○		
Industrial machines and equipment	• Punch pressses			○	○			○	○	
	• Press machines				○	○			○	○
	• Welding machines				○	○		○	○	○
	• Painting machines				○	○			○	○
	• Textile machine				○	○			○	○
	• Coil winders				○	○		○	○	
	• Woodworking machines			○	○	○		○	○	○
	• Glass processing machines				○	○			○	○
	• Stone cutting machines				○	○			○	○
	• Tire forming machines					○			○	○
	• ATC				○	○			○	○
	• Industrial robots			○	○	○		○	○	○
	• Materials handling equipment				○	○			○	○
	• Packing machines				○	○			○	○
	• Construction machines					○				○
Semiconductor facilities	• Probers	○						○	○	
	• Wire bonders		○	○				○	○	
	• PCB drillers			○	○			○	○	
	• Wafer slicers	○	○					○		
	• Wafer dicers	○	○					○		
	• Chip mounters			○	○			○	○	
	• IC handlers			○	○				○	
	• Scanners			○	○				○	
	• Lithographic machines	○	○					○	○	
Others	• Measuring/inspection equipment	○	○	○	○				○	
	• Three-dimensional measuring equipment	○	○	○	○			○	○	
	• Medical equipment		○	○	○				○	○
	• OA equipment				○	○			○	○
	• Railway cars					○			○	○
	• Stage systems					○				○
	• Pneumatic equipment				○	○			○	○

Note: Only Z1 and Z0 are available for PN grade.
For random-matching type, preload "ZH" and "ZZ" are available for PH grade. For PC grade, "ZH", "ZZ" and "ZT" are available.

4. Combination of accuracy grade and preload

(1) Accuracy grades

- The accuracy grade which matches the characteristic of each series is set for the NSK linear guides.
- **Table 4.4** shows the accuracy grades available for each series.
- Refer to "**3. Application examples of accuracy grade**" which shows cases of appropriate accuracy grade for specific purpose.

Table 4.4 Accuracy grades and applicable series

Series	Preloaded assembly (not random matching)					Random-matching type	
	Ultra precision	Super precision	High precision	Precision grade	Normal grade	High precision	Normal grade
	P3	P4	P5	P6	PN	PH	PC
NH, NS	○	○	○	○	○	○	○
VH	○	○	○	○	○		○
LA	○	○	○	○			
LW			○	○	○		○
PE, LE		○	○	○	○		○
PU, LU		○	○	○	○		○
Miniature LH		○	○	○	○		
LL					○		
HA	○	○	○				
HS	○	○	○				
RA	○	○	○	○		○*	

*) Only RA25 to RA65 are available in random matching.

(2) Preload

- Several classifications of preload that match the characteristic of each series are set for the NSK linear guides.
- The classification of preload for each series are shown in **Table 4.5**.
- Refer to the specifications of each series for details of radial clearance, preload, and rigidity.
- "**3. Application examples of accuracy grade**" shows the cases of appropriate preload classifications and accuracy grades for specific purposes.

Table 4.5 Classification of preload

Series	Preloaded assembly (not random matching)				Random-matching type		
	Heavy preload	Medium preload	Slight preload	Fine clearance	Medium preload	Slight preload	Fine clearance
	Z4	Z3	Z1	Z0	ZH	ZZ	ZT
NH, NS		○	○	○	○	○	○
VH		○	○	○		○	○
LA	○	○					
LW		(○)	○	○		○	○
PE, LE			○	○			○
PU, LU			○	○			○
Miniature LH			○	○			
LL				○			
HA		○	○				
HS		○	○				
RA		○	○		○	○	

Notes: 1) Z3 preload classification is only applicable to LW35 and LW50 for LW Series.
2) Only RA25 to RA65 are available in random matching.
3) The preload code of "Z" is omitted from the specification number. Only the number of preload classification code is specified on the last code of the reference number. (Refer to the reference number of each series.)

(3) Combinations of accuracy grade and preload

• Combinations of accuracy grade and preload are shown in **Table 4.6**.

Table 4.6 Combinations of accuracy grade and preload type

	Accuracy grade	Preload
Preloaded assembly	P3 – P6	Z4 – Z0
	PN	Z1, Z0
Random-matching type	PC, PH*1, *2	ZH, ZZ, ZT

*1) The random-matching type is available for the models of RA25 to RA65. PH grade is set for the accuracy.
*2) ZH and ZZ preload are available for the PH accuracy grade.

A-3-5 Maximum Rail Length

General Industrial Use Unit: mm

Series	Material \ Size	15	20	25	30	35	45	55	65
NH	Special high carbon steel	2 980	3 960	3 960	4 000	4 000	3 990	3 960	3 900
	Stainless steel	1 800	3 500	3 500	3 500				
VH	Special high carbon steel	2 000	3 960	3 960	4 000	4 000	3 990	3 960	
	Stainless steel	1 800	3 500	3 500	3 500				
TS	Special high carbon steel	1 960	2 920	4 000	4 040	4 040			
NS	Special high carbon steel	2 920	3 960	3 960	4 000	4 000			
	Stainless steel	1 700	3 500	3 500	3 500	3 500			

Unit: mm

Series	Material \ Size	17	21	27	35	50
LW	Special high carbon steel	1 000	1 600	2 000	2 000	2 000

Liquid Crystal Display and Semiconductor Unit: mm

Series	Material \ Size	05	07	08	09	10	12	15
PU	Stainless steel	210	375		600		800	1 000
LU	Special high carbon steel				1 200		1 800	2 000
	Stainless steel	210	375		600		800	1 000
PE	Stainless steel	150	600		800		1 000	1 200
LE	Stainless steel	150	600		800		1 000	1 200
LH	Stainless steel			375		600	800	

Machine Tools Unit: mm

Series	Material \ Size	15	20	25	30	35	45	55	65
RA	Special high carbon steel	2 000	3 000	3 900	3 900	3 900	3 650	3 600	3 600
LA	Special high carbon steel			3 960	4 000	4 000	3 990	3 960	3 900

High-Precision Machine and High-Precision Measuring Equipment Unit: mm

Series	Material \ Size	15	20	25	30	35	45	55
HA	Special high carbon steel			3 960	4 000	4 000	3 990	3 960
HS	Special high carbon steel	2 000	3 960	3 960	4 000	4 000		
	Stainless steel	1 700	3 500	3 500	3 500	3 500		

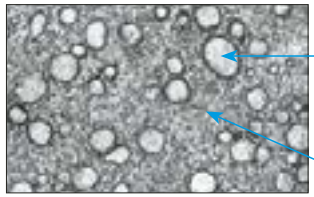
A-3-6 Lubrication

1. NSK linear guides equipped with "NSK K1™" lubrication unit

NSK K1 lowers machine operation cost, and reduces impact on the environment.

What is "long-term, maintenance-free" operation?
Ball screws and linear guides which are equipped with NSK K1 do not require maintenance for five years or up to 10 000 km operational distance.

What is NSK K1 lubrication unit?
NSK K1 is a lubrication device which combines oil and resin in a single unit. The porous resin contains a large amount of lubrication oil. Touching its surface to the raceway of a rail close to the ball contact point NSK K1 constantly supplies fresh oil which seeps from the resin.



Enlarged surface of NSK K1 Lubrication Unit 100μm

Polyolefin
Unlike vinyl chloride products, polyolefin does not produce dioxin. Polyolefin is also being used increasingly at supermarkets for food wrapping.

Lubrication oil
It is mineral oil-based lubricant. The oil has a viscosity of 100 cSt.

Remarkable capacity with new material:
NSK K1™ lubrication unit information

- A NSK K1 lubrication unit (referred to as NSK K1 hereafter) equipped with an NSK linear guide is an outstanding new lubrication material.
- A Newly developed porous synthetic resin contains large volume of lubricant oil that seeps out and enhances lubricating function.
- Simply install NSK K1 inside a standard end seal (rubber).
- We also provide NSK K1 lubrication unit for sanitary environments suited for food processing machinery, medical equipment and their ancillaries for the environment where hygiene control is essential. For details, refer to **"A-3-9 3. NSK Linear Guides for Food Processing Equipment and Medical Devices for Sanitary Environment"**.

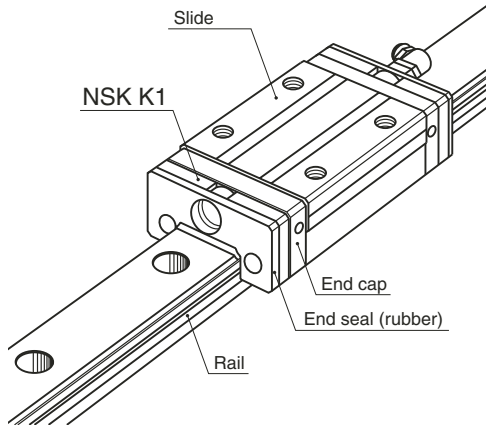


Fig. 6.1

(1) Features

NSK K1 comprises a part of the compact and efficient lubrication unit.

1) Maintenance is required only infrequently

Used with grease, the lubrication function lasts for a long time. Ideal for systems/environments in which replenishing is difficult.

▼

For automotive component processing lines, etc.

2) Does not pollute the environment

A very small volume of grease combined with NSK K1 can provide sufficient lubrication in the environment where grease is undesirable as well as in the environment where high cleanliness is required.

▼

Food processing/medical equipment, liquid crystal displays/semiconductor manufacturing equipment, etc.

We also provide NSK K1 lubrication unit for sanitary environment suited for food processing machinery, medical equipment and their ancillaries for the environment where hygiene control is essential. For details, refer to **"A-3-9 3. NSK Linear Guides for Food Processing Equipment and Medical Devices for Sanitary Environment"**.

3) Good for applications where lubricant is washed away

Used with grease, life of the machine is prolonged even when the machine is washed entirely by water, or in an environments where the machine is exposed to rain or wind.

▼

Food processing equipment, housing/construction machines, etc.

4) Maintains efficiency in dusty environments

In environments where oil- and grease-absorbing dust is produced, long-term efficiency in lubrication and prevention from foreign inclusions is maintained by using NSK K1 in combination with grease.

▼

Woodworking machines, etc.

*Stainless steel linear guides are available for use in corrosive environments or other environments where rusting is a potential problem.

(2) Functions

NSK K1 has various superb functions. NSK's ample test data and field performances confirm NSK K1 abilities.

1) Durability test at high speed, with no other lubrication

Fig. 6.2 shows test results under these conditions.
The linear guide operated with no lubricant is unable to travel after a short period because breakage occurs. Equipped with NSK K1, the linear guide easily travels 25 000 km.

Conditions: Sample ; LH30AN (preload Z1)
Travel speed ; 200 m/min
Stroke ; 1 800 mm
No lubricant: Completely degreased, no lubrication
NSK K1: Completely degreased, no lubrication + NSK K1

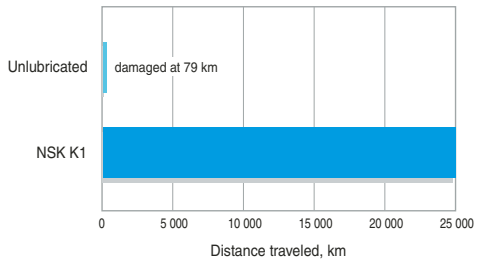


Fig. 6.2 Durability test at high speed, with no lubrication (lubricated by NSK K1 only)

2) Immersion test

Fig. 6.3 shows the test results after a linear guide is immersed in water once per week for 24 hours at a time, then traveled for 2 700 km. Without NSK K1, the ball groove sufrace wore out at an early stage and broke. With NSK K1, the wear was reduced to about 1/3 (**Table 6.1**). This test proves the effect of NSK K1.

Conditions: Sample ; LS30 Stainless steel (preload Z1)
Travel speed ; 24 m/min
Stroke ; 400 mm
Load ; 4 700 N/Slide
Lubricant ; Fully packed with grease (*) exclusive use for food proccesing machines
Immersing condition:
Immersed and traveled once per week for 24 hours at a time.

* Grease made in U.S.A.
Characteristic
Consistency: 280
Base oil viscosity: 580 (cSt)

Table 6.1 Comparison in wear of grooves and steel balls (2 700 km)

Unit: μm

Lubricating condition	Ball slide groove	Rail groove	Steel balls
With NSK K1	16 – 18	2 – 3	6 – 8
Without NSK K1	30 – 45	9 – 11	17 – 25

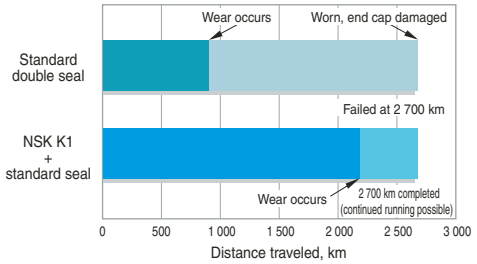


Fig. 6.3 Durability test immersed in water

4) Dust generation

Fig. 6.5 is a comparison of dust generation of NSK K1. The combination of NSK K1 and NSK Clean Grease LG2 (low dust generation grease) generates as little dust as fluorine grease (vacuum grease).

Conditions: Sample ; LS20
Travel speed ; 36 m/min

3) Durability test with wood chips

Wood chips absorb lubricant. Maintaining lubrication in such environment is extremely difficult. **Fig. 6.4** shows that the life when NSK K1 is added to a standard seal is two times longer than the life when two seals are combined (standard double seal).

Conditions: Sample ; LH30AN (preload Z1)
Travel speed ; 24 m/min
Stroke ; 400 mm
Load ; 490 N/Slide
Seal specifications/lubricant:
Standard double Seal···Standard double Seal + AS2 Grease
NSK K1·····NSK K1 + Standard seal + AS2 Grease
Wood chip conditions:
1····· Volume of wood chips: Large
2····· Volume of wood chips: Medium

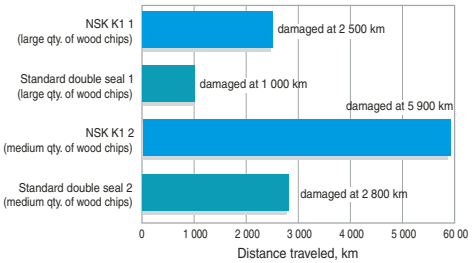


Fig. 6.4 Durability test with wood chips

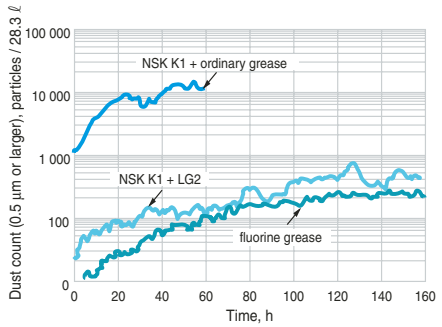


Fig. 6.5 Comparison of dust emission

(3) Specifications

1) Applicable series and sizes

a) Can be installed in NH, NS, LW, PU, LU, PE, LE, LH, RA, LA, HA, and HS series. It is standard equipment for the VH and TS Series.

b) Can be used with stainless steel materials and surface-treated items.

2) Standard specifications

a) NSK K1 is installed between the end seal and end cap.
For the TS series, it is installed in the end cap. (Double-seal specification, and specification with protector are also available upon request.)

b) NSK standard grease is packed inside the slide.
(You may specify the type of grease and its volume if required.)

c) Accuracy and preload classifications are the same as standard items. (Dynamic friction increases slightly due to NSK K1.)

3) Number of installed NSK K1

Normally, one NSK K1 should be installed on both ends of slides. (two K1s for one slide)
However, more NSK K1 may be required under more stringent operating conditions and environment. Please consult NSK for details in such a case.

Precautions for handling

To maintain high fuctionality of the NSK K1, observe the following precautions.

1. Temperature range for use: Maximum temperature in use: 50°C
   Momentary maximum temperature in use: 80°C

2. Chemicals that should not come into contact with NSK K1:
   Do not leave the NSK K1 in an organic solvent, such as hexane and thinner that remove oil, or rust preventive oil that contains white kerosene.

Note: Water-type cutting oil, oil-type cutting oil, mineral-oil type grease and ester-type grease do not damage NSK K1.

2. Lubrication

Mainly there are two ways of lubrication, grease and oil, for linear guides.
Use a lubricant agent and method most suitable to condition requirements and the purpose to optimize functions of linear guides.
In general, lubricants with low base oil kinematic viscosity are used for high-speed operation, in which thermal expansion has a large impact, and in low temperatures.
Lubrication with high base oil kinematic viscosity is used for oscillating operations, operations in low speeds and in high temperatures.
The following are lubrication methods by grease and by oil.

(1) Grease Lubrication

Grease lubrication is widely used because it does not require a special oil supply system or piping. Grease lubriction accessories available from NSK are:
- Various types of grease in bellows tube which can be instantly attached to the hand grease pump;
- NSK Grease Unit that consists of a hand grease pump and various nozzles. These are compact and easy to use.

1) NSK grease lubricants

Table 6.2 shows the marketed general grease widely used for linear guides. In addition to these grease, NSK provides special grease for specific conditions and purposes.

Table 6.2 Grease lubricant for linear guides

Type	Thickener	Base oil	Base oil kinematic viscosity mm^2/s (40°C)	Range of use temperature (°C)	Purpose
AS2*1	Lithium type	Mineral oil	130	–10 – 110	For general use at high load
PS2*2	Lithium type	Synthetic oil + synthetic hydrocarbon oil	15.9	–50 – 110	For low temperature and high frequency operation
LG2	Lithium type	Mineral oil + synthetic hydrocarbon oil	32	–20 – 70	For clean environment
LGU	Diurea	Synthetic hydrocarbon oil	95.8	–30 – 120	For clean environment
NF2	Urea composite type	Synthetic hydrocarbon oil	26	–40 – 100	For fretting resistant

*1) Standard grease of NH, VH, TS, NS, LW, LH, RA, LA, HA, and HS Series.
*2) Standard grease of PU, LU, PE, and LE Series.

[1] NSK Grease AS2

● Features

It is environmentally friendly and widely used grease for high-load applications. It is mineral oil based grease containing lithium thickener and several additives. It is superb in load resistance as well as stability in oxidization. It not only maintains good lubrication over a long period of time, but also demonstrates superb capability in retaining water. Even containing a large amount of water, it does not lose grease when it is softened.

● Application

It is standard grease for general NSK linear guides. It is prevalently used in many applications because of its high base oil viscosity, high-load resistance, and stability in oxidization.

● Nature

Thickener	Lithium soap base
Base oil	Mineral oil
Consistency	275
Dropping point	181°C
Volume of evaporation	0.24% (99°C, 22 hr)
Copper corrosion test	Satisfactory (Method B, 100°C, 24 hr)
Oil separation	2.8% (100°C, 24 hr)
Base oil kinematic viscosity	130 mm^2/s (40°C)

[2] NSK Grease PS2

● Features

The major base oil component is synthetic oil with mineral oil. It is an excellent lubrication especially for low-temperature operation. It is for a high-speed and light-load application.

● Application

It is standard grease for NSK miniature linear guides. It is especially superb for low-temperature operation, but also functions well in normal temperatures, making it ideal for small equipment with light load.

● Nature

Thickener	Lithium soap base
Base oil	Synthetic oil + Synthetic hydrocarbon oil
Consistency	275
Dropping point	190°C
Volume of evaporation	0.60% (99°C, 22 hr)
Copper corrosion test	Satisfactory (Method B, 100°C, 24 hr)
Oil separation	3.6% (100°C, 24 hr)
Base oil kinematic viscosity	15.9 mm^2/s (40°C)

[3] NSK Grease LG2

● Features

This grease was developed by NSK to be exclusively used for linear guides in clean room. Compared to the fluorine grease which is commonly used in clean room, LG2 has several advantages such as:

- Higher in lubrication function
- Longer lubrication life
- More stable torque (resistant to wear)
- Higher rust prevention.

In dust generation, LG2 is more than equal to the fluorine grease in keeping dust volume low. Since the base oil is not special oil but mineral oil, LG2 can be handled in the same manner as general grease.

● Application

LG2 is the lubrication grease for linear guides for semiconductor and liquid crystal display (LCD) processing equipment which require a highly clean environment. Because LG2 is exclusively for a clean environment at normal temperatures, however, it cannot be used in a vacuum environment.

Refer to "Special environment" in page A60 for the detailed data on superb characteristics of NSK Grease LG2.

● Nature

Thickener	Lithium soap base
Base oil	Mineral oil + Synthetic hydrocarbon oil
Consistency	199
Dropping point	201°C
Volume of evaporation	1.40% (99°C, 22 hr)
Copper corrosion test	Satisfactory (Method B, 100°C, 24 hr)
Oil separation	0.8% (100°C, 24 hr)
Base oil kinematic viscosity	32 mm^2/s (40°C)

[4] NSK Grease LGU

● Features

This is a proprietary urea base grease of NSK featuring low dust emission exclusively for linear guides which are used in clean room.

In comparison with the fluorine base grease, which has been used commonly in clean room, LGU has better lubricating property, longer duration of lubricant, better torque variation, much better anti-rust property, and equivalent or better dust generation. In addition, this grease can be handled in the same way as the other common grease because high-grade synthetic oil is used as the base oil.

LGU grease contains much less metallic elements compared to LG2 grease. It can be used in high temperature environment.

● Application

This is exclusive lubrication grease for linear guides that are installed in equipment that requires cleanliness, as same as LG2 grease, and it can be used in high temperature range of –30°C to 180°C.

This grease cannot be used in vacuum.

● Nature

Thickener	Diurea
Base oil	Synthetic hydrocarbon oil
Consistency	201
Dropping point	260°C
Volume of evaporation	0.09% (99°C, 22 hr)
Copper corrosion test	Satisfactory (Method B, 100°C, 24 hr)
Oil separation	0.6% (100°C, 24 hr)
Base oil kinematic viscosity	95.8 mm^2/s (40°C)

[5] NSK Grease NF2

● Features

It uses high-grade synthetic oil as the base oil and urea base organic compound as the thickener. It has remarkable anti-fretting corrosion property. It can be used in wide temperature range, from low to high, and has superior lubrication life.

● Application

This grease suits for linear guides whose application includes oscillating operations. Allowable temperature range is –40°C to 100°C.

● Nature

Thickener	Diurea
Base oil	Synthetic hydrocarbon oil
Consistency	288
Dropping point	260°C
Volume of evaporation	0.22% (99°C, 22 hr)
Copper corrosion test	Satisfactory (Method B, 100°C, 24 hr)
Oil separation	0.5% (100°C, 24 hr)
Base oil kinematic viscosity	26 mm^2/s (40°C)

● Precautions for handling

- Wash the linear guides to remove oil prior to applying Clean Grease LG2 or LGU, so the grease functions are fully utilized.
- The clean grease is exclusively used for clean environments at normal pressure.

2) How to replenish grease

Use the grease fitting of a slide if an exclusive grease supply system is not used. Supply the required amount of grease by a grease pump.
Wipe off old grease and accumulated dust before supplying new grease. If the grease fitting is not used, apply grease directly to the rail. Remove the seal if possible, and move the slide few strokes so the grease permeates it. A hand grease pump, an exclusive and easy lubricating device for linear guides, is available at NSK.

3) Volume of grease to be replenished

Once grease is replenished, another supply is not required for a long time. But under some operational conditions, it is necessary to periodically replenish grease. The following are replenishing methods.

• When there is an exclusive grease supply system and the volume from the spout can be controlled, the criterion is:

All at once, replenish the amount that fills about 50% of the internal space of the slide. This method eliminates waste of grease, and is efficient.
Page A46 shows the internal spaces of slide of each series for your reference.

• When replenishing grease using a grease gump:
Use a grease pump and fill the inside of slide with grease. Supply grease until it comes out from the slide area. Move the slide by hand while filling them with grease, so the grease permeates all areas. Do not operate the machine immediately after replenishing. Always try to run-in the system a few times to spread the grease throughout the system and to remove excess grease from inside. Running-in operation is necessary because the sliding force of the linear guide greatly increases immediately after the replenishment (full-pack state) and may cause problems. Grease's stirring resistance is accountable for this phenomenon. Wipe off excess grease that accumulates at the end of the rail after trial runs, so the grease does not scatter to other areas.

4) Intervals of checks and replenishments

Although the grease is of high quality, it gradually deteriorates and its lubrication function diminishes. Also, the grease in the slide is gradually removed by stroke movement. In some environments, the grease becomes dirty, and foreign objects may enter a slide. New grease should be replenished depending on the frequency of use. The following is a guide of intervals of grease replenishments to linear guides.

Table 6.3 Intervals of checks and replenishments for grease lubrication

Intervals of checks	Items to be checked	Intervals of replenishments
3-6 months	Dirt, foreign matters such as cutting chip	Usually once per year is sufficient. Every 3 000 km for a system such as material handling equipment that travels more than 3 000 km per year. Replenish if checking results warrant it necessary.

Notes: 1) As a general rule, do not mix greases of different brands. Grease structure may be destroyed if greases of different thickeners are mixed. Even when greases have the same thickener, different additives in them may have an adverse effect on each other.

2) Grease viscosity varies by temperature. Viscosity is particular high in winter due to low temperature. Pay attention to increase in linear guide's sliding resistance in such occasion.

Table 6.4 Inside space of the slide

NH Series

Unit: cm³

Model No. \ Series	NH	
	High-load type	Ultra-high-load type
15	3	4
20	6	8
25	9	13
30	13	20
35	22	30
45	47	59
55	80	100
65	139	186

VH Series

Unit: cm³

Model No. \ Series	VH	
	High-load type	Ultra-high-load type
15	3	4
20	6	8
25	9	13
30	13	20
35	22	30
45	47	59
55	80	100

TS Series

Unit: cm³

Model No. \ Series	TS
15	2
20	3
25	6
30	9
35	15

NS Series

Unit: cm³

Model No. \ Series	NS	
	Medium-load type	High-load type
15	2	3
20	3	4
25	5	8
30	8	12
35	12	19

RA Series

Unit: cm³

Model No. \ Series	RA	
	High-load type	Ultra-high-load type
15	1	1.5
20	2	2.5
25	3	3.5
30	5	6
35	6	8
45	10	13
55	15	20
65	33	42

LW Series

Unit: cm³

Model No. \ Series	LW
17	3
21	3
27	7
35	24
50	52

PU, LU Series

Unit: cm³

Model No. \ Series	PU		LU	
	Standard type	High-load type	Standard type	High-load type
05	0.1	–	0.1	–
07	0.1	–	0.1	–
09	0.2	0.3	0.2	0.3
12	0.3	0.4	0.3	0.4
15	0.8	1.1	0.8	1.1

PE, LE Series

Unit: cm³

Model No. \ Series	PE		LE		
	Standard type	High-load type	Medium-load type	Standard type	High-load type
05	0.1	–	0.1	0.1	–
07	0.2	–	0.1	0.2	0.3
09	0.4	0.5	0.2	0.4	0.5
12	0.5	0.7	0.3	0.5	0.7
15	1.2	1.6	0.8	1.2	1.6

Miniature LH Series

Unit: cm³

Model No. \ Series	LH
08	0.2
10	0.4
12	1.2

LA Series

Unit: cm³

Model No. \ Series	LA	
	High-load type	Ultra-high-load type
25	8	12
30	14	18
35	21	29
45	38	48
55	68	86
65	130	177

HA, HS Series

Unit: cm³

Model No. \ Series	HA	HS
15	–	5
20	–	9
25	16	16
30	27	25
35	42	40
45	67	–
55	122	–

5) NSK grease unit

A hand grease pump and lubrication grease contained in a bellows tube (80 g of grease) which can be loaded to the grease pump.

Grease in a bellows tube

[1] Composition of NSK grease unit

Components and grease types are shown below.

	Name	(Tube color)	Reference number
NSK Grease Unit			
NSK Grease (80 g in a bellows tube)	NSK Grease AS2	(Ocher)	NSK GRS AS2
	NSK Grease PS2	(Orange)	NSK GRS PS2
	NSK Grease LG2	(Blue)	NSK GRS LG2
	NSK Grease LGU	(Yellow)	NSK GRS LGU
	NSK Grease NF2	(Gray)	NSK GRS NF2
NSK Hand Grease Pump Unit			
NSK Hand Grease Pump (Straight nozzle NSK HGP NZ1 -- One nozzle is provided with a hand grease pump.)			NSK HGP
Grease nozzle (used with a hand grease pump)			
	NSK straight nozzle		NSK HGP NZ1
	NSK chuck nozzle		NSK HGP NZ2
	NSK drive fitting nozzle		NSK HGP NZ3
	NSK point nozzle		NSK HGP NZ4
	NSK flexible nozzle		NSK HGP NZ5
	NSK flexible extension pipe		NSK HGP NZ6
	NSK straight extension pipe		NSK HGP NZ7

[2] NSK greases (80 g in a bellows tube)

Refer to pages A43 and D14 for their natures and details.

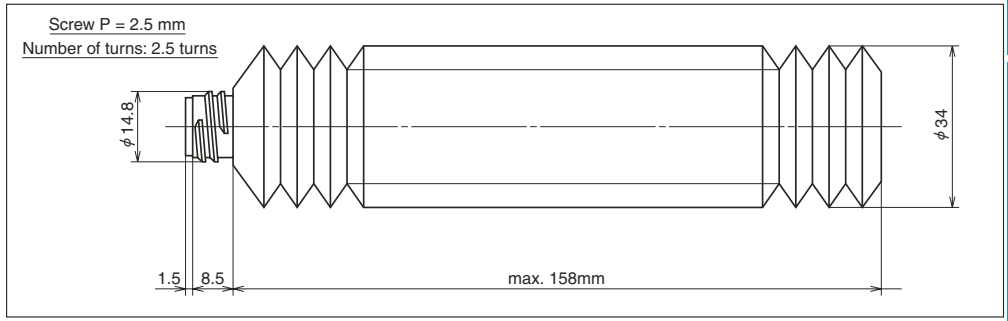


Fig. 6.6 Bellows tube

[3] NSK hand grease pump unit

a) NSK Hand Grease Pump
(Reference number: NSK HGP)

●Features

- Light-weight ·····Can be operated by one hand, yet there is no worry to make a mistake.
- Inserting by high pressure···Insert at 15 Mpa.
- No leaking ·····Does not leak when held upside down.
- Easy to change grease····Simply attach grease in bellows tube.
- Remaining grease ·····Can be confirmed through slit on tube.
- Several nozzles ·····Five types of nozzles to choose from.

●Specifications

- Discharge rate·····15 MPa
- Spout volume ·····0.35 cc/shot
- Mass of main body·····Without nozzle 240 g
  Provided nozzle 90 g
- Outer diameter of bellows grease tube····· φ38.1
- Accessories·····Several nozzles for a unique application can be attached

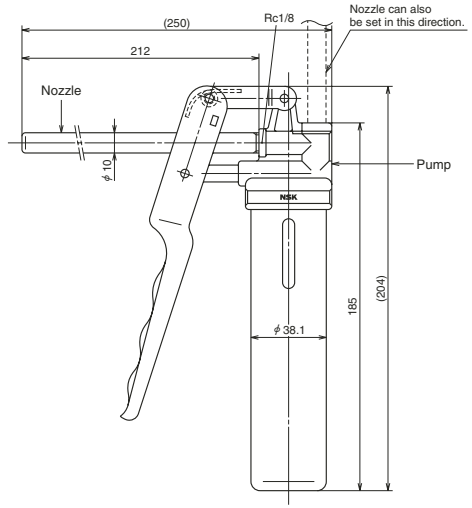


Fig. 6.7 NSK Hand Grease Pump with NSK straight nozzle

*Air is contained in the unopened bellows tube. Try the system tens of times when to use the hand grease pump. The tube will be use after deflated from the tube.

b) Nozzles

Table 6.5 Nozzles that can be attached to NSK Hand Grease Pump

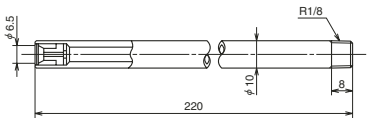
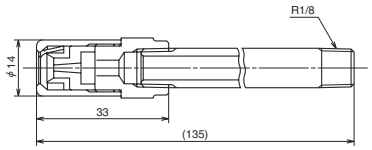
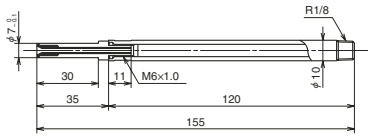
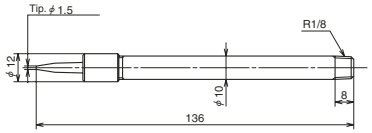
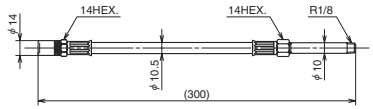
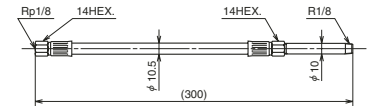
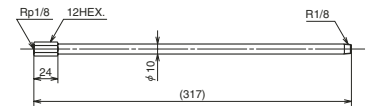
Name	Designation code	Use	Dimensions
NSK straight nozzle	NSK HGP NZ1	Can be used with grease fitting A, B, and C under JIS B1575 standard.	
NSK chuck nozzle	NSK HGP NZ2	Same as above. However, there is no need to press the hand pump because the grease fitting and the nozzle come into contact due to the chucking mechanism at the tip.	
NSK fitting nozzle	NSK HGP NZ3	Dedicated for the -ϕ3 drive-in grease fitting.	
NSK point nozzle	NSK HGP NZ4	Used for linear guides that do not have grease fitting. Supplies grease directly to the ball grooves, or through the opening of slide or slide to inside.	
NSK flexible nozzle	NSK HGP NZ5	The tip of the flexible nozzle is a chuck nozzle. The straight nozzle is not available for use.	
NSK flexible extension pipe	NSK HGP NZ6	Flexible extension pipe connects the grease pump and the nozzle	
NSK straight extension pipe	NSK HGP NZ7	Straight extension pipe connects the grease pump and the nozzle.	

Table 6.6 Grease fittings used for NSK linear guide

Series	Model No.	Tap hole for grease fitting	Standard grease fitting	Straight nozzle NZ1	Chuck nozzle NZ2	Drive-in fitting nozzle NZ3	Point nozzle NZ4	Flexible nozzle NZ5
NH Series	NH15	ϕ3	Drive-in type			○		
	NH20, 25, 30, 35*	M6×0.75	B type	○	○			○
	NH45, 55, 65	Rc1/8	B type	○	○			○
VH Series	VH15	ϕ3	Drive-in type			○		
	VH20, 25, 30, 35*	M6×0.75	B type	○	○			○
	VH45, 55	Rc1/8	B type	○	○			○
TS Series	TS15	ϕ3	Drive-in type			○		
	TS20, 25, 30, 35*	M6×0.75	B type	○	○			○
NS Series	NS15	ϕ3	Drive-in type			○		
	NS20, 25, 30, 35*	M6×0.75	B type	○	○			○
LW Series	LW17	ϕ3	Drive-in type			○		
	LW21, 27, 35*	M6×0.75	B type	○	○			○
	LW50	Rc1/8	B type	○	○			○
PU Series	PU05, 07, 09, 12	–	–				○	
	PU15	ϕ3	Drive-in type			○		
LU Series	LU05, 07, 09, 12, 15	–	–				○	
PE Series	PE05, 07, 09, 12	–	–				○	
	PE15	ϕ3	Drive-in type			○		
LE Series	LE05, 07, 09, 12, 15	–	–				○	
Miniature LH Series	LH08, LH10	–	–				○	
	LH12	ϕ3	Drive-in type			○		
RA Series	RA15, 20	ϕ3	Drive-in type			○		
	RA25, 30, 35*	M6×0.75	B type	○	○			○
	RA45, 55, 65	Rc1/8	B type	○	○			○
LA Series	LA25, 30, 35*	M6×0.75	B type	○	○			○
	LA45, 55, 65	Rc1/8	B type	○	○			○
HA Series	HA25, 30, 35*	M6×0.75	B type	○	○			○
	HA45, 55	Rc1/8	B type	○	○			○
HS Series	HS15	ϕ3	Drive-in type			○		
	HS20, 25, 30, 35*	M6×0.75	B type	○	○			○

Note: PU, LU, PE, and LE Series; Apply grease directly to ball groove, etc. using a point nozzle.

*) When using a chuck nozzle, make sure that it does not interfere with the table on linear guides.

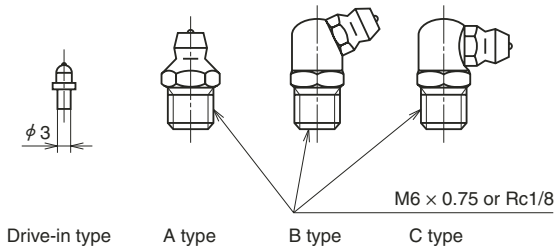


Fig. 6.8 Grease fittings

A long threaded grease fitting is required because of dust-proof parts. Please refer to the sections pertaining to the lubrication and dust-proof parts of each series.

(2) Oil lubrication

Required amount of new oil is regularly supplied by:

- Manual or automatic intermittent supply system;
- Oil mist lubricating system via piping.

Equipment for oil lubrication is more costly than one for grease lubrication. However, oil mist lubricating system supplies air as well as oil, thus raising the inner pressure of the slide. This prevents foreign matters from entering, and the air cools the system. Use an oil of high atomizing rate such as ISO VG 32-68 for the oil mist lubrication system.

ISO VG 68-220 are recommended for common intermittent replenishment system. Approximate volume of oil Q for a slide of linear guide per hour can be obtained by the following formula.

In case of all ball type linear guides except LA series

$Q \geq n/150$ (cm^3/hr)

In case of LA and RA series

$Q \geq n/100$ (cm^3/hr)

n: Linear guide size code

e.g. When NH45 is used,

$n = 45$,

Therefore,

$Q = 45/150 = 0.3$ cm^3/hr

For the oil lubrication by gravity drip, the oil supply position and installation position of the slide are crucial. In case of linear guide, unless it is installed to a horizontal position, the oil flows only on the down side, and does not spread to all raceway surface. This may cause insufficient lubrication. Please consult NSK to correct such situations prior to use. NSK has the internal design which allows oil lubricant to flow throughout the system.

Table 6.7 shows the criterion of intervals of oil checks and replenishments.

Table 6.7 Intervals of checks and replenishments

Method	Intervals of checks	Items to check	Replenishment or intervals of changes
Automatic intermittent supply	Weekly	Volume of oil, dirt, etc.	Replenish at each check. Suitable volume for tank capacity.
Oil bath	Daily before operation	Oil surface	Make a suitable criterion based on consumption

Notes: 1) As with grease lubrication, do not mix oil lubricant with different types.

2) Some components of the linear guide are made of plastic. Avoid using an oil that adversely affects synthetic resin.

3) When using oil mist lubricating system, please confirm an oil supply amount at the each outlet port.

A-3-7 Dust Proof

1. Standard specification parts

- To keep foreign matters from entering inside the slide, NSK linear guides have end seals on both ends, bottom seals at the bottom surfaces, and an inner seal in the inside of slide.
- The seals for standard specification for each series are shown in **Table 7.1**.
- Seal friction per a standard slide is shown in the technical description of the dust-proof parts of each series.

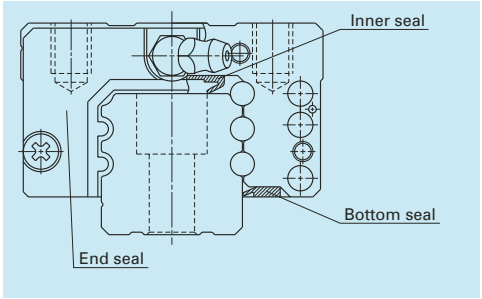


Fig. 7.1

Table 7.1 Standard seals

		End seal	Bottom seal	Inner seal
NH Series	NH15	○	○	–
	NH20, NH25, NH30, NH35, NH45, NH55, NH65	○	○	△
VH Series	VH15	○	○	–
	VH20, VH25, VH30, VH35, VH45, VH55	○	○	△
TS Series	TS15, TS20, TS25, TS30, TS35	○	○	○
NS Series	NS15	○	○	–
	NS20, NS25, NS30, NS35	○	○	△
LW Series	LW17, LW21, LW27, LW35, LW50	○	○	–
PU Series	PU05, PU07, PU09, PU12, PU15	○	–	–
LU Series	LU05, LU07, LU09	△	–	–
	LU12, LU15	○	–	–
PE Series	PE05, PE07, PE09, PE12, PE15	○	–	–
LE Series	LE05, LE07, LE09, LE12, LE15	○	–	–
Miniature LH Series	LH08, LH10	○	–	–
	LH12	○	○	–
RA Series	RA15, RA20	○	○	△
	RA25, RA30, RA35, RA45, RA55, RA65	○	○	○
LA Series	LA25, LA30, LA35, LA45, LA55, LA65	○	○	△
HA Series	HA25, HA30, HA35, HA45, HA55	○	○	○
HS Series	HS15, HS20, HS25, HS30, HS35	○	△	–

○ : Equipped as a standard feature
△ : Available upon request

2. Dust-proof parts

• NSK has the following items for the dust-proof parts. Select a suitable type for the operating environment.

Table 7.2 Optional dust-proof parts

Name	Purpose	Reference page
NSK K1 lubrication unit	Made of oil impregnated resin. Enhances lubricating functions.	A38 – A41
Double seal	It combines two end seals for enhancing sealing function.	A53
Protector	Protect the end seal from hot and hard contaminants.	A54
Rail cap	Prevents foreign matters, such as swarf generated in cutting operation from clogging the rail-mounting holes.	A54
Inner seal	Installed inside a slide, and prevents foreign matters from entering the rolling contact surface.	A55
Bellows	Covers the linear guide.	A55
Rail cover *	Covers the rail top surface, and prevents foreign matters, such as cutting dust, from collecting in the rail mounting holes.	A310

*) The rail cover is available only for RA25 to RA65 of RA series.

(1) Double seal

• It is a combination of two end seals to enhance seal function.
• When the double seal is installed, the end seal section becomes thicker than the standard item. Please pay attention to the increase in a slide length when designing the mounting dimension of slide and the table stroke. Please refer to the section of dust-proof components for the dimensional increase in the length direction of each series due to fitting of double seal.
• Double-seal set: Can be installed to a completed standard ball slide assembly later upon request. It comprises two end seals, two collars, and two machine screws for installation (**Fig. 7.2**). The product reference numbers of each series are described on the section of dust-proof parts.
• When attaching a grease fitting to the end cap after the double seal is equipped, you require a connector shown in **Fig. 7.2**. Please specify the connector set when ordering the linear guides.
• For VH, RA, LA, HA, and HS Series, the double-seal set can be only installed before shipping from the factory.

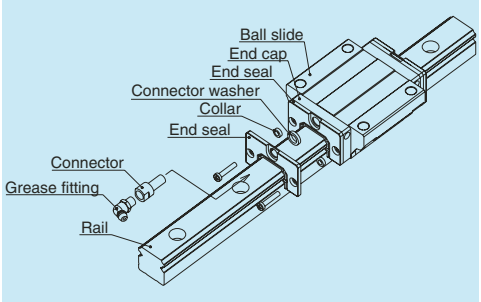


Fig. 7.2 Double seal

(2) Protector

• A protector is usually installed outside the end seal to prevent high-temperature fine particles such as welding spatter and other hard foreign matters from entering the slide.
• Same as the case with the double seal, when the protector is installed, the slide becomes longer. Take this thickness of slide into consideration for determining the relevant dimensions such as the system stroke and the ball slide installation envelope. An increase in the length of the ball slide due to the installation of protector is shown in the technical description of the dust-proof parts of each series.
• The protectors are available from the stock and we can install them to a completed standard slide assembly upon request. The model numbers of the protectors for ordering are shown in the technical explanation of the dust -proof parts of each series.
• When attaching a grease fitting to the end cap after the protector is equipped, you require the connector shown in **Fig. 7.3**. Please specify the connector set when ordering the linear guides.
• For VH, RA, LA, HA, and HS Series, the protector can only be installed only before shipping from the factory.

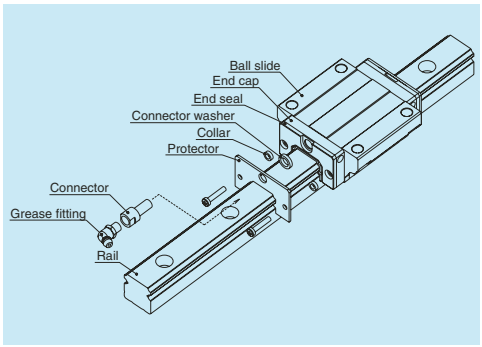


Fig. 7.3 Protector

(3) Bolt-hole cap to plug the bolt holes for rail mounting

• After the rail is mounted to the machine base, a bolt-hole cap is used to plug the bolt hole to prevent foreign matters from clogging up the hole and from entering into the slide (**Fig. 7.4**).
• The bolt-hole cap is made of synthetic resin which has superb in its resistance to oil and abrasion.
• Sizes of the bolt for the each linear guide model as well as the reference number of the bolt-hole cap are shown in the technical description of the dust-proof parts of each series.
• To insert the cap into the rail bolt hole, use a flat dolly block (**Fig. 7.5**). Pound the cap gradually until its height becomes flush with the rail top surface.
• You can reorder extra bolt hole caps. Sizes of the bolts and each model number of bolt-hole caps are shown in the technical description of the dust-proof parts of each series.
• Caps which are made of metal is also available upon request.

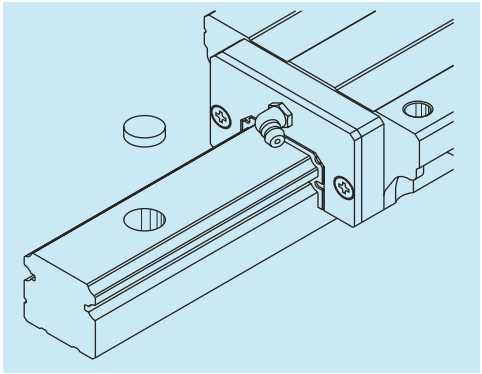


Fig. 7.4

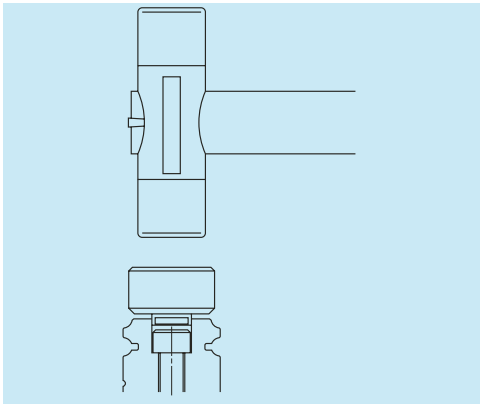


Fig. 7.5

(4) Inner seal

- The end seal installed on both ends of a slide cannot arrest entire contaminant, though the missed amount is negligible. An inner seal protects the rolling contact surface from such contaminant which entered inside the slide (**Fig. 7.6**).
- The inner seal is installed inside the slide. Therefore, the appearance in size and the shape are the same as the standard slide. (The inner seal is already installed before shipping.)
- It is strongly recommended to use the bellows and the double seal along with the inner seal to maintain the precision of the linear guide.
- Refer to **Table 7.1** for availability of inner seal.

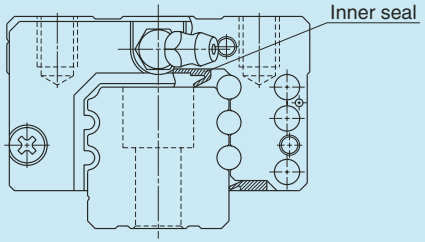


Fig. 7.6 Inner seal when installed

[1] Installation of bellows NH and NS Series

*** Fixing to the ball slide (Fig. 7.7)**

- Remove two machine screws (M_2) which secure the end seals to the end of the slide (**Fig. 7.7**). For NS15, hold the end cap by hand. Otherwise, the end cap is detached from the ball slide, and the balls inside may spill out.
- Then insert a spacer to the hole for securing the end seal. Fasten the mounting plate at the end of the bellows to the slide with a slightly longer machine screw (provided with the bellows).

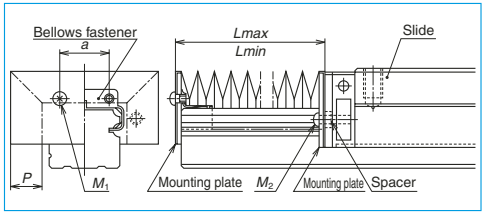


Fig. 7.7

(5) Bellows

- A bellows covers entire linear guide. It has been used widely as a way of protection in an environment where foreign matters are prevalent.
- NSK has bellows exclusively for NH, NS, LW and LA Series. They have a middle bellows and a bellows at both ends. For NH Series, there are low and high type bellows which are in compliance with their slide types.
- The high type is used for AN and BN types. The low type is used for EM, GM, AL and BL types. The top of the high type bellows is slightly lower than the top surface of the slide.
- When a high type bellows is installed to the slide with the height code L (such as AL), the top of the bellows becomes higher than the slide. However, it is advantageous for stroke because the pitch of the bellows becomes larger than the low type.
- Special bellows are required when installing the linear guide vertically, or hanging it from a ceiling. Please consult NSK in such a case.
- When a bellows is used, please be advised that we cannot put a grease fitting on the end of slide to which the bellows is attached. If you require the grease fitting, it shall be put on the side of end cap or slide body. Consult NSK for details.
- For the dimension of bellows, please refer to the section of dust proof parts of each series.

*** Fixing to the rail**

- To install bellows for NH and NS Series, lightly knock a fastener exclusively for bellows to the end of the rail (**Fig. 7.7**). Then secure the mounting plate to the end of the bellows through the tap hole of the fastener.
- As described above, a bellows can be easily fixed to the end of the rail without adding a tap hole on the end of the rail.
- Bellows fastener is available only for the horizontal mounting positions. For other mounting positions, sliding plate is required (see **Fig. 7.10** on page A56.)

For fixing to the rail, make tap holes to the rail end surface. Fix the bellows mounting plate to the rail end surface through these tap holes by using a machine screw. NSK processes a tap hole to the rail end face when ordered with a linear guide.

[2] LW and LA Series

*** Fixing to the ball slide (Fig. 7.8 and Fig. 7.9)**

- Remove two machine screws which secure the end seal. (For LW17 and LW21, hold the end cap by hand while removing the machine screw. Otherwise, the end cap is detached from the slide, and the balls inside may spill over and fall.)
- Insert a spacer to the securing hole of the end seal, fasten the mounting plate on the end of the bellows using a slightly longer machine screw (provided with the bellows).

*** Fixing to the rail**

- Make two tap holes to the rail end surface. Fix the bellows mounting plate with machine screws to the rail end surface through these tap holes. NSK processes the tap holes to the rail end surface when ordered with a linear guide.

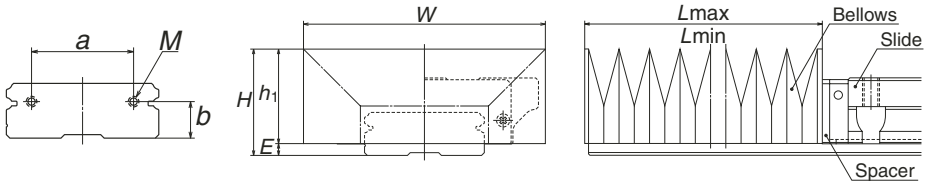


Fig. 7.8

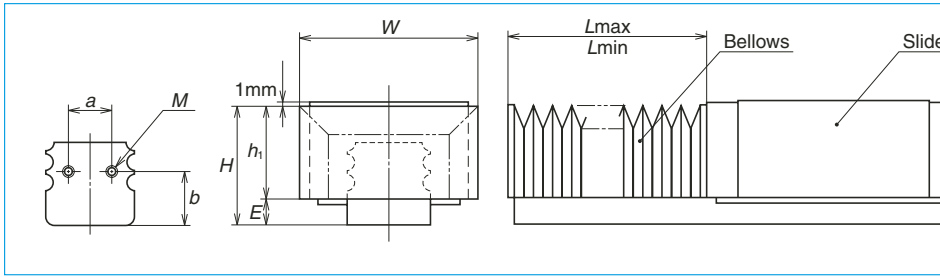


Fig. 7.9

Calculating length of bellows

- The formula is as follows.
- A bellows forms one block (BL) with six folds as shown in **Fig. 7.10**. The stroke is determined by multiplying by an integer of this BL.
- Length when stretched to the maximum length :

***L*max = 7 × P × Number of BL**

- Length when contracted to the minimum length :

***L*min = 17 × Number of BL**

- Stroke : **St = *L*max – *L*min**
- The dimension of P and the number of BL are shown in the bellows dimension table of each series.

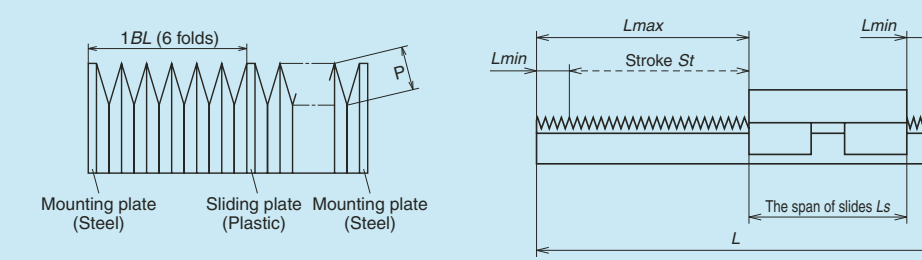


Fig. 7.10

A-3-8 Rust Prevention (Stainless Steel and Surface Treatment)

1. Stainless steel

NSK linear guide is available in stainless steel.

○Stainless steel standard series

PU Series PE Series
LE Series Miniature LH Series LL Series

○Available in stainless steel

NH Series
NS Series
LU Series

Select from the above when using in the environments which invite rust.

2. Surface treatment

(1) Recommended surface treatment

We recommend "low temperature chrome plating" and "fluoride low temperature chrome plating" for rust prevention because of the result of the humidity chamber test for antirust characteristics and their cost-effectiveness.

However, never apply any organic solvent to those treatments for degreasing because it has adverse effect on antirust characteristics.

Refer to the next page for the results of humidity chamber test.

Please consult NSK for other surface treatment.

○**Low temperature chrome plating (Electrolytic rust prevention black treatment)**

- Used to prevent corrosion, light reflection, and for cosmetic purpose.

○**Fluoride low temperature chrome plating**

- Fluoroplastic coating is provided following the low temperature chrome plating.
- Resistance to corrosion is higher than electrolytic rust prevention film treatment.

(2) Rust prevention of fluoride low temperature chrome plating

The use environment of NSK linear guides is expanding from general industrial machines, semiconductor and liquid crystal manufacturing systems to aerospace equipment.

Among all measures to cope with environment, rust prevention is the most challenging. Such environment includes:

- Moisture for washing machines and other equipment
- Chemicals used in the wet processing of semiconductor and liquid crystal display manufacturing equipment

NSK has developed electrolytic rust prevention black film treatment (black chrome plating) which is added by fluororesin impregnating treatment. (Hereinafter referred as "Fluoride low temperature chrome plating") This surface treatment methods has proved its superiority as the rust prevention of linear guides which are used in the above equipment.

● What is "Fluoride low temperature chrome plating?"

This is a type of black chrome plating which forms a black film (1 to 2 μm in thickness) on the metal surface. Fluoroplastic coating is added to the film to increase corrosion resistance.

- Accuracy control is easily manageable due to low temperature treatment and to the absence of hydrogen embrittlement.
- Product accuracy is less affected due to the thin film which has high-corrosion resistance.
- This method is superior to other surface treatments in durability on the rolling surface.
- Inexpensive compared with products with other surface treatment and stainless steel products.

However, do not use organic solvent because it adversely affects antirust property of the plating.

● Humidity chamber test

Table 8.1 Results of the humidity test

Characteristic \ Test sample			Fluoride low temperature chrome plating (Recommended)	Hard chrome plating (Reference)	Electroless nickel plating (Reference)	Equivalent to SUS440C material	Standard steel
Corrosion-resistant property	Rusting	Top	(Ground) B	(Ground) B	(Ground) A	(Ground) C	(Ground) D
		Side	(Ground) A	(Ground) A	(Ground) A	(Ground) C	(Ground) E
		Bottom	(Ground) A	(Ground) A	(Ground) A	(Ground) C	(Ground) E
		End	(Machined) A	(Machined) C	(Machined) A	(Machined) C	(Machined) E
		Chamfer/grinding recess	(Drawn) A	(Drawn) D	(Drawn) A	(Drawn) C	(Drawn) E
	<Test conditions> ● Testing chamber: High temperature, highly moist chamber (made by DABAI ESPEC) ● Temperature: 70°C ● Relative humidity: 95% ● Testing time: 96 h Time to "ramp-up" and "ramp-down" conditions of the temperature and the humidity Ramp-up: 5 h Ramp-down: 2 h						
							
	Film thickness		5 μm	0.5 – 7 μm	10 μm	—	—

Rusting A: No rust B: Not rusted, but slightly discolored
C: Spotty rust D: Slightly rusted E: Completely rusted

● Chemical corrosion resistance test

Table 8.2 Results of the corrosion resistance test

Test conditions Rail base material : Equivalent to SUS440C
Chemical density : 1 mol/ℓ

Fluoride low temperature chrome plating		Hard chrome plating (reference)	None surface treatment
	Immersed in solution for 24 hrs Nitric acid		
	Immersed in solution for 24 hrs Fluoride		
	Immersed in solution for 72 hrs Hydrochloric acid type washing solution $HC\ell : H_2O_2 : H_2O = 1 : 1 : 8$		
○	Hydrochloric acid (immersed)	○	▲
○	Sulfuric acid (immersed)	○	×
○	Ammonia or sodium hydroxide	○	△

○: Normal △: Partial surface damage ▲: Overall surface damage ×: Corroded

● Surface treatment durability test

Peeling resistance of surface treatment

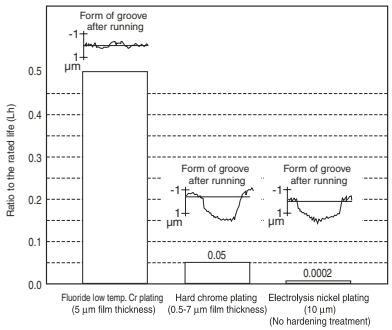


Fig. 8.1 Results of durability test

● Total evaluation

Table 8.3 Evaluation

	Rust prevention ability	Quality stability	Durability	Cost
Fluoride low temperature chrome plating (recommended)	◎	○	◎	◎
Hard chrome plating (reference)	○	×	△	△
Electroless nickel plating (reference)	◎	△	×	△
Material equivalent to SUS440C	○	◎	◎	△

◎: Excellent ○: Suitable in use
△: Not so good for use ×: Problem in use

A-3-9 Special Environment

1. Heat-resistant specifications

- Standard linear guides use plastic for rolling element recirculation component. The maximum temperature in use for standard linear guides is 80°C.
- Use the linear guide with heat-resistant specifications under temperatures that exceed this limit.

Table 9.1 Comparison of materials: Standard and heat-resistant specifications

Component	Standard specification	Heat-resistant specification
Rail	Special high carbon steel (equivalent to SUS440C/JIS)	Special high carbon steel (equivalent to SUS440C/JIS)
Slide	Special high carbon steel (equivalent to SUS440C/JIS)	Special high carbon steel (equivalent to SUS440C/JIS)
Rolling elements	SUJ2, SUS440C	SUJ2, SUS440C
Retainer	Polyacetals	SUS304
Retaining wire	SUS304	SUS304
End cap	Polyacetals	SUS316L
Return guide	Polyacetals	SUS316L
End seal	Acrylonitril-butadiene rubber, SPC/JIS and stainless steel	Fluoro rubber, SPC/JIS and stainless steel
Bottom seal	Acrylonitril-butadiene rubber, SPC/JIS and stainless steel	Fluoro rubber, SPC/JIS and stainless steel

Heat resistant linear guides

NH Series **NS Series**
LW Series **LU Series**
LE Series

See page A66 for the availability.

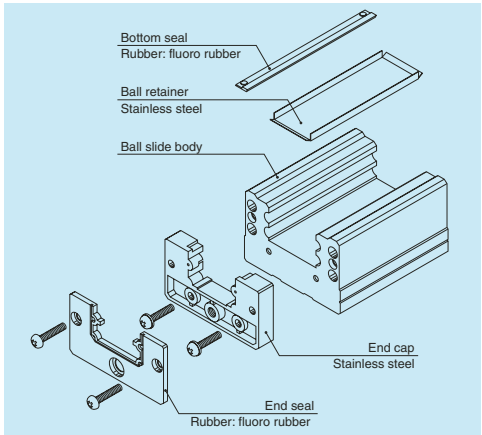


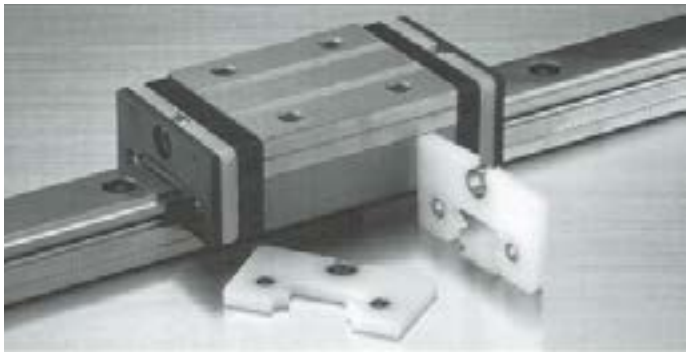
Fig. 9.1

2. Vacuum and clean specifications

- Based on its abundant experience and technology, NSK manufactures linear guides that can be used in a vacuum or in clean environment. Please consult NSK for more details.
- Linear guide specifications vary for environmental conditions.
  For example, "all stainless steel plus special grease, or solid film lubricant is suitable" for vacuum environment.
- NSK has low-dust generating grease **"LG2"** which is ideal for clean environment.
  Refer to page A43 for details.

3. "NSK linear guides for food processing equipment and medical devices" for sanitary environment

Used with NSK K1 for food processing equipment and medical devices and grease for food processing equipment.



What is "NSK K1™" for food processing equipment and medical devices?

With an amazing innovation lubrication unit, the NSK K1 for food processing equipment and medical devices utilizing the US Food and Drug Administration (FDA) compliant material, provides reliability when used in food processing equipment and medical devices. The newly developed porous synthetic resin contains abundant lubricant.

With the basic function of highly praised NSK K1 lubrication unit for general industry, more sophisticated materials make it applicable in food and medical equipment.

It also offers easy installation: it is installed inside the standard end seal.

(1) Features

1) The highest grade of category H1 grease of USDA standard is used for NSK K1 lubrication unit.

*category H1: Lubricants permitted for use where there is possibility of incidental food contact

*USDA: USDA (The United States Department of Agriculture)

<Features of grease for food processing machines>

• This grease is approved by USDA H1. (National Science Foundation [NSF] carries out certification for USDA.)

• Superb water resistance and antirust capability

• Superb wear resistance

• Applicable for a centralized oiling system

2) Appropriate volume of grease

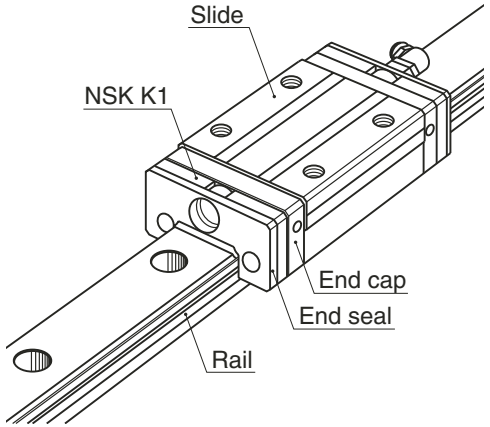
A supply of appropriate volume of grease reduces grease draining and scattering, and maintains a clean environment.

(2) Available models

Table 9.2 shows available models.

Table 9.2

NH Series	NH15, NH20, NH25, NH30 and NH35
NS Series	NS15, NS20, NS25, NS30 and NS35
LW Series	LW17, LW21, LW27 and LW35
PU Series	PU09, PU12 and PU15
LU Series	LU09, LU12 and LU15
PE Series	PE09, PE12 and PE15
LE Series	LE09, LE12 and LE15
Miniature LH Series	LH12



Precautions for use

To maintain optimal performance of NSK K1 lubrication unit over a long time, please follow the instructions below:

1. Temperatures range for use: Maximum temperature in use: 50°C
   Momentary maximum temperature in use: 80°C
2. Chemicals that should not come to contact:
   Do not leave NSK K1 lubrication unit in organic solvent, white kerosene such as hexane, thinner which removes oil, and rust prevention oil which contains white kerosene.

Note: Water-type cutting oil, oil-type cutting oil and grease such as mineral-type and ester-type do not damage NSK K1 lubrication unit.

4. Specifications for special environments

Table 9.3 Linear guide specifications

Environment	Condition	NSK linear guide specifications				Technical Explanation Page No.
		Rail, slide	Steel balls/rollers	Ball Recirculation component	Lubrication/surface treatment	
Clean	Atmosphere, normal temperature	Standard material	Standard material	Standard material	LG2 Grease, LGU Grease	D8
					NSK K1 lubrication unit	D10
		Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	LG2 Grease, LGU Grease	D8
					NSK K1 lubrication unit	D10
					Fluoride low temperature chrome plating	D5
	Atmosphere–Vacuum, normal temperature				Fluoride grease	
	Atmosphere–Vacuum up to 200°C					
Vacuum	Atmosphere–Vacuum, normal temperature	Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	Fluoride grease	
	Atmosphere–Vacuum up to 200°C					
	Atmosphere–Vacuum up to 300°C				Molybdenum disulfide	
	High vacuum up to 500°C				Special silver film	D7
Corrosion resistance	Vapor, steam	Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel		
		Standard material	Standard material	Standard material	Fluoride low temperature chrome plating	D5
	Acid, alkali			Austenitic stainless steel		D5
		Martensitic stainless steel	Martensitic stainless steel			D5
	Acid, alkali, clean				Fluoride low temperature chrome plating	D5
					LG2 Grease, LGU Grease	D8
	Strong acid, strong alkali				Fluoride low temperature chrome plating	D5
					Fluoride grease	
	Organic solvent				Fluoride grease	
High temperature	Atmosphere up to 150°C	Standard material	Standard material	Austenitic stainless steel	ET-100K Grease	
		Martensitic stainless steel	Martensitic stainless steel			
	Atmosphere Up to 200°C				Fluoride grease	
	Atmosphere Up to 200°C, Corrosion resistant				Fluoride grease	
Low temperature	-273°C and higher	Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	Solid lubricant	
Radiation resistance	Atmosphere	Standard material	Standard material	Standard material	Radiation resistant grease	
		Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel		
Foreign matters	Fine particles, wooden chips	Standard material	Standard material	Standard material	NSK K1 lubrication unit	D10
		Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel		D10
	Water, under water		Standard material	Standard material		D10
			Martensitic stainless steel	Austenitic stainless steel		D10

5. Lubrication and materials

(1) Lubrication

Grease can be used for high rotation and magnetic field. However, grease evaporates or solidifies in special environment such as vacuum, high temperature, and low temperature. Solid lubricant is used when it is difficult to use grease. Functions of solid lubricant differ greatly by condition where it is used. It is important to select the most suitable solid lubrication for the environment.

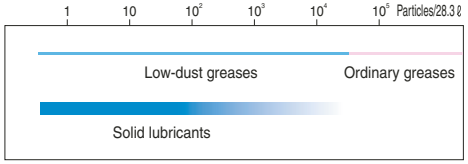


Fig. 9.2 Lubrication in clean environment

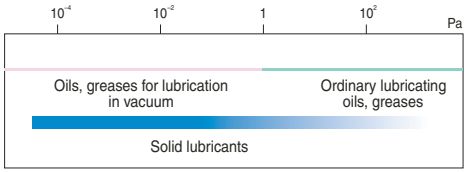


Fig. 9.3 Lubrication in vacuum

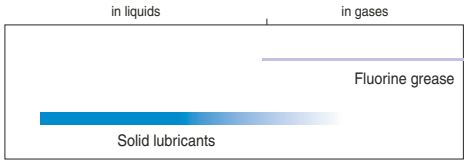


Fig. 9.4 Lubrication in corrosive environment

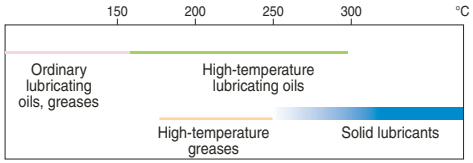


Fig. 9.5 Lubrication in high temperature

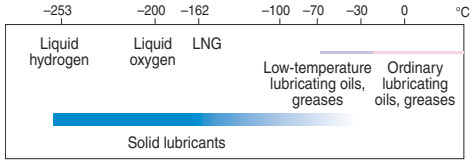


Fig. 9.6 Lubrication in low temperature

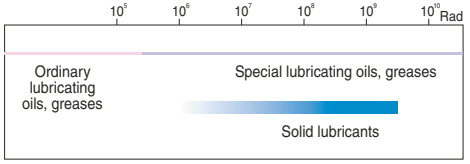


Fig. 9.7 Lubrication in radioactive environment

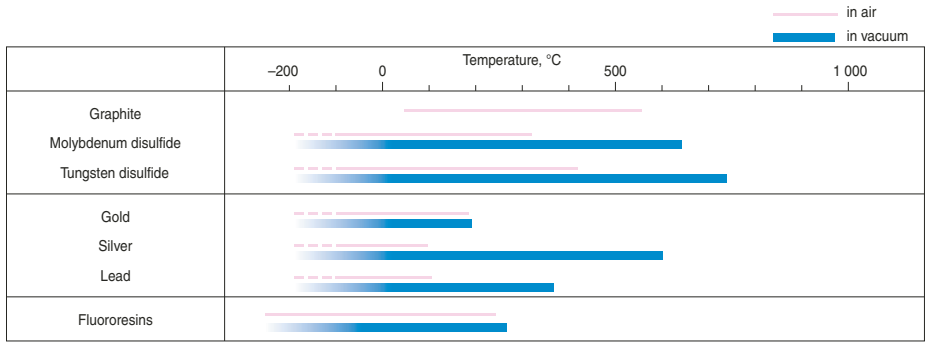


Fig. 9.8 Temperature range for using solid lubricants

(2) Materials

Iron type metals are used in vacuum, high temperature, and high speed environments as the basic material. We generally use nonmagnetic stainless steel for nonmagnetic materials.

Table 9.4 Characteristics of metal materials

Application	Type of steel	Linear expansivity $\times 10^{-6}$/°C	Young's modulus GPa	Hardness * HB
For clean environment, vacuum environment, corrosion resistance, low temperature, high temperature, radioactive resistance	Martensitic stainless steel SUS440C	10.1	200	580
	Austenitic stainless steel SUS304	16.3	193	150
	Precipitation hardened stainless steel SUS630	10.8	200	277 – 363
Nonmagnetic	Nonmagnetic stainless steel	17.0	195	420

*) Hardness of steel is usually indicated by Rockwell C Scale. For comparison, these figures are expressed by Brinell number.

6. Responsiveness of NSK linear guides for special environments

Series	Model No.	Special environment which linear guide can tolerate					
		Clean	Vacuum	Corrosion	High temp.	Hygienic	High dust proofing
NH	NH15	○		○		○	
	NH20	○	○	○	○	○	
	NH25	○	○	○	○	○	
	NH30	○	○	○	○	○	
	NH35	○		○	○	○	
	NH45	○		○	○		
	NH55	○		○			
	NH65	○		○			
VH	VH15	○		○			○
	VH20	○		○			○
	VH25	○		○			○
	VH30	○		○			○
	VH35	○		○			○
	VH45	○		○			○
	VH55	○		○			○
TS	TS15	○		○			
	TS20	○		○			
	TS25	○		○			
	TS30	○		○			
	TS35	○		○			
NS	NS15	○	○	○	○	○	
	NS20	○	○	○	○	○	
	NS25	○	○	○	○	○	
	NS30	○	○	○	○*	○	
	NS35	○		○		○	
LW	LW17	○		○	○*	○	
	LW21	○		○	○*	○	
	LW27	○		○	○	○	
	LW35	○		○		○	
	LW50	○		○			
PU	PU05	○		○			
	PU07	○		○			
	PU09	○		○		○	
	PU12	○		○		○	
	PU15	○		○		○	
LU	LU05	○		○			
	LU07	○		○			
	LU09_L	○	○	○	○	○	
	LU09_R	○		○		○	
	LU12_L	○	○	○	○	○	
	LU12_R	○		○		○	
	LU15	○	○	○	○*	○	

Series	Model No.	Special environment which linear guide can tolerate					
		Clean	Vacuum	Corrosion	High temp.	Hygienic	High dust proofing
PE	PE05	○		○			
	PE07	○		○			
	PE09	○		○		○	
	PE12	○		○		○	
	PE15	○		○		○	
LE	LE05	○		○			
	LE07	○	○	○	○*		
	LE09_L	○	○	○	○*	○	
	LE09_R	○		○		○	
	LE12_L	○	○	○	○	○	
	LE12_R	○		○		○	
	LE15_L	○	○	○	○	○	
	LE15AR	○		○		○	
Miniature LH	LH08	○		○			
	LH10	○		○			
	LH12	○		○		○	
RA	RA15	○		○			
	RA20	○		○			
	RA25	○		○			
	RA30	○		○			
	RA35	○		○			
	RA45	○		○			
	RA55	○		○			
	RA65	○		○			
LA	LA25	○		○			
	LA30	○		○			
	LA35	○		○			
	LA45	○		○			
	LA55	○		○			
	LA65	○		○			
HA	HA25	○		○			
	HA30	○		○			
	HA35	○		○			
	HA45	○		○			
	HA55	○		○			
HS	HS15	○		○			
	HS20	○		○			
	HS25	○		○			
	HS30	○		○			
	HS35	○		○			

*) Applicable except for the dust-proofing parts.

7. Precautions for handling

Please observe the following precautions to maintain high functions of NSK linear guide.

- Products are washed to remove oil, and wrapped in a way to protect them from moisture. Use the product as soon as possible after opening the package.
- After opening, store the products in a clean, air-tight container such as desiccater with desiccating agent (e.g. silica gel). Do not apply rust preventive oil or an antirust paper that vaporizes rust preventive agent.
- Wear plastic gloves and handle product in a clean place.

Note: Please refer to the catalog "CAT. No. E1258 SPACEA" for the details of special environmental use.

A-3-10 Arrangement and Mounting of Linear Guide

1. Arrangement

- For NSK linear guides, the datum surfaces of the rail and of the slide are either marked with a "datum surface groove" or with an "arrow."
- In case that two or more linear guides are used together, one linear guide is designated as a reference side guide, and the rest is adjusting side guide(s). The reference side linear guide has its reference number, serial number, and "KL" mark on the opposite side of the datum surface (**Fig. 10.1**).
- When the datum surfaces of the reference side rail and slides are pressed to their mounting datum surfaces respectively, the variation of distance (mounting width W_2 or W_3) between the datum surfaces of the rails and that of the slides must be a minimum and therefore, it is specified as the standard. (**Figs. 10.2** and **10.3**)
- The ways to indicate the datum surfaces of each series are shown in **Table 10.1**.

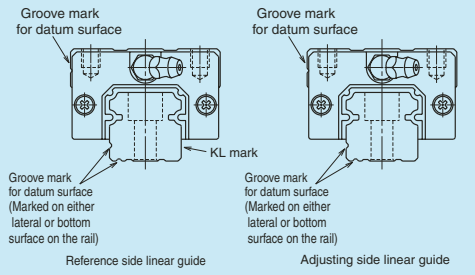


Fig. 10.1 Datum surface

Example of arrangement

- The arrangement of the linear guides must be determined taking into account the table mounting position (horizontal, vertical, inclined, or upside-down), strokes and the size of the machine base to which the table is mounted. **Table 10.2** shows common arrangement examples and their properties (features/precautions).

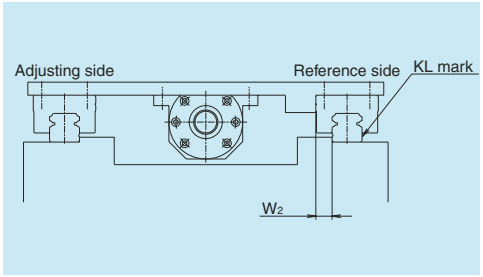


Fig. 10.2 Most common setting of the reference side rail

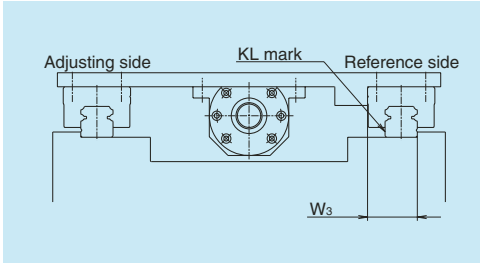


Fig. 10.3 Setting of the reference side rail in certain occasions

Table 10.1 Marks on the rail datum surfaces in each series

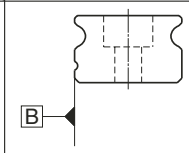
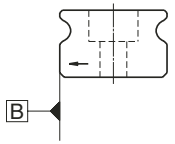
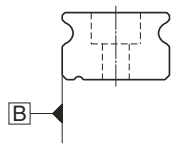
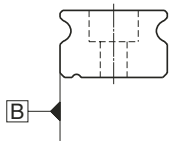
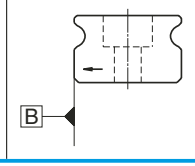
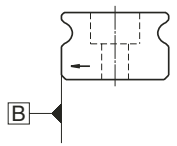
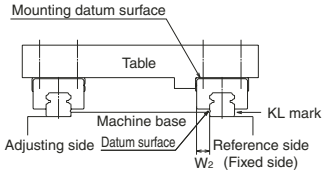
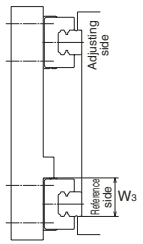
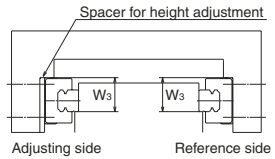
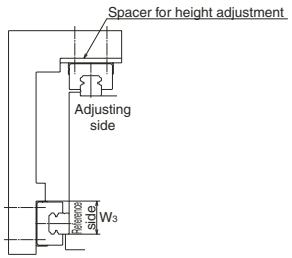
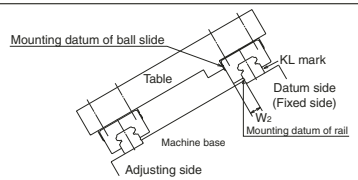
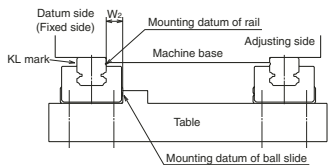
Material \ Model No.	Standard	LU05, 07, 09 PU05, 09, 12, 15 LE07, 09, 12	LU12, 15, NH15, NS15	PU07 LE05, 15 LE09, 12 (with a ball retainer) PE series LH08, 10, 12 LW17, 21 RA15
Special high carbon steel				
Stainless steel				

Table 10.2 Arrangement example

Arrangement	Features/Precautions
	• Easy for a highly-accurate installation (recommended arrangement)
	• Easy in highly-accurate installation • The lubricant oil may not be supplied to slides. When oil lubricant is used, special care is required to design the oil supply routing.
	• Slightly difficult for a highly-accurate installation • The life of the linear guides is affected by the mounting accuracy. • When oil lubricant is used, special care is required to design the oil supply routing.
	• Difficult for a highly-accurate installation • When oil lubricant is used, special care is required to design the oil supply routing.
	• Rather easy for a highly-accurate installation • When oil lubricant is used, special care is required to design the oil supply routing.
	• Easy in highly-accurate installation if the linear guides are installed to the machine base first, and then hung them upside down along with the machine base. • The slide may detach from the rail and fall down if the linear guide is damaged and rolling elements in the slide fall out. It is necessary to take preventive measures against the falling of the ball slide.

2. Mounting accuracy

(1) Accuracy of the mounting base of machine

- The mounting accuracy of linear guide usually copies the accuracy of the machine base.
- However, when two or more slides are assembled to each rail, the table stroke becomes shorter than the mounting surface. This, along with the fact that the mounting error is evenly spread, contributes to a higher table accuracy than the mounting surface accuracy, reducing the error to about 1/3 in average (**Fig. 10.4**).

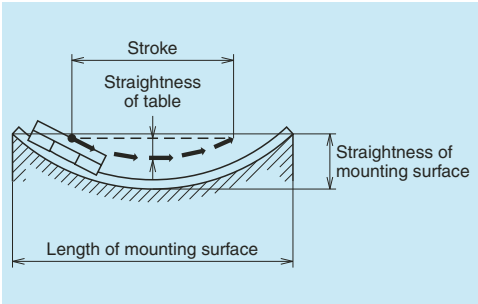
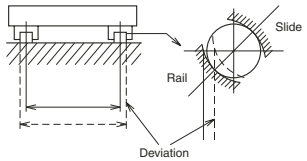
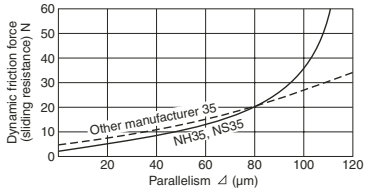
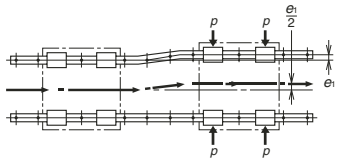


Fig. 10.4

(2) Installation error

- Mounting error affects mainly three factors: life, friction and accuracy (**Table 10.3**).

Table 10.3 Influence of mounting error

Factor	Influence	
Life		• Large mounting error generates a force which twists the slide and reduces its life. • It also distorts the contact point of the ball and the groove, and changes contact angle, thus lowering the table rigidity.
Friction		• NH and NS Series are affected very little by mounting error thanks to their small friction. (self aligning capability) • However, because of off-set Gothic arch grooves, their friction suddenly soars once the mounting error exceeds a certain level. • The mounting error severely affects friction of LA Series with heavy preload.
Accuracy		• When the rigidity of four slides is equal, the theoretical straightness becomes 1/2 of the installation error "e_1". • However, this value becomes slightly larger due to the deformation of the rail and the machine base.

(3) Permissible values of mounting error

- Among the three factors of life, friction, and accuracy, which are affected by the mounting error, NSK focuses on the life factor to determine the permissible mounting accuracy. The specifications are based on the following conditions.

For ball linear guides
- The permissible load per ball slide due to the mounting error is 10% of the basic dynamic load rating C_{50}.
- The rated life is 5 000 km.
- The rigidity of the machine base is infinite.

For roller linear guide
- The permissible load per roller slide due to the mounting error is 10% of the basic dynamic load rating C_{100}.
- The rated life is 10 000 km.
- The rigidity of the machine base is infinite.

C_{50} ; Basic dynamic load rating for 50 km rated fatigue life

C_{100} ; Basic dynamic load rating for 100 km rated fatigue life

- **Figs. 10.5** and **10.6** are representing the mounting errors of e_1 and e_2. Their permissible values are shown in the description of "**5. Installation**" of the each series.

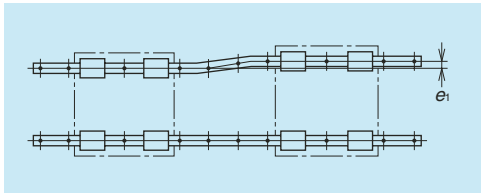


Fig. 10.5

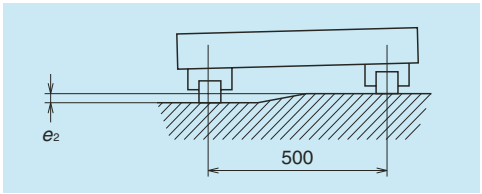


Fig. 10.6

(4) Running accuracy and the influence of even-off effect

- When mounting on a machine base, the linear guide is affected by the flatness of the mounting surface. However, in the case of two-rail/four-slide specification, which is most widely used, the straightness as a table unit is generally less than the straightness as a single component. This is due to the even-off effect generated by the shorter table stroke, compared to the rail length, as well as by interaction between the rails and slides.
- **Fig. 10.9** shows an actually measured straightness of the table which uses NSK linear guides. In this case, the final straightness of the table is about 1/5 of the straightness of the mounting surface.

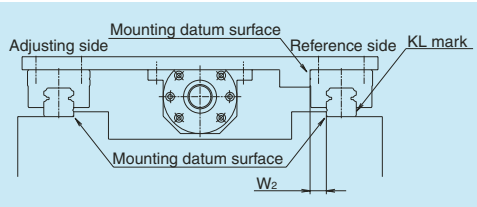


Fig. 10.7

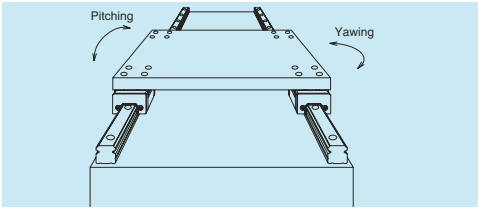


Fig. 10.8

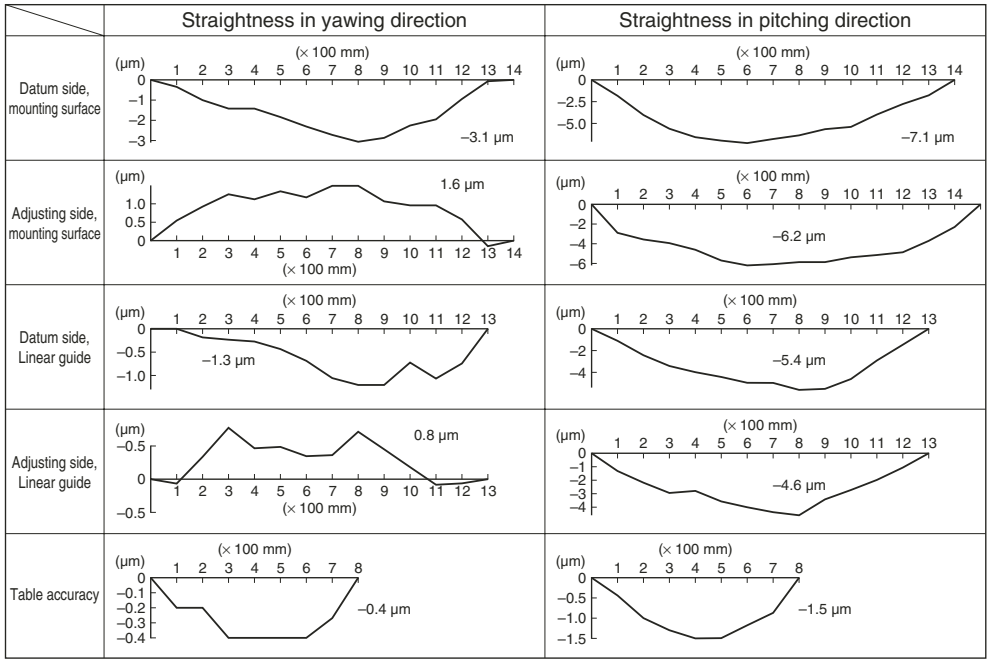


Fig. 10.9 Straightness of the table equipped with linear guide

3. Installation

(1) Shoulder height of the mounting surface of the machine base and corner radius r

- **Figs. 10.10** and **10.11**, show shoulder height of the mounting surface of the machine base and the size of corner radius. These figures are relevant when the linear guide is pressed to the shoulder of the machine base or table (the raised section from where the mounting surface begins), and horizontally secured to it. Recommended sizes are shown in the clause of "Shoulder height and corner radius r" of each series introduction.
- The shoulder should be thick (wide) enough, so it is not deformed by the pressing force.

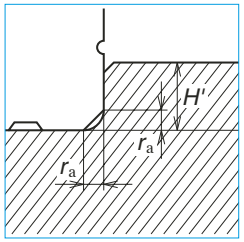


Fig. 10.10 Shoulder for the rail datum surface

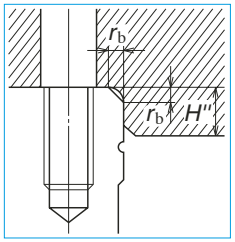


Fig. 10.11 Shoulder for the slide datum surface

(2) Tightening torque of the bolt

- **Table 10.4** shows tightening torque of the bolt when the rail is secured to the fixture of race way grinding machine.
- Apply same torque in this table when securing the rail to the machine base. Equal accuracy at the time of grinding can be obtained.

Table 10.4 Bolt tightening torque (Bolt material: High carbon chromium steel)

Unit: N·m

Bolt size	Tightening torque	Bolt size	Tightening torque
M2.3	0.38	M10	43
M2.5	0.58	M12	76
M3	1.06	M14	122
M4	2.5	M16	196
M5	5.1	M18	265
M6	8.6	M22	520
M8	22	—	—

(3) Installation procedures

- There are two installation ways depending on the accuracy requirement.
  a. Installation with high accuracy
  b. Accuracy is not high, but easy to install
- For both methods, wipe off the rust preventive oil applied to the linear guide. Remove burrs and small bumps on the machine base and table mounting surface with an oilstone (**Fig. 10.12**).
  Apply machine oil or similar oil with low viscosity to the mounting surface to increase the rust preventive effect.
- Linear guides are precision products. Handle them with care.

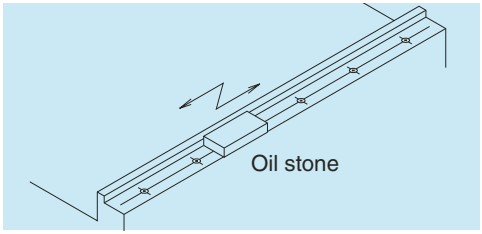


Fig. 10.12

1) Highly accurate installation
A) Rail installation procedures
a) When the machine base has a shoulder for the reference side rail.

[1] Confirm that the rail is reference side rail, and the datum surface of the rail comes to face to face with the shoulder of the machine base. Keep the slides on the rail, and carefully place the rail on the machine base on its mounting surface. Loosely tighten the bolts.
At this time, press the rail from sideways to make the rail tightly contact to the shoulder of the machine base. When using a shoulder plate, refer to **Table 10.4** for the bolt tightening torque (**Fig. 10.13**).
Refer to "**4. Various methods to press linear guide sideways.**"

[2] For final tightening of the bolts to secure the rail, tighten the bolt on either end of the rail, then proceed to other end.
If the datum surface is on the left side as shown in **Fig. 10.14**, tighten the bolt at the farthest end first, then proceed to the near end.
This way, creates a bolt rotating force that presses the rail against the shoulder. (Therefore, the rail is pressed sufficiently tight against the shoulder by merely pressing the rail by hand. However, if there is a possibility applying a lateral impact load, it is necessary to use a shoulder plate to prevent the rail from slipping.)

[3] If the mounting surface of the machine base where the adjusting side rail is installed also has a shoulder, repeat the steps [1] - [2].

[4] If there is no shoulder on the mounting surface of the machine base for the adjusting side rail: Secure a measuring table to the slides of the reference side rail (**Fig. 10.15**). Use this to adjust the parallelism of the adjusting side rail. Check parallelism of the adjusting side rail with a dial indicator from one end of the rail, tightening the bolts one by one.
The measuring table is more stable if secured to two slides, but one slides is sufficient.
Parallelism between two rails can also be checked by the same method in **Fig. 10.15** when there is a shoulder on the surface where the adjusting side rail is installed.

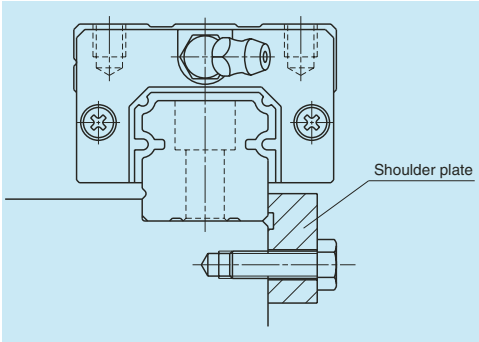


Fig. 10.13 Pressing the rail from sideways

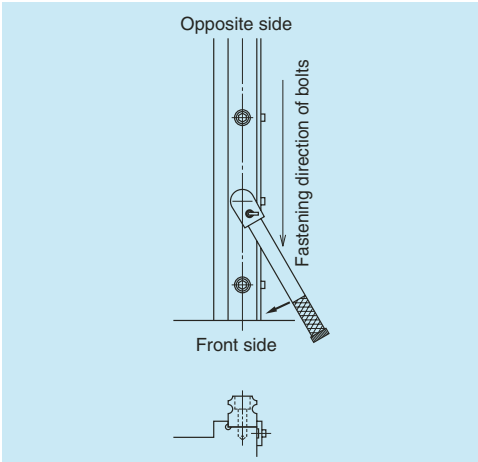


Fig. 10.14 Rail installation

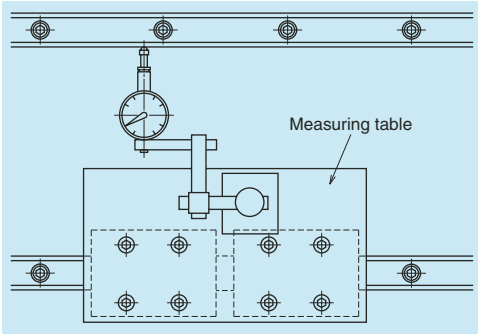


Fig. 10.15 Measuring parallelism

b) When the machine base does not have a shoulder on the side where the reference side rail is installed

[1] Carefully place the reference side rail on its mounting surface of the machine base. Loosely tighten the bolts. Do not tighten the bolts all the way, but stop tightening when the bolt enters halfway into the bolt hole. This makes the proceeding steps easier.

[2] Place the straight edge almost parallel to the reference side rail which is temporarily secured by the bolts. (At both ends of the rail and straight edge, the distance between them shall be almost same.)

[3] Once the position of the straight edge is determined, use it as the reference. With a dial indicator, check parallelism with the rail, and adjust the rail if necessary. Then tighten the bolts.
Ensure that the straight edge does not move while the bolts are being tightened.
This procedure should be carried out starting from one end of the rail to the other end (**Fig. 10.16**).

[4] Finally tighten all bolts with specified torque.

[5] There are two ways for installation of adjusting side rail:
1. Based on the straight edge which is used for reference side rail installation
2. Based on the reference side rail which is installed prior to the adjusting side rail.
In both cases, use a dial indicator to measure parallelism.
Other procedures are the same as [1] - [4] above, and the [4] for the case where there is a shoulder on the machine base.

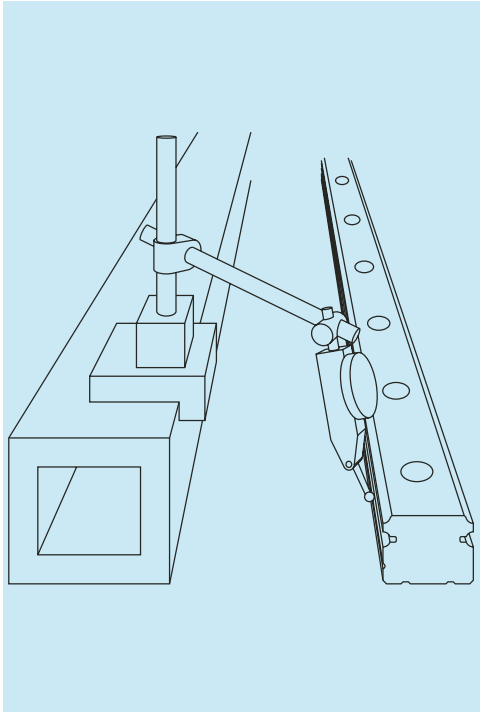


Fig. 10.16

B) Procedures for slide installation
a) When the table has a shoulder

[1] Arrange the slides so that locations match to their mounting section of the table. Carefully place the table on the slides. Loosely tighten all bolts.

[2] While pressing the table from sideways, further tighten the bolts which secure the slides on the reference side, so the table shoulder and the slide's mounting datum surface are sufficiently tightly pressed.
If a shoulder plate is provided, first tighten the bolts of the plate, then further tighten the bolts to the slides (**Fig. 10.17**).

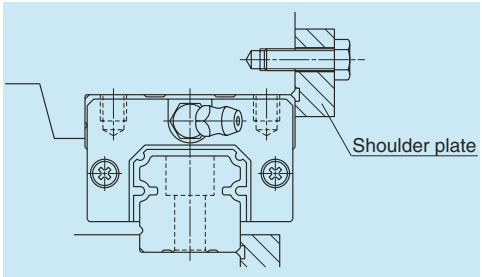


Fig. 10.17 Pressing slide from sideways

[3] Then, further tighten the bolts for slides on the adjusting side rail.
Move the table by hand to confirm that there is no abnormality such as excessive friction force during stroking. (This confirms that the correct installation steps were taken.)
[4] Finally, tighten all bolts with standard torque.

b) When table does not have a shoulder
[1] Arrange the slides so that locations match to their mounting section of the table. Carefully place the table on the slides. Loosely tighten bolts to secure the slides.
[2] Since the table does not have a shoulder, immediately tighten the bolts further to secure slides.
[3] Move the table by hand to confirm that there is no abnormality. Finally, tighten all bolts with the specified torque.

2) Easy installation
[1] Carefully place the reference side rail on the machine base. Then tighten the bolts to the specified torque.
[2] Loosely tighten the bolts on the adjusting side rail.
[3] Tighten the slides on the reference side rail and one slide on the adjustment side rail with the specified torque. Leave the rest of the slide on the adjusting side rail loosely tightened (**Fig. 10.18**).
[4] While moving the table with each pitch of the bolt for rail: With the specified torque, tighten the rail mounting bolt which is located immediately adjacent to the slide on the adjusting side rail that had been firmly tightened.
Take this procedure from one end to the other.
[5] Return the table to the original position once. Then, tighten the rest of the slides on the adjusting side to the specified torque. By the same procedure as in [4], tighten the rest of the rail mounting bolts to the specified torque. Move the table to check any abnormality such as large friction force.

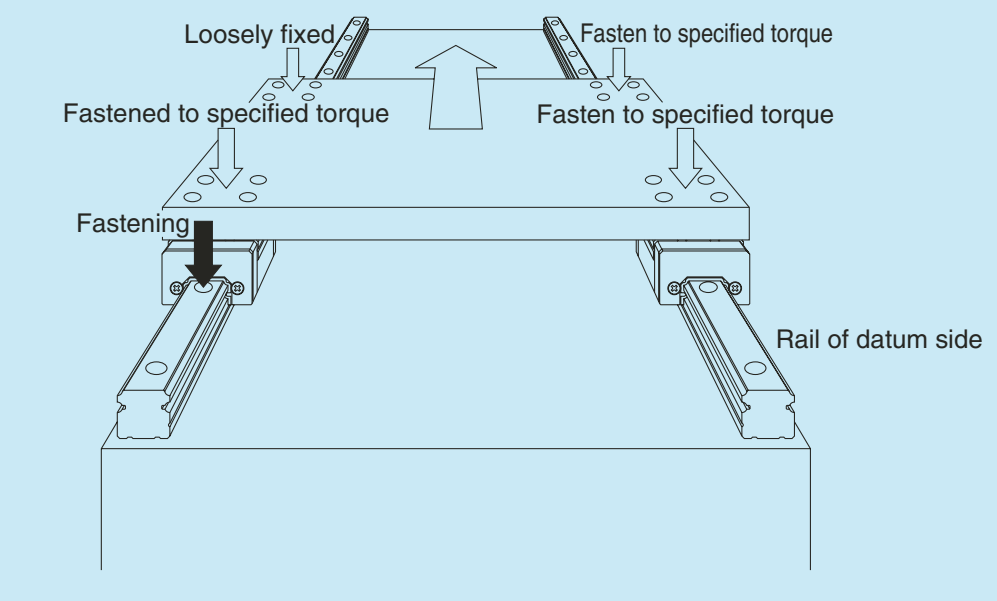


Fig. 10.18 Easy installation

(4) Various methods to press linear guide sideways

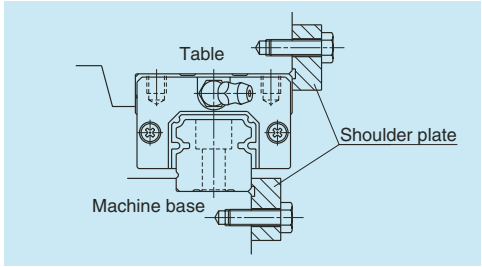


Fig. 10.19 Recommended method

- This method is most widely used, and generally recommended. The slides and the rail should protrude slightly from the sides of the table and the machine base. The shoulder plate should have a recess, so that the corners of the rail and slide do not touch the shoulder plate.

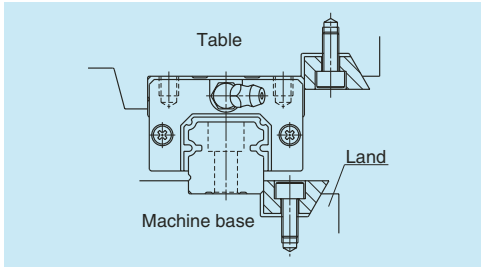


Fig. 10.20 Installation that requires caution

- A tapered block is squeezed in. However, the slightest tightening of the bolt generates a large pressing force to the side. Too much tightening may cause the rail to deform, or the land (shown in the figure left) to warp to the right. This method requires caution.

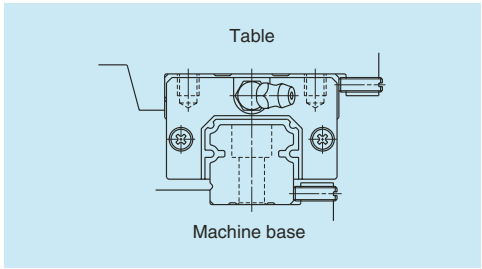


Fig. 10.21

- The bolt that presses rail must be thin due to limited space.

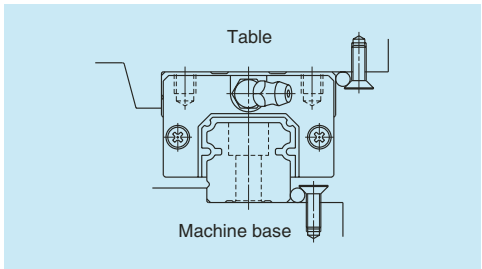


Fig. 10.22

- Press a needle roller with a taper section of the head of a slotted pan head screw. Watch out for the position of the screw.

4. Assembly random-matching type linear guide

- Slides of random-matching type are assembled on a provisional rail (an inserting tool) when it is delivered (**Fig. 10.23**).
- NSK standard grease is packed into the slide, allowing immediate use.

Assembly procedures of a random-matching type linear guide

Follow steps as described below.

(1) Wipe off the rust preventive oil from the rail and slide.

(2) Please match a groove mark for the datum surface of slide and rail to set a desired assembling state W_2 or W_3.

(3) Align the provisional rail to the rail in the bottom and side surfaces. Press the provisional rail lightly against the rail, and move the slide over the rail (**Fig. 10.23**).

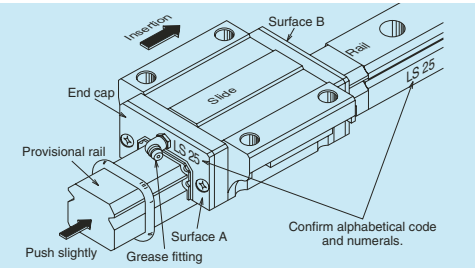


Fig. 10.23 Inserting slide into the rail

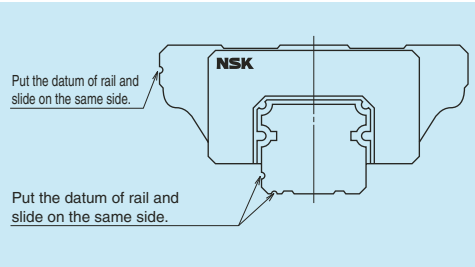


Fig. 10.24

5. Butting rail specification

- A rail which requires the length that exceeds the machine capacity manufactured maximum length comes in butting specification.
- The rails with butting specification are marked with alphabet (A, B, C ...) and an arrow on the opposite side of the mounting datum surface. Use the alphabets and arrows for assembly order and direction of the rail (**Fig. 10.25**). The random-matching rails for butting specification are only marked with the arrows.
- The pitch of the rail mounting hole on the butting section should be as F in **Fig. 10.26**. When two rails are used in parallel, the butted sections should not align. This is to avoid change in the running accuracy of the table at the butted sections.
- We recommend shifting the butting sections more than the length of a slide. If the higher running accuracy is required, consider installing the slides into the table so that they do not simultaneously pass the butting sections.

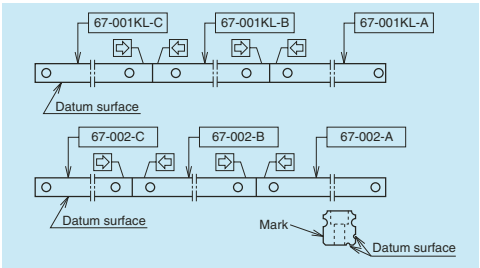


Fig. 10.25

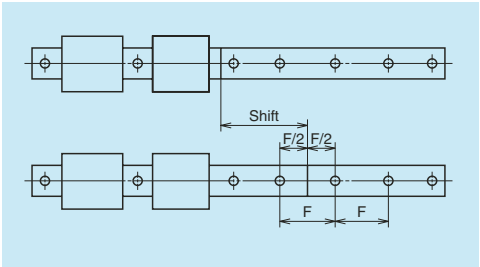


Fig. 10.26

6. Handling preloaded assembly

- In case of the preloaded assembly (not random-matching type), do not remove slides from the rail as a general rule.
- If it is unavoidable to remove slides from the rail, make certain to use a provisional rail (a jig used to insert a slide to the rail) as shown in **Fig. 10.27**.
- The provisional rails for each series and sizes are available.
- Pay due attention to the assembly mark when returning the slide back to the rail. Follow the cautions described below.

Mark for assembling ball slide and rail

- Rails of preloaded assembly (not random-matching type) are marked with a reference number and a serial number on the opposite of the datum surface.
- Slides to be combined are also marked with the same serial number (the reference number is not marked).
- Furthermore, slides are marked with an arrow. Slides should be positioned with their arrows facing each other.
- In case that the slides had to be removed from the rail, confirm their serial numbers and the directions of arrows for re-assembly (**Fig. 10.28**).
- When two or more rails are used in a single set, serial numbers are in sequence if their reference numbers are the same. The linear guide with smallest serial number has the "KL" mark (**Fig. 10.29**).
- When two or more rails of different reference number are used in a single set, the rails and slides have the same serial number. In this case, when slides are removed from the rail, it is unclear which rail each slide was previously installed on. When removing ball slides from the rail for an unavoidable reason (**Fig. 10.30**), sufficient precaution is required.

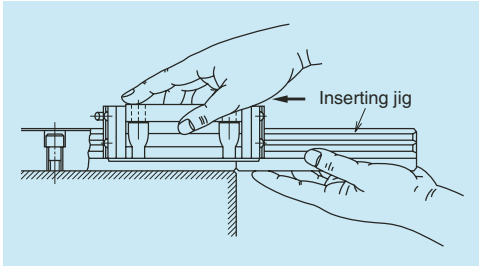


Fig. 10.27

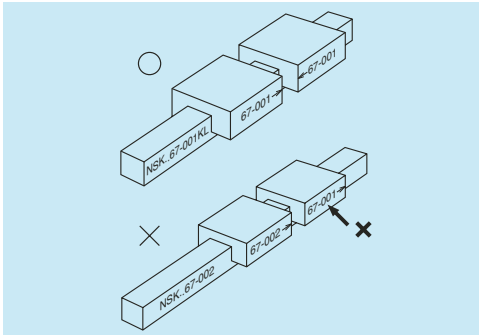


Fig. 10.28

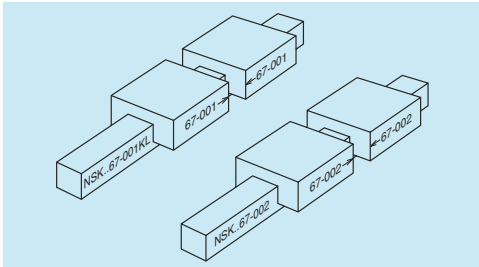


Fig. 10.29 When two rails have the same reference number

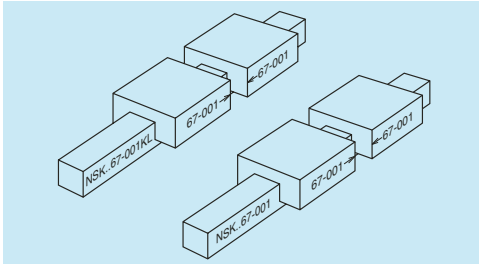


Fig. 10.30 When two rails have different reference number

A-3-11 Drills to Select Linear Guide

1. Single axis material handling system

This section explains the selection of linear guide, life calculation, and deformation at load acting point for a single axis material handling system equipped with linear guides.

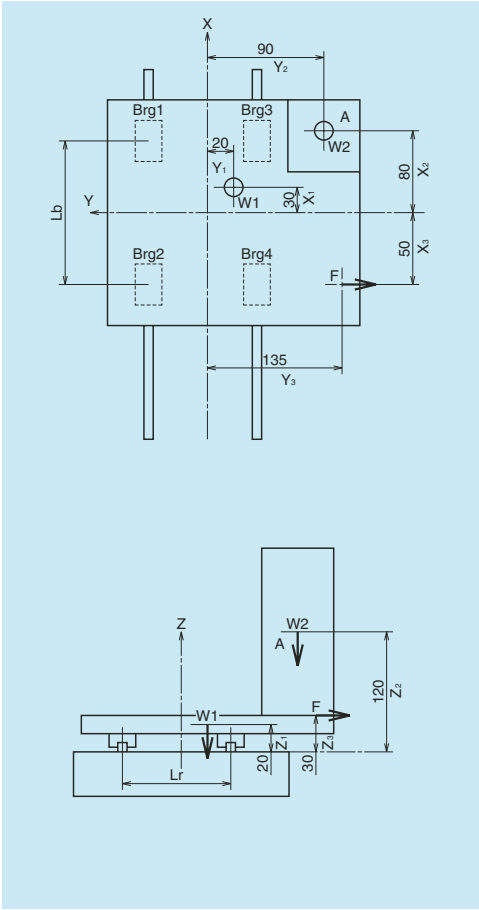


Fig. 11.1 Single axis material handling system

The work load is applied only to one way of stroke. Assume that the load is acting in full stroke as the condition of acting load is unknown.

Specification of the single axis material handling system

Table weight	W1	: 150 (N)
Weight of the work	W2	: 200 (N)
Acting load	F	: 200 (N)
Ball slide span	L_b	: 100 (mm)
Rail span	L_r	: 90 (mm)

Load point coordinates from the table center (mm)

Load	X axis	Y axis	Z axis
W1	30	–20	20
W2	80	–90	120
F	–50	–135	30

Stroke: 1 000 mm
(1 cycle: 2 000 mm)

Environment	: 10 – 30 (°C)
Travel speed	: 12 (m/min)
Time to reach travel speed	: 0.25 (sec)
Operating hour	: 16 (hr/day)

(1) Selection of linear guide model

Select a type of linear guide from **"A-1-2 Structure and Characteristics of Linear Guide."** Since this material handling system has two rails and four ball slides, **NH, NS, and PU Series** are suitable.

Here, we temporary select PU15 because of the dimensions of mounting space.

(2) Calculating life

Calculate life of the selected PU15AL based on **"A-3-2 Rating Life and Basic Load Rating."**

Linear guide PU15AL

Basic dynamic load rating C_{100} **: 4 400 (N)**
Basic static load rating C_0 **: 6 600 (N)**

Load conditions of the linear guide

Table weight	W1	: 150 (N)
Weight of the work	W2	: 200 (N)
Applied load	F	: 200 (N)
Rail span	L_r	: 90 (mm)
Ball slide span	L_b	: 100 (mm)

From the time to reach travel speed and the travel speed, the table acceleration is 0.8 m/sec^2. Therefore, it is not necessary to take into account inertial force brought about by the table mass.

Calculation of the load applied to ball slide

Calculate two occasions:

1. There is the work mounted on the table.
2. No work mounted on the table.

From **Pattern 4** on page A19 in **Table 2.2**

When a work is mounted on the table

Vertical loads

$$M1=\sum_{j=1}^{n}\left(F_{yj}\cdot Z_{yj}\right)+\sum_{k=1}^{n}\left(F_{zk}\cdot Y_{zk}\right)$$
$$=F\cdot Z_3+W1\cdot Y_1+W2\cdot Y_2$$
$$=-200\times 30+150\times(-20)+200\times(-90)$$
$$=-27\,000\ (\text{N}\cdot\text{mm})$$

$$M2=\sum_{i=1}^{n}\left\{F_{xi}\cdot\left(Z_{xi}-Z_b\right)\right\}+\sum_{k=1}^{n}\left(F_{zk}\cdot X_{zk}\right)$$
$$=W1\cdot X_1+W2\cdot X_2$$
$$=150\times 30+200\times 80$$
$$=20\,500\ (\text{N}\cdot\text{mm})$$

$$F_{r1}=\frac{\sum_{k=1}^{n}F_{zk}}{4}+\frac{M1}{2\cdot L}+\frac{M2}{2\cdot \ell}$$
$$=\frac{W1+W2}{4}+\frac{M1}{2\cdot L_r}+\frac{M2}{2\cdot L_b}$$
$$=\frac{150+200}{4}+\frac{-27\,000}{2\times 90}+\frac{20\,500}{2\times 100}$$
$$=40\ (\text{N})$$

Similarly
$F_{r2}=-165$(N)
$F_{r3}=\ 340$(N)
$F_{r4}=\ 135$(N)

Lateral loads

$$M3=-\sum_{i=1}^{n}\left\{F_{xi}\cdot\left(Y_{xi}-Y_b\right)\right\}+\sum_{j=1}^{n}\left(F_{yj}\cdot X_{yj}\right)$$
$$=F\cdot X_3$$
$$=-200\times(-50)$$
$$=10\,000\ (\text{N}\cdot\text{mm})$$

$$F_{s1} = F_{s3} = \frac{\sum_{j=1}^{n} F_{yj}}{4} + \frac{M3}{2 \cdot l}$$
$$= \frac{F}{4} + \frac{M3}{2L_b}$$
$$= \frac{-200}{4} + \frac{10\,000}{2 \times 100}$$
$$= 0 \text{ (N)}$$

Similarly
$F_{s2} = F_{s4} = -100$(N)

No work mounted on the table
Vertical load

$$M1 = \sum_{j=1}^{n} (F_{yj} \cdot Z_{yj}) + \sum_{k=1}^{n} (F_{zk} \cdot Y_{zk})$$
$$= F \cdot Z_3 + W1 \cdot Y_1$$
$$= -200 \times 30 + 150 \times (-20)$$
$$= -9\,000 \text{ (N·mm)}$$

$$M2 = \sum_{i=1}^{n} \{F_{xi}(Z_{xi} - Z_b)\} + \sum_{k=1}^{n} (F_{zk} \cdot X_{zk})$$
$$= W1 \cdot X_1$$
$$= 150 \times 30$$
$$= 4\,500 \text{ (N·mm)}$$

$$F_{r1} = \frac{\sum_{k=1}^{n} F_{zk}}{4} + \frac{M1}{2 \cdot L} + \frac{M2}{2 \cdot l}$$
$$= \frac{W1}{4} + \frac{M1}{2 \cdot L_r} + \frac{M2}{2 \cdot L_b}$$
$$= \frac{150}{4} + \frac{-9\,000}{2 \times 90} + \frac{4\,500}{2 \times 100}$$
$$= 10 \text{ (N)}$$

Similarly
$F_{r2} = -35$ (N)
$F_{r3} = 110$ (N)
$F_{r4} = 65$ (N)

Lateral loads

$$M3 = -\sum_{i=1}^{n} \{F_{xi} \cdot (Y_{xi} - Y_b)\} + \sum_{j=1}^{n} (F_{yj} \cdot X_{yj})$$
$$= F \cdot X_3$$
$$= -200 \times (-50)$$
$$= 10\,000 \text{ (N·mm)}$$

$$F_{s1} = F_{s3} = \frac{\sum_{j=1}^{n} F_{yj}}{4} + \frac{M3}{2 \cdot l}$$
$$= \frac{F}{4} + \frac{M3}{2 \cdot L_b}$$
$$= \frac{-200}{4} + \frac{10\,000}{2 \times 100}$$
$$= 0 \text{ (N)}$$

Similarly
$F_{s2} = F_{s4} = -100$ (N)

For calculation, take into consideration the positive or negative signs (+ or -) for load point coordinates.

Calculation of dynamic equivalent load
Use **"A-3-2.2 3. Calculation of dynamic equivalent load."**
It matches Position 4 in **"Table 2.3 Loads in the arrangement of linear guides."** Ball slide loads that must be considered are vertical and lateral direction loads.

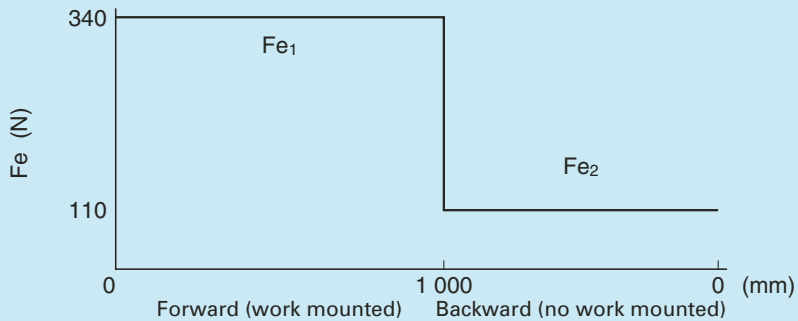
In case of PU15AL,
Vertical direction dynamic equivalent load
$$F_r = F_r$$
Lateral direction dynamic equivalent load
$$F_{se} = F_s \cdot \tan\alpha = F_s$$
Use the formula for full dynamic equivalent load (page A23) to calculate F_e.
Results are shown in the table below.

Unit: N

Work mounted	Slide1	Slide2	Slide3	Slide4
F_r ($F_{r1} - F_{r4}$)	40	– 165	340	135
F_{se} ($F_{s1} - F_{s4}$)	0	– 100	0	– 100
F_e	40	215	340	185
No work mounted	Slide1	Slide2	Slide3	Slide4
F_r ($F_{r1} - F_{r4}$)	10	– 35	110	65
F_{se} ($F_{s1} - F_{s4}$)	0	– 100	0	– 100
F_e	10	118	110	133

Based on the results of calculations, a ball slide that bears the maximum dynamic equivalent load shall be taken as the representative of the linear guides for further life calculation. For this case, we take the Slide3.
Therefore;
Work mounted $F_{e1} = 340$ **(N)**
No work mounted $F_{e2} = 110$ **(N)**

Calculation of mean effective load
Based on **"A-3-2.2 4. Calculation of mean effective load,"** calculate from the largest full dynamic equivalent loads.



Cycle patterns of full dynamic equivalent load

From the cycle pattern, the mean effective load matches the case **"(1) When load and running distance vary stepwise."** Therefore, use the following formula.
Assuming that L is: $L = L_1 + L_2$.

$$Fm = \sqrt[3]{\frac{1}{L}\left(F_{e1}^3 L_1 + F_{e2}^3 L_2\right)}$$
$$= \sqrt[3]{\frac{1}{2\,000}\left(340^3 \times 1\,000 + 110^3 \times 1\,000\right)}$$
$$= 273 \text{ (N)}$$

Determine various coefficients

Determine applicable coefficients from **"A-3-2.2 5. Various coefficients."**

Load factors

Use conditions are: Travel speed, 12 m/min; Acceleration, 0.8 m/sec^2 (0.082 G). As the load factor f_w is in the range of 1.0 to 1.5, use common value $\boldsymbol{f_w = 1.2}$.

Hardness coefficient

The hardness of NSK linear guides is HRC58 to 62. Use a hardness coefficient $\boldsymbol{f_H = 1}$ and take the value of basic dynamic load rating as it is.

Calculate rating life

Use **"A-3-2.2 6. Calculation of basic rating life."**

The basic dynamic load rating (C_{100}) of linear guide PU15AL : 4 400 (N)
Mean effective load F_m : 273 (N)
Load factor f_w : 1.2
Hardness coefficient f_H : 1

$$\text{Rating fatigue life } L = 100 \times \left(\frac{f_H \cdot C_{100}}{f_w \cdot F_m}\right)^3$$
$$= 100 \times \left(\frac{1 \times 4\,400}{1.2 \times 273}\right)^3$$
$$= \text{approximately 242 280 (km)}$$

Travel speed, 12 m/min; Operating hours, 16 hr/day.
Convert the above rating fatigue life into hours:

$$\frac{242\,280 \times 1\,000}{12 \times 60 \times 16} = \text{approximately 21 030 (days)}$$

Examine static load

Based on **"A-3-2.2 7. Examination of static load,"** find out on which ball slide the static equivalent load P_0 becomes largest.
The basic static load rating (C_0) of linear guide PU15AL: 6 600 (N)
Ball slide No. 3 bears the largest load.
P_0 at this time:

$$P_0 = F_r + F_s = 340$$

Therefore, static permissible load coefficient f_s is:

$$f_s = \frac{C_0}{P_0} = \frac{6\,600}{340} = 19.4$$

There is no problem at this value.

(3) Selection of accuracy grade and preload

Based on **"A-3-4 3. Application examples of accuracy,"** select accuracy grade PN and preload Z1 for material handling system.

(4) Calculation of deformation

Calculate deformation by the weight of the mounted work W_2. From **"Rigidity of PU series,"** the rigidity of linear guide PU15AL with Z1 preload is:

$\boldsymbol{K_s = K_r = 45 \text{ (N/μm)} = 45\,000 \text{ (N/mm)}}$

Deformation by the weight of the mounted work W_2 can be obtained as the difference in deformation when W_2 applies or does not apply.

From Pattern 4 in Table 2.2 (page A19)

Work mounted:

$$\delta_{x1} = Y_d \cdot \frac{F_{s2} - F_{s1}}{L_b \cdot K_s} + Z_d \cdot \frac{F_{r1} - F_{r2}}{L_b \cdot K_r}$$
$$= -90 \times \frac{-100 - 0}{100 \times 45\,000} + 120 \times \frac{40 - (-165)}{100 \times 45\,000}$$
$$= 0.0075 \text{ (mm)} = 7.5 \text{ (μm)}$$

Similarly, $\delta_{y1} = -0.0082$ (mm) $= -8.2$ (μm)
$\delta_{z1} = 0.0123$ (mm) $= 12.3$ (μm)

No work mounted:

$$\delta_{x2} = Y_d \cdot \frac{F_{s2} - F_{s1}}{L_b \cdot K_s} + Z_d \cdot \frac{F_{r1} - F_{r2}}{L_b \cdot K_r}$$
$$= -90 \times \frac{-100 - 0}{100 \times 45\,000} + 120 \times \frac{10 - (-35)}{100 \times 45\,000}$$
$$= 0.0032 \text{ (mm)} = 3.2 \text{ (μm)}$$

Similarly, $\delta_{y2} = -0.0023$ (mm) $= -2.3$ (μm)
$\delta_{z2} = 0.0039$ (mm) $= 3.9$ (μm)

Therefore, the difference in deformation by whether there is a mounted work or not is as follows:

$\delta_x = \delta_{x1} - \delta_{x2} = 7.5 - 3.2 = 4.3$ (μm)
$\delta_y = \delta_{y1} - \delta_{y2} = -8.2 - (-2.3) = -5.9$ (μm)
$\delta_z = \delta_{z1} - \delta_{z2} = 12.3 - 3.9 = 8.4$ (μm)

2. Machining center

The following is a calculation example of a horizontal type machining center. Arrangements of each axis are shown in **Fig. 11.2** (front view) and **Fig. 11.3** (side view).

Operating conditions

Dimensions and load conditions are:

X axis column's weight	Wx :	7 500 (N)
Y axis spindle head's weight	Wy :	2 500 (N)
Z axis table's weight	Wz :	5 500 (N)
X axis rail span	XL_r :	450 (mm)
X axis ball slide span	XL_b :	310 (mm)
Y axis rail span	YL_r :	410 (mm)
Y axis ball slide span	YL_b :	308 (mm)
Z axis rail span	ZL_r :	660 (mm)
Z axis ball slide span	ZL_b :	420 (mm)

X axis stroke : 400 (mm)
Y axis stroke : 350 (mm)
Z axis stroke : 500 (mm)

Average rapid traverse speed : 15 (m/min) [Max. 30 (m/min)]
Starting accelerating speed : 1 (G)
Milling speed : 2.5 (m/min)
Drilling speed : 0.8 (m/min)

Cutting load
Milling process $Fx = Fy =$ 1 000 (N)
Drilling process $Fz =$ 3 000 (N)

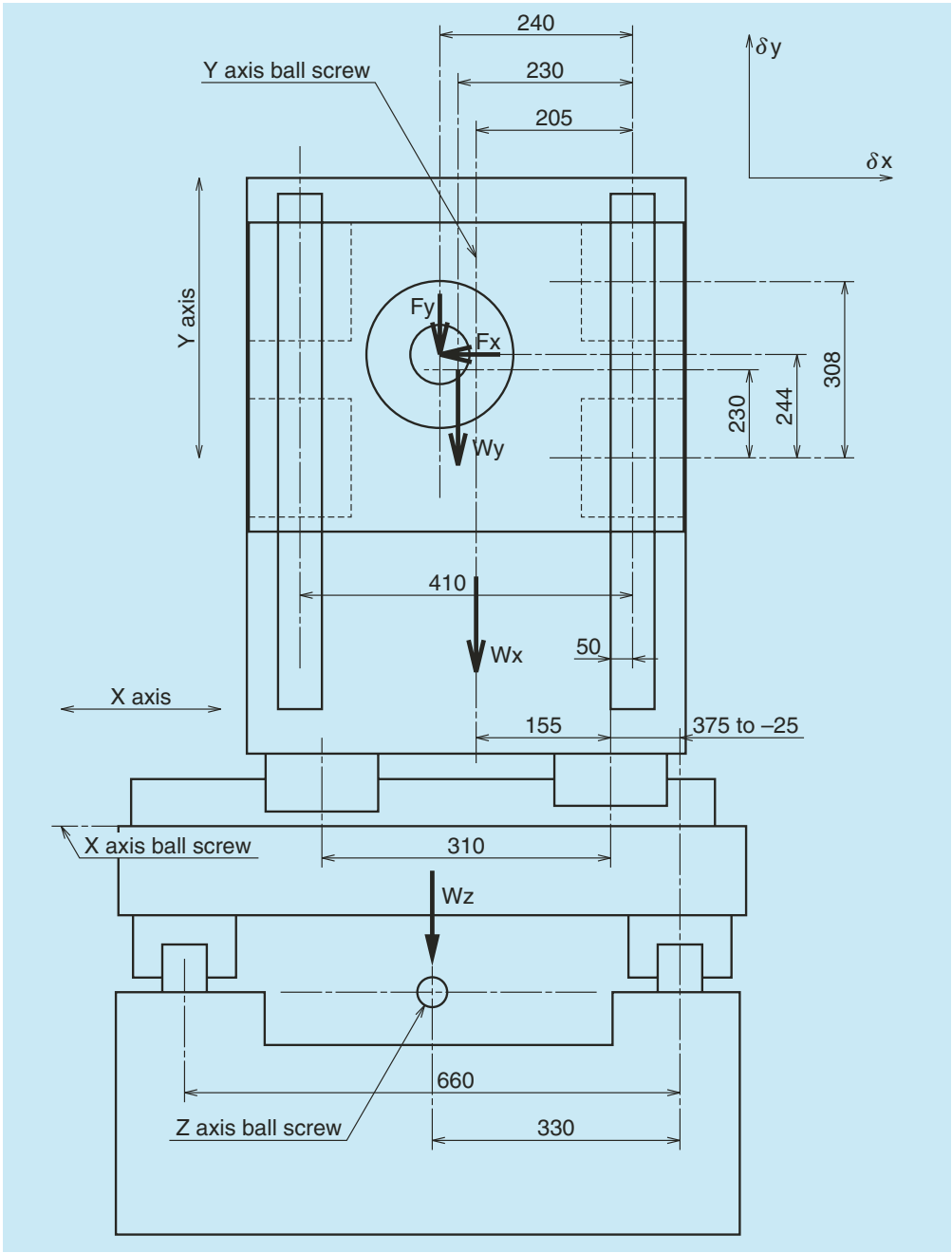


Fig. 11.2 Machining center (front view)

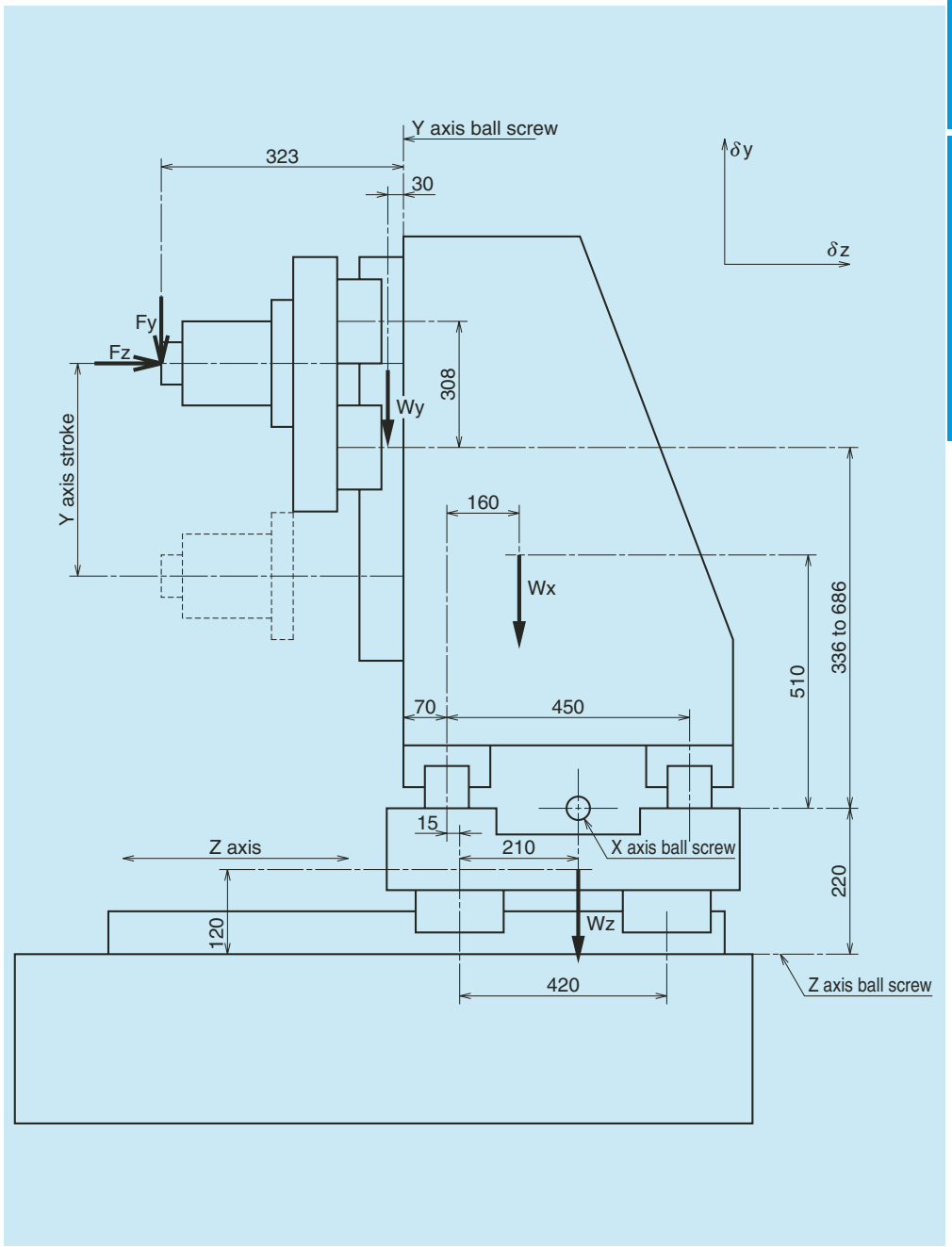


Fig. 11.3 Machining center (side view)

(1) Selection of linear guide model

From the operating conditions, the linear guide should be LA Series which is suitable for the machining center.

Select below temporarily from shaft diameter of ball screw:

X axis LA55
Y axis LA35
Z axis LA65

(2) Selection of accuracy grade and preload

For machining center, select accuracy grade P5 and preload Z3.

(3) Calculation of life expectancy

Examination shall be done in three cases, no cutting load, milling process, and drilling process.

Inertial force associated with the starting acceleration is not considered in this case. However, it must be calculated for more accurate figures.

Calculation of the loads that apply to the ball slide

In case of no cutting load: *Fx* = *Fy* = *Fz* = 0

Calculate load on X, Y, Z axes using **"Table 2.2"** in **"A-3-2.2 2. Calculating load to a ball slide."**

X axis: Loads to be considered Wx and Wy
Y axis: Loads to be considered Wy
Z axis: Loads to be considered Wx, Wy, and Wz

Unit: N

Axis	Load direction	Slide1	Slide2	Slide3	Slide4
X axis	Vertical direction *Fr*	1 156	955	4 045	3 844
	Lateral direction *Fs*	0	0	0	0
Y axis	Vertical direction *Fr*	122	–122	122	–122
	Lateral direction *Fs*	102	–102	102	–102
Z axis	Vertical direction *Fr*	765	3 860	3 890	6 985
	Lateral direction *Fs*	0	0	0	0

In case of milling process: *Fx* = *Fy* = 1 000 (N)

Similarly,

X axis: Loads to be considered *Wx*, *Wy*, *Fx*, and *Fy*
Y axis: Loads to be considered *Wy*, *Fx*, and *Fy*
Z axis: Loads to be considered *Wx*, *Wy*, *Wz*, *Fx*, and *Fy*

The table below shows the calculation of each load coordinates at stroke end which imposes most strict condition.

Unit: N

Axis	Load direction	Slide1	Slide2	Slide3	Slide4
X axis	Vertical direction *Fr*	2 277	–1 039	6 539	3 224
	Lateral direction *Fs*	997	–997	997	–997
Y axis	Vertical direction *Fr*	252	–1 040	1 040	–252
	Lateral direction *Fs*	54	–554	54	–554
Z axis	Vertical direction *Fr*	–771	3 796	4 453	9 020
	Lateral direction *Fs*	486	–986	486	–986

In case of drilling process: *Fz* = 3 000 (N)

X axis: Loads to be considered *Wx*, *Wy*, and *Fz*
Y axis: Loads to be considered *Wy* and *Fz*
Z axis: Loads to be considered *Wx*, *Wy*, *Wz*, and *Fz*

The table below shows calculation of each load coordinates at a stroke end which imposes most strict condition.

Unit: N

Axis	Load direction	Slide1	Slide2	Slide3	Slide4
X axis	Vertical direction *Fr*	4 256	4 055	945	744
	Lateral direction *Fs*	919	581	919	581
Y axis	Vertical direction *Fr*	305	938	561	1 195
	Lateral direction *Fs*	102	–102	102	–102
Z axis	Vertical direction *Fr*	4 872	–247	7 997	2 878
	Lateral direction *Fs*	839	–839	839	–839

Calculation of dynamic equivalent load

Next, find dynamic equivalent load under each cutting condition. From **"Table 2.3"** in **"A-3-2.2 3. Calculation of dynamic equivalent load,"** the necessary loads, *Fr* and *Fse* are, as the linear guide model is LA Series, obtained as follows.

Vertical dynamic equivalent load

$$Fr = Fr$$

Lateral dynamic equivalent load

$$Fse = Fs \cdot \tan\alpha = Fs$$

From the above, calculate *Fe* using formulas for full dynamic equivalent loads shown in page A23. From calculation, the largest full dynamic equivalent loads are as follows.

Axis	Largest full dynamic equivalent load Fe (N)		
	No cutting load	For milling process	For drilling process
X axis	4 045	7 038	4 716
Y axis	173	1 317	1 246
Z axis	6 985	9 513	8 417

Calculation of full dynamic equivalent load taking account of preload

It is necessary to include the amount of preload for the calculation of rating life when Z3 preload is specified. Consider each preload and calculate full dynamic equivalent load. Calculate *Fep* using formulas in **"A-3-3 6. Load and rating life when the preload is taken into account".**

Preload P (X axis linear guide LA55): 8 100 (N)
Preload P (Y axis linear guide LA35): 3 450 (N)
Preload P (Z axis linear guide LA65): 13 800 (N)

From the above, the full dynamic equivalent loads taking preload into account are smaller than the load at which preload is relieved.

Axis	Largest full dynamic equivalent load Fe (N)		
	No cutting load	For milling process	For drilling process
X axis	10 336	12 104	10 724
Y axis	3 542	4 171	4 131
Z axis	17 663	19 138	18 494

Calculation of mean effective load

Calculate the mean effective loads from full dynamic equivalent loads. If duty cycle in the cutting process is not clear, set the mean effective load to 70% of the largest full dynamic equivalent load in all processes.

Therefore,

X axis: 12 104 × 0.7 = 8 473 (N)
Y axis: 4 171 × 0.7 = 2 920 (N)
Z axis: 19 138 × 0.7 = 13 397 (N)

Determine various coefficients

Determine them based on **"A-3-2.2 5. Various coefficients."**

For this case the factors are following.

Load coefficient f_W : 1.5

Hardness coefficient f_H : 1

Calculation of rating life

Based on the calculated loads and various coefficients, calculate the rating life from **"A-3-2.2 6. Calculation of rating life."**

Basic dynamic load rating C_{100}
(X axis linear guide LA55): 111 000 (N)
Basic dynamic load rating C_{100}
(Y axis linear guide LA35): 49 000 (N)
Basic dynamic load rating C_{100}
(Z axis linear guide LA65): 206 000 (N)

Load coefficient f_W: 1.5

Hardness coefficient f_H: 1

Rating fatigue life $L = 100 \times \left(\frac{f_H \cdot C_{100}}{f_w \cdot F_m} \right)^3$

From this,

In case of X axis Lx = 66 617 (km)
In case of Y axis Ly = 140 012 (km)
In case of Z axis Lz = 107 722 (km)

In case of roller linear guides, refer to **"A-3-2.2 6. Calculation of rating life"** (page A25).

Examination of static loads based on "A-3-2.2 7"

Basic static load rating C_0
(X axis linear guide LA55): 215 000 (N)
Basic static load rating C_0
(Y axis linear guide LA35): 98 000 (N)
Basic static load rating C_0
(Z axis linear guide LA65): 420 000 (N)

Examine a case of high-load milling process with large load.

X axis $fs = \frac{C_0}{P_0} = \frac{C_0}{(F_r + F_s)} = \frac{215\,000}{(6\,539 + 997)} = 28.5$

Similarly,

Y axis fs = 61.5

Z axis fs = 42.0

Therefore, there is no problem.

(3) Calculation of deformation

Calculate deformation at the processing points. (The stroke position is the stroke end positions on Y axis and X axis.)

Rigidity of X axis linear guide LA55Z3: 1 400 (N/μm)
Rigidity of Y axis linear guide LA35Z3: 825 (N/μm)
Rigidity of Z axis linear guide LA65Z3: 1 730 (N/μm)

Calculate using Pattern 4 in Table 2.2.

Load conditions	Deformation direction	Deformation of each axis (μm)			Total deformation (μm)
		X axis	Y axis	Z axis	
Table weight alone	δx	–0.2	–0.1	–3.1	–3.4
	δy	–4.6	–0.3	–4.2	–9.1
	δz	–4.3	–0.1	–4.9	–9.3
Milling process	δx	–9.9	–1.3	–6.7	–17.9
	δy	–6.4	–1.7	–5.2	–13.3
	δz	–6.1	–0.4	–7.7	–14.2
Drilling process	δx	–0.9	–0.3	–4.6	–5.8
	δy	1.4	0.8	2.8	5.0
	δz	5.5	1.2	7.6	14.3

Therefore, deformation at processing points at time of milling is:

δx = –17.9 – (–3.4) = –14.5 (μm)
δy = –13.3 – (–9.1) = –4.2 (μm)
δz = –14.2 – (–9.3) = –4.9 (μm)

Deformation at processing points at time of drilling is:

δx = –5.8 – (–3.4) = –2.4 (μm)
δy = 5.0 – (–9.1) = 14.1 (μm)
δz = 14.3 – (–9.3) = 23.6 (μm)

If a rating life of this long period is not required, select a smaller linear guide model, and calculate the life again.

To reduce deformation at the processing point, select a linear guide model with higher rigidity, and then calculate the life again.

A-3-12 Reference

The articles in "Motion & Control (NSK Technical Journals)" which refer to NSK linear guides are listed in the table below for user convenience.
"Motion & Control" is compiled to introduce NSK products and its technologies.
For inquiries and orders of "Motion & Controls," please contact your local NSK sales offices, or Representatives.

Table 12.1 Motion & Control (NSK Technical Journal): Articles relating to linear guides (1997 –)

Issue No.	Date of Publication	Articles related to linear guides
No.5	Dec. 1998	Development of the NSK K1 Seal for Linear Guides
No.8	May. 2000	NSK Linear Guides for High-Temperature Environments
No.9	Oct. 2000	Recent Developments in Highly Precise NSK Linear Guides
No.9	Oct. 2000	High-Performance Seals for NSK Linear Guides
No.11	Oct. 2001	Development of the NSK S1 Series™ Ball Screws and Linear Guides High Load Capacity Mini LH Series of NSK Linear Guides
No.12	Apr. 2002	NSK Linear Guides & Ball Screws Equipped with NSK K1™ Lubrication Unit
No.12	Apr. 2002	NSK S1 Series™ NSK Linear Guides and Ball Screws
No.13	Oct. 2002	Translide™ -New Rolling Element Linear Motion Bearing-
No.14	May. 2003	New Generation of NSK Linear Guides Miniature PU Series
No.15	Dec. 2003	Ultra-Precision NSK Linear Guides for Machine Tools-the HA Series
No.16	Aug. 2004	Numerical analysis Technology & NSK Linear Guides for Machine Tools
No.16	Aug. 2004	NSK RA Series Roller Guide
No.18	Aug. 2005	New Generation of NSK linear Guides Miniature PU Series/PE Series
No.20	Aug. 2007	V1 Series of Highly Dust-Resistant NSK Linear Guides
No.21	Dec.2009	Technological Trends of NSK Linear Guides for Industrial Machines Highly Accurate HS Series of Ultra-Precision NSK Linear Guides Linear Guides for Food Machine and Medical Devices
No.22	Mar. 2011	Technological Trends of NSK Linear Guides for Industrial Machines High-Accuracy HS Series of Ultra-Precision NSK Linear Guides NSK Linear Guides for Food Processing Equipment and Medical Devices
No.23	Jun. 2013	Technological Trends in Linear Motion Rolling Guides for Machine Tools

A-4 NSK Linear Guides™

1. Structure of NSK Linear Guides

By avoiding structural complexity, and by reducing the number of components, we not only enhanced the precision of linear guides, but also are able to keep costs low. We have added NSK's patented unique structural feature to the original invention (**Fig. 1**). This contributes to higher precision and lower prices.

NSK linear guides consist of a rail and a slide (**Fig. 2**). The balls or rollers roll on the race way surface, and are scooped up by the end caps attached to both ends of the slide. Then, the balls or rollers go through a passage made in the slide and circulate back to the other end.

2. Characteristics of NSK Linear Guides

The use of a unique offset Gothic arch groove (**Fig. 3**) allows the ball type of NSK linear guides to satisfy groove designs required for specific purposes.

This unique groove design facilitates precise measurement of the ball groove, thus enabling the stable and highly accurate production of the slides and the rails for random matching. (**Fig. 4**)

On top of that, we have developed and marketed the NSK Roller Guides, representing the culmination of NSK's analysis technology and tribology.

Such technologies ensure the features of NSK linear guides outlined below.

(1) High precision and quality

- High precision and quality come from our superb production and measuring technologies, strengthened by extensive experience in antifriction rotary bearings and ball screw production. Our quality assurance extends to the smallest components.

(2) High reliability and durability

- Logical simplicity in shape, along with stable processing, maintains high precision and reliability.
- Super-clean materials, our advanced heat treatment and processing technologies increase product durability.

(3) Abundant in type for any purpose

- Various series are available, and their slide models and size categories are standardized to satisfy any requirement. Our technology, polished by abundant experience in the use of special materials and surface treatments, meets the customer's most demanding expectations.

(4) Development of random-matching parts for short delivery time

- The adoption of the Gothic arch groove which makes measuring easy, and a new reliable quality control method has made random-matching of the rails and the ball or roller slides possible. The parts are stocked as standard products, thereby reducing delivery time.

(5) Patented static load carrying capacity (shock-resistance)

- When a super-high load (impact) is applied, our Gothic arch groove spreads the load to surfaces which usually do not come into contact in the ball type NSK linear guides. This increases impact load resistance (**Fig. 5**).

(6) Lineup of extremely high-load capacity series

- The LA series provides a top class high-load capacity for the ball linear guides through a unique load carrying configuration with three ball recirculation circuits on the one side.
  By installing rollers that are the largest possible diameter and length, the NSK roller linear guides have realized the world's highest load capacity, far superior to the roller linear guides of other companies.

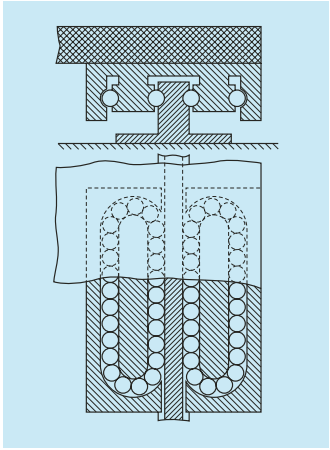


Fig. 1 • French Patent in 1932.
• Inventor: Gretsh (German)

NSK added its patented technology to the invention in Fig. 1, and improved the linear guide structure and realized low cost design.

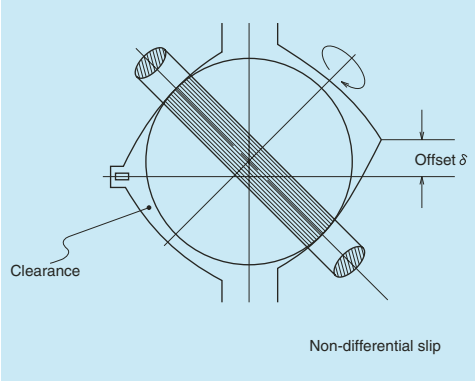


Fig. 3 Two contact point at offset Gothic arch groove

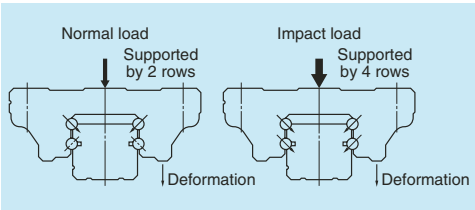


Fig. 5 Shock-resistance

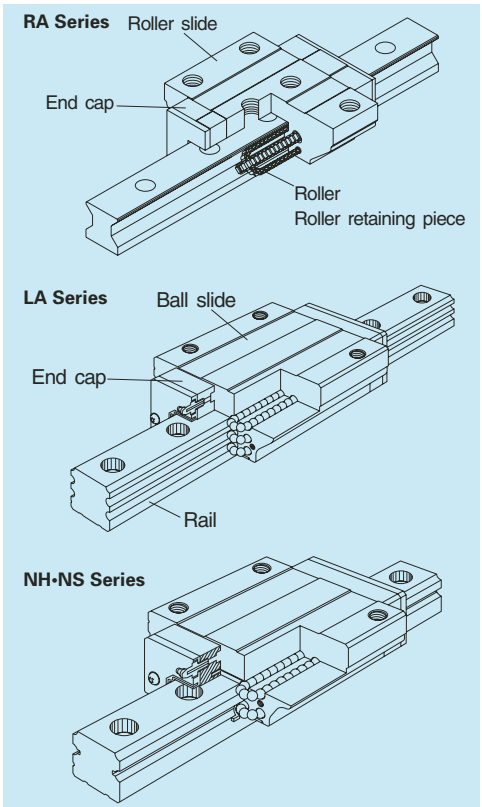


Fig. 2 Structure of NSK linear guides

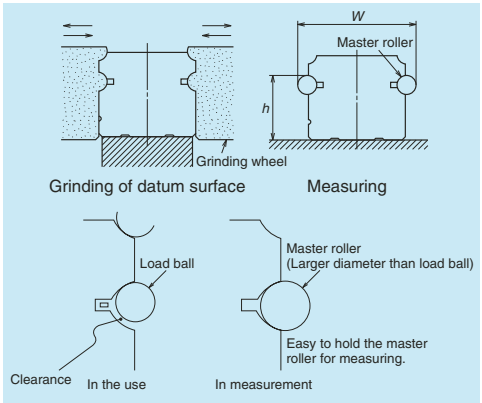
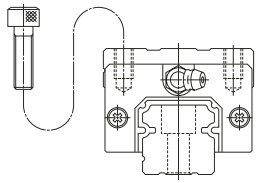
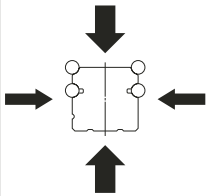
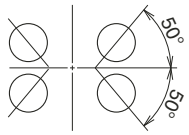
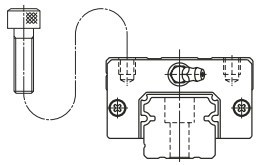
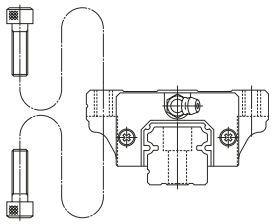
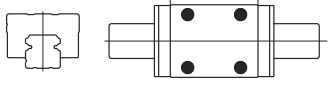
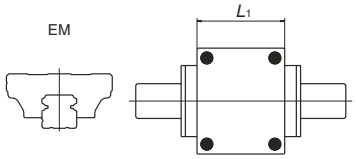
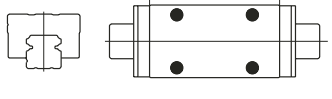
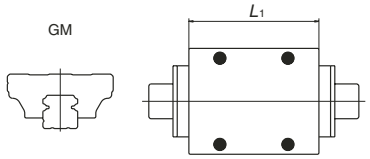


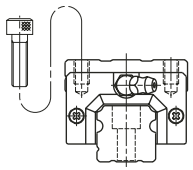
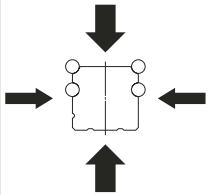
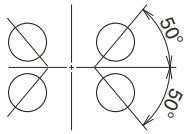
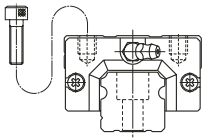
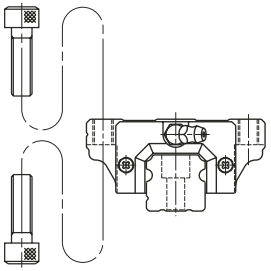
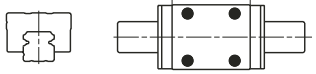
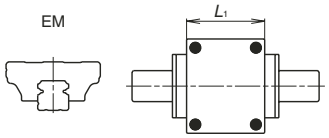
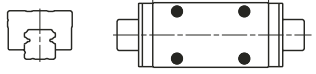
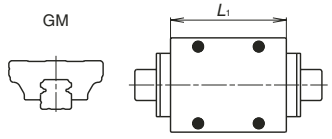
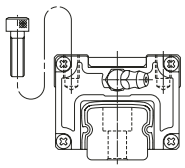
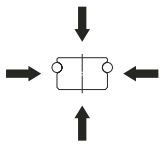
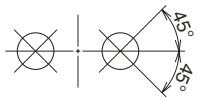
Fig. 4 Processing and measuring grooves

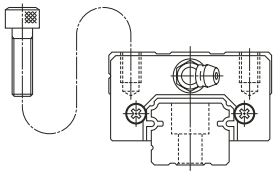
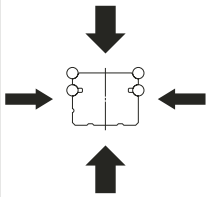
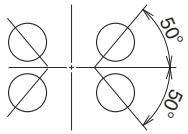
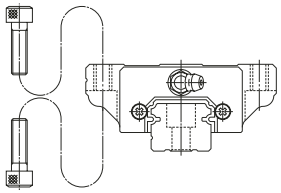
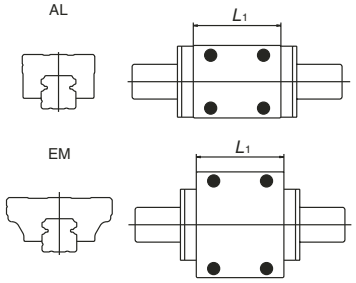
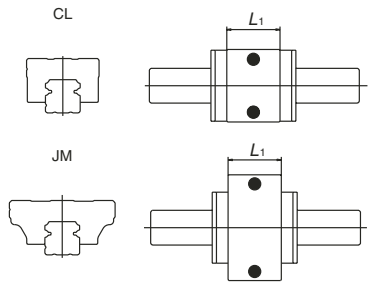
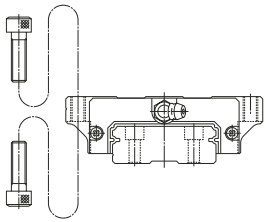
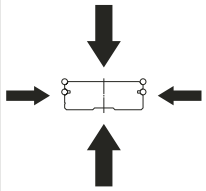
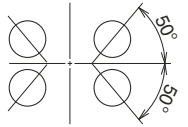
Measuring grooves accuracy is easy. You can obtain highly accurate results for all types of NSK series. This is why you can purchase rails and slides separately for random matching.

3. Types and Characteristics of NSK Linear Guides

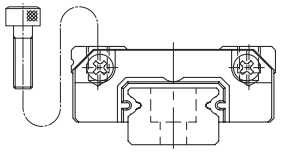
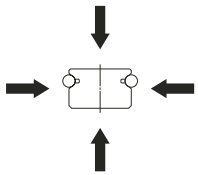
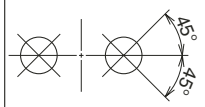
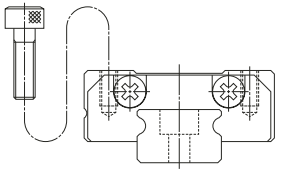
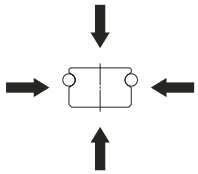
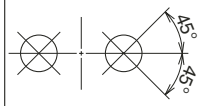
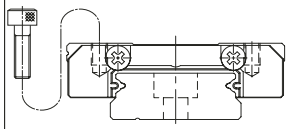
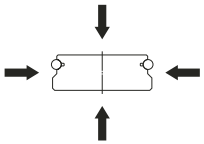
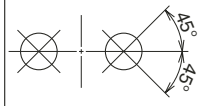
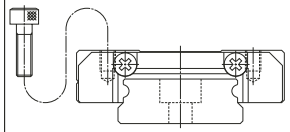
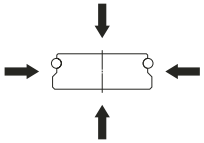
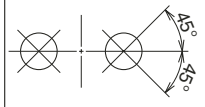
Category		Series	Slide shape	Shape/installation method	Load direction/capacity	Rolling element contact structure	Characteristics	Applications	Page
High vertical load carrying capacity type	Self-aligning type	NH	AN BN				The NH series is applicable to a wide range of uses from general industrial use to high-accuracy application. Random-matching of rails and ball slides is available as a standard. ● The contact angle between the ball and ball groove is set at 50 degrees. This design increases the load carrying capacity against the vertical directions, which is the main load acting direction in most operations. ● The DF contact structure greatly absorbs the installation error in the perpendicular direction to the rail. ● Balls make contact at two points thanks to the offset Gothic arch groove. This keeps friction to a minimum. ● High resistance against shock load due to the unique load-carrying structure. ● Gothic arch groove renders measuring of ball grooves accurate and easy. ● Standardized random-matching type allows separate purchase of rails and ball slides. ● Stainless steel standard type is also available for small sizes (NH15 to NH30).	• Cartesian type robots • Robots that remove plastic molds from injection machine • Material handling equipment • Food processing machines • Packaging/packing machines • Printing machines • Woodworking machines • Paper manufacturing machines • Measuring equipment • Inspecting equipment • Semiconductor manufacturing equipment • LCD manufacturing equipment • Medical equipment • Electric discharge machines • Laser cutting machines • Press machines • Tool grinders • Flat surface grinders • NC lathes • Machining centers • Automatic tool changers	A113
			AL BL						
			EM GM						
			High-load type AN, AL						
			EM						
			Super-high-load type BN, BL						
			GM						

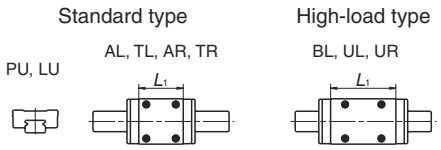
Note: For customers who have used the former LH or SH series, NH series is recommended as a substitute. Please confirm the correlation between NH series and former ones on the comparative table at A319.

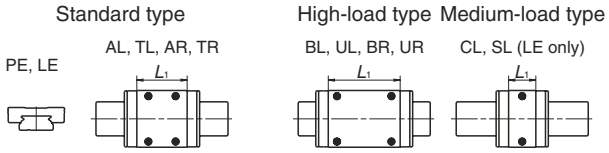
Category		Series	Slide shape	Shape/installation method	Load direction/capacity	Rolling element contact structure	Characteristics	Applications	Page
High vertical load carrying capacity type	Self-aligning type	VH	AN BN				The VH series delivers outstanding dust-proof functionality and thus ensures long operating life under contaminated environments. Random-matching of rails and ball slides is available as a standard. ● The contact angle between the ball and the raceway is set at 50 degrees. This design increases the load carrying capacity against vertical directions, which is the main load acting direction in most operations. ● The DF contact structure greatly absorbs the installation error in the perpendicular direction to the rail. ● Thanks to the offset Gothic arch groove, balls make contacts at two points. This keeps friction to a minimum. ● High resistance against shock load due to the unique load carrying structure. ● Gothic arch groove renders measuring groove accurate and easy. ● Standardized random-matching type allows separate purchase of rails and ball slides. ● Penetration of fine contaminants is less than 1/10 of the existing products. ● Operating life under contaminated environments is more than 5 times longer.	• Automotive manufacturing equipment • Press machines • Machine tools loader/un-loader • Tire molding machines • Woodworking machines • Automatic doors	A133
			AL BL						
			EM GM						
			High-load type AN, AL  EM 			Super-high-load type BN, BL  GM 	
Four-way equal load carrying capacity type	Standard type	TS	AN				The TS series is suitable for transfer equipment. ● The newly developed manufacturing processes contribute to low cost. ● Standardized random-matching type allows separate purchase of rails and ball slides.	• Automotive manufacturing equipment • Press machines • Loader/unloader of machine tools • Tire molding machines • Woodworking machines • Automatic doors	A151

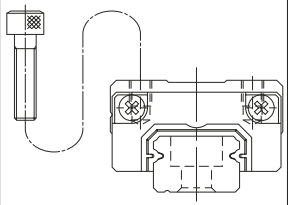
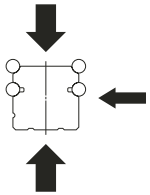
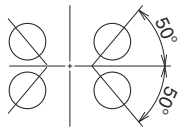
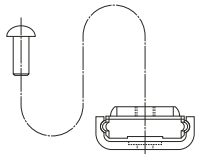
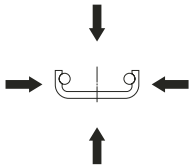
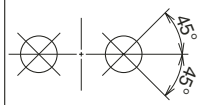
Category		Series	Slide shape	Shape/installation method	Load direction/capacity	Rolling element contact structure	Characteristics	Applications	Page
High vertical load carrying capacity type	Self-aligning type	NS	CL AL				The NS series is low in height, and is applicable to a wide range of uses from general industrial use to high-accuracy application. Random-matching of rails and ball slides is available as a standard. ● Compact and low profile. ● The contact angle between the ball and the groove is set at 50 degrees. This design increases the load carrying capacity against vertical directions, which is the main load direction prevalent in most operations. ● The DF contact structure greatly absorbs the installation error in the perpendicular direction of the rail. ● Thanks to the offset Gothic arch groove, balls make contacts at two points. This keeps friction to a minimum. ● High resistance against shock load due to the unique load carrying structure. ● Gothic arch groove renders measuring groove accurate and easy. ● Standardized random-matching type allows separate purchase of rails and ball slides. ● Stainless steel type is also available.	• Cartesian type robots • Robots that remove plastic molds from injection machine • Material handling equipment • Food processing machines • Packaging/packing machines • Printing machines • Woodworking machines • Paper manufacturing machines • Measuring equipment • Inspection equipment • Semiconductor manufacturing equipment • LCD manufacturing equipment • Medical equipment • Electric discharge machines • Laser cutting machines • Press machines	A157
			JM EM						
			High-load type AL EM					Medium-load type CL JM	
	High moment capacity type	LW	EL				High-moment rigidity and low profile products are most suited for a single rail linear guideway system. Random-matching of rails and ball slides is available as a standard. ● The wide rail contributes to a high rolling moment carrying capacity and to great moment rigidity of a single rail linear guideway system. ● Balls contact at two points in the Gothic arch groove, thus keeping friction to a minimum. ● High resistance against shock load ● Standardized random-matching type allows separate purchase of rails and ball slides.	• Semiconductor manufacturing equipment • LCD manufacturing equipment • Conveyor systems • Medical equipment • Microscope XY stages	A175

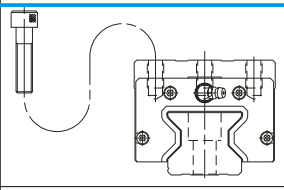
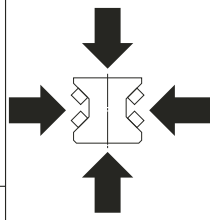
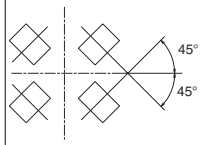
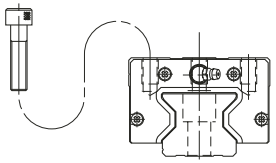
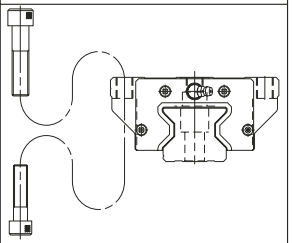
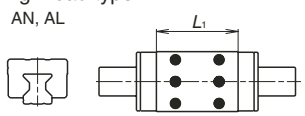
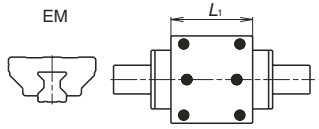
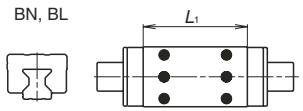
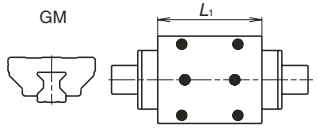
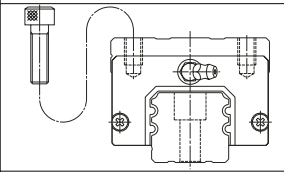
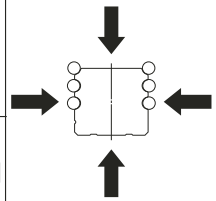
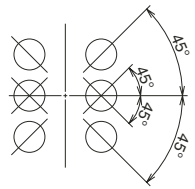
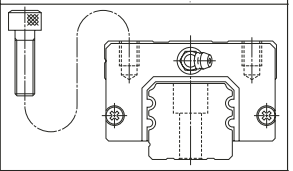
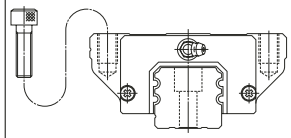
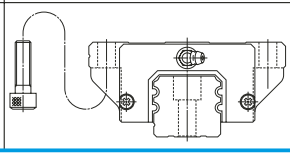
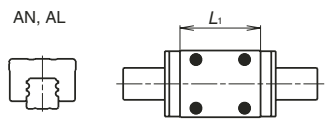
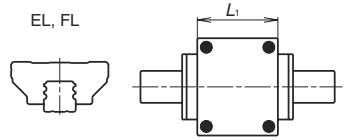
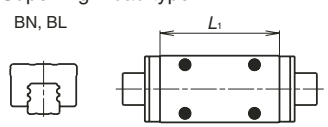
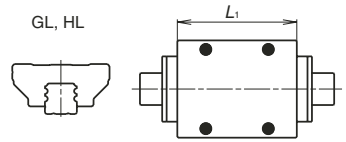
Note: For customers who have used the former LS or SS series, NS series is recommended as a substitute. Please confirm the correlation between NS series and former ones on the comparative table at A319.

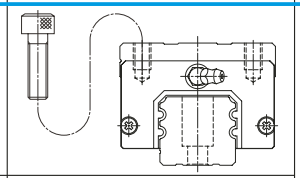
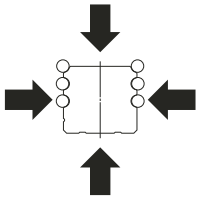
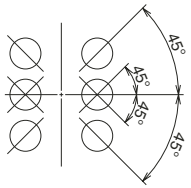
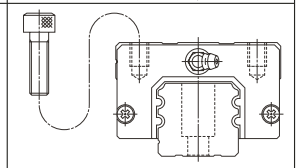
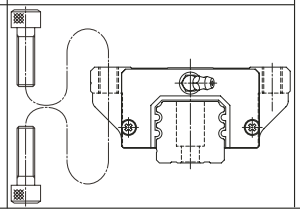
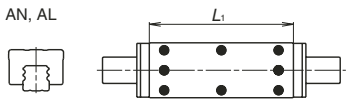
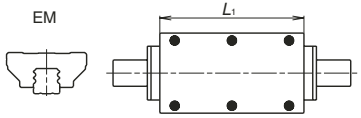
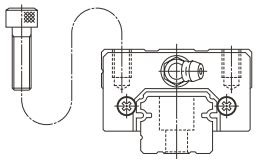
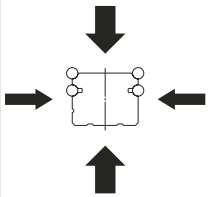
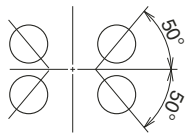
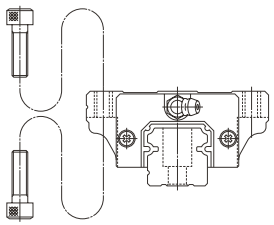
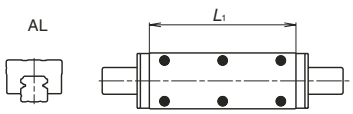
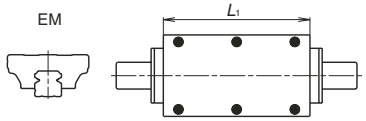
Category		Series	Slide shape	Shape/installation method	Load direction/capacity	Rolling element contact structure	Characteristics	Applications	Page
Miniature type	Standard type	PU	AL AR TR UR BL				Low inertia and low dust generation miniature series. ● Low dust generation and highly smooth operation ● Super-compact size ● Stainless steel is the standard material. ● A ball retainer is a standard equipment. ● Standardized random-matching type allows separate purchase of rails and ball slides.	• Semiconductor manufacturing equipment • LCD manufacturing equipment • Medical equipment • Optical stages • Microscope XY stages • Conveying system of optical fibers • Miniature robots • Computer peripherals • Pneumatic equipment	A191
		LU	AL TL AR TR BL UL				Miniature series ● Extremely compact size ● Stainless steel is the standard material. ● A ball retainer is a standard equipment. ● Standardized random-matching type allows separate purchase of rails and ball slides.		A201
	High moment capacity type	PE	AR TR UR BR				Wide rail miniature with low inertia and low dust generation. ● Low dust generation and highly smooth operation ● Super-compact size ● Stainless steel is the standard material. ● A ball retainer is a standard equipment. ● Standardized random-matching type allows separate purchase of rails and ball slides.	• Semiconductor manufacturing equipment • LCD manufacturing equipment • Medical equipment • Optical stages • Microscope XY stages • Conveying optical fibers • Miniature robots • Computer peripherals • Pneumatic equipment	A213
		LE	AL TL AR TR BL UL CL SL				Miniature wide series ● Super-small size in wide rail type ● Stainless steel is the standard material. ● A ball retainer is a standard equipment. ● Standardized random-matching type allows separate purchase of rails and ball slides.		A223





Category		Series	Slide shape	Shape/installation method	Load direction/capacity	Rolling element contact structure	Characteristics	Applications	Page
Miniature type	Self-aligning type	LH	AN				High vertical load carrying capacity and self-aligning type miniature series ● The contact angle between the ball and ball groove is set at 50 degrees. This design increases the load carrying capacity against the vertical directions, which is the main load acting direction in most operations. ● The DF contact structure greatly absorbs the installation error in the perpendicular direction to the rail. ● Balls make contact at two points thanks to the offset Gothic arch groove. This keeps friction to a minimum. ● High resistance against shock load due to the unique load-carrying structure. ● Gothic arch groove renders measuring of ball grooves accurate and easy. ● A ball retainer is a standard equipment. (LH10～12) ● Stainless steel type is standard.	• Semiconductor manufacturing equipment • LCD manufacturing equipment • Medical equipment • Optical stages • Microscope XY stages • Miniature robots • Computer peripherals • Pneumatic equipment	A237
	Lightweight type	LL	PL				The LL series is a compact and lightweight miniature linear guide for press molding. ● Rails and ball slides are made of thin steel plate, and thus making them very light. ● Stainless steel is the standard material.	• Platter pen heads • Robot hands • Pneumatic equipment	A247

Category		Series	Slide shape	Shape/installation method	Load direction/capacity	Rolling element contact structure	Characteristics	Applications	Page
Four-way equal load carrying capacity type	Super-rigid type	RA	AN BN				The RA series roller guides have realized the world highest load capacity. Super-high rigidity and smooth motion contribute to higher performance of machine tools. ● Unique and optimum design of rollers and other component facilitate the high-load capacity and high rigidity. ● High-performance seals, a standard feature in the roller guides, maintain the initial performance for a prolonged time. ● The installation of retaining piece achieves smooth motion. ● Standardized random-matching type allows separate purchase of rails and roller slides.	• Machining centers • NC lathes • Heavy cutting machine tools • Gear cutters • Electric discharge machines • Press machines • Various types of grinders	A253
			AL BL						
			EM GM				High-load type AN, AL  EM  Super-high-load type BN, BL  GM 		
Four-way equal load carrying capacity type	Super-rigid type	LA	AN BN				As well as providing a low friction operation, the LA series provides a top class high-load capacity for the ball linear guides. The series is most suited for machine tools. ● The contact angle between the ball and the raceway is set at 45 degrees. This makes load carrying capacity and rigidity equal in vertical and lateral directions. ● Six-row ball grooves support the load from vertical and lateral directions, enhancing rigidity and increasing load carrying capacity. ● Appropriate friction ● Best suited for machine tools.	• Machining centers • NC lathes • Heavy cutting machine tools • Gear cutters • Electric discharge machines • Press machines • Various types of grinders	A271
			AL BL						
			EL GL						
			FL HL				High-load type AN, AL  EL, FL  Super-high-load type BN, BL  GL, HL 		

Category		Series	Slide shape	Shape/installation method	Load direction/capacity	Rolling element contact structure	Characteristics	Applications	Page
Four-way equal load carrying capacity type	Super rigidity, high-precision type	HA	AN				The HA Series ball guide with high-precision and high-load carrying capacity, featuring high-motion accuracy equivalent to hydrostatic linear bearings. ● Ball passage vibration has been reduced to one-third of conventional models by ultra-long ball slides and specification of new design. ● The contact angle between the ball and the raceway is set at 45 degrees. This makes load carrying capacity and rigidity equal in vertical and lateral directions. ● High motion accuracy is realized by the feature of super-finished ball groove (optional). ● End seals, bottom seals, and inner seals of high dust-proof specification are the standard equipment. ● Best suited for high-grade machine tools.	• Die molding machines • High precision processing machine • Heavy cutting machine tools • Gear cutters • Press machines • Various types of NC grinders	A291
			AL						
			EM						
			AN, AL				EM 		
High vertical load carrying capacity type	Self-aligning, super-precision type	HS	AL				The HS Series ball guide with high-precision featuring high-motion accuracy equivalent to hydrostatic linear bearings. ● Ball passage vibration has been reduced to one-third of conventional models by ultra-long ball slides and specification of new design. ● The contact angle between the ball and the raceway is set at 50 degrees. The load carrying capacity against vertical directions, which is the main load acting direction in most operations, increases by this design. ● The DF contact structure greatly absorbs the installation error in the perpendicular direction of rail. ● Thanks to the offset Gothic arch groove, balls make contacts at two points, thus keeping friction low.	• High precision processing machines • Electric discharge machines • Various types of NC grinders • LCD manufacturing equipment	A305
			EM						
			AL				EM 		

4. Guide to Technical Services

(1) CAD drawing data

NSK offers CAD data for linear guides. Please download it from the website of NSK.

NSK website

http://www.nsk.com

- Data in drawings are filed in the actual size (some parts are simplified). You can use these data without processing.
- Drawings are three-views projection.
- Dimension lines are omitted to render the data as standard drawing for database.

Data offered by CAD

NSK linear guides

NH Series
VH Series
TS Series
NS Series
LW Series
PU Series
LU Series
PE Series
LE Series
Miniature LH Series
RA Series
LA Series
HA Series
HS Series

(2) Telephone consultation with NSK engineers

This catalog contains technical explanation for each section. However, some descriptions and explanations may be insufficient due to page limitation, etc. To amend this shortcoming, NSK offers telephone assistance. NSK engineers are pleased to help you. Our local offices are listed in the last part of this catalog. Call local NSK office or Representative in your area.

5. Linear Guides: Handling Precautions

NSK linear guides are high quality and are easy to use. NSK places importance on safety in design. For maximum safety, please follow precautions as outlined below.

(1) Lubrication

Confirm lubrication.

a. If your linear guide is rust prevention specification, thoroughly wipe the rust prevention oil and put lubricant inside of slide before using. For seal lubrication products, put lubricant on the rail.
b. Do not mix greases of different brands.
c. If your linear guide is rust prevention specifications, put lubricant inside of slide before using.

(2) Handling

Handle with care.

Do not disassemble.

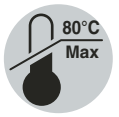
Do not drop.

Do not give impact.

a. Slides for random-matching are installed to the provisional rail when they leave the factory. Handle the slide with care during installation to the rail.
b. Do not disassemble the linear guide unless absolutely necessary. Not only does it allow dust to enter, but it lessens precision.
c. The slide may move by simply leaning the rail. Make sure that the slide does not disengage from the rail.
d. Standard end cap is made of plastic. Beating it or hitting it against an object may cause damage.

(3) Precautions in use

Do not contaminate.



Temperature limitation.

Do not hang upside down.

a. Make every effort not to allow dust and foreign objects to enter.
b. Please apply splash guard or bellows to the linear guide to prevent sticking resolvent or coolant when it contains corrosive material.
c. The temperature of the place where linear guides are used should not exceed 80°C (excluding heat-resistant type linear guides). A higher temperature may damage the plastic end cap.
d. If the user cuts the rail, thoroughly remove burrs and sharp edges on the cut surface.
e. When hanging upside-down (e.g. the rail is installed upside-down on the ceiling in which the slide faces downward), should the end cap be damaged, causing the balls or rollers to fall out, the slide may be detached from the rail and fall. For such use, take measures including installing a safety device.

(4) Storage

Store in the correct position.

a. Linear guide may bend if the rail is stored in inappropriate position. Place it on a suitable surface, and store it in a flat position.

6. Design Precautions

The following points must be heeded in examining the life.

In case of oscillating stroke

- If the balls or rollers do not rotate all the way, but only halfway, and if this minute stroke is repeated, lubricant disappears from the contact surface of balls or rollers and raceways. This generates "fretting," a premature wear. Fretting cannot be entirely prevented in such a case but it can be mitigated.
- We recommend anti-fretting grease for oscillating stroke operations. Even in a case using a standard grease, the life can be markedly prolonged by adding a normal stroke travel (about the slide length) once every several thousand cycles.

When applying pitching or yawing moment

- Load applied to the ball or roller rows inside the slide is inconsistent if pitching or yawing moment load is applied. Loads are heavy on the balls or rollers on each end of the row.
- In such a case, a heavy load lubricant grease or oil is recommended. Another countermeasure is using one size larger model of linear guide to reduce the load per ball or roller.
- Moment load is insignificant for 2-rail, 4-slide combination which is commonly used.

When an extraordinary large load is applied during stroke

- If an extraordinary large load is applied at certain position of the stroke, calculate not only the life based on the mean effective load, but also the life based on the load in this range.
- When an extraordinary heavy load is applied and thus the application of high tensile stress to fixing bolts of the rails and slides is foreseen, the strength of the bolts should be considered.

When calculated life is extraordinarily short (Less than 3 000 km in calculated life.)

- In such a case, the contact pressure to the balls or rollers and the rolling contact surface is extraordinarily high.
- When a linear guide is operated under such state continually, the life is significantly affected by the loss of lubrication and the presence of dust, and thus the actual life becomes shorter than calculated.
- It is necessary to reconsider the number of slides, the arrangement of slides, and the type of model in order to reduce the load to the slide.
- It is necessary to consider preload for calculation of rating life when selecting Z3 (medium preload) or Z4 (heavy preload) as a preload. For the calculation of full dynamic equivalent loads that consider preload, see "A-3-3 6" on page A31. Please consult NSK for details.

Application at high speed

- The standard maximum allowable speed of a linear guide under normal conditions is 100 m/min. However, the maximum allowable speed can be affected by accuracy of installation, temperature, external loading etc.
- The end cap with high speed specification must be used when operating speed exceeds the permissible speed. In such a case, please consult NSK.

A-5 Technical Description and Dimension Table for NSK Linear Guides

A-5-1 General Industrial Use

A-5-1.1 NH Series

1. Features

(1) Improve rating life dramatically

Based on the LH series characterized by reliability and performance, a significant increase in durability has been attained. New ball groove geometry is introduced, which has been developed by utilizing NSK's state-of-the-art tribological and analytical technologies. Due to the optimized distribution of contact surface pressures, the rating life has dramatically increased.

As compared with the LH Series, the load rating capacity of the NH series has increased to 1.3 times, while the life span has increased to twice*1. These features enable you to design a machine with a longer life and downsize the machine. Thus, your design capability is greatly enhanced.

*1: Representative values of series.

(2) Ball circulation path with excellent high-speed property

By reexamining the design practice for the ball circulation path, we have attained smooth ball circulation and reduced noise level. So, NH series is suited for high-speed applications compared with the LH Series.

(3) All mounting dimensions are the same as those for the LH and SH Series

Regarding the mounting dimensions (mounting parts' dimensions), such as the mounting height, mounting width, mounting hole diameter/pitch of the linear guide, etc., the mounting dimensions of the NH Series remain the same as those of the conventional LH series and SH series. So, the new NH Series linear guides can be used without making any design changes.

(4) High self-aligning capability (rolling direction)

Same as the DF combination in angular contact bearings, self-aligning capability is high because the cross point of the contact lines of balls and grooves comes inside, and thus reducing moment rigidity.

This increases the capacity to absorb errors in installation.

(5) High load carrying capacity to vertical direction

The contact angle is set at 50 degrees, and thus increasing load carrying capacity as well as rigidity in vertical direction.

(6) High resistance against impact load

The bottom ball groove is formed in Gothic arch and the center of the top and bottom grooves are offset as shown in **Fig. 2**. The vertical load is generally carried by the top ball rows, where balls are contacting at two points. Because of this design, the bottom ball rows will carry load when a large impact load is applied vertically as shown in **Fig. 3**. This assures high resistance to the impact load.

(7) High accuracy

As showing in **Fig. 4**, fixing the master rollers to the ball grooves is easy thanks to the Gothic arch groove. This makes easy and accurate measuring of ball grooves.

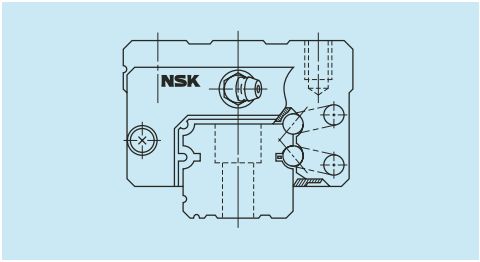


Fig. 1 NH Series

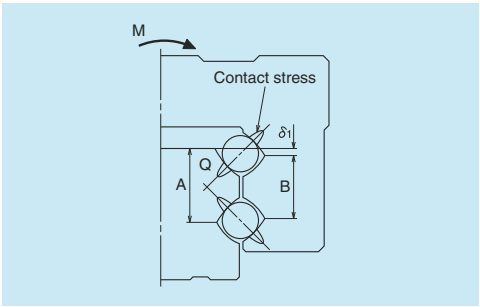


Fig. 2 Enlarged illustration of the offset Gothic arch groove

Note: For customers who have used the former LH or SH series, NH series is recommended as a substitute. Please confirm the correlation between NH series and former ones on the comparative table at A319.

(8) Easy to handle, and designed with safety in mind.

Balls are retained in the retainer, therefore they do not fall out when the ball slide is withdrawn from the rail.

(9) Abundant models and sizes

Each size of NH Series has various models of ball slides, rendering the linear guide available for numerous uses.

(10) Fast delivery

Lineup of random-matching rails and ball slides supports and facilitates fast delivery.

High precision grade and medium preload types are also available in randam matching. (Special high-carbon steel products)

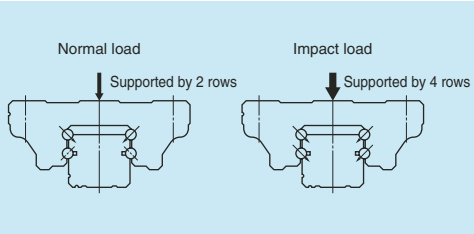


Fig. 3 When load is applied

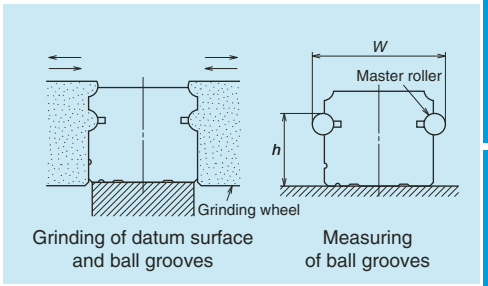
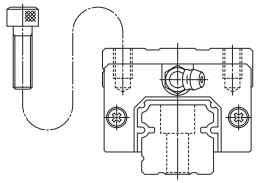
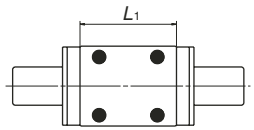
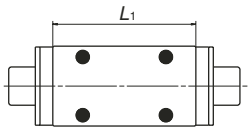
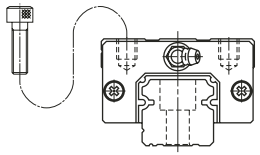
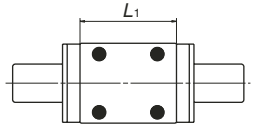
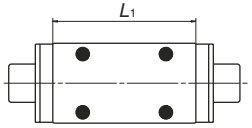
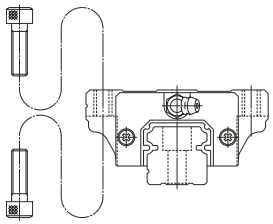
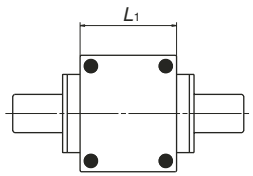
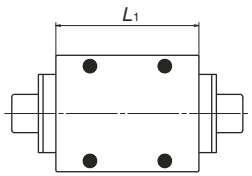


Fig. 4 Rail grinding and measuring

2. Ball slide shape

Ball slide Model	Shape/installation method	Type (Upper row, Rating: Lower row, Ball slide length)	
		High-load type	Super-high-load type
		Standard	Long
AN BN		AN 	BN 
AL BL		AL 	BL 
EM GM		EM 	GM 

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

Rail length (mm) over	or less	Preloaded assembly (not random matching) Ultra precision P3	Super precision P4	High precision P5	Precision grade P6	Normal grade PN	Random-matching type High precision PH	Normal grade PC
–	50	2	2	2	4.5	6	2	6
50	80	2	2	3	5	6	3	6
80	125	2	2	3.5	5.5	6.5	3.5	6.5
125	200	2	2	4	6	7	4	7
200	250	2	2.5	5	7	8	5	8
250	315	2	2.5	5	8	9	5	9
315	400	2	3	6	9	11	6	11
400	500	2	3	6	10	12	6	12
500	630	2	3.5	7	12	14	7	14
630	800	2	4.5	8	14	16	8	16
800	1 000	2.5	5	9	16	18	9	18
1 000	1 250	3	6	10	17	20	10	20
1 250	1 600	4	7	11	19	23	11	23
1 600	2 000	4.5	8	13	21	26	13	26
2 000	2 500	5	10	15	22	29	15	29
2 500	3 150	6	11	17	25	32	17	32
3 150	4 000	9	16	23	30	34	23	34

(2) Accuracy standard

The preloaded assembly has five accuracy grades; Ultra precision P3, Super precision P4, High precision P5, Precision P6 and Normal PN grades, while the random-matching type has High precision PH and Normal PC grade.

• Tolerance of preloaded assembly

Table 2

Unit: μm

Characteristics \ Accuracy grade	Ultra precision P3	Super precision P4	High precision P5	Precision grade P6	Normal grade PN
Mounting height H Variation of H (All ball slides on a set of rails)	±10 3	±10 5	±20 7	±40 15	±80 25
Mounting width W_2 or W_3 Variation of W_2 or W_3 (All ball slides on reference rail)	±15 3	±15 7	±25 10	±50 20	±100 30
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	Shown in **Table 1**, **Fig. 5**, and **Fig. 6**				

• Tolerance of random-matching type

Table 3

Unit: μm

Accuracy grade	High precision grade PH		Normal grade PC	
Characteristics \ Model No.	NH15, 20, 25, 30, 35	NH45, 55, 65	NH15, 20, 25, 30, 35	NH45, 55, 65
Mounting height H	±20	±30	±20	±30
Variation of mounting height H	15① 30②	20① 35②	15① 30②	20① 35②
Mounting width W_2 or W_3	±30	±35	±30	±35
Variation of mounting width W_2 or W_3	20	30	25	30
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	See **Table 1**, **Fig. 5** and **Fig. 6**			

Note: ① Variation on the same rail ② Variation on multiple rails

(3) Combinations of accuracy and preload

Table 4

		Accuracy grade: Ultra precision	Super precision	High precision	Precision grade	Normal grade	High precision	Normal grade
Without NSK K1 lubrication unit		P3	P4	P5	P6	PN	PH	PC
With NSK K1 lubrication unit		K3	K4	K5	K6	KN	KH	KC
With NSK K1 for food and medical equipment		F3	F4	F5	F6	FN	FH	FC
Preload	Fine clearance Z0	○	○	○	○	○	—	—
	Slight preload Z1	○	○	○	○	○	—	—
	Medium preload Z3	○	○	○	○	—	—	—
	Random-matching type with fine clearance ZT	—	—	—	—	—	—	○
	Random-matching type with slight preload ZZ	—	—	—	—	—	○	○
	Random-matching type with medium preload ZH	—	—	—	—	—	○	○

(4) Assembled accuracy

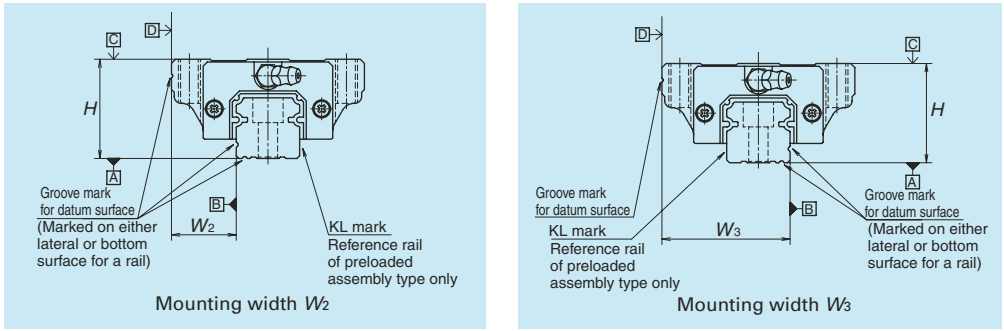


Fig. 5 Special high carbon steel

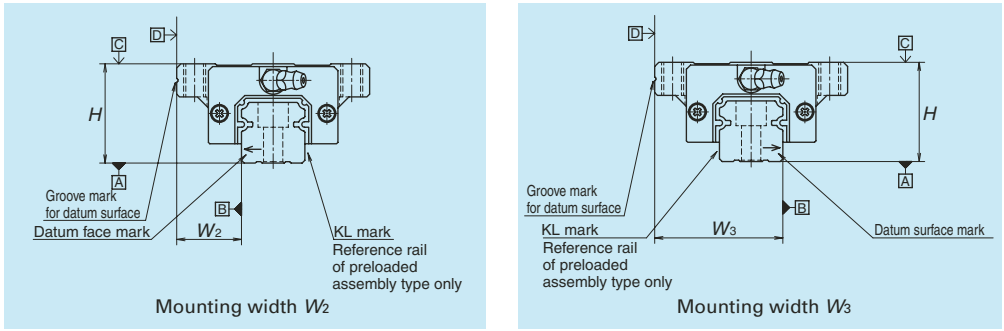


Fig. 6 Stainless steel

(5) Preload and rigidity

We offer six levels of preload: Slight preload Z1, Medium preload Z3 and Fine clearance Z0, along with random-matching type of Medium preload ZH, Slight preload ZZ and Fine clearance ZT.

• Preload and rigidity of preloaded assembly

Table 5

	Model No.	Preload (N)		Rigidity (N/μm)			
				Vertical direction		Lateral direction	
		Slight preload Z1	Medium preload Z3	Slight preload Z1	Medium preload Z3	Slight preload Z1	Medium preload Z3
High-load type	NH15 AN, EM	78	490	137	226	98	186
	NH20 AN, EM	147	835	186	335	137	245
	NH25 AL, AN, EM	196	1 270	206	380	147	284
	NH30 AL, AN	245	1 570	216	400	157	294
	NH30 EM	294	1 770	265	480	186	355
	NH35 AL, AN, EM	390	2 350	305	560	216	390
	NH45 AL, AN, EM	635	3 900	400	745	284	540
	NH55 AL, AN, EM	980	5 900	490	910	345	645
	NH65 AN, EM	1 470	8 900	580	1 070	400	755
Super-high-load type	NH15 BN, GM	98	685	196	345	137	284
	NH20 BN, GM	196	1 080	265	480	196	355
	NH25 BL, BN, GM	245	1 570	294	560	216	400
	NH30 BL, BN, GM	390	2 260	360	665	265	480
	NH35 BL, BN, GM	490	2 940	430	795	305	570
	NH45 BL, BN, GM	785	4 800	520	960	370	695
	NH55 BL, BN, GM	1 180	7 050	635	1 170	440	835
	NH65 BN, GM	1 860	11 300	805	1 480	550	1 040

Note: Clearance for Fine clearance Z0 is 0 to 3μm. Therefore, preload is zero.
However, Z0 of PN grade is 0 to 15μm.

• Clearance and preload of random-matching type

Table 6 Unit: μm

Model No.	Fine clearance ZT	Slight preload ZZ	Medium preload ZH
NH15	–4 — 15	–4 — 0	–7 — –3
NH20	–5 — 15	–5 — 0	–8 — –3
NH25		–5 — 0	–9 — –4
NH30		–7 — 0	–12 — –5
NH35		–7 — 0	–12 — –5
NH45		–7 — 0	–14 — –7
NH55		–9 — 0	–18 — –9
NH65		–9 — 0	–19 — –10

Note: Minus sign denotes that a value is an amount of preload (elastic deformation of balls).

4. Maximum rail length

Table 7 shows the limitations of rail length (maximum length). However, the limitations vary by accuracy grades.

Table 7 Length limitations of rails Unit: mm

Series	Material \ Size	15	20	25	30	35	45	55	65
NH	Special high carbon steel	2 980	3 960	3 960	4 000	4 000	3 990	3 960	3 900
	Stainless steel	1 800	3 500	3 500	3 500				

Note: Rails can be butted if user requirement exceeds the rail length shown in the table. Please consult NSK.

5. Installation

(1) Permissible values of mounting error

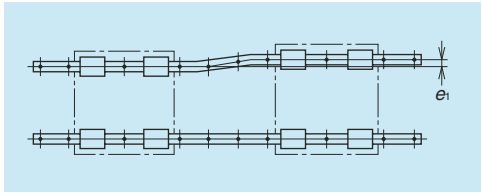


Fig. 7

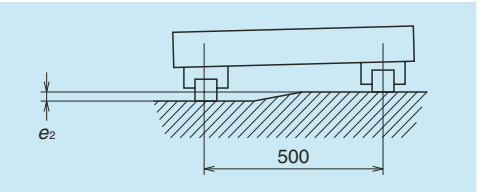


Fig. 8

Table 8 Unit: μm

Value	Preload	Model No. NH15	NH20	NH25	NH30	NH35	NH45	NH55	NH65
Permissible values of parallelism in two rails e_1	Z0, ZT	22	30	40	45	55	65	80	110
	Z1, ZZ	18	20	25	30	35	45	55	70
	Z3, ZH	13	15	20	25	30	40	45	60
Permissible values of parallelism (height) in two rails e_2	Z0, ZT	375μm/500mm							
	Z1, ZZ, Z3, ZH	330μm/500mm							

(2) Shoulder height of the mounting surface and corner radius r

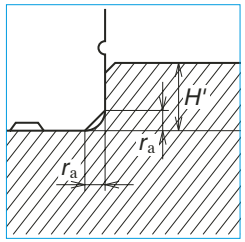


Fig. 9 Shoulder for the rail datum surface

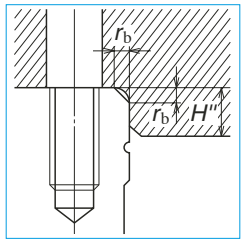


Fig. 10 Shoulder for the ball slide datum surface

Table 9 Unit: mm

Model No.	Corner radius (maximum) r_a	r_b	Shoulder height H'	H''
NH15	0.5	0.5	4	4
NH20	0.5	0.5	4.5	5
NH25	0.5	0.5	5	5
NH30	0.5	0.5	6	6
NH35	0.5	0.5	6	6
NH45	0.7	0.7	8	8
NH55	0.7	0.7	10	10
NH65	1	1	11	11

6. Maximum allowable speed

An indication of the standard maximum allowable speed aiming at 10,000km operation with NH series under normal conditions is shown in Table 10. However, the maximum allowable speed can be affected by accuracy of installation, operating temperature, external load, etc. If the operation is made exceeding the permissible distance and speed, please consult NSK.

Table 10 Maximum allowable speed Unit: m/min

Series \ Size	15	20	25	30	35	45	55	65
NH	300					200		150

7. Lubrication components

Refer to pages A38 and D13 for the lubrication of linear guides.

(1) Types of lubrication accessories

Fig. 11 and **Table 11** show grease fittings and tube fittings.

We provide lubrication accessories with extended thread body length (L) for the addition of dust-proof accessories such as NSK K1 lubrication unit, double seal and protector.

We provide a suitable lubrication accessory for the special requirement on dust-proof accessories.

Consult NSK for a lubrication accessory with extended length of thread body for your convenience of replenishing lubricant.

When you require stainless lubrication accessories, please ask NSK.

(2) Mounting position of lubrication accessories

The standard position of grease fittings is the end face of ball slide. We mount them on a side of end cap for an option. (**Fig. 12**)

Please consult NSK for installation of grease or tube fittings to the ball slide body or side of end cap.

When using a piping unit with thread of M6 × 1, you require a connector to connect to a grease fitting mounting hole with M6 × 0.75. The connector is available from NSK.

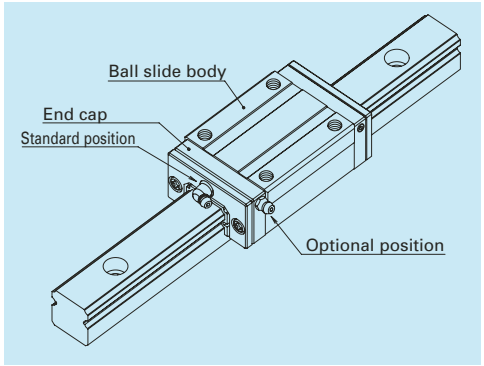


Fig. 12 Mounting position of lubrication accessories

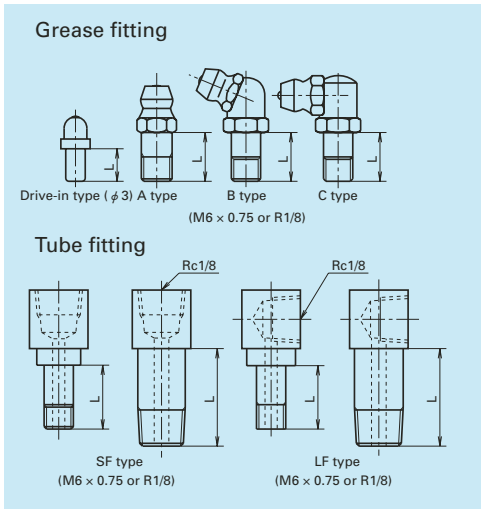


Fig. 11 Grease fitting and tube fitting

Table 11 Unit: mm

Model No.	Dust-proof specification	Grease fitting	Tube fitting
		Thread body length L	Thread body length L
NH15	Standard	5	–
	With NSK K1	10	–
	Double seal	*	–
	Protector	*	–
NH20	Standard	5	–
	With NSK K1	12	–
	Double seal	10	–
	Protector	10	–
NH25	Standard	5	5
	With NSK K1	12	12
	Double seal	10	9
	Protector	10	9
NH30	Standard	5	6
	With NSK K1	14	13
	Double seal	12	11
	Protector	12	11
NH35	Standard	5	6
	With NSK K1	14	13
	Double seal	12	11
	Protector	12	11
NH45	Standard	8	17
	With NSK K1	18	21.5
	Double seal	14	17
	Protector	14	17
NH55	Standard	8	17
	With NSK K1	18	21.5
	Double seal	14	17
	Protector	14	17
NH65	Standard	8	17
	With NSK K1	20	25.5
	Double seal	16	19
	Protector	16	17

*) A connector is required for this model. Please contact NSK for grease fittings.

8. Dust-proof components

(1) Standard specification

The NH Series can be readily used as they have a dust protection means for normal conditions. As the standard equipment, the ball slides have an end seal on both ends, and bottom seals at the bottom.

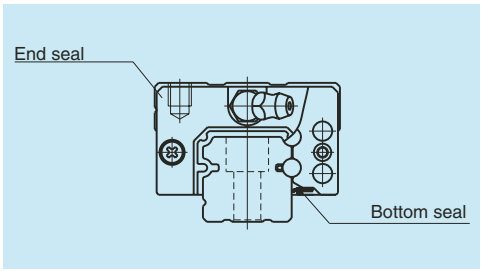


Fig. 13

Table 12 Seal friction per ball slide (maximum value) Unit: N

Series \ Size	15	20	25	30	35	45	55	65
NH	8	9	10	10	12	17	22	29

(2) NSK K1™ lubrication unit

Table 13 shows the dimension of linear guides equipped with the NSK K1 lubrication unit.

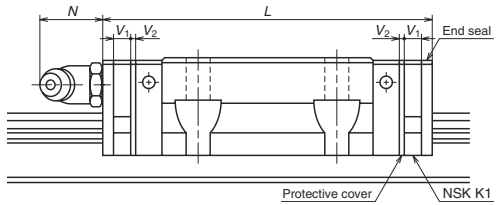


Table 13 Unit: mm

Model No.	Ball slide length	Ball slide model	Standard ball slide length	Ball slide length installed with two NSK K1 *L*	Per NSK K1 thickness V_1	Protective cover thickness V_2	Protruding area of the grease fitting *N*
NH15	Standard	AN, EM	55	65.6	4.5	0.8	(5)
	Long	BN, GM	74	84.6			
NH20	Standard	AN, EM	69.8	80.4	4.5	0.8	(14)
	Long	BN, GM	91.8	102.4			
NH25	Standard	AL, AN, EM	79.0	90.6	5.0	0.8	(14)
	Long	BL, BN, GM	107	118.6			
NH30	Standard	AL, AN	85.6	97.6	5.0	1.0	(14)
		EM	98.6	110.6			
	Long	BL, BN, GM	124.6	136.6			
NH35	Standard	AL, AN, EM	109	122	5.5	1.0	(14)
	Long	BL, BN, GM	143	156			
NH45	Standard	AL, AN, EM	139	154	6.5	1.0	(15)
	Long	BL, BN, GM	171	186			
NH55	Standard	AL, AN, EM	163	178	6.5	1.0	(15)
	Long	BL, BN, GM	201	216			
NH65	Standard	AN, EM	193	211	8.0	1.0	(16)
	Long	BN, GM	253	271			

Notes: 1) NSK K1 for food and medical equipments are available for NH15 to NH35.
2) Ball slide length equipped with NSK K1 = (Standard ball slide length) + (Thickness of NSK K1, V_1 × Number of NSK K1) + (Thickness of the protective cover, V_2 × 2)

(3) Double seal

Use a double seal set as showing in **Table 14**, when installing an extra seal to completed standard products. (**Fig. 14**)
When installing a grease fitting after the installation of double seals, a connector as showing in **Fig.14** is required.

(4) Protector

Use a protector set as showing **Table 15**, when installing a protector to completed standard products. (**Fig.15**)
When installing a grease fitting after the installation of protectors, a connector as showing in **Fig.15** is required.

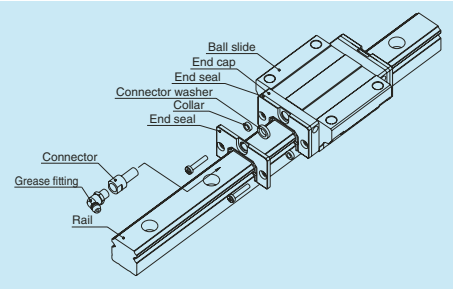


Fig. 14 Double seal

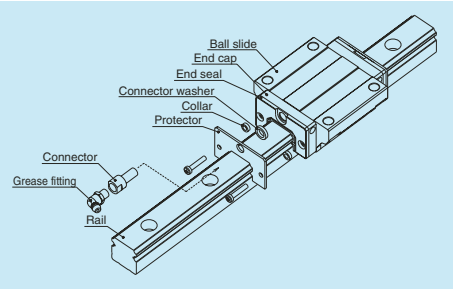


Fig. 15 Protector

Table 14 Double-seal set

Model No.	Reference No.		Increased thickness V_3 (mm)
	Without connector	With connector	
NH15	LH15WS-01	*	2.5
NH20	LH20WS-01	LH20WSC-01	2.5
NH25	LH25WS-01	LH25WSC-01	2.8
NH30	LH30WS-01	LH30WSC-01	3.6
NH35	LH35WS-01	LH35WSC-01	3.6
NH45	LH45WS-01	LH45WSC-01	4.3
NH55	LH55WS-01	LH55WSC-01	4.3
NH65	LH65WS-01	LH65WSC-01	4.9

Table 15 Protector set

Model No.	Reference No.		Increased thickness V_4 (mm)
	Without connector	With connector	
NH15	LH15PT-01	*	2.7
NH20	LH20PT-01	LH20PTC-01	2.9
NH25	LH25PT-01	LH25PTC-01	3.2
NH30	LH30PT-01	LH30PTC-01	4.2
NH35	LH35PT-01	LH35PTC-01	4.2
NH45	LH45PT-01	LH45PTC-01	4.9
NH55	LH55PT-01	LH55PTC-01	4.9
NH65	LH65PT-01	LH65PTC-01	5.5

*) For installation of a connector to a drive-in type grease fitting, contact NSK.

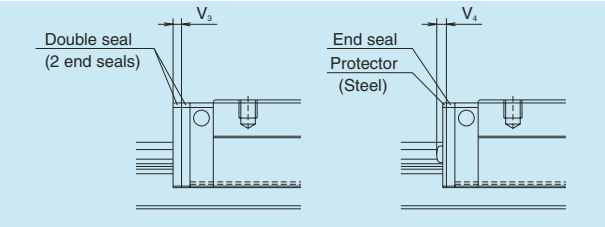


Fig. 16

(5) Cap to plug the rail mounting bolt hole

Table 16 Caps to plug rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
NH15	M4	LG-CAP/M4	20
NH20	M5	LG-CAP/M5	20
NH25	M6	LG-CAP/M6	20
NH30, NH35	M8	LG-CAP/M8	20
NH45	M12	LG-CAP/M12	20
NH55	M14	LG-CAP/M14	20
NH65	M16	LG-CAP/M16	20

(6) Inner seal

Inner seal is only available for models shown in the table below.

Table 17

Series	Model No.
NH	NH20, NH25, NH30, NH35, NH45, NH55, NH65

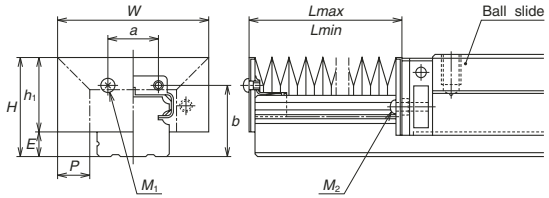
(7) Bellows

- A bellows fastener kit, which includes one of bellows faster, two of M_1 set screws, two of M_2 set screws, and two collars for M_2 set screws as showing Fig. 7.7 on page A55, is supplied with ellows for the ends.
- Middle bellows are supplied with four set screws and four collars.
- Use a bellows fastener kit as showing **Table 18**, when installing bellows to completed standard products.
- When NSK K1, double seals or protectors are used, the set screws of bellows fastener kit are unable to use.
  Please contact NSK for details.
- Bellows fastener is available only for the horizontal mounting positions. For other mounting positions, sliding plate is required (see **Fig. 7.10** on page A56).
  For fixing to the rail, make tap holes to the rail end surface. Fix the bellows mounting plate to the rail end surface through these tap holes by using a machine screw. NSK processes a tap hole to the rail end face when ordered with a linear guide.

Table 18 Bellows fastner kit reference No.

Model No.	Kit reference No.
NH20	LH20FS-01
NH25	LH25FS-01
NH30	LH30FS-01
NH35	LH35FS-01
NH45	LH45FS-01
NH55	LH55FS-01
NH65	LH65FS-01

Dimension tables of bellows
NH Series



Bellows reference number

J A H 20 N 08

- Bellows
- A: Bellows for the ends
  B: Middle bellows
- Bellows for NH series
- Size number of linear guide
- N: High type L: Low type
- Number of BL (fold number)

Fig. 17 Dimensions of bellows

Table 19 Dimensions of bellows Unit: mm

Model No.	*H*	h_1	*E*	*W*	*P*	*a*	*b*	BL minimum length	M_1Tap x depth	M_2Tap x depth
JAH20N	29.5	24.5	5	48	10	13	22	17	M3 × 5	M2.5 × 16
JAH25L	35	28	7	51	10	16	26	17	M3 × 5	M3 × 18
JAH25N	39	32		61	15					
JAH30L	41	32	9	60	12	18	31	17	M4 × 6	M4 × 22
JAH30N	44	35		66	15					
JAH35L	47	37.5	9.5	72	15	24	34	17	M4 × 6	M4 × 23
JAH35N	54	44.5		82	20					
JAH45L	59	45	14	83	15	32	44.5	17	M5 × 8	M5 × 28
JAH45N	69	55		103	25					
JAH55L	69	54	15	101	20	40	50.5	17	M5 × 8	M5 × 30
JAH55N	79	64		121	30					
JAH65N	89	73	16	131	30	48	61	17	M6 × 8	M6 × 35

Table 20 Numbers of folds (BL) and lengths of bellows Unit: mm

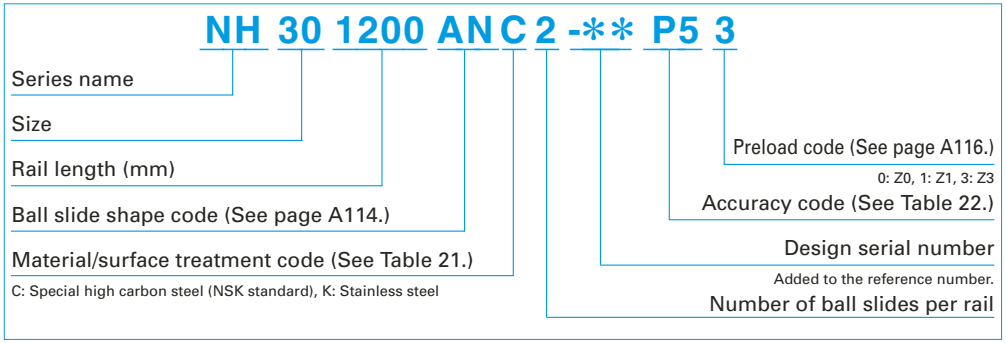
Model No.	Number of BL	2	4	6	8	10	12	14	16	18	20
	L_{min}	34	68	102	136	170	204	238	272	306	340
JAH20N	Stroke	106	212	318	424	530	636	742	848	954	1 060
	L_{max}	140	280	420	560	700	840	980	1 120	1 260	1 400
JAH25L	Stroke	106	212	318	424	530	636	742	848	954	1 060
	L_{max}	140	280	420	560	700	840	980	1 120	1 260	1 400
JAH25N	Stroke	176	352	528	704	880	1 056	1 232	1 408	1 584	1 760
	L_{max}	210	420	630	840	1 050	1 260	1 470	1 680	1 890	2 100
JAH30L	Stroke	134	268	402	536	670	804	938	1 072	1 206	1 340
	L_{max}	168	336	504	672	840	1 008	1 176	1 344	1 512	1 680
JAH30N	Stroke	176	352	528	704	880	1 056	1 232	1 408	1 584	1 760
	L_{max}	210	420	630	840	1 050	1 260	1 470	1 680	1 890	2 100
JAH35L	Stroke	176	352	528	704	880	1 056	1 232	1 408	1 584	1 760
	L_{max}	210	420	630	840	1 050	1 260	1 470	1 680	1 890	2 100
JAH35N	Stroke	246	492	738	984	1 230	1 476	1 722	1 968	2 214	2 460
	L_{max}	280	560	840	1 120	1 400	1 680	1 960	2 240	2 520	2 800
JAH45L	Stroke	176	352	528	704	880	1 058	1 232	1 408	1 584	1 760
	L_{max}	210	420	630	840	1 050	1 260	1 470	1 680	1 890	2 100
JAH45N	Stroke	316	632	948	1 264	1 580	1 896	2 212	2 528	2 844	3 160
	L_{max}	350	700	1 050	1 400	1 750	2 100	2 450	2 800	3 150	3 500
JAH55L	Stroke	246	492	738	984	1 230	1 476	1 722	1 968	2 214	2 460
	L_{max}	280	560	840	1 120	1 400	1 680	1 960	2 240	2 520	2 800
JAH55N	Stroke	386	772	1 158	1 544	1 930	2 316	2 702	3 088	3 474	3 860
	L_{max}	420	840	1 260	1 680	2 100	2 520	2 940	3 360	3 780	4 200
JAH65N	Stroke	386	772	1 158	1 544	1 930	2 316	2 702	3 088	3 474	3 860
	L_{max}	420	840	1 260	1 680	2 100	2 520	2 940	3 360	3 780	4 200

Note: The values of an odd number BL quantity (3, 5, 7, ...) can be obtained by adding two values of even number BL on the both sides, then by dividing the sum by 2.

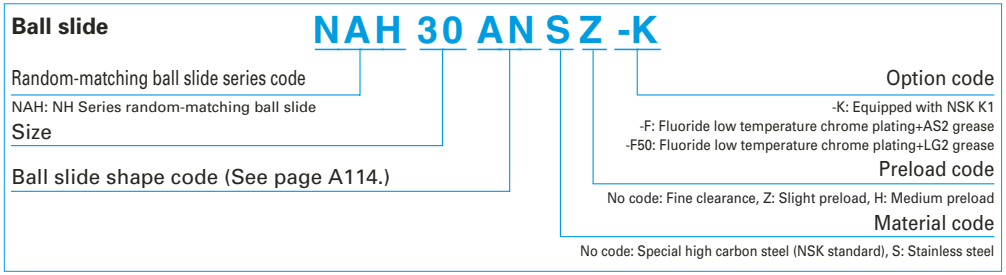
9. Reference number

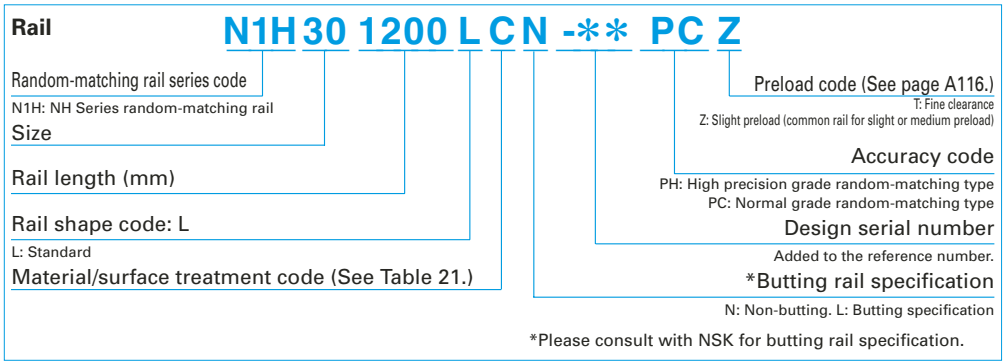
Reference numbers shall be set to individual NSK linear guide when its specifications are finalized, and it is indicated on its specification drawing.
Please specify the reference number, except design serial number, to identify the product when ordering, requiring estimates, or inquiring about specifications from NSK.

(1) Reference number for preloaded assembly



(2) Reference number for random-matching type





The reference number coding for the assembly of random-matching type is the same as that of the preloaded assembly. However, only preload codes of "fine clearance T", "slight preload Z" and "medium preload H" are available (refer to page A116).

Table 21 Material/surface treatment code

Code	Description
C	Special high carbon steel (NSK standard)
K	Stainless steel (NH15 to NH30 only)
D	Special high carbon steel with surface treatment
H	Stainless steel with surface treatment
Z	Other, special

Note: High-precision grade and medium preload of random-matching type are not available in stainless steel.

Table 22 Accuracy code

Accuracy	Standard (Without NSK K1)	With NSK K1	With NSK K1 for food and medical equipment
Ultra precision grade	P3	K3	F3
Super precision grade	P4	K4	F4
High precision grade	P5	K5	F5
Precision grade	P6	K6	F6
Normal grade	PN	KN	FN
High precision grade (random-matching type)	PH	KH	FH
Normal grade (random-matching type)	PC	KC	FC

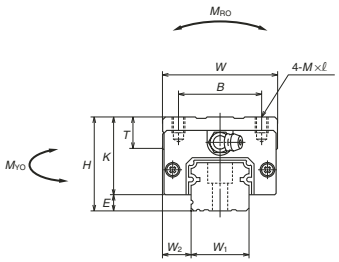
Note: Refer to pages A38 and A61 for NSK K1 lubrication unit.

10. Dimensions
NH-AN (High-load type / Standard)
NH-BN (Super-high-load type / Long)

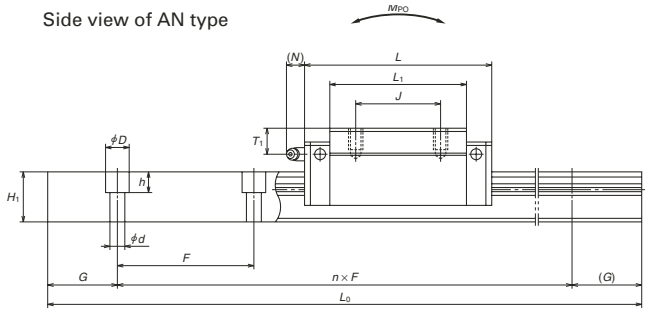
NH 30 1200 AN C 2 - PC Z**

- Series name: NH
- Size: 30
- Rail length (mm): 1200
- Ball slide shape code (See page A114.): AN
- Material/surface treatment code (See Table 21.): C
  - C: Special high carbon steel (NSK standard), K: Stainless steel
- Number of ball slides per rail: 2
- Design serial number: -**
  - Added to the reference number.
- Accuracy code (See Table 22.): PC
- Preload code (See page A116.): Z
  - 0: Z0, 1: Z1, 3: Z3, T: ZT, Z: ZZ, H: ZH

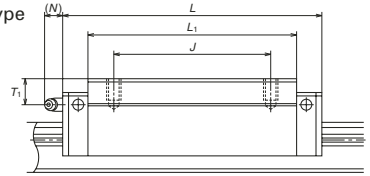
Front view of AN and BN types



Side view of AN type



Side view of BN type



Model No.	Assembly Height H	E	W_2	Ball slide Width W	Length L	Mounting hole B	J	M × pitch × ℓ	L_1	K	T	Grease fitting Hole size	T_1	N	Width W_1	Height H_1
NH15AN	28	4.6	9.5	34	55	26	26	M4×0.7×6	39	23.4	8	ϕ3	8.5	3.3	15	15
NH15BN					74				58							
NH20AN	30	5	12	44	69.8	32	36	M5×0.8×6	50	25	12	M6×0.75	5	11	20	18
NH20BN					91.8		50		72							
NH25AN	40	7	12.5	48	79	35	35	M6×1×9	58	33	12	M6×0.75	10	11	23	22
NH25BN					107		50		86							
NH30AN	45	9	16	60	85.6	40	40	M8×1.25×10	59	36	14	M6×0.75	10	11	28	26
NH30BN					124.6		60		98							
NH35AN	55	9.5	18	70	109	50	50	M8×1.25×12	80	45.5	15	M6×0.75	15	11	34	29
NH35BN					143		72		114							
NH45AN	70	14	20.5	86	139	60	60	M10×1.5×17	105	56	17	Rc1/8	20	13	45	38
NH45BN					171		80		137							
NH55AN	80	15	23.5	100	163	75	75	M12×1.75×18	126	65	18	Rc1/8	21	13	53	44
NH55BN					201		95		164							
NH65AN	90	16	31.5	126	193	76	70	M16×2×20	147	74	23	Rc1/8	19	13	63	53
NH65BN					253		120		207							

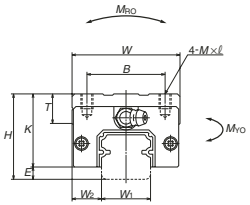
Notes: 1) External appearance of stainless steel ball slides differs from those of carbon steel ball slides.

Reference number for ball slide of random-matching type

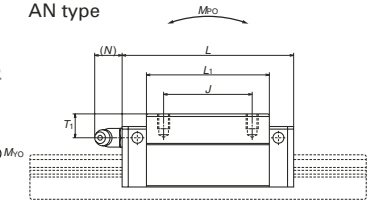
Ball slide NAH 30 AN S Z -K

- Random-matching ball slide series code: NAH
  - NAH: NH Series random-matching ball slide
- Size: 30
- Ball slide shape code (See page A114.): AN
- Material code: S
  - No code: Special high carbon steel (NSK standard), S: Stainless steel
- Preload code: Z
  - No code: Fine clearance, Z: Slight preload, H: Medium preload
- Option code: -K
  - -K: Equipped with NSK K1
  - -F: Fluoride low temperature chrome plating+AS2 grease
  - -F50: Fluoride low temperature chrome plating+LG2 grease

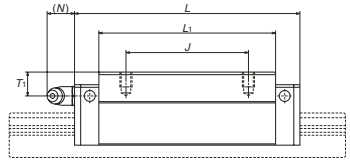
AN and BN types



AN type



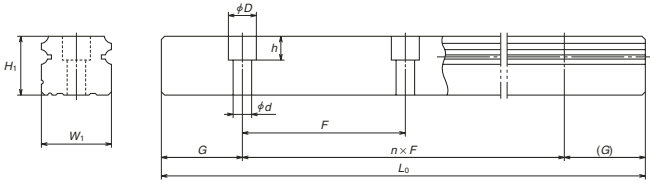
BN type



Reference number for rail of random-matching type

Rail N1H30 1200 L C N - PC Z**

- Random-matching rail series code: N1H
  - N1H: NH Series random-matching rail
- Size: 30
- Rail length (mm): 1200
- Rail shape code: L
  - L: Standard
- Material/surface treatment code (See Table 21.): C
- *Butting rail specification: N
  - N: Non-butting, L: Butting specification
  - *Please consult with NSK for butting rail specification.
- Design serial number: -**
  - Added to the reference number.
- Accuracy code: PC
  - PH: High precision grade, PC: Normal grade
- Preload code (See page A116.): Z
  - T: Fine clearance.
  - Z: Slight preload (common rail for medium preload)



Unit: mm

Rail Pitch F	Mounting bolt hole d × D × h	G (reference)	Max. length L_{0max}. ( ) for stainless	Basic load rating 2)Dynamic [50km] C_{50}(N)	[100km] C_{100}(N)	Static C_0 (N)	Static moment (N·m) M_{RO}	M_{PO} One slide	M_{PO} Two slides	M_{YO} One slide	M_{YO} Two slides	Weight Ball slide (kg)	Rail (kg/m)
60	4.5×7.5×5.3	20	2 980 (1 800)	14 200	11 300	20 700	108	94.5	575	79.5	480	0.18	1.6
				18 100	14 400	32 000	166	216	1 150	181	965	0.26	
60	6×9.5×8.5	20	3 960 (3 500)	23 700	18 800	32 500	219	185	1 140	155	955	0.33	2.6
				30 000	24 000	50 500	340	420	2 230	355	1 870	0.48	
60	7×11×9	20	3 960 (3 500)	33 500	26 800	46 000	360	320	1 840	267	1 540	0.55	3.6
				45 500	36 500	71 000	555	725	3 700	610	3 100	0.82	
80	9×14×12	20	4 000 (3 500)	41 000	32 500	51 500	490	350	2 290	292	1 920	0.77	5.2
				61 000	48 500	91 500	870	1 030	5 600	865	4 700	1.3	
80	9×14×12	20	4 000	62 500	49 500	80 500	950	755	4 500	630	3 800	1.5	7.2
				81 000	64 500	117 000	1 380	1 530	8 350	1 280	7 000	2.1	
105	14×20×17	22.5	3 990	107 000	84 500	140 000	2 140	1 740	9 750	1 460	8 150	3.0	12.3
				131 000	104 000	187 000	2 860	3 000	15 600	2 520	13 100	3.9	
120	16×23×20	30	3 960	158 000	125 000	198 000	3 600	3 000	16 300	2 510	13 700	4.7	16.9
				193 000	153 000	264 000	4 850	5 150	26 300	4 350	22 100	6.1	
150	18×26×22	35	3 900	239 000	190 000	281 000	6 150	4 950	27 900	4 150	23 400	7.7	24.3
				310 000	246 000	410 000	8 950	10 100	51 500	8 450	43 500	10.8	

2) The basic load rating comply with the ISO standard. (ISO 14728-1, 14728-2)
C_{50}; the basic dynamic load rating for 50 km rated fatigue life C_{100} ; the basic dynamic load rating for 100 km rated fatigue life
The basic static load rating shows static permissible load.

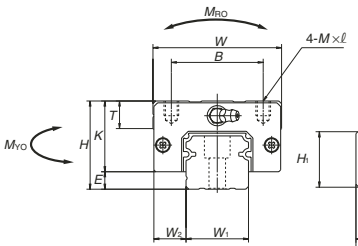
3) High-precision grade and medium preload of random-matching type are available for high-carbon steel products.

NH-AL (High-load type / Standard)
NH-BL (Super-high-load type / Long)

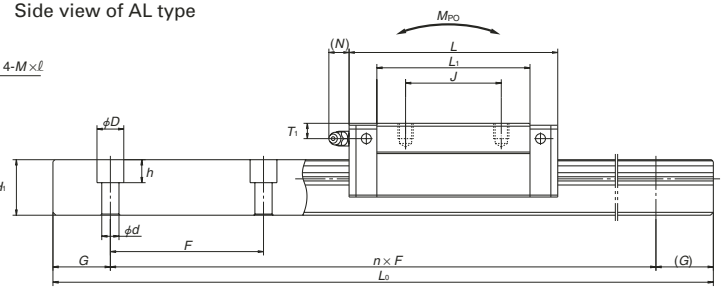
NH 30 1200 AL C 2 - ** PC Z**

- Series name: NH
- Size: 30
- Rail length (mm): 1200
- Ball slide shape code (See page A114.): AL
- Material/surface treatment code (See Table 21.): C
  C: Special high carbon steel (NSK standard), K: Stainless steel
- Number of ball slides per rail: 2
- Design serial number: -**
  Added to the reference number.
- Accuracy code (See Table 22.): PC
- Preload code (See page A116.): Z
  0: Z0, 1: Z1, 3: Z3, T: ZT, Z: ZZ, H: ZH

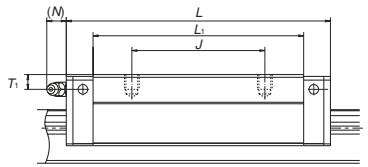
Front view of AL and BL types



Side view of AL type



Side view of BL type



Model No.	Assembly Height H	E	W_2	Ball slide Width W	Length L	Mounting hole B	J	M × pitch × ℓ	L_1	K	T	Grease fitting Hole size	T_1	N	Width W_1	Height H_1
NH25AL	36	7	12.5	48	79	35	35	M6×1×6	58	29	12	M6×0.75	6	11	23	22
NH25BL					107		50		86							
NH30AL	42	9	16	60	85.6	40	40	M8×1.25×8	59	33	14	M6×0.75	7	11	28	26
NH30BL					124.6		60		98							
NH35AL	48	9.5	18	70	109	50	50	M8×1.25×8	80	38.5	15	M6×0.75	8	11	34	29
NH35BL					143		72		114							
NH45AL	60	14	20.5	86	139	60	60	M10×1.5×10	105	46	17	Rc1/8	10	13	45	38
NH45BL					171		80		137							
NH55AL	70	15	23.5	100	163	75	75	M12×1.75×13	126	55	15	Rc1/8	11	13	53	44
NH55BL					201		95		164							

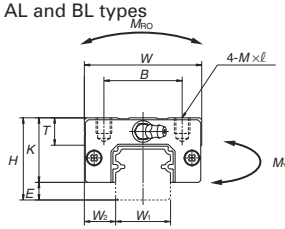
Notes: 1) External appearance of stainless steel ball slides differs from those of carbon steel ball slides.

Reference number for ball slide of random-matching type

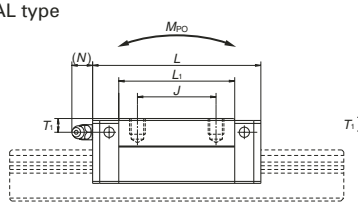
Ball slide **NAH 30 AL S Z -K**

- Random-matching ball slide series code: NAH
  NAH: NH Series random-matching ball slide
- Size: 30
- Ball slide shape code (See page A114.): AL
- Material code: S
  No code: Special high carbon steel (NSK standard), S: Stainless steel
- Preload code: Z
  No code: Fine clearance, Z: Slight preload, H: Medium preload
- Option code: -K
  -K: Equipped with NSK K1
  -F: Fluoride low temperature chrome plating+AS2 grease
  -F50: Fluoride low temperature chrome plating+LG2 grease

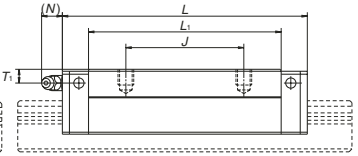
AL and BL types



AL type



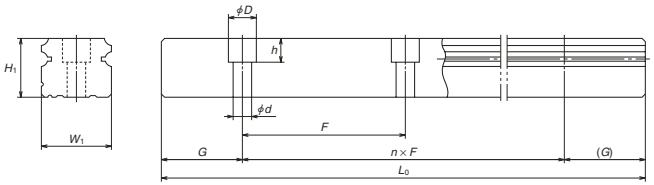
BL type



Reference number for rail of random-matching type

Rail **N1H30 1200 L C N -** ** PC Z**

- Random-matching rail series code: N1H
  N1H: NH Series random-matching rail
- Size: 30
- Rail length (mm): 1200
- Rail shape code: L
  L: Standard
- Material/surface treatment code (See Table 21.): C
- *Butting rail specification: N
  N: Non-butting. L: Butting specification
  *Please consult with NSK for butting rail specification.
- Design serial number: -**
  Added to the reference number.
- Accuracy code: PC
  PH: High precision grade
  PC: Normal grade
- Preload code (See page A116.): Z
  T: Fine clearance.
  Z: Slight preload (common rail for medium preload)



Unit: mm

Rail Pitch F	Mounting bolt hole d × D × h	G (reference)	Max. length L_{0max}. ( ) for stainless	Basic load rating 2)Dynamic [50km] C_{50}(N)	[100km] C_{100}(N)	Static C_0 (N)	Static moment (N·m) M_{RO}	M_{PO} One slide	M_{PO} Two slides	M_{YO} One slide	M_{YO} Two slides	Weight Ball slide (kg)	Rail (kg/m)
60	7×11×9	20	3 960	33 500	26 800	46 000	360	320	1 840	267	1 540	0.46	3.6
			(3 500)	45 500	36 500	71 000	555	725	3 700	610	3 100	0.69	
80	9×14×12	20	4 000	41 000	32 500	51 500	490	350	2 290	292	1 920	0.69	5.2
			(3 500)	61 000	48 500	91 500	870	1 030	5 600	865	4 700	1.16	
80	9×14×12	20	4 000	62 500	49 500	80 500	950	755	4 500	630	3 800	1.2	7.2
				81 000	64 500	117 000	1 380	1 530	8 350	1 280	7 000	1.7	
105	14×20×17	22.5	3 990	107 000	84 500	140 000	2 140	1 740	9 750	1 460	8 150	2.2	12.3
				131 000	104 000	187 000	2 860	3 000	15 600	2 520	13 100	2.9	
120	16×23×20	30	3 960	158 000	125 000	198 000	3 600	3 000	16 300	2 510	13 700	3.7	16.9
				193 000	153 000	264 000	4 850	5 150	26 300	4 350	22 100	4.7	

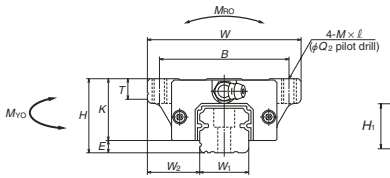
2) The basic load rating comply with the ISO standard. (ISO 14728-1, 14728-2)
C_{50}; the basic dynamic load rating for 50 km rated fatigue life C_{100} ; the basic dynamic load rating for 100 km rated fatigue life
The basic static load rating shows static permissible load.
3) High-precision grade and medium preload of random-matching type are available for high-carbon steel products.

NH-EM (High-load type / Standard)
NH-GM (Super-high-load type / Long)

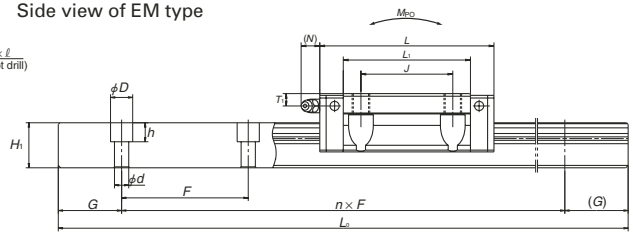
NH 30 1200 EM C 2 - PC Z**

- Series name: NH
- Size: 30
- Rail length (mm): 1200
- Ball slide shape code (See page A114.): EM
- Material/surface treatment code (See Table 21.): C
  C: Special high carbon steel (NSK standard), K: Stainless steel
- Number of ball slides per rail: 2
- Design serial number: -**
  Added to the reference number.
- Accuracy code (See Table 22.): PC
- Preload code (See page A116.): Z
  0: Z0, 1: Z1, 3: Z3, T: ZT, Z: ZZ, H: ZH

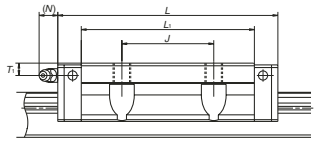
Front view of EM and GM types



Side view of EM type



Side view of GM type



Model No.	Assembly Height H	E	W_2	Ball slide Width W	Length L	Mounting hole B	J	M × pitch × ℓ	Q_2	L_1	K	T	Grease fitting Hole size	T_1	N	Width W_1	Height H_1
NH15EM	24	4.6	16	47	55	38	30	M5×0.8×7	4.4	39	19.4	8	φ3	4.5	3.3	15	15
NH15GM					74					58							
NH20EM	30	5	21.5	63	69.8	53	40	M6×1×9.5	5.3	50	25	10	M6×0.75	5	11	20	18
NH20GM					91.8					72							
NH25EM	36	7	23.5	70	79	57	45	M8×1.25×10	6.8	58	29	11	M6×0.75	6	11	23	22
NH25GM					107			(M8×1.25×11.5)		86		(12)					
NH30EM	42	9	31	90	98.6	72	52	M10×1.5×12	8.6	72	33	11	M6×0.75	7	11	28	26
NH30GM					124.6			(M10×1.5×14.5)		98		(15)					
NH35EM	48	9.5	33	100	109	82	62	M10×1.5×13	8.6	80	38.5	12	M6×0.75	8	11	34	29
NH35GM					143					114							
NH45EM	60	14	37.5	120	139	100	80	M12×1.75×15	10.5	105	46	13	Rc1/8	10	13	45	38
NH45GM					171					137							
NH55EM	70	15	43.5	140	163	116	95	M14×2×18	12.5	126	55	15	Rc1/8	11	13	53	44
NH55GM					201					164							
NH65EM	90	16	53.5	170	193	142	110	M16×2×24	14.6	147	74	23	Rc1/8	19	13	63	53
NH65GM					253					207							

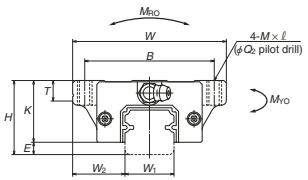
Notes: 1) Parenthesized dimensions are for items made of stainless steel.
2) External appearance of stainless steel ball slides differs from those of carbon steel ball slides.

Reference number for ball slide of random-matching type

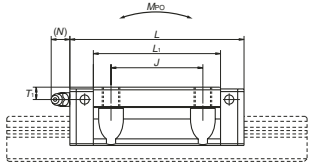
Ball slide NAH 30 EM S Z -K

- Random-matching ball slide series code: NAH
  NAH: NH Series random-matching ball slide
- Size: 30
- Ball slide shape code (See page A114.): EM
- Material code: S
  No code: Special high carbon steel (NSK standard), S: Stainless steel
- Preload code: Z
  No code: Fine clearance, Z: Slight preload, H: Medium preload
- Option code: -K
  -K: Equipped with NSK K1
  -F: Fluoride low temperature chrome plating+AS2 grease
  -F50: Fluoride low temperature chrome plating+LG2 grease

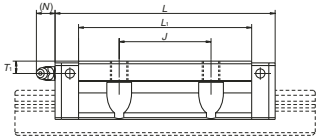
EM and GM types



EM type



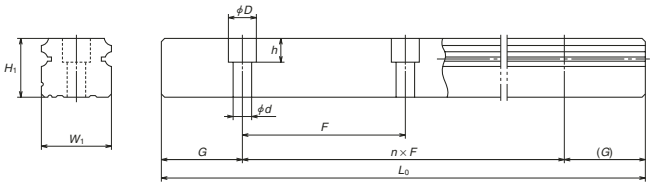
GM type



Reference number for rail of random-matching type

Rail N1H30 1200 L C N - PC Z**

- Random-matching rail series code: N1H
  N1H: NH Series random-matching rail
- Size: 30
- Rail length (mm): 1200
- Rail shape code: L
  L: Standard
- Material/surface treatment code (See Table 21.): C
- *Butting rail specification: N
  N: Non-butting. L: Butting specification
  *Please consult with NSK for butting rail specification.
- Design serial number: -**
  Added to the reference number.
- Accuracy code: PC
  PH: High precision grade
  PC: Normal grade
- Preload code (See page A116.): Z
  T: Fine clearance.
  Z: Slight preload (common rail for medium preload)



Unit: mm

Rail Pitch F	Mounting bolt hole d × D × h	G (reference)	Max. length L_{0max}. ( ) for stainless	Basic load rating [3]Dynamic [50km] C_{50}(N)	[100km] C_{100}(N)	Static C_0 (N)	Static moment (N·m) M_{RO}	M_{PO} One slide	M_{PO} Two slides	M_{YO} One slide	M_{YO} Two slides	Weight Ball slide (kg)	Rail (kg/m)
60	4.5×7.5×5.3	20	2 980	14 200	11 300	20 700	108	94.5	575	79.5	480	0.17	1.6
			(1 800)	18 100	14 400	32 000	166	216	1 150	181	965	0.25	
60	6×9.5×8.5	20	3 960	23 700	18 800	32 500	219	185	1 140	155	955	0.45	2.6
			(3 500)	30 000	24 000	50 500	340	420	2 230	355	1 870	0.65	
60	7×11×9	20	3 960	33 500	26 800	46 000	360	320	1 840	267	1 540	0.63	3.6
			(3 500)	45 500	36 500	71 000	555	725	3 700	610	3 100	0.93	
80	9×14×12	20	4 000	47 000	37 500	63 000	600	505	3 150	425	2 650	1.2	5.2
			(3 500)	61 000	48 500	91 500	870	1 030	5 600	865	4 700	1.6	
80	9×14×12	20	4 000	62 500	49 500	80 500	950	755	4 500	630	3 800	1.7	7.2
				81 000	64 500	117 000	1 380	1 530	8 350	1 280	7 000	2.4	
105	14×20×17	22.5	3 990	107 000	84 500	140 000	2 140	1 740	9 750	1 460	8 150	3	12.3
				131 000	104 000	187 000	2 860	3 000	15 600	2 520	13 100	3.9	
120	16×23×20	30	3 960	158 000	125 000	198 000	3 600	3 000	16 300	2 510	13 700	5	16.9
				193 000	153 000	264 000	4 850	5 150	26 300	4 350	22 100	6.5	
150	18×26×22	35	3 900	239 000	190 000	281 000	6 150	4 950	27 900	4 150	23 400	10	24.3
				310 000	246 000	410 000	8 950	10 100	51 500	8 450	43 500	14.1	

3) The basic load rating comply with the ISO standard. (ISO 14728-1, 14728-2)
C_{50}: the basic dynamic load rating for 50 km rated fatigue life C_{100} ; the basic dynamic load rating for 100 km rated fatigue life
The basic static load rating shows static permissible load.
4) High-precision grade and medium preload of random-matching type are available for high-carbon steel products.

A-5-1.2 VH Series

1. Features

(1) High-performance end seals

High-performance end seals with a multi-lip structure prevent the entry of various foreign matters.

(2) NSK K1™ lubrication unit (standard)

Outstanding lubrication support of NSK K1 further improves sealing capability and durability. Additional NSK K1 units can be mounted for specific usage conditions and environments.

(3) Tapped holes on a rail bottom surface (optional)

In addition to standard mounting bolt holes (counterbores on a rail top surface), a specification for tapped holes on a rail bottom surface for enhanced sealing capability is available for the VH Series. (Refer to the dimension table.)

(4) High self-aligning capability (rolling direction)

Same as the DF combination in angular contact bearings, self-aligning capability is high because the cross point of the contact lines of balls and grooves comes inside, reducing moment rigidity.

This increases the capacity to absorb errors in installation.

(5) High load carrying capacity to vertical direction

The contact angle is set at 50 degrees, thus increasing load carrying capacity as well as rigidity in vertical direction.

(6) High resistance against impact load

The bottom ball groove is formed in Gothic arch and the center of the top and bottom grooves are offset as shown in **Fig. 2**. The vertical load is generally carried by the top rows, at where balls are contacting at two points. Because of this design, the bottom rows will carry load when a large impact load is applied vertically as shown in **Fig. 3**. This assures high resistance to the impact load.

(7) High accuracy

As showing in **Fig. 4**, fixing the master rollers to the ball grooves is easy thanks to the Gothic arch groove. This makes easy and accurate measuring of ball grooves.

(8) Random matching type

Random-matching of rails and ball slides are available.

(9) Improve rating life dramatically

New ball groove geometry is introduced, which has been developed by utilizing NSK's state-of-the-art tribological and analytical technologies. Due to the optimized distribution of contact surface pressures, the rating life has dramatically increased. As compared with the conventional products, the load rating capacity has increased to 1.3 times, while the life span has increased to twice[*1].

*1: Representative values of series.

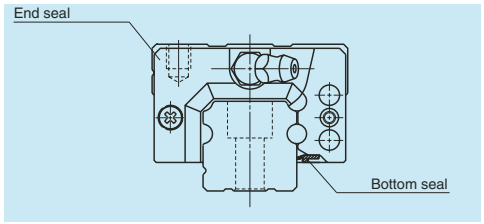


Fig. 1 VH Series

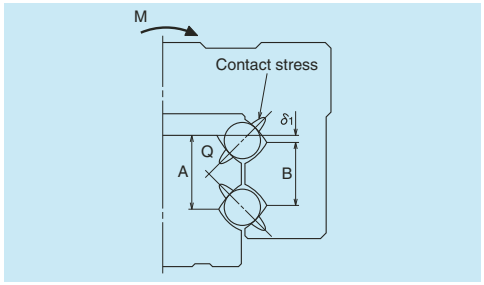


Fig. 2 Enlarged illustration of the offset Gothic arch groove

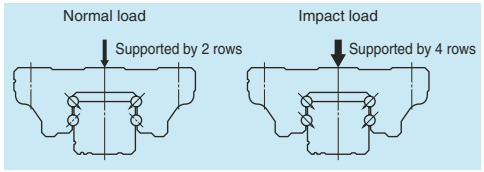


Fig. 3 When load is applied

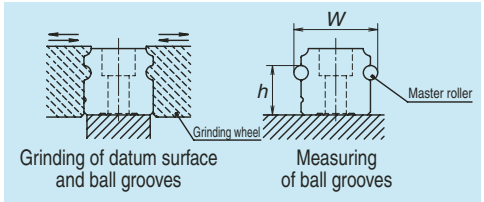


Fig. 4 Rail grinding and measuring

●Comparison with NSK standard products

Less than 1/10 the level of fine contaminants

Results of dust-proof tests reveal that the entry of fine contaminants is reduced to less than one-tenth of existing standard series due to improvements in sealing capability.

Test sample	: VH30AN
Speed	: 16.7 mm/sec
Contaminant	: Graphite powder (average grain size: 0.037 mm) + Grease

Operating life under contaminated environments is more than 5 times longer

Durability test with rubber fragments

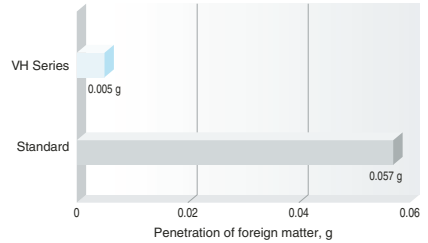
Extreme durability tests under contaminated environments using rubber fragments show that durability of the VH Series extended more than five times longer than the existing standard series, as shown in the graph.

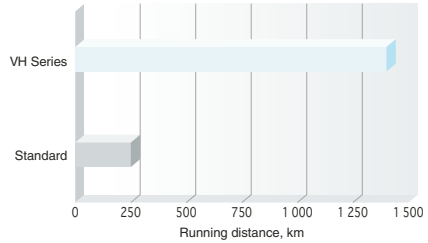
Test sample	: VH30AN, preload code Z1 (preload of 245 N)
Rail orientation	: Horizontal (wall mount)
Speed	: 500 mm/sec
Lubrication	: AS2 grease (prepacked AS2 only)
Contaminant	: Rubber fragments

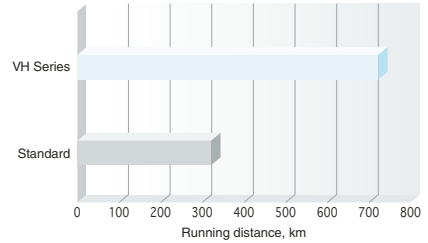
Durability test with fine wood particles

Extreme durability tests in a contaminated environment with fine wood particles show that durability of the VH Series is more than doubled compared to the standard series, as shown in the graph.

Test sample	: VH30AN (preload of 3 200 N)
Rail orientation	: Horizontal (wall mount)
Speed	: 400 mm/sec
Lubrication	: AS2 grease (prepacked AS2 only)
Contaminant	: Fine wood particles





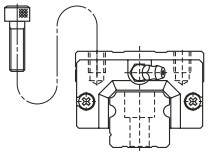
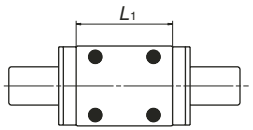
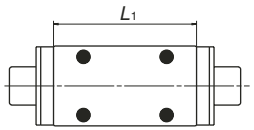
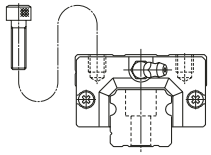
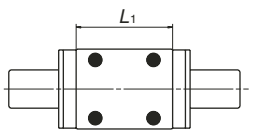
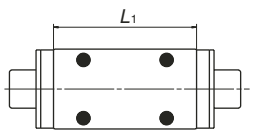
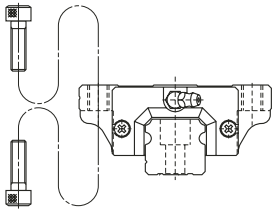
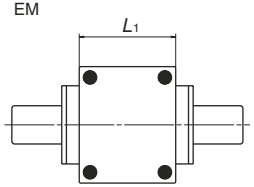
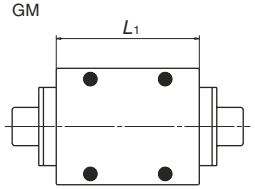


Before the passage of ball slide
(Heavily contaminated with wood particle)

After the passage of ball slide
(All contaminant particles are swept away)

The data shown in the catalog are the results of our tests, and no warranty is given to sealing performance on actual usage on machinery. Sealing performance is affected by usage environment and lubrication conditions. Dust covers and other measures to keep machinery free of dust are recommended.

2. Ball slide shape

Ball slide Model	Shape/installation method	Type (Upper row, Rating: Lower row, Ball slide length) High-load type Standard	Super-high-load type Long
AN BN		AN 	BN 
AL BL		AL 	BL 
EM GM		EM 	GM 

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1 Unit: μm

Rail length (mm) over	or less	Preloaded assembly (not random matching) Ultra precision K3	Super precision K4	High precision K5	Precision grade K6	Normal grade KN	Random-matching type Normal grade KC
–	50	2	2	2	4.5	6	6
50	80	2	2	3	5	6	6
80	125	2	2	3.5	5.5	6.5	6.5
125	200	2	2	4	6	7	7
200	250	2	2.5	5	7	8	8
250	315	2	2.5	5	8	9	9
315	400	2	3	6	9	11	11
400	500	2	3	6	10	12	12
500	630	2	3.5	7	12	14	14
630	800	2	4.5	8	14	16	16
800	1 000	2.5	5	9	16	18	18
1 000	1 250	3	6	10	17	20	20
1 250	1 600	4	7	11	19	23	23
1 600	2 000	4.5	8	13	21	26	26
2 000	2 500	5	10	15	22	29	29
2 500	3 150	6	11	17	25	32	32
3 150	4 000	9	16	23	30	34	34

(2) Accuracy standard

The preloaded assembly has five accuracy grades; Ultra precision K3, Super precision K4, High precision K5, Precision K6, and Normal KN grades, while the random-matching type has Normal KC grade only.

- **Tolerance of preloaded assembly**

Table 2 Unit: μm

Characteristics \ Accuracy grade	Ultra precision K3	Super precision K4	High precision K5	Precision grade K6	Normal grade KN
Mounting height H Variation of H (All ball slides on a set of rails)	±10 3	±10 5	±20 7	±40 15	±80 25
Mounting width W_2 or W_3 Variation of W_2 or W_3 (All ball slides on reference rail)	±15 3	±15 7	±25 10	±50 20	±100 30
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	Shown in **Table 1**, **Fig. 5** and **Fig. 6**				

- **Tolerance of random-matching type: Normal grade KC**

Table 3 Unit: μm

Characteristics \ Model No.	VH15, 20, 25, 30, 35	VH45, 55
Mounting height H	±20	±30
Variation of mounting height H	15① 30②	20① 35②
Mounting width W_2 or W_3	±30	±35
Variation of mounting width W_2 or W_3	25	30
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	See **Table 1**, **Fig. 5** and **Fig. 6**	

Note: ① Variation on the same rail ② Variation on multiple rails

(3) Combinations of accuracy and preload

Table 4

		Accuracy grade					
		Ultra precision	Super precision	High Precision	Precision grade	Normal grade	Normal grade
With NSK K1 lubrication unit		K3	K4	K5	K6	KN	KC
Preload	Fine clearance Z0	○	○	○	○	○	—
	Slight preload Z1	○	○	○	○	○	—
	Medium preload Z3	○	○	○	○	—	—
	Random-matching type with fine clearance ZT	—	—	—	—	—	○
	Random-matching type with slight preload ZZ	—	—	—	—	—	○

(4) Assembled accuracy

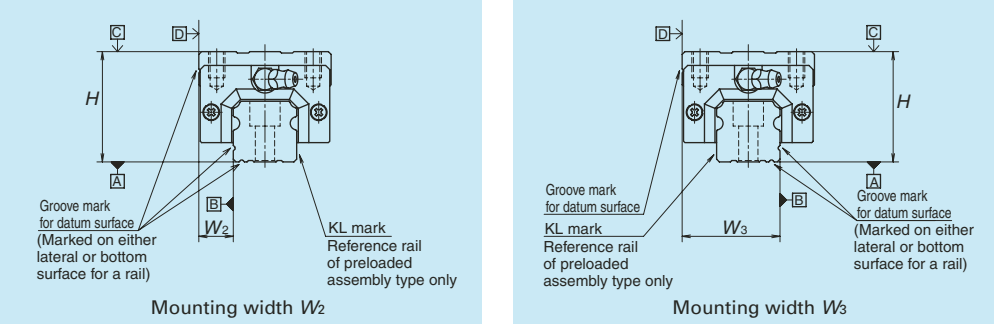


Fig. 5 Special high carbon steel

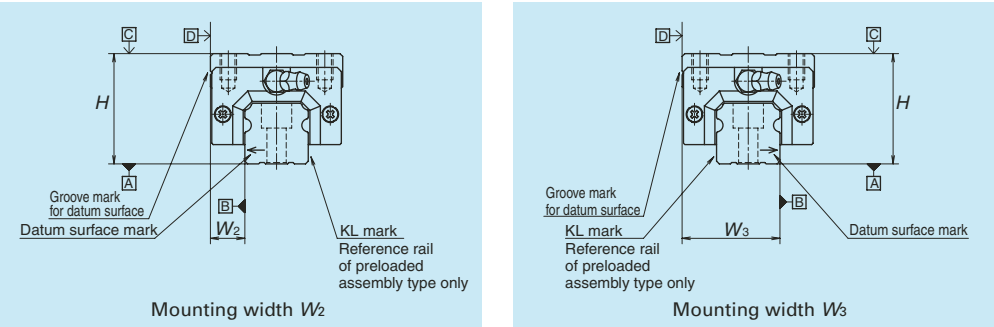


Fig. 6 Stainless steel

(5) Preload and rigidity

We offer five levels of preload: Slight preload Z1, Medium preload Z3 and Fine clearance Z0, along with random-matching type of Fine clearance ZT and Slight preload ZZ.

• Preload and rigidity of preloaded assembly

Table 5

	Model No.	Preload (N)		Rigidity (N/μm)			
				Vertical direction		Lateral direction	
		Slight preload Z1	Medium preload Z3	Slight preload Z1	Medium preload Z3	Slight preload Z1	Medium preload Z3
High-load type	VH15 AN, EM	78	490	137	226	98	186
	VH20 AN, EM	147	835	186	335	137	245
	VH25 AN, AL, EM	196	1 270	206	380	147	284
	VH30 AN, AL	245	1 570	216	400	157	294
	VH30 EM	294	1 770	265	480	186	355
	VH35 AN, AL, EM	390	2 350	305	560	216	390
	VH45 AN, AL, EM	635	3 900	400	745	284	540
	VH55 AN, AL, EM	980	5 900	490	910	345	645
Super-high-load type	VH15 BN, GM	98	685	196	345	137	284
	VH20 BN, GM	196	1 080	265	480	196	355
	VH25 BN, BL, GM	245	1 570	294	560	216	400
	VH30 BN, BL, GM	390	2 260	360	665	265	480
	VH35 BN, BL, GM	490	2 940	430	795	305	570
	VH45 BN, BL, GM	785	4 800	520	960	370	695
	VH55 BN, BL, GM	1 180	7 050	635	1 170	440	835

Note: Clearance for Fine clearance Z0 is 0 to 3 μm. Therefore, preload is zero.
However, Z0 of PN grade is 0 to 15 μm.

· Preload of random-matching type

Table 6 Unit: μm

Model No.	Fine clearance ZT	Slight preload ZZ
VH15	–4 – 15	–4 – 0
VH20	–5 – 15	–5 – 0
VH25		–5 – 0
VH30		–7 – 0
VH35		–7 – 0
VH45		–7 – 0
VH55		–9 – 0

Note: Minus sign denotes that a value is an amount of preload (elastic deformation of balls).

4. Maximum rail length

Table 7 shows the limitations of rail length (maximum length). However, the limitations vary by accuracy grade.

Table 7 Length limitations of rails Unit: mm

Series	Size / Material	15	20	25	30	35	45	55
VH	Special high carbon steel	2 000	3 960	3 960	4 000	4 000	3 990	3 960
	Stainless steel	1 800	3 500	3 500	3 500			

Note: Rails can be butted if user requirement exceeds the rail length shown in the table. Please consult NSK.

5. Installation

(1) Permissible values of mounting error

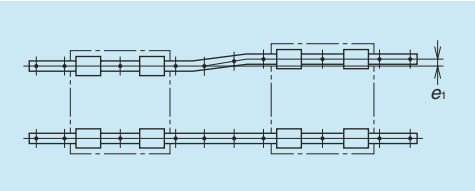


Fig. 7

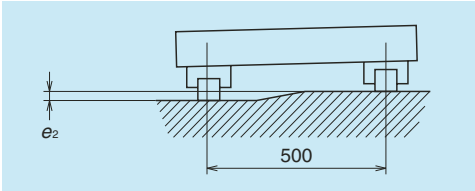


Fig. 8

Table 8

Unit: μm

Value	Preload	Model No.						
		VH15	VH20	VH25	VH30	VH35	VH45	VH55
Permissible values of parallelism in two rails e_1	Z0, ZT	22	30	40	45	55	65	80
	Z1, ZZ	18	20	25	30	35	45	55
	Z3	13	15	20	25	30	40	45
Permissible values of parallelism (height) in two rails e_2	Z0, ZT	375 μm/500 mm						
	Z1, ZZ, Z3	330 μm/500 mm						

(2) Shoulder height of the mounting surface and corner radius r

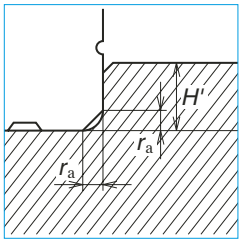


Fig. 9 Shoulder for the rail datum surface

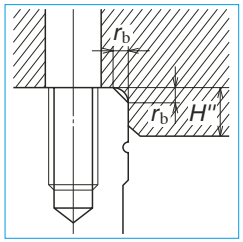


Fig. 10 Shoulder for the ball slide datum surface

Table 9

Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H'	H''
VH15	0.5	0.5	4	4
VH20	0.5	0.5	4.5	5
VH25	0.5	0.5	5	5
VH30	0.5	0.5	6	6
VH35	0.5	0.5	6	6
VH45	0.7	0.7	8	8
VH55	0.7	0.7	10	10

(3) Specification for tapped holes on a rail bottom surface

- Applicable accuracy grades are precision grade (K6) and normal grades (KN and KC) only.
- The minimum rail length for production is 400 mm.
- The tapping pitch is the same as the pitch for regular mounting bolt holes. Please refer to the dimension table.

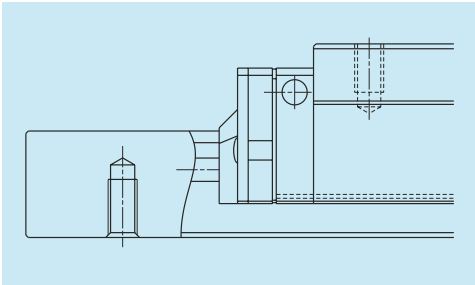


Fig. 11

6. Lubrication components

Refer to pages A38 and D13 for the lubrication of linear guides.

(1) Types of lubrication accessories

Fig. 12 and **Table 10** show grease fittings and tube fittings.

We provide lubrication accessories with extended thread body length (L) for the addition of dust-proof accessories such as NSK K1 lubrication unit, double seal and protector.

We provide a suitable lubrication accessory for the special requirement on dust-proof accessories.

Consult NSK for a lubrication accessory with extended length of thread body for your convenience of replenishing lubricant.

Please ask NSK for stainless lubrication accessories.

(2) Mounting position of lubrication accessories

The standard position of grease fittings is the end face of ball slide. We mount them on a side of end cap for an option. (**Fig. 13**)

Please consult NSK for installation of grease or tube fittings to the ball slide body or side of end cap.

When using a piping unit with thread of M6 × 1, you require a connector to connect to a grease fitting mounting hole with M6 × 0.75. The connector is available from NSK.

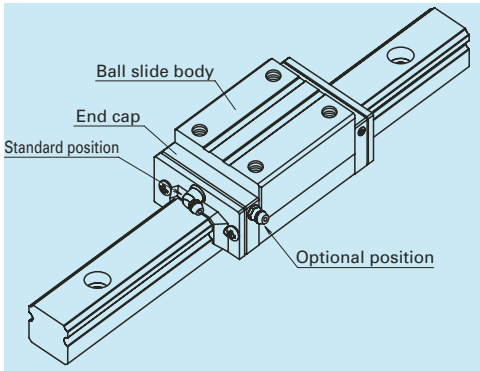


Fig. 13 Mounting position of lubrication accessories

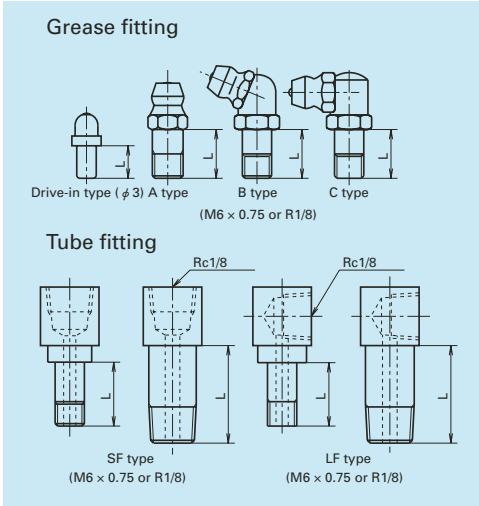


Fig. 12 Grease fitting and tube fitting

Table 10

Unit: mm

Model No.	Dust-proof specification	Grease fitting	Tube fitting
		Thread body length L	Thread body length L
VH15	Standard*	10	–
	Double seal	**	–
	Protector	**	–
VH20	Standard*	12	–
	Double seal	18	–
	Protector	18	–
VH25	Standard*	12	16
	Double seal	18	23***
	Protector	18	18
VH30	Standard*	14	18
	Double seal	22	25
	Protector	22	19
VH35	Standard*	14	15
	Double seal	22	25
	Protector	22	22
VH45	Standard*	18	21.5
	Double seal	22	32
	Protector	28	30
VH55	Standard*	18	20
	Double seal	22	32
	Protector	28	30

*) NSK K1 units are mounted as a standard specification for VH series.

**) A connector is required for grease fitting. Please contact NSK.

***) Only available for AN and BN type ball slides.

7. Dust-proof components

(1) Standard specification

To keep foreign matters from entering inside the ball slide, VH Series has an end seal on both ends, and bottom seals at the bottom.
Two NSK K1, one at each end, are installed as the standard equipment.

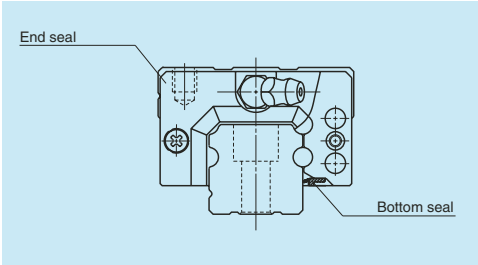


Fig. 14

Table 11 Seal friction per ball slide (maximum value)

Unit: N

Series \ Size	15	20	25	30	35	45	55
VH	11	13	14	17	23	33	44

(2) Double seal and protector

For VH Series, double-seal and protector can be installed only before shipping from the factory. Please consult NSK when you require them.
Table 12 shows the ball slide length when a double seal set and a protector are installed.

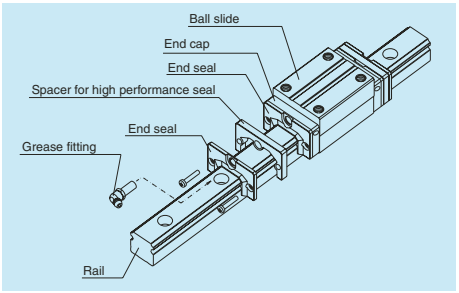


Fig. 15 Double seal

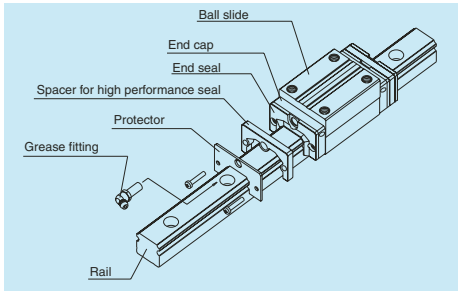


Fig. 16 Protector

Table 12 Dimension of installing dust-proof optional components

Unit: mm

Model No.	Ball slide length	Ball slide model	Ball slide length L		
			Standard	Double seal installation	Protector installation
VH15	Standard type	AN, EM	70.6	81.6	77
	Long type	BN, GM	89.6	100.6	96
VH20	Standard type	AN, EM	87.4	100.4	94.2
	Long type	BN, GM	109.4	122.4	116.2
VH25	Standard type	AN, AL, EM	97	110	104.4
	Long type	BN, BL, GM	125	138	132.4
VH30	Standard type	AN, AL	104.4	120.4	114.8
		EM	117.4	133.4	127.8
	Long type	BN, BL, GM	143.4	159.4	153.8
VH35	Standard type	AN, AL, EM	128.8	144.8	139.2
	Long type	BN, BL, GM	162.8	178.8	173.2
VH45	Standard type	AN, AL, EM	161.4	180.4	174.2
	Long type	BN, BL, GM	193.4	212.4	206.2
VH55	Standard type	AN, AL, EM	185.4	204.4	198.2
	Long type	BN, BL, GM	223.4	242.4	236.2

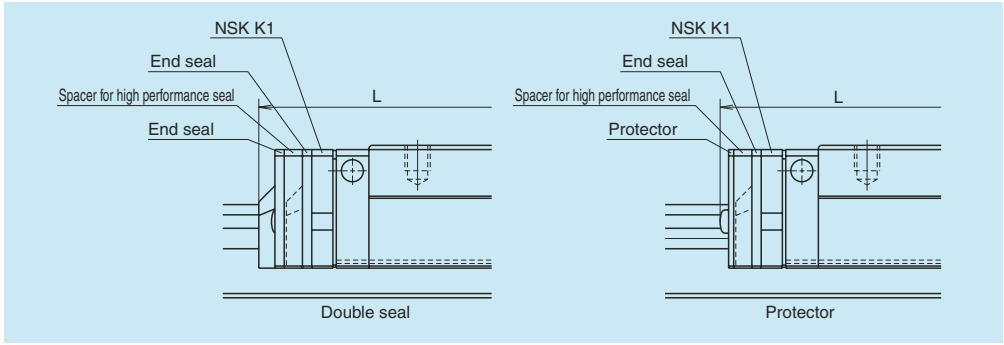


Fig. 17

(3) Cap to plug the rail mounting bolt hole

Table 13 Caps to plug rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
VH15	M4	LG-CAP/M4	20
VH20	M5	LG-CAP/M5	20
VH25	M6	LG-CAP/M6	20
VH30, VH35	M8	LG-CAP/M8	20
VH45	M12	LG-CAP/M12	20
VH55	M14	LG-CAP/M14	20

(4) Inner seal

The availability of inner seal is limited to the models shown below.

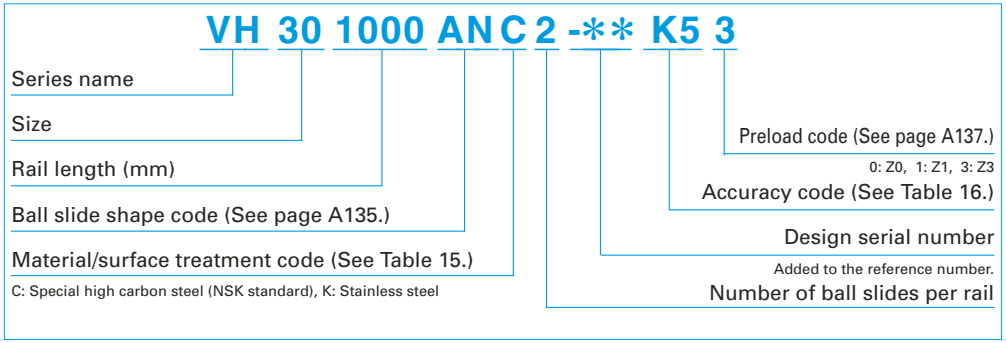
Table 14

Series	Model No.
VH	VH20, VH25, VH30, VH45, VH55

8. Reference number

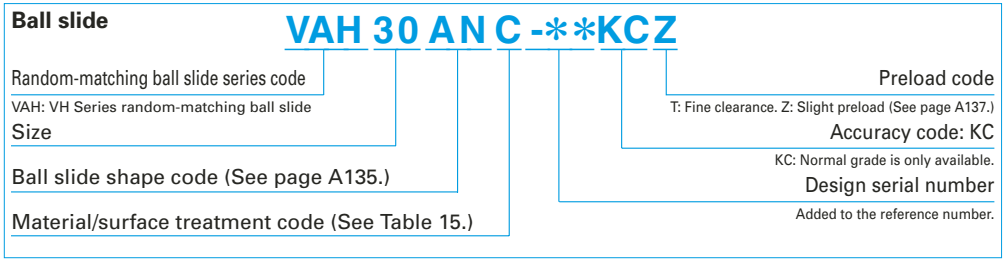
Reference numbers shall be set to individual NSK linear guide when its specifications are finalized, and it is indicated on its specification drawing.
Please specify the reference number, except design serial number, to identify the product when ordering, requiring estimates, or inquiring about specifications from NSK.

(1) Reference number for preloaded assembly

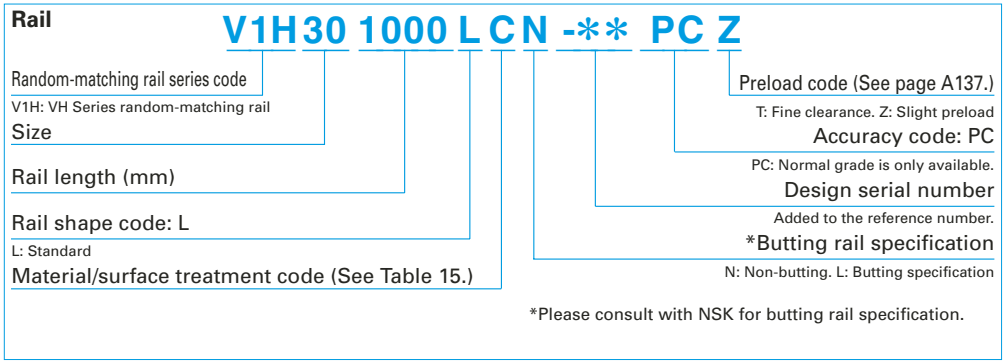


(2) Reference number for random-matching type

Ball slide



Rail



*Please consult with NSK for butting rail specification.

The reference number coding for the assembly of random-matching type is the same as that of preloaded assembly. However, the preload code of "fine clearance T" and "slight preload Z" is only applicable (refer to page A137).

Table 15 Material/surface treatment code

Code	Description
C	Special high carbon steel (NSK standard) + counterbores on a rail top surface
K	Stainless steel + counterbores on a rail top surface
D	Special high carbon steel with surface treatment + counterbores on a rail top surface
H	Stainless steel with surface treatment + counterbores on a rail top surface
V	Special high carbon steel (NSK standard) + tapped holes on a rail bottom surface
J	Stainless steel + tapped holes on a rail bottom surface
W	Special high carbon steel with surface treatment + tapped holes on a rail bottom surface
S	Stainless steel with surface treatment + tapped holes on a rail bottom surface
Z	Other, special

Table 16 Accuracy code

Accuracy	Standard (with NSK K1)
Ultra precision grade	K3
Super precision grade	K4
High precision grade	K5
Precision grade	K6
Normal grade	KN
Normal grade (random-matching type)	KC

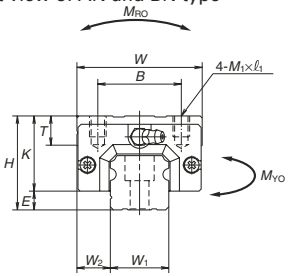
Note: Refer to page A38 for NSK K1 lubrication unit.

9. Dimensions
VH-AN (High-load type / Standard)
VH-BN (Super-high-load type/ Long)

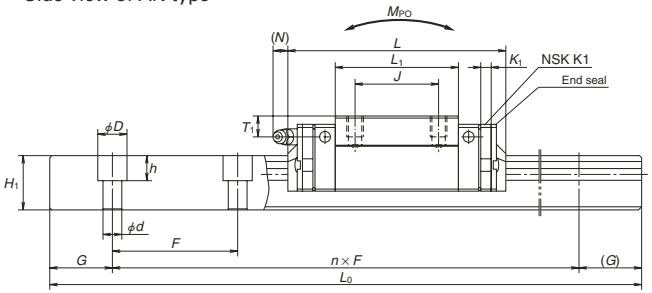
VH 30 1000 AN C 2 - ** KC Z**

- Series name
- Size
- Rail length (mm)
- Ball slide shape code (See page A135.)
- Material/surface treatment code (See Table 15.)
  C: Special high carbon steel (NSK standard), K: Stainless steel
- Number of ball slides per rail
- Design serial number
  Added to the reference number.
- Accuracy code (See Table 16.)
- Preload code (See page A137.)
  0: Z0, 1: Z1, 3: Z3, T: ZT, Z: ZZ

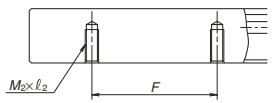
Front view of AN and BN type



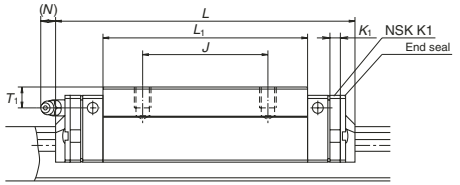
Side view of AN type



Specification for tapped holes on a rail bottom face



Side view of BN type



Model No.	Assembly Height H	E	W2	Ball slide Width W	Length L	Mounting hole B	J	M×pitch×ℓ	L1	K	T	K1	Grease fitting Hole size	T1	N	Width W1	Height H1
VH15AN	28	4.6	9.5	34	70.6〈 77〉	26	26	M4×0.7×6	39	23.4	8	4.5	φ3	8.5	1 〈 8.2〉	15	15
VH15BN					89.6〈 96〉				58								
VH20AN	30	5	12	44	87.4〈 94.2〉	32	36	M5×0.8×6	50	25	12	4.5	M6×0.75	5	11.1〈12.3〉	20	18
VH20BN					109.4〈116.2〉		50		72								
VH25AN	40	7	12.5	48	97 〈104.4〉	35	35	M6×1×9	58	33	12	5	M6×0.75	10	9.6〈12.9〉	23	22
VH25BN					125 〈132.4〉		50		86								
VH30AN	45	9	16	60	104.4〈114.8〉	40	40	M8×1.25×10	59	36	14	5	M6×0.75	10	11.4〈14.2〉	28	26
VH30BN					143.4〈153.8〉		60		98								
VH35AN	55	9.5	18	70	128.8〈139.2〉	50	50	M8×1.25×12	80	45.5	15	5.5	M6×0.75	15	10.9〈13.7〉	34	29
VH35BN					162.8〈173.2〉		72		114								
VH45AN	70	14	20.5	86	161.4〈174.2〉	60	60	M10×1.5×17	105	56	17	6.5	Rc1/8	20	12.5〈14.1〉	45	38
VH45BN					193.4〈206.2〉		80		137								
VH55AN	80	15	23.5	100	185.4〈198.2〉	75	75	M12×1.75×18	126	65	18	6.5	Rc1/8	21	12.5〈14.1〉	53	44
VH55BN					223.4〈236.2〉		95		164								

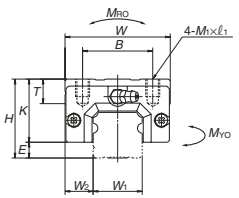
Notes: 1) Figure inside 〈 〉 is the dimension when equipped with the protector.
2) VH Series does not have a ball retainer. Be aware that balls fall out when the ball slide is withdrawn from the rail.
3) External appearance of stainless steel ball slides differs from those of carbon steel ball slides.

Reference number for ball slide of random-matching type

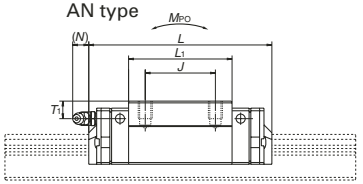
Ball slide **VAH 30 AN C -**KCZ**

- Random-matching ball slide series code
  VAH: VH Series random-matching ball slide
- Size
- Ball slide shape code (See page A135.)
- Material/surface treatment code (See Table 15.)
- Preload code (See page A137.)
  T: Fine clearance. Z: Slight preload
- Accuracy code: KC
  KC: Normal grade is only available.
- Design serial number
  Added to the reference number.

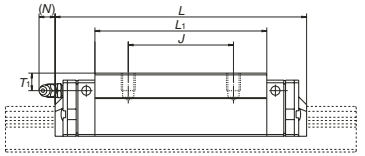
AN and BN types



AN type



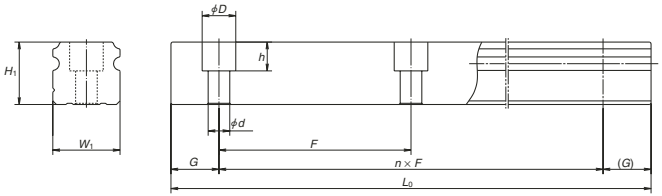
BN type



Reference number for rail of random-matching type

Rail **V1H30 1000 L C N -** ** PC Z**

- Random-matching rail series code
  V1H: VH Series random-matching rail
- Size
- Rail length (mm)
- Rail shape code: L
  L: Standard
- Material/surface treatment code (See Table 15.)
- *Butting rail specification
  N: Non-butting. L: Butting specification
  *Please consult with NSK for butting rail specification.
- Preload code (See page A137.)
  T: Fine clearance. Z: Slight preload
- Accuracy code: PC
  PC: Normal grade is only available.
- Design serial number
  Added to the reference number.



Unit: mm

Rail Pitch F	Mounting bolt hole d×D×h	Tapped hole M2×pitch×ℓ2	G (reference)	Max. length L0max. ( ) for stainless	Basic load rating 4)Dynamic [50km] C50(N)	[100km] C100(N)	Static C0 (N)	Static moment (N·m) MRO	MPO One slide	MPO Two slides	MYO One slide	MYO Two slides	Weight Ball slide (kg)	Rail (kg/m)
60	4.5×7.5×5.3	M5×0.8×8	20	2 000 [1 800]	14 200	11 300	20 700	108	94.5	575	79.5	480	0.18	1.6
					18 100	14 400	32 000	166	216	1 150	181	965	0.26	
60	6×9.5×8.5	M6×1×10	20	3 960 [3 500]	23 700	18 800	32 500	219	185	1 140	155	955	0.33	2.6
					30 000	24 000	50 500	340	420	2 230	355	1 870	0.48	
60	7×11×9	M6×1×12	20	3 960 [3 500]	33 500	26 800	46 000	360	320	1 840	267	1 540	0.55	3.6
					45 500	36 500	71 000	555	725	3 700	610	3 100	0.82	
80	9×14×12	M8×1.25×15	20	4 000 [3 500]	41 000	32 500	51 500	490	350	2 290	292	1 920	0.77	5.2
					61 000	48 500	91 500	870	1 030	5 600	865	4 700	1.3	
80	9×14×12	M8×1.25×17	20	4 000	62 500	49 500	80 500	950	755	4 500	630	3 800	1.5	7.2
					81 000	64 500	117 000	1 380	1 530	8 350	1 280	7 000	2.1	
105	14×20×17	M12×1.75×24	22.5	3 990	107 000	84 500	140 000	2 140	1 740	9 750	1 460	8 150	3.0	12.3
					131 000	104 000	187 000	2 860	3 000	15 600	2 520	13 100	3.9	
120	16×23×20	M14×2×24	30	3 960	158 000	125 000	198 000	3 600	3 000	16 300	2 510	13 700	4.7	16.9
					193 000	153 000	264 000	4 850	5 150	26 300	4 350	22 100	6.1	

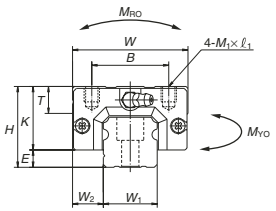
4) The basic load rating comply with the ISO standard. (ISO 14728-1, 14728-2)
C_{50}: the basic dynamic load rating for 50 km rated fatigue life C_{100}: the basic dynamic load rating for 100 km rated fatigue life
The basic static load rating shows static permissible load.

VH-AL (High-load type / Standard)
VH-BL (Super-high-load type / Long)

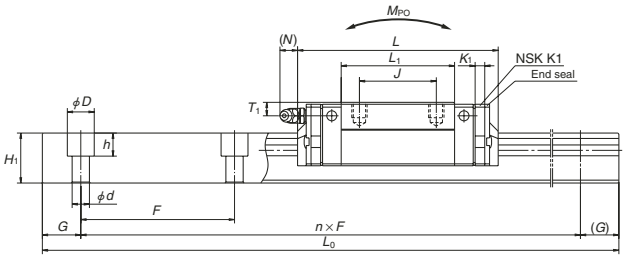
VH 30 1000 AL C 2 - KC Z**

- Series name: VH
- Size: 30
- Rail length (mm): 1000
- Ball slide shape code (See page A135.): AL
- Material/surface treatment code (See Table 15.): C
  C: Special high carbon steel (NSK standard), K: Stainless steel
- Number of ball slides per rail: 2
- Design serial number: -**
  Added to the reference number.
- Accuracy code (See Table 16.): KC
- Preload code (See page A137.): Z
  0: Z0, 1: Z1, 3: Z3, T: ZT, Z: ZZ

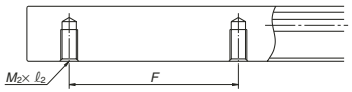
Front view of AL and BL type



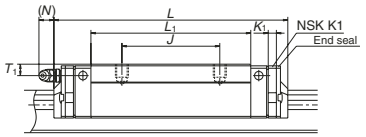
Side view of AL type



Specification for tapped holes on a rail bottom face



Side view of BL type



Model No.	Assembly Height H	E	W_2	Ball slide Width W	Length L	Mounting hole B	J	M×pitch×ℓ	L_1	K	T	K_1	Grease fitting Hole size	T_1	N	Width W_1	Height H_1
VH25AL	36	7	12.5	48	97 ⟨104.4⟩	35	35	M6×1×6	58	29	12	5	M6×0.75	6	9.6 ⟨12.9⟩	23	22
VH25BL					125 ⟨132.4⟩		50		86								
VH30AL	42	9	16	60	104.4 ⟨114.8⟩	40	40	M8×1.25×8	59	33	14	5	M6×0.75	7	11.4 ⟨14.2⟩	28	26
VH30BL					143.4 ⟨153.8⟩		60		98								
VH35AL	48	9.5	18	70	128.8 ⟨139.2⟩	50	50	M8×1.25×8	80	38.5	15	5.5	M6×0.75	8	10.9 ⟨13.7⟩	34	29
VH35BL					162.8 ⟨173.2⟩		72		114								
VH45AL	60	14	20.5	86	161.4 ⟨174.2⟩	60	60	M10×1.5×10	105	46	17	6.5	Rc1/8	10	12.5 ⟨14.1⟩	45	38
VH45BL					193.4 ⟨206.2⟩		80		137								
VH55AL	70	15	23.5	100	185.4 ⟨198.2⟩	75	75	M12×1.75×13	126	55	15	6.5	Rc1/8	11	12.5 ⟨14.1⟩	53	44
VH55BL					223.4 ⟨236.2⟩		95		164								

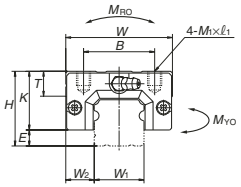
Notes: 1) Figure inside ⟨ ⟩ is the dimension when equipped with the protector.
2) VH Series does not have a ball retainer. Be aware that balls fall out when the ball slide is withdrawn from the rail.
3) External appearance of stainless steel ball slides differs from those of carbon steel ball slides.

Reference number for ball slide of random-matching type

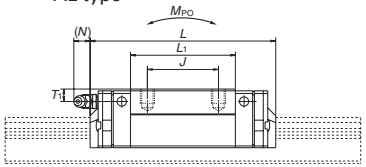
Ball slide VAH 30 AL C -KC Z**

- Random-matching ball slide series code: VAH
  VAH: VH Series random-matching ball slide
- Size: 30
- Ball slide shape code (See page A135.): AL
- Material/surface treatment code (See Table 15.): C
- Design serial number: -**
  Added to the reference number.
- Accuracy code: KC
  KC: Normal grade is only available.
- Preload code (See page A137.): Z
  T: Fine clearance. Z: Slight preload

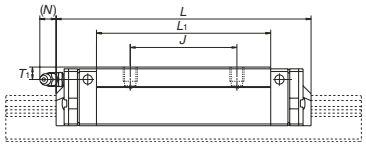
AL and BL types



AL type



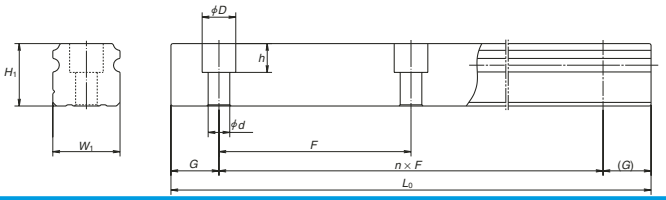
BL type



Reference number for rail of random-matching type

Rail V1H30 1000 L C N - PC Z**

- Random-matching rail series code: V1H
  V1H: VH Series random-matching rail
- Size: 30
- Rail length (mm): 1000
- Rail shape code: L
  L: Standard
- Material/surface treatment code (See Table 15.): C
- *Butting rail specification: N
  N: Non-butting. L: Butting specification
  *Please consult with NSK for butting rail specification.
- Design serial number: -**
  Added to the reference number.
- Accuracy code: PC
  PC: Normal grade is only available.
- Preload code (See page A137.): Z
  T: Fine clearance. Z: Slight preload



Unit: mm

Rail Pitch F	Mounting bolt hole d×D×h	Tapped hole M_2×pitch×ℓ_2	G (reference)	Max. length L_{0max}· ( ) for stainless	Basic load rating [4]Dynamic [50km] C_{50}(N)	[100km] C_{100}(N)	Static C_0 (N)	Static moment (N·m) M_{RO}	M_{PO} One slide	M_{PO} Two slides	M_{YO} One slide	M_{YO} Two slides	Weight Ball slide (kg)	Rail (kg/m)
60	7×11×9	M6×1×12	20	3 960 [3 500]	33 500	26 800	46 000	360	320	1 840	267	1 540	0.46	3.6
					45 500	36 500	71 000	555	725	3 700	610	3 100	0.69	
80	9×14×12	M8×1.25×15	20	4 000 [3 500]	41 000	32 500	51 500	490	350	2 290	292	1 920	0.69	5.2
					61 000	48 500	91 500	870	1 030	5 600	865	4 700	1.16	
80	9×14×12	M8×1.25×17	20	4 000	62 500	49 500	80 500	950	755	4 500	630	3 800	1.2	7.2
					81 000	64 500	117 000	1 380	1 530	8 350	1 280	7 000	1.7	
105	14×20×17	M12×1.75×24	22.5	3 990	107 000	84 500	140 000	2 140	1 740	9 750	1 460	8 150	2.2	12.3
					131 000	104 000	187 000	2 860	3 000	15 600	2 520	13 100	2.9	
120	16×23×20	M14×2×24	30	3 960	158 000	125 000	198 000	3 600	3 000	16 300	2 510	13 700	3.7	16.9
					193 000	153 000	264 000	4 850	5 150	26 300	4 350	22 100	4.7	

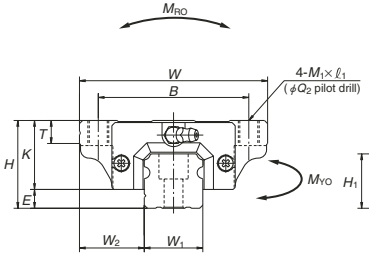
4) The basic load rating comply with the ISO standard. (ISO 14728-1, 14728-2)
C_{50}; the basic dynamic load rating for 50 km rated fatigue life C_{100}; the basic dynamic load rating for 100 km rated fatigue life
The basic static load rating shows static permissible load.

VH-EM (High-load type / Standard)
VH-GM (Super-high-load type / Long)

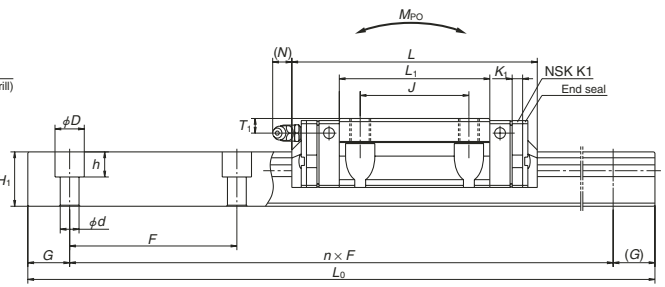
VH 30 1000 EM C 2 - KC Z**

- Series name: VH
- Size: 30
- Rail length (mm): 1000
- Ball slide shape code (See page A135.): EM
- Material/surface treatment code (See Table 15.): C
  - C: Special high carbon steel (NSK standard), K: Stainless steel
- Number of ball slides per rail: 2
- Design serial number: -**
  - Added to the reference number.
- Accuracy code (See Table 16.): KC
- Preload code (See page A137.): Z
  - 0: Z0, 1: Z1, 3: Z3, T: ZT, Z: ZZ

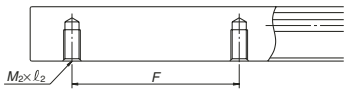
Front view of EM and GM type



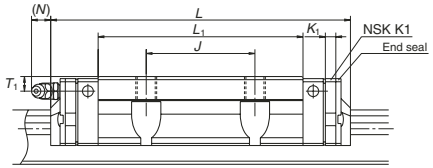
Side view of EM type



Specification for tapped holes on a rail bottom face



Side view of GM type



Model No.	Assembly Height H	E	W_2	Ball slide Width W	Length L	Mounting hole B	J	Q_1 × ℓ_1 M_1 × pitch × ℓ_1	Q_2	L_1	K	T	K_1	Grease fitting Hole size	T_1	N	Width W_1	Height H_1
VH15EM	24	4.6	16	47	70.6〈 77〉	38	30	M5×0.8×7	4.4	39	19.4	8	4.5	ϕ3	4.5	1 〈 8.2〉	15	15
VH15GM					89.6〈 96〉					58								
VH20EM	30	5	21.5	63	87.4〈 94.2〉	53	40	M6×1×9.5	5.3	50	25	10	4.5	M6x0.75	5	11.1〈12.3〉	20	18
VH20GM					109.4〈116.2〉					72								
VH25EM	36	7	23.5	70	97 〈104.4〉	57	45	M8×1.25×10	6.8	58	29	11	5	M6x0.75	6	9.6〈12.9〉	23	22
VH25GM					125 〈132.4〉			[M8×1.25×11.5]		86		[12]						
VH30EM	42	9	31	90	117.4〈127.8〉	72	52	M10×1.5×12	8.6	72	33	11	5	M6x0.75	7	11.4〈14.2〉	28	26
VH30GM					143.4〈153.8〉			[M10×1.5×14.5]		98		[15]						
VH35EM	48	9.5	33	100	128.8〈139.2〉	82	62	M10×1.5×13	8.6	80	38.5	12	5.5	M6x0.75	8	10.9〈13.7〉	34	29
VH35GM					162.8〈173.2〉					114								
VH45EM	60	14	37.5	120	161.4〈174.2〉	100	80	M12×1.75×15	10.5	105	46	13	6.5	Rc1/8	10	12.5〈14.1〉	45	38
VH45GM					193.4〈206.2〉					137								
VH55EM	70	15	43.5	140	185.4〈198.2〉	116	95	M14×2×18	12.5	126	55	15	6.5	Rc1/8	11	12.5〈14.1〉	53	44
VH55GM					223.4〈236.2〉					164								

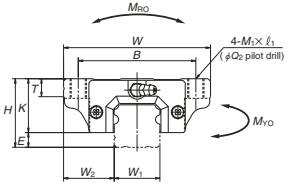
Notes: 1) Figure inside 〈 〉 is the dimension when equipped with the protector.
2) Figure inside [ ] is applied to stainless products.
3) VH Series does not have a ball retainer. Be aware that balls fall out when the ball slide is withdrawn from the rail.
4) External appearance of stainless steel ball slides differs from those of carbon steel ball slides.

Reference number for ball slide of random-matching type

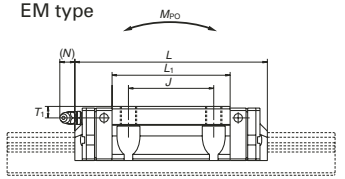
Ball slide VAH 30 EM C -KCZ**

- Random-matching ball slide series code: VAH
  - VAH: VH Series random-matching ball slide
- Size: 30
- Ball slide shape code (See page A135.): EM
- Material/surface treatment code (See Table 15.): C
- Design serial number: -**
  - Added to the reference number.
- Accuracy code: KC
  - KC: Normal grade is only available.
- Preload code (See page A137.): Z
  - T: Fine clearance. Z: Slight preload

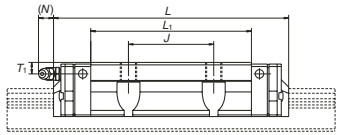
EM and GM types



EM type



GM type

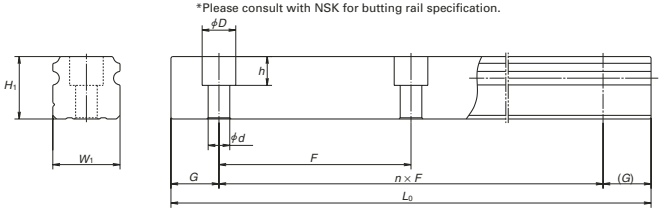


Reference number for rail of random-matching type

Rail V1H 30 1000 L C N - PC Z**

- Random-matching rail series code: V1H
  - V1H: VH Series random-matching rail
- Size: 30
- Rail length (mm): 1000
- Rail shape code: L
  - L: Standard
- Material/surface treatment code (See Table 15.): C
- *Butting rail specification: N
  - N: Non-butting. L: Butting specification
- Design serial number: -**
  - Added to the reference number.
- Accuracy code: PC
  - PC: Normal grade is only available.
- Preload code (See page A137.): Z
  - T: Fine clearance. Z: Slight preload

*Please consult with NSK for butting rail specification.



Unit: mm

Rail Pitch F	Mounting bolt hole d × D × h	Tapped hole M_2 × pitch × ℓ_2	G (reference)	Max. length L_{0max}. ( ) for stainless	Basic load rating [5]Dynamic [50km] C_{50}(N)	[100km] C_{100}(N)	Static C_0 (N)	Static moment (N·m) M_{RO}	M_{PO} One slide	M_{PO} Two slides	M_{YO} One slide	M_{YO} Two slides	Weight Ball slide (kg)	Rail (kg/m)
60	4.5×7.5×5.3	M5×0.8×8	20	2 000 [1 800]	14 200	11 300	20 700	108	94.5	575	79.5	480	0.17	1.6
					18 100	14 400	32 000	166	216	1 150	181	965	0.25	
60	6×9.5×8.5	M6×1×10	20	3 960 [3 500]	23 700	18 800	32 500	219	185	1 140	155	955	0.45	2.6
					30 000	24 000	50 500	340	420	2 230	355	1 870	0.65	
60	7×11×9	M6×1×12	20	3 960 [3 500]	33 500	26 800	46 000	360	320	1 840	267	1 540	0.63	3.6
					45 500	36 500	71 000	555	725	3 700	610	3 100	0.93	
80	9×14×12	M8×1.25×15	20	4 000 [3 500]	47 000	37 500	63 000	600	505	3 150	425	2 650	1.2	5.2
					61 000	48 500	91 500	870	1 030	5 600	865	4 700	1.6	
80	9×14×12	M8×1.25×17	20	4 000	62 500	49 500	80 500	950	755	4 500	630	3 800	1.7	7.2
					81 000	64 500	117 000	1 380	1 530	8 350	1 280	7 000	2.4	
105	14×20×17	M12×1.75×24	22.5	3 990	107 000	84 500	140 000	2 140	1 740	9 750	1 460	8 150	3.0	12.3
					131 000	104 000	187 000	2 860	3 000	15 600	2 520	13 100	3.9	
120	16×23×20	M14×2×24	30	3 960	158 000	125 000	198 000	3 600	3 000	16 300	2 510	13 700	5.0	16.9
					193 000	153 000	264 000	4 850	5 150	26 300	4 350	22 100	6.5	

5) The basic load rating comply with the ISO standard. (ISO 14728-1, 14728-2)
C_{50}: the basic dynamic load rating for 50 km rated fatigue life C_{100}: the basic dynamic load rating for 100 km rated fatigue life
The basic static load rating shows static permissible load.

A-5-1.3 TS Series

1. Features

(1) Inexpensive
Newly developed manufacturing process of rail and design of ball slide contribute to substantial cost reductions.

(2) High capacity
Optimum ball diameter for higher capacity design.

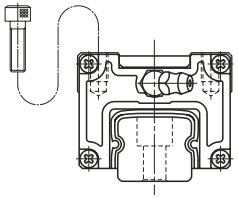
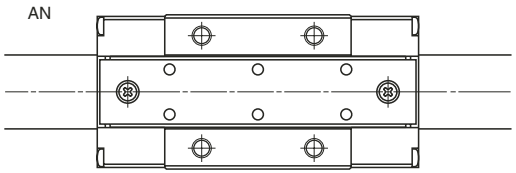
(3) High dust proof capability
Dust-tight high performance end seals, bottom seals, and inner seals are built-in as a standard feature. (Optional protector is available for protection against hot debris such as welding spatters or hard contaminants.)

(4) Maintenance free
NSK K1 lubrication unit is equipped as a standard specification for long-term maintenance-free operation.

(5) Rust prevention
NSK provides a lineup of products with antirust surface treatment for corrosive environments.

(6) Fast delivery
Lineup of random-matching rails and ball slides supports and facilitates fast delivery.

2. Ball slide shape

Ball slide Model	Shape / installation method	Type
AN		AN 

3. Accuracy and preload

- Accuracy grade: Normal grade for transportation
- Torelance of mounting height *H*: ±0.1 mm
- Running parallelism: 100 µm or less
- Running parallelism (height): 500 µm/500 mm
- Clearance: 60 µm or less

4. Maximum rail length

Table 1 shows the limitations of rail length.

Table 1 Length limitations of rails

Unit: mm

Series	Material \ Size	15	20	25	30*	35*
TS	Special high carbon steel	1 960	2 920	4 000	4 040	4 040

Note: Rails can be butted if user requirement exceeds the rail length shown in the table. In such a case, please consult NSK.
*) The maximum length of a rail coated with fluoride low temperature chrome plate is 4 000 mm (G = 80).

5. Lubrication components

Refer to pages A38 and D13 for the lubrication of linear guides.

(1) Types of lubrication accessories
Fig. 1 and **Table 2** show grease fittings and tube fittings.

(2) Mounting position of lubrication accessories
The standard position of grease fittings is the end face of ball slide. You may mount them on the side of end cap for an option. (**Fig. 2**)
Please consult NSK for installation of grease or tube fittings to the ball slide body or side of end cap.
When using a piping unit with thread of M6 × 1, you require a connector for the connection to a grease fitting mounting hole with M6 × 0.75. The connector is available from NSK.

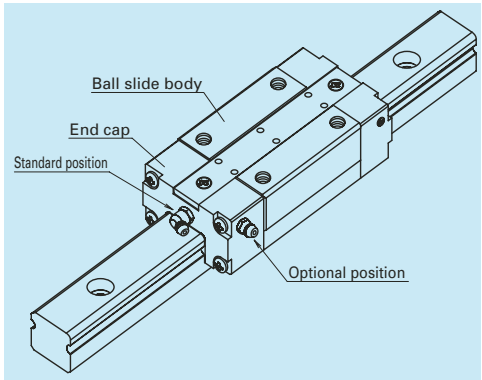


Fig. 2

6. Dust-proof components

(1) Standard specification
To keep contaminants from entering inside the ball slide, the TS Series has an end seal and NSK K1 on both ends, and bottom seals at the bottom. Also, the inner seal is a standard equipment. The series can be readily used in a normal environment.

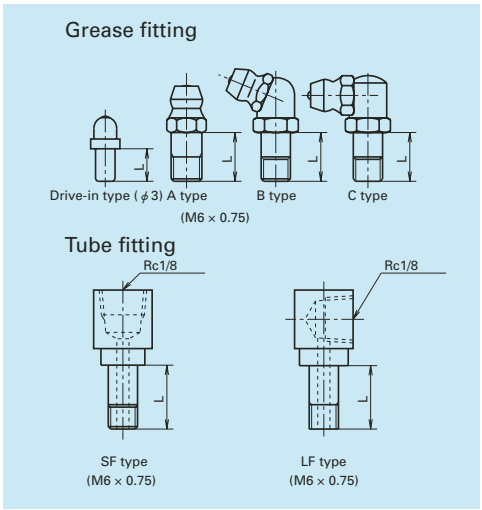


Fig. 1 Grease fitting and tube fitting

Table 2 Unit: mm

Model No.	Dust-proof specification	Grease fitting Thread body length L	Tube fitting Thread body length L
TS15	Standard*	5	–
	Protector	5	–
TS20	Standard*	5	6
	Protector	5	6
TS25	Standard*	5	6
	Protector	5	6
TS30	Standard*	5	6
	Protector	5	6
TS35	Standard*	5	6
	Protector	5	6

*) NSK K1 units are mounted as a standard specification for TS Series.

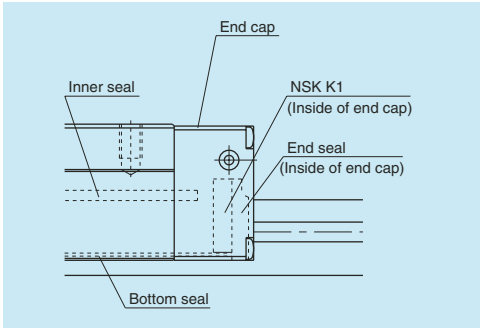


Fig. 3

(2) Protector

Please consult NSK as the protector for TS Series can be installed only before shipping from the factory.
Fig. 4 and **Table 3** show the ball slide length when protector is installed.

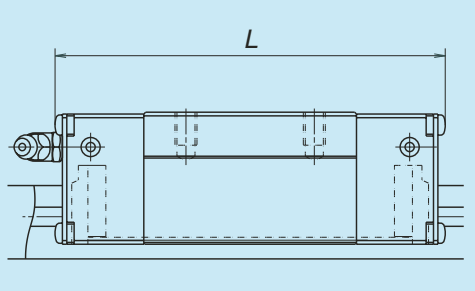


Fig. 4

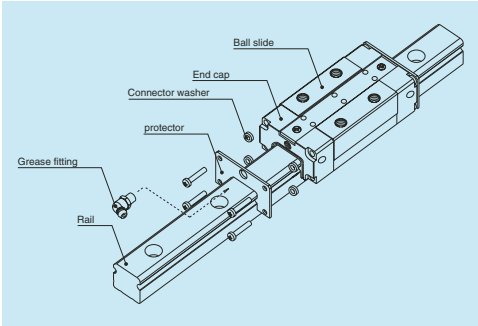


Fig. 5 Protector

Table 3 Dimension when equipped with the protector

Model No.	Ball slide length L	
	Standard length	Protector installation*
TS15	72.2	77.6
TS20	87	92.8
TS25	100	106.4
TS30	115	123.4
TS35	135.8	144.2

*) The table shows the ball slide length when one protector is installed in both ends.

(3) Cap to plug the rail mounting bolt hole

Table 4 Caps to plug rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
TS15	M4	LG-CAP/M4	20
TS20	M5	LG-CAP/M5	20
TS25	M6	LG-CAP/M6	20
TS30, TS35	M8	LG-CAP/M8	20

Note: Cap to plug the bolt hole for rail mounting is exclusive for rail design of type I.

7. Reference number

Reference numbers shall be set to individual NSK linear guide when its specifications are finalized, and it is indicated on its specification drawing.
Please specify the reference number, except design serial number, to identify the product when ordering, requiring estimates, or inquiring about specifications from NSK.

(1) Reference number for assembly of random-matching ball slide and rail

TS 30 2400 AN P 2 - ** **KL S**

- Series name
- Size
- Rail length (mm)
- Ball slide shape code (See page A151.)
- Surface treatment/Rail design code
  P: No surface treatment/Counterbores on a rail top surface (Type I)
  V: No surface treatment/Tapped holes on a rail bottom surface (Type II)
  R: With surface treatment/Counterbores on a rail top surface (Type I)
  W: With surface treatment/Tapped holes on a rail bottom surface (Type II)
- Number of ball slides per rail
- Design serial number
  Added to the reference number.
- Accuracy code: KL
  KL: Normal grade is only available.
- Preload code: S
  S: Clearance of 60 μm or less

(2) Reference number for random-matching type

Ball slide

TAS 30 AN -F

- Random-matching ball slide series code
  TAS: TS Series random-matching ball slide
- Size
- Ball slide shape code (See page A151.)
- Option code
  No code: No surface treatment + AS2 grease
  -F: Fluoride low temperature chrome plating + AS2 grease
  -F50: Fluoride low temperature chrome plating + LG2 grease

Rail

T1S 30 2400 L P N - ** **PL S**

- Random-matching rail series code
  T1S: TS Series random-matching rail
- Size
- Rail length (mm)
- Rail shape code: L
  L: Standard
- Surface treatment/rail design code (See above.)
- *Butting rail specification
  N: Non-butting. L: Butting specification
- Design serial number
  Added to the reference number.
- Accuracy code: PL
  PL: Normal grade is only available.
- Preload code: S
  S: Clearance of 60 μm or less

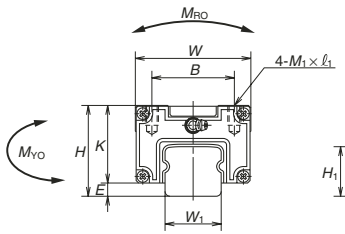
*Please consult with NSK for butting rail specification.

8. Dimensions

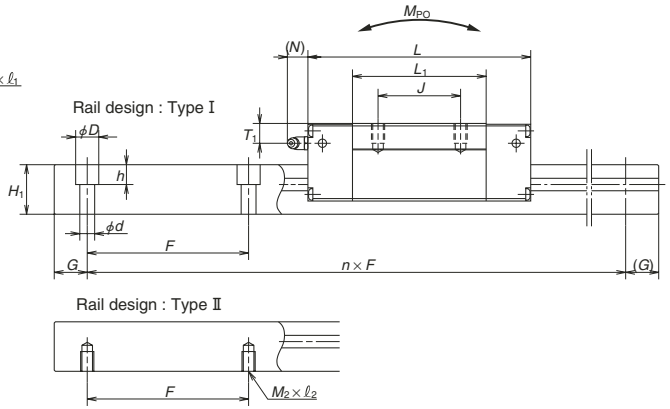
TS 30 2400 AN P 2 - KL S**

- Series name
- Size
- Rail length (mm)
- Ball slide shape code (See page A151.)
- Surface treatment/Rail design code
  - P: No surface treatment/Counterbores on a rail top surface (Type Ⅰ)
  - V: No surface treatment/Tapped holes on rail bottom surface (Type Ⅱ)
  - R: Fluoride low temperature chrome plating/Counterbores on rail topsurface (Type Ⅰ)
  - W: Fluoride low temperature chrome plating/Tapped holes on a rail bottom surface (Type Ⅱ)
- Number of ball slides per rail
- Design serial number (Added to the reference number.)
- Accuracy code: KL (KL: Normal grade is only available.)
- Preload code: S (S: Clearance of 60 μm or less)

Front view



Side view



Rail design : Type Ⅱ

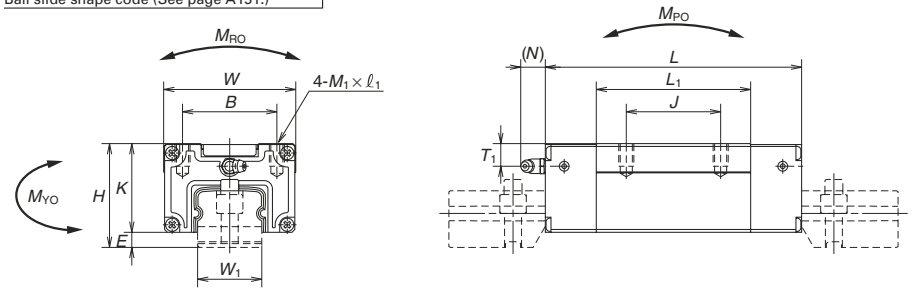
Model No.	Assembly Height $H_{\pm 0.1}$	Assembly E	Ball slide Width W	Ball slide Length L	Mounting hole B	Mounting hole J	Mounting hole $M_1 \times$ pitch $\times \ell_1$	L_1	K	Grease fitting Hole size	Grease fitting T_1	Grease fitting N	width W_1	height H_1	Pitch F
TS15AN	28	3	34	72.2	26	26	M4×0.7×6	39	25	ϕ3	6.5	5	15	14	120
TS20AN	30	3	44	87	32	36	M5×0.8×8	50	27	M6×0.75	6.5	14	20	15	120
TS25AN	40	4	48	100	35	35	M6×1×9	58	36	M6×0.75	9.5	14	23	20	120
TS30AN	45	6.5	60	115	40	40	M8×1.25×10	70	38.5	M6×0.75	9.5	14	28	25	160
TS35AN	55	8	70	135.8	50	50	M8×1.25×12	81.8	47	M6×0.75	12	14	34	30	160

Notes: 1) TS Series does not have a ball retainer. Be aware that balls fall out when the ball slide is withdrawn from the rail.

Reference number for ball slide of random-matching type

Ball slide **TAS 30 AN -F**

- Random-matching ball slide series code (TAS: TS Series random-matching ball slide)
- Size
- Ball slide shape code (See page A151.)
- Option code (No code: No surface treatment + AS2 grease; -F: Fluoride low temperature chrome plating + AS2 grease; -F50: Fluoride low temperature chrome plating + LG2 grease)



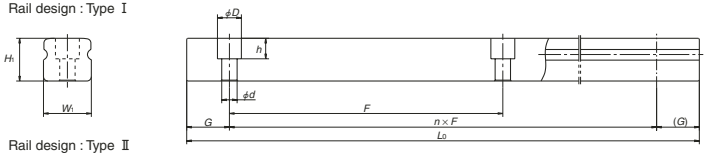
Reference number for rail of random-matching type

Rail **T1S 30 1200 L P N -** PL S**

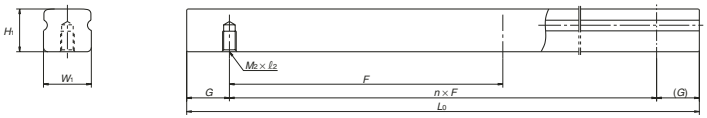
- Random-matching rail series code (T1S: TS Series random-matching rail)
- Size
- Rail length (mm)
- Rail shape code: L (L: Standard)
- Surface treatment/rail design code (See page A155.)
- *Butting rail specification (N: Non-butting. L: Butting specification)
- Design serial number (Added to the reference number.)
- Accuracy code: PL (PL: Normal grade is only available.)
- Preload code: S (S: Clearance of 60 μm or less)

*Please consult with NSK for butting rail specification.

Rail design : Type Ⅰ



Rail design : Type Ⅱ



Unit: mm

Rail: Mounting hole Type Ⅰ $d \times D \times h$	Rail: Mounting hole Type Ⅱ $M_2 \times$ pitch $\times \ell_2$	G (reference)	Max. length L_{0max}. ( ) for stainless	Basic load rating: [2]Dynamic [50km] C_{50}(N)	Dynamic [100km] C_{100}(N)	Static C_0 (N)	Static moment (N·m) M_{RO}	M_{PO} One slide	M_{PO} Two slides	M_{YO} One slide	M_{YO} Two slides	Weight: Ball slide (kg)	Rail (kg/m)
4.5×7.5×5.3	M4×0.7×6	20	1 960	9 800	7 800	11 800	92	63.5	585	63.5	585	0.21	1.5
6×9.5×8.5	M5×0.8×8	20	2 920	15 700	12 500	19 100	196	137	1 110	137	1 110	0.37	2.1
7×11×9	M6×1×9	20	4 000	21 800	17 300	26 000	320	217	1 730	217	1 730	0.47	3.4
9×14×12	M8×1.25×12	20	4 040*	31 000	24 800	37 500	565	395	2 810	395	2 810	0.77	5.3
9×14×12	M8×1.25×12	20	4 040*	46 500	37 000	53 000	970	635	4 750	635	4 750	1.3	7.7

2) The basic load rating comply with the ISO standard. (ISO 14728-1, 14728-2)
C_{50}: the basic dynamic load rating for 50 km rated fatigue life C_{100}: the basic dynamic load rating for 100 km rated fatigue life
3) Consult with NSK when using a TS Series in a single rail configuration.
* Maximum length of fluoride low-temperature chrome plated products is 4 000 (G = 80).

A-5-1.4 NS Series

1. Features

(1) Improve rating life dramatically

Based on the LS series characterized by reliability and performance, a significant increase in durability has been attained. New ball groove geometry is introduced, which has been developed by utilizing NSK's state-of-the-art tribological and analytical technologies. Due to the optimized distribution of contact surface pressures, the rating life has dramatically increased.

As compared with the LS Series, the load rating capacity of the NS series has increased to 1.3 times, while the life span has increased to twice[*1]. These features enable you to design a machine with a longer life and downsize the machine. Thus, your design capability is greatly enhanced.

*1: Representative values of series.

(2) Ball circulation path with excellent high-speed property

By reexamining the design practice for the ball circulation path, we have attained smooth ball circulation and reduced noise level. So, NS series is suited for high-speed applications compared with the LS Series.

(3) All mounting dimensions are the same as those for the LS and SS Series

Regarding the mounting dimensions (mounting parts' dimensions), such as the mounting height, mounting width, mounting hole diameter/pitch of the linear guide, etc., the mounting dimensions of the NS Series remain the same as those of the conventional LS series and SS series. So, the new NS Series linear guides can be used without making any design changes.

(4) High self aligning capability (rolling direction)

Same as the DF combination in angular contact bearings, self-aligning capability is high because the cross point of the contact lines of balls and grooves comes inside, and thus reducing moment rigidity. This increases the capacity to absorb errors in installation.

(5) High load carrying capacity to vertical direction

The contact angle is set at 50 degrees, and thus increasing load carrying capacity as well as rigidity against the load in vertical direction.

(6) High resistance against impact load

The bottom ball groove is formed in Gothic arch and the center of the top and bottom grooves are offset as shown in **Fig. 2**. The vertical load is usually carried by top 2 rows, where balls are contacting at two points. Because of this design, the bottom rows will carry the load when a large impact load is applied as shown in **Fig. 3**. This assures high resistance to the impact load.

(7) High accuracy

As showing in **Fig. 4**, fixing the measuring rollers to the ball grooves is simple thanks to the Gothic arch groove. This makes easy and accurate measuring of ball grooves.

(8) Easy to handle, and designed with safety in mind.

Balls are retained in the retainer and do not fall out when the ball slide is withdrawn from the rail.

(9) Abundant models and sizes come in series.

Each size of NS Series has several ball slide models, rendering the linear guide available for numerous uses. The NS Series also has standardized long stainless- steel rail (maximum 3 500 mm).

(10) Fast delivery

Lineup of random-matching rails and ball slides supports and facilitates fast delivery.

High precision grade and medium preload types are also available in random matching. (Special high-carbon steel products)

Note: For customers who have used the former LS or SS series, NS series is recommended as a substitute. Please confirm the correlation between NS series and former ones on the comparative table at A319.

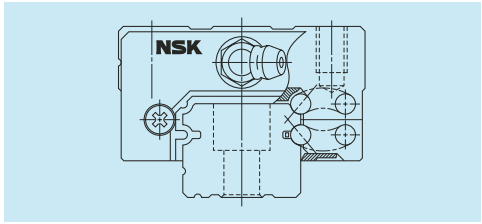


Fig. 1 NS Series

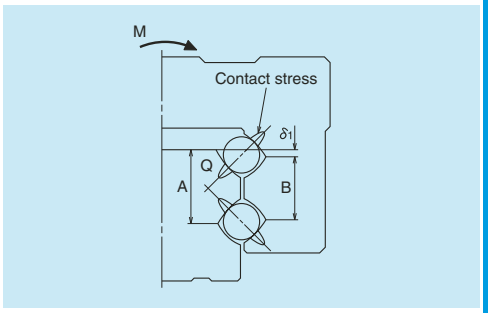


Fig. 2 Enlarged illustration of the offset Gothic arch groove

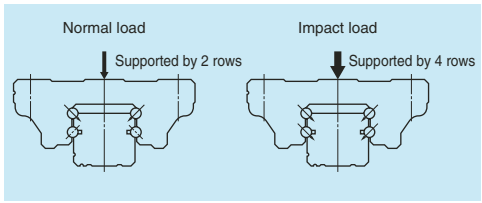


Fig. 3 When load is applied

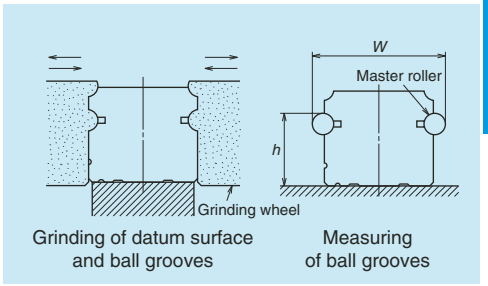
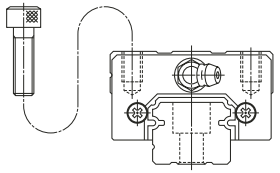
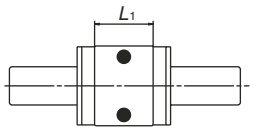
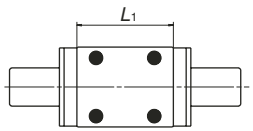
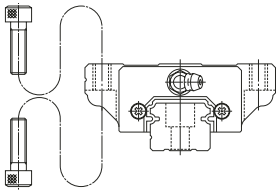
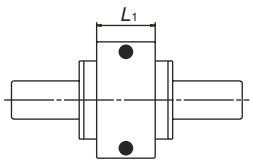
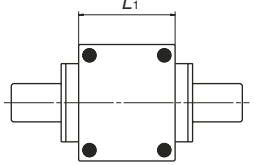


Fig. 4 Rail-grinding and measuring

2. Ball slide shape

Ball slide Model	Shape/installation method	Type (Upper row, Rating: Lower row, Ball slide length)	
		Medium-load type	High-load type
		Standard	Long
AL CL		CL 	AL 
EM JM		JM 	EM 

Note: High-precision grade and medium preload of random-matching type are not applicable to EL, JL, FL and KL models.

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

Rail length (mm) over	or less	Preloaded assembly (not random matching) Ultra precision P3	Super precision P4	High precision P5	Precision grade P6	Normal grade PN	Random-matching type High precision PH	Normal grade PC
–	50	2	2	2	4.5	6	2	6
50	80	2	2	3	5	6	3	6
80	125	2	2	3.5	5.5	6.5	3.5	6.5
125	200	2	2	4	6	7	4	7
200	250	2	2.5	5	7	8	5	8
250	315	2	2.5	5	8	9	5	9
315	400	2	3	6	9	11	6	11
400	500	2	3	6	10	12	6	12
500	630	2	3.5	7	12	14	7	14
630	800	2	4.5	8	14	16	8	16
800	1 000	2.5	5	9	16	18	9	18
1 000	1 250	3	6	10	17	20	10	20
1 250	1 600	4	7	11	19	23	11	23
1 600	2 000	4.5	8	13	21	26	13	26
2 000	2 500	5	10	15	22	29	15	29
2 500	3 150	6	11	17	25	32	17	32
3 150	4 000	9	16	23	30	34	23	34

(2) Accuracy standard

The preloaded assembly has five accuracy grades; Ultra precision P3, Super precision P4, High precision P5, Precision P6 and Normal PN grades, while the random-matching type has High-precision PH and Normal PC grade.

• Tolerance of preloaded assembly

Table 2

Unit: μm

Characteristics \ Accuracy grade	Ultra precision P3	Super precision P4	High precision P5	Precision grade P6	Normal grade PN
Mounting height H Variation of H (All ball slides on a set of rails)	±10 3	±10 5	±20 7	±40 15	±80 25
Mounting width W_2 or W_3 Variation of W_2 or W_3 (All ball slides on reference rail)	±15 3	±15 7	±25 10	±50 20	±100 30
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	See **Table 1**, **Fig. 5** and **Fig. 6**				

• Tolerance of random-matching type

Table 3

Unit: μm

Characteristics \ Model No.	High precision grade PH	Normal grade PC
Mounting height H	±20	±20
Variation of mounting height H	15①	15①
	30②	30②
Mounting width W_2 or W_3	±30	±30
Variation of mounting width W_2 or W_3	20	25
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	See **Table 1**, **Fig. 5** and **Fig. 6**	

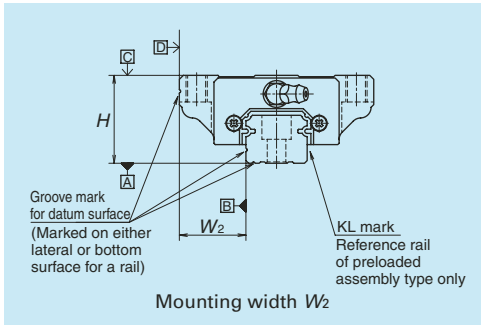
Notes: ① Variation on the same rail
② Variation on multiple rails

(3) Combinations of accuracy and preload

Table 4

		Accuracy grade: Ultra precision	Super precision	High precision	Precision grade	Normal grade	High precision	Normal grade
Without NSK K1 lubrication unit		P3	P4	P5	P6	PN	PH	PC
With NSK K1 lubrication unit		K3	K4	K5	K6	KN	KH	KC
With NSK K1 for food and medical equipment		F3	F4	F5	F6	FN	FH	FC
Preload	Fine clearance Z0	○	○	○	○	○	—	—
	Slight preload Z1	○	○	○	○	○	—	—
	Medium preload Z3	○	○	○	○	—	—	—
	Random-matching type with fine clearance ZT	—	—	—	—	—	—	○
	Random-matching type with slight preload ZZ	—	—	—	—	—	○	○
	Random-matching type with medium preload ZH	—	—	—	—	—	○	○

(4) Assembled accuracy



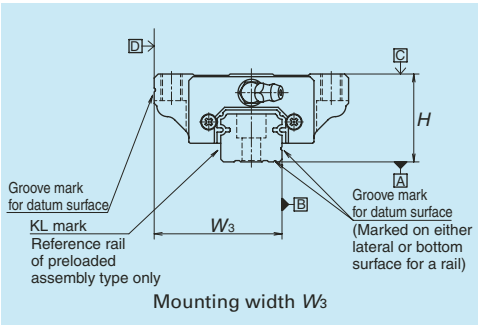
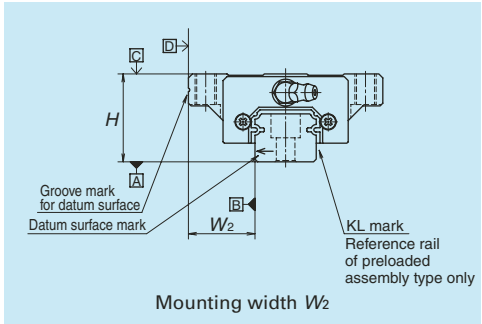


Fig. 5 Special high carbon steel



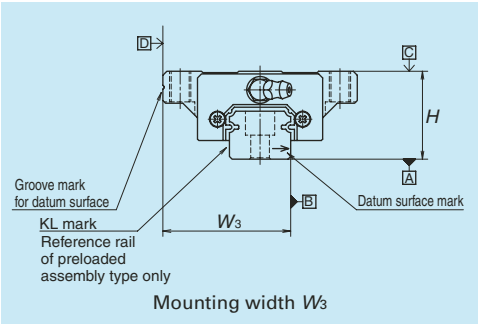


Fig. 6 Stainless steel

(5) Preload and rigidity

We offer six levels of preload: Slight preload Z1, Medium preload Z3 and Fine clearance Z0, along with random-matching type of Medium preload ZH, Fine clearance ZT and Slight preload ZZ.

• Preload and rigidity of preloaded assembly

Table 5

	Model No.	Preload (N)		Rigidity (N/μm)			
				Vertical direction		Lateral direction	
		Slight preload Z1	Medium preload Z3	Slight preload Z1	Medium preload Z3	Slight preload Z1	Medium preload Z3
High-load type	NS15 AL, EM	69	390	127	226	88	167
	NS20 AL, EM	88	540	147	284	108	206
	NS25 AL, EM	147	880	206	370	147	275
	NS30 AL, EM	245	1 370	255	460	186	345
	NS35 AL, EM	345	1 960	305	550	216	400
Medium-load type	NS15 CL, JM	49	294	78	147	59	108
	NS20 CL, JM	69	390	108	186	78	137
	NS25 CL, JM	98	635	127	235	88	177
	NS30 CL, JM	147	980	147	275	108	206
	NS35 CL, JM	245	1 370	186	335	137	245

Note: Clearance for Fine clearance Z0 is 0 to 3μm. Therefore, preload is zero.
However, Z0 of PN grade is 0 to 15μm.

• Clearance and preload of random-matching type

Table 6

Unit: μm

Model No.	Fine clearance ZT	Slight preload ZZ	Medium preload ZH
NS15	–4 — 15	–4 — 0	–7 — –3
NS20	–4 — 15	–4 — 0	–7 — –3
NS25	–5 — 15	–5 — 0	–9 — –4
NS30	–5 — 15	–5 — 0	–9 — –4
NS35	–5 — 15	–6 — 0	–10 — –4

Note: Minus sign denotes that a value is an amount of preload (elastic deformation of balls).

4. Maximum rail length

Table 7 shows the limitations of rail length (maximum length). However, the limitations vary by accuracy grade.

Table 7 Length limitations of rails

Unit: mm

Series	Size / Material	15	20	25	30	35
NS	Special high carbon steel	2 920	3 960	3 960	4 000	4 000
	Stainless steel	1 700	3 500	3 500	3 500	3 500

Note: Rails can be butted if user requirement exceeds the rail length shown in the table. Please consult NSK.

5. Installation

(1) Permissible values of mounting error

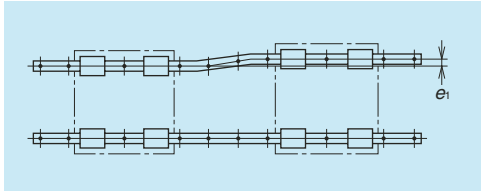


Fig. 7

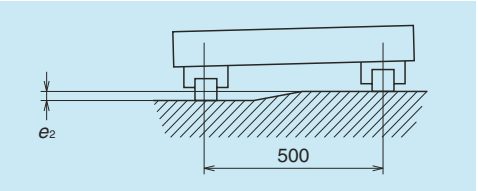


Fig. 8

Table 8

Unit: μm

Value	Preload	Model No. NS15	NS20	NS25	NS30	NS35
Permissible values of parallelism in two rails e_1	Z0, ZT	20	22	30	35	40
	Z1, ZZ	15	17	20	25	30
	Z3, ZH	12	15	15	20	25
Permissible values of parallelism (height) in two rails e_2	Z0, ZT	375 μm/500 mm				
	Z1, ZZ, Z3, ZH	330 μm/500 mm				

(2) Shoulder height of the mounting surface and corner radius r

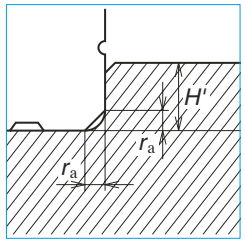


Fig. 9 Shoulder for the rail datum surface

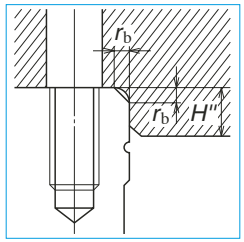


Fig. 10 Shoulder for the ball slide datum surface

Table 9

Unit: mm

Model No.	Corner radius (maximum) r_a	r_b	Shoulder height H'	H''
NS15	0.5	0.5	4	4
NS20	0.5	0.5	4.5	5
NS25	0.5	0.5	5	5
NS30	0.5	0.5	6	6
NS35	0.5	0.5	6	6

6. Maximum allowable speed

An indication of the standard maximum allowable speed aiming at 10,000km operation with NS series under normal conditions is shown in Table 10. However, the maximum allowable speed can be affected by accuracy of installation, operating temperature, external load, etc. If the operation is made exceeding the permissible distance and speed, please consult NSK.

Table 10 Maximum allowable speed Unit: m/min

Series / Size	15	20	25	30	35
NS	300				

7. Lubrication components

Refer to pages A38 and D13 for the lubrication of linear guides.

(1) Types of lubrication accessories

Fig. 11 and **Table 11** show grease fittings and tube fittings.

We provide lubrication accessories with extended thread body length (L) for the addition of dust-proof accessories such as NSK K1 lubrication unit, double seal and protector.

We provide a suitable lubrication accessory for the special requirement on dust-proof accessories.

Consult NSK for a lubrication accessory with extended length of thread body for your convenience of replenishing lubricant.

When you require stainless lubrication accessories, please ask NSK.

(2) Mounting position of lubrication accessories

The standard position of grease fittings is the end face of ball slide. We mount them on a side of end cap for an option. (**Fig. 12**)

Please consult NSK for installation of grease or tube fittings to the ball slide body or side of end cap.

When using a piping unit with thread of M6 × 1, you require a connector to connect to a grease fitting mounting hole with M6 × 0.75. The connector is available from NSK.

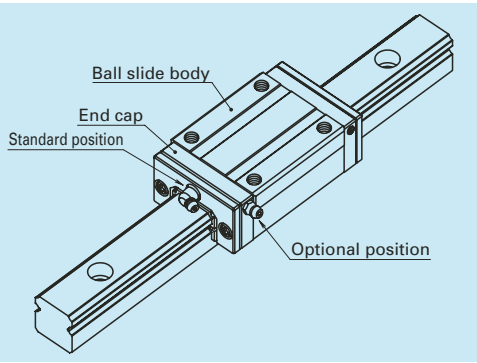


Fig. 12 Mounting position of lubrication accessories

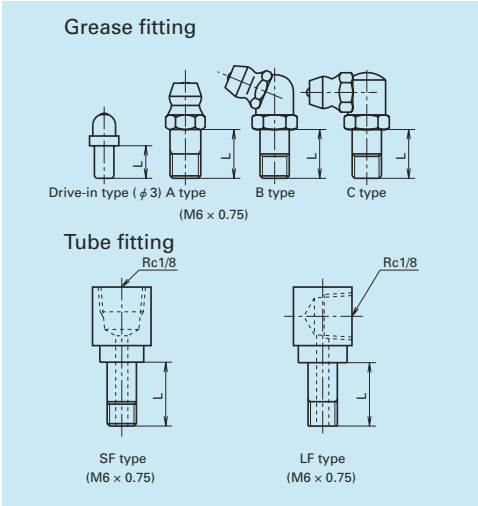


Fig. 11 Grease fitting and tube fitting

Table 11 Unit: mm

Model No.	Dust-proof specification	Grease fitting	Tube fitting
		Thread body length L	Thread body length L
NS15	Standard	5	–
	With NSK K1	10	–
	Double seal	*	–
	Protector	*	–
NS20	Standard	5	–
	With NSK K1	10	–
	Double seal	8	–
	Protector	8	–
NS25	Standard	5	6
	With NSK K1	12	11
	Double seal	10	9
	Protector	10	9
NS30	Standard	5	6
	With NSK K1	14	13
	Double seal	12	11
	Protector	12	11
NS35	Standard	5	6
	With NSK K1	14	13
	Double seal	12	11
	Protector	12	11

*) A connector is required for this model. Please contact NSK for grease fittings.

8. Dust-proof components

(1) Standard specification

The NS Series can be readily used as they have a dust protection means for normal conditions. As the standard equipment, the ball slides have an end seal on both ends, and bottom seals at the bottom.

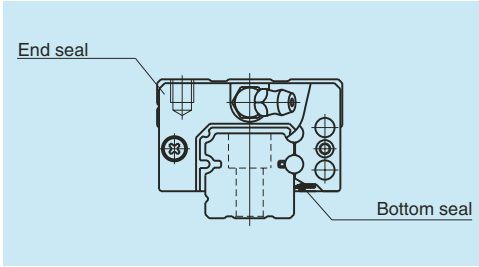


Fig. 13

Table 12 Seal friction per ball slide (maximum value)

Unit: N

Series \ Size	15	20	25	30	35
NS	8	9	9	9	10

(2) NSK K1™ lubrication unit

Table 13 shows the dimension of linear guides equipped with the NSK K1 lubrication unit.

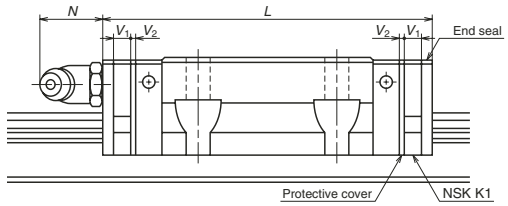


Table 13 Unit: mm

Model No.	Ball slide length	Ball slide model	Standard ball slide length	Ball slide length installed with two NSK K1 *L*	Per NSK K1 thickness V_1	Protective cover thickness V_2	Protruding area of the grease fitting *N*
NS15	Standard	AL, EM	56.8	66.4	4.0	0.8	(5)
	Short	CL, JM	40.4	50			
NS20	Standard	AL, EM	65.2	75.8	4.5	0.8	(14)
	Short	CL, JM	47.2	57.8			
NS25	Standard	AL, EM	81.6	92.2	4.5	0.8	(14)
	Short	CL, JM	59.6	70.2			
NS30	Standard	AL, EM	96.4	108.4	5.0	1.0	(14)
	Short	CL, JM	67.4	79.4			
NS35	Standard	AL, EM	108	121	5.5	1.0	(14)
	Short	CL, JM	77	90			

Note: Ball slide length equipped with NSK K1 = (Standard ball slide length) + (Thickness of NSK K1, V_1 × Number of NSK K1) + (Thickness of the protective cover, V_2 × 2)

(3) Double seal

Use a double seal set as showing in **Table 14**, when installing an extra seal to completed standard products. (**Fig. 14**)
When installing a grease fitting after the installation of double seals, a connector as showing **Fig.14** is required.

(4) Protector

Use a protector set as showing **Table 15**, when installing a protector to completed standard products. (**Fig.15**)
When installing a grease fitting after the installation of protectors, a connector as showing **Fig.15** is required.

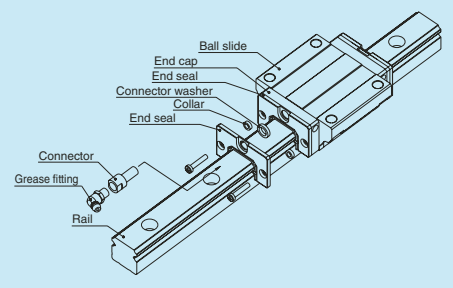


Fig. 14 Double seal

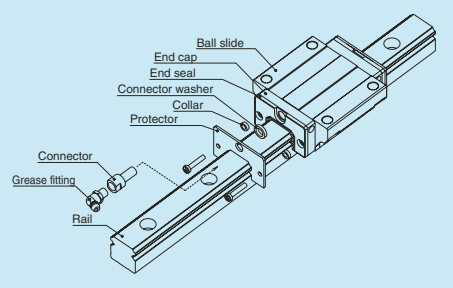


Fig. 15 Protector

Table 14 Double-seal set

Model No.	Reference No.		Increased thickness V_3 (mm)
	Without connector	With connector	
NS15	LS15WS-01	*	2.8
NS20	LS20WS-01	LS20WSC-01	2.5
NS25	LS25WS-01	LS25WSC-01	2.8
NS30	LS30WS-01	LS30WSC-01	3.6
NS35	LS35WS-01	LS35WSC-01	3.6

Table 15 Protector set

Model No.	Reference No.		Increased thickness V_4 (mm)
	Without connector	With connector	
NS15	LS15PT-01	*	3
NS20	LS20PT-01	LS20PTC-01	2.7
NS25	LS25PT-01	LS25PTC-01	3.2
NS30	LS30PT-01	LS30PTC-01	4.2
NS35	LS35PT-01	LS35PTC-01	4.2

*) For installation of a connector to a drive-in type grease fitting, contact NSK.

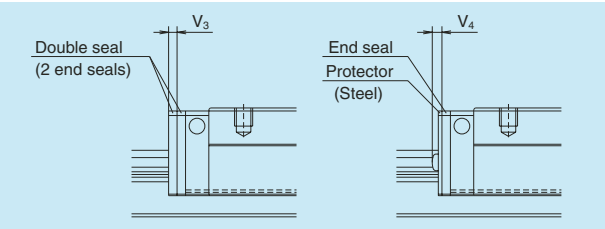


Fig. 16

(5) Cap to plug the rail mounting bolt hole

Table 16 Caps to plug rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
NS15	M3	LG-CAP/M3	20
NS15	M4	LG-CAP/M4	20
NS20	M5	LG-CAP/M5	20
NS25, NS30	M6	LG-CAP/M6	20
NS35	M8	LG-CAP/M8	20

(6) Inner seal

Inner seal is only available for the models shown below.

Table 17

Series	Model No.
NS	NS20, NS25, NS30, NS35

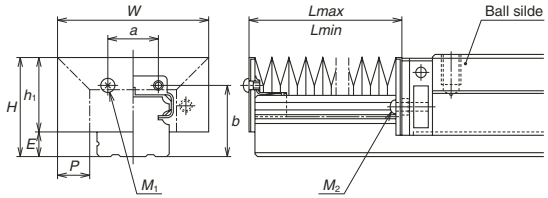
(7) Bellows

- A bellows fastener kit, which includes one of bellows faster, two of M_1 set screws, two of M_2 set screws, and two collars for M_2 set screws as showing Fig. 7.7 on page A55, is supplied with bellows for the ends.
- Middle bellows are supplied with four set screws and four collars.
- Use a bellows fastener kit as showing **Table 18**, when installing bellows to completed standard products.
- When NSK K1, double seals or protectors are used, the set screws of bellows fastener kit are unable to use.
  Please contact NSK for details.
- Bellows fastener is available only for the horizontal mounting positions. For other mounting positions, sliding plate is required (see **Fig. 7.10** on page A56).
  For fixing to the rail, make tap holes to the rail end surface. Fix the bellows mounting plate to the rail end surface through these tap holes by using a machine screw. NSK processes a tap hole to the rail end face when ordered with a linear guide.

Table 18 Bellows fastner kit reference No.

Model No.	Kit reference No.
NS15	LS15FS-01
NS20	LS20FS-01
NS25	LS25FS-01
NS30	LS30FS-01
NS35	LS35FS-01

Dimension tables of bellows
NS Series



Bellows reference number

J A S 15 L 08

- J: Bellows
- A: Bellows for the ends
- B: Middle bellows
- S: Bellows for NS series
- 15: Size number of linear guide
- L: Low type
- 08: Number of BL (fold number)

Fig. 17 Dimensions of bellows

Table 19 Dimensions of bellows Unit: mm

Model No.	*H*	h_1	*E*	*W*	*P*	*a*	*b*	BL minimum length	M_1 Tap x depth	M_2 Tap x depth
JAS15L	23.5	18.9	4.6	43	10	8	16.5	17	M3 × 5	M3 × 14
JAS20L	27	21	6	48	10	13	19.7	17	M3 × 5	M2.5 × 14
JAS25L	32	25	7	51	10	15	23.2	17	M3 × 5	M3 × 18
JAS30L	41	32	9	66	15	16	29	17	M4 × 6	M4 × 19
JAS35L	47	36.5	10.5	72	15	22	33.5	17	M4 × 6	M4 × 22

Table 20 Numbers of folds (BL) and lengths of bellows Unit: mm

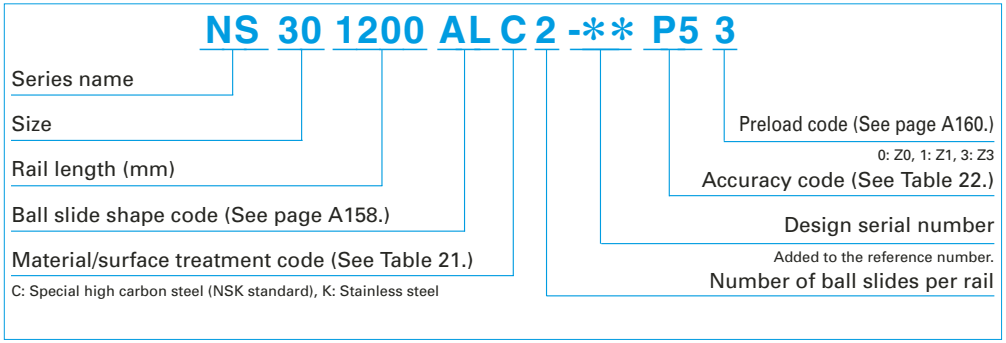
Model No.	Number of BL	2	4	6	8	10	12	14	16	18	20
	L_{min}	34	68	102	136	170	204	238	272	306	340
JAS15L	Stroke	106	212	318	424	530	636	742	848	954	1 060
	L_{max}	140	280	420	560	700	840	980	1 120	1 260	1 400
JAS20L	Stroke	106	212	318	424	530	636	742	848	954	1 060
	L_{max}	140	280	420	560	700	840	980	1 120	1 260	1 400
JAS25L	Stroke	106	212	318	424	530	636	742	848	954	1 060
	L_{max}	140	280	420	560	700	840	980	1 120	1 260	1 400
JAS30L	Stroke	176	352	528	704	880	1 056	1 232	1 408	1 584	1 760
	L_{max}	210	420	630	840	1 050	1 260	1 470	1 680	1 890	2 100
JAS35L	Stroke	176	352	528	704	880	1 056	1 232	1 408	1 584	1 760
	L_{max}	210	420	630	840	1 050	1 260	1 470	1 680	1 890	2 100

Note: The values of an odd number BL quantity (3, 5, 7, ...) can be obtained by adding two values of even number BL on the both side, then by dividing the sum by 2.

9. Reference number

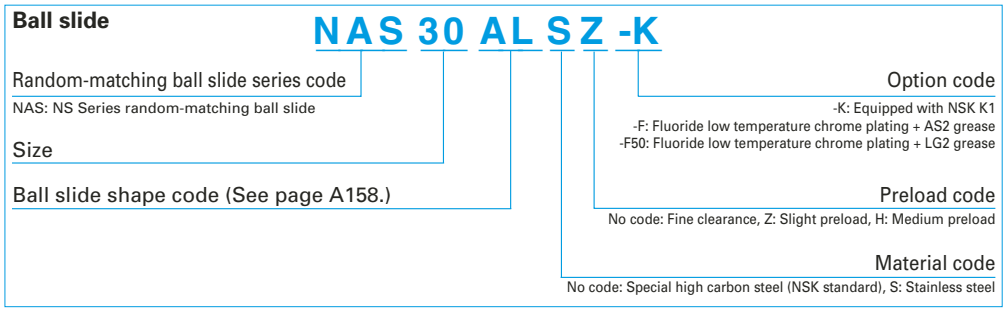
Reference numbers shall be set to individual NSK linear guide when its specifications are finalized, and it is indicated on its specification drawing.
Please specify the reference number, except design serial number, to identify the product when ordering, requiring estimates, or inquiring about specifications from NSK.

(1) Reference number for preloaded assembly

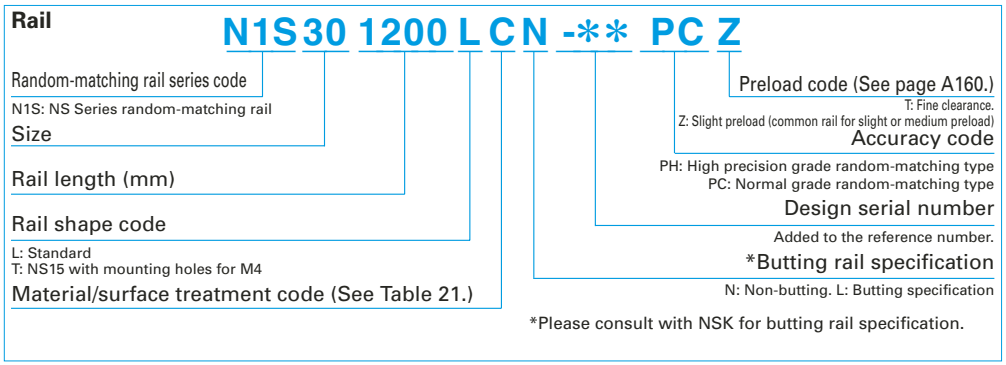


(2) Reference number for random-matching type

Ball slide



Rail



*Please consult with NSK for butting rail specification.

The reference number coding for the assembly of random-matching type is the same as that of the preloaded assembly. However, only preload codes of "fine clearance T" and "slight preload Z" are available (refer to page A160).

Table 21 Material/surface treatment code

Code	Description
C	Special high carbon steel (NSK standard)
K	Stainless steel
D	Special high carbon steel with surface treatment
H	Stainless steel with surface treatment
Z	Other, special

Note: High-precision grade and medium preload of random-matching type are not available in stainless steel.

Table 22 Accuracy code

Accuracy	Standard (Without NSK K1)	With NSK K1	With NSK K1 for food and medical equipment
Ultra precision grade	P3	K3	F3
Super precision grade	P4	K4	F4
High precision grade	P5	K5	F5
Precision grade	P6	K6	F6
Normal grade	PN	KN	FN
High precision grade (random-matching type)	PH	KH	FH
Normal grade (random-matching type)	PC	KC	FC

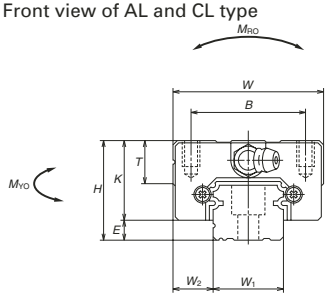
Note: Refer to pages A38 and A61 for NSK K1 lubrication unit.

10. Dimensions
NS-CL (Medium-load type / Short)
NS-AL (High-load type / Standard)

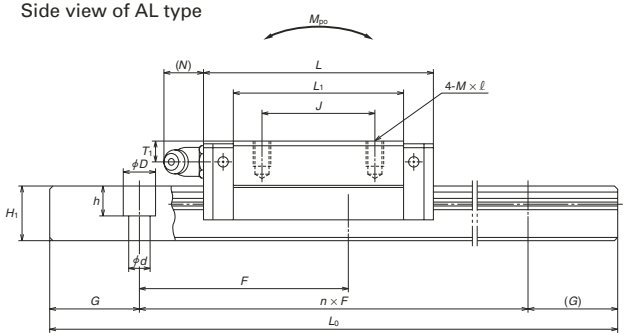
NS 30 1200 AL C 2 - PC Z**

- Series name
- Size
- Rail length (mm)
- Ball slide shape code (See page A158.)
- Material/surface treatment code (See Table 21.)
  C: Special high carbon steel (NSK standard), K: Stainless steel
- Number of ball slides per rail
- Design serial number
  Added to the reference number.
- Accuracy code (See Table 22.)
- Preload code (See page A160.)
  0: Z0, 1: Z1, 3: Z3, T: ZT, Z: ZZ, H: ZH

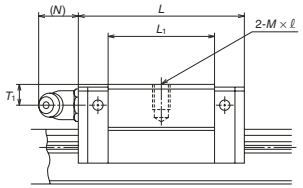
Front view of AL and CL type



Side view of AL type



Side view of CL type



Model No.	Assembly Height H	E	W_2	Ball slide Width W	Length L	Mounting hole B	J	M × pitch × ℓ	L_1	K	T	Grease fitting Hole size	T_1	N	Width W_1	Height H_1
NS15CL	24	4.6	9.5	34	40.4	26	—	M4×0.7×6	23.6	19.4	10	ϕ3	6	3	15	12.5
NS15AL					56.8		26		40							
NS20CL	28	6	11	42	47.2	32	—	M5×0.8×7	30	22	12	M6×0.75	5.5	11	20	15.5
NS20AL					65.2		32		48							
NS25CL	33	7	12.5	48	59.6	35	—	M6×1×9	38	26	12	M6×0.75	7	11	23	18
NS25AL					81.6		35		60							
NS30CL	42	9	16	60	67.4	40	—	M8×1.25×12	42	33	13	M6×0.75	8	11	28	23
NS30AL					96.4		40		71							
NS35CL	48	10.5	18	70	77	50	—	M8×1.25×12	49	37.5	14	M6×0.75	8.5	11	34	27.5
NS35AL					108		50		80							

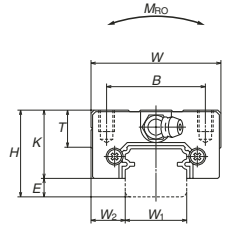
Notes: 1) External appearance of stainless steel ball slides differs from those of carbon steel ball slides.

Reference number for ball slide of random-matching type

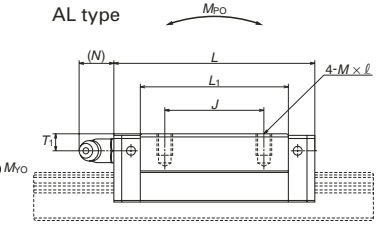
Ball slide NAS 30 AL S Z -K

- Random-matching ball slide series code
  NAS: NS Series random-matching ball slide
- Size
- Ball slide shape code (See page A158.)
- Material code
  No code: Special high carbon steel (NSK standard), S: Stainless steel
- Preload code
  No code: Fine clearance, Z: Slight preload, H: Medium preload
- Option code
  -K: Equipped with NSK K1
  -F: Fluoride low temperature chrome plating + AS2 grease
  -F50: Fluoride low temperature chrome plating + LG2 grease

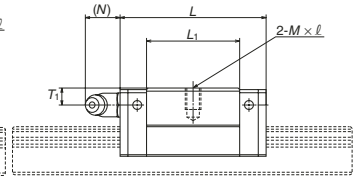
AL and CL types



AL type



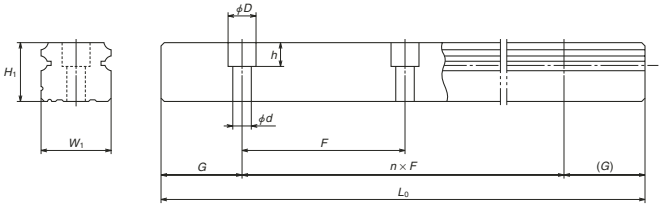
CL type



Reference number for rail of random-matching type

Rail N1S 30 1200 L C N - PC Z**

- Random-matching rail series code
  N1S: NS Series random-matching rail
- Size
- Rail length (mm)
- Rail shape code
  L: Standard
  T: NS15 with mounting holes for M4
- Material/surface treatment code (See Table 21.)
- *Butting rail specification
  N: Non-butting. L: Butting specification
  *Please consult with NSK for butting rail specification.
- Design serial number
  Added to the reference number.
- Accuracy code
  PH: High-precision grade
  PC: Normal grade
- Preload code (See page A160.)
  T: Fine clearance.
  Z: Slight preload(common rail for medium preload)



Unit: mm

Rail Pitch F	Mounting bolt hole d × D × h	G (reference)	Max. length $L_{0max.}$ ( ) for stainless	Basic load rating 2)Dynamic [50km] C_{50}(N)	[100km] C_{100}(N)	Static C_0 (N)	Static moment (N·m) M_{RO}	M_{PO} One slide	M_{PO} Two slides	M_{YO} One slide	M_{YO} Two slides	Weight Ball slide (kg)	Rail (kg/m)
60	*3.5×6×4.5 4.5×7.5×5.3	20	2 920 (1 700)	7 250 11 200	5 750 8 850	9 100 16 900	45.5 84.5	24.5 77	196 470	20.5 64.5	165 395	0.14 0.20	1.4
60	6×9.5×8.5	20	3 960 (3 500)	10 600 15 600	8 400 12 400	13 400 23 500	91.5 160	46.5 133	330 755	39 111	279 630	0.19 0.28	2.3
60	7×11×9	20	3 960 (3 500)	17 700 26 100	14 000 20 700	20 800 36 500	164 286	91 258	655 1 470	76 217	550 1 230	0.34 0.51	3.1
80	7×11×9	20	4 000 (3 500)	24 700 38 000	19 600 30 000	29 600 55 000	282 520	139 435	1 080 2 650	116 365	905 2 220	0.58 0.85	4.8
80	9×14×12	20	4 000 (3 500)	34 500 52 500	27 300 42 000	40 000 74 500	465 865	220 695	1 670 4 000	185 580	1 400 3 350	0.86 1.3	7.0

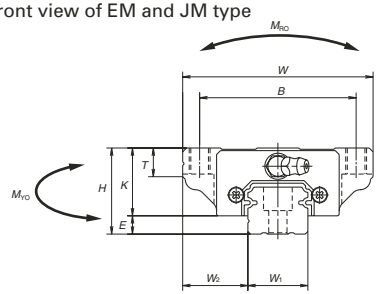
2) The basic load rating comply with the ISO standard. (ISO 14728-1, 14728-2)
C_{50}; the basic dynamic load rating for 50 km rated fatigue life C_{100}; the basic dynamic load rating for 100 km rated fatigue life
The basic static load rating shows static permissible load.
3) High-precision grade and medium preload of random-matching type are available for special high carbon steel products.
* Standard mounting hole of NS15 rail is for M3 bolts (Hole size: 3.5 × 6 × 4.5).
If you require mounting hole for M4 bolts (Hole size: 4.5 × 7.5 × 5.3), please specify when ordering.

NS-JM (Medium-load type / Short)
NS-EM (High-load type / Standard)

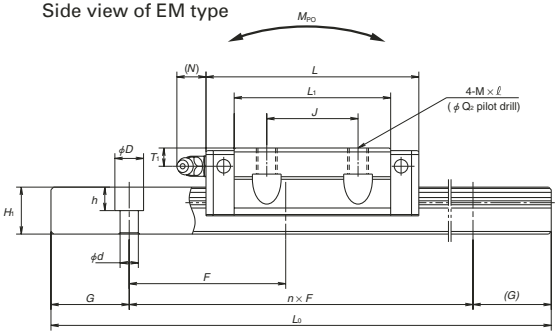
NS 30 1200 EM C 2 - ** PC Z**

- Series name
- Size
- Rail length (mm)
- Ball slide shape code (See page A158.)
- Material/surface treatment code (See Table 21.)
  C: Special high carbon steel (NSK standard), K: Stainless steel
- Number of ball slides per rail
- Design serial number
  Added to the reference number.
- Accuracy code (See Table 22.)
- Preload code (See page A160.)
  0: Z0, 1: Z1, 3: Z3, T: ZT, Z: ZZ, H: ZH

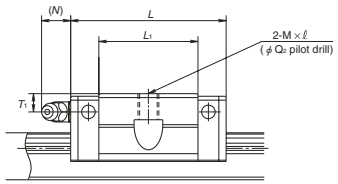
Front view of EM and JM type



Side view of EM type



Side view of JM type



Model No.	Assembly Height H	E	W_2	Ball slide Width W	Length L	Mounting hole B	J	$M \times$ pitch $\times \ell$	Q_2	L_1	K	T	Grease fitting Hole size	T_1	N	Width W_1	Height H_1
NS15JM	24	4.6	18.5	52	40.4	41	—	M5×0.8×7	4.4	23.6	19.4	8	ϕ3	6	3	15	12.5
NS15EM					56.8		26			40							
NS20JM	28	6	19.5	59	47.2	49	—	M6×1×9	5.3	30	22	10	M6×0.75	5.5	11	20	15.5
NS20EM					65.2		32	(M6×1×9.5)		48							
NS25JM	33	7	25	73	59.6	60	—	M8×1.25×10	6.8	38	26	11	M6×0.75	7	11	23	18
NS25EM					81.6		35	(M8×1.25×11.5)		60		(12)					
NS30JM	42	9	31	90	67.4	72	—	M10×1.5×12	8.6	42	33	11	M6×0.75	8	11	28	23
NS30EM					96.4		40	(M10×1.5×14.5)		71		(15)					
NS35JM	48	10.5	33	100	77	82	—	M10×1.5×13	8.6	49	37.5	12	M6×0.75	8.5	11	34	27.5
NS35EM					108		50	(M10×1.5×14.5)		80		(15)					

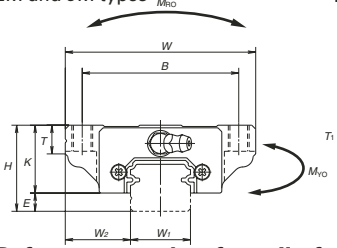
Notes: 1) External appearance of stainless steel ball slides differs from those of carbon steel ball slides.
2) Parenthesized dimensions are for items made of stainless steel.

Reference number for ball slide of random-matching type

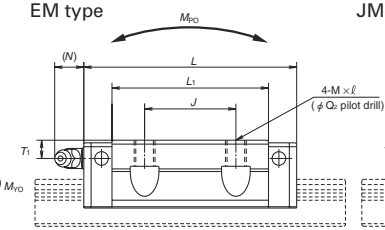
Ball slide **NAS 30 EM S Z -K**

- Random-matching ball slide series code
  NAS: NS Series random-matching ball slide
- Size
- Ball slide shape code (See page A158.)
- Option code
  -K: Equipped with NSK K1
  -F: Fluoride low temperature chrome plating + AS2 grease
  -F50: Fluoride low temperature chrome plating + LG2 grease
- Preload code
  No code: Fine clearance, Z: Slight preload, H: Medium preload
- Material code
  No code: Special high carbon steel (NSK standard), S: Stainless steel

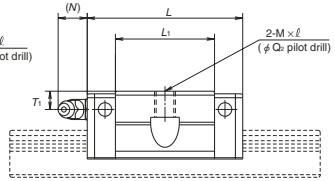
EM and JM types



EM type



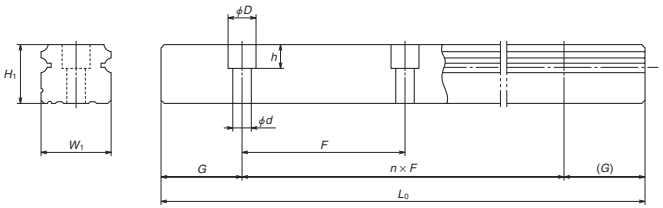
JM type



Reference number for rail of random-matching type

Rail **N1S 30 1200 L C N -** ** PC Z**

- Random-matching rail series code
  N1S: NS Series random-matching rail
- Size
- Rail length (mm)
- Rail shape code
  L: Standard
  T: NS15 with mounting holes for M4
- Material/surface treatment code (See Table 21.)
- *Butting rail specification
  N: Non-butting. L: Butting specification
  *Please consult with NSK for butting rail specification.
- Design serial number
  Added to the reference number.
- Accuracy code
  PH: High-precision grade
  PC: Normal grade
- Preload code (See page A160.)
  T: Fine clearance.
  Z: Slight preload(common rail for medium preload)



Unit: mm

Rail Pitch F	Mounting bolt hole $d \times D \times h$	G (reference)	Max. length $L_{0max.}$ ( ) for stainless	Basic load rating [3]Dynamic [50km] C_{50}(N)	[100km] C_{100}(N)	Static C_0 (N)	Static moment (N·m) M_{RO}	M_{PO} One slide	M_{PO} Two slides	M_{YO} One slide	M_{YO} Two slides	Weight Ball slide (kg)	Rail (kg/m)
60	✻3.5×6×4.5	20	2 920	7 250	5 750	9 100	45.5	24.5	196	20.5	165	0.17	1.4
	4.5×7.5×5.3		(1 700)	11 200	8 850	16 900	84.5	77	470	64.5	395	0.26	
60	6×9.5×8.5	20	3 960	10 600	8 400	13 400	91.5	46.5	330	39	279	0.24	2.3
			(3 500)	15 600	12 400	23 500	160	133	755	111	630	0.35	
60	7×11×9	20	3 960	17 700	14 000	20 800	164	91	655	76	550	0.44	3.1
			(3 500)	26 100	20 700	36 500	286	258	1 470	217	1 230	0.66	
80	7×11×9	20	4 000	24 700	19 600	29 600	282	139	1 080	116	905	0.76	4.8
			(3 500)	38 000	30 000	55 000	520	435	2 650	365	2 220	1.2	
80	9×14×12	20	4 000	34 500	27 300	40 000	465	220	1 670	185	1 400	1.2	7
			(3 500)	52 500	42 000	74 500	865	695	4 000	580	3 350	1.7	

3) The basic load rating comply with the ISO standard. (ISO 14728-1, 14728-2)
C_{50}; the basic dynamic load rating for 50 km rated fatigue life C_{100}; the basic dynamic load rating for 100 km rated fatigue life
The basic static load rating shows static permissible load.
4) High-precision grade and medium preload of random-matching type are available for special high carbon steel products.
✻ Standard mounting hole of NS15 rail is for M3 bolts (Hole size: 3.5 × 6 × 4.5).
If you require mounting hole for M4 bolts (Hole size: 4.5 × 7.5 × 5.3), please specify when ordering.

A-5-1.5 LW Series

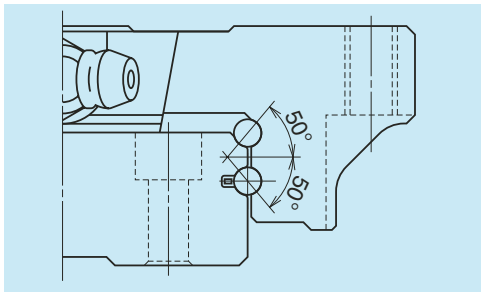


Fig. 1 Balls in contact

1. Features

(1) Ideal for use of single rail

Thanks to the wide rail, rigidity and load carrying capacity are high against moment load from rolling direction. This makes the LW Series ideal for a single rail, compact linear guideway system.

(2) High load carrying capacity to vertical direction

The contact angle is set at 50 degrees, increasing load carrying capacity as well as rigidity in vertical direction.

(3) High resistance against impact load

Same as the NH and NS series, the offset Gothic arch grooves support a large load, such as an impact, by four rows.

(4) High accuracy

Fixing master rollers to ball grooves is easy thanks to the Gothic arch groove. This makes easy and accurate measuring of ball grooves.

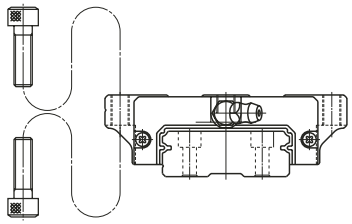
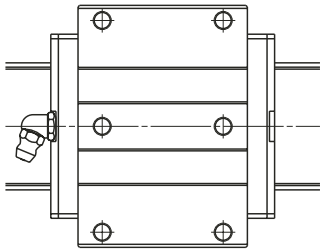
(5) Easy to handle, and designed with safety in mind.

Balls are retained in the retainer and do not fall out when a ball slide is withdrawn from the rail.

(6) Fast delivery

Lineup of random-matching rails and ball slides supports and facilitates fast delivery.

2. Ball slide shape

Ball slide Model	Shape / installation method	Type
EL		EL 

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

Rail length (mm) over	or less	Preloaded assembly (not random matching) High precision P5	Precision grade P6	Normal grade PN	Random-matching type Normal grade PC
–	50	2	4.5	6	6
50	80	3	5	6	6
80	125	3.5	5.5	6.5	6.5
125	200	4	6	7	7
200	250	5	7	8	8
250	315	5	8	9	9
315	400	6	9	11	11
400	500	6	10	12	12
500	630	7	12	14	14
630	800	8	14	16	16
800	1 000	9	16	18	18
1 000	1 250	10	17	20	20
1 250	1 600	11	19	23	23
1 600	2 000	13	21	26	26
2 000	2 500	15	22	29	29
2 500	3 150	17	25	32	32
3 150	4 000	23	30	34	34

(2) Accuracy standard

The preloaded assembly has three accuracy grades; High precision P5, Precision P6, and Normal PN grades, while the random-matching type has Normal PC grade only.

• **Tolerance of preloaded assembly type**

Table 2

Unit: μm

Characteristics \ Accuracy grade	High precision P5	Precision grade P6	Normal grade PN
Mounting height H Variation of H (All ball slides on a set of rails)	±20 7	±40 15	±80 25
Mounting width W_2 or W_3 Variation of W_2 or W_3 (All ball slides on reference rail)	±25 10	±50 20	±100 30
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	Shown in **Table 1** and **Fig. 2**		

• **Tolerance of random-matching type: Normal grade PC**

Table 3

Unit: μm

Characteristics \ Model No.	LW17, 21, 27, 35, 50
Mounting height H	±20
Variation of mounting height H	15①
	30②
Mounting width W_2 or W_3	±30
Variation of mounting width W_2 or W_3	25
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	See **Table 1** and **Fig. 2**

Note: ① Variation on the same rail
② Variation on multiple rails

(3) Combination of accuracy and preload

Table 4

		Accuracy grade			
		High precision	Precision grade	Normal grade	Normal grade
Without NSK K1 lubrication unit		P5	P6	PN	PC
With NSK K1 lubrication unit		K5	K6	KN	KC
With NSK K1 for food and medical equipment		F5	F6	FN	FC
Preload	Fine clearance Z0	○	○	○	—
	Slight preload Z1	○	○	○	—
	Medium preload Z3	○	○	—	—
	Random-matching type with fine clearance ZT	—	—	—	○
	Random-matching type with slight preload ZZ	—	—	—	○

Note: Z3 medium preload is only applicable to models of LW35 and LW50.

(4) Assembled accuracy

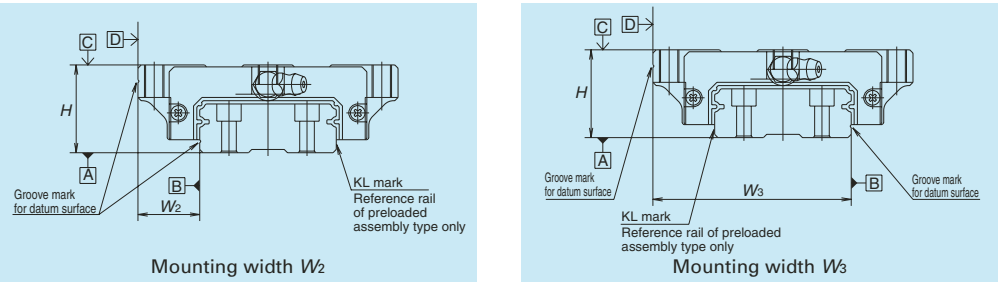


Fig. 2

(5) Preload and rigidity

We offer five levels of preload: Slight preload Z1, Medium preload Z3 and Fine clearance Z0, along with Random-matching type of Fine clearance ZT and Slight preload ZZ. Rigidities are for the median of the preload range.

- **Preload and rigidity of preloaded assembly**

Table 5

Model No.	Preload (N)		Rigidity (N/μm) Vertical direction		Lateral direction	
	Slight preload Z1	Medium preload Z3	Slight preload Z1	Medium preload Z3	Slight preload Z1	Medium preload Z3
LW17 EL	0 – 245	–	156	–	112	–
LW21 EL	0 – 294	–	181	–	130	–
LW27 EL	0 – 390	–	226	–	167	–
LW35 EL	0 – 490	785	295	440	213	315
LW50 EL	0 – 590	1 470	345	600	246	425

Note: Clearance for Fine clearance Z0 is 0 to 3μm. Therefore, preload is zero. However, Z0 of PN grade is 0 to 15μm.

- **Clearance and preload of random-matching type**

Table 6 Unit: μm

Model No.	Fine clearance ZT	Slight preload ZZ
LW17	–3 – 15	–3.5 – 0
LW21	–3 – 15	–3.5 – 0
LW27	–4 – 15	–4 – 0
LW35	–5 – 15	–5 – 0
LW50	–5 – 15	–7 – 0

Note: Minus sign denotes elastic deformation of balls representing.

4. Maximum rail length

- **Table 7** shows the limitations of rail length (maximum length). However, the limitations vary by accuracy grade.

Table 7 Length limitations of rails Unit: mm

Series	Size / Material	17	21	27	35	50
LW	Special high carbon steel	1 000	1 600	2 000	2 000	2 000

Note: Rails can be butted if user requirement exceeds the rail length shown in the table. Please consult NSK.

5. Installation

(1) Permissible values of mounting error

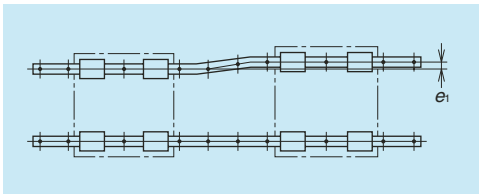


Fig. 3

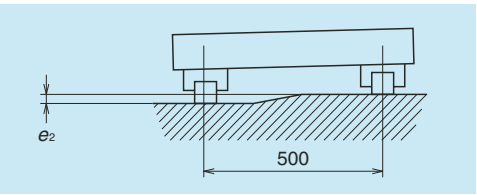


Fig. 4

Table 8 Unit: μm

Value	Preload	Model No. LW17	LW21	LW27	LW35	LW50
Permissible values of parallelism in two rails e_1	Z0, ZT	20	20	25	38	50
	Z1, ZZ	9	9	13	23	34
Permissible values of parallelism (height) in two rails e_2	Z0, ZT	100 μm/500 mm				
	Z1, ZZ	45 μm/500 mm				

(2) Shoulder height of the mounting surface and corner radius r

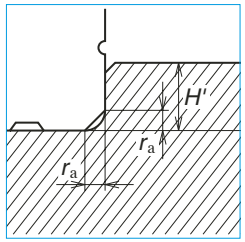


Fig. 5 Shoulder for the rail datum surface

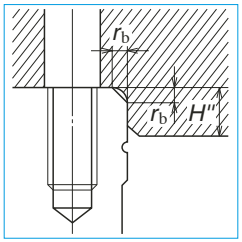


Fig. 6 Shoulder for the ball slide datum surface

Table 9 Unit: mm

Model No.	Corner radius (maximum) r_a	r_b	Shoulder height H'	H''
LW17	0.3	0.3	2.2	4
LW21	0.3	0.3	2.5	5
LW27	0.5	0.5	3.5	5
LW35	0.5	0.8	3.5	5
LW50	0.8	0.8	4	6

6. Lubrication components

Refer to pages A38 and D13 for the lubrication of linear guides.

(1) Types of lubrication accessories

Fig. 7 and **Table 10** show grease fittings and tube fittings.

We provide lubrication accessories with extended thread body length (L) for the addition of dust-proof accessories such as NSK K1 lubrication unit, double seal and protector.

We provide a suitable lubrication accessory for the special requirement on dust-proof accessories.

Consult NSK for a lubrication accessory with extended length of thread body for your convenience of replenishing lubricant.

Please ask NSK for stainless lubrication accessories.

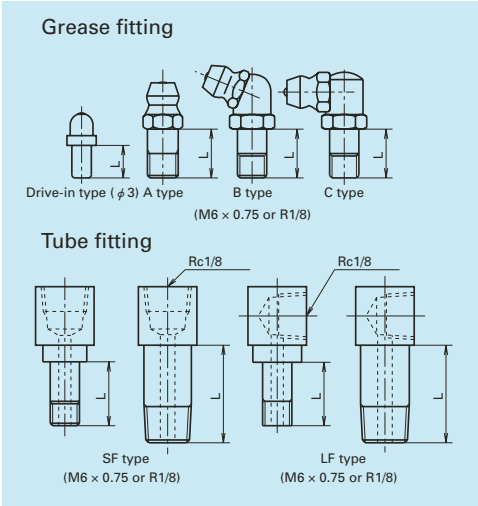


Fig. 7 Grease fitting and tube fitting

Table 10 Unit: mm

Model No.	Dust-proof specification	Grease fitting	Tube fitting
		Thread body length L	Thread body length L
LW17	Standard	5	–
	With NSK K1	10	–
	Double seal	*	–
	Protector	*	–
LW21	Standard	5	–
	With NSK K1	12	–
	Double seal	10	–
	Protector	10	–
LW27	Standard	5	5
	With NSK K1	12	12
	Double seal	10	9
	Protector	10	9
LW35	Standard	5	6
	With NSK K1	14	13
	Double seal	10	9
	Protector	10	9
LW50	Standard	8	17
	With NSK K1	18	19
	Double seal	14	17
	Protector	14	17

*) A connector is required for the grease fitting. Please contact NSK.

(2) Mounting position of lubrication accessories

The standard position of grease fittings is the end face of ball slide. We may mount them on a side of end cap for LW27, 35, and 50 as an option. (**Fig. 8**)

Please consult NSK for installation of grease or tube fittings to the ball slide body or side of end cap.

When using a piping unit with thread of M6 × 1, you require a connector for a connection to a grease fitting mounting hole with M6 × 0.75. The connector is available from NSK.

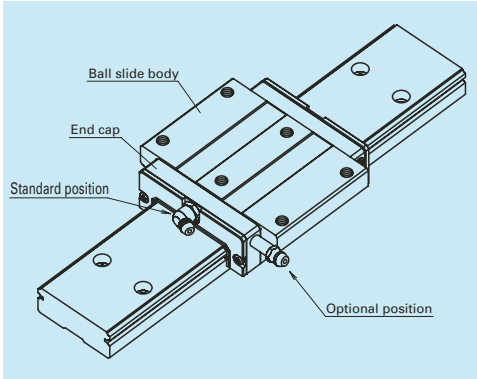


Fig. 8 Mounting position of lubrication accessories

7. Dust-proof components

(1) Standard Specification

The LW Series can be readily used as they have a dust protection means for normal conditions. As the standard equipment, the series has an end seal on both ends and bottom seals at the bottom.

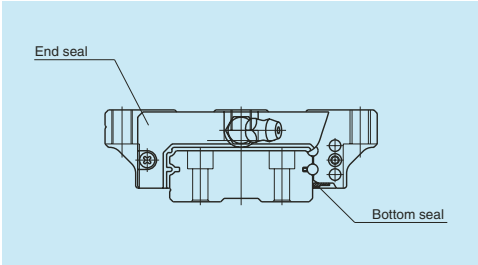


Fig. 9

Table 11 Seal friction per ball slide (maximum value) Unit: N

Series \ Size	17	21	27	35	50
LW	6	8	12	16	20

(2) NSK K1™ lubrication unit

Table 12 shows the dimension of linear guides equipped with the NSK K1 lubrication unit.

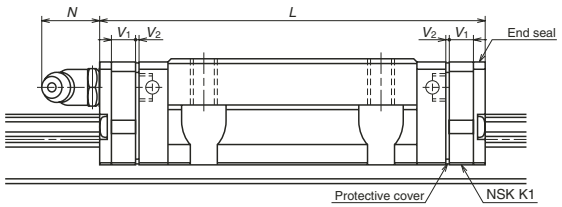


Table 12 Unit: mm

Model No.	Ball slide length	Ball slide model	Standard ball slide length	Ball slide length installed with two NSK K1 *L*	Per NSK K1 thickness V_1	Protective cover thickness V_2	Protruding area of the grease fitting *N*
LW17	Standard	EL	51.4	61.6	4.5	0.6	(5)
LW21	Standard	EL	58.8	71.4	5.5	0.8	(13)
LW27	Standard	EL	74	86.6	5.5	0.8	(13)
LW35	Standard	EL	108	123	6.5	1.0	(13)
LW50	Standard	EL	140.6	155.6	6.5	1.0	(14)

Note: 1) NSK K1 for food and medical equipments are available for the models of LW17 to LW35.
2) Ball slide length equipped with NSK K1 = (Standard ball slide length) + (Thickness of NSK K1, V_1 x Number of NSK K1) + (Thickness of the protective cover, V_2 x 2)

(3) Double seal

Use a double seal set as showing in **Table 13**, when installing an extra seal to completed standard products. (**Fig. 10**)
When installing a grease fitting after the installation of double seals, a connector as showing **Fig.10** is required.

(4) Protector

Use a protector set as showing **Table 14**, when installing a protector to completed standard products. (**Fig.11**)
When installing a grease fitting after the installation of protectors, a connector as showing **Fig.11** is required.

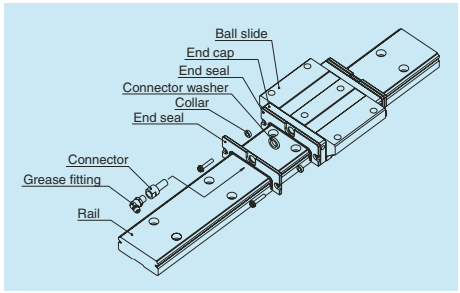


Fig. 10 Double seal

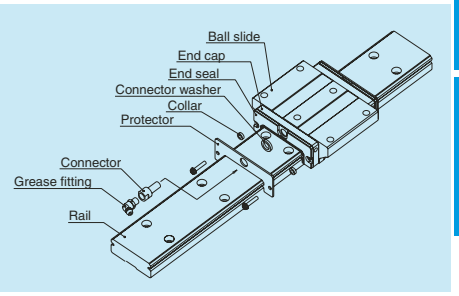


Fig. 11 Protector seal

Table 13 Double-seal set

Model No.	Reference No.		Increased thickness V_3 (mm)
	Without connector	With connector	
LW17	LW17WS-01	*	2.6
LW21	LW21WS-01	LW21WSC-01	2.8
LW27	LW27WS-01	LW27WSC-01	2.5
LW35	LW35WS-01	LW35WSC-01	3
LW50	LW50WS-01	LW50WSC-01	3.6

*) For installation of a connector to a drive-in type grease fitting, contact NSK.

Table 14 Protector set

Model No.	Reference No.		Increased thickness V_4 (mm)
	Without connector	With connector	
LW17	LW17PT-01	*	3.2
LW21	LW21PT-01	LW21PTC-01	3.2
LW27	LW27PT-01	LW27PTC-01	2.9
LW35	LW35PT-01	LW35PTC-01	3.6
LW50	LW50PT-01	LW50PTC-01	4.2

*) For installation of a connector to a drive-in type grease fitting, contact NSK.

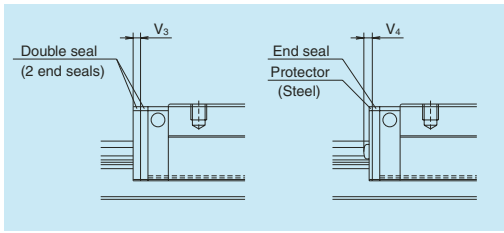


Fig. 12

(5) Cap to plug the rail mounting bolt hole

Table 15 Caps to plug rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
LW17, LW21, LW27	M4	LG-CAP/M4	20
LW35	M6	LG-CAP/M6	20
LW50	M8	LG-CAP/M8	20

(6) Bellows

· Make tap holes to the rail end face to fix the bellows mounting plate. NSK processes tap holes to the rail end face when ordered with a linear guide.

Dimension tables of bellows
LW series

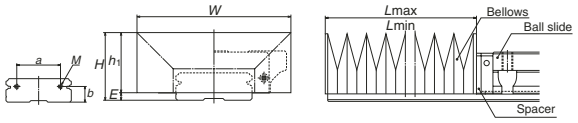


Fig. 13

Bellows reference number

J A W 21 L 08

- Bellows
- A: Bellows for the ends
- B: Middle bellows
- Bellows for LW series
- Size number of linear guide
- N: High type L: Low type
- Number of BL (fold number)

Table 16 Dimensions of bellows

Unit: mm

Model No.	*H*	h_1	*E*	*W*	*P*	*a*	*b*	BL minimum length	Tap (*M*) x depth
JAW17N	25.5	23	2.5	68	15	22	6	17	M3 × 6
JAW21N	29	26	3	75	17	26	7	17	M3 × 6
JAW27N	37	33	4	85	20	28	10	17	M3 × 6
JAW35L	34	30	4	100	14	48	12	17	M4 × 8
JAW35N	41	37		115	20				
JAW50L	46.5	42	4.5	135	20	70	14	17	M4 × 8
JAW50N	56.5	52		160	30				

Table 17 Numbers of folds (BL) and length of bellows

Unit: mm

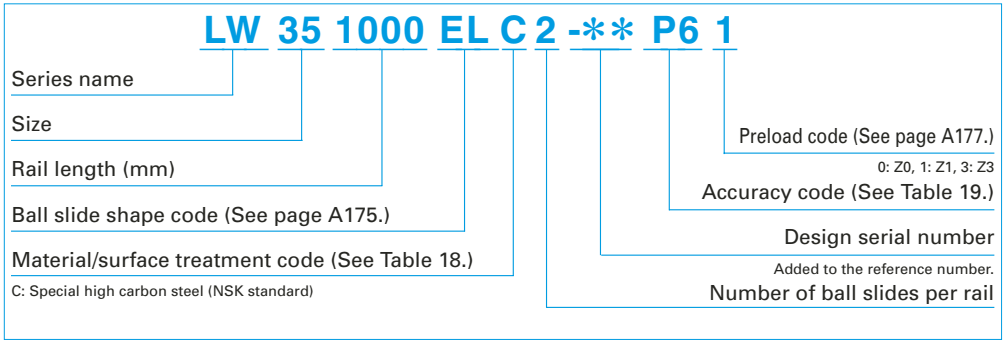
Model No.	Number of BL	2	4	6	8	10	12	14	16	18	20
	*L*min	34	68	102	136	170	204	238	272	306	340
JAW17N	Stroke	176	352	528	704	880	1 056	1 232	1 408	1 584	1 760
	*L*max	210	420	630	840	1 050	1 260	1 470	1 680	1 890	2 100
JAW21N	Stroke	204	408	612	816	1 020	1 224	1 428	1 632	1 836	2 040
	*L*max	238	476	714	952	1 190	1 428	1 666	1 904	2 142	2 380
JAW27N	Stroke	246	492	738	984	1 230	1 476	1 722	1 968	2 214	2 460
	*L*max	280	560	840	1 120	1 400	1 680	1 960	2 240	2 520	2 800
JAW35L	Stroke	162	324	486	648	810	972	1 134	1 296	1 458	1 620
	*L*max	196	392	588	784	980	1 176	1 372	1 568	1 764	1 960
JAW35N	Stroke	218	436	654	872	1 090	1 308	1 526	1 744	1 962	2 180
	*L*max	252	504	756	1 008	1 260	1 512	1 764	2 016	2 268	2 520
JAW50L	Stroke	246	492	738	984	1 230	1 476	1 722	1 968	2 214	2 460
	*L*max	280	560	840	1 120	1 400	1 680	1 960	2 240	2 520	2 800
JAW50N	Stroke	386	772	1 158	1 544	1 930	2 316	2 702	3 088	3 474	3 860
	*L*max	420	840	1 260	1 680	2 100	2 520	2 940	3 360	3 780	4 200

Note: The values of an odd number BL quantity (3, 5, 7, ...) can be obtained by adding two values of even number BL on the both sides, then by dividing the sum by 2.

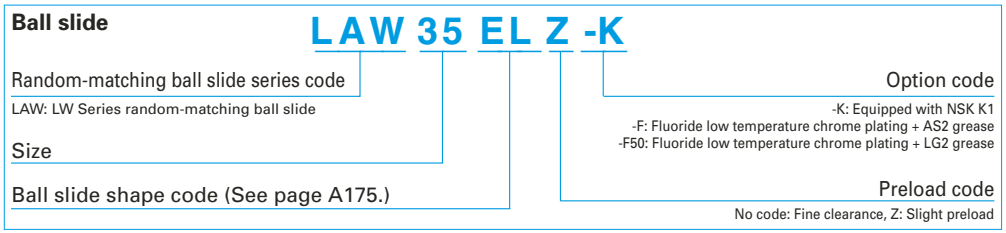
8. Reference number

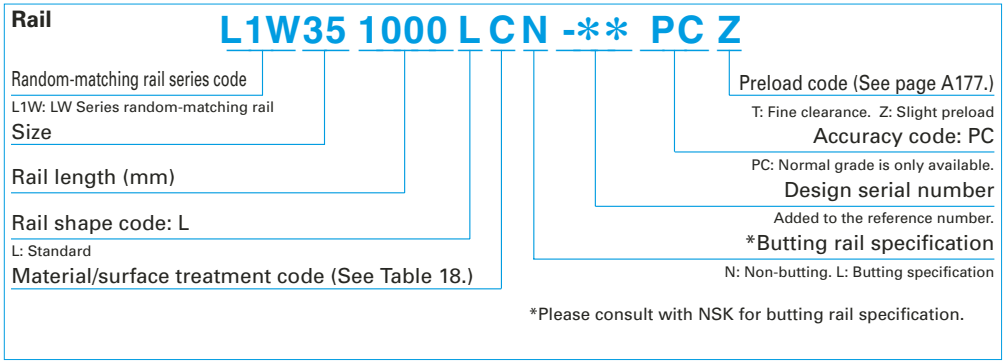
Reference numbers shall be set to individual NSK linear guide when its specifications are finalized, and it is indicated on its specification drawing.
Please specify the reference number, except design serial number, to identify the product when ordering, requiring estimates, or inquiring about specifications from NSK.

(1) Reference number for preloaded assembly



(2) Reference number for random-matching type





The reference number coding for the assembly of random-matching type is the same as that of preloaded assembly. However, only preload codes of "fine clearance T" and "slight preload Z" are available (refer to page A177).

Table 18 Material/surface treatment code

Code	Description
C	Special high carbon steel (NSK standard)
D	Special high carbon steel with surface treatment
Z	Other, special

Table 19 Accuracy code

Accuracy	Standard (Without NSK K1)	With NSK K1	With NSK K1 for food and medical equipment
High precision grade	P5	K5	F5
Precision grade	P6	K6	F6
Normal grade	PN	KN	FN
Normal grade (random-matching type)	PC	KC	FC

Note: Refer to pages A38 and A61 for NSK K1 lubrication unit.

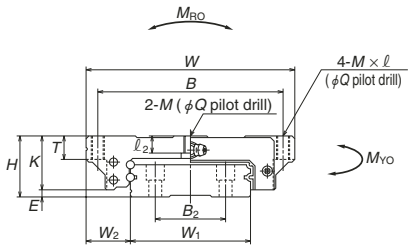
(9) Dimensions

LW-EL

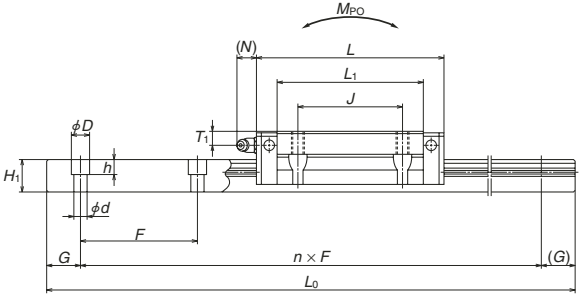
LW 35 1000 EL C 2 - PC Z**

- Series name: LW
- Size: 35
- Rail length (mm): 1000
- Ball slide shape code (See page A175.): EL
- Material/surface treatment code (See Table 18.): C
  - C: Special high carbon steel (NSK standard)
- Number of ball slides per rail: 2
- Design serial number: -** (Added to the reference number.)
- Accuracy code (See Table 19.): PC
- Preload code (See page A177.): Z
  - 0: Z0, 1: Z1, 3: Z3, T: ZT, Z: ZZ

Front view



Side view

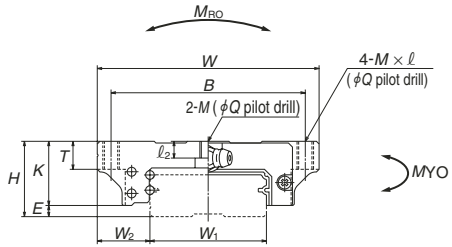


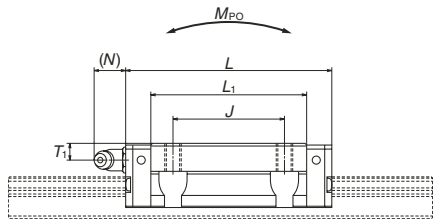
Model No.	Assembly			Ball slide												Rail	
	Height			Width	Length	Mounting hole								Grease fitting			Width	Height
	H	E	W_2	W	L	B	J	$M \times$ pitch $\times \ell$	ℓ_2	Q	L_1	K	T	Hole size	T_1	N	W_1	H_1
LW17EL	17	2.5	13.5	60	51.4	53	26	M4×0.7×6	3.2	3.3	35	14.5	6	φ3	4	3	33	8.7
LW21EL	21	3	15.5	68	58.8	60	29	M5×0.8×8	3.7	4.4	41	18	8	M6×0.75	4.5	11	37	10.5
LW27EL	27	4	19	80	74	70	40	M6×1×10	6	5.3	56	23	10	M6×0.75	6	11	42	15
LW35EL	35	4	25.5	120	108	107	60	M8×1.25×14	9	6.8	84	31	14	M6×0.75	8	11	69	19
LW50EL	50	4.5	36	162	140.6	144	80	M10×1.5×18	14	8.6	108	45.5	18	Rc1/8	14	14	90	24

Reference number for ball slide of random-matching type

LAW 35 EL Z -K

- Random-matching ball slide series code: LAW
  - LAW: LW Series random-matching ball slide
- Size: 35
- Ball slide shape code (See page A175.): EL
- Option code: -K
  - -K: Equipped with NSK K1
  - -F: Fluoride low temperature chrome plating + AS2 grease
  - -F50: Fluoride low temperature chrome plating + LG2 grease
- Preload code: Z
  - No code: Fine clearance, Z: Slight preload



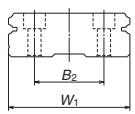


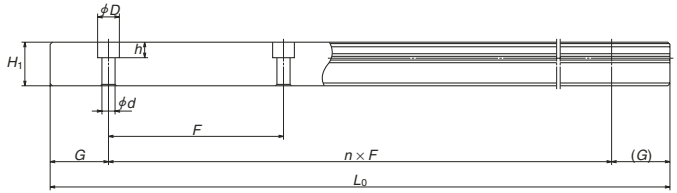
Reference number for rail of random-matching type

Rail **L1W35 1000 L C N -** PC Z**

- Random-matching rail series code: L1W
  - L1W: LW Series random-matching rail
- Size: 35
- Rail length (mm): 1000
- Rail shape code: L
  - L: Standard
- Material/surface treatment code (See Table 18.): C
- *Butting rail specification: N
  - N: Non-butting. L: Butting specification
- Design serial number: -** (Added to the reference number.)
- Accuracy code: PC
  - PC: Normal grade is only available.
- Preload code (See page A177.): Z
  - T: Fine clearance. Z: Slight preload

*Please consult with NSK for butting rail specification.





Unit: mm

Rail					Basic load rating							Weight	
Pitch	Mounting bolt hole	G	Max. length $L_{0max.}$ ( ) for stainless	1) Dynamic		Static	Static moment (N·m)					Ball slide	Rail
				[50km]	[100km]	C_0	M_{RO}	M_{PO}		M_{YO}			
B_2	F	$d \times D \times h$	(reference)		C_{50}(N)	C_{100}(N)	(N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
18	40	4.5×7.5×5.3	15	1 000	5 600	4 450	11 300	135	44	288	37	242	0.2	2.1
22	50	4.5×7.5×5.3	15	1 600	6 450	5 150	13 900	185	65.5	400	55	335	0.3	2.9
24	60	4.5×7.5×5.3	20	2 000	12 800	10 200	26 900	400	171	970	143	815	0.5	4.7
40	80	7×11×9	20	2 000	33 000	26 400	66 500	1 690	645	3 550	545	2 990	1.5	9.6
60	80	9×14×12	20	2 000	61 500	48 500	117 000	3 900	1 530	8 200	1 280	6 900	4.0	15.8

Note: The basic load rating comply with the ISO standard. (ISO 14728-1, 14728-2)
C_{50}: the basic dynamic load rating for 50 km rated fatigue life C_{100}: the basic dynamic load rating for 100 km rated fatigue life

A-5-2 Liquid Crystal Display and Semiconductor

A-5-2.1 PU Series (Miniature type)

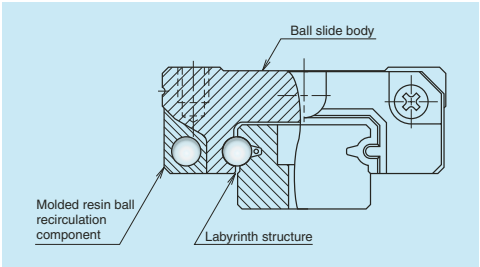


Fig. 1

1. Features

(1) Motion performance

Newly designed recirculation component facilitates smooth circulation of steel balls.

(2) Lightweight

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

(3) Reduced noise intensity

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

(4) Low dust generation

The structure is designed to prevent dust generation.

(5) Excellent dust-proofing

It is designed to minimize the clearance between the side of rails and the inner walls of the slide, and prevent foreign matters from entering the ball slide.

(6) High corrosion resistance

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

(7) Easy to handle

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

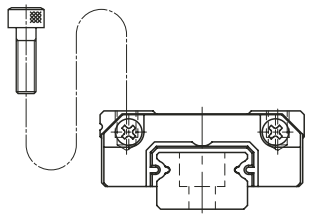
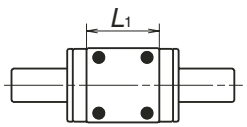
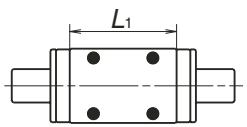
(8) Long-term maintenance-free

Superb features of NSK K1 Lubrication unit realize a long-term, maintenance-free operation.

(9) Fast delivery

Lineup of random-matching rails and ball slides facilitates fast delivery. (PU09 to PU15)

2. Ball slide shape

Ball slide Model	Shape/installation method	Type (Upper row, Rating: Lower row, Ball slide length)	
		Standard type	High-load type
		Standard	Long
AR TR AL UR BL BR		TR, AR, AL 	UR, BL, BR 

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

Rail length (mm) over	or less	Preloaded assembly type (not random matching) Super precision P4	High precision P5	Precision grade P6	Normal grade PN	Random-matching type Normal grade PC
–	50	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

(2) Accuracy standard

The preloaded assembly has four accuracy grades; Super precision P4, High precision P5, Precision grade P6, and normal grade PN, while the random-matching type has Normal grade PC only.

Table 2 shows the accuracy standard for the preloaded assembly type while **Table 3** shows the accuracy standard for the random-matching types.

• Tolerance of preloaded assembly

Table 2 Unit: μm

Characteristics \ Accuracy grade	Super precision P4	High precision P5	Precision grade P6	Normal grade PN
Mounting height *H* Variation of *H* (All ball slides on a set of rails)	±10 5	±15 7	±20 15	±40 25
Mounting width W_2 or W_3 Variation of W_2 or W_3 (All ball slides on reference rail)	±15 7	±20 10	±30 20	±50 30
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	Shown in **Table 1** and **Fig. 2**			

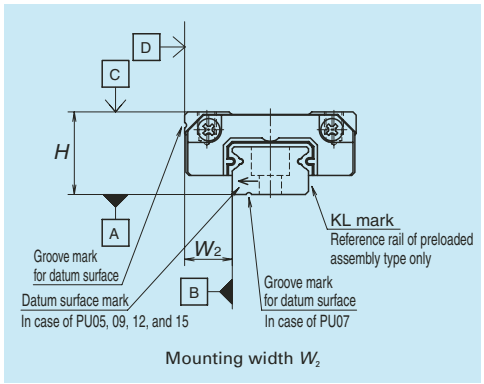
• Tolerance of random-matching type: Normal grade PC

Table 3 Unit: μm

Characteristics \ Model No.	PU09, 12 and 15
Mounting height *H*	±20
Variation of mounting height *H*	15① 30②
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 Running parallelism of surface D to surface B	Shown in **Table 1** and **Fig. 2**

Notes: ① Variation on the same rail ② Variation on multiple rails

(3) Assembled accuracy



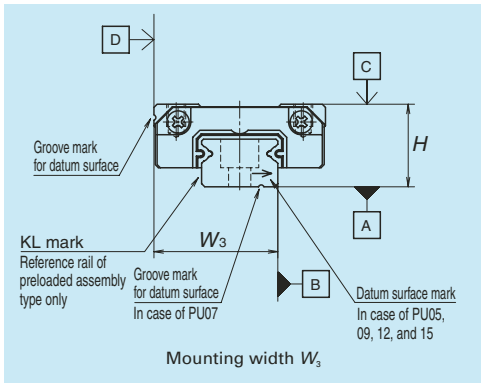


Fig. 2

Note: Please refer to page A67 for marks on the datum surfaces.

(4) Preload and rigidity

We offer three levels of preload: Slight preload Z1 and Fine clearance Z0 for preloaded assembly type, along with Fine clearance ZT for random-matching type. Values for preload and rigidity of the preloaded assembly type are shown in **Table 4**. Rigidities are for the median of the preload range.

• Preload and rigidity of preloaded assembly

Table 4

	Model No.	Preload (N)	Rigidity (N/μm)
		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

Note: Clearance of Fine clearance Z0 is 0 to 3 μm. Therefore, preload is zero.

• Clearance of random-matching type

Table 5 Unit: μm

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

4. Maximum rail length

Table 6 shows the limitations of rail length (maximum length). However, the limitations vary by accuracy grade.

Table 6 Length limitations of rails

Unit: mm

Series	Material \ Size	05	07	09	12	15
PU	Stainless steel	210	375	600	800	1 000

Note: Rails can be butted if user requirement exceeds the rail length shown in the table. Please consult NSK.

5. Installation

(1) Permissible values of mounting error

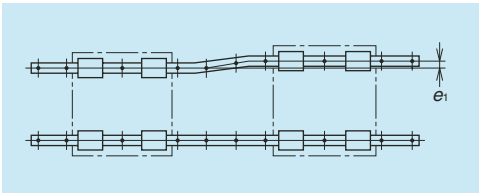


Fig. 3

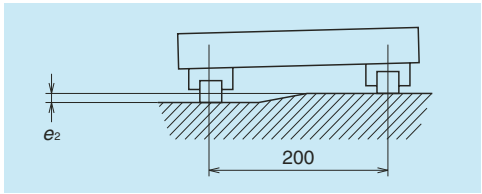


Fig. 4

Table 7

Unit: μm

Value	Preload	Model No.				
		PU05	PU07	PU09	PU12	PU15
Permissible values of parallelism in two rails e_1	Z0, ZT	10	12	15	20	25
	Z1	7	10	13	15	21
Permissible values of parallelism (height) in two rails e_2	Z0, ZT	150 μm/200 mm				
	Z1	90 μm/200 mm				

(2) Shoulder height of the mounting surface and corner radius r

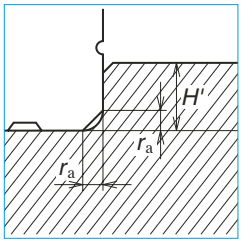


Fig. 5 Shoulder for the rail datum surface

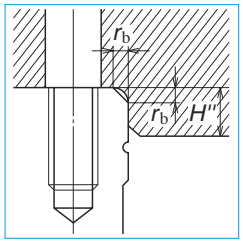


Fig. 6 Shoulder for the ball slide datum surface

Table 8

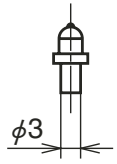
Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H′	H″*
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

*) H″ is the minimum recommended value based on the dimension T in dimension table.

6. Lubrication accessory

Model of PU15 can select drive-in type grease fitting as an option.
For the models of PU05 to PU12, apply grease directly to the ball grooves of rail using a point nozzle.



Drive-in type

7. Dust-proof components

(1) Standard specification

An end seal provided to both ends of a ball slide as a standard feature.
Seal friction per standard ball slide is shown in **Table 9**.

Table 9 Seal friction per ball slide (maximum value)

Unit: N

Series \ Size	05	07	09	12	15
PU	0.3	0.3	0.5	0.5	0.5

(2) NSK K1™ lubrication unit

Table 10 shows the dimension of linear guides equipped with the NSK K1 lubrication unit.

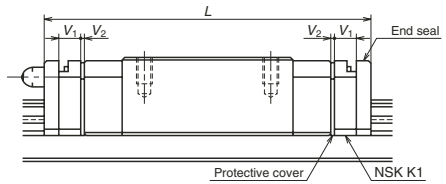


Table 10

Unit: mm

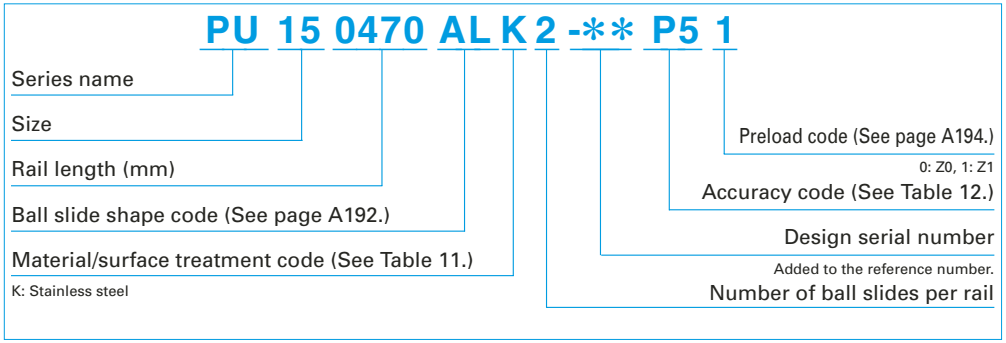
Model No.	Ball slide length	Ball slide model	Standard ball slide length	Ball slide length equipped with two NSK K1 L	Thickness of NSK K1, V_1	Thickness of protective cover, V_2
PU05	Standard	TR	19.4	24.4	2	0.5
PU07	Standard	AR	23.4	29.4	2.5	0.5
PU09	Standard	TR	30	36.4	2.7	0.5
	Long	UR	41	47.4		
PU12	Standard	TR	35	42	3	0.5
	Long	UR	48.7	55.7		
PU15	Standard	AL	43	51.2	3.5	0.6
	Long	BL	61	69.2		

Note: Ball slide length equipped with NSK K1 =
(Standard ball slide length) + (Thickness of NSK K1, V_1 × Number of NSK K1) +
(Thickness of the protective cover V_2 × 2)

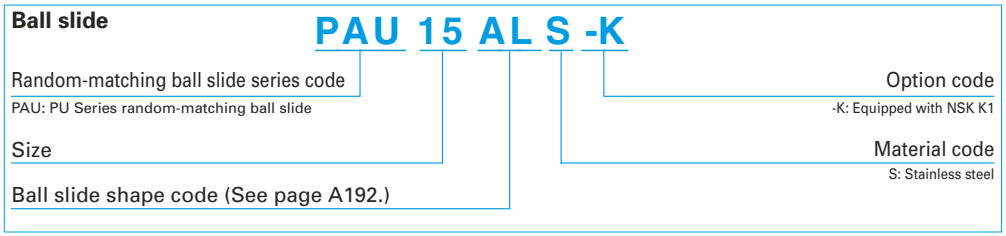
8. Reference number

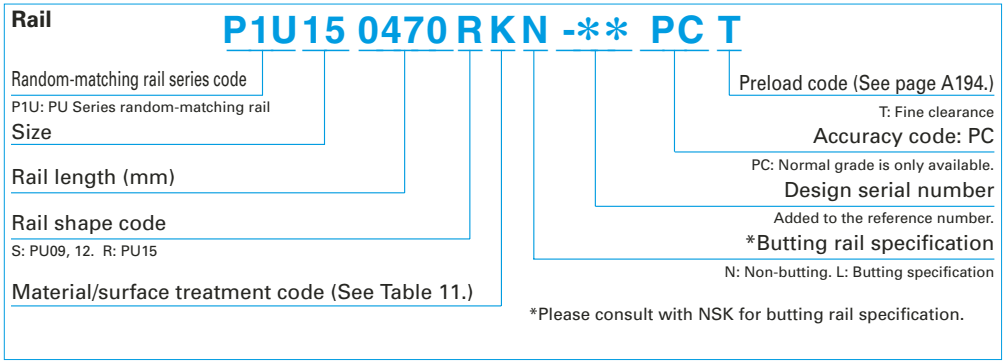
Reference numbers shall be set to individual NSK linear guide when its specifications are finalized, and it is indicated on its specification drawing.
Please specify the reference number, except design serial number, to identify the product when ordering, requiring estimates, or inquiring about specifications from NSK.

(1) Reference number for preloaded assembly



(2) Reference number for random-matching type





The reference number coding for the assembly of random-matching type is the same as that of preloaded assembly. However, only preload code of "fine clearance T" is available (refer to page A194).

Table 11 Material/surface treatment code

Code	Description
K	Stainless steel
H	Stainless steel with surface treatment
Z	Other, special

Table 12 Accuracy code

Accuracy	Standard (Without NSK K1)	With NSK K1	With NSK K1 for food and medical equipment
Super precision grade	P4	K4	F4
High precision grade	P5	K5	F5
Precision grade	P6	K6	F6
Normal grade	PN	KN	FN
Normal grade (random-matching type)	PC	KC	FC

Note: Refer to pages A38 and A61 for the NSK K1 lubrication unit.

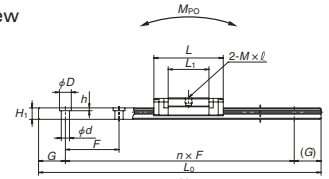
9. Dimensions

PU-TR, AR, AL (Standard type / Standard)
PU-UR, BL (High-load type / Long)

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

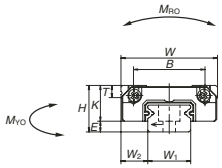
- Series name
- Size
- Rail length (mm)
- Ball slide shape code (See page A192.)
- Material/surface treatment code (See Table 11.)
  K: Stainless steel
- Number of ball slides per rail
- Design serial number
  Added to the reference number.
- Accuracy code (See Table 12.)
- Preload code (See page A194.)
  0: Z0, 1: Z1, T: ZT

Side view

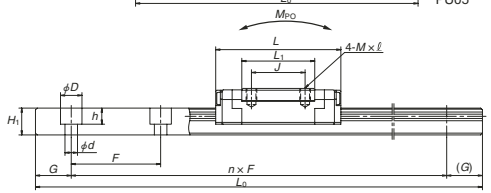


PU05

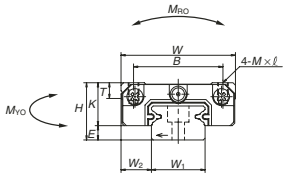
Front view



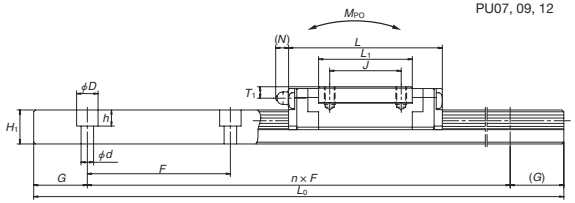
PU05, 07, 09, 12



PU07, 09, 12



PU15



PU15

Unit: mm

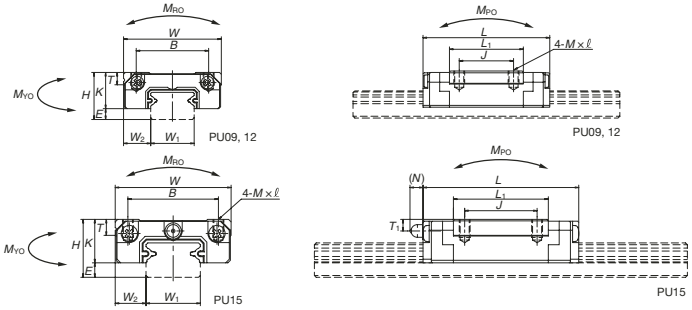
Model No.	Assembly Height H	E	W_2	Ball slide Width W	Length L	Mounting hole B	J	M×pitch×ℓ	L_1	K	T	Oil hole Hole size	T_1	N	Width W_1	Height H_1
PU05TR	6	1	3.5	12	19.4	8	—	M2×0.4×1.5	11.4	5	2.3	φ0.9	1.5	—	5	3.2
PU07AR	8	1.5	5	17	23.4	12	8	M2×0.4×2.4	13.3	6.5	2.45	φ1.5	1.8	—	7	4.7
PU09TR	10	2.2	5.5	20	30	15	10	M3×0.5×3	19.6	7.8	2.6	—	—	—	9	5.5
PU09UR					41		16		30.6							
PU12TR	13	3	7.5	27	35	20	15	M3×0.5×3.5	20.4	10	3.4	—	—	—	12	7.5
PU12UR					48.7		20		34.1							
PU15AL	16	4	8.5	32	43	25	20	M3×0.5×5	26.2	12	4.4	φ3	3.2	(3.6)	15	9.5
PU15BL					61		25		44.2							

Notes: 1) The ball slide of PU05TR has only two mounting tap holes in the center.

Reference number for ball slide of random-matching type

PAU 15 AL S -K

- Random-matching ball slide series code
  PAU: PU Series random-matching ball slide
- Size
- Ball slide shape code (See page A192.)
- Option code
  -K: Equipped with NSK K1
- Material code
  S: Stainless steel

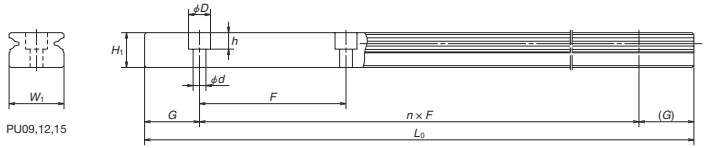


Reference number for rail of random-matching type

Rail P1U15 0470 R K N - ** PC T**

- Random-matching rail series code
  P1U: PU Series random-matching rail
- Size
- Rail length (mm)
- Rail shape code
  S: PU09, 12. R: PU15
- Material/surface treatment code (See Table 11.)
- *Butting rail specification
  N: Non-butting. L: Butting specification
- Design serial number
  Added to the reference number.
- Accuracy code: PC
  PC: Normal grade is only available.
- Preload code (See page A194.)
  T: Fine clearance

*Please consult with NSK for butting rail specification.



Unit: mm

Rail Pitch F	Mounting bolt hole d×D×h	G (reference)	Maximum length L_{0max}	Basic load rating 2) Dynamic [50km] C_{50}(N)	[100km] C_{100}(N)	Static C_0 (N)	Static moment (N·m) M_{RO}	M_{PO} One slide	M_{PO} Two slides	M_{YO} One slide	M_{YO} Two slides	Weight Ball slide (g)	Rail (g/100mm)
15	2.3×3.3×0.8	5	210	520	410	775	2.06	1.28	9.90	1.28	9.90	4	11
15	2.4×4.2×2.3	5	375	1 090	860	1 370	5.20	2.70	21.8	2.70	21.8	8	23
20	3.5×6×4.5	7.5	600	1 490	1 180	2 150	9.90	6.10	41.0	6.10	41.0	16	35
				2 100	1 670	3 500	16.2	15.6	88.0	15.6	88.0	25	
25	3.5×6×4.5	10	800	2 830	2 250	3 500	21.1	11.4	73.5	11.4	73.5	32	65
				4 000	3 150	5 700	34.5	28.3	174	28.3	174	53	
40	3.5×6×4.5	15	1 000	5 550	4 400	6 600	49.5	25.6	190	25.6	190	59	105
				8 100	6 400	11 300	84.5	69.5	435	69.5	435	100	

2) The basic load rating comply with the ISO standard. (ISO 14728-1, 14728-2)
C_{50}: the basic dynamic load rating for 50 km rated fatigue life C_{100}: the basic dynamic load rating for 100 km rated fatigue life
3) To fix rail of PU05TR, use M2 x 0.4 cross-recessed pan head machine screw for precision instrument.
(JCIS 10-70 No. 0 pan head machine screw No.1.)
(JCIS: Japanese Camera Industrial Standard.)

A-5-2.2 LU Series (Miniature type)

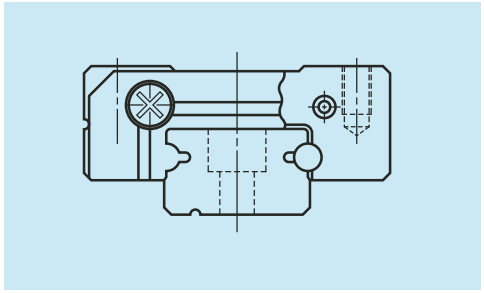


Fig. 1 LU Series

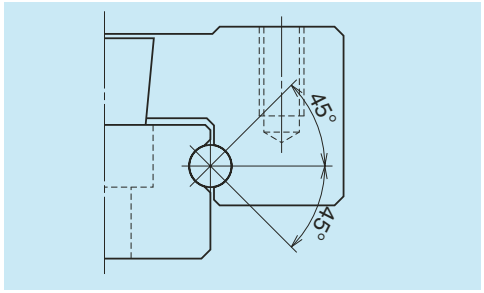


Fig. 2 Balls are in contact.

1. Features

(1) Super-small type

This compact guide owes its design to the single ball groove on both right and left sides (Gothic arch) .

(2) Equal load carrying capacity in vertical and lateral directions

The contact angle is set at 45 degrees, thus facilitating the equal load carrying capacity in vertical and lateral directions. This also provides equal rigidity in both directions.

(3) Stainless steel is also standardized

Items made of the martensitic stainless steel are available as standard.

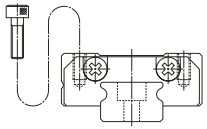
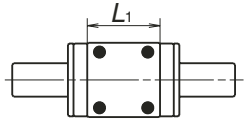
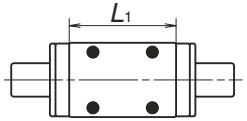
(4) Some series have a ball retainer

Ball slide types AR and TR come with a ball retainer. Balls are retained in the retainer and do not fall out when the ball slide is withdrawn from the rail. (Ball slides of random-matching type as well as LU15 come with ball retainer.)

(5) Fast delivery

Random-matching of rails and ball slides are available. (LU09 to LU15)

2. Ball slide shape

Ball slide Model	Shape/installation method	Type (Upper row, Rating: Lower row, Ball slide length)	
		Standard type	High-load type
		Standard	Long
AL TL AR TR BL UL		AL, TL, TR, AR 	BL, UL 

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

Rail length (mm) over	or less	Preloaded assembly type (not random matching) Super precision P4	High precision P5	Precision grade P6	Normal grade PN	Random-matching type Normal grade PC
–	50	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	1000	5	9	16	18	18
1000	1250	6	10	17	20	20

(2) Accuracy standard

The preloaded assembly type has four accuracy grades; Super precision P4, High precision P5, Precision P6, and Normal grade PN, while the random-matching type has Normal grade PC only.

Table 2 shows the accuracy standard for the preloaded assembly type, while **Table 3** shows the accuracy standard for the random-matching type.

• Tolerance of preloaded assembly

Table 2 Unit: μm

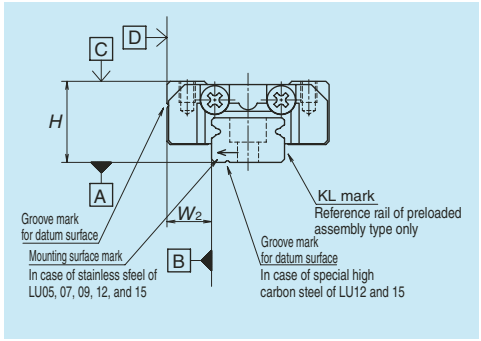
Characteristics \ Accuracy grade	Super precision P4	High precision P5	Precision grade P6	Normal grade PN
Mounting height H Variation of H (All ball slides on a set of rails)	±10 5	±15 7	±20 15	±40 25
Mounting width W_2 or W_3 Variation of W_2 or W_3 (All ball slides on reference rail)	±15 7	±20 10	±30 20	±50 30
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	Refer to **Table 1** and **Fig. 3**			

• Tolerance of random-matching type: Normal grade PC

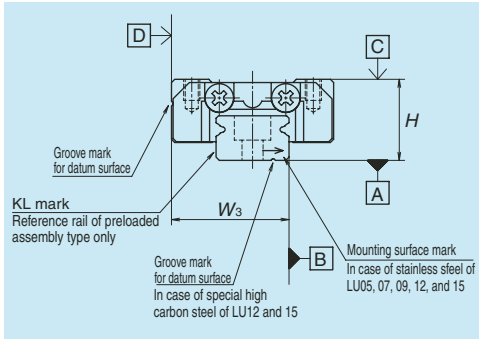
Table 3 Unit: μm

Characteristics \ Accuracy grade	LU09, 12, 15
Mounting height H	±20
Variation of mounting height H	40
Mounting width W_2 or W_3	±20
Variation of mounting width W_2 or W_3	40
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	Refer to **Table 1** and **Fig. 3**

(3) Assembled accuracy



Mounting width W_2



Mounting width W_3

Fig. 3

Note: Please refer to page A67 for marks on the datum surfaces.

(4) Preload and rigidity

We offer three levels of preload: Slight preload Z1 and Fine clearance Z0, along with random-matching type of Fine clearance ZT. Values for preload and rigidity of the preloaded assembly type are shown in **Table 4**. Rigidities are for the median of the preload range.

• Preload and rigidity of preloaded assembly

Table 4

	Model No.	Preload (N) Slight preload (Z1)	Rigidity (N/μm) Slight preload (Z1)
Standard type	LU05 TL	0 – 3	15
	LU07 AL	0 – 8	22
	LU09 AL, TL	0 – 12	26
	LU09 AR, TR	0 – 10	30
	LU12 AL, TL	0 – 17	33
	LU12 AR, TR	0 – 17	33
	LU15 AL	0 – 33	45
High-load type	LU09 BL, UL	0 – 17	43
	LU12 BL, UL	0 – 25	52
	LU15 BL	0 – 51	75

Note: Clearance of Fine clearance Z0 is 0 to 3 μm. Therefore, preload is zero. However, the clearance of the Z0 of PN grade is 3 to 10 μm.

• Clearance of random-matching type

Table 5 Unit: μm

Model No.	Fine clearance ZT
LU09	0 – 15
LU12	
LU15	

4. Maximum rail length

Table 6 shows the limitations of rail length.

However, the limitations vary by accuracy grades.

Table 6 Length limitation of rails Unit: mm

Series	Material \ Size	05	07	09	12	15
LU	Special high carbon steel	–	–	1 200	1 800	2 000
	Stainless steel	210	375	600	800	1 000

Note: Rails can be butted if user requirement exceeds the rail length shown in the table. Please consult NSK.

5. Installation

(1) Permissible values of mounting error

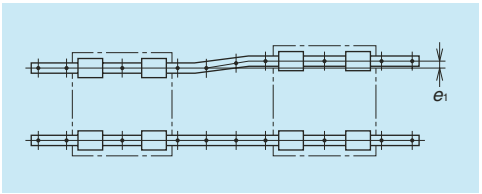


Fig. 4

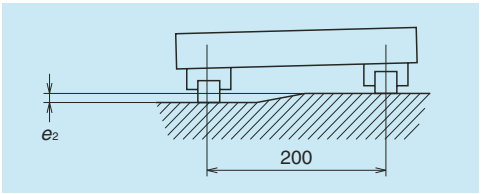


Fig. 5

Table 7

Unit: μm

Value	Preload	Model No.				
		LU05	LU07	LU09	LU12	LU15
Permissible values of parallelism in two rails e_1	Z0, ZT	10	12	15	20	25
	Z1	7	10	13	15	21
Permissible values of parallelism (height) in two rails e_2	Z0, ZT	150 μm/200 mm				
	Z1	90 μm/200 mm				

(2) Shoulder height of the mounting surface and corner radius r

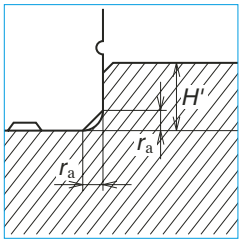


Fig. 6 Shoulder for the rail datum surface

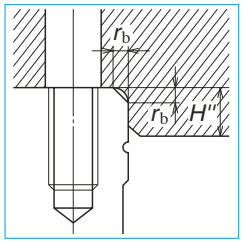


Fig. 7 Shoulder for the ball slide datum surface

Table 8

Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H'	H''
LU05	0.2	0.2	0.7	2
LU07	0.2	0.3	1.2	3
LU09	0.3	0.3	1.9	3
LU12	0.3	0.3	2.5	4
LU15	0.3	0.5	3.5	5

6. Lubrication accessories

There is no standard grease fitting for LU05 to LU15.

For the LU Series, apply grease directly to the ball grooves of rail using a point nozzle.

7. Dust-proof components

(1) Standard specification

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

LU05TL, LU07AL, LU09AL, and LU09TL can install the side seal as an option.

• Seal friction per standard ball slide is shown in **Table 9**.

Table 9 Seal friction per ball slide (maximum value)

Unit: N

Series \ Size	05	07	09	12	15
LU	0.3	0.3	0.5	0.5	0.5

(2) NSK K1™ lubrication unit

The installed dimensions of the NSK K1 lubrication unit are shown in **Table 10**.

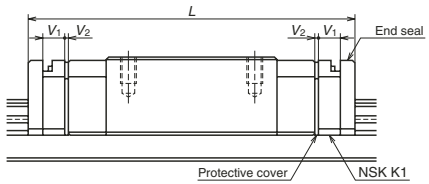


Table 10

Unit: mm

Model No.	Ball slide length	Ball slide model	Standard ball slide length	Ball slide length installed with two NSK K1 *L*	Per NSK K1 thickness V_1	Protective cover thickness V_2
LU05	Standard	TL	18*	24.4	2.0	0.5
LU07	Standard	AL	20.4*	29.4	2.5	0.5
LU09	Standard	AR, TR	30	36.4	2.7	0.5
	Standard	AL, TL	26.8*	34.2		
	Long	BL, UL	41	47.4		
LU12	Standard	AR, TR	35.2	42.2	3.0	0.5
	Standard	AL, TL	34	41		
	Long	BL, UL	47.5	54.5		
LU15	Standard	AL	43.6	51.8	3.5	0.6
	Long	BL	61	69.2		

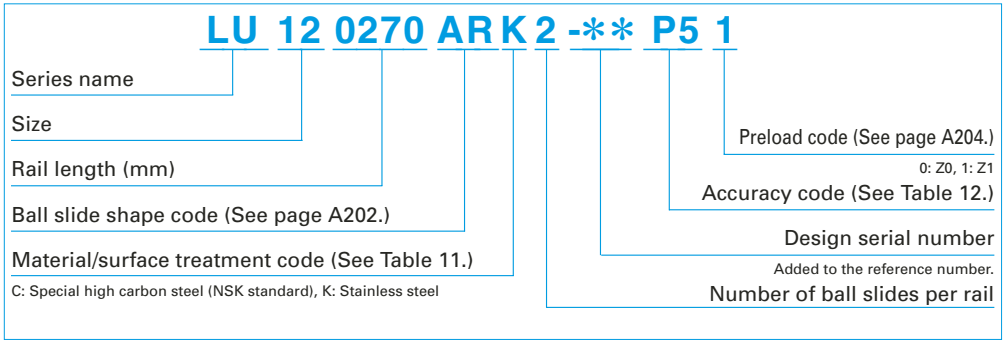
*) Standard ball slide length of LU05TL, LU07AL, LU09AL and LU09TL does not include the thickness of the end seal (1.5 mm). However, it includes the height of the screw head for end cap installation (Included length – LU05, 0.8 mm; LU07, no projection; LU09, 1 mm)

Note: Ball slide length equipped with NSK K1 =
(Standard ball slide length) + (Thickness of NSK K1, V_1 × Number of NSK K1) +
(Thickness of the protective cover V_2 × 2)

8. Reference number

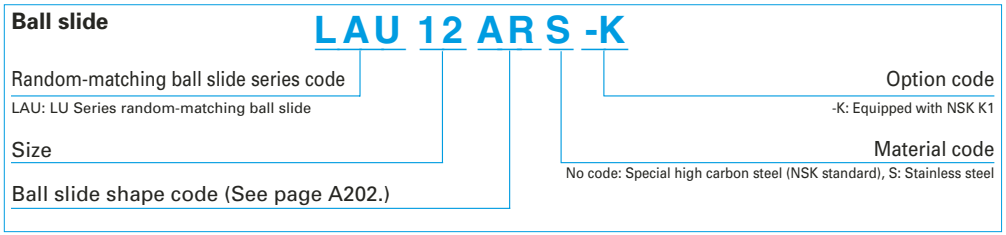
Reference numbers shall be set to individual NSK linear guide when its specifications are finalized, and it is indicated on its specification drawing.
Please specify the reference number, except design serial number, to identify the product when ordering, requiring estimates, or inquiring about specifications from NSK.

(1) Reference number for preloaded assembly

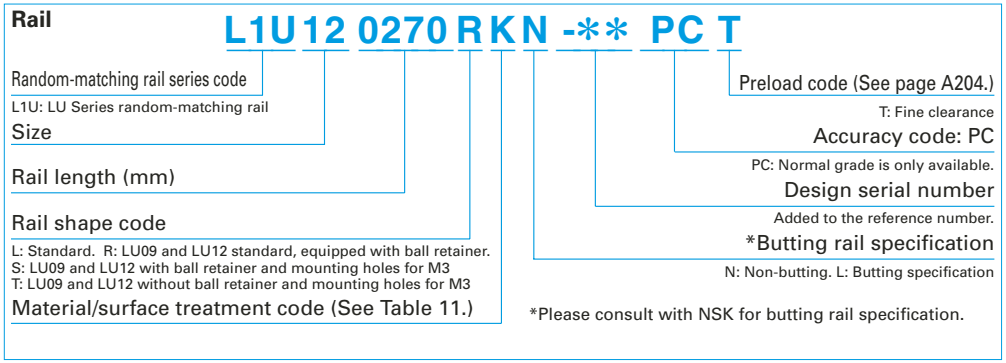


(2) Reference number for random-matching type

Ball slide



Rail



The reference number coding for the assembly of random-matching type is the same as that of the preloaded assembly. However, only the preload code of "Fine clearance T" is available (refer to page A204).

Table 11 Material/surface treatment code

Code	Description
C	Special high carbon steel (NSK standard)
K	Stainless steel
D	Special high carbon steel with surface treatment
H	Stainless steel with surface treatment
Z	Other, special

Table 12 Accuracy code

Accuracy	Standard (Without NSK K1)	With NSK K1
Super precision grade	P4	K4
High precision grade	P5	K5
Precision grade	P6	K6
Normal grade	PN	KN
Normal grade (random-matching type)	PC	KC

Note: Refer to page A38 for NSK K1 lubrication unit.

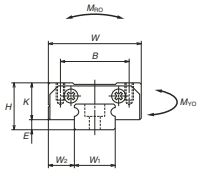
9. Dimensions

LU-AL (Standard type / Standard, LU15 is equipped with ball retainer)
LU-TL (Standard type / Standard, Large mounting hole)
LU-AR (Standard type / Standard, With ball retainer)
LU-TR (Standard type / Standard, Large mounting hole, with ball retainer)

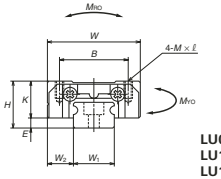
LU 12 0270 AR K 2 - PC T**

- Series name
- Size
- Rail length (mm)
- Ball slide shape code (See page A202.)
- Material/surface treatment code (See Table 11.)
  C: Special high carbon steel (NSK standard), K: Stainless steel
- Number of ball slides per rail
- Design serial number
  Added to the reference number.
- Accuracy code (See Table 12.)
- Preload code (See page A204.)
  0: Z0, 1: Z1, T: ZT

Front view

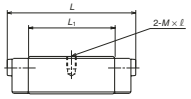


LU05TL, LU07AL
LU09AL, TL

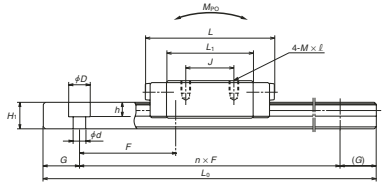


LU09AR, TR
LU12AL, TL, AR, TR
LU15AL

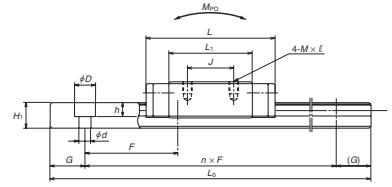
Side view



LU05TL



LU07AL
LU09AL, TL



LU09AR, TR
LU12AL, TL, AR, TR
LU15AL

Model No.	Assembly Height H	E	W_2	Ball slide Width W	Length L	Mounting hole B	J	M × pitch × ℓ	L_1	K	Width W_1	Height H_1	Pitch F
LU05TL	6	1	3.5	12	18	8	—	M2×0.4×1.5	12	5	5	3.2	15
LU07AL	8	1.5	5	17	20.4	12	8	M2×0.4×2.4	13.6	6.5	7	4.7	15
LU09AL **LU09TL**	10	2.2	5.5	20	26.8	15	13 10	M2×0.4×2.5 M3×0.5×3	18	7.8	9	5.5	20
LU09AR **LU09TR**	10	2.2	5.5	20	30	15	13 10	M2×0.4×2.5 M3×0.5×3	20	7.8	9	5.5	20
LU12AL **LU12TL**	13	3	7.5	27	34	20	15	M2.5×0.45×3 M3×0.5×3.5	21.8	10	12	7.5	25
LU12AR **LU12TR**	13	3	7.5	27	35.2	20	15	M2.5×0.45×3 M3×0.5×3.5	21.8	10	12	7.5	25
LU15AL	16	4	8.5	32	43.6	25	20	M3×0.5×4	27	12	15	9.5	40

Notes 1) LU05TL, LU07AL, LU09TL, LU09AR, LU09TR, LU12AR and LU12TR come in stainless steel only.
2) Ball slide of LU05TL has only two mounting tap holes in the center.
3) End seals of LU05TL, LU07AL, LU09AL and LU09TL are available on request.

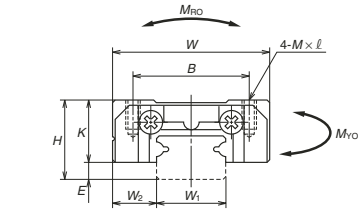
Reference number for ball slide of random-matching type

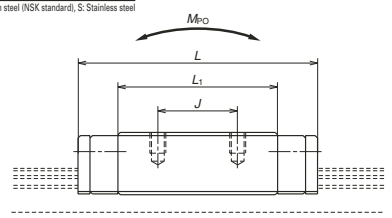
Random matching with retainer: LU09 - 12 are AR/TR, LU15 is AL.

LAU-AR (With ball retainer)
LAU-TR (Large mounting hole, with ball retainer)
LAU-AL (LU15 is equipped with ball retainer)

LAU 12 AR S -K

- Random-matching ball slide series code
  LAU: LU Series random-matching ball slide
- Size
- Ball slide shape code (See page A202.)
- Material code
  No code: Special high carbon steel (NSK standard), S: Stainless steel
- Option code
  -K: Equipped with NSK K1



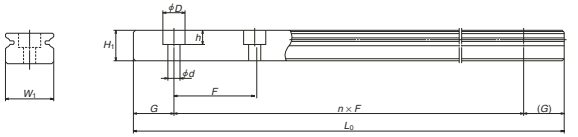


Reference number for rail of random-matching type

L1U 12 0270 R K N - PC T**

- Random-matching rail series code
  L1U: LU Series random-matching rail
- Size
- Rail length (mm)
- Rail shape code
  L: Standard. R:LU09 and LU12 standard equipped with ball retainer.
  S: LU09 and LU12 with ball retainer and mounting holes for M3
  T: LU09 and LU12 without ball retainer and mounting holes for M3
- Material/surface treatment code (See Table 11.)
- *Butting rail specification
  N: Non-butting. L: Butting specification
- Design serial number
  Added to the reference number.
- Accuracy code: PC
  PC: Normal grade is only available.
- Preload code (See page A204.)
  T: Fine clearance

*Please consult with NSK for butting rail specification.



Unit: mm

Rail Mounting bolt hole d × D × h	G (reference)	Max. length L_{0max}. ( ) for stainless	Basic load rating 5)Dynamic [50km] C_{50}(N)	[100km] C_{100}(N)	Static C_0 (N)	Static moment (N·m) M_{RO}	M_{PO} One slide	M_{PO} Two slides	M_{YO} One slide	M_{YO} Two slides	Weight Ball slide (g)	Rail (g/100 mm)
2.3×3.3×1.5	5	— (210)	545	435	740	1.93	1.22	8.85	1.22	8.85	4	11
2.4×4.2×2.3	5	— (375)	1 090	865	1 370	4.90	2.66	18.6	2.66	18.6	10	23
2.6×4.5×3 3.5×6×4.5	7.5	1 200 (600)	1 760	1 400	2 220	10.2	6.10	38.5	6.10	38.5	17	35
2.6×4.5×3 3.5×6×4.5	7.5	— (600)	1 490	1 180	2 150	9.9	6.10	41.0	6.10	41.0	19	35
3×5.5×3.5 3.5×6×4.5	10	1 800 (800)	2 830	2 250	3 500	21.1	11.4	78.5	11.4	78.5	38	65
3×5.5×3.5 3.5×6×4.5	10	— (800)	2 830	2 250	3 500	21.1	11.4	81.5	11.4	81.5	38	65
3.5×6×4.5	15	2 000 (1 000)	5 550	4 400	6 600	49.5	25.6	193	25.6	193	70	105

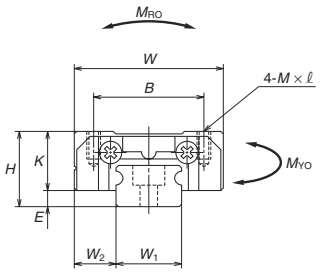
4) To fix rail of LU05TL, use M2 × 0.4 cross-recessed pan head machine screw for precision instrument.
(JCIS 10-70 No. 0 pan head machine screw No.1.)
(JCIS: Japanese Camera Industrial Standard.)
5) The basic load rating comply with the ISO standard. (ISO 14728-1, 14728-2)
C_{50}: the basic dynamic load rating for 50 km rated fatigue life C_{100}: the basic dynamic load rating for 100 km rated fatigue life

LU-BL (High-load type / Long)
LU-UL (High-load type / Long, large mounting hole)

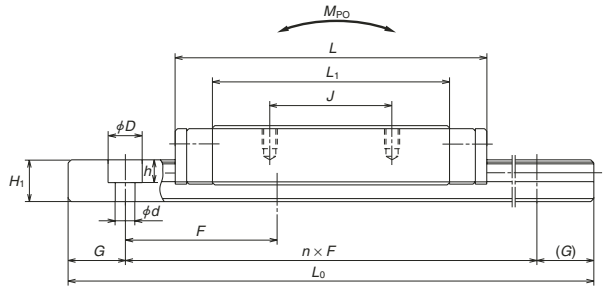
LU 12 0270 BL K 2 - ** P5 1**

- Series name
- Size
- Rail length (mm)
- Ball slide shape code (See page A202.)
- Material/surface treatment code (See Table 11.)
  C: Special high carbon steel (NSK standard), K: Stainless steel
- Number of ball slides per rail
- Design serial number
  Added to the reference number.
- Accuracy code (See Table 12.)
- Preload code (See page A204.)
  0: Z0, 1: Z1

Front view



Side view



Unit: mm

Model No.	Assembly Height H	Assembly E	Assembly W_2	Ball slide Width W	Ball slide Length L	Ball slide Mounting hole B	Ball slide Mounting hole J	Ball slide Mounting hole M × pitch × ℓ	L_1	K	Width W_1	Height H_1	Pitch F
LU09BL	10	2.2	5.5	20	41	15	16	M2×0.4×2.5	31.2	7.8	9	5.5	20
LU09UL								M3×0.5×3					
LU12BL	13	3	7.5	27	47.5	20	20	M2.5×0.45×3	35.3	10	12	7.5	25
LU12UL								M3×0.5×3.5					
LU15BL	16	4	8.5	32	61	25	25	M3×0.5×4	44.4	12	15	9.5	40

Notes 1) LU09UL is available only in stainless steel.
2) LU15BL is equipped with ball retainer.

Rail Mounting bolt hole d × D × h	G (reference)	Max. length $L_{0max.}$ ( ) for stainless	Basic load rating [3]Dynamic [50km] C_{50}(N)	[100km] C_{100}(N)	Static C_0 (N)	Static moment (N·m) M_{RO}	M_{PO} One slide	M_{PO} Two slides	M_{YO} One slide	M_{YO} Two slides	Weight Ball slide (g)	Rail (g/100 mm)
2.6×4.5×3	7.5	1 200 (600)	2 600	2 070	3 900	17.9	17.2	98.0	17.2	98.0	29	35
3.5×6×4.5												
3×5.5×3.5	10	1 800 (800)	4 000	3 150	5 700	34.5	28.3	169	28.3	169	59	65
3.5×6×4.5												
3.5×6×4.5	15	2 000 (1 000)	8 100	6 400	11 300	84.5	69.5	435	69.5	435	107	105

3) The basic load rating comply with the ISO standard. (ISO 14728-1, 14728-2)
C_{50}; the basic dynamic load rating for 50 km rated fatigue life C_{100}; the basic dynamic load rating for 100 km rated fatigue life

A-5-2.3 PE Series (Miniature wide type)

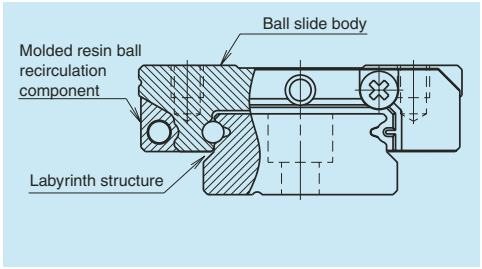


Fig. 1

1. Features

(1) Ideal for use of single rail

The PE Series linear guides are miniature and wide rail type. Thanks to the wide rail, load carrying capacity is high against moment load from rolling direction.

(2) Motion performance

Newly designed recirculation component facilitates smooth circulation of steel balls.

(3) Lightweight

The ball slide is fabricated to be approximately 20% lighter than that of the LE Series by the application of resin to a part of its body.

(4) Reduced noise intensity

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

(5) Low dust generation

The structure is designed to prevent dust generation.

(6) Excellent dust-proofing

It is designed to minimize the clearance between the side of rails and the inner walls of the slide, and prevent foreign matters from entering the ball slide.

(7) High corrosion resistance

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

(8) Easy to handle

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

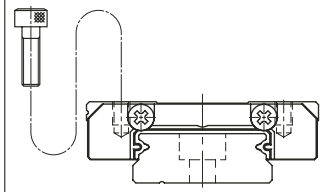
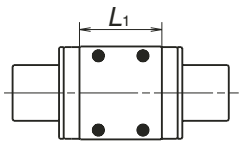
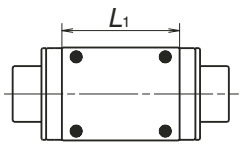
(9) Long-term maintenance-free

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

(10) Fast delivery

Lineup of random-matching rails and ball slides in the series supports random matching and facilitates fast delivery. (PE09 to PE15)

2. Ball slide shape

Ball slide Model	Shape/installation method	Type (Upper row, Rating: Lower row, Ball slide length)	
		Standard type	High-load type
		Standard	Long
AR TR UR BR		AR, TR 	UR, BR 

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

Rail length (mm) over	or less	Preloaded assembly type (not random matching) Super precision P4	High precision P5	Precision grade P6	Normal grade PN	Random-matching type Normal grade PC
–	50	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

(2) Accuracy standard

The preloaded assembly type has four accuracy grades; Super precision P4, High precision P5, Precision P6, and Normal PN grades, while the random-matching type has Normal grade PC only.

Table 2 shows the accuracy standard for the preloaded assembly type while **Table 3** shows the accuracy standard for the random-matching types.

• Tolerance of preloaded assembly

Table 2 Unit: μm

Characteristics \ Accuracy grade	Super precision P4	High precision P5	Precision grade P6	Normal grade PN
Mounting height *H* Variation of *H* (All ball slides on a set of rails)	±10 5	±15 7	±20 15	±40 25
Mounting width W_2 or W_3 Variation of W_2 or W_3 (All ball slides on reference rail)	±15 7	±20 10	±30 20	±50 30
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	Shown in **Table 1** and **Fig. 2**			

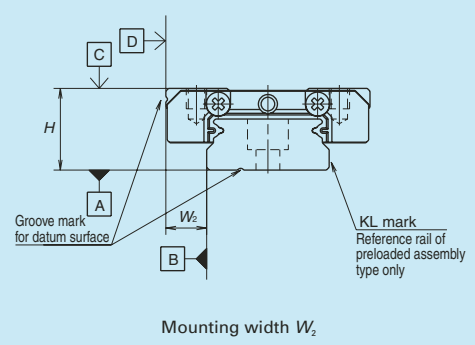
• Tolerance of random-matching type: Normal grade PC

Table 3 Unit: μm

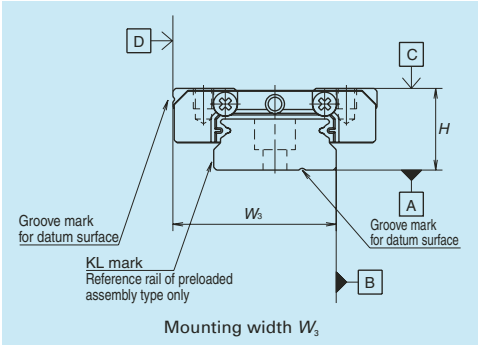
Characteristics \ Model No.	PE09, 12 and 15
Mounting height *H*	±20
Variation of mounting height *H*	15① 30②
Mounting width W_2 or W_3	±20
Variation of mounting width W_2 or W_3	20
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	Shown in **Table 1** and **Fig. 2**

Note: ① Variation on the same rail ② Variation on multiple rails

(3) Assembled accuracy



Mounting width W_2



Mounting width W_3

Fig. 2

(4) Preload and rigidity

We offer three levels of preload: Slight preload Z1 and Fine clearance Z0, along with random-matching type of Fine clearance ZT. Values for preload and rigidity of the preloaded assembly types are shown in **Table 4**. Rigidities are for the median of the preload range.

• Preload and rigidity of preloaded assembly

Table 4

	Model No.	Preload (N)	Rigidity (N/μm)
		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

Note: Clearance of Fine clearance Z0 is 0 to 3 μm. Therefore, preload is zero.

• Clearance of random-matching type

Table 5 Unit: μm

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

4. Maximum rail length

Table 6 shows the limitations of rail length.

However, the limitations vary by accuracy grades.

Table 6 Length limitations of rails

Unit: mm

Series	Material \ Size	05	07	09	12	15
PE	Stainless steel	150	600	800	1 000	1 200

Note: Rails can be butted if user requirement exceeds the rail length shown in the table. Please consult NSK.

5. Installation

(1) Permissible values of mounting error

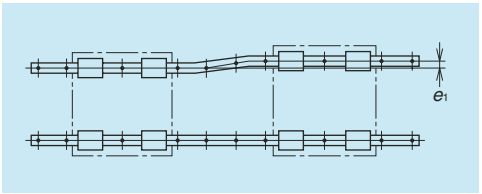


Fig. 3

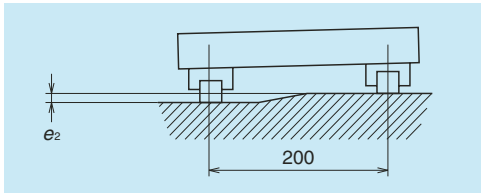


Fig. 4

Table 7 Unit: μm

Value	Preload	Model No.				
		PE05	PE07	PE09	PE12	PE15
Permissible values of parallelism in two rails e_1	Z0, ZT	10	12	15	18	22
	Z1	5	7	10	13	17
Permissible values of parallelism (height) in two rails e_2	Z0, ZT	50 μm/200 mm				
	Z1	35 μm/200 mm				

(2) Shoulder height of the mounting surface and corner radius r

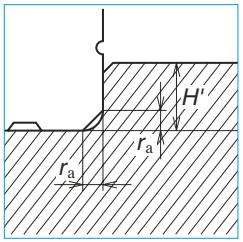


Fig. 5 Shoulder for the rail datum surface

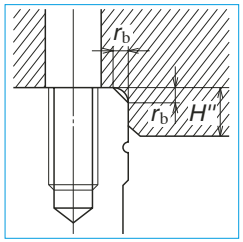


Fig. 6 Shoulder for the ball slide datum surface

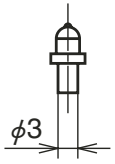
Table 8 Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H′	H″*
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

*) H″ is the minimum recommended value based on the dimension T in dimension table.

6. Lubrication accessory

Model of PE15 can select drive-in type grease fitting as an option.
For the model of PE05 to PE12, apply grease directly to the ball grooves of rail using a point nozzle.



Drive-in type

7. Dust-proof components

(1) Standard specification

End seal: Provided to both ends of the ball slide as a standard feature.
Seal friction per standard ball slide is shown in **Table 9**.

Table 9 Seal friction per ball slide (maximum value) Unit: N

Series \ Size	05	07	09	12	15
PE	0.4	0.4	0.8	1	1.2

(2) NSK K1™ lubrication unit

Table 10 shows the dimension of linear guides equipped with the NSK K1 lubrication unit.

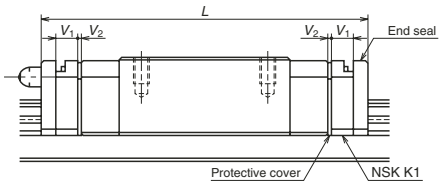


Table 10 Unit: mm

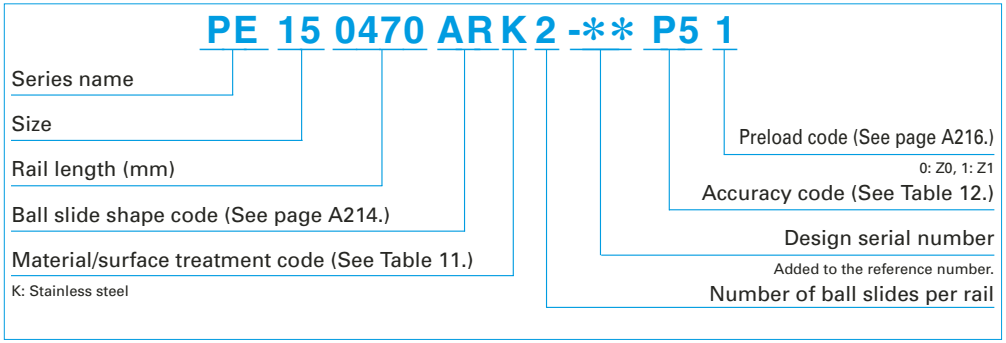
Model No.	Ball slide length	Ball slide model	Standard ball slide length	Ball slide length equipped with two NSK K1 L	Thickness of NSK K1, V_1	Thickness of protective cover, V_2
PE05	Standard	AR	24.1	28.9	2	0.4
PE07	Standard	TR	31.1	37.1	2.5	0.5
PE09	Standard	TR	39.8	46.8	3	0.5
	Long	UR	51.2	58.2		
PE12	Standard	AR	45	53	3.5	0.5
	Long	BR	60	68		
PE15	Standard	AR	56.6	66.2	4	0.8
	Long	BR	76	85.6		

Note: Ball slide length equipped with NSK K1 =
(Standard ball slide length) + (Thickness of NSK K1, V_1 × Number of NSK K1) +
(Thickness of the protective cover V_2 × 2)

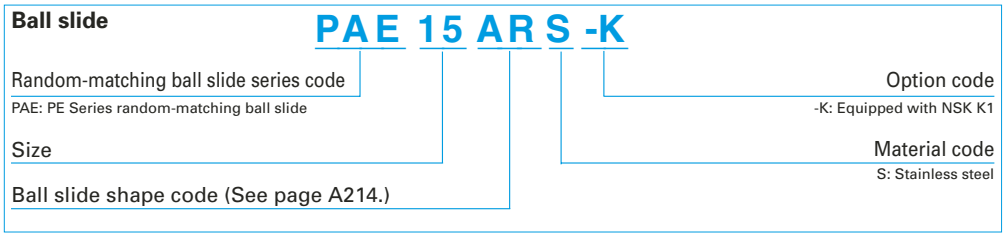
8. Reference number

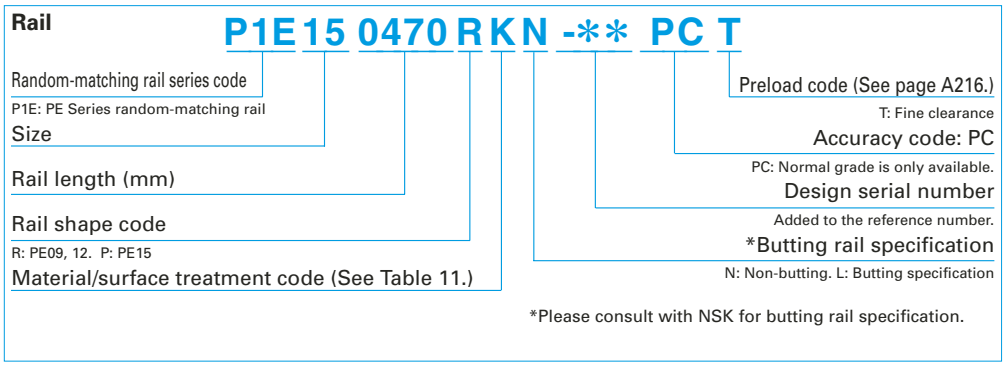
Reference numbers shall be set to individual NSK linear guide when its specifications are finalized, and it is indicated on its specification drawing.
Please specify the reference number, except design serial number, to identify the product when ordering, requiring estimates, or inquiring about specifications from NSK.

(1) Reference number for preloaded assembly



(2) Reference number for random-matching type





Reference number coding for the assembly of random-matching type is the same as that of the preloaded assembly. However, only preload code of "Fine clearance T" is available (refer to page A216).

Table 11 Material/surface treatment code

Code	Description
K	Stainless steel
H	Stainless steel with surface treatment
Z	Other, special

Table 12 Accuracy code

Accuracy	Standard (Without NSK K1)	With NSK K1	With NSK K1 for food and medical equipment
Super precision grade	P4	K4	F4
High precision grade	P5	K5	F5
Precision grade	P6	K6	F6
Normal grade	PN	KN	FN
Normal grade (random-matching type)	PC	KC	FC

Note: Refer to pages A38 and A61 for NSK K1 lubrication unit.

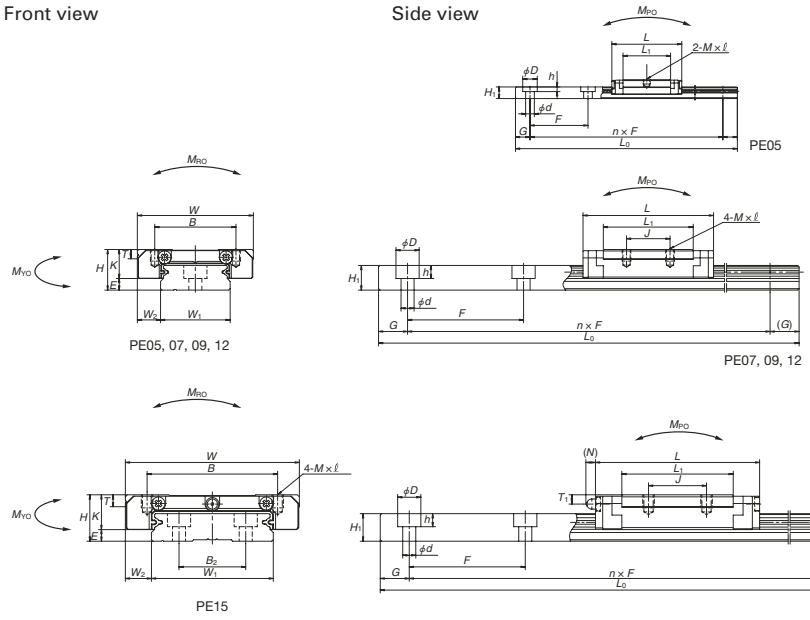
9. Dimensions
PE-AR, TR (Standard type / Standard)
PE-UR, BR (High-load type / Long)

PE 15 0470 AR K 2 - ** PC T**

- Series name
- Size
- Rail length (mm)
- Ball slide shape code (See page A214.)
- Material/surface treatment code (See Table 11.)
  K: Stainless steel
- Number of ball slides per rail
- Design serial number
  Added to the reference number.
- Accuracy code (See Table 12.)
- Preload code (See page A216.)
  0: Z0, 1: Z1, T: ZT

Front view

Side view



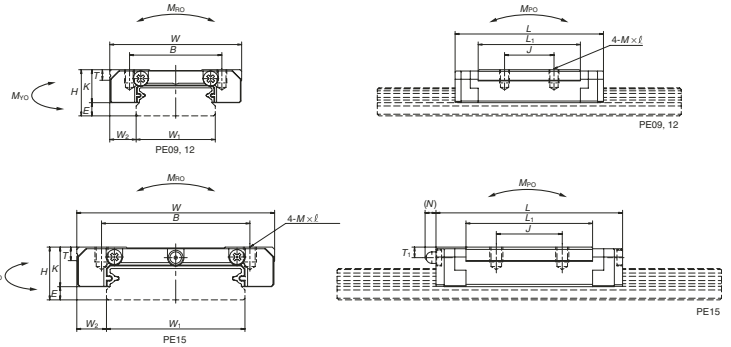
Model No.	Assembly Height H	E	W_2	Ball slide Width W	Length L	Mounting hole B	J	M × pitch × ℓ	L_1	K	T	Oil hole Hole size	T_1	N	Width W_1	Height H_1
PE05AR	6.5	1.4	3.5	17	24.1	13	—	M2.5×0.45×1.5	16.4	5.1	2.5	ϕ0.9	1.3	—	10	4
PE07TR	9	2	5.5	25	31.1	19	10	M3×0.5×2.8	20.8	7	3	ϕ1.9	1.9	—	14	5.2
PE09TR **PE09UR**	12	4	6	30	39.8 51.2	21 23	12 24	M3×0.5×3	26.6 38	8	2.8	ϕ2	2.3	—	18	7.5
PE12AR **PE12BR**	14	4	8	40	45 60	28	15 28	M3×0.5×4	31 46	10	3.2	ϕ2.5	2.7	—	24	8.5
PE15AR **PE15BR**	16	4	9	60	56.6 76	45	20 35	M4×0.7×4.5	38.4 57.8	12	4.1	ϕ3	3.2	(3.3)	42	9.5

Notes: 1) Ball slide of PE05AR has only two mounting tap holes in the center.

Reference number for ball slide of random-matching type

PAE 15 AR S -K

- Random-matching ball slide series code
  PAE: PE Series random-matching ball slide
- Size
- Ball slide shape code (See page A214.)
- Option code
  -K: Equipped with NSK K1
- Material code
  S: Stainless steel

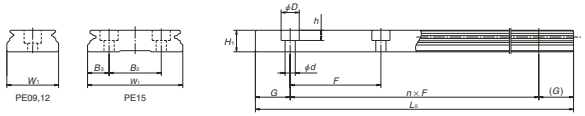


Reference number for rail of random-matching type

P1E 15 0470 R K N - ** PC T**

- Random-matching rail series code
  P1E: PE Series random-matching rail
- Size
- Rail length (mm)
- Rail shape code
  R: PE09, 12. P: PE15
- Material/surface treatment code (See Table 11.)
- *Butting rail specification
  N: Non-butting. L: Butting specification
- Design serial number
  Added to the reference number.
- Accuracy code: PC
  PC: Normal grade is only available.
- Preload code (See page A216.)
  T: Fine clearance

*Please consult with NSK for butting rail specification.



Unit: mm

Rail B_2	Pitch F	Mounting bolt hole d × D × h	G (reference)	Maximum length L_{0max}	Basic load rating [2]Dynamic [50km] C_{50}(N)	[100km] C_{100}(N)	Static C_0 (N)	Static moment (N·m) M_{RO}	M_{PO} One slide	M_{PO} Two slides	M_{YO} One slide	M_{YO} Two slides	Weight Ball slide (g)	Rail (g/100 mm)
—	20	3×5×1.6	7.5	150	690	550	1 160	6.00	2.75	17.5	2.75	17.5	7	34
—	30	3.5×6×3.2	10	600	1 580	1 260	2 350	16.7	7.20	46.0	7.20	46.0	19	55
—	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
—	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
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

2) The basic load rating comply with the ISO standard. (ISO 14728-1, 14728-2)
C_{50}: the basic dynamic load rating for 50 km rated fatigue life
C_{100}: the basic dynamic load rating for 100 km rated fatigue life
3) To fix rail of PE05AR, use M2.5 × 0.45 cross-recessed pan head machine screw for precision instrument. (JCIS 10-70 No. 0 pan head machine screw No.3.)
(JCIS: Japanese Camera Industrial Standard.)

A-5-2.4 LE Series (Miniature wide type)

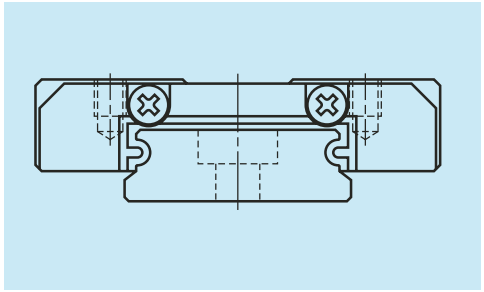


Fig. 1 LE Series

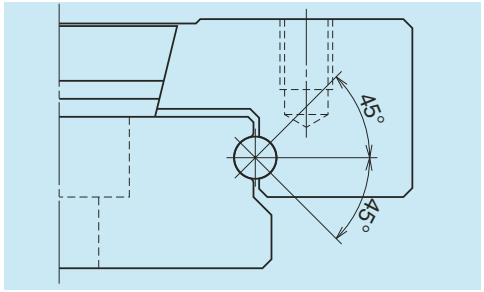


Fig. 2 Balls in contact

1. Features

(1) Ideal for use of single rail

The LE Series linear guides are miniature and wide rail type. Thanks to the wide rail, load carrying capacity is high against moment load from rolling direction.

(2) Equal load carrying capacity in vertical and lateral directions

Contact angle is set at 45 degrees, equally dispersing the load from vertical and lateral directions. This also provides equal rigidity in the two directions.

(3) Guides are super-thin.

Super-thin guides owe their design to the single ball groove on right and left sides (Gothic arch).

(4) High accuracy

Fixing the master rollers to the ball grooves is easy thanks to the Groove arch groove. This makes easy and accurate measuring of ball grooves.

(5) Stainless steel is standard.

Rails and ball slides are made of martensitic stainless steel.

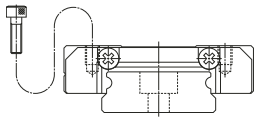
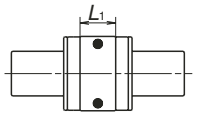
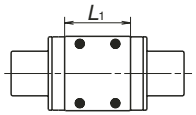
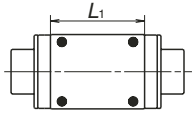
(6) Ball retainer is available in some series.

Some series come with a ball retainer (ball slide shape: AR and TR). Balls are retained in the retainer and do not fall out when a ball slide is withdrawn from the rail (random-maching type ball slides come with a ball retainer).

(7) Fast delivery

Random matching of rails and ball slides are available. (LE09 to LE15)

2. Ball slide shape

Ball slide Model	Shape/installation method	Type (Upper row, Rating: Lower row, Ball slide length)		
		Medium-load type	Standard type	High-load type
		Short	Standard	Long
AL TL AR TR BL UL CL SL		CL, SL 	AL, TL, AR, TR 	BL, UL 

Specification	Detail	Type		
Mounting hole	Normal	CL*	AL, AR	BL*
	Large	SL*	TL, TR	UL*
Ball retainer	Without	CL, SL	AL, TL	BL, UL
	With	—	AR, TR	—

* Only applicable to LE09

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

Rail length (mm) over	or less	Preloaded assembly type (not random matching) High precision P5	Precision grade P6	Normal grade PN	Random-matching type Normal grade PC
–	50	2	4.5	6	6
50 –	80	3	5	6	6
80 –	125	3.5	5.5	6.5	6.5
125 –	200	4	6	7	7
200 –	250	5	7	8	8
250 –	315	5	8	9	9
315 –	400	6	9	11	11
400 –	500	6	10	12	12
500 –	630	7	12	14	14
630 –	800	8	14	16	16
800 –	1 000	9	16	18	18
1 000 –	1 250	10	17	20	20

(2) Accuracy standard

The preloaded assembly type has three accuracy grades; High precision P5, Precision P6, and Normal PN grades, while the random-matching type has Normal grade PC only.

Table 2 shows the accuracy standard for the preloaded assembly type while **Table 3** shows the accuracy standard for the random-matching type.

• Tolerance of preloaded assembly

Table 2 Unit: μm

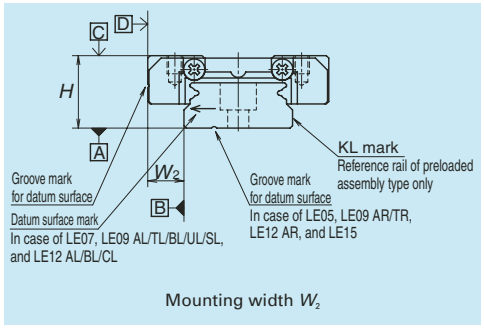
Characteristics \ Accuracy grade	High precision P5	Precision grade P6	Normal grade PN
Mounting height H Variation of H (All ball slides on a set of rails)	±15 7	±20 15	±40 25
Mounting width W_2 or W_3 Variation of W_2 or W_3 (All ball slides on reference rail)	±20 10	±30 20	±50 30
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	Refer to **Table 1** and **Fig. 3**		

• Tolerance of random-matching type: Normal grade PC

Table 3 Unit: μm

Characteristics \ Accuracy grade	LE09, 12, 15
Mounting height H	±20
Variation of mounting height H	40
Mounting width W_2 or W_3	±20
Variation of mounting width W_2 or W_3	40
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	Refer to **Table 1** and **Fig. 3**

(3) Assembled accuracy



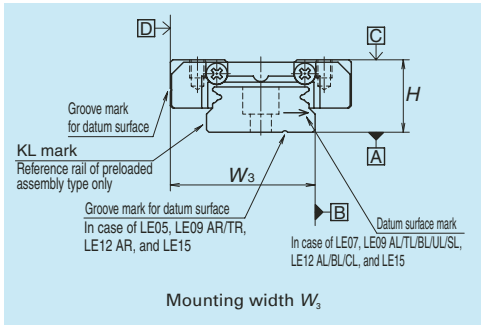


Fig. 3

(4) Preload and rigidity

We offer three levels of preload: Slight preload Z1 and Fine clearance Z0 for the preloaded assembly type, along with Fine clearance ZT for the random-matching type. Values for preload and rigidity of the preloaded assembly type are shown in **Table 4**. Rigidities are for the median of the preload range.

• Preload and rigidity of preloaded assembly

Table 4

	Model No.	Preload (N) Slight preload (Z1)	Rigidity (N/μm) Slight preload (Z1)
Standard type	LE05 AL	0 – 23	36
	LE07 TL	0 – 29	46
	LE09 AL, TL, AR, TR	0 – 37	61
	LE12 AL, AR	0 – 40	63
	LE15 AL, AR	0 – 49	66
Medium-load type	LE05 CL	0 – 18	29
	LE07 SL	0 – 16	28
	LE09 CL, SL	0 – 21	33
	LE12 CL	0 – 23	36
	LE15 CL	0 – 29	44
High-load type	LE07 UL	0 – 43	71
	LE09 BL, UL	0 – 54	86
	LE12 BL	0 – 59	97
	LE15 BL	0 – 75	114

Note: The clearance of Fine clearance Z0 is 0 to 3 μm. Therefore, preload is zero. However, the clearance of the Z0 of PN grade is 3 to 10 μm.

• Clearance of random-matching type

Table 5 Unit: μm

Model No.	Fine clearance ZT
LE09	0 – 15
LE12	
LE15	

4. Maximum rail length

Table 6 shows the limitations of rail length. The limitations vary by accuracy grades.

Table 6 Length limitation of rails Unit: mm

Series	Size / Material	05	07	09	12	15
LE	Stainless steel	150	600	800	1 000	1 200

Note: Rails can be butted if user requirement exceeds the rail length shown in the table. Please consult NSK.

5. Installation

(1) Permissible values of mounting error

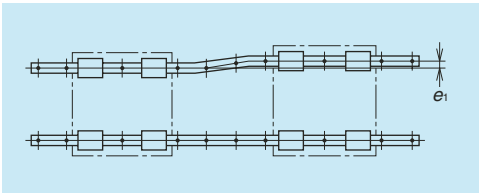


Fig. 4

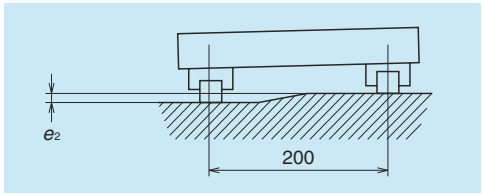


Fig. 5

Table 7

Unit: μm

Value	Preload	Model No.				
		LE05	LE07	LE09	LE12	LE15
Permissible values of parallelism in two rails e_1	Z0, ZT	10	12	15	18	22
	Z1	5	7	10	13	17
Permissible values of parallelism (height) in two rails e_2	Z0, ZT	50 μm/200 mm				
	Z1	35 μm/200 mm				

(2) Shoulder height of the mounting surface and corner radius r

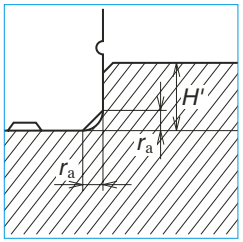


Fig. 6 Shoulder for the rail datum surface

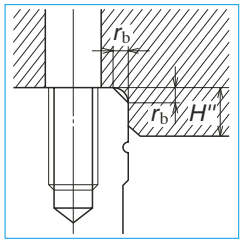


Fig. 7 Shoulder for the ball slide datum surface

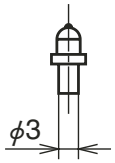
Table 8

Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H'	H''
LE05	0.2	0.2	1.1	2
LE07	0.2	0.3	1.7	3
LE09	0.3	0.3	3.5	3
LE12	0.3	0.3	3.5	4
LE15	0.3	0.5	3.5	5

6. Lubrication accessories

Model of LE15AR can select drive-in type grease fitting as option.
There is no standard grease fitting for LE05 to LE12.
For the models of LE05 to LE15 except for LE15AR, apply grease directly to the ball grooves of rail, using a point nozzle.



Drive-in type

7. Dust-proof components

(1) Standard specification

End seal: Provided to both ends of the ball slide as a standard feature.
• Seal friction per standard ball slide is shown in **Table 9**.

Table 9 Seal friction per ball slide (maximum value)

Unit: N

Series \ Size	05	07	09	12	15
LE	0.4	0.4	0.8	1.0	1.2

(2) NSK K1™ lubrication unit

The installed dimensions of NSK K1 lubrication unit are shown in **Table 10**.

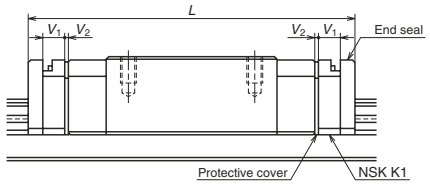


Table 10

Unit: mm

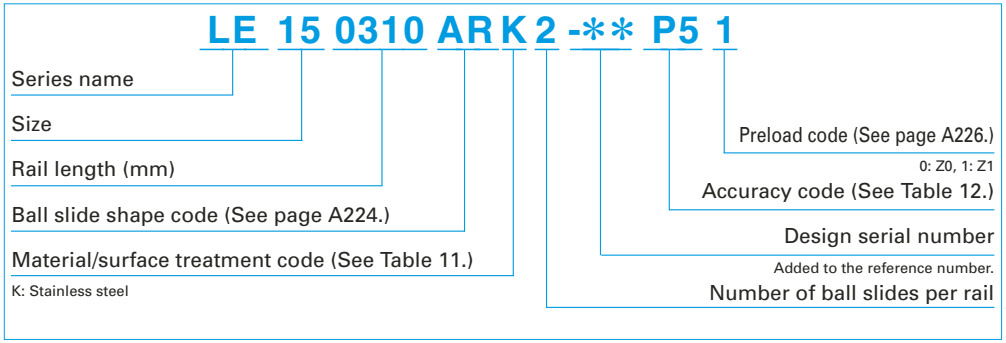
Model No.	Ball slide length	Ball slide model	Standard ball slide length	Ball slide length installed with two NSK K1 L	Per NSK K1 thickness V_1	Protective cover thickness V_2
LE07	Standard	TL	31	37	2.5	0.5
	Long	UL	42	48		
	Short	SL	22.4	28.4		
LE09	Standard	AL, TL	39	46	3.0	0.5
	Standard	AR, TR	39.8	46.8		
	Long	BL, UL	50.4	57.4		
	Short	CL, SL	26.4	33.4		
LE12	Standard	AL	44	52	3.5	0.5
	Standard	AR	45	53		
	Long	BL	59	67		
	Short	CL	30.5	38.5		
LE15	Standard	AL	55.0	64.6	4.0	0.8
	Standard	AR	56.6	66.2		
	Long	BL	74.4	84		
	Short	CL	41.4	51		

Note: Ball slide length equipped with NSK K1 =
(Standard ball slide length) + (Thickness of NSK K1, V_1 × Number of NSK K1) + (Thickness of the protective cover V_2 × 2)

8. Reference number

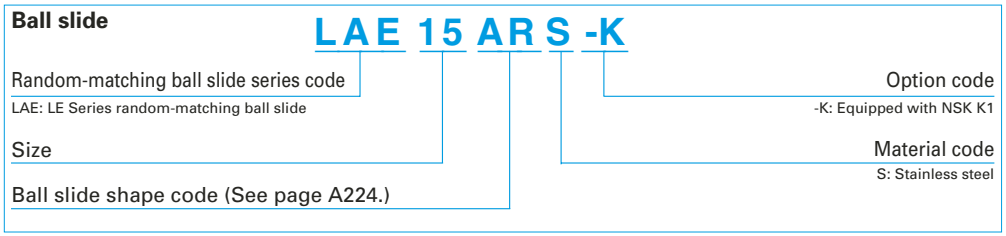
Reference numbers shall be set to individual NSK linear guide when its specifications are finalized, and it is indicated on its specification drawing.
Please specify the reference number, except design serial number, to identify the product when ordering, requiring estimates, or inquiring about specifications from NSK.

(1) Reference number for preloaded assembly

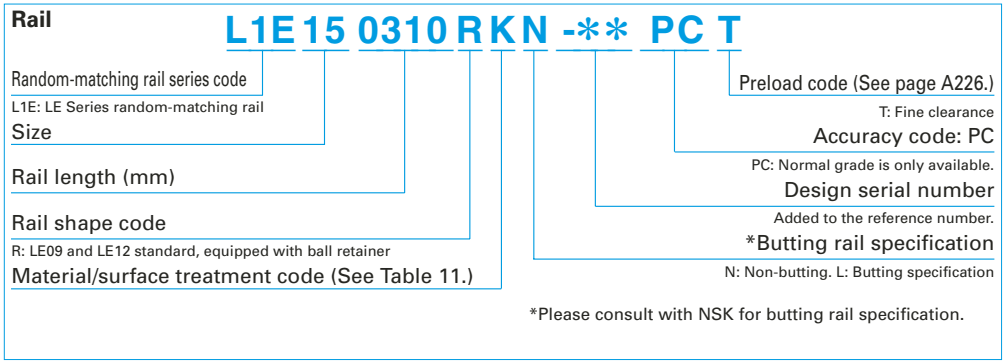


(2) Reference number for random-matching type

Ball slide



Rail



*Please consult with NSK for butting rail specification.

The reference number coding for the assembly of random-matching type is the same as that of the preloaded assembly. However, only the preload code of "Fine clearance T" is available (refer to page A226).

Table 11 Material/surface treatment code

Code	Description
K	Stainless steel
H	Stainless steel with surface treatment
Z	Other, special

Table 12 Accuracy code

Accuracy	Standard (Without NSK K1)	With NSK K1
High precision grade	P5	K5
Precision grade	P6	K6
Normal grade	PN	KN
Normal grade (random-matching type)	PC	KC

Note: Refer to page A38 for NSK K1 lubrication unit.

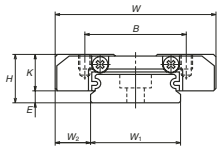
9. Dimensions

LE-AL (Standard type / Standard)
LE-TL (Standard type / Standard, large mounting hole)
LE-AR (Standard type / Standard, with ball retainer)
LE-TR (Standard type / Standard, large mounting hole, with ball retainer)

LE 15 0310 AR K 2 - PC T**

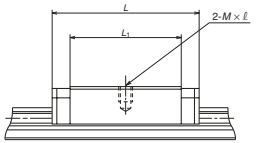
- Series name
- Size
- Rail length (mm)
- Ball slide shape code (See page A224.)
- Material/surface treatment code (See Table 11.)
  K: Stainless steel
- Number of ball slides per rail
- Design serial number
  Added to the reference number.
- Accuracy code (See Table 12.)
- Preload code (See page A226.)
  0: Z0, 1: Z1, T: ZT

Front view

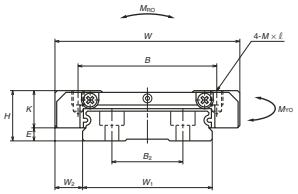


LE05, 07, 09, 12

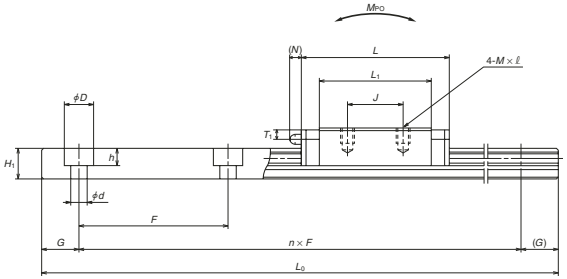
Side view



LE05



LE15



LE07, 09, 12, 15

Model No.	Assembly			Ball slide							Grease fitting			Rail			
	Height			Width	Length	Mounting hole								Width	Height		Pitch
	H	E	W_2	W	L	B	J	$M \times$ pitch $\times \ell$	L_1	K	Hole size	T_1	N	W_1	H_1	B_2	F
LE05AL	6.5	1.4	3.5	17	24	13	—	M2.5×0.45×2	17	5.1	—	—	—	10	4	—	20
LE07TL	9	2	5.5	25	31	19	10	M3×0.5×3	21.2	7	—	—	—	14	5.2	—	30
LE09AL **LE09TL**	12	4	6	30	39	21	12	M2.6×0.45×3 M3×0.5×3	27.6	8	—	—	—	18	7.5	—	30
LE09AR **LE09TR**	12	4	6	30	39.8	21	12	M2.6×0.45×3 M3×0.5×3	27.6	8	—	—	—	18	7.5	—	30
LE12AL **LE12AR**	14	4	8	40	44 45	28	15	M3×0.5×4	31	10	—	—	—	24	8.5	—	40
LE15AL **LE15AR**	16	4	9	60	55 56.6	45	20	M4×0.7×4.5	38.4	12	— ϕ3	— 3.2	— 3	42	9.5	23	40

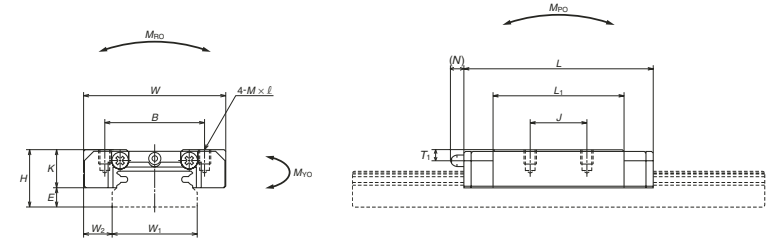
Notes: 1) Ball slide of LE05 has only two mounting tap holes.

Reference number for ball slide of random-matching type

Random matching with retainer: LAE09AR/TR, LAE12AR, LAE15AR
LAE-AR (With ball retainer)
LAE-TR (Large mounting hole with ball retainer)

LAE 15 AR S -K

- Random-matching ball slide series code
  LAE: LE Series random-matching ball slide
- Size
- Ball slide shape code (See page A224.)
- Material code
  S: Stainless steel
- Option code
  -K: Equipped with NSK K1



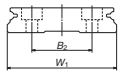
Reference number for rail of random-matching type

Rail L1E 15 0310 R K N - PC T**

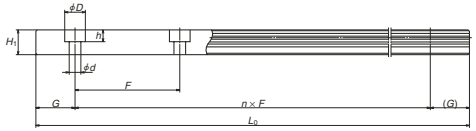
- Random-matching rail series code
  L1E: LE Series random-matching rail
- Size
- Rail length (mm)
- Rail shape code
  R: LE09 and LE12 standard equipped with ball retainer
- Material/surface treatment code (See Table 11.)
- *Butting rail specification
  N: Non-butting, L: Butting specification
- Design serial number
  Added to the reference number.
- Accuracy code: PC
  PC: Normal grade is only available.
- Preload code (See page A226.)
  T: Fine clearance

*Please consult with NSK for butting rail specification.

LE09, 12



LE15



Unit: mm

Rail			Basic load rating								Weight	
Mounting bolt hole	G	Max. length	[2]Dynamic		Static	Static moment (N·m)					Ball slide	Rail
			[50km]	[100km]	C_0	M_{RO}	M_{PO}		M_{YO}			
$d \times D \times h$	(reference)	L_{0max}	C_{50}(N)	C_{100}(N)	(N)		One slide	Two slides	One slide	Two slides	(g)	(g/100 mm)
3×5×1.6	7.5	150	725	575	1 110	5.65	2.58	16.9	2.58	16.9	11	34
3.5×6×3.2	10	600	1 580	1 260	2 350	16.7	7.20	46.0	7.20	46.0	25	55
3.5×6×4.5	10	800	3 000	2 400	4 500	36.5	17.3	110	17.3	110	40	95
3.5×6×4.5	10	800	3 000	2 400	4 500	36.5	17.3	113	17.3	113	40	95
4.5×8×4.5	15	1 000	4 350	3 450	6 350	70.5	29.3	175 180	29.3	175 180	75	140
4.5×8×4.5	15	1 200	7 600	6 050	10 400	207	59.0	360 370	59.0	360 370	150	275

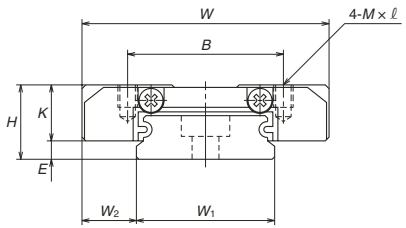
2) The basic load rating comply with the ISO standard. (ISO 14728-1, 14728-2)
C_{50}: the basic dynamic load rating for 50 km rated fatigue life C_{100}: the basic dynamic load rating for 100 km rated fatigue life
3) For fixing a rail of LE05AL, use M2.5 × 0.45 cross-recessed pan head machine screw for precision instruments.
(JCIS 10-70: No.0 pan head machine screw No.3) (JCIS: Japanese Camera Industrial Standard)

LE-BL (High-load type / Long)
LE-UL (High-load type / Long, large mounting hole)

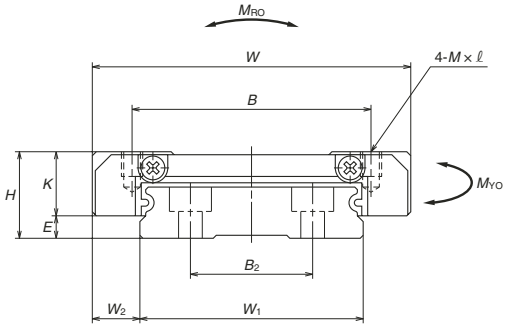
LE 15 0310 BL K 2 - P5 1**

- Series name
- Size
- Rail length (mm)
- Ball slide shape code (See page A224.)
- Material/surface treatment code (See Table 11.)
  - K: Stainless steel
- Number of ball slides per rail
- Design serial number
  - Added to the reference number.
- Accuracy code (See Table 12.)
- Preload code (See page A226.)
  - 0: Z0, 1: Z1

Front view

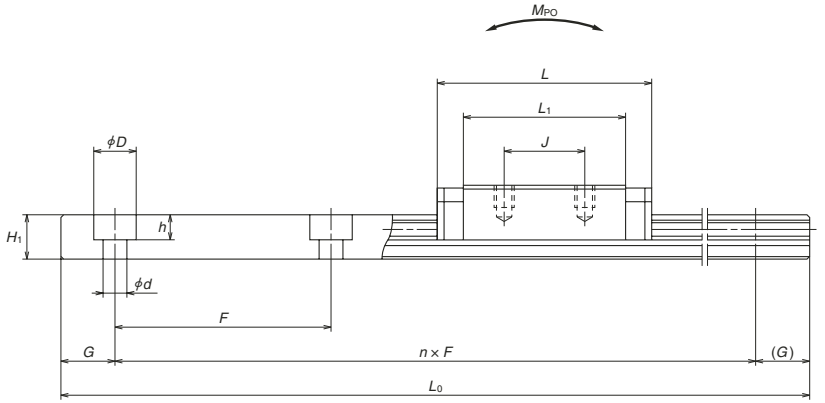


LE07, 09, 12



LE15

Side view



Unit: mm

Model No.	Assembly			Ball slide							Rail			Weight	
	Height			Width	Length	Mounting hole					Width	Height			Pitch
	H	E	W_2	W	L	B	J	$M \times$ pitch $\times \ell$	L_1	K	W_1	H_1	B_2		F
LE07UL	9	2	5.5	25	42	19	19	M3×0.5×3	32.2	7	14	5.2	—		30
LE09BL **LE09UL**	12	4	6	30	50.4	23	24	M2.6×0.45×3 M3×0.5×3	39	8	18	7.5	—		30
LE12BL	14	4	8	40	59	28	28	M3×0.5×4	46	10	24	8.5	—		40
LE15BL	16	4	9	60	74.4	45	35	M4×0.7×4.5	57.8	12	42	9.5	23		40

Rail			Basic load rating								Weight	
Mounting bolt hole	G	Max. length	[1]Dynamic		Static	Static moment (N·m)					Ball slide	Rail
			[50km]	[100km]	C_0	M_{RO}	M_{PO}		M_{YO}			
$d \times D \times h$	(reference)	L_{0max}	C_{50}(N)	C_{100}(N)	(N)		One slide	Two slides	One slide	Two slides	(g)	(g/100 mm)
3.5×6×3.2	10	600	2 180	1 730	3 700	26.4	17.3	94.5	17.3	94.5	39	55
3.5×6×4.5	10	800	4 000	3 150	6 700	54.5	37.5	206	37.5	206	58	95
4.5×8×4.5	15	1 000	5 800	4 600	9 550	106	63.5	340	63.5	340	115	140
4.5×8×4.5	15	1 200	10 300	8 200	16 000	320	135	725	135	725	235	275

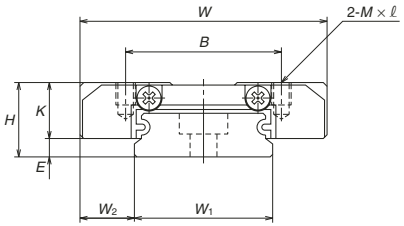
Note: 1) The basic load rating comply with the ISO standard. (ISO 14728-1, 14728-2)
C_{50}: the basic dynamic load rating for 50 km rated fatigue life
C_{100}: the basic dynamic load rating for 100 km rated fatigue life

LE-CL (Medium-load type / Short)
LE-SL (Medium-load type / Short, large mounting hole)

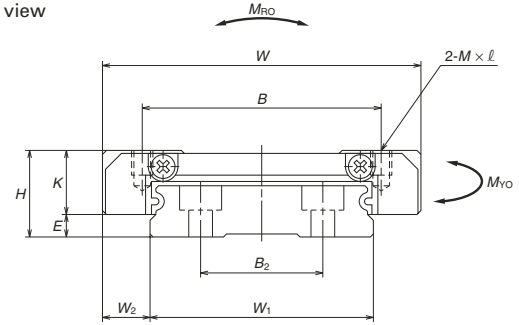
LE 15 0310 CL K 2 - P5 1**

- Series name
- Size
- Rail length (mm)
- Ball slide shape code (See page A224.)
- Material/surface treatment code (See Table 11.)
  - K: Stainless steel
- Number of ball slides per rail
- Design serial number
  - Added to the reference number.
- Accuracy code (See Table 12.)
- Preload code (See page A226.)
  - 0: Z0, 1: Z1

Front view

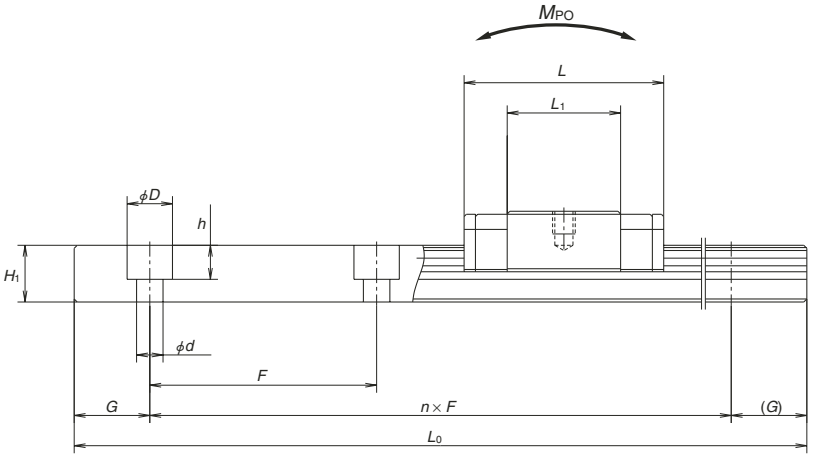


LE05, 07, 09, 12



LE15

Side view



Unit: mm

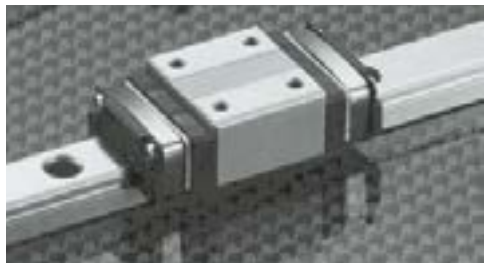
Model No.	Assembly			Ball slide							Rail				Weight	
	Height			Width	Length	Mounting hole					Width	Height		Pitch		
	H	E	W_2	W	L	B	J	$M \times$ pitch $\times \ell$	L_1	K	W_1	H_1	B_2	F		
LE05CL	6.5	1.4	3.5	17	20	13	—	M2.5×0.45×2	13	5.1	10	4	—	20		
LE07SL	9	2	5.5	25	22.4	19	—	M3×0.5×3	12.6	7	14	5.2	—	30		
LE09CL **LE09SL**	12	4	6	30	26.4	21	—	M2.6×0.45×3 M3×0.5×3	15	8	18	7.5	—	30		
LE12CL	14	4	8	40	30.5	28	—	M3×0.5×4	17.5	10	24	8.5	—	40		
LE15CL	16	4	9	60	41.4	45	—	M4×0.7×4.5	24.8	12	42	9.5	23	40		

Notes: 1) Ball slide of CL and SL types have only two mounting tap holes in the center.

Rail			Basic load rating								Weight	
Mounting bolt hole	G	Max. length	[2]Dynamic		Static	Static moment (N·m)					Ball slide	Rail
			[50km]	[100km]	C_0	M_{RO}	M_{PO}		M_{YO}			
$d \times D \times h$	(reference)	L_{0max}	C_{50}(N)	C_{100}(N)	(N)		One slide	Two slides	One slide	Two slides	(g)	(g/100 mm)
3×5×1.6	7.5	150	595	470	835	4.25	1.51	10.0	1.51	10.0	8	34
3.5×6×3.2	10	600	980	775	1 170	8.35	2.01	18.5	2.01	18.5	17	55
3.5×6×4.5	10	800	1 860	1 480	2 240	18.2	4.85	41.0	4.85	41.0	25	95
4.5×8×4.5	15	1 000	2 700	2 140	3 150	35.0	8.15	67.0	8.15	67.0	50	140
4.5×8×4.5	15	1 200	5 000	3 950	5 650	113	19.4	162	19.4	162	110	275

2) The basic load rating comply with the ISO standard. (ISO 14728-1, 14728-2)
C_{50}: the basic dynamic load rating for 50 km rated fatigue life C_{100}: the basic dynamic load rating for 100 km rated fatigue life
3) For fixing a rail of LE05CL, use cross-recessed pan head machine screw for precision instruments M2.5 × 0.45 (JCIS 10-70: Japan Camera Industry Association, No.0, class 3).

A-5-2.5 Miniature LH Series



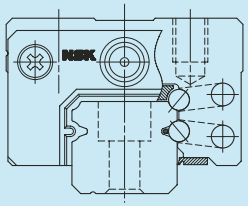


Fig. 1 LH Series

1. Features

(1) High self-aligning capability (rolling direction)

Same as the DF combination in angular contact bearings, self-aligning capability is high because the cross point of the contact lines of balls and grooves comes inside, and thus reducing moment rigidity.
This increases the capacity to absorb errors in installation.

(2) High load carrying capacity to vertical direction

The contact angle is set at 50 degrees, and thus increasing load carrying capacity as well as rigidity in vertical direction.

(3) High resistance against impact load

The bottom ball groove is formed in Gothic arch and the center of the top and bottom grooves are offset as shown in **Fig. 2**. The vertical load is generally carried by the top ball rows, where balls are contacting at two points. Because of this design, the bottom ball rows will carry load when a large impact load is applied vertically as shown in **Fig. 3**. This assures high resistance to the impact load.

(4) High accuracy

As showing in **Fig. 4**, fixing the master rollers to the ball grooves is easy thanks to the Gothic arch groove. This makes easy and accurate measuring of ball grooves.

(5) High corrosion resistance

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

(6) Easy to handle

Safety design includes a retainer that prevents steel balls from dropping out of the ball slide even when the slide is removed from the rail. (LH10-12)

(7) Long-term maintenance-free

Superb features of NSK K1 Lubrication unit realize a long-term, maintenance-free operation.

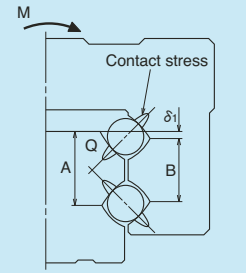


Fig. 2 Enlarged illustration of the offset Gothic arch groove

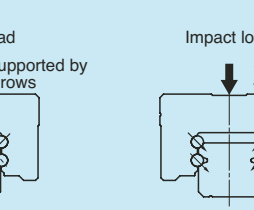


Fig. 3 When load is applied

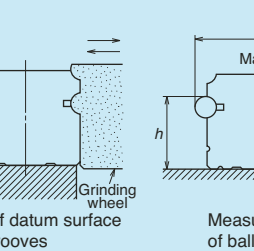
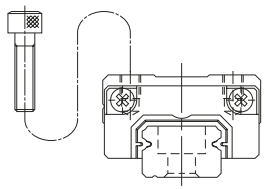
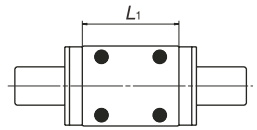


Fig. 4 Rail grinding and measuring

2. Ball slide shape

Ball slide Model	Shape/installation method	Type
AN		AN 

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1 Unit: μm

Rail length (mm) over	or less	Preloaded assembly: Super precision P4	High precision P5	Precision grade P6	Normal grade PN
–	50	2	2	4.5	6
50	80	2	3	5	6
80	125	2	3.5	5.5	6.5
125	200	2	4	6	7
200	250	2.5	5	7	8
250	315	2.5	5	8	9
315	400	3	6	9	11
400	500	3	6	10	12
500	630	3.5	7	12	14
630	800	4.5	8	14	16

(2) Accuracy standard

The preloaded assembly has four accuracy grades; Super precision P4, High precision P5, Precision P6 and Normal PN grades.

- **Tolerance of preloaded assembly**

Table 2 Unit: μm

Characteristics \ Accuracy grade	Super precision P4	High precision P5	Precision grade P6	Normal grade PN
Mounting height H	±10	±20	±40	±80
Variation of H (All ball slides on a set of rails)	3	5	7	15
Mounting width W_2 or W_3	±10	±15	±25	±50
Variation of W_2 or W_3 (All ball slides on reference rail)	5	7	10	20
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	Shown in **Table 1**, **Fig. 5**			

(3) Combinations of accuracy and preload

Table 3

		Accuracy grade			
		Super precision	High precision	Precision grade	Normal grade
Without NSK K1 lubrication unit		P4	P5	P6	PN
With NSK K1 lubrication unit		K4	K5	K6	KN
With NSK K1 for food and medical equipment		F4	F5	F6	FN
Preload	Fine clearance Z0	○	○	○	○
	Slight preload Z1	○	○	○	○

(4) Assembled accuracy

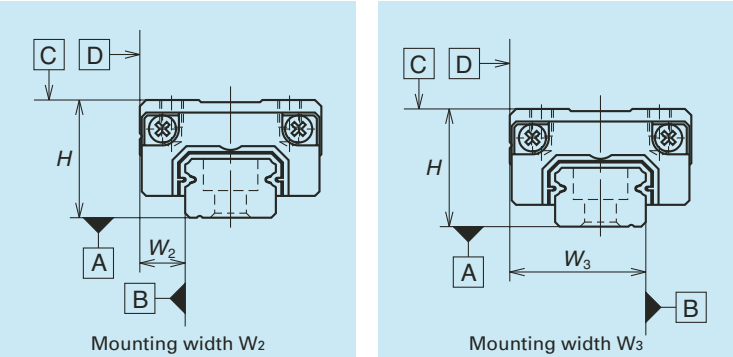


Fig. 5

(5) Preload and rigidity

We offer two levels of preload: Slight preload Z1 and Fine clearance Z0.

• **Preload and rigidity of preloaded assembly**

Table 4

Model No.	Preload (N)	Rigidity (N/μm)	
		Vertical direction	Lateral direction
	Slight preload Z1	Slight preload Z1	Slight preload Z1
LH08AN	5	33	23
LH10AN	9	44	31
LH12AN	22	68	47

Note: Clearance for Fine clearance Z0 is 0 to 3μm. Therefore, preload is zero. However, Z0 of PN grade is 0 to 5μm.

4. Maximum rail length

Table 5 shows the limitations of rail length (maximum length). However, the limitations vary by accuracy grades.

Table 5 Length limitations of rails

Unit: mm

Series	Size / Material	08	10	12
LH	Stainless steel	375	600	800

Note: Rails can be butted if user requirement exceeds the rail length shown in the table. Please consult NSK.

5. Installation

(1) Permissible values of mounting error

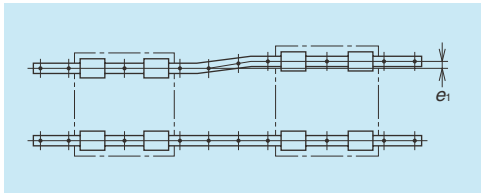


Fig. 6

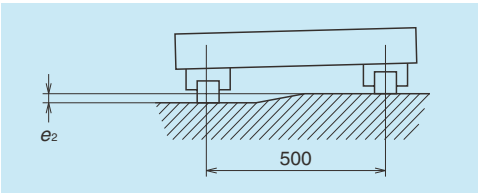


Fig. 7

Table 6

Unit: μm

Value	Preload	Model No.		
		LH08	LH10	LH12
Permissible values of parallelism in two rails e_1	Z0	9	12	19
	Z1	8	11	18
Permissible values of parallelism (height) in two rails e_2	Z0	375μm/500mm		
	Z1	330μm/500mm		

(2) Shoulder height of the mounting surface and corner radius r

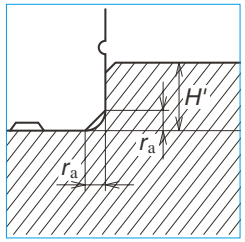


Fig. 8 Shoulder for the rail datum surface

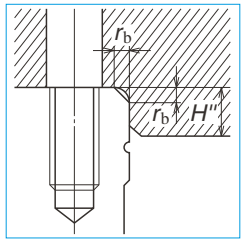


Fig. 9 Shoulder for the ball slide datum surface

Table 7

Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H'	H''
LH08	0.3	0.5	1.8	3
LH10	0.3	0.5	2.1	4
LH12	0.5	0.5	2.7	4

6. Lubrication accessory

Model of LH12 can select drive-in type grease fitting as an option.
For the models of LH08 to LH10, apply grease directly to the ball grooves of rail using a point nozzle.

Fig. 10

7. Dust-proof components

(1) Standard specification

The LH Series can be readily used as they have a dust protection means for normal conditions. As the standard equipment, the ball slides have an end seal on both ends, and bottom seals at the bottom.
However, the bottom seals are not used to LH08 and 10.

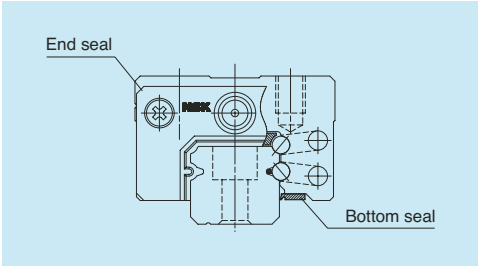


Fig. 11

Table 8 Seal friction per ball slide (maximum value)

Unit: N

Series \ Size	08	10	12
LH	0.5	1	1.5

(2) NSK K1™ lubrication unit

Table 9 shows the dimension of linear guides equipped with the NSK K1 lubrication unit

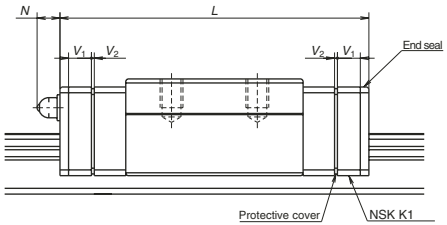


Table 9

Unit: mm

Model No.	Ball slide length	Ball slide model	Standard ball slide length	Ball slide length installed with two NSK K1 L	Per NSK K1 thickness V_1	Protective cover thickness V_2	Protruding area of the grease fitting N
LH08	Standard	AN	24	31	3	0.5	—
LH10	Standard	AN	31	40	4	0.5	—
LH12	Standard	AN	45	54	4	0.5	(4)

Notes: 1) NSK K1 for food and medical equipment are available for LH12.
2) Ball slide length equipped with NSK K1 = (Standard ball slide length) + (Thickness of NSK K1, V_1 × Number of NSK K1) + (Thickness of the protective cover, V_2 × 2)

(3) Cap to plug the rail mounting bolt hole

Table 10 Caps to plug rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
LH12	M3	LG-CAP/M3	20

8. Reference number

Reference numbers shall be set to individual NSK linear guide when its specifications are finalized, and it is indicated on its specification drawing.
Please specify the reference number, except design serial number, to identify the product when ordering, requiring estimates, or inquiring about specifications from NSK.

(1) Reference number for preloaded assembly

LH 12 0800 AN K 2 - ** **P5 1**

- Series name
- Size
- Rail length (mm)
- Ball slide shape code (See page A238.)
- Material/surface treatment code (See Table 11.)
  K: Stainless steel
- Number of ball slides per rail
- Design serial number
  Added to the reference number.
- Accuracy code (See Table 12.)
- Preload code (See page A239.)
  0: Z0, 1: Z1

Table 11 Material/surface treatment code

Code	Description
K	Stainless steel
H	Stainless steel with surface treatment
Z	Other, special

Table 12 Accuracy code

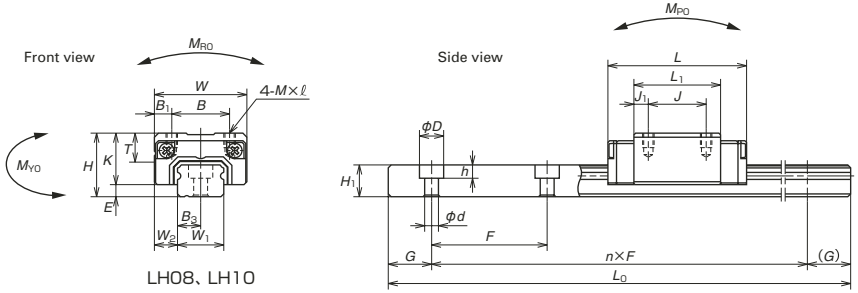
Accuracy	Standard (Without NSK K1)	With NSK K1	With NSK K1 for food and medical equipment
Super precision grade	P4	K4	F4
High precision grade	P5	K5	F5
Precision grade	P6	K6	F6
Normal grade	PN	KN	FN

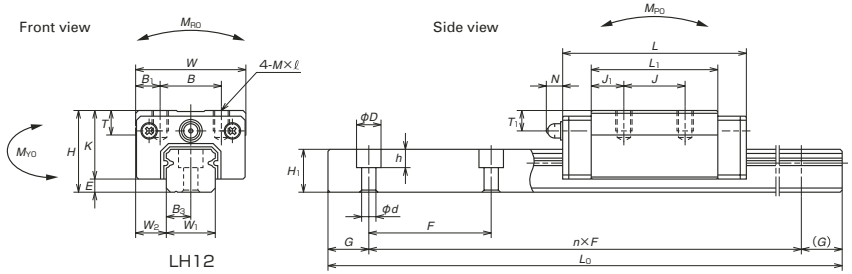
Note: Refer to pages A38 and A61 for NSK K1 lubrication unit.

9. Dimensions

LH 12 0800 AN K 2 - P5 1**

- Series name
- Size
- Rail length (mm)
- Ball slide shape code (See page A238.)
- Material/surface treatment code (See Table 11.)
  K: Stainless steel
- Number of ball slides per rail
- Design serial number
  Added to the reference number.
- Accuracy code (See Table 12.)
- Preload code (See page A239.)
  0: Z0, 1: Z1





Unit: mm

Model No.	Assembly			Ball slide											Rail				Basic load rating								Weight	
	Height			Width	Length	Mounting hole						Grease fitting			Width	Height	Pitch	Mounting bolt hole	G	Max. length	[2]Dynamic		Static	Static moment (N·m)					Ball slide	Rail
																					[50km]	[100km]								
	H	E	W_2	W	L	B	J	$M \times$ pitch $\times \ell$	L_1	K	T	Hole size	T_1	N	W_1	H_1	F	$d \times D \times h$	(reference)	L_{0max}	C_{50}(N)	C_{100}(N)	C_0 (N)	M_{RO}	M_{PO} One slide	M_{PO} Two slides	M_{YO} One slide	M_{YO} Two slides	(g)	(g/100 mm)
LH08AN	11	2.1	4	16	24	10	10	M2×0.4×2.5	15	8.9	—	—	—	—	8	5.5	20	2.4×4.2×2.3	7.5	375	1 240	985	2 630	7.25	4.55	32.5	3.8	27.2	13	31
LH10AN	13	2.4	5	20	31	13	12	M2.6×0.45×3	20.2	10.6	6	—	—	—	10	6.5	25	3.5×6×3.5	10	600	2 250	1 790	4 500	16.2	10.5	73.0	8.8	61.0	26	44
LH12AN	20	3.2	7.5	27	45	15	15	M4×0.7×5	31	16.8	6	ϕ3	5	4	12	10.5	40	3.5×6×4.5	15	800	5 650	4 500	11 300	47.5	41.5	254	35	214	82	88

Notes: 1) LH08 does not have a ball retainer. Be aware that balls fall out when the ball slide is withdrawn from the rail.

2) The basic load rating comply with the ISO standard. (ISO 14728-1, 14728-2)
C_{50}; the basic dynamic load rating for 50 km rated fatigue life C_{100} ; the basic dynamic load rating for 100 km rated fatigue life

A-3-2.6 LL Series

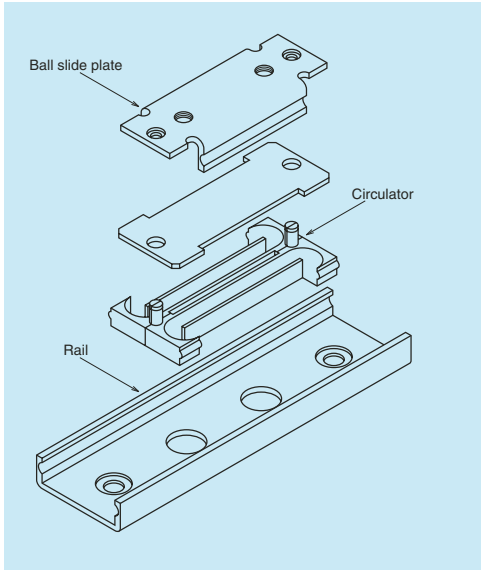


Fig. 1 LL Series structure

1. Features

(1) Super light-weight

This compact guide has a single ball groove on both right and left sides (Gothic arch). Rails and ball slides are made of stainless steel plate, therefore they are lightweight.

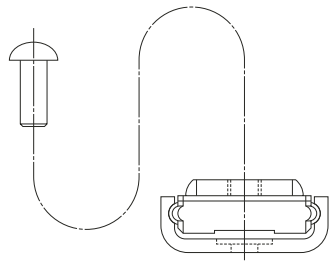
(2) Compact

The ball groove is made outside the ball slide to reduce overall size and to obtain high speed.

(3) High corrosion resistance

High corrosion resistant martensitic stainless steel is used as standard material.

2. Ball slide model

Ball slide model	Shape/installation method
PL	

3. Accuracy and preload

(1) Accuracy standard

The LL Series has a Normal grade PN as the accuracy grade.
Table 1 shows the tolerance.

Table 1 Tolerance of Normal grade (PN)

Unit: μm

Characteristic \ Model No.	LL15
Mounting height	±20
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	20 (See **Fig. 2.**)

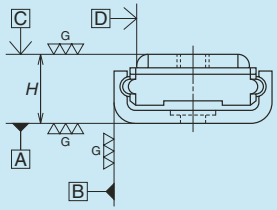


Fig. 2 Standard LL

(2) Preload

We offer clearance for the LL Series.
Table 2 shows the specification of clearance.

Table 2 Radial clearance

Unit: μm

Model No.	Clearance
LL15	0 – 10

4. Maximum rail length

Table 3 Length limitation of rails

Unit: mm

Series	Size / Material	15				
LL	Stainless steel	40	60	75	90	120

5. Reference number

Reference numbers shall be set to individual NSK linear guide when its specifications are finalized, and it is indicated on its specification drawing.
Please specify the reference number, except design serial number, to identify the product when ordering, requiring estimates, or inquiring about specifications from NSK.

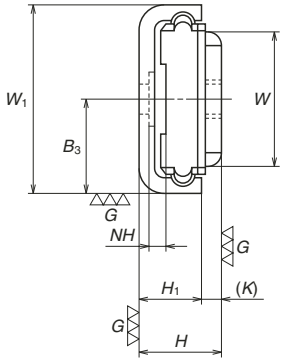
LL 15 0060 PL K 1 - ** PN 0**

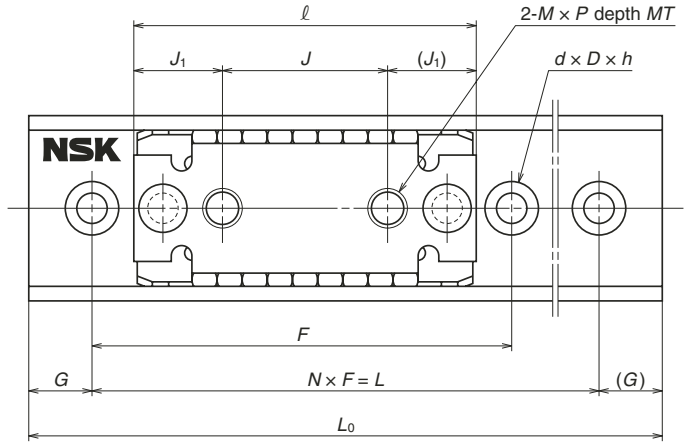
- LL: Series name
- 15: Size
- 0060: Rail length (mm)
- PL: Ball slide shape code (See page A247.)
- K: Material / surface treatment code: K
  - K: Stainless steel
- 1: Number of ball slides per rail
- -** : Design serial number
  - Added to the reference number.
- PN: Accuracy code: PN
  - PN: Normal grade is only available.
- 0: Preload code: 0
  - 0: Z0

6. Dimensions

LL 15 0060 PL K 1 - ** PN 0**

- Series name
- Size
- Rail length (mm)
- Ball slide shape code (See page A247.)
- Material / surface treatment code: K
  K: Stainless steel
- Number of ball slides per rail
- Design serial number
  Added to the reference number.
- Accuracy code: PN
  PN: Normal grade is only available.
- Preload code: 0
  0: Z0





Unit: mm

Model No.	Assembly Height H	Assembly W1	Ball slide Width W	Ball slide Length ℓ	Mounting hole J	Mounting hole M × pitch	Mounting hole MT	J1	K	Height H1	Pitch F	N
LL15	6.5	15	10.6	27	13	M3×0.5	1.2	7	1.5	5	30	1
											40	1
											30	2
											40	2
											50	2

Rail Mounting bolt hole d × D × h	NH	B3	G	Length L0	Basic load rating 5) Dynamic [50km] C50(N)	Dynamic [100km] C100(N)	Static C0 (N)	Static moment MRO (N·m)	Static moment MPO (N·m)	Static moment MYO (N·m)	Ball dia. DW	Weight Ball slide (g)	Weight Rail (g)
2.4×5×0.4	1.2	7.5	5	40	880	700	785	7	3	3	2	6	9
			10	60									11
			7.5	75									13
			5	90									16
			10	120									21

Notes:
1) The LL Series does not have a ball retainer. Be aware that the balls fall out when the ball slide is withdrawn from the rail.
2) Seals are not available. Please provide the dust-prevention measures on the equipment.
3) Do not use an installation screw on the ball slide which exceeds the dimension MT (maximum screw-in depth) in the dimension table.
4) To fix the rail, use M2 × 0.4 cross recessed machine screw for precision instrument.
(JCIS10-70 No.0 pan head machine screw No.1)
(JCIS: Japanese Camera Industrial Standard)

5) C_{50}; the basic dynamic load rating for 50 km rated fatigue life
C_{100}; the basic dynamic load rating for 100 km rated fatigue life

A-5-3 Machine Tools

A-5-3.1 RA Series

1. Features

(1) Super-high load capacity

By installing rollers that are the largest possible diameter and length within the existing standard cross-section dimension in a rational layout based on our advanced analysis technology, we have realized the world's highest load capacity,* far superior to conventional roller guides. Super-long life is achieved and impact load can be sufficiently handled.

* As of September 1, 2003; NSK's reserch and comparison on the existing products of the same sizes.

(2) Super-high rigidity

Using NSK's advanced analysis technology, we pursued a complete, optimal design, down to the detailed shape of roller slides and rails, thereby realizing super-high rigidity superior to that of competitor's roller guides.

(3) Super-high motion accuracy

NSK has developed its own unique method of simulating rolling element passage vibration and method of designing optimal roller slide specifications for damping roller passage vibration. These developments have dramatically enhanced roller slide motion accuracy for the RA series.

(4) Smooth motion

Installation of a retaining piece between rollers restrains the roller skew peculiar to roller slides, thereby achieving smooth motion.

(5) Low friction

Using rollers for rolling elements helps minimize dynamic friction.

(6) Random matching

Random-matching of rails and roller slides are available. (RA25 to RA65)

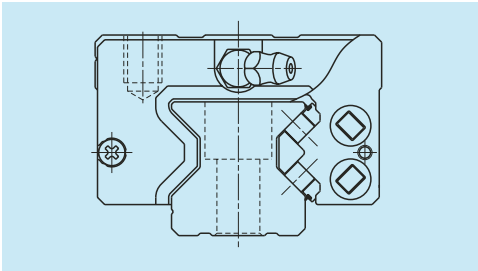
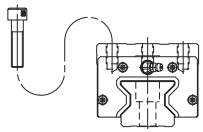
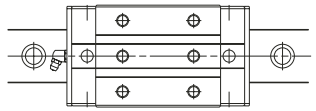
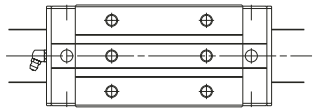
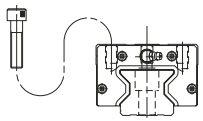
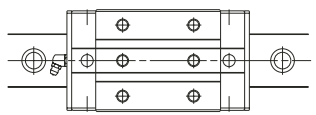
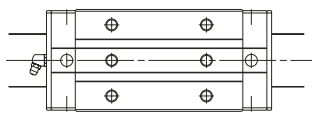
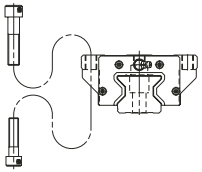
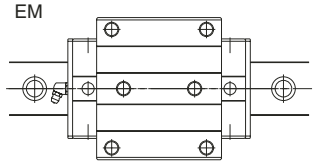
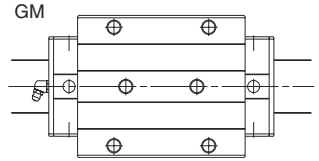


Fig. 1 RA Series

Fig. 2 Analysis example

Fig. 3 Random-matching type

2. Roller slide shape

Roller slide model	Shape/installation method	Type (Upper row, Rating: Lower row, Roller slide length)	
		High-load type	Super-high-load type
		Standard	Long
AN BN		AN 	BN 
AL BL		AL 	BL 
EM GM		EM 	GM 

3. Accuracy and preload

(1) Running parallelism of roller slide

Table 1

Unit: μm

Rail length (mm)	Ultra precision P3	Super precision P4	High precision P5 PH	Precision grade P6
	Preloaded assembly	Preloaded assembly	Preloaded assembly Random-matching type	Preloaded assembly
– 50	2	2	2	4.5
50 – 80	2	2	3	5
80 – 125	2	2	3.5	5.5
125 – 200	2	2	4	6
200 – 250	2	2.5	5	7
250 – 315	2	2.5	5	8
315 – 400	2	3	6	9
400 – 500	2	3	6	10
500 – 630	2	3.5	7	12
630 – 800	2	4	8	14
800 – 1 000	2.5	4.5	9	16
1 000 – 1 250	3	5	10	17
1 250 – 1 600	4	6	11	19
1 600 – 2 000	4.5	7	13	21
2 000 – 2 500	5	8	15	22
2 500 – 3 150	6	9.5	17	25
3 150 – 3 500	9	16	23	30

(2) Accuracy standard

The preloaded assembly has four accuracy grades; Ultra precision P3, Super precision P4, High precision P5, and Precision P6 grades, while the random-matching type has High precision PH grade only.

• **Tolerance of preloaded assembly**

Table 2 Unit: μm

Characteristics \ Accuracy grade	Ultra precision P3	Super precision P4	High precision P5	Precision grade P6
Mounting height *H*	±8	±10	±20	±40
Variation of *H* (All roller slides on a set of rails)	3	5	7	15
Mounting width W_2 or W_3	±10	±15	±25	±50
Variation of W_2 or W_3 (All roller slides on reference rail)	3	7	10	20
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	Shown in **Table 1** and **Fig. 4**			

• **Tolerance of random-matching type**

Table 3 Unit: μm

Characteristics \ Accuracy grade	High precision PH
Mounting height *H*	±20
Variation of mounting height *H*	15① 25②
Mounting width W_2 or W_3	±25
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	See **Table 1** and **Fig. 4**

Note: ① Variation on the same rail ② Variation on multiple rails

(3) Combination of accuracy and preload

Table 4

		Accuracy grade				
		Ultra precision	Super precision	High precision	Precision grade	High precision
	Without NSK K1 lubrication unit	P3	P4	P5	P6	PH
	With NSK K1 lubrication unit	K3	K4	K5	K6	KH
Preload	Slight preload Z1	○	○	○	○	—
	Medium preload Z3	○	○	○	○	—
	Random-matching type with slight preload ZZ	—	—	—	—	○
	Random-matching type with medium preload ZH	—	—	—	—	○

(4) Assembled accuracy

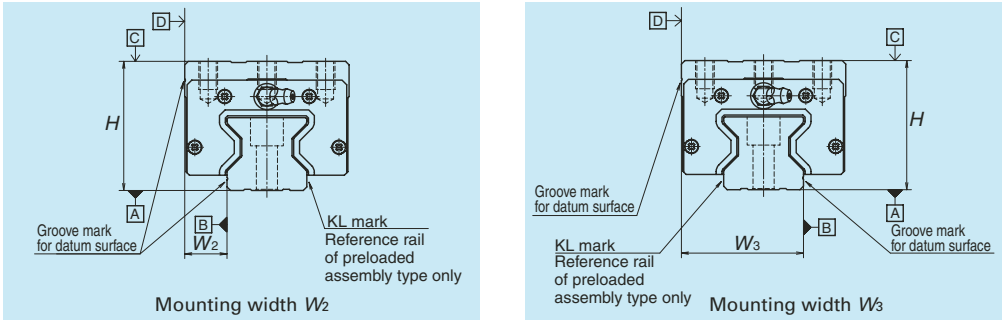


Fig. 4

(5) Preload and rigidity

Four types of preload are available: Medium preload Z3 and Slight preload Z1 for preloaded assembly, and Medium preload ZH and slight preload ZZ for Random-matching type.

• **Preload of preloaded assembly**

Table 5

	Model No.	Preload (N)	
		Slight preload (Z1)	Medium preload (Z3)
High-load type	RA15 AN, AL, EM	—	1 030
	RA20 AN, EM	—	1 920
	RA25 AN, AL, EM	880	2 920
	RA30 AN, AL, EM	1 170	3 890
	RA35 AN, AL, EM	1 600	5 330
	RA45 AN, AL, EM	2 780	9 280
	RA55 AN, AL, EM	3 870	12 900
	RA65 AN, EM	6 300	21 000
Super-high-load type	RA15 BN, BL, GM	—	1 300
	RA20 BN, GM	—	2 400
	RA25 BN, BL, GM	1 060	3 540
	RA30 BN, BL, GM	1 430	4 760
	RA35 BN, BL, GM	2 020	6 740
	RA45 BN, BL, GM	3 480	11 600
	RA55 BN, BL, GM	5 040	16 800
	RA65 BN, GM	8 640	28 800

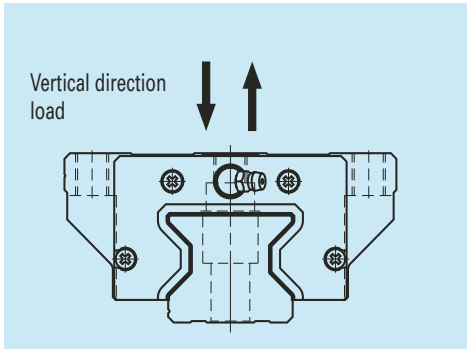
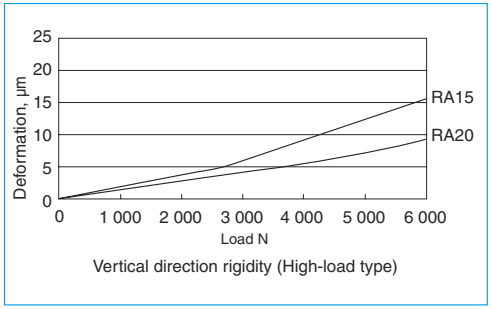
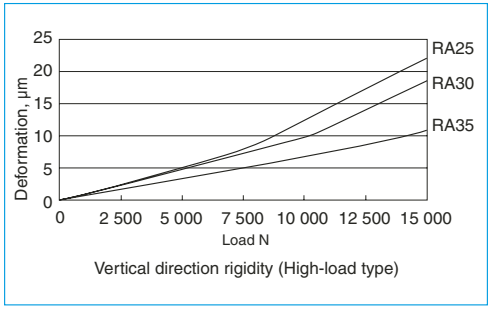


Fig. 5 Direction of load

• **Rigidity of medium preload**





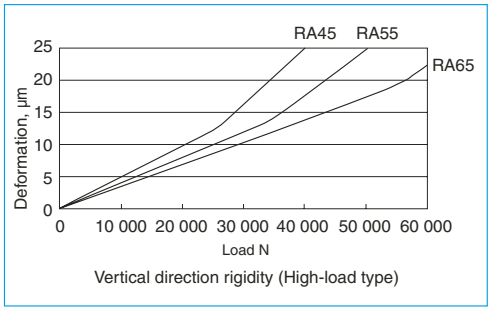
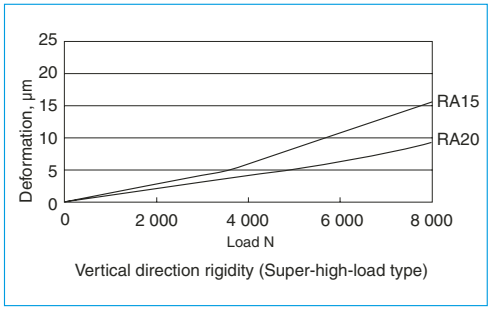
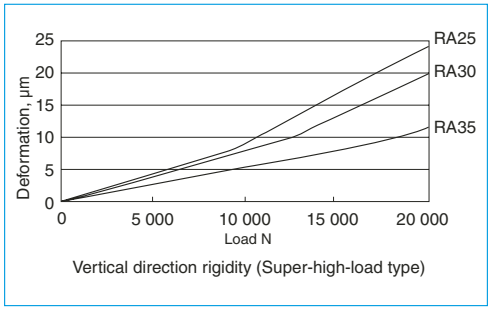


Fig. 6 Vertical direction theoretical rigidity line: High-load type (Roller slide shape: AN, AL, EM)





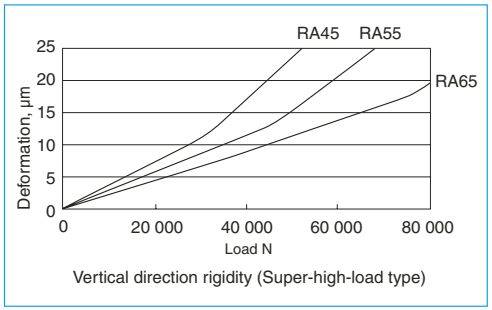


Fig. 7 Vertical direction theoretical rigidity line: Super-high-load type (Roller slide shape: BN, BL, GM)

4. Maximum rail length

Table 5 shows the limitations of rail length (maximum length). However, the limitations vary by accuracy grades.

Table 6 Length limitation of rails

Unit: mm

Series \ Size	15	20	25	30	35	45	55	65
RA	2 000	3 000	3 900	3 900	3 900	3 650	3 600	3 600

Note: Rails can be butted if user requirement exceeds the rail length shown in the table. Please consult NSK.

5. Installation

(1) Permissible values of mounting error

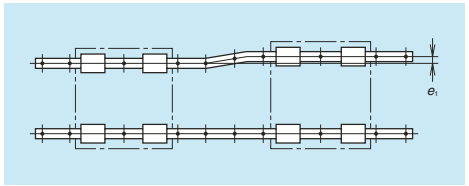


Fig. 8

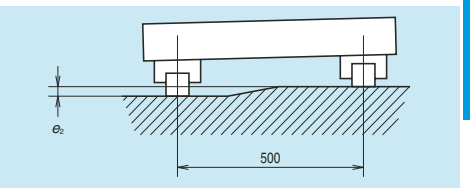


Fig. 9

Table 7

Unit: μm

Value	Preload	Model No. RA15	RA20	RA25	RA30	RA35	RA45	RA55	RA65
Permissible values of parallelism in two rails e_1	Z1, ZZ	—	—	14	18	21	27	31	49
	Z3 , ZH	5	7	9	11	13	17	19	30
Permissible values of parallelism (height) in two rails e_2	Z1, ZZ	—		290 μm / 500 mm					
	Z3 , ZH	150 μm / 500 mm							

(2) Shoulder height of the mounting surface and corner radius r

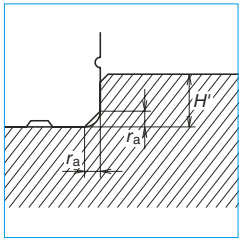


Fig. 10 Shoulder for the rail datum surface

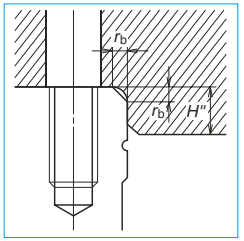


Fig. 11 Shoulder for the roller slide datum surface

Table 8

Unit: mm

Model No.	Corner radius (maximum) r_a	r_b	Shoulder height H'	H''
RA15	0.5	0.5	3	4
RA20	0.5	0.5	4	5
RA25	0.5	1	4	5
RA30	1	1	5	6
RA35	1	1	5	6
RA45	1.5	1	6	8
RA55	1.5	1.5	7	10
RA65	1.5	1.5	11	11

6. Lubrication components

Refer to pages A38 and D13 for the lubrication of linear guides.

(1) Types of lubrication accessories

Fig. 14 and **Table 11** show grease fittings and tube fittings.

(2) Mounting position of lubrication accessories

- The standard position of grease fittings and tube fittings is the end face of roller slide. We can mount them on a side of end cap for an option. (**Fig. 12**) Please consult NSK for installation of grease or tube fittings to the roller slide body or the side of end cap.
- A lubrication hole can also be provided on the top of the end cap. **Fig.13**, **Table 9** and **Table 10** show the mounting position. A spacer is required for AN and BN shape roller slides. The spacers are available from NSK.
- When using a piping unit with thread of M6 × 1, you require a connector to connect it to a grease fitting mounting hole with M6 × 0.75. The connectors are available from NSK.

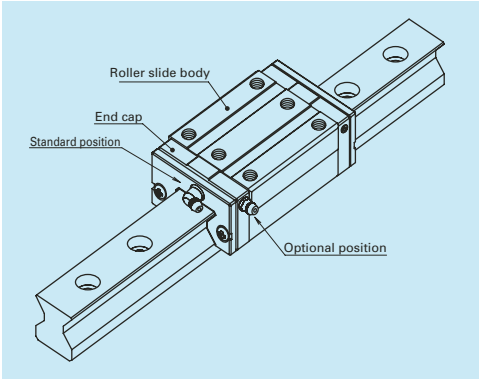


Fig. 12 Mounting position of lubrication accessories

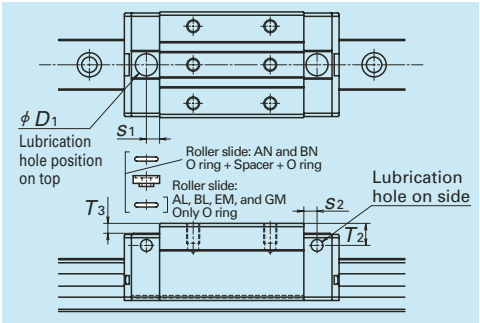


Fig.13 Top and side lubrication hole positions

Table 9 Top and side lubrication hole positions

Unit: mm

Model No.	Roller slide model	Grease fitting size	s_2	T_2	O ring (JIS)	Spacer	D_1	s_1	T_3
RA15	AN, BN	ϕ3	4	7	P5	Necessary	8.2	4.4	4.2
RA20		ϕ3	4	4	P6	—	9.2	5.4	0.2
RA25		M6×0.75	6	10	P7	Necessary	10.2	6	4.5
RA30		M6×0.75	5	10	P7	Necessary	10.2	6	3.5
RA35		M6×0.75	5.5	15	P7	Necessary	10.2	7	7.4
RA45		Rc 1/8	7.2	20	P7	Necessary	10.2	7.2	10.4
RA55		Rc 1/8	7.2	21	P7	Necessary	10.2	7.2	10.4
RA65		Rc 1/8	7.2	19	P7	—	10.2	7.2	0.4

Table 10 Top and side lubrication hole positions

Unit: mm

Model No.	Roller slide model	Grease fitting size	s_2	T_2	O ring (JIS)	D_1	s_1	T_3
RA15	AL, BL, EM, GM	ϕ3	4	3	P5	8.2	4.4	0.2
RA20	EM, GM	ϕ3	4	4	P6	9.2	5.4	0.2
RA25	AL, BL, EM, GM	M6×0.75	6	6	P7	10.2	6	0.4
RA30		M6×0.75	5	7	P7	10.2	6	0.4
RA35		M6×0.75	5.5	8	P7	10.2	7	0.4
RA45		Rc 1/8	7.2	10	P7	10.2	7.2	0.4
RA55		Rc 1/8	7.2	11	P7	10.2	7.2	0.4
RA65	EM, GM	Rc 1/8	7.2	19	P7	10.2	7.2	0.4

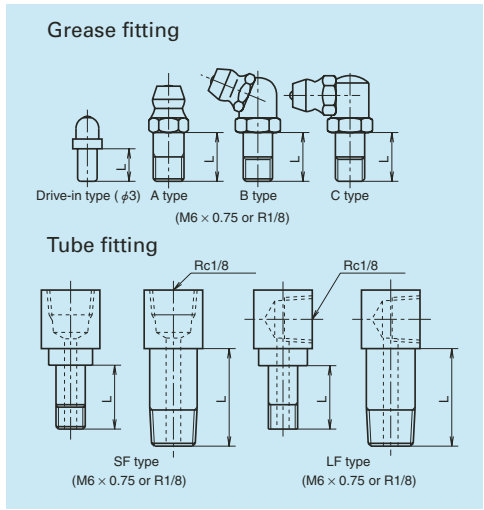


Fig. 14 Grease fitting and tube fitting

7. Dust-proof components

(1) Standard specification

The RA series is equipped with end, inner* and bottom seals to prevent foreign matter from entering the inside of the roller slide. Under normal applications, the RA series can be used without modification.

For severe usage conditions, optional rail covers** are available. Contact NSK for information on how to mount the cover.

*) Inner seals for the models of RA15 and RA20 are available as options.

**) The rail cover is available to the models of RA25 to RA65.

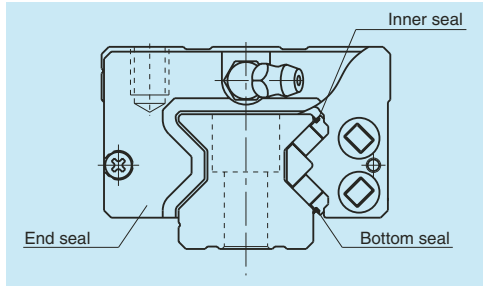


Fig. 15

Table 11

Unit: mm

Model No.	Dust-proof specification	Grease fitting Drive-in fitting Thread body length L	Tube fitting Thread body length L
RA15	Standard	5	–
	With NSK K1	10	–
	Double seal	8	–
	Protector	8	–
RA20	Standard	5	–
	With NSK K1	10	–
	Double seal	8	–
	Protector	10	–
RA25	Standard	5	5
	With NSK K1	12	12
	Double seal	10	9
	Protector	10	9
RA30	Standard	5	6
	With NSK K1	14	15
	Double seal	12	11
	Protector	12	11
RA35	Standard	5	6
	With NSK K1	14	15
	Double seal	12	11
	Protector	12	11
RA45	Standard	8	17
	With NSK K1	18	21.5
	Double seal	14	17
	Protector	14	17
RA55	Standard	8	17
	With NSK K1	18	21.5
	Double seal	14	17
	Protector	14	17
RA65	Standard	8	17
	With NSK K1	20	20
	Double seal	14	17
	Protector	14	17

Fig. 16 Rail cover

Table 12 Seal friction per roller slide (maximum value)

Unit: N

Series \ Size	15	20	25	30	35	45	55	65
RA	4	5.5	5	5	6	8	8	14

(2) NSK K1™ lubrication unit

Table 12 shows the dimension of linear guides equipped with the NSK K1 lubrication unit.

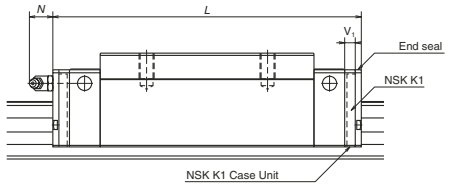


Table 13 Unit: mm

Model No.	Roller slide length	Roller slide model	Standard roller slide length	With two NSK K1	Thickness of NSK K1 V_1	Protruding area of the grease fitting N
RA15	Standard	AN, AL, EM	70	79	4.5	(3)
	Long	BN, BL, GM	85.4	94.4		
RA20	Standard	AN, EM	86.5	95.5	4.5	(3)
	Long	BN, GM	106.3	115.3		
RA25	Standard	AN, AL, EM	97.5	107.5	5	(11)
	Long	BN, BL, GM	115.5	125.5		
RA30	Standard	AN, AL, EM	110.8	122.8	6	(11)
	Long	BN, BL, GM	135.4	147.4		
RA35	Standard	AN, AL, EM	123.8	136.8	6.5	(11)
	Long	BN, BL, GM	152	165		
RA45	Standard	AN, AL, EM	154	168	7	(14)
	Long	BN, BL, GM	190	204		
RA55	Standard	AN, AL, EM	184	198	7	(14)
	Long	BN, BL, GM	234	248		
RA65	Standard	AN, EM	228.4	243.4	7.5	(14)
	Long	BN, GM	302.5	317.5		

Note: Roller slide length equipped with NSK K1 = (Standard roller slide length) + (Thickness of NSK K1 Case Unit × Number of NSK K1 Case Unit)

(3) Double seal and protector

For RA Series, double seal and protector can be installed only before shipping from the factory. **Table 14** shows the increased thickness when end seal and protector are installed.

Table 14 Unit: mm

Model No.	Thickness of end seal V_3	Thickness of protector V_4
RA15	3	2.7
RA20	3	3.3
RA25	3.2	3.3
RA30	3.4	3.6
RA35	3.4	3.6
RA45	4	4.2
RA55	4	4.2
RA65	5	5.5

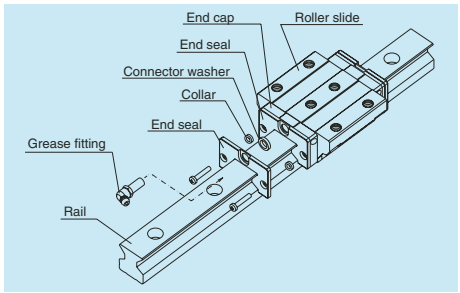


Fig. 17 Double seal

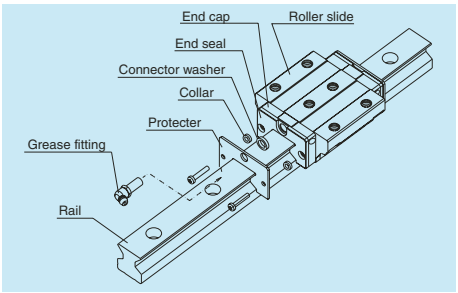


Fig. 18 Protector

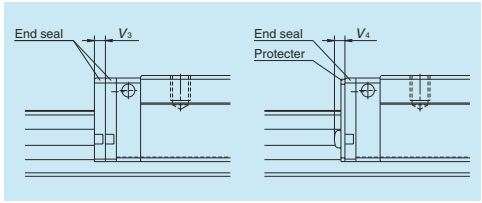


Fig. 19

(4) Rail cover

When the rail cover is used, use the cover bracket to secure the rail cover. **Fig.20** shows the dimensions for the cover bracket. The required room at the end of the rail is:

- Inside: 10.5 mm or less
- Outside: 4 mm or less (Common to the models of RA25 to RA65)
  Please confirm the interference with your machine at the stroke end.
- Machine stroke
- Room for the end of the rail

The height of the rail with the rail cover is shown in **Table 15**.

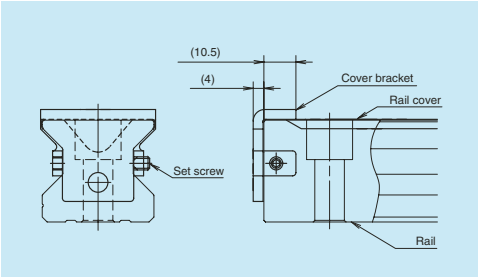


Fig. 20 End configuration of rail equipped with the rail cover

Table 15 Height of rails equipped with rail cover Unit: mm

Model No.	Standard height H_1	Cover installation
RA25	24	24.25
RA30	28	28.25
RA35	31	31.25
RA45	38	38.3
RA55	43.5	43.8
RA65	55	55.3

(5) Cap to plug the rail mounting bolt hole

Table 16 Caps to plug rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
RA15	M4	LG-CAP/M4	20
RA20	M5	LG-CAP/M5	20
RA25	M6	LG-CAP/M6	20
RA30, RA35	M8	LG-CAP/M8	20
RA45	M12	LG-CAP/M12	20
RA55	M14	LG-CAP/M14	20
RA65	M16	LG-CAP/M16	20

8. Reference number

Reference numbers shall be set to individual NSK linear guide when its specifications are finalized, and it is indicated on its specification drawing.
Please specify the reference number, except design serial number, to identify the product when ordering, requiring estimates, or inquiring about specifications from NSK.

(1) Reference number for preloaded assembly

RA 35 1000 AN C 2 - ** P6 3**

- Series name
- Size
- Rail length (mm)
- Roller slide shape code (See page A254.)
- Material/surface treatment code (See Table 17.)
  - C: Special high carbon steel (NSK standard)
- Number of roller slides per rail
- Design serial number
  - Added to the reference number.
- Accuracy code (See Table 18.)
- Preload code (See page A255.)
  - 1: Z1, 3: Z3

(2) Reference number for random-matching type

Roller slide

RAA 35 AN PH H -F

- Random-matching roller slide series code
  - RAA: RA Series random-matching roller slide
- Size
- Roller slide shape code (See page A254.)
- Accuracy code
  - PH, KH: High-precision grade random-matching type (See Table 18.)
- Preload code: Z
  - Z: Slight preload, H: Medium preload
- Option code
  - No code: No surface treatment
  - -F: Fluoride low temperature chrome plating
  - -C: No surface treatment + Rail cover
  - -CF: Fluoride low temperature chrome plating + Rail cover

Rail

R1A 35 1000 L C N - ** PH Z**

- Random-matching rail series code
  - R1A: RA Series random-matching rail
- Size
- Rail length (mm)
- Rail shape code: L
  - L: Standard
- Material/surface treatment code (See Table 17.)
- *Butting rail specification
  - N: Non-butting. L: Butting specification
- Design serial number
  - Added to the reference number.
- Accuracy code (See Table 18.)
  - PH: High-precision grade random-matching type
- Preload code: Z
  - Z: Common for slight and medium preload (See page A255.)

*Please consult with NSK for butting rail specification.

The reference number coding for the assembly of random-matching type is the same as that of the preloaded assembly. However, the applicable preload codes are "slight preload Z" and "medium preload H". (See page A255.)

Table 17 Material/surface treatment code

Code	Description
C	Special high carbon steel (NSK standard)
D	Special high carbon steel with surface treatment
Z	Other, special

Table 18 Accuracy code

Accuracy	Standard (Without NSK K1)	With NSK K1
Ultra precision grade	P3	K3
Super precision grade	P4	K4
High precision grade	P5	K5
Precision grade	P6	K6
High precision grade (Random-matching type)	PH	KH

Note: Refer to pages A38 for NSK K1 lubrication unit.

9. Dynamic friction

- Dynamic friction standard per ball slide is shown in table 19.
- The dynamic function under the actual situation, AS2 grease, NSK standard grease, impregnated into standard specification that two end seals, inner seal and bottom seal. Inner seals for models of RA15 and RA20 are available as option.
- Dynamic friction changed with the grease.

Table 19 Dynamite Friction

Unit: N

Model No.	High-load type	Super-high-load type
RA15	21	24
RA20	22	28
RA25	27	34
RA30	33	42
RA35	42	53
RA45	56	69
RA55	80	95
RA65	120	138

Note: Table 19 is standard.

10. Dimensions

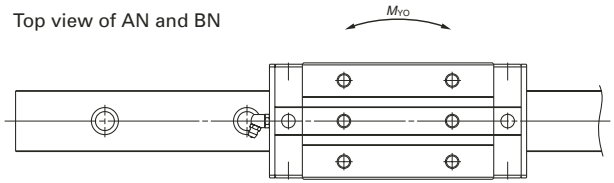
RA-AN (High-load type / Standard)

RA-BN (Super-high-load type / Long)

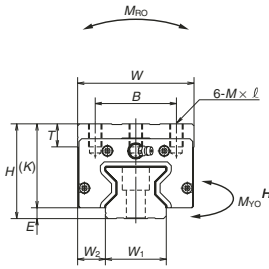
RA 35 1000 AN C 2 - PH H**

- Series name: RA
- Size: 35
- Rail length (mm): 1000
- Roller slide shape code (See page A254.): AN
- Material/surface treatment code (See Table 17.): C
  - C: Special high carbon steel (NSK standard)
- Number of roller slides per rail: 2
- Design serial number: -** (Added to the reference number.)
- Accuracy code (See Table 18.): PH
- Preload code (See page A255.): H
  - 1: Z1, 3: Z3, Z: ZZ, H: ZH

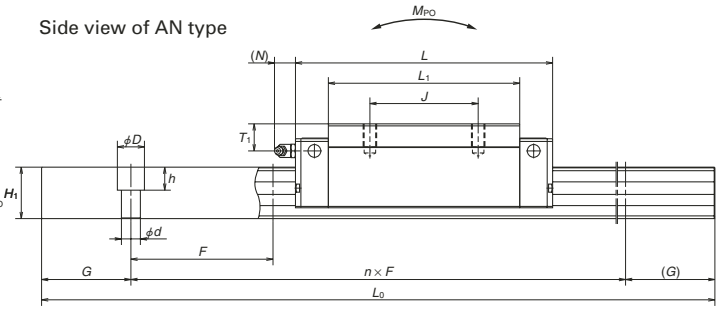
Top view of AN and BN



Front view of AN and BN types



Side view of AN type



Model No.	Assembly Height H	E	W_2	Ball slide Width W	Length L	Mounting hole B	J	M×pitch×ℓ	L_1	K	T	Grease fitting Hole size	T_1	N	Width W_1	Height H_1
RA15AN	28	4	9.5	34	70	26	26	M4×0.7×6	44.8	24	8	φ3	8	3	15	16.3
RA15BN					85.4				60.2							
RA20AN	30	5	12	44	86.5	32	36	M5×0.8×6	57.5	25	12	φ3	4	3	20	20.8
RA20BN					106.3		50		77.3							
RA25AN	40	5	12.5	48	97.5	35	35	M6×1×9	65.5	35	12	M6×0.75	10	11	23	24
RA25BN					115.5		50		83.5							
RA30AN	45	6.5	16	60	110.8	40	40	M8×1.25×11	74	38.5	14	M6×0.75	10	11	28	28
RA30BN					135.4		60		98.6							
RA35AN	55	6.5	18	70	123.8	50	50	M8×1.25×12	83.2	48.5	15	M6×0.75	15	11	34	31
RA35BN					152		72		111.4							
RA45AN	70	8	20.5	86	154	60	60	M10×1.5×17	105.4	62	17	Rc1/8	20	14	45	38
RA45BN					190		80		141.4							
RA55AN	80	9	23.5	100	184	75	75	M12×1.75×18	128	71	18	Rc1/8	21	14	53	43.5
RA55BN					234		95		178							
RA65AN	90	13	31.5	126	228.4	76	70	M16×2×20	155.4	77	22	Rc1/8	19	14	63	55
RA65BN					302.5		120		229.5							

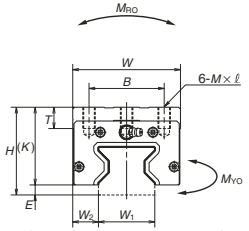
Notes: 1) Select either one of two F dimensions, the standard or the parenthesized semi-standard dimension, for the pitch of rail fixing bolt holes. If not specified, the standard dimension of F is applied.

Reference number for roller slide of random-matching type

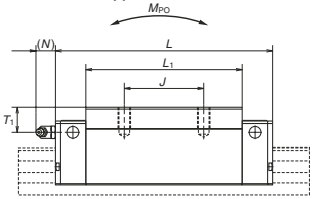
Ball slide **RAA 35 AN PH H -F**

- Random-matching roller slide series code: RAA (RAA: RA Series random-matching roller slide)
- Size: 35
- Roller slide shape code (See page A254.): AN
- Accuracy code: PH (PH, KH: High-precision grade random-matching type (See Table 18.))
- Preload code: H (Z: Slight preload, H: Medium preload)
- Option code: -F (No code: No surface treatment; -F: Fluoride low temperature chrome plating; -C: No surface treatment + Rail cover; -CF: Fluoride low temperature chrome plating + Rail cover)

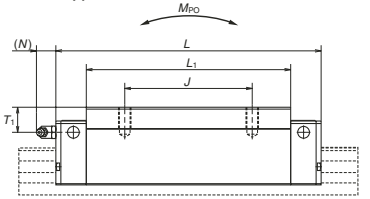
AN and BN types



AN type



BN type

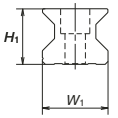


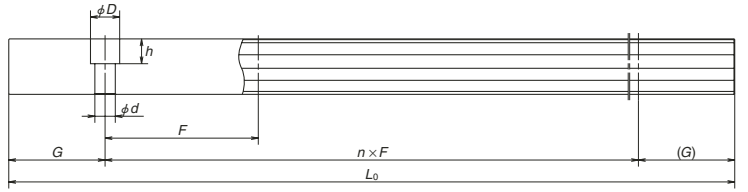
Reference number for rail of random-matching type

Rail **R1A35 1000 L C N -** PH Z**

- Random-matching rail series code: R1A (R1A: RA Series random-matching rail)
- Size: 35
- Rail length (mm): 1000
- Rail shape code: L (L: Standard)
- Material/surface treatment code (See Table 17.): C
- *Butting rail specification: N (N: Non-butting, L: Butting specification)
- Design serial number: -** (Added to the reference number.)
- Accuracy code: PH (PH: High-precision grade random-matching type)
- Preload code: Z (Z: Common for slight and medium preload (See A255.))

*Please consult with NSK for butting rail specification.





Unit: mm

Rail Pitch F	Mounting bolt hole d×D×h	G (reference)	Maximum length L_{0max}	Basic load rating [3]Dynamic [50km] C_{50}(N)	[100km] C_{100}(N)	Static C_0 (N)	Static moment (N·m) M_{RO}	M_{PO} One slide	M_{PO} Two slides	M_{YO} One slide	M_{YO} Two slides	Weight Ball slide (kg)	Rail (kg/m)
60	4.5×7.5×5.3	20	2 000	12 600	10 300	27 500	260	210	1 320	210	1 320	0.21	1.6
(30)				16 000	13 000	37 000	350	375	2 130	375	2 130	0.30	
60	6×9.5×8.5	20	3 000	23 600	19 200	52 500	665	505	3 100	505	3 100	0.38	2.6
(30)				29 500	24 000	70 000	890	900	5 000	900	5 000	0.50	
30	7×11×9	20	3 900	36 000	29 200	72 700	970	760	4 850	760	4 850	0.60	3.4
(60)				43 500	35 400	92 900	1 240	1 240	7 200	1 240	7 200	0.91	
40	9×14×12	20	3 900	47 800	38 900	93 500	1 670	1 140	7 100	1 140	7 100	1.0	4.9
(80)				58 500	47 600	121 000	2 170	1 950	11 500	1 950	11 500	1.3	
40	9×14×12	20	3 900	65 500	53 300	129 000	2 810	1 800	11 000	1 800	11 000	1.6	6.8
(80)				82 900	67 400	175 000	3 810	3 250	17 800	3 250	17 800	2.1	
52.5	14×20×17	22.5	3 650	114 000	92 800	229 000	6 180	4 080	24 000	4 080	24 000	3.0	10.9
(105)				143 000	116 000	305 000	8 240	7 150	39 000	7 150	39 000	4.1	
60	16×23×20	30	3 600	159 000	129 000	330 000	10 200	7 060	41 000	7 060	41 000	4.9	14.6
(120)				207 000	168 000	462 000	14 300	13 600	72 000	13 600	72 000	6.7	
75	18×26×22	35	3 600	259 000	210 000	504 000	19 200	12 700	78 500	12 700	78 500	9.3	22.0
(150)				355 000	288 000	756 000	28 700	28 600	153 000	28 600	153 000	12.2	

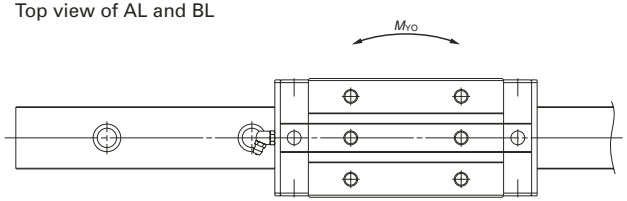
2) The random-matching type is available for the models of RA25 to RA65.
3) The basic load rating comply with the ISO standard. (ISO 14728-1, 14728-2)
C_{50}; the basic dynamic load rating for 50 km rated fatigue life
C_{100}; the basic dynamic load rating for 100 km rated fatigue life

RA-AL (High-load type / Standard)
RA-BL (Super-high-load type / Long)

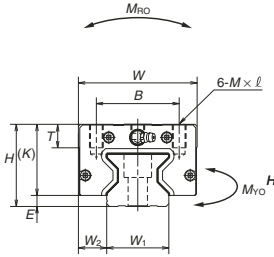
RA 35 1000 AL C 2 - PH H**

- Series name
- Size
- Rail length (mm)
- Roller slide shape code (See page A254.)
- Material/surface treatment code (See Table 17.)
  C: Special high carbon steel (NSK standard)
- Number of roller slides per rail
- Design serial number
  Added to the reference number.
- Accuracy code (See Table 18.)
- Preload code (See page A255.)
  1: Z1, 3: Z3, Z: ZZ, H: ZH

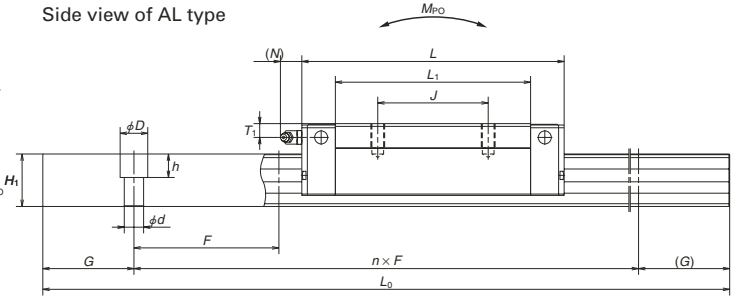
Top view of AL and BL



Front view of AL and BL types



Side view of AL type



Model No.	Assembly Height H	E	W_2	Ball slide Width W	Length L	Mounting hole B	J	M× pitch × ℓ	L_1	K	T	Grease fitting Hole size	T_1	N	Width W_1	Height H_1
RA15AL	24	4	9.5	34	70	26	26	M4×0.7×5.5	44.8	20	8	ϕ3	4	3	15	16.3
RA15BL					85.4				60.2							
RA25AL	36	5	12.5	48	97.5	35	35	M6×1×8	65.5	31	12	M6×0.75	6	11	23	24
RA25BL					115.5		50		83.5							
RA30AL	42	6.5	16	60	110.8	40	40	M8×1.25×11	74	35.5	14	M6×0.75	7	11	28	28
RA30BL					135.4		60		98.6							
RA35AL	48	6.5	18	70	123.8	50	50	M8×1.25×12	83.2	41.5	15	M6×0.75	8	11	34	31
RA35BL					152		72		111.4							
RA45AL	60	8	20.5	86	154	60	60	M10×1.5×16	105.4	52	17	Rc1/8	10	14	45	38
RA45BL					190		80		141.4							
RA55AL	70	9	23.5	100	184	75	75	M12×1.75×18	128	61	18	Rc1/8	11	14	53	43.5
RA55BL					234		95		178							

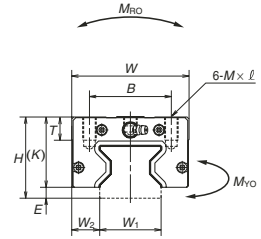
Notes: 1) Select either one of two F dimensions, the standard or the parenthesized semi-standard dimension, for the pitch of rail fixing bolt holes. If not specified, the standard dimension of F is applied.

Reference number for roller slide of random-matching type

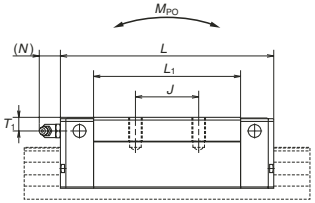
Ball slide **RAA 35 AL PH H -F**

- Random-matching roller slide series code
  RAA: RA Series random-matching roller slide
- Size
- Roller slide shape code (See page A254.)
- Option code
  No code: No surface treatment
  -F: Fluoride low temperature chrome plating
  -C: No surface treatment + Rail cover
  -CF: Fluoride low temperature chrome plating + Rail cover
- Preload code: Z
  Z: Slight preload, H: Medium preload
- Accuracy code
  PH, KH: High-precision grade random-matching type (See Table 18.)

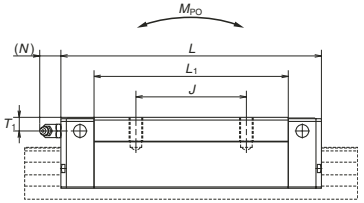
AL and BL types



AL type



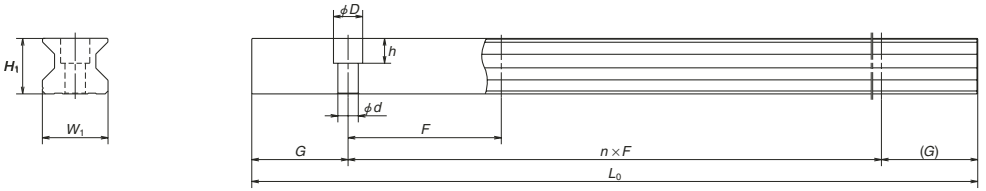
BL type



Reference number for rail of random-matching type

Rail **R1A35 1000 L C N -** PH Z**

- Random-matching rail series code
  R1A: RA Series random-matching rail
- Size
- Rail length (mm)
- Rail shape code: L
  L: Standard
- Material/surface treatment code (See Table 17.)
- *Butting rail specification
  N: Non-butting. L: Butting specification
  *Please consult with NSK for butting rail specification.
- Design serial number
  Added to the reference number.
- Accuracy code
  PH: High-precision grade random-matching type.
- Preload code: Z
  Z: Common for slight and medium preload (See A255.)



Unit: mm

Rail Pitch F	Mounting bolt hole d×D×h	G (reference)	Maximum length L_{0max}	Basic load rating [3]Dynamic [50km] C_{50}(N)	[100km] C_{100}(N)	Static C_0 (N)	Static moment (N·m) M_{RO}	M_{PO} One slide	M_{PO} Two slides	M_{YO} One slide	M_{YO} Two slides	Weight Ball slide (kg)	Rail (kg/m)
60	4.5×7.5×5.3	20	2 000	12 600	10 300	27 500	260	210	1 320	210	1 320	0.17	1.6
(30)				16 000	13 000	37 000	350	375	2 130	375	2 130	0.25	
30	7×11×9	20	3 900	36 000	29 200	72 700	970	760	4 850	760	4 850	0.45	3.4
(60)				43 500	35 400	92 900	1 240	1 240	7 200	1 240	7 200	0.80	
40	9×14×12	20	3 900	47 800	38 900	93 500	1 670	1 140	7 100	1 140	7 100	0.85	4.9
(80)				58 500	47 600	121 000	2 170	1 950	11 500	1 950	11 500	1.1	
40	9×14×12	20	3 900	65 500	53 300	129 000	2 810	1 800	11 000	1 800	11 000	1.2	6.8
(80)				82 900	67 400	175 000	3 810	3 250	17 800	3 250	17 800	1.7	
52.5	14×20×17	22.5	3 650	114 000	92 800	229 000	6 180	4 080	24 000	4 080	24 000	2.5	10.9
(105)				143 000	116 000	305 000	8 240	7 150	39 000	7 150	39 000	3.4	
60	16×23×20	30	3 600	159 000	129 000	330 000	10 200	7 060	41 000	7 060	41 000	4.1	14.6
(120)				207 000	168 000	462 000	14 300	13 600	72 000	13 600	72 000	5.7	

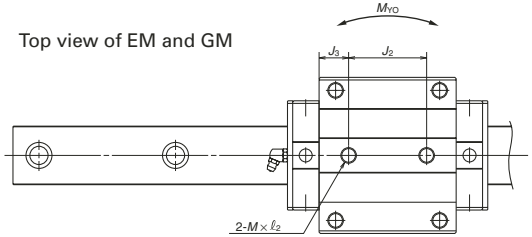
2) The random-matching type is available for the models of RA25 to RA55.
3) The basic load rating comply with the ISO standard. (ISO 14728-1, 14728-2)
C_{50}; the basic dynamic load rating for 50 km rated fatigue life
C_{100}; the basic dynamic load rating for 100 km rated fatigue life

RA-EM (High-load type / Standard)
RA-GM (Super-high-load type / Long)

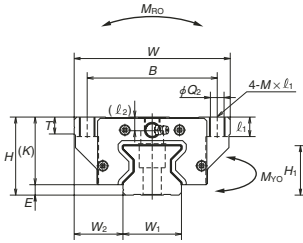
RA 35 1000 EM C 2 - PH H**

- Series name: RA
- Size: 35
- Rail length (mm): 1000
- Roller slide shape code (See page A254.): EM
- Material/surface treatment code (See Table 17.): C
  - C: Special high carbon steel (NSK standard)
- Number of roller slides per rail: 2
- Design serial number: -**
  - Added to the reference number.
- Accuracy code (See Table 18.): PH
- Preload code (See page A255.): H
  - 1: Z1, 3: Z3, Z: ZZ, H: ZH

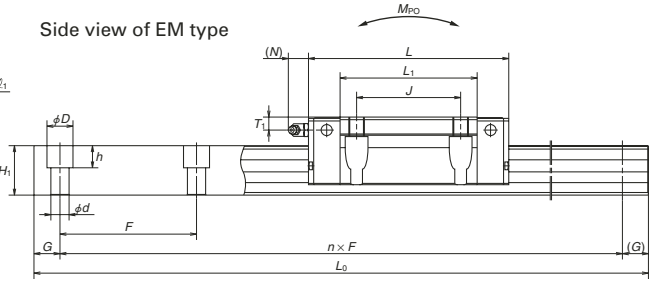
Top view of EM and GM



Front view of EM and GM types



Side view of EM type



Model No.	Assembly Height H	E	W_2	Ball slide Width W	Length L	Mounting hole B	J	J_2	$M\times$pitch$\times\ell_1(\ell_2)$	O_2	L_1	K	T	Grease fitting Hole size	T_1	N
RA15EM	24	4	16	47	70	38	30	26	M5×0.8×8.5 (6.5)	4.4	44.8	20	8	ϕ3	4	3
RA15GM					85.4						60.2					
RA20EM	30	5	21.5	63	86.5	53	40	35	M6×1×9.5 (8)	5.3	57.5	25	10	ϕ3	4	3
RA20GM					106.3						77.3					
RA25EM	36	5	23.5	70	97.5	57	45	40	M8×1.25×10 (11)	6.8	65.5	31	11	M6×0.75	6	11
RA25GM					115.5						83.5					
RA30EM	42	6.5	31	90	110.8	72	52	44	M10×1.5×12 (12.5)	8.6	74	35.5	11	M6×0.75	7	11
RA30GM					135.4						98.6					
RA35EM	48	6.5	33	100	123.8	82	62	52	M10×1.5×13 (7)	8.6	83.2	41.5	12	M6×0.75	8	11
RA35GM					152						111.4					
RA45EM	60	8	37.5	120	154	100	80	60	M12×1.75×15 (10.5)	10.5	105.4	52	13	Rc1/8	10	14
RA45GM					190						141.4					
RA55EM	70	9	43.5	140	184	116	95	70	M14×2×18 (13)	12.5	128	61	15	Rc1/8	11	14
RA55GM					234						178					
RA65EM	90	13	53.5	170	228.4	142	110	82	M16×2×24 (18.5)	14.6	155.4	77	22	Rc1/8	19	14
RA65GM					302.5						229.5					

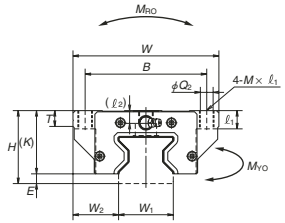
Notes: 1) Select either one of two F dimensions, the standard or the parenthesized semi-standard dimension, for the pitch of rail fixing bolt holes. If not specified, the standard dimension of F is applied.

Reference number for roller slide of random-matching type

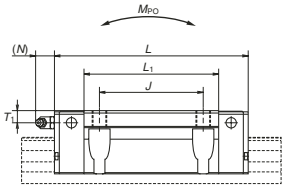
Ball slide RAA 35 EM PH H -F

- Random-matching roller slide series code: RAA
  - RAA: RA Series random-matching roller slide
- Size: 35
- Roller slide shape code (See page A254.): EM
- Option code: -F
  - No code: No surface treatment
  - -F: Fluoride low temperature chrome plating
  - -C: No surface treatment + Rail cover
  - -CF: Fluoride low temperature chrome plating + Rail cover
- Preload code: H
  - Z: Slight preload, H: Medium preload.
- Accuracy code: PH
  - PH, KH: High-precision grade random-matching type (See table 18.)

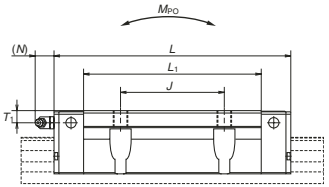
EM and GM types



EM type



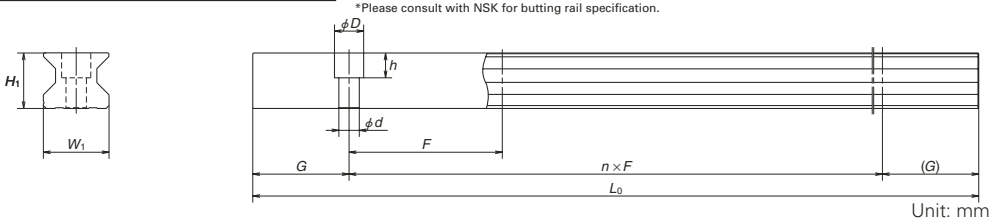
GM type



Reference number for rail of random-matching type

Rail R1A35 1000 L C N - PH Z**

- Random-matching rail series code: R1A
  - R1A: RA Series random-matching rail
- Size: 35
- Rail length (mm): 1000
- Rail shape code: L
  - L: Standard
- Material/surface treatment code (See Table 17.): C
- *Butting rail specification: N
  - N: Non-butting. L: Butting specification
  - *Please consult with NSK for butting rail specification.
- Design serial number: -**
  - Added to the reference number.
- Accuracy code: PH
  - PH: High-precision grade random-matching type.
- Preload code: Z
  - Z: Common for slight and medium preload (See A255)



Unit: mm

Rail Width W_1	Height H_1	Pitch F	Mounting bolt hole $d\times D\times h$	G reference	Maximum length L_{0max}	Basic load rating [3]Dynamic [50km] C_{50}(N)	[100km] C_{100}(N)	Static C_0 (N)	Static moment (N·m) M_{RO}	M_{PO} One slide	M_{PO} Two slides	M_{YO} One slide	M_{YO} Two slides	Weight Ball slide (kg)	Rail (kg/m)
15	16.3	60	4.5×7.5×5.3	20	2 000	12 600	10 300	27 500	260	210	1 320	210	1 320	0.21	1.6
		(30)				16 000	13 000	37 000	350	375	2 130	375	2 130	0.28	
20	20.8	60	6×9.5×8.5	20	3 000	23 600	19 200	52 500	665	505	3 100	505	3 100	0.45	2.6
		(30)				29 500	24 000	70 000	890	900	5 000	900	5 000	0.65	
23	24	30	7×11×9	20	3 900	36 000	29 200	72 700	970	760	4 850	760	4 850	0.80	3.4
		(60)				43 500	35 400	92 900	1 240	1 240	7 200	1 240	7 200	1.1	
28	28	40	9×14×12	20	3 900	47 800	38 900	93 500	1 670	1 140	7 100	1 140	7 100	1.3	4.9
		(80)				58 500	47 600	121 000	2 170	1 950	11 500	1 950	11 500	1.7	
34	31	40	9×14×12	20	3 900	65 500	53 300	129 000	2 810	1 800	11 000	1 800	11 000	1.7	6.8
		(80)				82 900	67 400	175 000	3 810	3 250	17 800	3 250	17 800	2.3	
45	38	52.5	14×20×17	22.5	3 650	114 000	92 800	229 000	6 180	4 080	24 000	4 080	24 000	3.2	10.9
		(105)				143 000	116 000	305 000	8 240	7 150	39 000	7 150	39 000	4.3	
53	43.5	60	16×23×20	30	3 600	159 000	129 000	330 000	10 200	7 060	41 000	7 060	41 000	5.4	14.6
		(120)				207 000	168 000	462 000	14 300	13 600	72 000	13 600	72 000	7.5	
63	55	75	18×26×22	35	3 600	259 000	210 000	504 000	19 200	12 700	78 500	12 700	78 500	12.2	22.0
		(150)				355 000	288 000	756 000	28 700	28 600	153 000	28 600	153 000	16.5	

2) The random-matching type is available for the models of RA25 to RA65.
3) The basic load rating comply with the ISO standard. (ISO 14728-1, 14728-2)
C_{50}; the basic dynamic load rating for 50 km rated fatigue life
C_{100}; the basic dynamic load rating for 100 km rated fatigue life

A-5-3.2 LA Series

1. Features

(1) High rigidity and high load carrying capacity

A set of three ball grooves is made on both sides of ball slide and a rail. This contributes to the increased rigidity and load carrying capacity. The top and bottom groove are formed in the circular arc with a closer radius of ball, which ensures great rigidity and load carrying capacity. With the Gothic arch center groove, rigidity and load carrying capacity are further increased.

(2) Moderate friction

A well-balanced combination of 2-point contacts at the top and bottom grooves and 4 points contact at the center groove provides moderate friction while ensuring rigidity by appropriate preload.

(3) Four-way equal load distribution

The contact angle of balls is set at 45 degrees in all grooves, thereby dispersing the load equally to four rows irrespective of load direction. This realizes equal rigidity and load carrying capacity in vertical and lateral directions and provides well-balanced design.

(4) Strong against shock load

Load from any direction, vertical and lateral, is received by four ball rows at all times. The number of the ball rows which receive the load is larger than in other linear guides, making this series stronger against shock load.

(5) High accuracy

As showing in **Fig. 4**, fixing the measuring rollers is easy thanks to the Gothic arch groove of the central ball groove. This benefits an accurate and measuring of ball groove for a highly precise and stable manufacturing.

(6) The dust protection design

The rail's cross section is designed as simple as possible, thereby improving the sealing efficiency combined with the enhanced sealing function. In addition, optional inner seals are available.

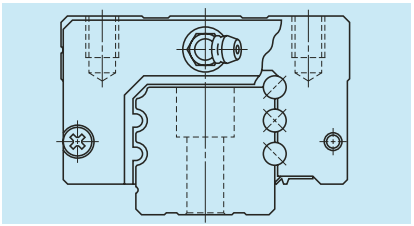


Fig. 1 LA Series

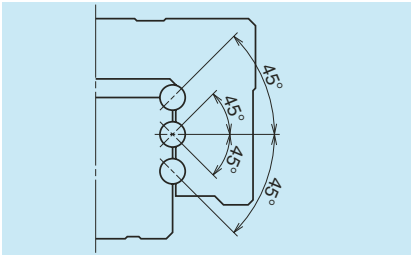


Fig. 2 Super rigidity design

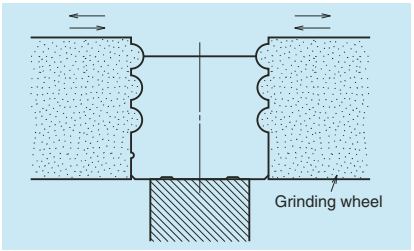


Fig. 3 Rail grinding

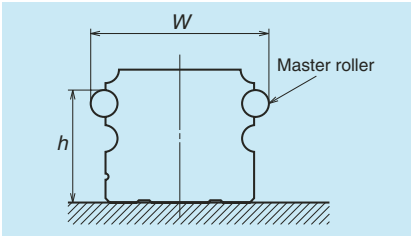
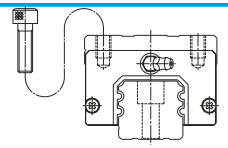
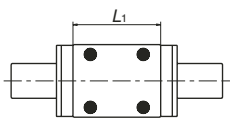
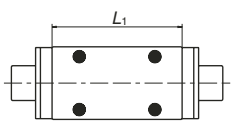
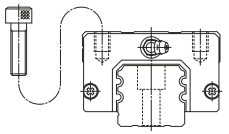
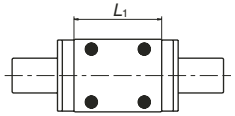
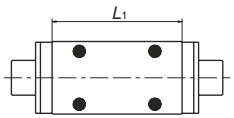
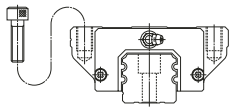
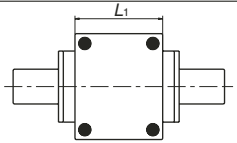
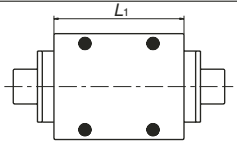
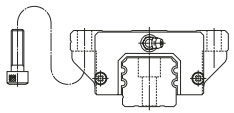
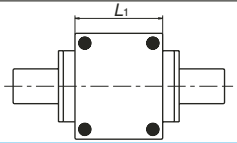
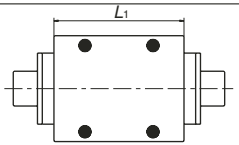


Fig. 4 Measuring groove accuracy

2. Ball slide shape

Ball slide Model	Shape/installation method	Type (Upper row, Rating: Lower row, Ball slide length)	
		High-load type	Super-high-load type
		Standard	Long
AN BN		AN 	BN 
AL BL		AL 	BL 
EL GL		EL 	GL 
FL HL		FL 	HL 

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

Rail length (mm) over	or less	Preloaded assembly (not random matching) Ultra precision P3	Super precision P4	High precision P5	Precision grade P6
–	50	2	2	2	4.5
50	80	2	2	3	5
80	125	2	2	3.5	5.5
125	200	2	2	4	6
200	250	2	2.5	5	7
250	315	2	2.5	5	8
315	400	2	3	6	9
400	500	2	3	6	10
500	630	2	3.5	7	12
630	800	2	4.5	8	14
800	1 000	2.5	5	9	16
1 000	1 250	3	6	10	17
1 250	1 600	4	7	11	19
1 600	2 000	4.5	8	13	21
2 000	2 500	5	10	15	22
2 500	3 150	6	11	17	25
3 150	4 000	9	16	23	30

(2) Accuracy standard

The LA Series has four accuracy grades: Ultra precision P3, Super precision P4, High precision P5, and Precision grade P6.

Table 2 Unit: μm

Characteristics \ Accuracy grade	Ultra precision P3	Super precision P4	High precision P5	Precision grade P6
Mounting height *H* Variation of *H* (All ball slides on a set of rails)	±10 3	±10 5	±20 7	±40 15
Mounting width W_2 or W_3 Variation of W_2 or W_3 (All ball slides on reference rail)	±15 3	±15 7	±25 10	±50 20
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	Shown in **Table 1** and **Fig. 5**			

(3) Assembled accuracy

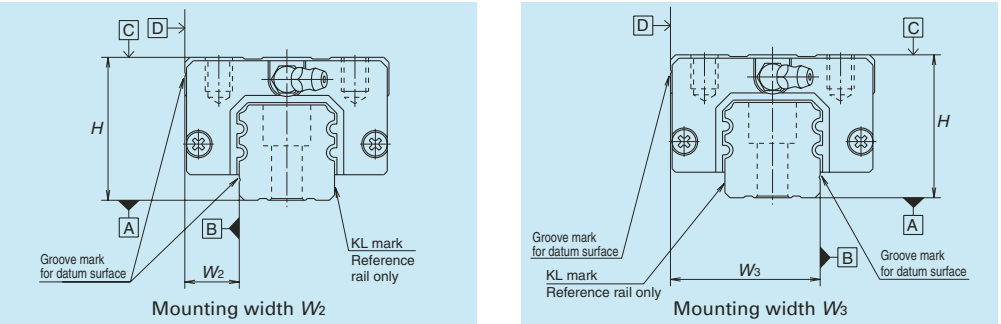


Fig. 5

4. Preload and rigidity

Table 3 shows preload and rigidity of LA Series.

The LA Series has two types of preload specification: Medium preload Z3 and Heavy preload Z4.

Table 3

	Model No.	Preload (N)		Rigidity (N/μm)	
		Medium preload Z3	Heavy preload Z4	Medium preload Z3	Heavy preload Z4
High-load type	LA25 AL, AN, EL, FL	1 670	2 110	475	550
	LA30 AL, AN, EL, FL	2 450	3 140	705	835
	LA35 AL, AN, EL, FL	3 450	4 300	825	970
	LA45 AL, AN, EL, FL	5 050	6 350	1 100	1 240
	LA55 AL, AN, EL, FL	8 100	10 200	1 400	1 540
	LA65 AN, EL, FL	13 800	18 800	1 730	2 030
Super-high-load type	LA25 BL, BN, GL, HL	2 260	2 840	700	820
	LA30 BL, BN, GL, HL	3 250	4 050	1 000	1 180
	LA35 BL, BN, GL, HL	4 450	5 650	1 200	1 400
	LA45 BL, BN, GL, HL	6 150	7 750	1 450	1 640
	LA55 BL, BN, GL, HL	9 550	12 100	1 840	2 020
	LA65 BN, GL, HL	18 000	24 400	2 450	2 840

4. Maximum rail length

Table 4 shows the limitations of rail length. However, the limitations vary by accuracy grades.

Table 4 Length limitations of rails Unit: mm

Series \ Size	25	30	35	45	55	65
LA	3 960	4 000	4 000	3 990	3 960	3 900

Note: Rails can be butted if user requirement exceeds the rail length shown in the table. Please consult NSK.

5. Installation

(1) Permissible values of mounting error

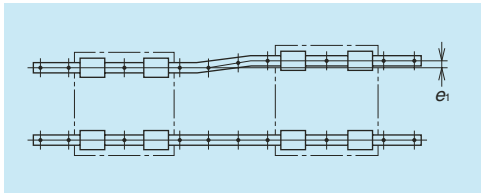


Fig. 6

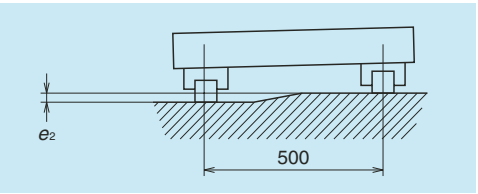


Fig. 7

Table 5 Unit: μm

Value	Preload	Model No.					
		LA25	LA30	LA35	LA45	LA55	LA65
Permissible values of parallelism in two rails e_1	Z3	15	17	20	25	30	40
	Z4	13	15	17	20	25	30
Permissible values of parallelism (height) in two rails e_2	Z3, Z4	185 μm/500 mm					

(2) Shoulder height of the mounting surface and corner radius r

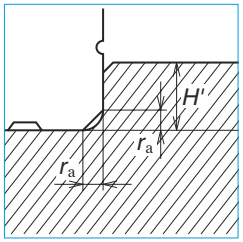


Fig. 8 Shoulder for the rail datum surface

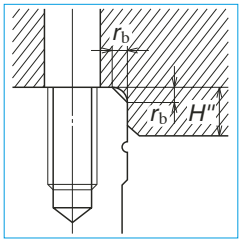


Fig. 9 Shoulder for the ball slide datum surface

Table 6 Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H'	H''
LA25	0.5	0.5	5	5
LA30	0.5	0.5	6	6
LA35	0.5	0.5	6	6
LA45	0.7	0.7	8	8
LA55	0.7	0.7	10	10
LA65	1	1	11	11

6. Lubrication components

Refer to pages A38 and D13 for the lubrication of linear guides.

(1) Types of lubrication accessories

Fig. 10 and **Table 7** show grease fittings and tube fittings.

(2) Mounting position of lubrication accessories

- The standard position of grease fittings is the end face of ball slide. We mount them on a side of end cap for an option. (**Fig. 11**) .
- Please consult NSK for installation of grease or tube fittings to the ball slide body or side of end cap.
- When using a piping unit with thread of M6 × 1, you require a connector to connect to a grease fitting mounting hole with M6 × 0.75. The connector is available from NSK.

Table 7 Unit: mm

Model No.	Dust proof specification	Grease fitting	Tube fitting
		Thread body length L	Thread body length L
LA25	Standard	5	5
	With NSK K1	14	12
	Double seal	10	9
	Protector	10	9
LA30	Standard	5	6
	With NSK K1	14	13
	Double seal	12	11
	Protector	12	11
LA35	Standard	5	6
	With NSK K1	14	13
	Double seal	12	11
	Protector	12	11
LA45	Standard	8	17
	With NSK K1	18	21.5
	Double seal	14	17
	Protector	14	17
LA55	Standard	8	17
	With NSK K1	18	21.5
	Double seal	14	17
	Protector	14	17
LA65	Standard	8	17
	With NSK K1	22	25.5
	Double seal	16	19
	Protector	16	17

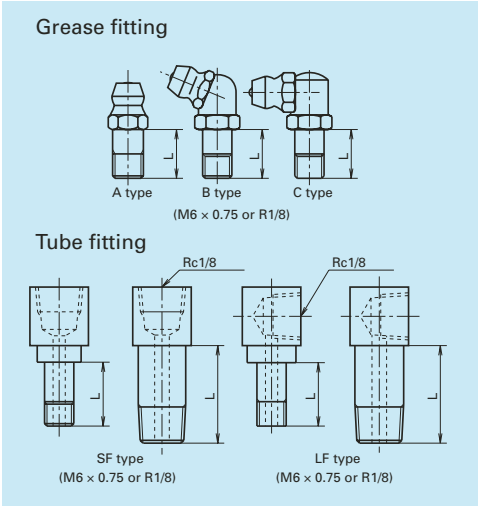


Fig. 10 Grease fitting and tube fitting

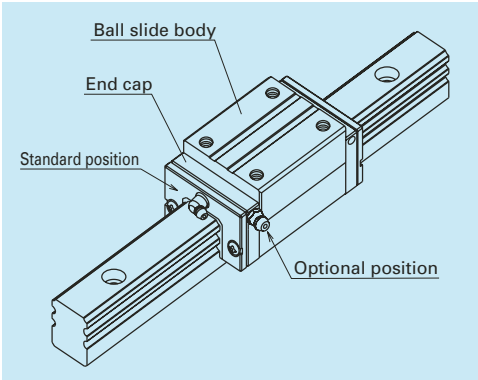


Fig. 11 Mounting position of lubrication accessories

7. Dust-proof components

(1) Standard Specification

The LA Series can be readily used as they have a dust protection means for normal conditions. As the standard equipment, the ball slides have an end seal on both ends, and bottom seals at the bottom.

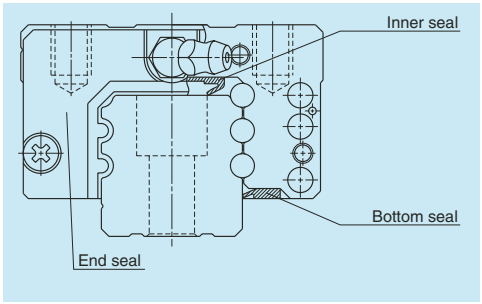


Fig. 12

Table 8 Seal friction per ball slide (maximum value) Unit: N

Series \ Size	25	30	35	45	55	65
LA	11	11	12	17	17	23

(2) NSK K1™ lubrication unit

Table 9 shows the dimension of linear guides equipped with the NSK K1 lubrication unit.

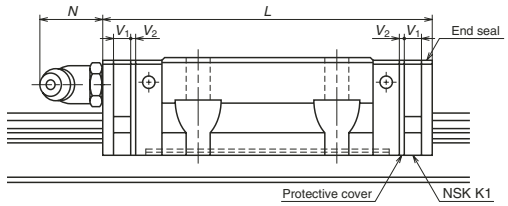


Table 9 Unit: mm

Model No.	Ball slide length	Ball slide model	Standard ball slide length	Ball slide length installed with two NSK K1 *L*	Per NSK K1 thickness V_1	Protective cover thickness V_2	Protruding area of the grease fitting *N*
LA25	Standard	AL, AN, EL, FL	79.8	91.8	5.0	1.0	(14)
	Long	BL, BN, GL, HL	107.8	119.8			
LA30	Standard	AL, AN, EL, FL	100.2	113.2	5.5	1.0	(14)
	Long	BL, BN, GL, HL	126.2	139.2			
LA35	Standard	AL, AN, EL, FL	110.6	123.6	5.5	1.0	(14)
	Long	BL, BN, GL, HL	144.6	157.6			
LA45	Standard	AL, AN, EL, FL	141.4	156.4	6.5	1.0	(15)
	Long	BL, BN, GL, HL	173.4	188.4			
LA55	Standard	AL, AN, EL, FL	165.4	180.4	6.5	1.0	(15)
	Long	BL, BN, GL, HL	203.4	218.4			
LA65	Standard	AN, EL, FL	196.2	214.2	8.0	1.0	(16)
	Long	BN, GL, HL	256.2	274.2			

Note: Ball slide length equipped with NSK K1 = (Standard ball slide length) + (Thickness of NSK K1, V_1 × Number of NSK K1) + (Thickness of the protective cover V_2 × 2)

(3) Double seal and protector

For the LA Series, a double seal and a protector can be installed only before shipping from the factory. Please consult with NSK when the double seal and the protectors are required.

Table 10 shows the increased thickness of V_3 and V_4 when end seals and protectors are installed (**Fig. 15**).

Table 10

Unit: mm

Model No.	Thickness of end seal: V_3	Thickness of protector: V_4
LA25	3.2	3.6
LA30	4.4	4.2
LA35	4.4	4.2
LA45	5.5	4.9
LA55	5.5	4.9
LA65	6.5	5.5

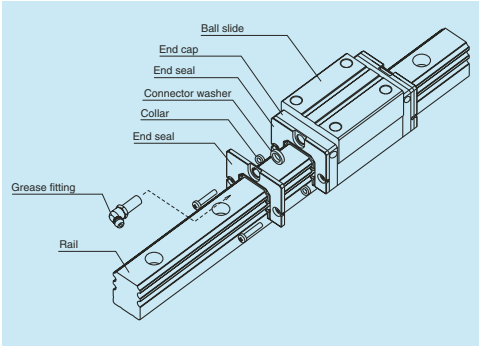


Fig. 13 Double seal

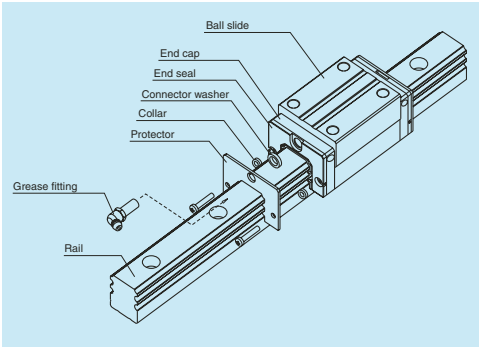


Fig. 14 Protector

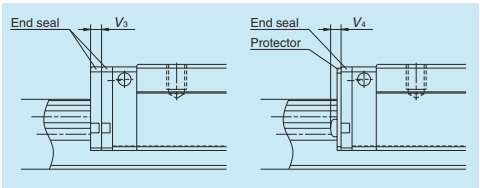


Fig. 15

(4) Cap to plug the rail mounting bolt hole

Table 11 Caps to plug rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
LA25	M6	LG-CAP/M6	20
LA30, LA35	M8	LG-CAP/M8	20
LA45	M12	LG-CAP/M12	20
LA55	M14	LG-CAP/M14	20
LA65	M16	LG-CAP/M16	20

(5) Bellows

Make tap holes to the rail end face to fix the bellows mounting plate.

NSK processes tap holes to the rail end face when ordered with a linear guide.

Dimension tables of bellows
LA Series

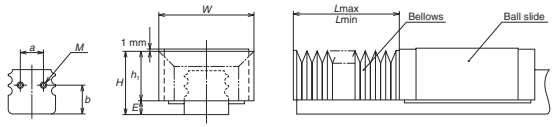


Fig. 16 Dimensions of bellows

Bellows reference number

J A A 30 L 08

- Bellows
- A: Bellows for the ends
- B: Middle bellows
- Bellows for LA series
- Number of BL (fold number)
- N: High type L: Low type
- Size number of linear guide

Table 12 Dimensions of bellows

Unit: mm

Model No.	*H*	h_1	*E*	*W*	*P*	*a*	*b*	Length of BL	Tap (M) × depth
JAA25L	35	29.5	5.5	55	12	12	13.8	17	M3 × 5
JAA25N	39	33.5	5.5	61	15	12	13.8	17	M3 × 5
JAA30L	41	33.5	7.5	60	12	14	17.5	17	M4 × 6
JAA30N	44	36.5	7.5	66	15	14	17.5	17	M4 × 6
JAA35L	47	39.5	7.5	72	15	15	18.8	17	M4 × 6
JAA35N	54	46.5	7.5	82	20	15	18.8	17	M4 × 6
JAA45L	59	49	10	93	20	25	22.5	17	M5 × 8
JAA45N	69	59	10	113	30	25	22.5	17	M5 × 8
JAA55L	69	57	12	101	20	35	27.1	17	M5 × 8
JAA55N	79	67	12	121	30	35	27.1	17	M5 × 8
JAA65N	89	75	14	131	30	40	33.3	17	M6 × 12

Table 13 Numbers of folds (BL) and length of bellows

Unit: mm

Type	Model No.	Length of BL	2	4	6	8	10	12	14	16	18	20
		L_{min}	34	68	102	136	170	204	238	272	306	340
Low type	JAA25L	Stroke	134	268	402	536	670	804	938	1 072	1 206	1 340
		L_{max}	168	336	504	672	840	1 008	1 176	1 344	1 512	1 680
High type	JAA25N	Stroke	176	352	528	704	880	1 056	1 232	1 408	1 584	1 760
		L_{max}	210	420	630	840	1 050	1 260	1 470	1 680	1 890	2 100
Low type	JAA30L	Stroke	134	268	402	536	670	804	938	1 072	1 206	1 340
		L_{max}	168	336	504	672	840	1 008	1 176	1 344	1 512	1 680
High type	JAA30N	Stroke	176	352	528	704	880	1 056	1 232	1 408	1 584	1 760
		L_{max}	210	420	630	840	1 050	1 260	1 470	1 680	1 890	2 100
Low type	JAA35L	Stroke	176	352	528	704	880	1 056	1 232	1 408	1 584	1 760
		L_{max}	210	420	630	840	1 050	1 260	1 470	1 680	1 890	2 100
High type	JAA35N	Stroke	246	492	738	984	1 230	1 476	1 722	1 968	2 214	2 460
		L_{max}	280	560	840	1 120	1 400	1 680	1 960	2 240	2 520	2 800
Low type	JAA45L	Stroke	246	492	738	984	1 230	1 476	1 722	1 968	2 214	2 460
		L_{max}	280	560	840	1 120	1 400	1 680	1 960	2 240	2 520	2 800
High type	JAA45N	Stroke	386	772	1 158	1 544	1 930	2 316	2 702	3 088	3 474	3 860
		L_{max}	420	840	1 260	1 680	2 100	2 520	2 940	3 360	3 780	4 200
Low type	JAA55L	Stroke	246	492	738	984	1 230	1 476	1 722	1 968	2 214	2 460
		L_{max}	280	560	840	1 120	1 400	1 680	1 960	2 240	2 520	2 800
High type	JAA55N	Stroke	386	772	1 158	1 544	1 930	2 316	2 702	3 088	3 474	3 860
		L_{max}	420	840	1 260	1 680	2 100	2 520	2 940	3 360	3 780	4 200
Low/high type	JAA65N*	Stroke	386	772	1 158	1 544	1 930	2 316	2 702	3 088	3 474	3 860
		L_{max}	420	840	1 260	1 680	2 100	2 520	2 940	3 360	3 780	4 200

* Bellows for LA65 is for both low and high types.

Note : The values of an odd number BL quantity (3, 5, 7, ...) can be obtained by adding two values of the even number BL on the both sides, then by dividing the sum by 2.

8. Reference number

Reference numbers shall be set to individual NSK linear guide when its specifications are finalized, and it is indicated on its specification drawing.
Please specify the reference number, except design serial number, to identify the product when ordering, requiring estimates, or inquiring about specifications from NSK.

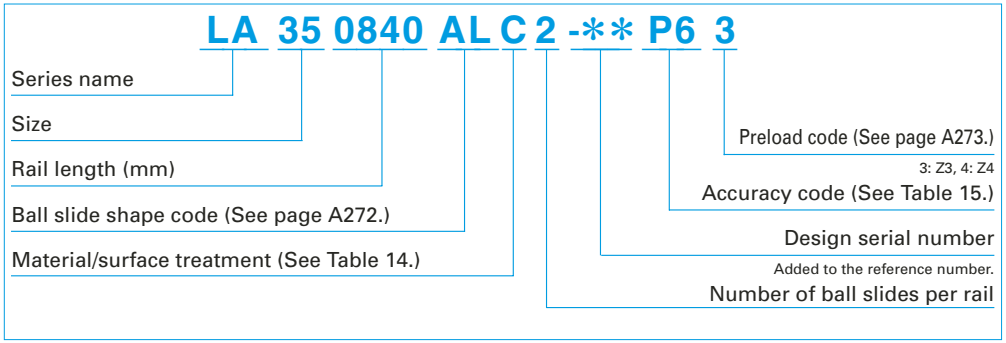


Table 14 Material/surface treatment code

Code	Description
C	Special high carbon steel (NSK standard)
D	Special high carbon steel with surface treatment
Z	Other, special

Table 15 Accuracy code

Accuracy	Standard (Without NSK K1)	With NSK K1
Ultra precision grade	P3	K3
Super precision grade	P4	K4
High precision grade	P5	K5
Precision grade	P6	K6

Note: Refer to pages A38 for NSK K1 lubrication unit.

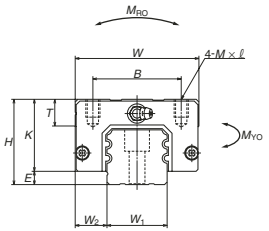
9. Dimensions

LA-AL (High-load type / Standard)
LA-BL (Super-high-load type / Long)

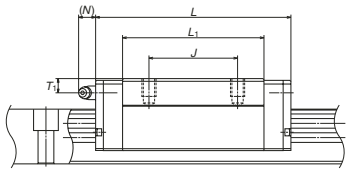
LA 35 0840 AL C 2 - ** P6 3**

- Series name
- Size
- Rail length (mm)
- Ball slide shape code (See page A272.)
- Material/surface treatment (See Table 14.)
- Number of ball slides per rail
- Added to the reference number.
- Design serial number
- Accuracy code (See Table 15.)
- 3: Z3, 4: Z4
- Preload code (See page A273.)

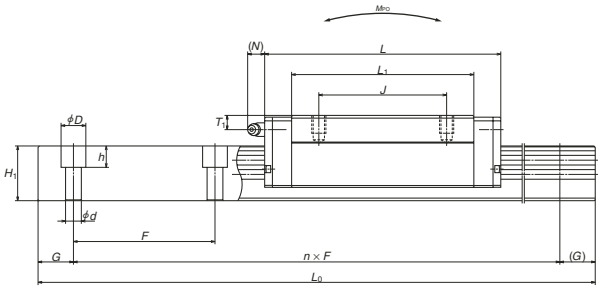
Front view of AL and BL types



Side view of AL type



Side view of BL type



Unit: mm

Model No.	Assembly Height H	E	W_2	Ball slide Width W	Length L	Mounting hole B	J	M × pitch × ℓ	L_1	K	T	Grease fitting Hole size	T_1	N	Width W_1	Height H_1
LA25AL	36	5.5	12.5	48	79.8	35	35	M6×1×7	58	30.5	8	M6×0.75	6	11	23	22
LA25BL					107.8		50		86							
LA30AL	42	7.5	16	60	100.2	40	40	M8×1.25×10	72	34.5	11	M6×0.75	6.5	11	28	28
LA30BL					126.2		60		98							
LA35AL	48	7.5	18	70	110.6	50	50	M8×1.25×10	80	40.5	15	M6×0.75	8	11	34	30.8
LA35BL					144.6		72		114							
LA45AL	60	10	20.5	86	141.4	60	60	M10×1.5×16	105	50	17	Rc1/8	10	13	45	36
LA45BL					173.4		80		137							
LA55AL	70	12	23.5	100	165.4	75	75	M12 × 1.75×16	126	58	18	Rc1/8	11	13	53	43.2
LA55BL					203.4		95		164							

Notes: 1) LA Series does not have a ball retainer. Be aware that balls fall out when the ball slide is withdrawn from the rail.

Rail Pitch F	Mounting bolt hole d × D × h	G (reference)	Max. length L_{0max}	Basic load rating 2)Dynamic [50km] C_{50}(N)	[100km] C_{100}(N)	Static C_0 (N)	Static moment (N·m) M_{RO}	M_{PO} One slide	M_{PO} Two slides	M_{YO} One slide	M_{YO} Two slides	Weight Ball slide (kg)	Rail (kg/m)
60	7×11×9	20	3 960	30 000	23 900	50 000	290	410	2 490	410	2 490	0.5	3.7
				40 500	32 500	77 000	445	935	5 000	935	5 000	0.8	
80	9×14×12	20	4 000	47 000	37 000	77 500	535	820	4 800	820	4 800	0.8	5.8
				58 000	46 000	105 000	725	1 470	8 050	1 470	8 050	1.2	
80	9×14×12	20	4 000	61 500	49 000	98 000	845	1 130	6 750	1 130	6 750	1.3	7.7
				80 500	64 000	143 000	1 240	2 330	12 500	2 330	12 500	1.6	
105	14×20×17	22.5	3 990	91 000	72 000	148 000	1 840	2 210	12 900	2 210	12 900	2.5	12.0
				111 000	88 000	197 000	2 460	3 850	20 600	3 850	20 600	3.2	
120	16×23×20	30	3 960	139 000	111 000	215 000	3 150	3 800	22 000	3 800	22 000	3.9	17.2
				172 000	137 000	292 000	4 250	6 800	36 000	6 800	36 000	5.1	

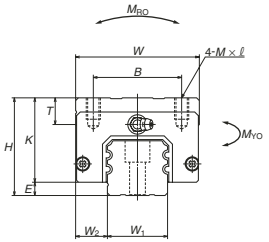
2) The basic load rating comply with the ISO standard. (ISO 14728-1, 14728-2)
C_{50}; the basic dynamic load rating for 50 km rated fatigue life
C_{100}; the basic dynamic load rating for 100 km rated fatigue life

LA-AN (High-load type / Standard)
LA-BN (Super-high-load type / Long)

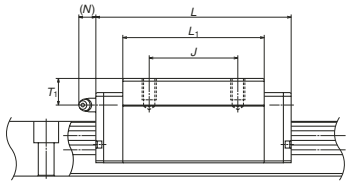
LA 35 0840 AN C 2 - ** P6 3**

- Series name
- Size
- Rail length (mm)
- Ball slide shape code (See page A272.)
- Material/surface treatment (See Table 14.)
- Number of ball slides per rail
- Added to the reference number.
- Design serial number
- Accuracy code (See Table 15.)
- 3: Z3, 4: Z4
- Preload code (See page A273.)

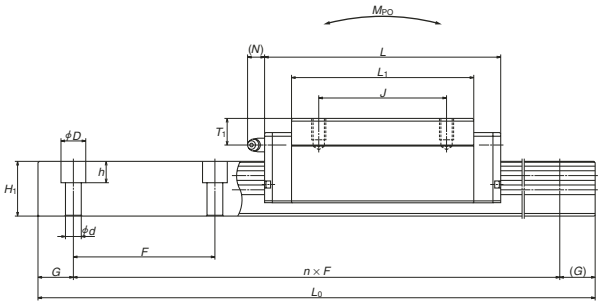
Front view of AN and BN types



Side view of AN type



Side view of BN type



Unit: mm

Model No.	Assembly Height H	E	W_2	Ball slide Width W	Length L	Mounting hole B	J	M × pitch × ℓ	L_1	K	T	Grease fitting Hole size	T_1	N	Width W_1	Height H_1
LA25AN	40	5.5	12.5	48	79.8	35	35	M6×1×10	58	34.5	12	M6×0.75	10	11	23	22
LA25BN					107.8		50		86							
LA30AN	45	7.5	16	60	100.2	40	40	M8×1.25×11	72	37.5	14	M6×0.75	9.5	11	28	28
LA30BN					126.2		60		98							
LA35AN	55	7.5	18	70	110.6	50	50	M8×1.25×12	80	47.5	15	M6×0.75	15	11	34	30.8
LA35BN					144.6		72		114							
LA45AN	70	10	20.5	86	141.4	60	60	M10×1.5×16	105	60	17	Rc1/8	20	13	45	36
LA45BN					173.4		80		137							
LA55AN	80	12	23.5	100	165.4	75	75	M12×1.75×18	126	68	18	Rc1/8	21	13	53	43.2
LA55BN					203.4		95		164							
LA65AN	90	14	31.5	126	196.2	76	70	M16×2×19	147	76	22	Rc1/8	19	13	63	55
LA65BN					256.2		120		207							

Notes: 1) LA Series does not have a ball retainer. Be aware that balls fall out when the ball slide is withdrawn from the rail.

Rail Pitch F	Mounting bolt hole d × D × h	G (reference)	Max. length L_{0max}	Basic load rating [2]Dynamic [50km] C_{50}(N)	[100km] C_{100}(N)	Static C_0 (N)	Static moment (N·m) M_{RO}	M_{PO} One slide	M_{PO} Two slides	M_{YO} One slide	M_{YO} Two slides	Weight Ball slide (kg)	Rail (kg/m)
60	7×11×9	20	3 960	30 000	23 900	50 000	290	410	2 490	410	2 490	0.6	3.7
				40 500	32 500	77 000	445	935	5 000	935	5 000	0.9	
80	9×14×12	20	4 000	47 000	37 000	77 500	535	820	4 800	820	4 800	0.9	5.8
				58 000	46 000	105 000	725	1 470	8 050	1 470	8 050	1.3	
80	9×14×12	20	4 000	61 500	49 000	98 000	845	1 130	6 750	1 130	6 750	1.5	7.7
				80 500	64 000	143 000	1 240	2 330	12 500	2 330	12 500	2.1	
105	14×20×17	22.5	3 990	91 000	72 000	148 000	1 840	2 210	12 900	2 210	12 900	3.0	12.0
				111 000	88 000	197 000	2 460	3 850	20 600	3 850	20 600	3.9	
120	16×23×20	30	3 960	139 000	111 000	215 000	3 150	3 800	22 000	3 800	22 000	4.7	17.2
				172 000	137 000	292 000	4 250	6 800	36 000	6 800	36 000	6.1	
150	18×26×22	35	3 900	260 000	206 000	420 000	7 300	9 050	51 000	9 050	51 000	7.7	25.9
				340 000	269 000	615 000	10 700	18 700	95 000	18 700	95 000	10.8	

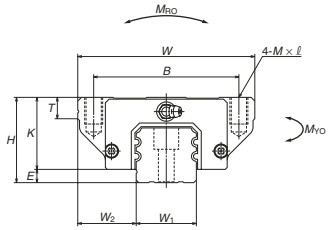
2) The basic load rating comply with the ISO standard. (ISO 14728-1, 14728-2)
C_{50}; the basic dynamic load rating for 50 km rated fatigue life
C_{100}; the basic dynamic load rating for 100 km rated fatigue life

LA-EL (High-load type / Standard)
LA-GL (Super-high-load type / Long)

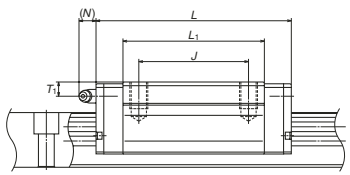
LA 35 0840 EL C 2 - P6 3**

- Series name
- Size
- Rail length (mm)
- Ball slide shape code (See page A272.)
- Material/surface treatment (See Table 14.)
- Number of ball slides per rail
  - Added to the reference number.
- Design serial number
- Accuracy code (See Table 15.)
  - 3: Z3, 4: Z4
- Preload code (See page A273.)

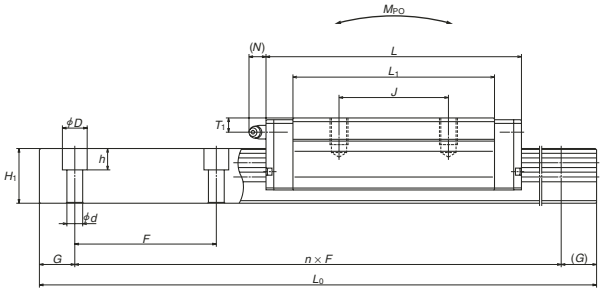
Front view of EL and GL types



Side view of EL type



Side view of GL type



Unit: mm

Model No.	Assembly			Ball slide											Rail		Weight	
	Height			Width	Length	Mounting hole					Grease fitting			Width	Height	Pitch	Mounting bolt hole	G	Max. length	Ball slide	Rail
	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}	(kg)	(kg/m)
LA25EL	36	5.5	23.5	70	79.8	57	45	M8×1.25×12	58	30.5	11	M6×0.75	6	11	23	22	60	7×11×9	20	3 960	0.8	3.7
LA25GL					107.8				86												1.1	
LA30EL	42	7.5	31	90	100.2	72	52	M10×1.5×16	72	34.5	11	M6×0.75	6.5	11	28	28	80	9×14×12	20	4 000	1.3	5.8
LA30GL					126.2				98												1.8	
LA35EL	48	7.5	33	100	110.6	82	62	M10×1.5×15	80	40.5	12	M6×0.75	8	11	34	30.8	80	9×14×12	20	4 000	1.9	7.7
LA35GL					144.6				114												2.6	
LA45EL	60	10	37.5	120	141.4	100	80	M12×1.75×18	105	50	13	Rc1/8	10	13	45	36	105	14×20×17	22.5	3 990	3.3	12.0
LA45GL					173.4				137												4.3	
LA55EL	70	12	43.5	140	165.4	116	95	M14×2×21	126	58	15	Rc1/8	11	13	53	43.2	120	16×23×20	30	3 960	5.5	17.2
LA55GL					203.4				164												7.2	
LA65EL	90	14	53.5	170	196.2	142	110	M16×2×24	147	76	22	Rc1/8	19	13	63	55	150	18×26×22	35	3 900	11.0	25.9
LA65GL					256.2				207												15.5	

Basic load rating								
[2]Dynamic		Static	Static moment (N·m)					
[50km]	[100km]	C_0	M_{RO}	M_{PO}		M_{YO}		
C_{50}(N)	C_{100}(N)	(N)		One slide	Two slides	One slide	Two slides	
30 000	23 900	50 000	290	410	2 490	410	2 490	
40 500	32 500	77 000	445	935	5 000	935	5 000	
47 000	37 000	77 500	535	820	4 800	820	4 800	
58 000	46 000	105 000	725	1 470	8 050	1 470	8 050	
61 500	49 000	98 000	845	1 130	6 750	1 130	6 750	
80 500	64 000	143 000	1 240	2 330	12 500	2 330	12 500	
91 000	72 000	148 000	1 840	2 210	12 900	2 210	12 900	
111 000	88 000	197 000	2 460	3 850	20 600	3 850	20 600	
139 000	111 000	215 000	3 150	3 800	22 000	3 800	22 000	
172 000	137 000	292 000	4 250	6 800	36 000	6 800	36 000	
260 000	206 000	420 000	7 300	9 050	51 000	9 050	51 000	
340 000	269 000	615 000	10 700	18 700	95 000	18 700	95 000	

Notes: 1) LA Series does not have a ball retainer. Be aware that balls fall out when the ball slide is withdrawn from the rail.

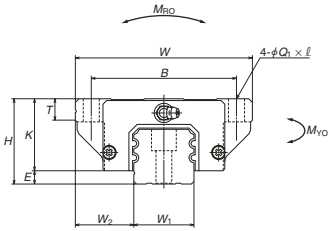
2) The basic load rating comply with the ISO standard. (ISO 14728-1, 14728-2)
C_{50}; the basic dynamic load rating for 50 km rated fatigue life
C_{100}; the basic dynamic load rating for 100 km rated fatigue life

LA-FL (High-load type / Standard)
LA-HL (Super-high-load type / Long)

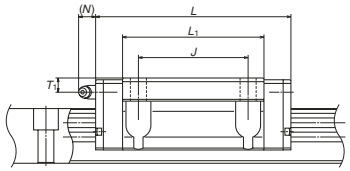
LA 35 0840 FL C 2 - ** P6 3**

- Series name
- Size
- Rail length (mm)
- Ball slide shape code (See page A272.)
- Material/surface treatment (See Table 14.)
- Number of ball slides per rail
- Design serial number (Added to the reference number.)
- Accuracy code (See Table 15.)
- Preload code (See page A273.) 3: Z3, 4: Z4

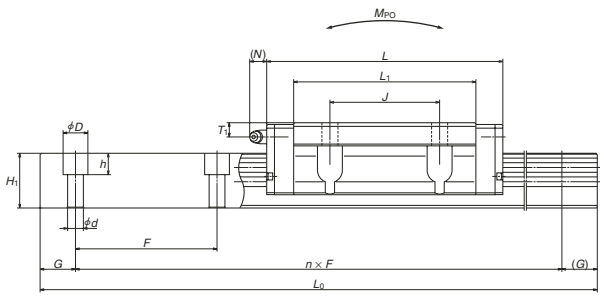
Front view of FL and HL types



Side view of FL type



Side view of HL type



Unit: mm

Model No.	Assembly Height H	E	W_2	Ball slide Width W	Length L	Mounting hole B	J	M × pitch × ℓ	L_1	K	T	Grease fitting Hole size	T_1	N	Width W_1	Height H_1
LA25FL	36	5.5	23.5	70	79.8	57	45	7×10	58	30.5	11	M6×0.75	6	11	23	22
LA25HL					107.8				86							
LA30FL	42	7.5	31	90	100.2	72	52	9×12	72	34.5	11	M6×0.75	6.5	11	28	28
LA30HL					126.2				98							
LA35FL	48	7.5	33	100	110.6	82	62	9×13	80	40.5	12	M6×0.75	8	11	34	30.8
LA35HL					144.6				114							
LA45FL	60	10	37.5	120	141.4	100	80	11×15	105	50	13	Rc1/8	10	13	45	36
LA45HL					173.4				137							
LA55FL	70	12	43.5	140	165.4	116	95	14×18	126	58	15	Rc1/8	11	13	53	43.2
LA55HL					203.4				164							
LA65FL	90	14	53.5	170	196.2	142	110	16×23	147	76	22	Rc1/8	19	13	63	55
LA65HL					256.2				207							

Notes: 1) LA Series does not have a ball retainer. Be aware that balls fall out when the ball slide is withdrawn from the rail.

Rail Pitch F	Mounting bolt hole d × D × h	G (reference)	Max. length L_{0max}	Basic load rating 2)Dynamic [50km] C_{50}(N)	[100km] C_{100}(N)	Static C_0 (N)	Static moment (N·m) M_{RO}	M_{PO} One slide	M_{PO} Two slides	M_{YO} One slide	M_{YO} Two slides	Weight Ball slide (kg)	Rail (kg/m)
60	7×11×9	20	3 960	30 000	23 900	50 000	290	410	2 490	410	2 490	0.8	3.7
				40 500	32 500	77 000	445	935	5 000	935	5 000	1.1	
80	9×14×12	20	4 000	47 000	37 000	77 500	535	820	4 800	820	4 800	1.3	5.8
				58 000	46 000	105 000	725	1 470	8 050	1 470	8 050	1.8	
80	9×14×12	20	4 000	61 500	49 000	98 000	845	1 130	6 750	1 130	6 750	1.9	7.7
				80 500	64 000	143 000	1 240	2 330	12 500	2 330	12 500	2.6	
105	14×20×17	22.5	3 990	91 000	72 000	148 000	1 840	2 210	12 900	2 210	12 900	3.3	12.0
				111 000	88 000	197 000	2 460	3 850	20 600	3 850	20 600	4.3	
120	16×23×20	30	3 960	139 000	111 000	215 000	3 150	3 800	22 000	3 800	22 000	5.5	17.2
				172 000	137 000	292 000	4 250	6 800	36 000	6 800	36 000	7.2	
150	18×26×22	35	3 900	260 000	206 000	420 000	7 300	9 050	51 000	9 050	51 000	11.0	25.9
				340 000	269 000	615 000	10 700	18 700	95 000	18 700	95 000	15.5	

2) The basic load rating comply with the ISO standard. (ISO 14728-1, 14728-2)
C_{50}; the basic dynamic load rating for 50 km rated fatigue life
C_{100}; the basic dynamic load rating for 100 km rated fatigue life

A-5-4 High-Precision Machine and High-Precision Measuring Equipment

A-5-4.1 HA Series

1. Features

(1) High motion accuracy

High motion accuracy is achieved in both narrow and wide ranges by the adoption of ultra-long ball slides and the optimum design of the ball recirculation component.

(2) Ball passage vibration reduced to one-third of our conventional models

Our extensive performance tests show ball passage vibration has been reduced to one-third of our conventional models, dramatically improving straightness in table unit.

(3) Installation of rail with greater accuracy

Increased counterbore depth of the rail mounting hole reduces rail deflection, which is caused by bolt tightening when fixing the rail to the mounting base to 50% or less. This feature restrains the pitching motion of ball slide whose frequency matches to the mounting hole pitch.

In addition, the length of mounting hole pitch has been reduced by one-half of the conventional models, so the rail can be more accurately installed in position.

(4) High rigidity and load capacity with lower friction

High rigidity, high load capacity and low friction are achieved by increasing the number of balls.

(5) Compact design

Reduced body size enables more compact machinery.

(6) Four-way equal load distribution

Contact angle is set at 45 degrees in all grooves, dispersing the load to four ball rows irrespective of load direction. This realizes equal rigidity and load carrying capacity in vertical and lateral directions and provides well-balanced design.

(7) Strong against shock load

Load from any direction, vertical and lateral, is received by four ball rows at all times. The number of the ball row which receives the load is larger than in other linear guides, making this series stronger against shock load.

(8) High accuracy at manufacturing

Fixing the measuring rollers to the ball grooves is easy thanks to the Gothic arch groove. Ball-groove measuring is accurate and simple. This benefits a highly precise and stable manufacturing.

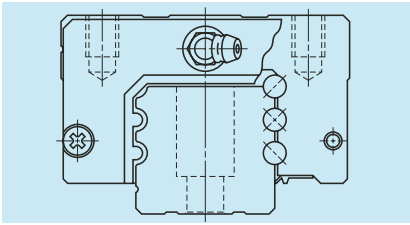


Fig. 1 HA Series

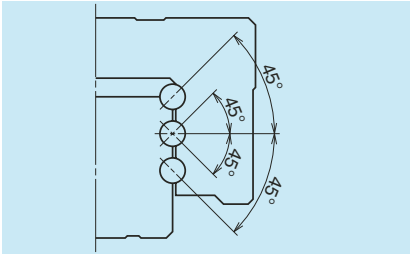


Fig. 2 Super rigidity design

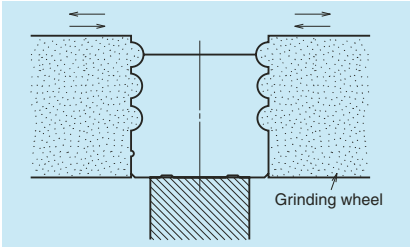


Fig. 3 Rail grinding

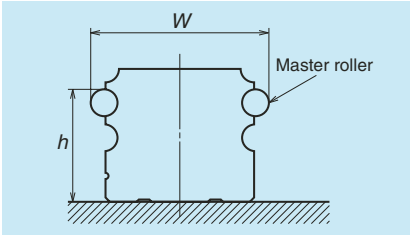


Fig. 4 Measuring groove accuracy

Measurement results of ball passage vibration

Ball passage vibration can translate into posture changes in the ball slide which result from ball passage (circulation). In the HA Series, this vibration has been substantially reduced to one-third of conventional models.

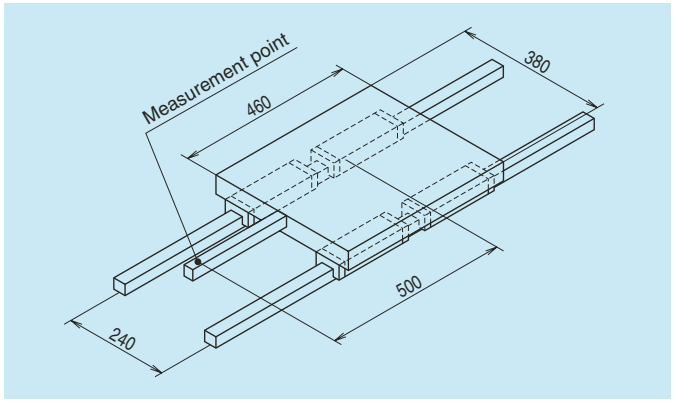


Fig. 5 Schematic view of measurement of ball passage vibration

HA Series

Model No.: HA30
Preload: Z3
Table dimensions: 460 mm × 380 mm

Conventional Series

Model No.: LA30
Preload: Z3
Table dimensions: 460 mm × 380 mm

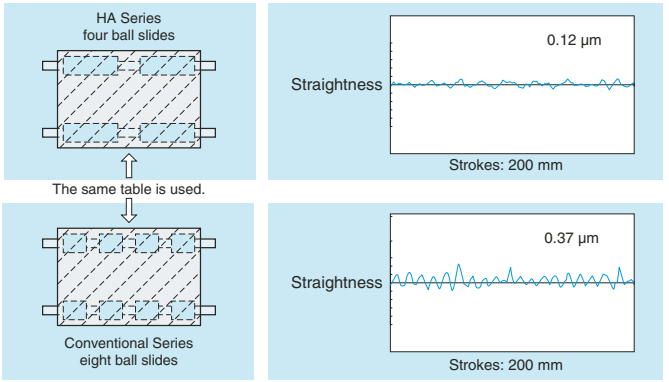
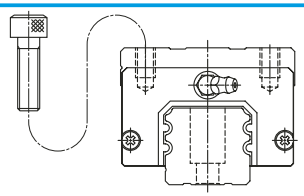
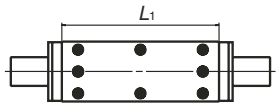
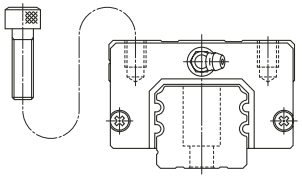
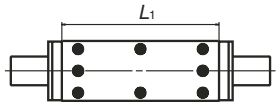
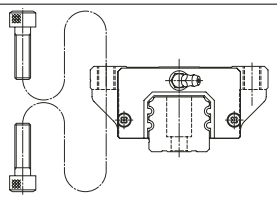
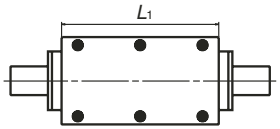


Fig. 6 Measurement results of HA Series and conventional Series

2. Ball slide shape

Ball slide Model	Shape/installation method	Type
AN		AN 
AL		AL 
EM		EM 

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1 Unit: μm

Rail length (mm) over	or less	Preloaded assembly Ultra precision P3	Super precision P4	High precision P5
–	200	2	2	4
200	250	2	2.5	5
250	315	2	2.5	5
315	400	2	3	6
400	500	2	3	6
500	630	2	3.5	7
630	800	2	4.5	8
800	1 000	2.5	5	9
1 000	1 250	3	6	10
1 250	1 600	4	7	11
1 600	2 000	4.5	8	13
2 000	2 500	5	10	15
2 500	3 150	6	11	17
3 150	4 000	9	16	23

(2) Accuracy standard

Three accuracy grades are available: Ultra precision P3, Super precision P4 and High precision P5.

Table 2 Unit: μm

Characteristics \ Accuracy grade	Ultra precision P3	Super precision P4	High precision P5
Mounting height H Variation of H (All ball slides on a set of rails)	±10 3	±10 5	±20 7
Mounting width W_2 or W_3 Variation of W_2 or W_3 (All ball slides on reference rail)	±15 3	±15 7	±25 10
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	Refer to **Table 1** and **Fig. 7**		

(3) Assembled accuracy

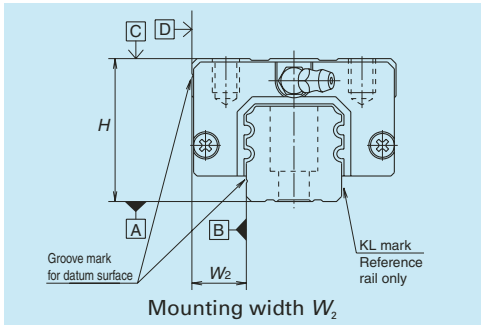


Fig. 7

(4) Preload and rigidity

Slight preload Z1 and Medium preload Z3 are available for preload, which can be selected for specific applications.

Table 3

Model No.	Preload (N) Slight preload (Z1)	Medium preload (Z3)	Rigidity (N/μm) Slight preload (Z1)	Medium preload (Z3)
HA25	735	2 990	635	1 030
HA30	1 030	4 400	880	1 270
HA35	1 470	6 100	1 030	1 620
HA45	1 960	8 150	1 230	2 060
HA55	3 150	13 100	1 520	2 450

4. Maximum rail length

Table 4 shows the limitations of rail length.
However, the limitations vary by accuracy grades.

Table 4 Length limitations of rails Unit: mm

Series \ Size	25	30	35	45	55
HA	3 960	4 000	4 000	3 990	3 960

Note: Rails can be butted if user requirement exceeds the rail length shown in the table. Please consult NSK.

5. Installation

(1) Permissible values of mounting error

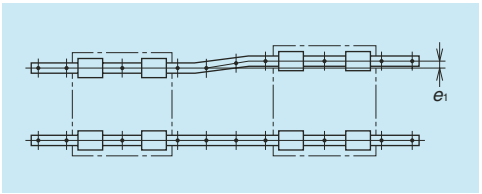


Fig. 8

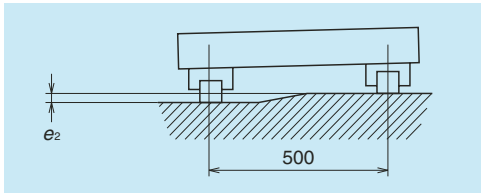


Fig. 9

Table 5

Unit: μm

Value	Preload	Model No.				
		HA25	HA30	HA35	HA45	HA55
Permissible values of parallelism in two rails e_1	Z1	20	20	23	26	34
	Z3	15	14	17	19	25
Permissible values of parallelism (height) in two rails e_2	Z1,Z3	250 μm/500 mm				

(2) Shoulder height of the mounting surface and corner radius r

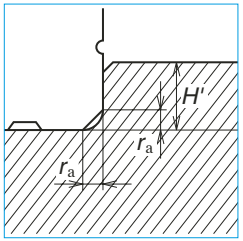


Fig. 10 Shoulder for the rail datum surface

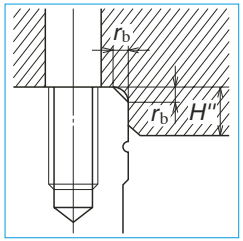


Fig. 11 Shoulder for the ball slide datum surface

Table 6

Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H'	H''
HA25	0.5	0.5	5	5
HA30	0.5	0.5	6	6
HA35	0.5	0.5	6	6
HA45	0.7	0.7	8	8
HA55	0.7	0.7	10	10

6. Lubrication components

Refer to pages A38 and D13 for linear guide lubrication.

(1) Types of lubrication accessories

Fig. 12 and **Table 7** show grease fittings and tube fittings.

We provide lubrication accessories with extended thread body length (L) for the addition of dust-proof accessories such as NSK K1 lubrication unit, double seal and protector.

We provide a suitable lubrication accessory for the special requirement on dust-proof accessories.

Consult NSK for a lubrication accessory with extended length of thread body for your convenience of replenishing lubricant.

When you require stainless lubrication accessories, please ask NSK.

(2) Mounting position of lubrication accessories

The standard position of grease fittings is the end face of ball slide. We mount them on the side of end cap for an option. (**Fig. 13**)

Please consult NSK for installation of grease or tube fittings to the ball slide body or the side of end cap.

When using a piping unit with thread of M6 × 1, you require a connector to connect to a grease fitting mounting hole with M6 × 0.75. The connector is available from NSK.

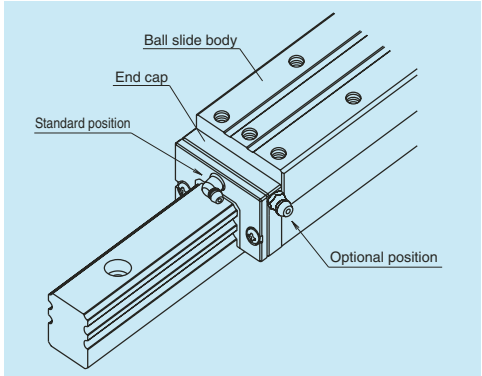


Fig. 13 Mounting position of lubrication accessories

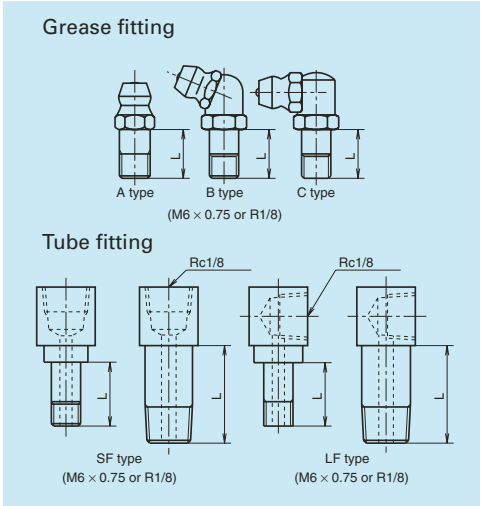


Fig. 12 Grease fitting and tube fitting

Table 7

Unit: mm

Model No.	Dust-proof specification	Grease fitting	Tube fitting
		Thread body length L	Thread body length L
HA25	Standard	5	5
	With NSK K1	14	12
	Double seal	10	9
	Protector	10	9
HA30	Standard	5	6
	With NSK K1	14	13
	Double seal	12	11
	Protector	12	11
HA35	Standard	5	6
	With NSK K1	14	13
	Double seal	12	11
	Protector	12	11
HA45	Standard	8	17
	With NSK K1	18	21.5
	Double seal	14	17
	Protector	14	17
HA55	Standard	8	17
	With NSK K1	18	21.5
	Double seal	14	17
	Protector	14	17

7. Dust-proof components

(1) Standard Specification

The HA Series can be readily used as they have a dust protection means for normal conditions. As the standard equipment, the ball slides have an end seal on both ends, bottom seals at the bottom, and an inner seal in inside.

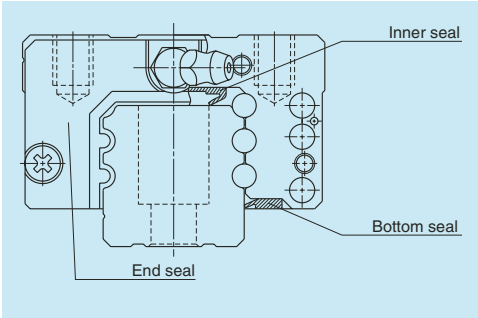


Fig. 14

Table 8 Seal friction per ball slide (maximum value)

Unit: N

Series \ Size	25	30	35	45	55
HA	17	17	19	21	22

(2) NSK K1™ lubrication unit

Table 9 shows the dimensions of linear guides equipped with the NSK K1 lubrication unit.

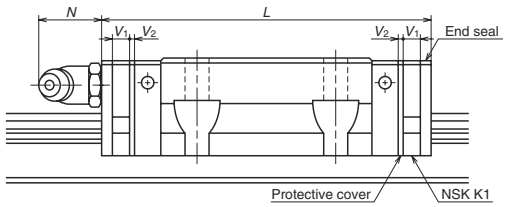


Table 9

Unit: mm

Model No.	Ball slide model	Standard ball slide length	Ball slide length installed with two NSK K1 *L*	Per NSK K1 thickness V_1	Protective cover thickness V_2	Protruding area of the grease fitting *N*
HA25	AN, EM	147.8	159.8	5.0	1.0	(14)
HA30	AN, EM	177.2	190.2	5.5	1.0	(14)
HA35	AN, AL, EM	203.6	216.6	5.5	1.0	(14)
HA45	AN, AL, EM	233.4	248.4	6.5	1.0	(15)
HA55	AN,AL, EM	284.4	299.4	6.5	1.0	(15)

Note: Ball slide length equipped with NSK K1 =
(Standard ball slide length) + (Thickness of NSK K1, V_1 × Number of NSK K1) + (Thickness of the protective cover V_2 × 2)

(3) Double seal and protector

For the HA Series, double seal and protectors can be installed only before shipping from the factory. Please consult with NSK when you require dust tight protection.

Table 10 shows the increased thickness of V_3, and V_4 when the end seal and the protector are installed.

Table 10

Unit: mm

Model No.	Thickness of end seal: V_3	Thickness of protector: V_4
HA25	3.2	3.6
HA30	4.4	4.2
HA35	4.4	4.2
HA45	5.5	4.9
HA55	5.5	4.9

(4) Caps to plug the rail mounting bolt hole

Table 11 Caps to plug rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
HA25	M6	LG-CAP/M6	20
HA30, HA35	M8	LG-CAP/M8	20
HA45	M12	LG-CAP/M12	20
HA55	M14	LG-CAP/M14	20

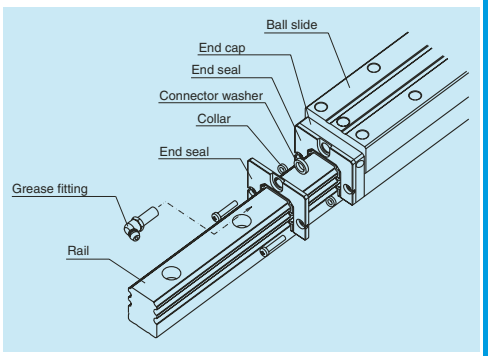


Fig. 15 Double seal

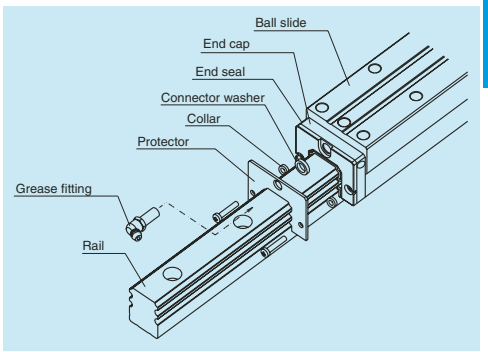


Fig. 16 Protector

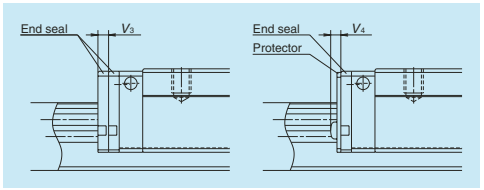


Fig. 17

8. Reference number

Reference numbers shall be set to individual NSK linear guide when its specifications are finalized, and it is indicated on its specification drawing.
Please specify the reference number, except design serial number, to identify the product when ordering, requiring estimates, or inquiring about specifications from NSK.

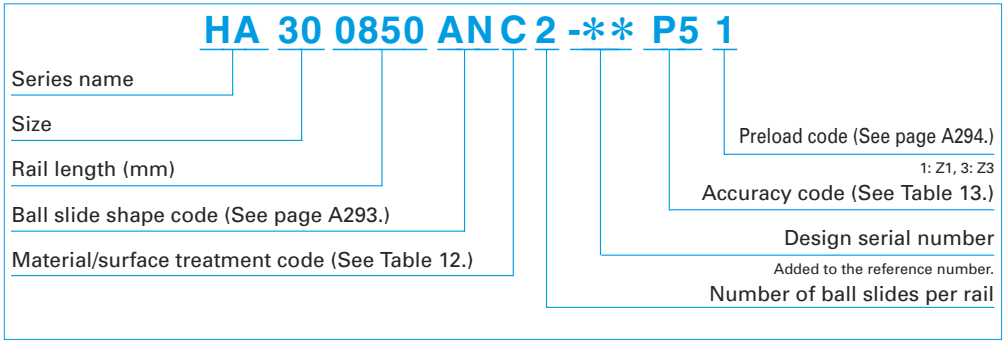


Table 12 Material/surface treatment code

Code	Description
C	Special high carbon steel (NSK standard)
D	Special high carbon steel with surface treatment
Z	Other, special

Table 13 Accuracy code

Accuracy	Standard (Without NSK K1)	With NSK K1
Ultra precision grade	P3	K3
Super precision grade	P4	K4
High precision grade	P5	K5

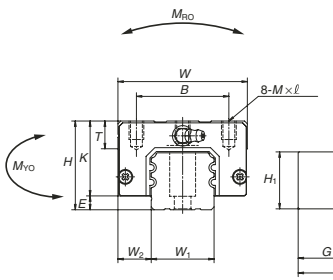
Note: Refer to page A38 for NSK K1 lubrication unit.

9. Dimensions
HA-AN
HA-AL

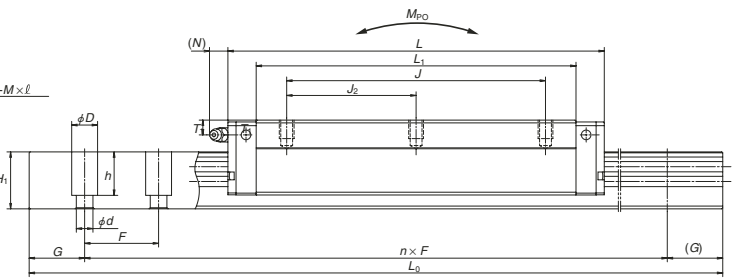
HA 30 0850 AN C 2 - P5 1**

- Series name
- Size
- Rail length (mm)
- Ball slide shape code (See page A293.)
- Material/surface treatment code (See Table 12.)
- Number of ball slides per rail
- Design serial number (Added to the reference number.)
- Accuracy code (See Table 13.)
- Preload code (See page A294.) (1: Z1, 3: Z3)

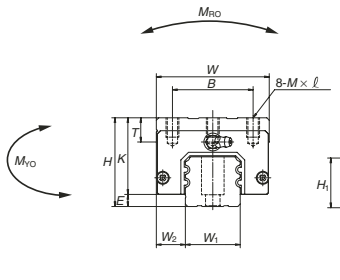
Front view of AL type



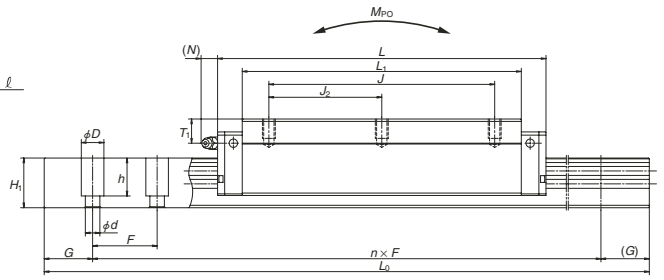
Side view of AL type



Front view of AN type



Side view of AN type



Unit: mm

Model No.	Assembly			Ball slide											Rail	
	Height			Width	Length	Mounting hole						Grease fitting			Width	Height
	H	E	W_2	W	L	B	J	J_2	M × pitch × ℓ	L_1	K	T	Hole size	T_1	N	W_1	H_1
HA25AN	40	5.5	12.5	48	147.8	35	100	50	M6×1.0×10	126	34.5	12	M6×0.75	10	11	23	22
HA30AN	45	7.5	16	60	177.2	40	120	60	M8×1.25×11	149	37.5	14	M6×0.75	9.5	11	28	28
HA35AN	55	7.5	18	70	203.6	50	140	70	M8×1.25×12	173	47.5	15	M6×0.75	15	11	34	30.8
HA35AL	48								M8×1.25×10		40.5			8			
HA45AN	70	10	20.5	86	233.4	60	160	80	M10×1.5×16	197	60	17	Rc1/8	20	13	45	36
HA45AL	60										50			10			
HA55AN	80	12	23.5	100	284.4	75	206	103	M12×1.75×18	245	68	18	Rc1/8	21	13	53	43.2
HA55AL	70										58			11			

Notes: 1) The HA Series does not have a ball retainer. Be aware that the balls fall out when a ball slide is withdrawn from the rail.

Rail				Basic load rating							Weight	
Pitch	Mounting bolt hole	G	Maximum length	[2]Dynamic		Static	Static moment (N·m)				Ball slide	Rail
				[50km]	[100km]	C_0	M_{RO}	M_{PO}		M_{YO}		
F	d × D × h	(reference)	L_{0max}	C_{50}(N)	C_{100}(N)	(N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
30	7×11×16.5	20	3 960	54 000	43 000	115 000	670	2 060	10 100	2 060	10 100	1.2	3.7
40	9×14×21	20	4 000	79 500	63 500	166 000	1 140	3 550	17 400	3 550	17 400	1.8	5.8
40	9×14×23.5	20	4 000	111 000	88 000	226 000	1 950	5 650	27 100	5 650	27 100	3.0	7.7
												2.6	
52.5	14×20×27	22.5	3 990	147 000	117 000	295 000	3 700	8 450	40 500	8 450	40 500	6.0	12.0
												5.0	
60	16×23×32.5	30	3 960	232 000	184 000	445 000	6 500	15 400	75 000	15 400	75 000	9.4	17.2
												7.8	

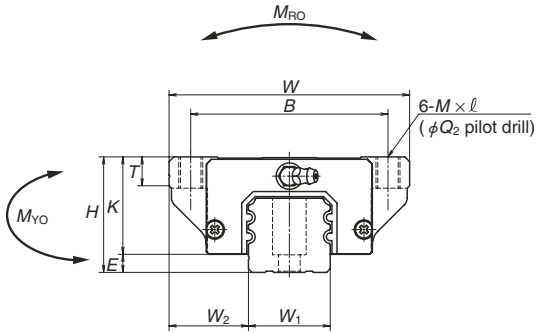
2) The basic load rating comply with the ISO standard. (ISO 14728-1, 14728-2)
C_{50}: the basic dynamic load rating for 50 km rated fatigue life C_{100}: the basic dynamic load rating for 100 km rated fatigue life

HA-EM

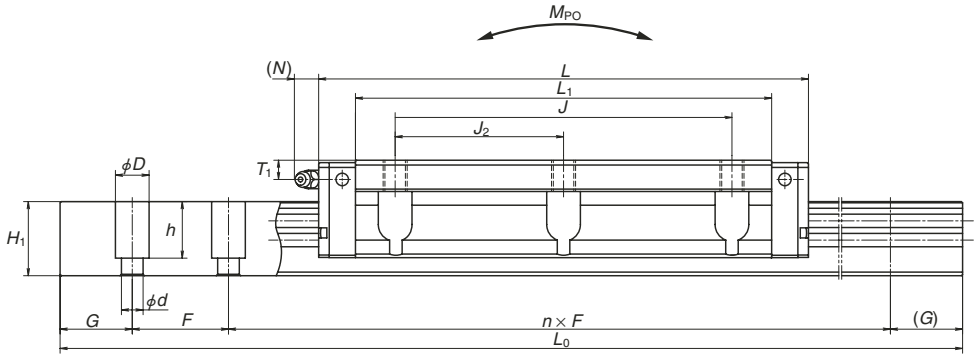
HA 30 0850 EM C 2 - P5 1**

- Series name
- Size
- Rail length (mm)
- Ball slide shape code (See page A293.)
- Material/surface treatment code (See Table 12.)
- Number of ball slides per rail
- Design serial number — Added to the reference number.
- Accuracy code (See Table 13.)
- Preload code (See page A294.) — 1: Z1, 3: Z3

Front view of EM type



Side view of EM type



Unit: mm

Model No.	Assembly			Ball slide												Rail	
	Height			Width	Length	Mounting hole								Grease fitting			Width	Height
	H	E	W_2	W	L	B	J	J_2	$M \times$ pitch $\times \ell$	Q_1	L_1	K	T	Hole size	T_1	N	W_1	H_1
HA25EM	36	5.5	23.5	70	147.8	57	100	50	M8×1.25×10	6.8	126	30.5	11	M6×0.75	6	11	23	22
HA30EM	42	7.5	31	90	177.2	72	120	60	M10×1.5×12	8.6	149	34.5	11	M6×0.75	6.5	11	28	28
HA35EM	48	7.5	33	100	203.6	82	140	70	M10×1.5×13	8.6	173	40.5	12	M6×0.75	8	11	34	30.8
HA45EM	60	10	37.5	120	233.4	100	160	80	M12×1.75×15	10.5	197	50	13	Rc1/8	10	13	45	36
HA55EM	70	12	43.5	140	284.4	116	206	103	M14×2×18	12.5	245	58	15	Rc1/8	11	13	53	43.2

Notes: 1) HA Series does not have a ball retainer. Be aware that the balls fall out when a ball slide is withdrawn from the rail.

Rail				Basic load rating							Weight	
Pitch	Mounting bolt hole	G	Maximum length	[2]Dynamic		Static	Static moment (N·m)				Ball slide	Rail
				[50km]	[100km]							
F	$d \times D \times h$	(reference)	L_{0max}	C_{50}(N)	C_{100}(N)	C_0 (N)	M_{RO}	M_{PO}		M_{YO}		
								One slide	Two slides	One slide / Two slides	(kg)	(kg/m)
30	7×11×16.5	20	3 960	54 000	43 000	115 000	670	2 060	10 100	2 060 / 10 100	1.6	3.7
40	9×14×21	20	4 000	79 500	63 500	166 000	1 140	3 550	17 400	3 550 / 17 400	2.6	5.8
40	9×14×23.5	20	4 000	111 000	88 000	226 000	1 950	5 650	27 100	5 650 / 27 100	3.8	7.7
52.5	14×20×27	22.5	3 990	147 000	117 000	295 000	3 700	8 450	40 500	8 450 / 40 500	6.6	12.0
60	16×23×32.5	30	3 960	232 000	184 000	445 000	6 500	15 400	75 000	15 400 / 75 000	11	17.2

2) The basic load rating comply with the ISO standard. (ISO 14728-1, 14728-2)
C_{50}; the basic dynamic load rating for 50 km rated fatigue life C_{100}; the basic dynamic load rating for 100 km rated fatigue life

A-5-4.2 HS Series

1. Features

(1) High motion accuracy

High motion accuracy is achieved in both narrow and wide ranges by adopting ultra-long ball slides and optimum design features for the ball recirculation component.

(2) Ball passage vibration reduced to one-third of our conventional models

Tests show ball passage vibration has been reduced to one-third of our conventional models, dramatically improving straightness in table unit.

(3) Installation of rail with greater accuracy

Increased counterbore depth of the rail mounting hole reduces rail deflection, which is caused by bolt tightening when fixing the rail to the mounting base, to 50% or less. This feature restrains the pitching motion of ball slide whose frequency matches to the mounting hole pitch.

In addition, the mounting hole pitch has been reduced by one-half of the conventional models, so the rail can be more accurately installed in position.

(4) High rigidity and load capacity with lower friction

High rigidity, high load capacity and low friction are achieved by increasing the number of balls.

(5) Compact design

Reduced body size enables more compact machinery.

(6) High load carrying capacity to vertical direction

The contact angle is set at 50 degrees, increasing load carrying capacity as well as rigidity against the load in vertical direction.

(7) High resistance against impact load

The bottom ball groove is formed in Gothic arch and the center of the top and bottom grooves are offset as shown in **Fig. 2**. The vertical load is usually carried by top two ball rows at where balls are contacting at two points. Because of this design, the bottom ball rows will carry the load when a large impact load is applied as shown in **Fig. 3**. This assures high resistance to the impact load.

(8) High accuracy at manufacturing

As showing in **Fig. 4**, fixing the measuring rollers to the ball groove is easy thanks to the Gothic arch groove. This makes easy and accurate measuring of ball grooves.

(9) Improve rating life dramatically

New ball groove geometry is introduced, which has been developed by utilizing NSK's state-of-the-art tribological and analytical technologies. Due to the optimized distribution of contact surface pressures, the rating life has dramatically increased.

As compared with the conventional products, the load rating capacity has increased to 1.3 times, while the life span has increased to twice[*1].

∗1: Representative values of series.

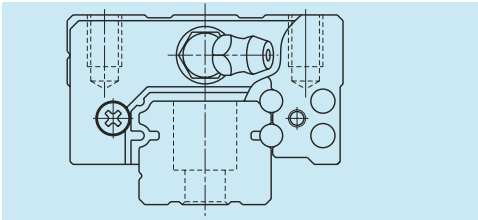


Fig. 1 HS Series

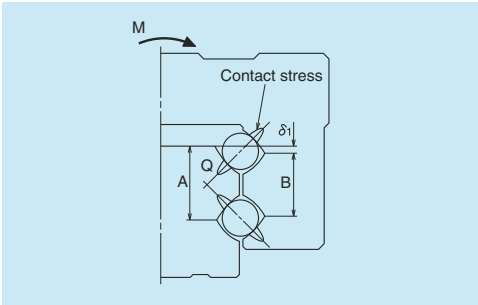


Fig. 2 Enlarged illustration: Offset Gothic arch

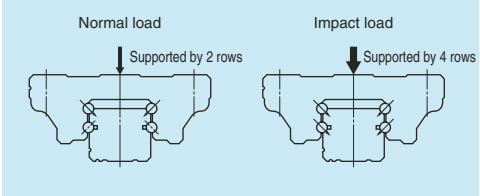


Fig. 3 When load is applied

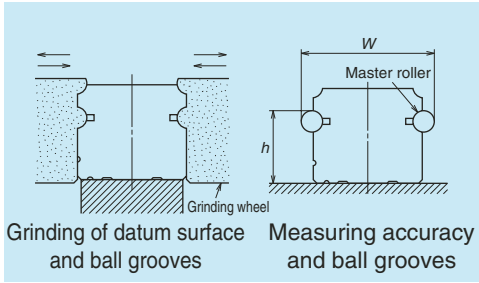


Fig. 4 Rail-grinding and measuring

Measurement results of ball passage vibration

Ball passage vibration can translate into posture changes in the ball slide which result from ball passage (circulation). In the HS Series, this vibration has been substantially reduced to one-third of conventional models.

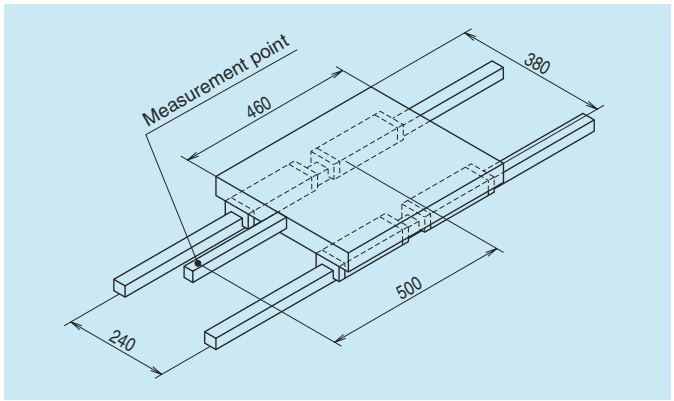


Fig. 5 Schematic view of measurement of ball passage vibration

HS Series

Model No.: HS30
Preload: Z1
Table dimensions: 460 mm × 380 mm

Conventional Series

Model No.: LS30
Preload: Z1
Table dimensions: 460 mm × 380 mm

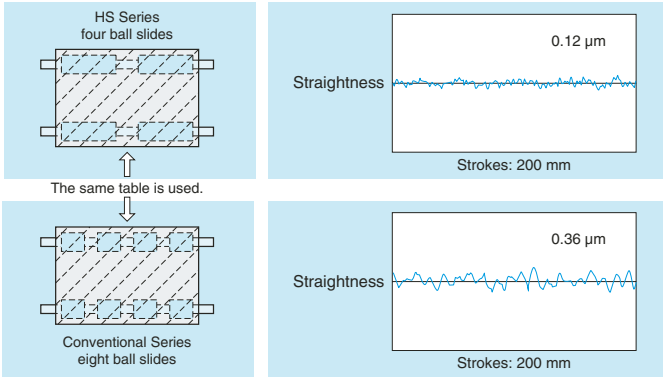
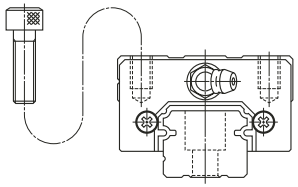
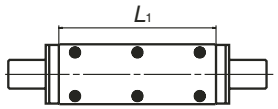
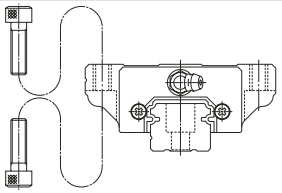
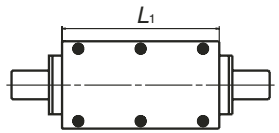


Fig. 6 Measurement results of HS Series and conventional Series

2. Ball slide shape

Ball slide Model	Shape/installation method	Type
AL		AL 
EM		EM 

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1 Unit: μm

Rail length (mm) over	or less	Preloaded assembly Ultra precision P3	Super precision P4	High precision P5
–	200	2	2	4
200	250	2	2.5	5
250	315	2	2.5	5
315	400	2	3	6
400	500	2	3	6
500	630	2	3.5	7
630	800	2	4.5	8
800	1 000	2.5	5	9
1 000	1 250	3	6	10
1 250	1 600	4	7	11
1 600	2 000	4.5	8	13
2 000	2 500	5	10	15
2 500	3 150	6	11	17
3 150	4 000	9	16	23

(2) Accuracy Standard

Three accuracy grades are available: Ultra precision P3, Super precision P4 and High precision P5.

Table 2 Unit: μm

Characteristics \ Accuracy grade	Ultra precision P3	Super precision P4	High precision P5
Mounting height H Variation of H (All ball slides on a set of rails)	±10 3	±10 5	±20 7
Mounting width W_2 or W_3 Variation of W_2 or W_3 (All ball slides on reference rail)	±15 3	±15 7	±25 10
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	Refer to **Table 1** and **Fig. 7**		

(3) Assembled accuracy

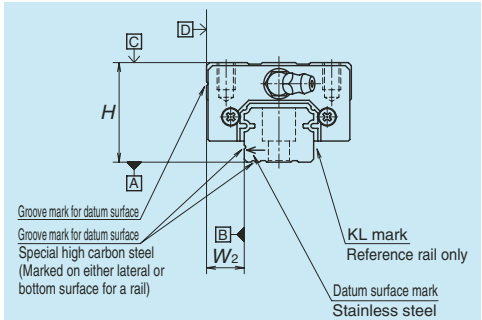


Fig. 7

(4) Preload and rigidity

Slight preload Z1 and Medium preload Z3 are available for preload, which can be selected for specific applications.

Table 3

Model No.	Preload (N)		Rigidity (N/μm)			
			Vertical direction		Lateral direction	
	Slight preload (Z1)	Medium preload (Z3)	Slight preload (Z1)	Medium preload (Z3)	Slight preload (Z1)	Medium preload (Z3)
HS15	98	785	260	530	173	355
HS20	147	1 030	305	600	212	415
HS25	245	1 620	385	735	263	505
HS30	390	2 550	505	965	345	665
HS35	590	3 550	610	1 140	415	780

4. Maximum rail length

Table 4 shows the limitation. The dimension in parenthesis is for stainless steel products. However, the limitations vary by accuracy grades.

Table 4 Length limitation of rails Unit: mm

Series \ Size	15	20	25	30	35
HS	2 000 (1 700)	3 960 (3 500)	3 960 (3 500)	4 000 (3 500)	4 000 (3 500)

Note: Rails can be butted if user requirement exceeds the rail length shown in the table. Please consult NSK.

5. Installation

(1) Permissible values of mounting error

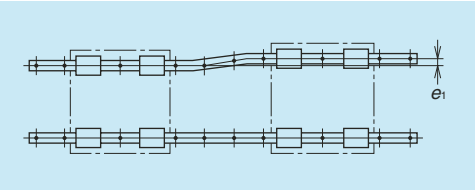


Fig. 8

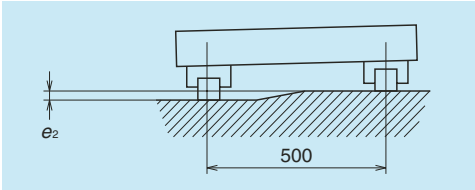


Fig. 9

Table 5

Unit: μm

Value	Preload	Model No.				
		HS15	HS20	HS25	HS30	HS35
Permissible values of parallelism in two rails e_1	Z1	18	20	26	31	37
	Z3	12	14	18	22	26
Permissible values of parallelism (height) in two rails e_2	Z1, Z3	330 μm/500 mm				

(2) Shoulder height of the mounting surface and corner radius r

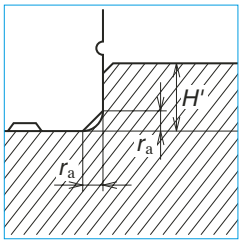


Fig. 10 Shoulder for the rail datum surface

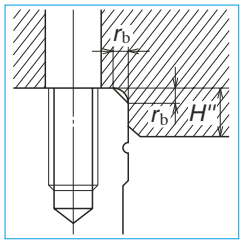


Fig. 11 Shoulder for the ball slide datum surface

Table 6

Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H'	H''
HS15	0.5	0.5	4	4
HS20	0.5	0.5	4.5	5
HS25	0.5	0.5	5	5
HS30	0.5	0.5	6	6
HS35	0.5	0.5	6	6

6. Lubrication components

Refer to pages A38 and D13 for linear guide lubrication.

(1) Types of lubrication accessories

Fig. 12 and **Table 7** show grease fittings and tube fittings.

We provide lubrication accessories with extended thread body length (L) for the addition of dust-proof accessories such as NSK K1 lubrication unit, double seal and protector.

We provide a suitable lubrication accessory for the special requirement on dust-proof accessories.

Consult NSK for a lubrication accessory with extended length of thread body for your convenience of replenishing lubricant.

When you require stainless lubrication accessories, please ask NSK.

(2) Mounting position of lubrication accessories

The standard position of grease fittings is the end face of ball slide. We mount them on the side of end cap for an option. (**Fig. 13**)

Please consult NSK for installation of grease or tube fittings to the ball slide body or the side of end cap.

When using a piping unit with thread of M6 × 1, you require a connector to connect to a grease fitting mounting hole with M6 × 0.75. The connector is available from NSK.

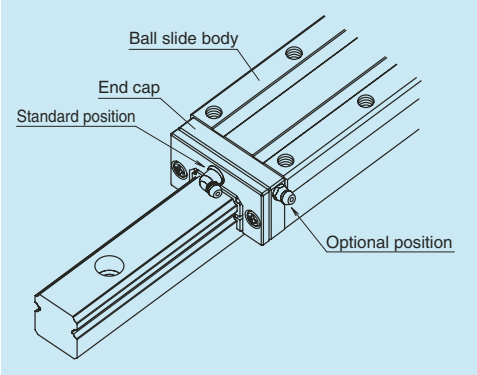


Fig. 13 Mounting position of lubrication accessories

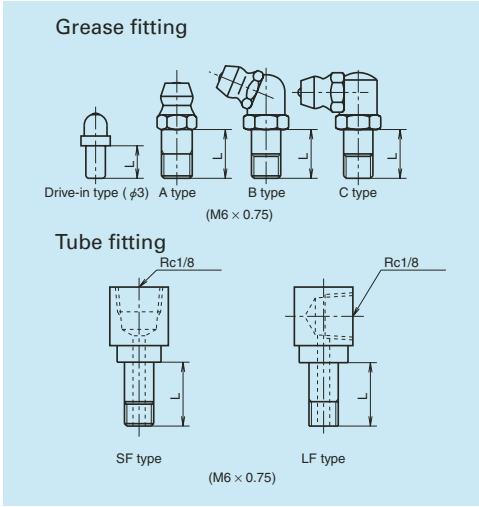


Fig. 12 Grease fitting and tube fitting

Table 7

Unit: mm

Model No.	Dust-proof specification	Grease fitting Drive-in	Tube fitting
		Thread body length L	Thread body length L
HS15	Standard	5	–
	With NSK K1	10	–
	Double seal	*	–
	Protector	*	–
HS20	Standard	5	–
	With NSK K1	10	–
	Double seal	8	–
	Protector	8	–
HS25	Standard	5	6
	With NSK K1	12	11
	Double seal	10	9
	Protector	10	9
HS30	Standard	5	6
	With NSK K1	14	13
	Double seal	12	11
	Protector	12	11
HS35	Standard	5	6
	With NSK K1	14	13
	Double seal	12	11
	Protector	12	11

*) A connector is required for this model. Please contact NSK.

7. Dust-proof components

(1) Standard Specification

The HS Series can be readily used as they have a dust protection means for normal conditions. As the standard equipment, the ball slides have an end seal on both ends.

Bottom seal is equipped on bottom as an option.

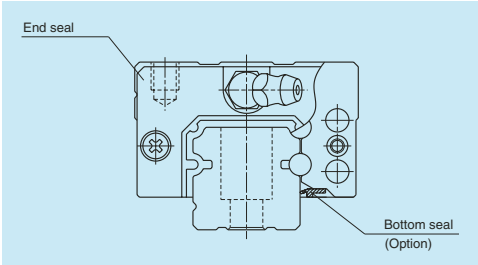


Fig. 14

Table 8 Seal friction per ball slide (maximum): end seal only

Unit: N

Series \ Size	15	20	25	30	35
HS	3	3	3	3	4

(2) NSK K1™ lubrication unit

Refer to **Table 9** for dimension of linear guides equipped with the NSK K1 lubrication unit.

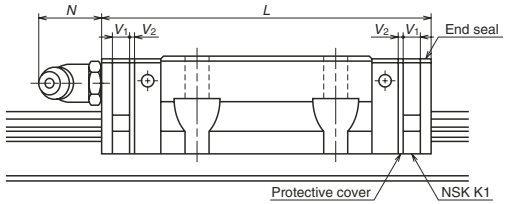


Table 9

Unit: mm

Model No.	Ball slide model	Standard ball slide length	Ball slide length installed with two NSK K1 *L*	Per NSK K1 thickness V_1	Protective cover thickness V_2	Protruding area of the grease fitting *N*
HS15	AL, EM	106	115.6	4.0	0.8	(5)
HS20	AL, EM	119.7	130.3	4.5	0.8	(14)
HS25	AL, EM	148	158.6	4.5	0.8	(14)
HS30	AL, EM	176.1	188.1	5.0	1.0	(14)
HS35	AL, EM	203.6	216.6	5.5	1.0	(14)

Note: Ball slide length equipped with NSK K1 =
(Standard ball slide length) + (Thickness of NSK K1, V_1 × Number of NSK K1) + (Thickness of the protective cover V_2 × 2)

(3) Double seal and protector

For the HS Series, double seal and protectors can be installed only before shipping from the factory. Please consult with NSK when you require dust tight protection.

Table 10 shows the increased thickness of V_3 and V_4 when the end seal and the protector are installed.

Table 10

Unit: mm

Model No.	Thickness of end seal: V_3	Thickness of protector: V_4
HS15	2.8	3
HS20	2.5	2.7
HS25	2.8	3.2
HS30	3.6	4.2
HS35	3.6	4.2

(4) Caps to plug the rail mounting bolt hole

Table 11 Caps to plug rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
HS15	M3	LG-CAP/M3	20
HS15	M4	LG-CAP/M4	20
HS20	M5	LG-CAP/M5	20
HS25, HS30	M6	LG-CAP/M6	20
HS35	M8	LG-CAP/M8	20

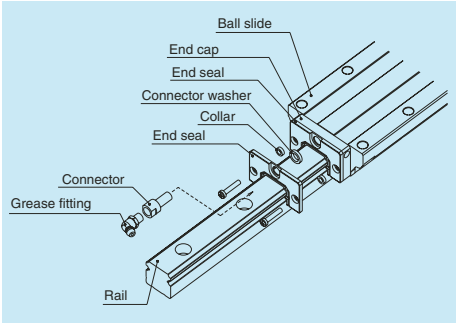


Fig. 15 Double seal

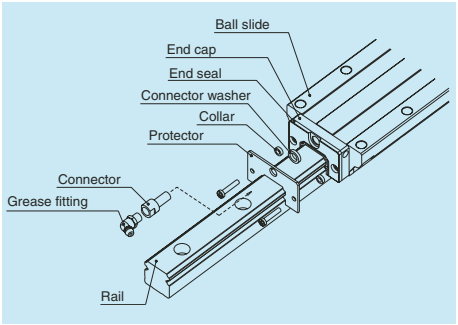


Fig. 16 Protector

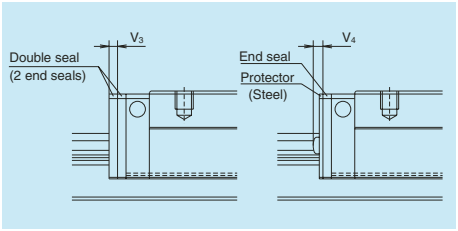


Fig. 17

8. Reference number

Reference numbers shall be set to individual NSK linear guide when its specifications are finalized, and it is indicated on its specification drawing.
Please specify the reference number, except design serial number, to identify the product when ordering, requiring estimates, or inquiring about specifications from NSK.

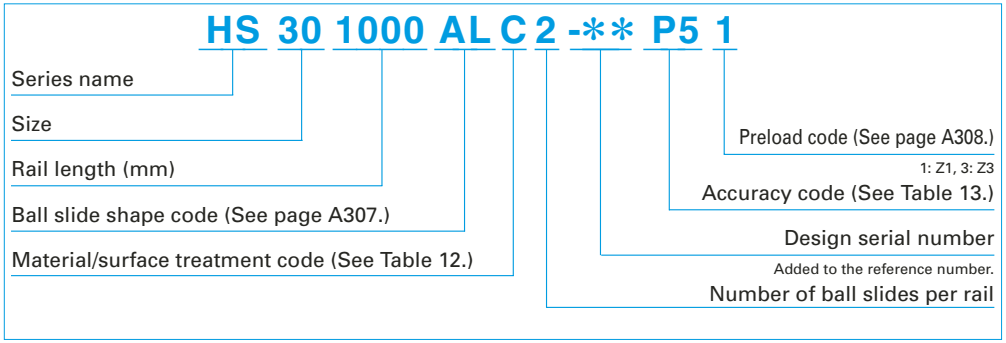


Table 12 Material/surface treatment code

Code	Description
C	Special high carbon steel (NSK standard)
K	Stainless steel
D	Special high carbon steel with surface treatment
H	Stainless steel with surface treatment
Z	Other, special

Table 13 Accuracy code

Accuracy	Standard (Without NSK K1)	With NSK K1
Ultra precision grade	P3	K3
Super precision grade	P4	K4
High precision grade	P5	K5

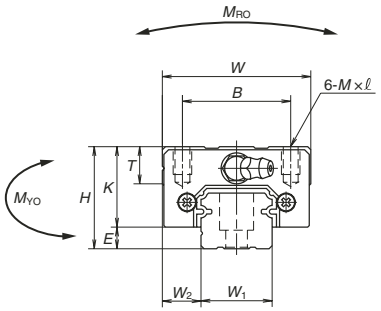
Note: Refer to page A38 for NSK K1 lubrication unit.

9. Dimensions
HS-AL

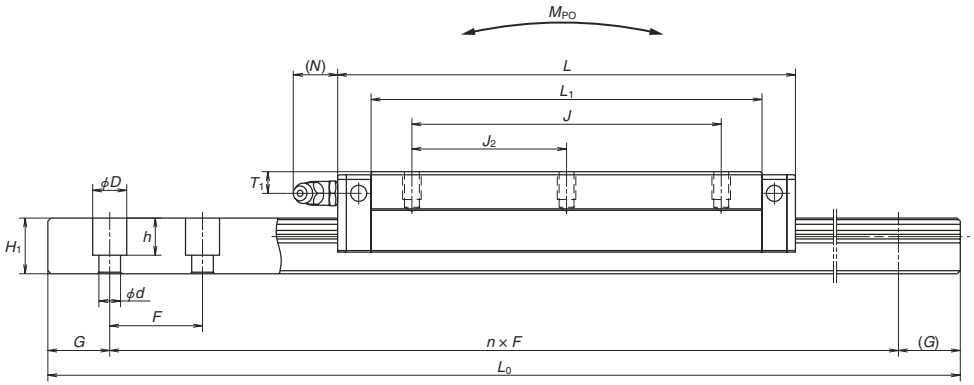
HS 30 1000 AL C 2 - P5 1**

- Series name
- Size
- Rail length (mm)
- Ball slide shape code (See page A307.)
- Material/surface treatment code (See Table 12.)
- Number of ball slides per rail
- Design serial number (Added to the reference number.)
- Accuracy code (See Table 13.)
- Preload code (See page A308.) 1: Z1, 3: Z3

Front view of AL types



Side view of AL type



Unit: mm

Model No.	Assembly			Ball slide											Width	Height
	Height			Width	Length	Mounting hole							Grease fitting				
	H	E	W_2	W	L	B	J	J_2	M × pitch × ℓ	L_1	K	T	Hole size	T_1	N	W_1	H_1
HS15AL	24	4.6	9.5	34	106	26	60	30	M4×0.7×6	89.2	19.4	10	ϕ3	6	3	15	12.5
HS20AL	28	6	11	42	119.7	32	80	40	M5×0.8×7	102.5	22	12	M6×0.75	5.5	11	20	15.5
HS25AL	33	7	12.5	48	148	35	100	50	M6×1×9	126.4	26	12	M6×0.75	7	11	23	18
HS30AL	42	9	16	60	176.1	40	120	60	M8×1.25×12	150.7	33	13	M6×0.75	8	11	28	23
HS35AL	48	10.5	18	70	203.6	50	140	70	M8×1.25×12	175.6	37.5	14	M6×0.75	8.5	11	34	27.5

Notes: 1) The HS Series does not have a ball retainer. Be aware that balls fall out when the ball slide is withdrawn from the rail.
2) External appearance of stainless steel ball slides differ from those of carbon steel ball slide.

Rail				Basic load rating						Weight	
Pitch	Mounting bolt hole	G	Max. length $L_{0max.}$ ( ) for stainless	[3]Dynamic [50km]	[100km]	Static	Static moment (N·m)			Ball slide	Rail
							M_{RO}	M_{PO}	M_{YO}		
F	d × D × h	(reference)		C_{50}(N)	C_{100}(N)	C_0 (N)		One slide / Two slides	One slide / Two slides	(kg)	(kg/m)
30	*3.5×6×8.5 4.5×7.5×8.5	20	2 000 (1 700)	20 500	16 300	40 000	199	395	1 990	335	1 670	0.34	1.4
30	6×9.5×10.5	20	3 960 (3 500)	27 300	21 600	52 000	350	590	2 930	495	2 460	0.52	2.3
30	7×11×12	20	3 960 (3 500)	44 500	35 000	78 000	605	1 090	5 450	910	4 600	0.85	3.1
40	7×11×16	20	4 000 (3 500)	68 000	54 000	127 000	1 190	2 120	10 600	1 780	8 850	1.7	4.8
40	9×14×20	20	4 000 (3 500)	94 500	75 000	172 000	1 980	3 350	16 600	2 820	13 900	2.5	7.0

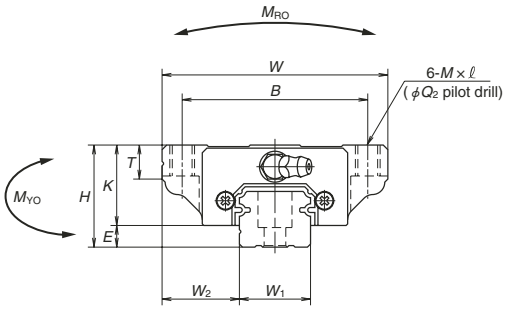
3) The basic load rating comply with the ISO standard. (ISO 14728-1, 14728-2)
C_{50}; the basic dynamic load rating for 50 km rated fatigue life C_{100}; the basic dynamic load rating for 100 km rated fatigue life
The basic static load rating shows static permissible load.
4) Parenthesized dimensions are applicable to stainless steel products.
*) Standard rail mounting bolt hole for HS15 is specified as hole for M3 (3.5 × 6 × 8.5). Please contact us to request a different hole for M4 (4.5 × 7.5 × 8.5).

HS-EM

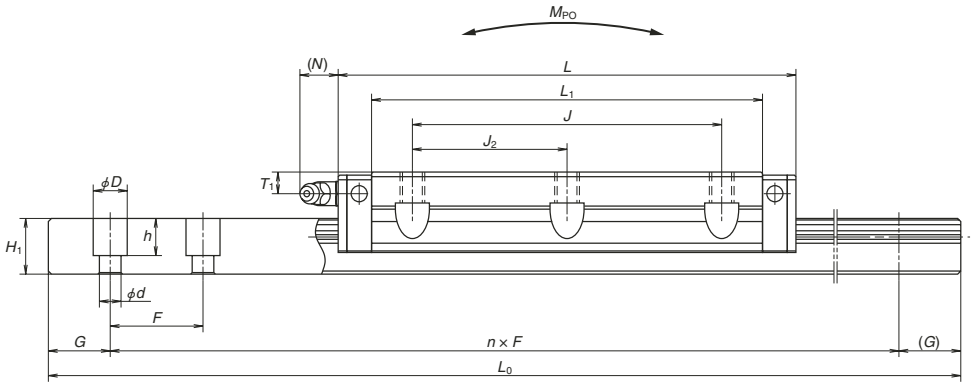
HS 30 1000 EM C 2 - ** P5 1**

- Series name
- Size
- Rail length (mm)
- Ball slide shape code (See page A307.)
- Material/surface treatment code (See Table 12.)
- Number of ball slides per rail
- Design serial number (Added to the reference number.)
- Accuracy code (See Table 13.)
- Preload code (See page A308.) (1: Z1, 3: Z3)

Front view of EM type



Side view of EM type



Unit: mm

Model No.	Assembly			Ball slide													Width	Height
	Height			Width	Length	Mounting hole								Grease fitting				
	H	E	W_2	W	L	B	J	J_2	M × pitch × ℓ	Q_2	L_1	K	T	Hole size	T_1	N	W_1	H_1
HS15EM	24	4.6	18.5	52	106	41	60	30	M5×0.8×7	4.4	89.2	19.4	8	ϕ3	6	3	15	12.5
HS20EM	28	6	19.5	59	119.7	49	80	40	M6×1×9 (M6×1×9.5)	5.3	102.5	22	10	M6×0.75	5.5	11	20	15.5
HS25EM	33	7	25	73	148	60	100	50	M8×1.25×10 (M8×1.25×11.5)	6.8	126.4	26	11 (12)	M6×0.75	7	11	23	18
HS30EM	42	9	31	90	176.1	72	120	60	M10×1.5×12 (M10×1.5×14.5)	8.6	150.7	33	11 (15)	M6×0.75	8	11	28	23
HS35EM	48	10.5	33	100	203.6	82	140	70	M10×1.5×13 (M10×1.5×14.5)	8.6	175.6	37.5	12 (15)	M6×0.75	8.5	11	34	27.5

Notes: 1) The HS Series does not have a ball retainer. Be aware that balls fall out when the ball slide is withdrawn from the rail.
2) External appearance of stainless steel ball slides differ from those of carbon steel ball slide.

Rail				Basic load rating								Weight	
Pitch	Mounting bolt hole	G	Max. length $L_{0max.}$ ( ) for stainless	[3]Dynamic		Static	Static moment (N·m)					Ball slide	Rail
				[50km]	[100km]	C_0	M_{RO}	M_{PO}		M_{YO}			
F	d × D × h	(reference)		C_{50}(N)	C_{100}(N)	(N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
30	*3.5×6×8.5 4.5×7.5×8.5	20	2 000 (1 700)	20 500	16 300	40 000	199	395	1 990	335	1 670	0.45	1.4
30	6×9.5×10.5	20	3 960 (3 500)	27 300	21 600	52 000	350	590	2 930	495	2 460	0.67	2.3
30	7×11×12	20	3 960 (3 500)	44 500	35 000	78 000	605	1 090	5 450	910	4 600	1.3	3.1
40	7×11×16	20	4 000 (3 500)	68 000	54 000	127 000	1 190	2 120	10 600	1 780	8 850	2.4	4.8
40	9×14×20	20	4 000 (3 500)	94 500	75 000	172 000	1 980	3 350	16 600	2 820	13 900	3.4	7.0

3) The basic load rating comply with the ISO standard. (ISO 14728-1, 14728-2)
C_{50}; the basic dynamic load rating for 50 km rated fatigue life C_{100}; the basic dynamic load rating for 100 km rated fatigue life
The basic static load rating shows static permissible load.
4) Parenthesized dimensions are applicable to stainless steel products.
*) Standard rail mounting bolt hole for HS15 is specified as hole for M3 (3.5 × 6 × 8.5). Please contact us to request a different hole for M4 (4.5 × 7.5 × 8.5).

5. The Comparative Table of Old and New Series

New Series			Former series					
Model No.	Ball slide mounting hole dimension M×pitch×ℓ <Q_2> [mm]	Dynamic load rating C_{50} [N]	Model No.	Ball slide mounting hole dimension M×pitch×ℓ <Q_2> Q_1×ℓ [mm]	Dynamic load rating C_{50} [N]	Model No.	Ball slide mounting hole dimension M×pitch×ℓ <Q_2> Q_1×ℓ [mm]	Dynamic load rating C_{50} [N]
NH15AN	M4×0.7×6	14 200	**LH15AN**	M4×0.7×6	10 800	**SH15AN**	M4×0.7×6	10 100
NH15BN	M4×0.7×6	18 100	**LH15BN**	M4×0.7×6	14 600	**SH15BN**	M4×0.7×6	13 400
NH15EM	M5×0.8×7 <4.4>	14 200	**LH15EL** **LH15EM** **LH15FL**	M5×0.8×8 M5×0.8×7 <4.4> 4.5×7	10 800	**SH15EL** **SH15EM** **SH15FL**	M5×0.8×8 M5×0.8×7 <4.4> 4.5×7	10 100
NH15GM	M5×0.8×7 <4.4>	18 100	**LH15GL** **LH15GM** **LH15HL**	M5×0.8×8 M5×0.8×7 <4.4> 4.5×7	14 600	**SH15GL** **SH15GM** **SH15HL**	M5×0.8×8 M5×0.8×7 <4.4> 4.5×7	13 400
NH20AN	M5×0.8×6	23 700	**LH20AN**	M5×0.8×6	17 400	**SH20AN**	M5×0.8×6	16 300
NH20BN	M5×0.8×6	30 000	**LH20BN**	M5×0.8×6	23 500	**SH20BN**	M5×0.8×6	21 600
NH20EM	M6×1×9.5 <5.3>	23 700	**LH20EL** **LH20EM** **LH20FL**	M6×1×10 M6×1×9.5 <5.3> 6×9.5	17 400	**SH20EL** **SH20EM** **SH20FL**	M6×1×10 M6×1×9.5 <5.3> 6×9.5	16 300
NH20GM	M6×1×9.5 <5.3>	30 000	**LH20GL** **LH20GM** **LH20HL**	M6×1×10 M6×1×9.5 <5.3> 6×9.5	23 500	**SH20GL** **SH20GM** **SH20HL**	M6×1×10 M6×1×9.5 <5.3> 6×9.5	21 600
NH25AL	M6×1×6	33 500	**LH25AL**	M6×1×6	25 600	**SH25AL**	M6×1×6	22 400
NH25AN	M6×1×9	33 500	**LH25AN**	M6×1×9	25 600	**SH25AN**	M6×1×9	22 400
NH25BL	M6×1×6	45 500	**LH25BL**	M6×1×6	34 500	**SH25BL**	M6×1×6	32 000
NH25BN	M6×1×9	45 500	**LH25BN**	M6×1×9	34 500	**SH25BN**	M6×1×9	32 000
NH25EM	M8×1.25×10(11.5) <6.8>	33 500	**LH25EL** **LH25EM** **LH25FL**	M8×1.25×16(12) M8×1.25×10(11.5) <6.8> 7×10(11.5)	25 600	**SH25EL** **SH25EM** **SH25FL**	M8×1.25×16(12) M8×1.25×10(11.5) <6.8> 7×10(11.5)	22 400
NH25GM	M8×1.25×10(11.5) <6.8>	45 500	**LH25GL** **LH25GM** **LH25HL**	M8×1.25×16(12) M8×1.25×10(11.5) <6.8> 7×10(11.5)	34 500	**SH25GL** **SH25GM** **SH25HL**	M8×1.25×16(12) M8×1.25×10(11.5) <6.8> 7×10(11.5)	32 000
NH30AL	M8×1.25×8	41 000	**LH30AL**	M8×1.25×8	31 000	**SH30AL**	M8×1.25×8	31 000
NH30AN	M8×1.25×10	41 000	**LH30AN**	M8×1.25×10	31 000	**SH30AN**	M8×1.25×10	31 000
NH30BL	M8×1.25×8	61 000	**LH30BL**	M8×1.25×8	46 000	**SH30BL**	M8×1.25×8	46 000
NH30BN	M8×1.25×10	61 000	**LH30BN**	M8×1.25×10	46 000	**SH30BN**	M8×1.25×10	46 000
NH30EM	M10×1.5×12(14.5) <8.6>	47 000	**LH30EL** **LH30EM** **LH30FL**	M10×1.5×18(15) M10×1.5×12(14.5) <8.6> 9×12(14.5)	35 500	**SH30EL** **SH30EM** **SH30FL**	M10×1.5×18(15) M10×1.5×12(14.5) <8.6> 9×12(14.5)	35 500
NH30GM	M10×1.5×12(14.5) <8.6>	61 000	**LH30GL** **LH30GM** **LH30HL**	M10×1.5×18(15) M10×1.5×12(14.5) <8.6> 9×12(14.5)	46 000	**SH30GL** **SH30GM** **SH30HL**	M10×1.5×18(15) M10×1.5×12(14.5) <8.6> 9×12(14.5)	46 000
NH35AL	M8×1.25×8	62 500	**LH35AL**	M8×1.25×8	47 500	**SH35AL**	M8×1.25×8	47 500
NH35AN	M8×1.25×12	62 500	**LH35AN**	M8×1.25×12	47 500	**SH35AN**	M8×1.25×12	47 500
NH35BL	M8×1.25×8	81 000	**LH35BL**	M8×1.25×8	61 500	**SH35BL**	M8×1.25×8	61 500
NH35BN	M8×1.25×12	81 000	**LH35BN**	M8×1.25×12	61 500	**SH35BN**	M8×1.25×12	61 500
NH35EM	M10×1.5×13 <8.6>	62 500	**LH35EL** **LH35EM** **LH35FL**	M10×1.5×20 M10×1.5×13 <8.6> 9×13	47 500	**SH35EL** **SH35EM** **SH35FL**	M10×1.5×20 M10×1.5×13 <8.6> 9×13	47 500
NH35GM	M10×1.5×13 <8.6>	81 000	**LH35GL** **LH35GM** **LH35HL**	M10×1.5×20 M10×1.5×13 <8.6> 9×13	61 500	**SH35GL** **SH35GM** **SH35HL**	M10×1.5×20 M10×1.5×13 <8.6> 9×13	61 500
NH45AL	M10×1.5×10	107 000	**LH45AL**	M10×1.5×10	81 000	**SH45AL**	M10×1.5×10	76 500
NH45AN	M10×1.5×17	107 000	**LH45AN**	M10×1.5×17	81 000	**SH45AN**	M10×1.5×17	76 500
NH45BL	M10×1.5×10	131 000	**LH45BL**	M10×1.5×10	99 000	**SH45BL**	M10×1.5×10	94 500
NH45BN	M10×1.5×17	131 000	**LH45BN**	M10×1.5×17	99 000	**SH45BN**	M10×1.5×17	94 500
NH45EM	M12×1.75×15 <10.5>	107 000	**LH45EL** **LH45EM** **LH45FL**	M12×1.75×24 M12×1.75×15 <10.5> 11×15	81 000	**SH45EL** **SH45EM** **SH45FL**	M12×1.75×24 M12×1.75×15 <10.5> 11×15	76 500
NH45GM	M12×1.75×15 <10.5>	131 000	**LH45GL** **LH45GM** **LH45HL**	M12×1.75×24 M12×1.75×15 <10.5> 11×15	99 000	**SH45GL** **SH45GM** **SH45HL**	M12×1.75×24 M12×1.75×15 <10.5> 11×15	94 500
NH55AL	M12×1.75×13	158 000	**LH55AL**	M12×1.75×13	119 000	**SH55AL**	M12×1.75×13	113 000
NH55AN	M12×1.75×18	158 000	**LH55AN**	M12×1.75×18	119 000	**SH55AN**	M12×1.75×18	113 000
NH55BL	M12×1.75×13	193 000	**LH55BL**	M12×1.75×13	146 000	**SH55BL**	M12×1.75×13	140 000
NH55BN	M12×1.75×18	193 000	**LH55BN**	M12×1.75×18	146 000	**SH55BN**	M12×1.75×18	140 000
NH55EM	M14×2×18 <12.5>	158 000	**LH55EL** **LH55EM** **LH55FL**	M14×2×28 M14×2×18 <12.5> 14×18	119 000	**SH55EL** **SH55EM** **SH55FL**	M14×2×28 M14×2×18 <12.5> 14×18	113 000
NH55GM	M14×2×18 <12.5>	193 000	**LH55GL** **LH55GM** **LH55HL**	M14×2×28 M14×2×18 <12.5> 14×18	146 000	**SH55GL** **SH55GM** **SH55HL**	M14×2×28 M14×2×18 <12.5> 14×18	140 000
NH65AN	M16×2×20	239 000	**LH65AN**	M16×2×20	181 000			
NH65BN	M16×2×20	310 000	**LH65BN**	M16×2×20	235 000			
NH65EM	M16×2×24 <14.6>	239 000	**LH65EL** **LH65EM** **LH65FL**	M16×2×24 M16×2×24 <14.6> 16×24	181 000			
NH65GM	M16×2×24 <14.6>	310 000	**LH65GL** **LH65GM** **LH65HL**	M16×2×24 M16×2×24 <14.6> M16×24	235 000			

Notes: 1) Parenthesized dimensions are for items made of stainless steel.
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.

New Series			Former series					
Model No.	Ball slide mounting hole dimension M×pitch×ℓ <Q_2> [mm]	Dynamic load rating C_{50} [N]	Model No.	Ball slide mounting hole dimension M×pitch×ℓ <Q_2> Q_1×ℓ [mm]	Dynamic load rating C_{50} [N]	Model No.	Ball slide mounting hole dimension M×pitch×ℓ <Q_2> Q_1×ℓ [mm]	Dynamic load rating C_{50} [N]
NS15CL	M4×0.7×6	7 250	**LS15CL**	M4×0.7×6	5 400	**SS15CL**	M4×0.7×6	4 900
NS15AL	M4×0.7×6	11 200	**LS15AL**	M4×0.7×6	8 350	**SS15AL**	M4×0.7×6	7 900
NS15JM	M5×0.8×7 <4.4>	7 250	**LS15JL** **LS15JM** **LS15KL**	M5×0.8×8 M5×0.8×7 <4.4> 4.5×7	5 400	**SS15JL** **SS15JM** **SS15KL**	M5×0.8×8 M5×0.8×7 <4.4> 4.5×7	4 900
NS15EM	M5×0.8×7 <4.4>	11 200	**LS15EL** **LS15EM** **LS15FL**	M5×0.8×8 M5×0.8×7 <4.4> 4.5×7	8 350	**SS15EL** **SS15EM** **SS15FL**	M5×0.8×8 M5×0.8×7 <4.4> 4.5×7	7 900
NS20CL	M5×0.8×7	10 600	**LS20CL**	M5×0.8×7	7 900	**SS20CL**	M5×0.8×7	7 250
NS20AL	M5×0.8×7	15 600	**LS20AL**	M5×0.8×7	11 700	**SS20AL**	M5×0.8×7	11 100
NS20JM	M6×1×9(9.5) <5.3>	10 600	**LS20JL** **LS20JM** **LS20KL**	M6×1×10 M6×1×9(9.5) <5.3> 5.5×9(9.5)	7 900	**SS20JL** **SS20JM** **SS20KL**	M6×1×10 M6×1×9(9.5) <5.3> 5.5×9(9.5)	7 250
NS20EM	M6×1×9(9.5) <5.3>	15 600	**LS20EL** **LS20EM** **LS20FL**	M6×1×10 M6×1×9(9.5) <5.3> 5.5×9(9.5)	11 700	**SS20EL** **SS20EM** **SS20FL**	M6×1×10 M6×1×9(9.5) <5.3> 5.5×9(9.5)	11 100
NS25CL	M6×1×9	17 700	**LS25CL**	M6×1×9	12 700	**SS25CL**	M6×1×9	12 700
NS25AL	M6×1×9	26 100	**LS25AL**	M6×1×9	18 800	**SS25AL**	M6×1×9	17 900
NS25JM	M8×1.25×10(11.5) <6.8>	17 700	**LS25JL** **LS25JM** **LS25KL**	M8×1.25×12 M8×1.25×10(11.5) <6.8> 7×10(11.5)	12 700	**SS25JL** **SS25JM** **SS25KL**	M8×1.25×12 M8×1.25×10(11.5) <6.8> 7×10(11.5)	12 700
NS25EM	M8×1.25×10(11.5) <6.8>	26 100	**LS25EL** **LS25EM** **LS25FL**	M8×1.25×12 M8×1.25×10(11.5) <6.8> 7×10(11.5)	18 800	**SS25EL** **SS25EM** **SS25FL**	M8×1.25×12 M8×1.25×10(11.5) <6.8> 7×10(11.5)	17 900
NS30CL	M8×1.25×12	24 700	**LS30CL**	M8×1.25×12	18 700	**SS30CL**	M8×1.25×12	18 700
NS30AL	M8×1.25×12	38 000	**LS30AL**	M8×1.25×12	28 800	**SS30AL**	M8×1.25×12	27 300
NS30JM	M10×1.5×12(14.5) <8.6>	24 700	**LS30JL** **LS30JM** **LS30KL**	M10×1.5×18(15) M10×1.5×12(14.5) <8.6> 9×12(14.5)	18 700	**SS30JL** **SS30JM** **SS30KL**	M10×1.5×18(15) M10×1.5×12(14.5) <8.6> 9×12(14.5)	18 700
NS30EM	M10×1.5×12(14.5) <8.6>	38 000	**LS30EL** **LS30EM** **LS30FL**	M10×1.5×18(15) M10×1.5×12(14.5) <8.6> 9×12(14.5)	28 800	**SS30EL** **SS30EM** **SS30FL**	M10×1.5×18(15) M10×1.5×12(14.5) <8.6> 9×12(14.5)	27 300
NS35CL	M8×1.25×12	34 500	**LS35CL**	M8×1.25×12	26 000	**SS35CL**	M8×1.25×12	26 000
NS35AL	M8×1.25×12	52 500	**LS35AL**	M8×1.25×12	40 000	**SS35AL**	M8×1.25×12	38 000
NS35JM	M10×1.5×13(14.5) <8.6>	34 500	**LS35JL** **LS35JM** **LS35KL**	M10×1.5×20(15) M10×1.5×13(14.5) <8.6> 9×13(14.5)	26 000	**SS35JL** **SS35JM** **SS35KL**	M10×1.5×20(15) M10×1.5×13(14.5) <8.6> 9×13(14.5)	26 000
NS35EM	M10×1.5×13(14.5) <8.6>	52 500	**LS35EL** **LS35EM** **LS35FL**	M10×1.5×20(15) M10×1.5×13(14.5) <8.6> 9×13(14.5)	40 000	**SS35EL** **SS35EM** **SS35FL**	M10×1.5×20(15) M10×1.5×13(14.5) <8.6> 9×13(14.5)	38 000

Notes: 1) Parenthesized dimensions are for items made of stainless steel.
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.

In VH series, the slide types in flange shape are focused.

After focused			Before focused		
Model No.	Ball slide mounting hole dimension M×pitch×ℓ <Q_2> [mm]	Dynamic load rating C_{50} [N]	Model No.	Ball slide mounting hole dimension M×pitch×ℓ Q_1×ℓ [mm]	Dynamic load rating C_{50} [N]
VH15EM	M5×0.8×7 <4.4>	14 200	**VH15EL** **VH15FL**	M5×0.8×8 4.5×7	10 800
VH15GM	M5×0.8×7 <4.4>	18 100	**VH15GL** **VH15HL**	M5×0.8×8 4.5×7	14 600
VH20EM	M6×1×9.5 <5.3>	23 700	**VH20EL** **VH20FL**	M6×1×10 6×9.5	17 400
VH20GM	M6×1×9.5 <5.3>	30 000	**VH20GL** **VH20HL**	M6×1×10 6×9.5	23 500
VH25EM	M8×1.25×10(11.5) <6.8>	33 500	**VH25EL** **VH25FL**	M8×1.25×16(12) 7×10(11.5)	25 600
VH25GM	M8×1.25×10(11.5) <6.8>	45 500	**VH25GL** **VH25HL**	M8×1.25×16(12) 7×10(11.5)	34 500
VH30EM	M10×1.5×12(14.5) <8.6>	47 000	**VH30EL** **VH30FL**	M10×1.5×18(15) 9×12(14.5)	35 500
VH30GM	M10×1.5×12(14.5) <8.6>	61 000	**VH30GL** **VH30HL**	M10×1.5×18(15) 9×12(14.5)	46 000
VH35EM	M10×1.5×13 <8.6>	62 500	**VH35EL** **VH35FL**	M10×1.5×20 9×13	47 500
VH35GM	M10×1.5×13 <8.6>	81 000	**VH35GL** **VH35HL**	M10×1.5×20 9×13	61 500
VH45EM	M12×1.75×15 <10.5>	107 000	**VH45EL** **VH45FL**	M12×1.75×24 11×15	81 000
VH45GM	M12×1.75×15 <10.5>	131 000	**VH45GL** **VH45HL**	M12×1.75×24 11×15	99 000
VH55EM	M14×2×18 <12.5>	158 000	**VH55EL** **VH55FL**	M14×2×28 14×18	119 000
VH55GM	M14×2×18 <12.5>	193 000	**VH55GL** **VH55HL**	M14×2×28 14×18	146 000

Notes: 1) Parenthesized dimensions are for items made of stainless steel.
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.

A-6 Other Linear Rolling Guide Products

A-6-1 Linear Rolling Bushing

1. Features

(1) Low friction

Low friction owes to its design: Balls come into point contacts with raceway surface: the balls smoothly re-circulate. There is very little stick slip.

(2) Low noise

Noise level is low due to the ball retainer which is made of a synthetic resin.

(3) High precision

Due to NSK's superb quality control, precision is guaranteed.

(4) Dust prevention

Series with seal is available. The seal has small friction, and is highly durable. Highly dust-preventive double-lip system has been adopted.

(5) Superb durability

The material of outer sleeve is vacuum degassed, highly pure, and is heat-treated with good expertise.

2. Models

There are three models

(1) Standard type LB (Fig. 1)

This model is the most commonly used, and is the only model that comes with a seal and in super precision grade.

Fig. 1 Standard type LB

(2) Adjustable clearance type LB-T (Fig. 2)

A part of the outer sleeve is cut open toward the axial direction. Used with a housing which can adjust inside diameter, it makes minute adjustment of the clearance between the linear shaft and the inscribed circle (an imaginary circle that connects the summit of the ball) of linear rolling bushing.

Fig. 2 Adjustable Clearance type LB-T

(3) Open type LB-K (Fig. 3)

A cut is made in the outer sleeve and retainer, to a width equivalent to one row of the retainer, to the axial direction. The opening is used to hold this linear rolling bushing by a support or base to prevent a long linear shaft from bending.

Fig. 3 Open type LB-K

3. Accuracy

(1) Accuracy grades

- Standard type LB ····· High precision grade S, and super precision grade SP are available.
- Space adjustment type LB-T ····· } High precision grade S is available.
- Open type LB-K ····· }

(2) Tolerance of rolling linear bushing, linear shaft and housing

Table 1 Tolerance for inscribed circle of the linear rolling bushing and shaft diameter

Unit: μm

Nominal dimension/ inscribed circle diameter /shaft diameter (mm)		Tolerance/inscribed circle diameter*1				Tolerance/width *B*		Tolerance/slot distance of retaining rings *Bn*		Recommended tolerance/ shaft diameter			
		High precision grade S		Super high precision grade SP		High precision grade S Super high precision grade SP		High precision grade S Super high precision grade SP		High precision grade S		Super high precision grade SP	
over	or less	upper	lower	upper	lower	upper	lower	upper	lower	upper	lower	upper	lower
2.5	6	0	-8	0	-5	0	-120	+240	-240	-6	-14	-4	-9
6	10									-6	-15	-4	-10
10	18									-6	-17	-4	-12
18	30	0	-10	0	-6					-6	-19	-4	-13
30	50	0	-12	0	-8					-7	-23	-5	-16

Table 2 Tolerance of linear rolling bush outside diameter, and housing inside diameter

Unit: μm

Nominal dimension/ outside diameter/housing inside diameter (mm)		Tolerance/outside diameter D*1				Eccentricity*2	Tolerance/housing inside diameter			
		High precision grade S		Super high precision grade SP		Super high precision grade SP	High precision grade S		Super high precision grade SP	
over	or less	upper	lower	upper	lower	Maximum	upper	lower	upper	lower
2.5	6	0	-10	0	-7	8	+12	0	+8	0
6	10						+15	0	+9	0
10	18						+18	0	+11	0
18	30	0	-12	0	-8	9	+21	0	+13	0
30	50	0	-14	0	-9	10	+25	0	+16	0

*1) For adjustable clearance type and open type, figures indicate tolerances before the cut is made.

*2) Eccentricity means the run-out of offset between the centers of outer sleeve diameter and inscribed circle diameter.

4. Composition of Reference Number

Example LB 35 N K Y S

- LB — Linear rolling bushing
- 35 — Nominal inscribed circle diameter (linear shaft nominal diameter)
- N — With retaining ring groove
- No code — Without retaining ring groove
- K — No code: Standard type LB; T: Adjustable clearance type LB-T; K: Open type LB-K
- Y — Plastic retainer
- S — Accuracy grade: S: High precision grade; SP: Super precision grade
- No code — No seal; D: Single-side seal; DD: Double-side seal

5. Lubrication and Friction

(1) Grease lubrication

① Supply at initial stage

At time of delivery, the linear rolling bushing has a coat of rust preventive agent. Wipe it off with clean kerosene or organic solvent. Dry with an air blower, etc., then apply grease.

Lithium soap based greases with consistency level of 2 are generally used (e.g. NSK Grease LR3, PS2, and AS2).

② Replenishment

- Sealed linear rolling bushing is designed to be a disposal item. Therefore, a replenishing grease is considered to be not required. However, if replenishment becomes necessary due to dirty environment or wear of the seal, remove the linear bushing from the shaft and replenish lubricant in the same manner as the initial lubricating.
- For items without seal, wipe off old grease from the linear shaft, and apply new grease.
- Intervals of replenishments are every 100 km in a dirty environment, 500 km in a slightly dirty environment, 1 000 km or no replenishing for a normal environment.

(2) Oil lubrication

It is not necessary to wash off the rust preventive agent applied before delivery.

Use an oil of ISO viscosity grade VG15-100. Drip the oil on the linear shaft by an oil supply system.

Temperature to use

−30°C to 50°C Viscosity VG15 – 46

50°C to 80°C Viscosity VG46 – 100

Lubricant is removed by the seal if the linear ball bearing has a seal. Therefore, the drip method cannot be used except for single-seal types.

(3) Friction coefficient

The linear rolling bushing has a small dynamic friction coefficient. This contributes to low power loss and temperature rise.

According to **Fig. 4**, dynamic friction coefficient is merely 0.001-0.004. Also, at the speed of under 60 m/min, there is no danger of the temperature rising.

Friction force can be obtained by the following formula.

$$F = \mu \cdot P \quad \cdots\cdots (1)$$

In this formula:

F : Friction force (N)

P : Load (vertical load to the shaft center line) (N)

μ : Friction coefficient (dynamic or static)

For a seal type, a seal resistance of 0.3 to 2.40 N is added to the above.

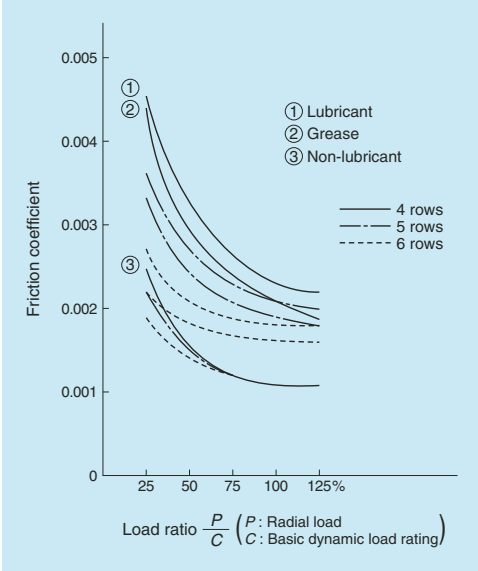


Fig. 4 Dynamic friction coefficient of linear rolling bushing

6. Range of Conditions to Use

Generally, use under the following conditions.

Please consult NSK when values exceed the ranges given below.

Temperature: – 30°C to 80°C

Speed: Up to 120 m/min

(excluding oscillation and short strokes)

7. Preload and Rigidity

The linear rolling bushing is normally used without applying preload. If high positioning accuracy is required, set the clearance between the linear rolling bush and the shaft at the range of 0 to 5 μm. Slight preload is a general rule (1% of basic dynamic load rating C -- see the dimension table).

The dimension table shows theoretical rigidity K when clearance with the shaft is zero, and a load of 0.1 C is applied to the summit of the ball.

Rigidity K_N, when load is not 0.1C, is obtained by the following formula.

$$K_N = K\,(P/0.1C)^{1/3} \quad \cdots\cdots (2)$$

In this formula:

K : Rigidity value in the dimension table (N/μm)

P : Radial load (N)

When the load is applied between the ball raws, the load becomes 1.122 times for 4 ball rows; 0.959 times for 5 ball rows; 0.98 times for 6 ball rows.

8. Basic Load Rating and Rated Life

(1) Basic dynamic load rating

Basic dynamic load rating C is: A radial load which allows 90% of a group of linear rolling bush to run a distance of 50 km without suffering damage when they are moved individually.

There is a relationship as below between C and the life

$$L = 50\, f_L^3 \quad \cdots\cdots (3)$$

$$f_L = C/P \quad \cdots\cdots (4)$$

In this formula:

L : Rated life (km)

P : Radial load (N)

f_L : Life factor (Refer to Fig. 5)

This formula is used provided that the shaft hardness is HRC58 or higher. Rated life is shorter if the shaft is softer. In this case, find the hardness factor f_H from Fig. 6, and multiply the value.

$$f_L = C \cdot f_H/P \quad \cdots\cdots (5)$$

Or

$$C = P \cdot f_L/f_H \quad \cdots\cdots (6)$$

Life in time can be obtained by the following formula, substituting for given stroke length, cycle numbers, and running distance:

$$L_h = (L/1.2 \cdot S \cdot n) \times 10^4 \quad \cdots\cdots (7)$$

In this formula:

L_h : Life hours (h)

L : Rated life (km)

S : Stroke (mm)

n : Cycles per minute (cpm)

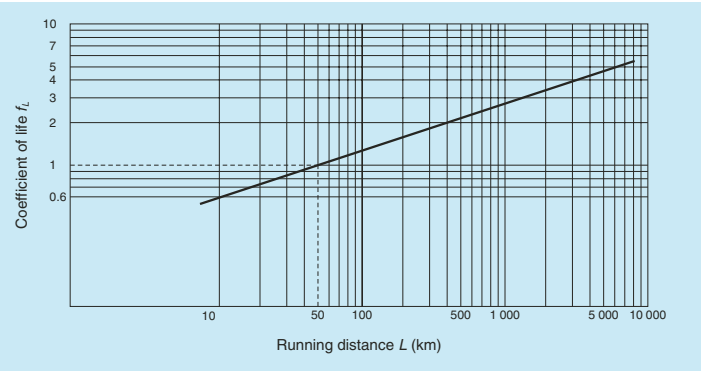


Fig. 5 Relationship between life factor and running distance

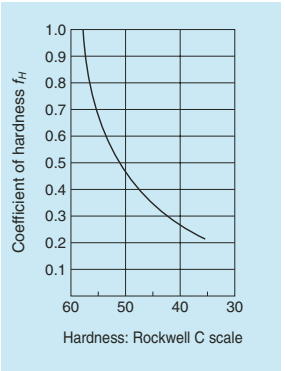


Fig. 6 Hardness factor

(2) Basic static load rating

It is a load that the total permanent deformation of outer sleeve, ball and shaft at the contact point, becomes 0.01% of the ball diameter when this load is applied to the rolling bushing. It is understood in general that this is the applicable load limit which causes this much permanent deformation without hampering operation.

(3) Calculation example

What is the appropriate rolling bushing size if required life is 5 000 hours?

Conditions are:

- Three linear rolling bushings are installed in two parallel shafts, and support a reciprocating table.
- Load 450 N is equally distributed to the three bushings.
- The table is required to reciprocate on the shafts at 200 times per minute at a stroke of 70 mm.
- Hardness of the shaft: HRC 55

450/3 = 150 (N)

- Load per linear rolling bushing is:

From Formula (7), the required life when indicated in distance is:

$$L = 5 \times 10^3 \times 1.2 \times 70 \times 200/10^4 = 8.4 \times 10^3 \text{ (km)}$$

From **Fig. 5** and **Fig. 6**,

Life factor $f_L = 5.6$

Hardness factor $f_H = 0.65$

Therefore, from Formula (6),

$$C = P \times f_L / f_H$$

$$= 150 \times 5.6/0.65 = 1\,292 \text{ (N)}$$

Based on the above, select linear rolling bushing LB30NY with shaft diameter of 30 mm, basic dynamic load rating of 1 400 N.

(4) Compensating load rating by ball row position

Load rating of the linear rolling bushing changes by the position of the ball circuit rows.

Permissible load is larger when it is applied to the middle of the ball circuit rows than when it is applied directly above the ball row (**Fig. 7**).

(Radial clearance set at zero in this case.)

Load ratings in the dimension table are in case "A" when it is applied directly above the ball circuit row. If used as in case "B," the load rating becomes larger (refer to **Fig. 7**).

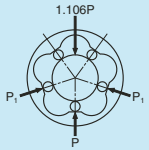
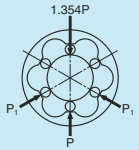
	A Load is directly above the ball rows	B Load is applied at the middle between the ball rows	Increase rate of load rating ($\frac{B}{A}$) Dynamic load rating	 Static load rating
4 rows			1.15	1.41
5 rows			1.19	1.46
6 rows			1.06	1.28

Fig. 7 Increasing rate of load rating by position of ball row (B/A)

9. Shaft Specification

Harden the shaft surface where the balls run with heat treatment to provide the following values.

- Surface hardness: HRC58 or over
- Depth of core hardness at HRC50 or higher
  - Depth for LB3; 0.3 mm or deeper
  - Depth for LB50; 1.2 mm or deeper

Roughness of the surface should be:

- For SP grade, and "the clearance for fit" with the ball bushing less than 5 µm -
  - Less than 0.8 S
- For SP grade with "the clearance" of more than 5 µm, and for S grade -
  - Less than 1.2 S

Bending should be:

- LB3 -- 15 µm/100 mm
- LB50 -- 100 µm/1 000 mm

An appropriate clearance for normal use conditions can be obtained when the tolerance in shaft diameter remains within the recommended range (refer to **Table 1** on page A322). For operations which require particular accuracy, select the shaft diameter which creates a clearance in the range of 0 to 0.005 (mm) for example, when assembled with the rolling bushing.

10. Dust Proof

Select a linear rolling bushing with seals to prevent moisture or foreign matters which are floating in the air from entering.

11. Installation

(1) Combination of shaft and linear rolling bushing

When the linear rolling bushing is installed in a linear motion table for its reciprocating movement, it is necessary to prevent the table from rotating.

In general, for this reason, two shafts installed with two linear rolling bushings on each are used.

Fig. 8 is an installation example.

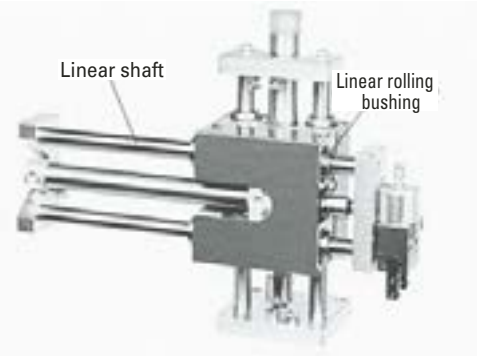
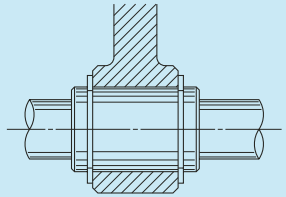


Fig. 8 Installation example

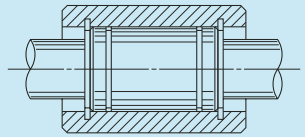
(2) Installation of linear rolling bushing

1) Standard type installation

Fig. 9 shows a method using a retainer ring. Linear rolling bushing can also be secured to the housing using a stop plate and/or screw.



Retaining ring method (1)



Retaining ring method (2)

Fig. 9 Installation using retaining rings

a) Housing inside diameter should be of a recommended value (**Table 2**, page A322). The entire rolling bushing contracts and gives excessive preload if: the inside diameter is small; the roundness or cylindricity is excessive. This may result in an unexpected failure.

b) To install linear rolling bushing, use a tool (**Fig. 10**) and squeeze it in, or use a holder and lightly pound it.

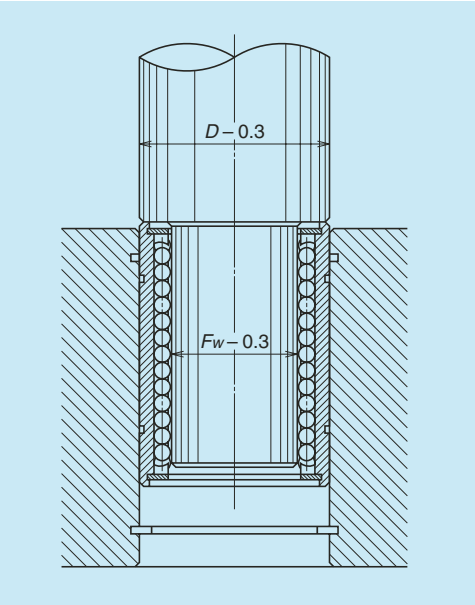


Fig. 10 Tool to install a linear rolling bushing

2) Installation of adjustable clearance type

Use a housing which can adjust the inside diameter of the rolling bushing. This way, the clearance between the rolling bushing and the linear shaft can be easily adjusted. Arrange the cut-open section of the rolling bushing at a 90-degree angle to the housing's cut-open section. This is the most effective way to evenly distribute deformation toward circumferential direction.

The tolerance of shaft diameter of the adjustable clearance type should be within the recommended range (refer to **Table 1** on page A322). As a general rule, set the preload at slight or light volume. (Do not provide excessive preload.) Use a dial gauge to measure and adjust clearance. However, here is an easy method to adjust .

First, loosen the housing until shaft turns freely. Then narrow the clearance gradually. Stop at the point when the shaft rotation becomes heavy. This creates a clearance zero or light preload.

3) Installation of open type

Use with clearance or with light preload.

Keep the tolerance in shaft diameter within the recommended range (refer to **Table 1** on page A322), so the preload shall not become excessive.

(Unlike the adjustable clearance type, clearance cannot be narrowed by rotating the shaft because the state of shaft rotation does not indicate how narrow the space has become. Narrowing clearance requires caution for open type.)

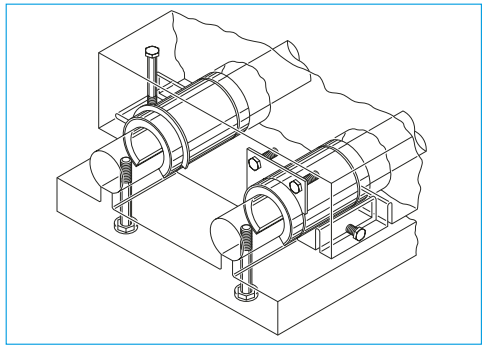


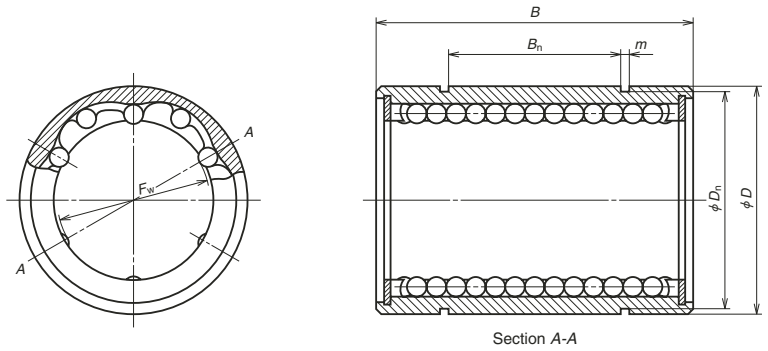
Fig. 11 Installation example of an open type

(3) Precaution for installing a shaft in the linear rolling bushing

1) To install two shafts parallel to each other, first install one shaft accurately. Use this as a reference, and install the other parallel to the first shaft. This makes installation easy.
2) Do not incline the shaft when inserting it into the linear rolling bushing. Do not force it to enter by twisting. This deforms the retainer, and causes the balls to fall out.
3) Do not use the shaft for rotating movement after inserting the shaft to the linear rolling bushing. The balls slip and damage the shaft.
4) Do not twist the shaft after it is inserted to the linear rolling bushing. The pressure scars the shaft.

12. Dimension tables

Model LB (standard type), no seal



Section *A-A*

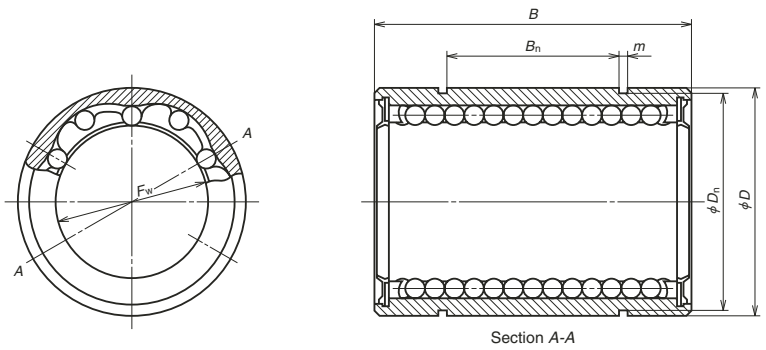
Unit: mm

Model No.	Inscribed circle diameter F_w	Outside diameter D	Length B	Retaining ring groove Distance B_n	Retaining ring groove Width m	Retaining ring groove Bottom diameter D_n	Stiffness*1 (N/μm)	Number of ball circuit	Weight (kg) (Reference only)	Basic dynamic load rating C (N)	Basic static load rating C_0 (N)
LB3Y	3	7	10	—	—	—	3	4	0.0016	20	39
LB4Y	4	8	12	—	—	—	4.5	4	0.0022	29	59
LB6NY	6	12	19	11	1.15	11.5	7	4	0.0074	74	147
LB8ANY*2	8	15	17	9	1.15	14.3	5.5	4	0.0094	78	118
LB8NY	8	15	24	15	1.15	14.3	9.5	4	0.014	118	226
LB10NY	10	19	29	19	1.35	18	12	4	0.025	206	355
LB12NY	12	21	30	20	1.35	20	13	4	0.028	265	500
LB13NY	13	23	32	20	1.35	22	13	4	0.040	294	510
LB16NY	16	28	37	23	1.65	26.6	14	4	0.063	440	635
LB20NY	20	32	42	27	1.65	30.3	19	5	0.088	610	1 010
LB25NY	25	40	59	37	1.9	38	35	6	0.267	1 000	1 960
LB30NY	30	45	64	40	1.9	42.5	41	6	0.305	1 400	2 500
LB35NY	35	52	70	45	2.2	49	48	6	0.440	1 510	2 800
LB40NY	40	60	80	56	2.2	57	54	6	0.520	2 230	4 000
LB50NY	50	80	100	68	2.7	76.5	69	6	1.770	4 100	7 100

*1): Refer to Section (7).

*2): Semi-standard item of which length B is shorter than standard.

Model LB (standard type), with seal

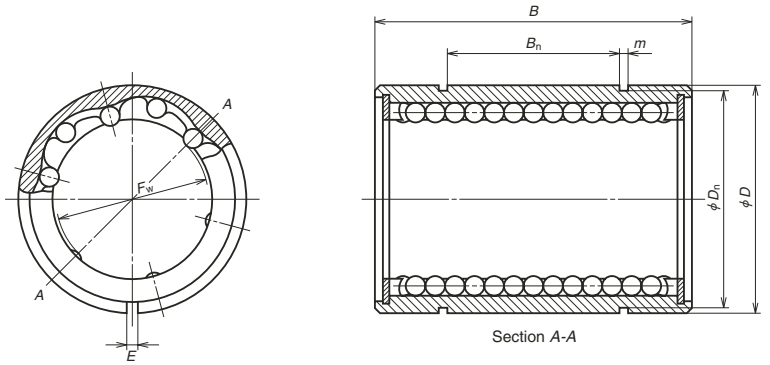


Unit: mm

*Model No.	Inscribed circle diameter F_w	Outside diameter D	Length B	Retaining ring groove Distance B_n	Retaining ring groove Width m	Retaining ring groove Bottom diameter D_n	Number of ball circuit	Weight (kg) (Reference only)	Basic dynamic load rating C (N)	Basic static load rating C_0 (N)
LB6NYDD	6	12	19	11	1.15	11.5	4	0.0074	74	147
LB8ANYDD	8	15	17	9	1.15	14.3	4	0.0094	78	118
LB8NYDD	8	15	24	15	1.15	14.3	4	0.014	118	226
LB10NYDD	10	19	29	19	1.35	18	4	0.025	206	355
LB12NYDD	12	21	30	20	1.35	20	4	0.028	265	500
LB13NYDD	13	23	32	20	1.35	22	4	0.040	294	510
LB16NYDD	16	28	37	23	1.65	26.6	4	0.063	440	635
LB20NYDD	20	32	42	27	1.65	30.3	5	0.088	610	1 010
LB25NYDD	25	40	59	37	1.9	38	6	0.267	1 000	1 960
LB30NYDD	30	45	64	40	1.9	42.5	6	0.305	1 400	2 500
LB35NYDD	35	52	70	45	2.2	49	6	0.440	1 510	2 800
LB40NYDD	40	60	80	56	2.2	57	6	0.520	2 230	4 000
LB50NYDD	50	80	100	68	2.7	76.5	6	1.770	4 100	7 100

*) Single-seal type is indicated as LB-D.

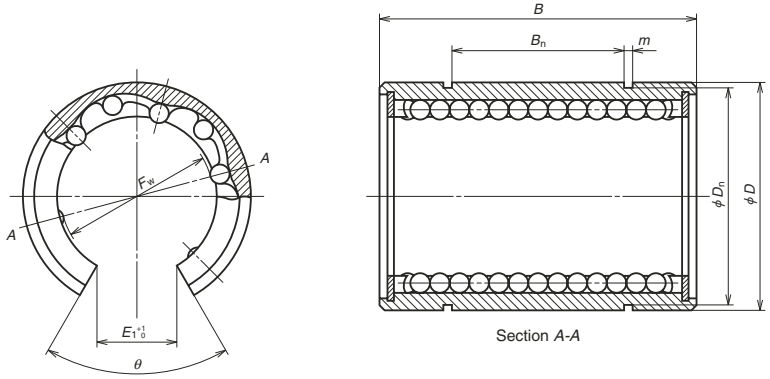
Model LB-T (Adjustable clearance type)



Unit: mm

Model No.	Inscribed circle diameter F_w	Outside diameter D	Length B	Opening width E	Retaining ring groove Distance B_n	Retaining ring groove Width m	Retaining ring groove Bottom diameter D_n	Number of ball circuit	Weight (kg) (Reference only)	Basic dynamic load rating C (N)	Basic static load rating C_0 (N)
LB6NTY	6	12	19	0.8	11	1.15	11.5	4	0.0073	74	147
LB8ANTY	8	15	17	1	9	1.15	14.3	4	0.0093	78	118
LB8NTY	8	15	24	1	15	1.15	14.3	4	0.014	118	226
LB10NTY	10	19	29	1.5	19	1.35	18	4	0.025	206	355
LB12NTY	12	21	30	1.5	20	1.35	20	4	0.028	265	500
LB13NTY	13	23	32	1.5	20	1.35	22	4	0.040	294	510
LB16NTY	16	28	37	1.5	23	1.65	26.6	4	0.062	440	635
LB20NTY	20	32	42	2	27	1.65	30.3	5	0.087	610	1 010
LB25NTY	25	40	59	2	37	1.9	38	6	0.265	1 000	1 960
LB30NTY	30	45	64	2	40	1.9	42.5	6	0.302	1 400	2 500
LB35NTY	35	52	70	3	45	2.2	49	6	0.44	1 510	2 800
LB40NTY	40	60	80	3	56	2.2	57	6	0.52	2 230	4 000
LB50NTY	50	80	100	3	68	2.7	76.5	6	1.75	4 100	7 100

Model LB-K (Open type)



Unit: mm

Model No.	Inscribed circle diameter F_w	Outside diameter D	Length B	Opening width E_1	Opening angle θ	Retaining ring groove Distance B_n	Retaining ring groove Width m	Retaining ring groove Bottom diameter D_n	Number of ball circuit	Weight (kg) (Reference only)	Basic dynamic load rating C (N)	Basic static load rating C_0 (N)
LB20NKY	20	32	42	11	60°	27	1.65	30.3	4	0.072	610	1 010
LB25NKY	25	40	59	13	50°	37	1.9	38	5	0.220	1 000	1 960
LB30NKY	30	45	64	15	50°	40	1.9	42.5	5	0.260	1 400	2 500
LB35NKY	35	52	70	17	50°	45	2.2	49	5	0.370	1 510	2 800
LB40NKY	40	60	80	20	50°	56	2.2	57	5	0.440	2 230	4 000
LB50NKY	50	80	100	25	50°	68	2.7	76.5	5	1.480	4 100	7 100

A-6-2 Crossed Roller Guide

1. Structure

Rollers with a retainer (hereinafter referred to as "retainer") are assembled in a pair of rails which have a V-shape groove. (The grooves form a 90-degree angle. Refer to **Figs. 1**, **2**.) Rollers are placed crisscrossed, and are able to support load in all directions, including moment loads.

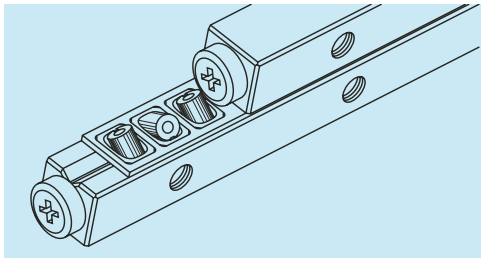


Fig. 1 Structure of crossed roller guide

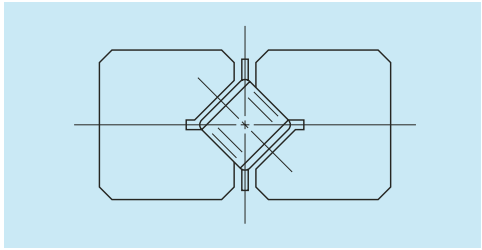


Fig. 2 Cross section of a crossed roller guide

2. Features

(1) High rigidity

This is attributable to the long contact area between the rollers and their accurately ground rolling surface.

(2) Superbly smooth movement, low noise

The window which directly embraces the roller is made of plastic for smooth and quiet operation, lowering clatter when the retainer and the rollers come into contact.

(3) Less micro-slip

Occasionally, a minute continuous slippage of the retainer to one direction, called "micro-slip," is caused due to installation error of the rail. After years of testing and research, NSK developed technology to minimize this.

(4) Easy installation

Installation is easy because the rail bending is minimal, and the bolt hole pitch for installation is precise.

(5) Long durability

The material is vacuum-degassed and highly pure, and is hardened by carburized heat treatment for superb resistance to wear and fatigue.

3. Accuracy

Accuracy grade P5 super precision and high precision grade P6 are available.

Fig. 3 shows parallelism of the roller's rolling surface to the mounting datum surface.

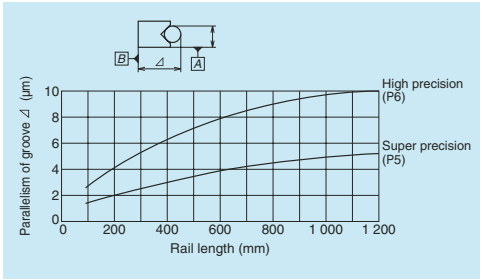


Fig. 3 Parallelism of the roller rolling surface

4. Rigidity

The number of the load rollers changes by the direction of the load. This is because the rollers are positioned crisscross.

That is, in case of **Fig. 4**:

The number of load rollers =1/2 × total roller number ·····(1)

In case of **Fig. 5**:

The number of load rollers = Total roller number ·····(2)

Fig. 6 shows changes in elastic deformation when there are 20 load rollers. If the total number of rollers is other than 20, use the graph in **Fig. 7**. Obtain the compensation factor which converts the elastic deformation value at time of 20 load rollers into the value when a specific number of rollers are loaded. That is, obtain a compensation factor on the ordinate that correspond to the number of load rollers on the abscissa. Then, multiply this factor by the elastic deformation value (on ordinates) which corresponds to the load (on abscissa) shown in **Fig. 6**.

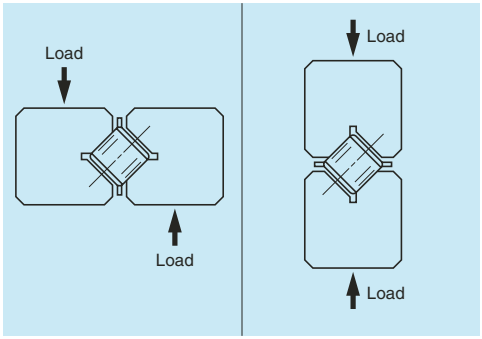


Fig. 4 Fig. 5

[Calculation example: Elastic deformation]

A retainer which contains 30 rollers (roller diameter 6 mm) is installed on both right and left side (**Fig. 8**). How large is the elastic deformation of the crossed roller guide when a load of 4 kN is applied to the table center?

[Answer]

A load of 2 kN is applied to each side of the crossed roller guide. The elastic deformation value on the ordinate which corresponds to the load 2 kN on the abscissa (in **Fig. 6**) is:

4.5 μm

This application of load is the same as in **Fig. 4**. Therefore, the number of load rollers is one-half of 30, or 15. From **Fig. 7**, the compensation factor on the ordinate which corresponds to 15 rollers on abscissa is:

1.3

Multiply 1.3 by 4.5 μm obtained above. The answer is:

$4.5 \times 1.3 \fallingdotseq 6$ μm

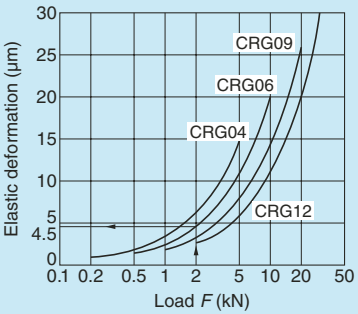


Fig. 6 Elastic deformation with 20 rollers

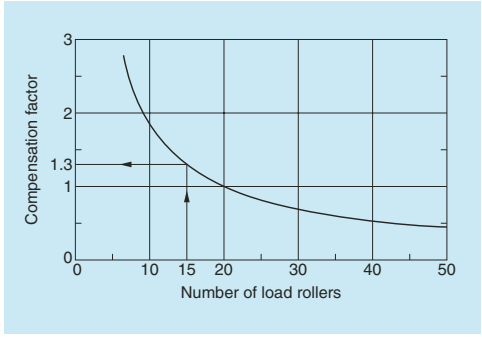


Fig. 7 Compensation factor to obtain elastic deformation

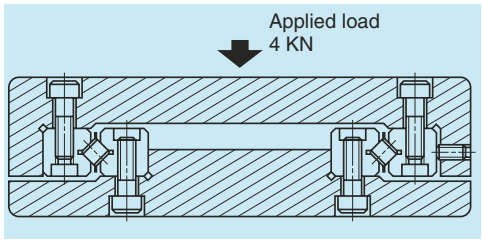


Fig. 8 Example calculation of elastic deformation (illustration)

5. Friction Force

If installation and lubrication are appropriate, the starting friction coefficient is markedly small as shown below:

μ = 0.005

6. Lengths of Rail and Retainer

The relationship of rail length L with stroke S is as follows:

When $S \leq 400$ mm, $L \geq 1.5S$ ····· (3)

When $S > 400$ mm, $L \geq S$ ····· (4)

Since the retainer travels a distance of half of the stroke, the retainer length K is:

$$K < L - \frac{S}{2} \cdots\cdots (5)$$

The retainer does not detach from the rail when condition in Formula (5) is satisfied (Refer to **Fig. 9**).

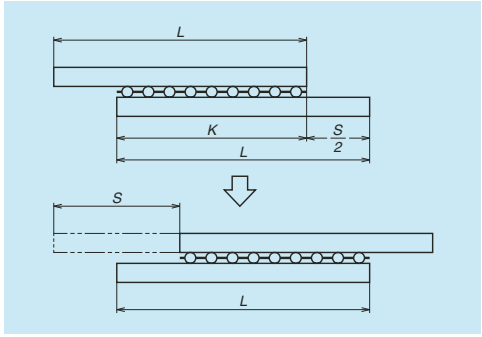


Fig. 9 Relationship of rail and retainer

7. Lubrication and Dust Proof

For grease lubrication, lithium soap based greases of consistency 1 or 2 are used.

For example; NSK Grease LR 3,
NSK Grease PS 2,
NSK Grease AS 2

For oil lubrication, JIS viscosity 32 to 150 is recommended.

When necessary, install a bellows on the rail, or install a seal on the side of the rail to arrest foreign matters and dust as shown in Fig. 10.

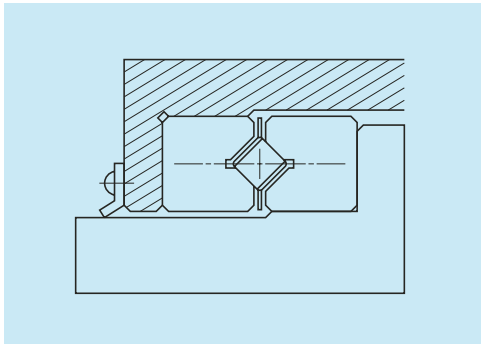


Fig. 10 Dust prevention (example)

8. Installation

Fig. 11 shows the standard installation procedures.

(1) Secure Rail 1 and 2 to the machine base using the fixing bolts. Secure Rail 3 to the table with the bolts. Temporarily secure Rail 4 and loosen the side bolt.

(2) Match the machine base and the table. Insert the retainer in the roller space. At this time, measure the distance from the rail end to the retainer end with a depth gauge to determine its position.
If the roller space is too narrow and the retainer does not go inside, slide Rail 4 toward the side bolt, then insert the retainer.

(3) Follow the reading of dial gauge which is previously set, and squeeze in all side bolts until they stop rattling. Do not apply excessive force.
When the side bolts are tightened, the rollers should be in the vicinity of the bolt position.
Then, secure Rail 4 with the fixing bolts.
Finally, install a stopper to the rail end.

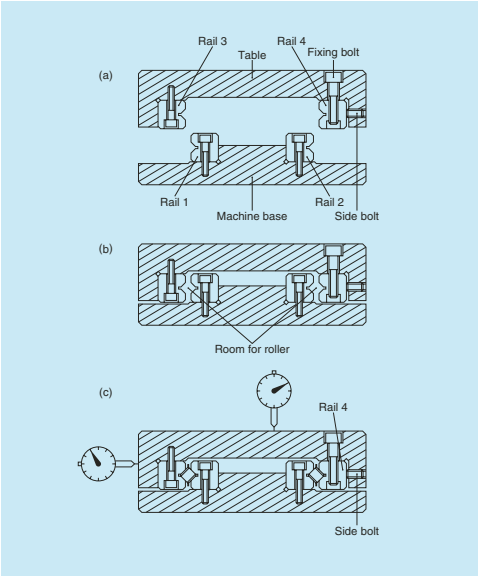


Fig. 11 Standard installation procedures

[Regarding preload]

As crossed roller guide has higher rigidity than other linear rolling guides, it does not need preload. It is also difficult to apply preload accurately. Crossed roller guide is usually used without clearance. For highly accurate applications, it is desirable to press the crossed roller guide by means of a bolt over the gib as shown in **Fig. 12**.

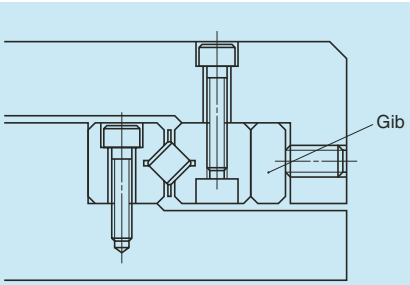


Fig. 12 Tightening using a gib

9. Basic Static Load Rating

Basic static load rating becomes larger in proportion to the number of the load rollers "n." Obtain basic static load rating per roller C_{01}. Then the basic static load rating C_{0n}, when the number of rollers is n, can be obtained as follows.

$$C_{0n} = n \times C_{01} \quad \cdots\cdots (6)$$

Values of C_{01} are shown in the dimension table.

10. Basic Dynamic Load Rating and Rated Life

Basic static load rating is based on a rated traveled distance of 50 km. The dimension table shows the value with 20 load rollers. When the number of load rollers is other than 20, a basic dynamic load rating C_n can be obtained by multiplying a compensation factor (obtained from **Fig. 13**.) by C in the dimension table.

(Suffix 'n' is to refer the number of load rollers.)

As an example; Number of load rollers: n = 15.

The compensation factor from **Fig. 13** is 0.8.

$$C_{15} = 0.8 \times C$$

Therefore, C_{15} is obtained from the following formula. Rated life (km) is shown in the formula below.

In this formula:

$$L = 50 \left(\frac{C_n}{f_w \cdot F_c} \right)^{\frac{10}{3}} \quad \cdots\cdots (7)$$

f_w: Load factor. 1.0 to 1.2 under smooth operation

F_c: Computed load which applies to the guide (kN)

Please refer to NSK Linear Guide Technical Description for details.

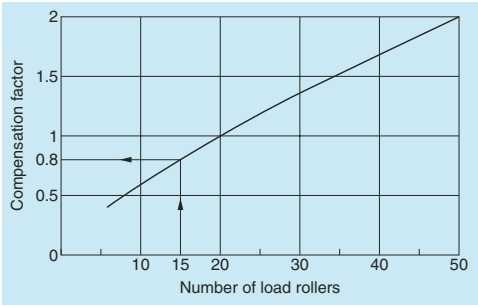


Fig. 13 Compensation factor for basic dynamic load rating

11. Reference Number and Standard Set for "One-Axis"

Specifications are indicated as a reference number as shown below.

CRG06-380 A P5 N

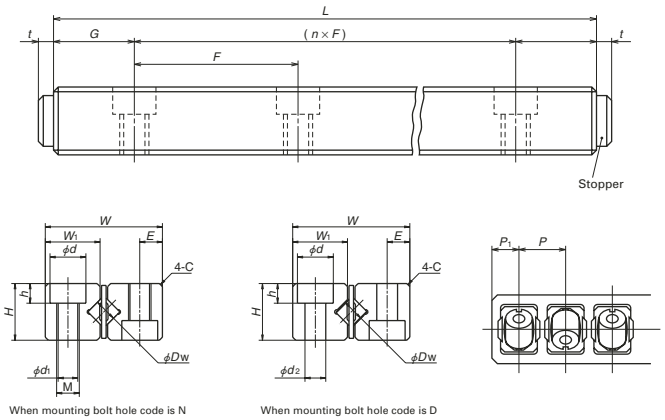
- Model number
- Rail length (mm)
- Shape of the rail cross section — Standard: A Semi-standard: T
- Accuracy grade — P5: Super precision grade; P6: High precision grade
- Holes for mounting — Tap hole: N; Drill hole: D

Notes : 1) Semi-standard T, a shape of rail cross section, is available only for CRG04. It is lower in H dimension, and wider in W dimension compared with A.

2) Standard set for "one axis" of the guide refers to 4 rails and 2 retainers which usually comprise the guide way for one axis.

12. Dimension Table

Crossed roller guide: Model CRG



Unit: mm

Model No.	D_w	W	H	w	C	E	d	h	d_1	d_2	M	G	F	t	P	P_1	Dynamic load rating C when rollers are 20 (N)	Static load rating C_{01} when roller is one (N)	L Max length High precision P5	L Max length Super high precision P6
CRG04…A	4	24	12	11.3	0.5	5	8	4.2	4.3	5	M 5x0.8	20	40	2.3	6.5	3.8	9 800	665	200	300
CRG04…T	4	26	10	12.3	0.5	5	8	4.2	4.3	5	M 5x0.8	12/15	38/40	2.3	6.5	3.8	9 800	665	200	300
CRG06…A	6	31	15	14.5	0.8	6	9.5	5.2	5.2	5.5	M 6x1	25	50	3.2	9.5	5.8	26 700	1 510	400	600
CRG09…A	9	44	22	20.7	1	9	11	6.2	6.8	7	M 8x1.25	50	100	4	14	8	72 500	3 400	600	900
CRG12…A	12	58	28	27.6	1.5	12	14	8.2	8.5	9	M10x1.5	50	100	5	20	12	130 000	6 050	900	1 200

Note: The area which embraces the roller is plastic for the standard retainer. A solid type made of steel plate is available for high temperature resistance.

A-6-3 Roller Pack

1. Structure

A roller pack comprises a main body which supports load from the guide way block via two rows of rollers; an end cap which changes the direction of the re-circulation of rollers at the end of the main body; a side plate which guides the rollers (**Fig. 1**). Roller pack is one of the linear rolling guides, where rollers are allowed to re-circulate infinitely.

There is a plate spring attached to a side of roller pack to prevent roller pack from falling out when it is turned upside down after assembly.

Other component of the roller pack is spring pin. Spring pin is on the top surface of the roller pack, and makes installation of wedge block and fitting plate easier.

Wedge block is a unit to provide preload (**Fig. 3**) to roller pack; a fitting plate (**Fig. 2**), functioning like a pivot, adjusts misalignment of roller pack automatically. Wedge of wedge block moves up and down to apply preload by turning the adjust screw.

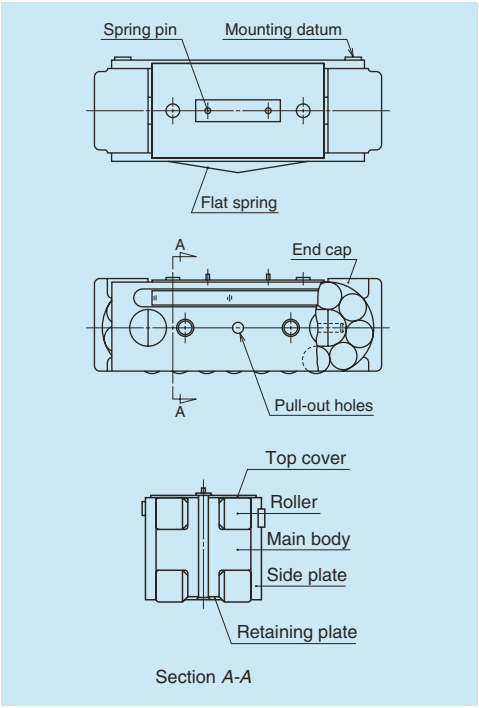


Fig. 1 Roller pack

Photo 1 Roller pack

Photo 2 Wedge block

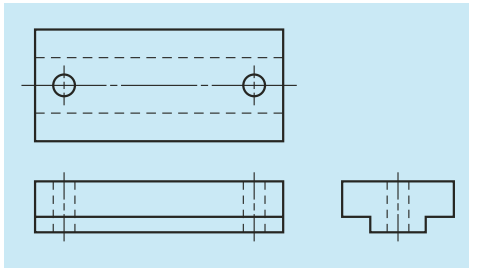


Fig. 2 Fitting plate

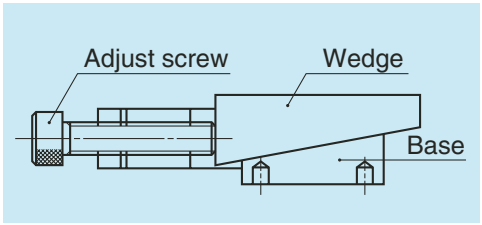


Fig. 3 Wedge block

2. Features

Roller pack has two remarkable characteristics other linear roller guide bearings do not have.

(1) No roller skewing

If the roller is long relative to its diameter, the roller inclines during operation. This phenomenon is called skewing. Skewing causes problems such as sudden rise in friction force. However, a short roller lacks large load carrying capacity. The roller introduced here solved the skewing problem, yet has a large load carrying capacity:
short rollers are combined into double rows.

(2) Load is applied equally.

This is due to a "fitting plate," a result of "changed way of conceiving." Installation is quite easy: Merely place the fitting plate through the two holes to spring pins. The stop pins are inserted to holes on the top surface of the roller pack. The contact area between the fitting plate and the main body is made small. This way, the self-alignment is automatically accomplished by elastic contact of both parts.

This distributes an equal load to the rollers, far extending the life, compared to conventional roller linear guides.

Other characteristics include: Easy to provide preload by the wedge block; can be installed to vertical shaft; and reduction in noise level.

3. Accuracy

The height tolerance of roller pack is 10 μm. Roller packs are grouped into a size difference of every 2 μm (corded by A to E) before delivery (**Table 1**).

Table 1 Height Classification

Unit: μm

Category	Code
over or less	
+3 – +5	A
+1 – +3	B
-1 – +1	C
-3 – -1	D
-5 – -3	E

4. Rigidity

Fig. 4 shows the relationship between load and deformation. This includes deformation caused by contact between: the rollers and main body; the rollers and guide way surface; the main body and fitting plate.

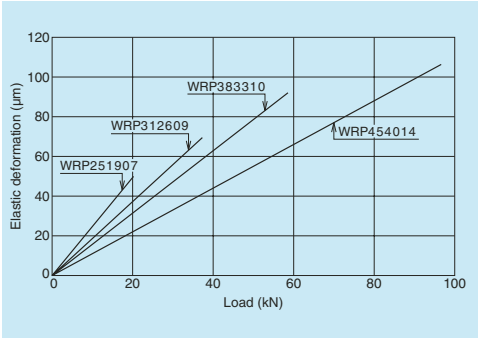


Fig. 4 Elastic deformation of the roller pack

5. Preload

Fig. 5 shows conversions of tightening torque of the wedge block adjust screw into preload volume. Use a dial gauge for accurate measurement.

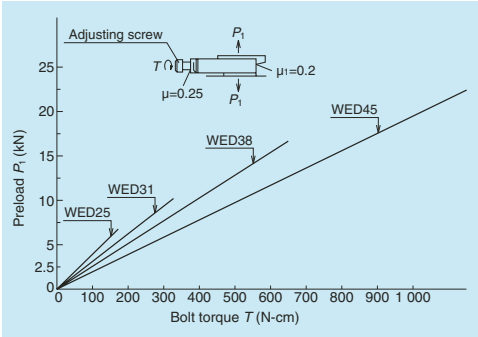


Fig. 5 Tightening torque of the adjust screw, and preload volume

6. Friction and Lubrication

(1) Lubricants and volume

Mineral oils are commonly used. Since roller pack is used under a relatively heavy load, the oil should, ideally, have high viscosity and provide a strong film. Select from JIS viscosity 32-150.

Criteria of oil supply per roller pack Q (cc/h) can be calculated by the following formula.

$$Q \geq S \times 1/4 \quad \cdots\cdots (1)$$

In this formula, S (stroke) is shown in meters. The oil volume, when the stroke is 1 m, per roller pack is more than 0.25 (cc/h). It is more desirable to supply a small amount of oil at short intervals than supplying a large amount at one time. In case of grease lubrication, use a grease of consistency 2. Albania EP2 is widely used.

(2) Friction coefficient

Starting friction coefficient is significantly small at under 0.005.

(3) Seal

It is necessary to install a wiper seal to the guide way surface to prevent foreign matters (swarf from cutting, and other dust) from entering the roller pack to enjoy the full benefit of the designed life of it. The material of the seal should have strong resistance to oil and wear. Felt and synthetic rubber (acrylonitril butadiene rubber) are some of the suitable materials. **Fig. 6** shows a general method to install the seals.

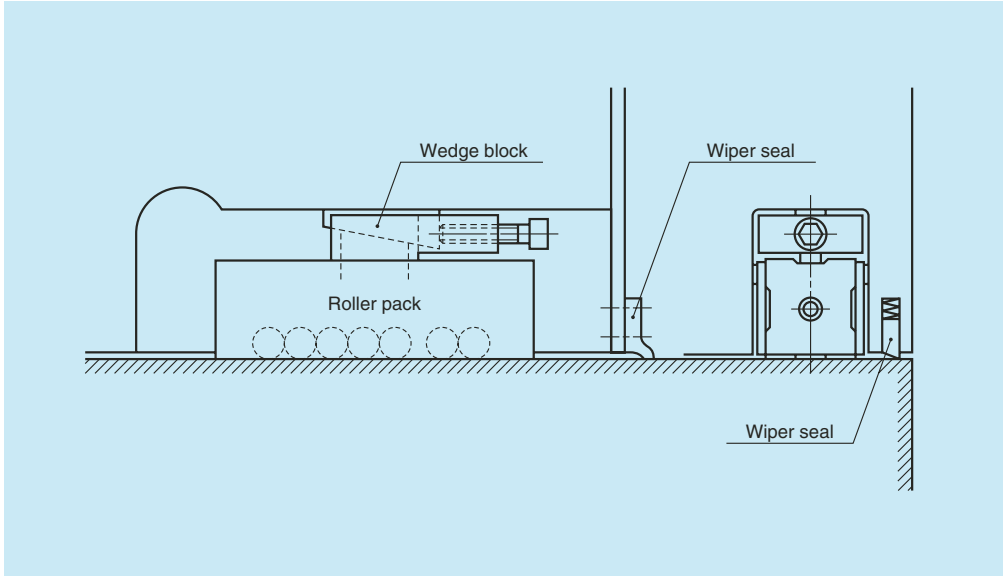


Fig. 6 Installation of seal

7. Installation

(1) Installation and applying preload

As shown in **Fig. 7**, it is basic that a fitting plate is installed on the roller pack which receives load, and a wedge block is installed on the roller pack which receives no load, but is only used for preload. All components should be secured with a stop pin, facing toward the direction of movement. To cut costs for processing, it is recommended to divide the pocket (which contains roller pack) into some blocks and secure them with bolts (**Fig. 7**). Preload is provided by the wedge block. Estimate the actual load beforehand, so the preload shall not be lost when a load is applied. A load variation equivalent to up to two times of the preload volume can be absorbed in this case.
(Take into consideration the rated life in 8. in determining preload volume.)

(2) Accuracy of way block

The following is the ideal accuracy specification and installation accuracy of way block as a guide surface.

Hardness by heat treatment
: More than HRC58 hardened depth 2 mm or more

Surface roughness
: Less than 1.6 S
Parallelism as a single unit: Less than 0.010 mm per meter

Parallelism after installation
: Less than 0.020 mm per meter

Please consult NSK when using cast iron or cast steel guide face.

(3) Pocket accuracy

Accuracy of the pocket in which the roller pack is mounted should satisfy the following conditions.

Pocket width
: Roller pack width + 0.10 to 0.20 mm

Parallelism of the pocket side faces to the guide way face
: Less than 0.010 mm per 100 mm.

Parallelism of the fitting plate (pocket bottom) mounting surface to the guide way face and parallelism of the wedge block mounting surface to the guide way surface :
: Less than 0.040 mm per 100 mm.

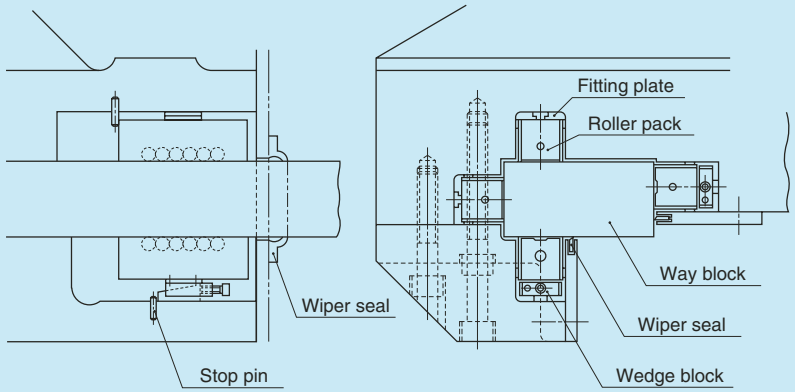


Fig. 7 Design of the roller pack pocket (example)

8. Rated life

Rated life L (km) is shown in the following formula.
In this formula:

$$L = 50 \left(\frac{C}{f_w \cdot F_c}\right)^{\frac{10}{3}} \quad \cdots\cdots (2)$$

C: Basic dynamic load rating (N)

f_w: Load factors. 1.0 to 1.2 at time of smooth operation

F_c: Calculated load (N) applied to the roller pack

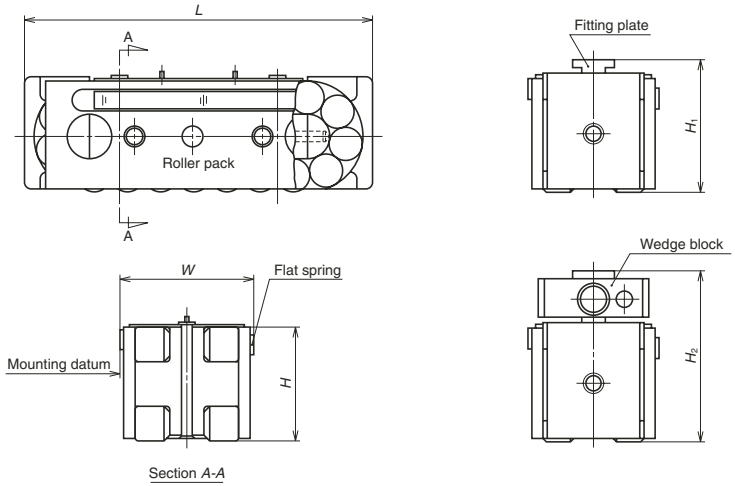
9. Disassembly

Remove the roller pack preloaded by the wedge block in the following manner.

- Loosen the adjust screw of the wedge block. Lightly tap the wedge. In case of light preload, the wedge loosens, and the roller pack can be pulled out.
- When pulling, put the bolt in the tap hole at the end of the end cap, and tug the bolt.
- In case of heavy load, the roller pack could not be pulled out by the above method. Hook a tool to the pull-out hole (**Fig. 1**) on the side plate of the roller pack, and pull out the roller pack.

10. Dimension Table

Roller pack: Model WRP

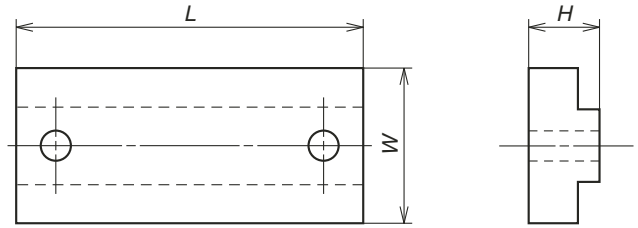


Unit: mm

Model No.	Width *W*	Height ±0.005 *H*	Length *L*	Applicable fitting plate reference No.	Assembled height H_1	Applicable wedge reference No.	Assembled height H_2	Basic dynamic load rating *C* (N)	Basic static load rating C_0 (N)
WRP 251907	25	19	65.5	WFT 25	24	WED 25	31 (30.4 – 31.6)	31 000	40 500
WRP 312609	31	26	85	WFT 31	31	WED 31	40 (39.4 – 40.6)	57 000	73 000
WRP 383310	38.1	33.31	104.4	WFT 38	38.91	WED 38	50.8 (50 – 51.5)	91 000	113 000
WRP 454014	45	40	138	WFT 45	45	WED 45	60 (59.2 – 60.8)	151 000	191 000

Note : Numbers in the parentheses in column H_2 show the adjustable height range of the wedge block.

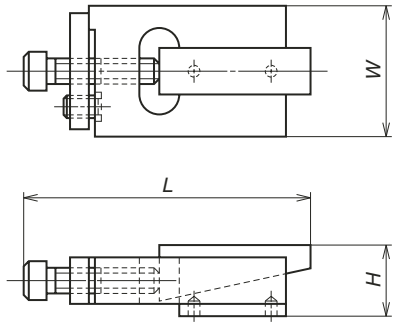
Fitting plate: Model WFT



Unit: mm

Model No.	Width *W*	Height (±0.01) *H*	Length *L*	Applicable roller pack
WFT 25	10	5	20	WRP 251907
WFT 31	12	5	26	WRP 312609
WFT 38	12.8	5.6	29	WRP 383310
WFT 45	16	5	40	WRP 454014

Wedge block: Model WED



Unit: mm

Model No.	Width *W*	Height *H*	Length *L*	Applicable roller pack
WED 25	23	12 (11.5 – 12.5)	47	WRP 251907
WED 31	28	14 (13.5 – 14.5)	63	WRP 312609
WED 38	35	17.47 (16.9 – 18.1)	76	WRP 383310
WED 45	40	20 (19.2 – 20.8)	95	WRP 454014

Note : Numbers in the parentheses in column H_2 show adjustable height range of the wedge block.

A-6-4 Linear Roller Bearings

1. Structure

Linear roller bearing comprises: A single row of rollers; the main body which supports load via rollers; the end cap which turns the roller re-circulating direction at the end of the main body from the loaded zone to the unloaded zone; a retaining wire which prevents rollers from falling out (**Fig. 1**). The main body, as the cylindrical roller bearing, has a rib at both sides. The rib guides the rollers to travel correctly, and assists the rollers to circulate infinitely in the bearing in a stable manner. This contributes to the bearing's linear movement without the restriction of travel range.

NSK also developed a highly functional preload pad (Photo 2) to provide a slight preload to the bearing. The preload pad basically comprises parallel plates and sandwiched bellevile springs, having adjusted its spring rate.

Preloaded pad can be used in a machine tool in the following manner.

When two bearings are installed with one on the top and the other under the way block (the bearings comprise a set), a preloaded pad is used at the bottom bearing. This provides an equal preload to the top and bottom bearings. This way, to a certain extent, the variation in the load and the uneven thickness of the way block can be absorbed.

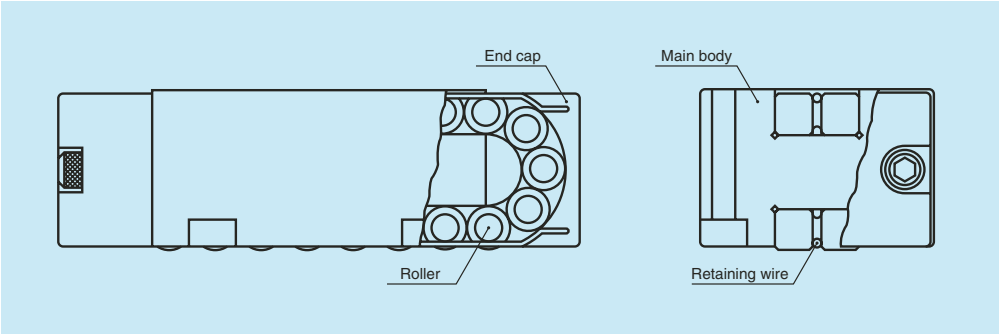


Fig. 1 Linear roller bearing

Photo 1 Linear roller bearing

Photo 2 Preload pad

2. Features

In addition to the general features of a roller bearing guide such as no-stick slip, small friction resistance, and easy maintenance, the linear roller bearing has several more advantages.

(1) No trouble by roller skewing

Skewing is the inclination of the rollers during operation. It causes friction force to suddenly soar. Skewing is apt to occur when the roller is long relative to its diameter. The proportion of the length and diameter is 1:2 for the products in this series. This is superior to the commonly used 1:3 ratio.

(2) Highly reliable

Retaining the rollers without allowing them to fall out of the bearing is a crucial function of the linear guide bearing. The simple and highly effective retaining wire has solved the problem for this product series.

(3) Compact design

Despite the load carrying capacity, this series is smaller in size than any other models. This contributes to the application which requires compact design.

(4) High rigidity

The contact area between the bearing and the mounting surface is large to increase rigidity.

3. Accuracy

The nominal height difference between bearings is 10 μm. The bearings are grouped into every 2 μm, and are coded before delivery (**Table 1**).

Table 1 Classification of height

Unit: μm

Category			Code
over		or less	
0	–	–2	A
–2	–	–4	B
–4	–	–6	C
–6	–	–8	D
–8	–	–10	E

4. Rigidity

Fig. 2 shows elastic deformation.

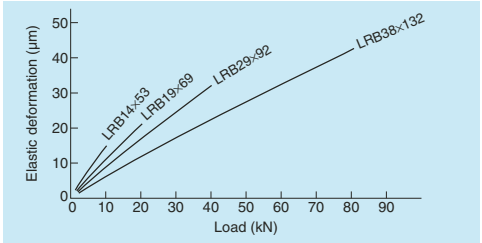


Fig. 2 Elastic deformation

5. Friction and Lubrication

(1) Lubricants and volume

Mineral oils are used in general. The linear roller bearing is used under relatively heavy load. An oil which has high viscosity and creates a strong oil film is ideal for linear roller guides. Select from JIS viscosity 32 to 150.

General oil supply for a linear roller bearing Q (cc/h) can be calculated by the following formula.

$$Q \geq S \times 1/4 \cdots\cdots (1)$$

In this formula, S (stroke) is shown in meters. Therefore, when the stroke is 1 m, the volume of lubricant per roller bearing is more than 0.25 (cc/h). It is recommended to supply a small amount of oil at short intervals rather than supplying a large amount at one time. In case of grease lubrication, a grease of consistency degree 2, such as Albania EP2, is generally used.

(2) Friction coefficient

Starting friction coefficient is significantly small at under 0.005.

(3) Seal

Install a wiper seal on the way block surface to prevent foreign matters (cutting chip and other contaminant from entering) to realize a full life of the linear roller bearing. The material of the seal should have strong resistance against oil and wear. Felt and synthetic rubber (acrylonitril-butadien rubber) are some of the suitable materials.

6. Installation

Secure the linear roller bearing using four bolts. The bearing main body has four holes for mounting.

Accuracy of way block
The ideal accuracy specification and mounting accuracy of a way block as a guide way surface are as follows.

Hardness by heat treatment
: More than HRC58 hardened depth
2 mm or more

Surface roughness
: Less than 1.6 S

Parallelism as a single unit
: Less than 0.010 mm per 1 m

Parallelism after installation
: Less than 0.020 mm per 1 m

Please consult NSK when using cast iron or cast steel guide way.

7. Rated life

Rated life L (km) is shown in the following formula.
In this formula:

$$L = 50 \left(\frac{C}{f_w \cdot F_c} \right)^{\frac{10}{3}} \quad \cdots\cdots(2)$$

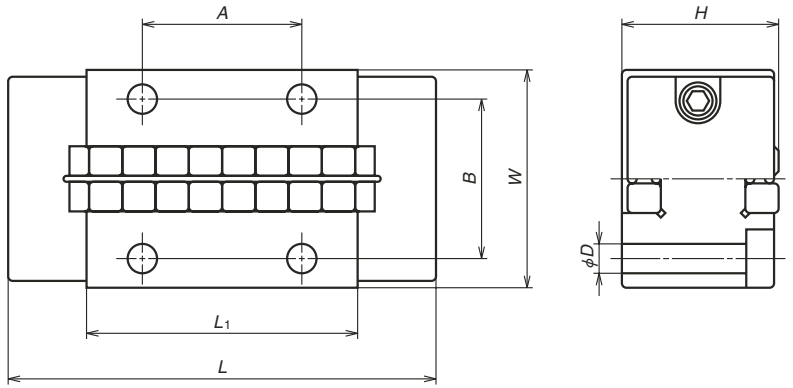
C : Basic dynamic load rating (N)

f_w : Load factor. 1.0 to 1.2 at time of smooth operation

F_c : Calculated load applied on the bearing (N)

8. Dimension Table

Linear roller bearing Model: LRB

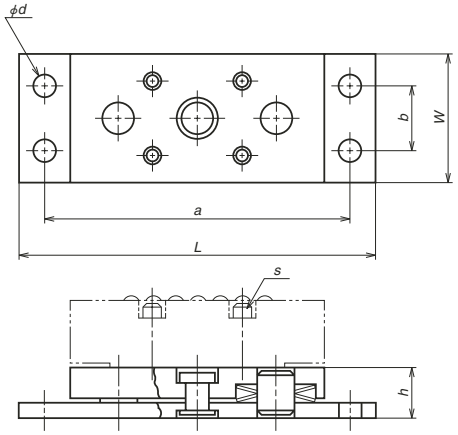


Unit: mm

Model No.	Width W	Height $H^{0}_{-0.010}$	Length L	L_1	Roller diameter × length	Mounting bolt hole D	Bolt hole distance A	Bolt hole distance B	Basic dynamic load rating C (N)	Basic static load rating C_0 (N)
LRB 14×53	26.5	14.29	52.8	32.8	φ 4×8	3.4	19	19.3	15 400	21 900
LRB 19×69	30.5	19.05	68.6	44.6	φ 5×10	3.4	25.4	23.3	27 000	39 000
LRB 29×92	41.5	28.58	92.0	59	φ 7.5×15	4.5	38.1	32.7	57 500	76 500
LRB 38×132	51.4	38.10	132.0	88	φ 10×20	5.5	50.8	41.5	119 000	159 000

Note: Bearings are grouped into heights of every 2 μm before delivery.

Preload pad Model: PRP



Unit: mm

Model No.	Applicable linear roller bearing	Height (no-load) *h* max.	Compressed height *h* min.	h min. Load when fully compressed (N)	*W*	*L*	*d*	*a*	*b*	*s* Hex. Socket cap screw
PRP 14×53	LRB 14×53	10.23	9.53	1 570	26	72	4.5	62	14	M3×16
PRP 19×69	LRB 19×69	11.53	11.10	2 650	30	96	4.5	86	18	M3×19
PRP 29×92	LRB 29×92	13.13	12.70	6 450	41	120	4.5	110	27	M3×25
PRP 38×132	LRB 38×132	16.28	15.88	12 000	51	157	4.5	147	35	M5×38