

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 guide consists of a rail and a ball or roller 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 ball or roller slides 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 stable and highly accurate production of the ball 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 feature 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 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 ball type. This increases shock 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 highest load capacity, far superior to the roller linear guides of other companies.

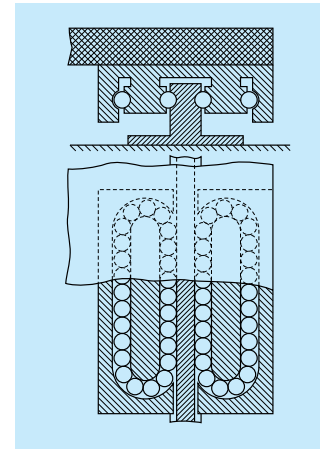


Fig. 1 • French Patent in 1932.
• Inventor : Gretsh (German)

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

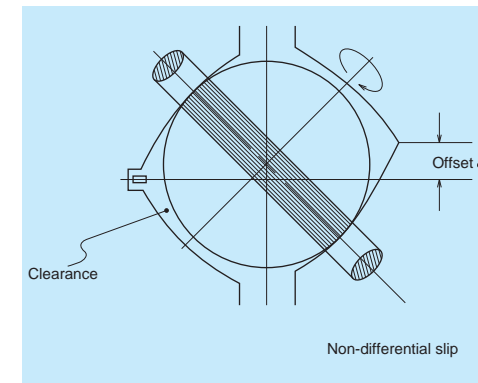


Fig. 3 Two contact point at offset Gothic arch groove

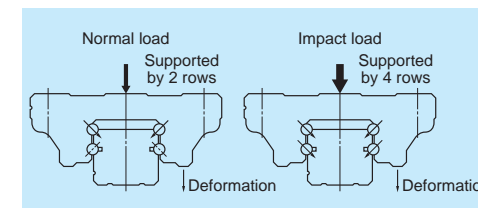


Fig. 5 Shock-resistance

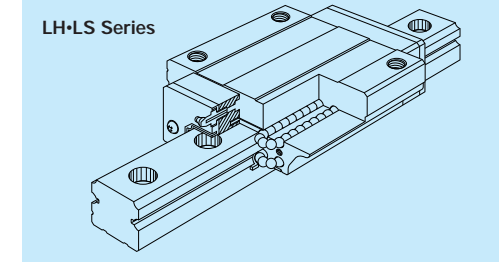
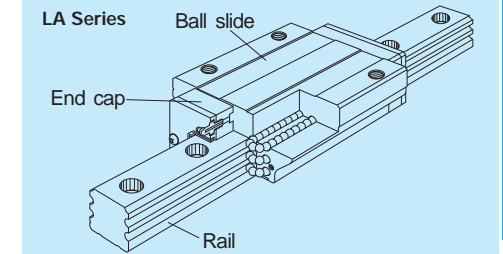
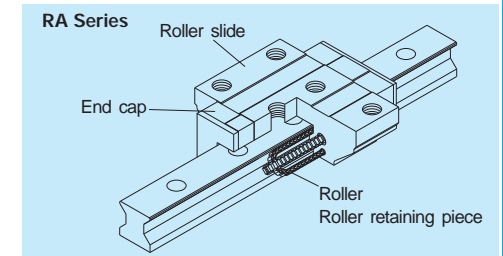


Fig. 2 Structure of NSK linear guides

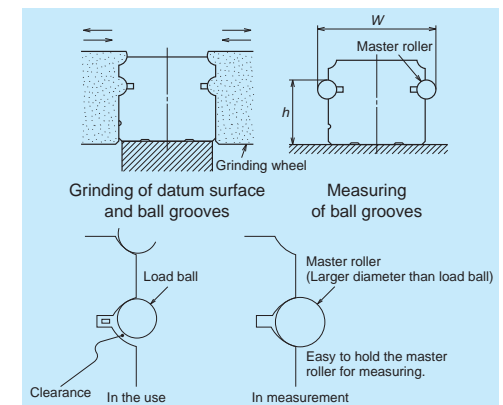


Fig. 4 Processing and measuring grooves

Measuring grooves 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	
High vertical load carrying capacity type	Self-aligning type	SH	AN BN			
			AL BL			
			EL GL			
			FL HL			
			EM GM			
			High-load type	AL, AN		

Characteristics	Applications	Page	
<p>The SH series has achieved lower noise, gentler tone, and smoother motion. Random assembly products of rails and ball slides are available as a standard.</p> <ul style="list-style-type: none"> ● Lower noise and gentler tone. ● The contact angle between the ball and ball groove is set at 50 degrees. The load carrying capacity against the vertical directions, which is practical in most operations, increases by this design. ● The DF contact structure greatly absorbs the error in the perpendicular direction to rail at the time of installation. ● Balls make contacts at two points thanks to the offset Gothic arch groove. This keeps friction to a minimum. ● Structural resistance against shock load. ● 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 type is also available (- #30). 	<ul style="list-style-type: none"> • Semiconductor manufacturing equipment • Liquid crystal display manufacturing equipment • Cartesian type robots • Robots that remove plastic molds from injection machine • Material handling • Food processing machines • Packaging/packing machines • Printing machines • Woodworking machines • Paper machines • Measuring equipment • Inspecting equipment • Medical equipment • Electric discharge machines • Laser cutting machines • Press • Tool grinders • Flat surface grinders • NC lathes • Machining centers • ATC 	A115	
<p>Super-high-load type</p> <p>BL, BN</p>		GL, HL, GM	

Category	Series	Slide shape	Shape/installation method	Load direction/capacity	Rolling element contact structure	
High vertical load carrying capacity type	Self-aligning type	SS	CL AL			
			JL EL			
			KL FL			
			JM EM			
			<p>High-load type</p> <p>AL</p>			
<p>EL, FL, EM</p>						
<p>Medium-load type</p> <p>CL</p>						
<p>JL, KL, JM</p>						

Characteristics	Applications	Page
<p>The SS series has achieved lower noise, gentler tone, and smoother motion, and has a low and compact design. Random assembly products of rails and ball slides are available as a standard.</p> <ul style="list-style-type: none"> ● Lower noise and gentler tone. ● Compact, low in height ● The contact angle between the ball and the ball groove is set at 50 degrees. The load carrying capacity against vertical directions, which is prevalent in most operations, increases by this design. ● The DF contact structure greatly absorbs the error in the perpendicular direction of rail at time of installation. ● Thanks to the offset Gothic arch groove, balls make contacts at two points. This keeps friction small. ● Great resistance against shock load. ● Gothic arch groove renders measuring groove accurate and easy. ● Standardized random-matching type allows separate purchase of rails and ball slide. ● Stainless steel type is also available. 	<ul style="list-style-type: none"> • Semiconductor manufacturing equipment • Liquid crystal display manufacturing equipment • Cartesian type robots • Robots that remove plastic molds from injection machine • Material handling • Food processing machines • Packaging/packing machines • Printing machines • Woodworking machines • Paper machines • Measuring equipment • Inspection equipment • Medical equipment • Electric discharge machines • Laser cutting machines • Press 	A139

Category	Series	Slide shape	Shape/installation method	Load direction/capacity	Rolling element contact structure	
High vertical load carrying capacity type	Self-aligning type	LH	AN BN			
			AL BL			
			EL GL			
			FL HL			
			EM GM			
			High-load type	AL, AN		

Characteristics	Applications	Page			
<p>The LH series is applicable to a wide range of uses from general industrial use to high-accuracy application.</p> <p>Random assembly products of rails and ball slides are available as a standard.</p> <ul style="list-style-type: none"> ● The contact angle between the ball and ball groove is set at 50 degrees. The load carrying capacity against the vertical directions, which is practical in most operations, increases by this design. ● The DF contact structure greatly absorbs the error in the perpendicular direction to rail at the time of installation. ● Balls make contacts at two points thanks to the offset Gothic arch groove. This keeps friction to a minimum. ● Structural resistance against shock load. ● 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 type is also available (- #30). 	<ul style="list-style-type: none"> • Cartesian type robots • Robots that remove plastic molds from injection machine • Material handling • Food processing machines • Packaging/packing machines • Printing machines • Woodworking machines • Paper machines • Measuring equipment • Inspecting equipment • Semiconductor manufacturing equipment • Liquid crystal display manufacturing equipment • Medical equipment • Electric discharge machines • Laser cutting machines • Press • Tool grinders • Flat surface grinders • NC lathes • Machining centers • ATC 	A161			
<p>Super-high-load type</p> <p>BL, BN</p>			GL, HL, GM		

Category	Series	Slide shape	Shape/installation method	Load direction/capacity	Rolling element contact structure	
High vertical load carrying capacity type	Self-aligning type	LS	CL AL			
			JL EL			
			KL FL			
			JM EM			
			<p>High-load type</p> <p>AL</p>			
<p>EL, FL, EM</p>						

Characteristics	Applications	Page
<p>The LS series is low in height, and applicable to a wide range of uses from general industrial use to high-accuracy application. Random assembly products of rails and ball slides are available as a standard.</p> <ul style="list-style-type: none"> ● Compact, low in height ● The contact angle between the ball and the groove is set at 50 degrees. The load carrying capacity against vertical directions, which is prevalent in most operations, increases by this design. ● The DF contact structure greatly absorbs the error in the perpendicular direction of rail at time of installation. ● Thanks to the offset Gothic arch groove, balls make contacts at two points. This keeps friction small. ● Great resistance against shock load. ● Gothic arch groove renders measuring groove accurate and easy. ● Standardized random-matching type allows separate purchase of rails and ball slide. ● Stainless steel type is also available. 	<ul style="list-style-type: none"> • Cartesian type robots • Robots that remove plastic molds from injection machine • Material handling • Food processing machines • Packaging/packing machines • Printing machines • Woodworking machines • Paper machines • Measuring equipment • Inspection equipment • Semiconductor manufacturing equipment • Liquid crystal display manufacturing equipment • Medical equipment • Electric discharge machines • Laser cutting machines • Press 	A185
<p>Medium-load type</p> <p>CL</p>	<p>JL, KL, JM</p>	

Category	Series	Slide shape	Shape/installation method	Load direction/capacity	Rolling element contact structure	
High vertical load carrying capacity type	Self-aligning type	VH	AN BN			
			AL BL			
			EL GL			
			FL HL			
			EM GM			
High vertical load carrying capacity type	High moment capacity type	LW	EL			
Four-directional iso-load carrying type	Standard type	TS	AN			

Characteristics	Applications	Page
<p>The VH series delivers outstanding functionality and long operating life under contaminated environments. Random assembly products of rails and ball slides are available as a standard.</p> <ul style="list-style-type: none"> ● The contact angle between the ball and the raceway is set at 50 degrees. The load carrying capacity against vertical directions, which is prevalent in most operations, increases by this design. ● The DF contact structure greatly absorbs the error in the perpendicular direction of rail at time of installation. ● Thanks to the offset Gothic arch groove, balls make contacts at two points. This keeps friction small. ● Great resistance against shock load. ● Gothic arch groove renders measuring groove accurate and easy. ● Standardized random-matching type allows separate purchase of rails and ball slide. ● Less than 1/10 the level of fine contaminants. ● Operating life under contaminated environments is more than 5 times longer. 	<ul style="list-style-type: none"> • Automotive manufacturing equipment • Press • Machine tools loader/un-loader • Tire molding machine • Woodworking machine • Automatic doors 	A207
<p>High-load type AL, AN</p> <p>EL, FL, EM</p> <p>Super-high-load type BL, BN</p> <p>GL, HL, GM</p>		
<p>High-moment rigidity and low profile products are most suited for a single linear guideway system. Random assembly products of rails and ball slides are available as a standard.</p> <ul style="list-style-type: none"> ● The rail is wide. This contributes to a high rolling moment carrying capacity and to great moment rigidity when only single linear guide is in use. ● Balls contact at two points in the offset Gothic arch groove, keeping friction small. ● High resistance against shock load ● Standardized random-matching assemblies allows separate purchase of rails and ball slides. 	<ul style="list-style-type: none"> • Semiconductor manufacturing equipment • Liquid crystal display manufacturing equipment • Conveyor systems • Medical equipment • Microscope XY stage 	A229
<p>The TS series is suitable for transfer equipment.</p> <ul style="list-style-type: none"> ● Newly developed manufacturing process contribute to low cost. ● Standardized random-matching assemblies allows separate purchase of rails and ball slides. 	<ul style="list-style-type: none"> • Automotive manufacturing equipment • Press • Machine tools loader/un-loader • Tire molding machine • Woodworking machine • Automatic doors 	A243

Category	Series	Slide shape	Shape/installation method	Load direction/capacity	Rolling element contact structure
Four-directional iso-load carrying type	Super-rigid type	RA	AN BN		
			AL BL		
			EM GM		
Four-directional iso-load carrying type	Super-rigid type	LA	AN BN		
			AL BL		
			EL GL		
			FL HL		

Characteristics	Applications	Page
<p>The RA series roller guides have realized the world highest load capacity. Super-high rigidity and smooth motion contribute to high performance of machine tools.</p> <ul style="list-style-type: none"> ● Unique design of rollers and optimum parts design 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. ● Random assembly products of rails and roller slides are available as a standard. 	<ul style="list-style-type: none"> • Machining centers • NC lathes • Heavy cutting machine tools • Gear cutters • Electric discharge machines • Press • Grinders 	A251
<p>High-load type AL, AN</p> <p>Super-high-load type BL, BN</p>	<p>EM</p> <p>GM</p>	
<p>The LA series provides a top class high-load capacity for the ball linear guides, even with not high friction. The series is most suited for machine tools.</p> <ul style="list-style-type: none"> ● 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 load from vertical and lateral directions, enhancing rigidity and increasing load carrying capacity. ● Appropriate friction ● Best for machine tools. 	<ul style="list-style-type: none"> • Machining centers • NC lathes • Heavy cutting machine tools • Gear cutters • Electric discharge machines • Press • Grinders 	A269
<p>High-load type AL, AN</p> <p>Super-high-load type BL, BN</p>	<p>EL, FL</p> <p>GL, HL</p>	

Category	Series	Slide shape	Shape/installation method	Load direction/capacity	Rolling element contact structure	
Miniature type	Standard type	PU	AL AR TR UR BL			
	High moment capacity type	PE	AR TR UR BR			
	Standard type	LU	AL TL AR TR BL UL			
	High moment capacity type	LE	AL TL AR TR BL UL CL SL AR TR			
		<p>Standard type</p> <p>LU, PU</p> <p>AL, TL, AR, TR</p>		<p>High-load type</p> <p>BL, UL, UR</p>		
Lightweight type	LL	PL				

Characteristics	Applications	Page			
<p>Low inertia and low dust generation miniature series.</p> <ul style="list-style-type: none"> ● Low dust generation, highly smooth operation ● Super-small size ● Stainless steel ● Series with a ball retainer ● Standardized random matching allows separate purchase of rails and ball slides. 	<ul style="list-style-type: none"> • Semiconductor manufacturing equipment • Liquid crystal display manufacturing equipment • Medical equipment • Optical stage • Microscope XY stage 	A289			
<p>Low inertia and low dust generation miniature wide series.</p> <ul style="list-style-type: none"> ● Low dust generation, highly smooth operation ● Super-small size ● Stainless steel is standard as the material. ● Series with a ball retainer is standardized. ● Standardized random matching allows separate purchase of rails and ball slides. 	<ul style="list-style-type: none"> • Conveying optical fiber • Small robots • Computer peripheral equipment • Pneumatic equipment 	A299			
<p>Miniature series</p> <ul style="list-style-type: none"> ● Super-small size ● Stainless steel is standard as the material. ● Series with a ball retainer is standardized. ● Standardized random matching allows separate purchase of rails and ball slides. 	<ul style="list-style-type: none"> • Semiconductor manufacturing equipment • Liquid crystal display manufacturing equipment • Medical equipment • Optical stage • Microscope XY stage 	A309			
<p>Miniature wide series</p> <ul style="list-style-type: none"> ● Super-small size in wide rail type ● Stainless steel is standard as the material. ● Series with a ball retainer is standardized. ● Standardized random matching allows separate purchase of rails and ball slides. 	<ul style="list-style-type: none"> • Conveying optical fiber • Small robots • Computer peripheral equipment • Pneumatic equipment 	A321			
		<p>Standard type</p> <p>LE, PE</p> <p>AL, TL, AR, TR</p>	<p>High-load type</p> <p>BL, UL, BR, UR</p>	<p>Medium-load type</p> <p>CL, SL (LE only)</p>	
<p>The LL series is a compact and lightweight miniature linear guide for press molding.</p> <ul style="list-style-type: none"> ● Rails and ball slides are thin steel plate, therefore they are lightweight. ● Stainless steel as a standard material 	<ul style="list-style-type: none"> • Part of platter pen head • Robot hand • Pneumatic equipment 	A335			

Category	Series	Slide shape	Shape/installation method	Load direction/capacity	Rolling element contact structure		
Four-directional iso-load carrying type	Super rigidity, high-precision type	HA	AN				
			AL				
			EM				
				AL, AN			
High vertical load carrying capacity type	Self-aligning, super-precision type	HS	AL				
			EM				
							AL

Characteristics	Applications	Page
<p>The HA Series ball guide with high-precision and high-load carrying capacity, featuring high-motion accuracy equivalent to hydrostatic bearings.</p> <ul style="list-style-type: none"> ● 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 super-finished ball groove feature (option). ● End seal, bottom seal, and inner seal of high dust proof specification are available as a standard. ● Best for high-grade working machine. 	<ul style="list-style-type: none"> • Die and mold tooling machine center • Precision processing machine • Heavy cutting machine tools • Gear cutters • Press machines • Grinders 	A341
<p>The HS Series ball guide with high-precision featuring high-motion accuracy equivalent to hydrostatic bearings.</p> <ul style="list-style-type: none"> ● 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 prevalent in most operations, increases by this design. ● The DF contact structure greatly absorbs the error in the perpendicular direction of rail at time of installation. ● Thanks to the offset Gothic arch groove, balls make contacts at two points. This keeps friction small. 	<ul style="list-style-type: none"> • Precision processing machine • Electric discharge machines • Grinders • Liquid crystal display manufacturing equipment 	A355

(4) Guide to Technical Services

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

SH Series
 SS Series
 LH Series
 LS Series
 LA Series
 LW Series
 PU Series
 PE Series
 LU Series
 LE Series
 RA 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 catalogue. 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.

- If your linear guide is rust prevention specification, thoroughly wipe the rust prevention oil, and put lubricant inside of slide before using.
- If you are using oil as lubricant, the oil may not reach the raceway depending on how the slide is installed. Consult NSK in such case.

2. Handling



Handle with care.



Do not disassemble.



Do not drop.



Do not give impact.

- Random-matching slides are installed to the provisional rail when they leave the factory. Handle the slide with care during installation to the rail.
- Do not disassemble the guide unless absolutely necessary. Not only does it allow dust to enter, but it lessens precision.
- Slide may move by simply leaning the rail. Make sure that the slide does not disengage from the rail.
- 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.

- Make every effort not to allow dust and foreign objects to enter.
- Please apply splash guard or bellows to the linear guide to prevent sticking resolvent or coolant when it contains corrosive material.
- 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.
- If the user cuts the rail, thoroughly remove burrs and sharp edges on the cut surface.
- 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.

- 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, but it can be mitigated.
- A grease which prevents fretting is recommended for oscillating stroke operations. Using a standard grease, 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 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 ball or roller.
- Moment load is insignificant for 2-rail, 4-slides 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 3000 km in calculated life.)

- In such case, the contact pressure to the balls or rollers and the rolling contact surface is extraordinarily high.
- Operated under such state continually, the life is significantly affected by the loss of lubrication and the presence of dust, and the actual life becomes shorter than calculated.
- It is necessary to reconsider arrangement, the number of slide, 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. Please consult NSK.



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. Please consult NSK.